POLITICAL LANDSCAPES OF LATE PREHISPANIC SONORA: A VIEW FROM THE MOCTEZUMA VALLEY

by

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DISSERTATION ABSTRACT

This dissertation offers a reformulation of social organization in eastern Sonora from the thirteenth to sixteenth centuries based on survey and excavation data collected in the Moctezuma Valley, Sonora, Mexico. Prior researchers, utilizing Spanish exploration era documents, argued for the presence of territorial polities that controlled large sections of river valleys with an elite class supported by the management of long distance trade. Previous archaeological research demonstrated hierarchy in settlement patterns, but differed in interpretations regarding the methods of *"elite"* ascendance. This dissertation addresses questions of both the scale of political organization and its likely underpinnings. Multiple data sets including artifact style boundaries, settlement pattern analysis, and consideration of ecological parameters demonstrate political organization rarely reached beyond local sections of river valleys. This suggests dozens of locally autonomous settlement communities were present in an area previously argued to contain less than ten political units.

Additionally, application of a diverse set of provenance techniques facilitated testing previous hypothesis regarding exchange in the region. The character of regional exchange systems appears to be mostly through down-the-line acquisition, likely orchestrated by aspirant leaders at the level of local settlement communities. These interactions rarely reached beyond near neighbors and excluded some immediately adjacent settlement communities. In contrast, the exchange of mundane ceramics crossed these same boundaries, indicating different segments of society forged incongruous social networks.

In summary, these data suggest the region would be a very poor conduit for long distance exchange, most aspirant leaders had only limited access to social valuables, and that the social landscape was sufficiently volatile that most households sought exterior ties as a means of risk reduction. Local warfare in conjunction with demographic and ecological factors are argued to play the predominant roles in generating the political landscape of eastern Sonora. Overall, small scales of political consolidation and minimal hierarchical control characterized the broader region.

INTRODUCTION

This dissertation presents the results of two seasons of fieldwork (survey and excavation) in the Moctezuma Valley, Sonora, Mexico. The project was intended to provide a reformulation of social organization in the region. Eastern Sonora has been the subject of far less research than either the neighboring U.S. Southwest or the northern limits of Mesoamerica. Even relative to the other middle range societies of Northwest Mexico, including the Casas Grandes and Trincheras areas, the Río Sonora is understudied. The majority of primary data collection carried out in this region and published in English is now nearing 40 years in age. As such, eastern Sonora has been excluded from most recent large scale discussions and not subject to the theoretical revisions that have taken place in most North American archaeology. This is despite the fact that many researchers acknowledge that the region likely played a critical role in large scale trajectories of the greater Northwest/Southwest (e.g. Lekson 2009; Wilcox, et al. 2008). This dissertation is intended to begin rectifying this situation.

The dissertation is composed of three separate publications: a monograph and two journal articles. The majority of data are presented in Appendix A, which corresponds to the monograph, to be published in the Arizona State Museum Archaeological Series. A much fuller introduction to prior research and the environmental settings of the project area can be found in the first two sections (chapters) of Appendix A. The following sections present settlements pattern data from survey, a detailed analysis of the 30,000 plus artifacts collected for this project, as well as site and feature descriptions, and analysis of rock art depictions. This is by far the largest dataset analyzed from the Moctezuma Valley and the largest data set of any sort from the broader region reported in English since the Río Sonora Project of the 1970s-1980s. It provides a significant contribution to a basic catalog of material culture in Northwest Mexico that should prove invaluable in all future analyses.

All material cultural sections are designed to address one principal theme of delineating variation at household, settlement, and settlement community levels, so that these basic building blocks of society can be accurately identified and employed in reconstructions of social organization. Given the still overall small scale of this project significant revisions will undoubtedly still be required to these inherently amorphous units that express ample variation. Nonetheless, several very clear patterns of material culture distributions suggestive of functional concerns as well as stylistic markers indicative of alternative ideological and social identities are easily discerned by most analyses. These patterns are most clearly demonstrated in comparisons between the large excavated sites, corresponding to variance expressed between what are argued to be different settlement community primate centers.

The chronology section (Chapter 10) of the monograph also provides a hitherto unachieved compilation of data to evaluate the potential for identifying clear chronological divisions in the Río Sonora region. Much more work is clearly needed on this front, but a basic outline beginning fully by A.D. 1100 is forwarded. The majority of settlement in the period prior to approximately A.D. 1000 is thought to have existed on river valley flood plains where recent fluvial activity has largely obfuscated identification. Most of the visible settlement system in the Moctezuma Valley appears to post date A.D. 1200. This is the approximate age of the sites excavated for this project that remained occupied at least until A.D. 1500.

Chapter 11 of the monograph (Appendix A) presents the first compendium of artifact provenance studies in the Río Sonora for ceramic, obsidian, shell, and mineral artifacts. These data, as well as a larger analysis of settlement patterns, ecological parameters, and comparisons with exterior data sets, are the subject of the following two chapters, which are also elaborated as journal article submissions and reviewed below. The Conclusions chapter of the monograph is divided into several sections that offer increasingly bold interpretive frameworks. The final sub-sections proffer a comprehensive reconstruction of Río Sonora social organization and how its character would have impacted larger pan-regional sociopolitical trajectories. In general, a less complex reconstruction, in terms of both vertical and horizontal differentiation is suggested. Warfare, as described in ethnohistoric texts, is argued to have been the principal venue in which aspiration leader aspirations were actualized. Both subsistence production and long distance trade are argued to have been of less importance in the region than previously hypothesized, although the later was clearly of interest to many aspirant leaders.

Appendix B presents a more succinct analysis of the scale of social and political integration in the region. Previous research left this variable mostly undefined. Ethnohistoric research by Riley (1987, 1999, 2005) seems to suggest territorial polities that spanned significant portions of river valleys and possibly even multiple valleys. Research by Doolittle (1984, 1988) demonstrated the scale was significantly smaller, but this was not a focus of his research and his findings were argued to largely support Riley's interpretation. Diverse lines of evidence are marshaled to demonstrate the size of settlement communities discernable in Doolittle's data are, in fact, the norm for the Río Sonora region and approximately matches the scale discovered in the Moctezuma Valley. Settlement pattern distributions from multiple river valleys in Northwest Mexico are analyzed with rank-size correlation approaches (Drennan and Peterson 2004). This data clearly demonstrates that there is significant variation in the structure of settlement patterns across Northwest Mexico, but for the most part, Río Sonora groups are organized into small communities confined to local arable reaches of river valley. This is largely the outgrowth of the distribution of arable land relative to narrow, *barranca*, sections of river courses. Artifact distribution data, including ceramic styles, lithic tool and projectile point types, and even limited adornment/jewelry data all seem to reflect these boundaries. The extent of many rare goods exchange networks is also conterminous with these boundaries. A consideration of demographic and ecological data further suggest that there is little reason to expect the scale of social integrtion ever exceeded what is suggested by these lines of evidence. The result of this analysis is a major reformulation of how the Río Sonora region was organized during the thirteenth to sixteenth centuries.

Appendix C builds on these arguments by considering how exchanged goods could potentially flow through such a balkanized landscape and what role they served in local ritual and political economies. To answer these questions a variety of materials were subjected to provenance analysis, including mundane ceramics, obsidian, shell and turquoise. The Moctezuma Valley is notable for its lack of social valuables that served to materialize ideologies that justified or confronted emergent inequalities. Aspirant leaders were apparently either ineffective or uninterested in tapping into larger macro-traditions that leveraged such social valuables in social ascendance strategies. Likewise, a lack of communal architecture or social valuables typically associated with signaling aspects of shared identity and solidarity, suggest there was little effort invested in contesting aggrandizing strategies.

There is some minimal evidence provided by obsidian data that select individuals did seek out naturally rare resources. Once acquired, these were utilized in local networks, likely as one component of a strategy to attract spatially proximate followers to support both production and warfare related endeavors. These items did not circulate widely and there appears to have been almost no exchange of such items between the two primate identified in the Moctezuma Valley. The same basic pattern is true of rare painted ceramics. All rare and/or foreign items seem to arrive in the Moctezuma Valley through down-the-line exchange. Again this is most fully demonstrated by obsidian, which overwhelmingly came from the most spatially proximate source. The fact that Teonadepa (the northern primate center) had access to connections near this source and El Nogal (the southern primate center) did not likely reflects the topology of local alliance formation between settlement communities.

Curiously, mundane ceramic provenance data indicate brownwares frequently circulated within the project area and between the settlement communities of El Nogal and Teonadepa. It is suggested that these exchanges reflect the formation of reciprocal relationships forged by individual households. This was likely done as a means to bank social capital in case of local depredations. Assuming the primary risks in this region were due to warfare and not subsistence, a strategy of crossing political boundaries would be a sound risk avoidance strategy. This would be especially true if the connections were forged across boundaries that crosscut alliance formations made by aspirant leaders likely to suffer from simultaneous depredations. The data thus show that all segments of society relied upon exchange to some extent in their navigation of the social landscape. However, most aspirant leadership strategies were clearly focused on other lines of ascendance and the overall character of the region would have largely precluded the sorts of economic long distance exchange hypothesized previously.

Together these three appendices offer a substantial reformulation of the culture history and causative factors in the prehispanic Río Sonora. Future work is clearly needed on a variety of important subjects, especially chronological refinement and the extension of political reconstructions back in time, prior to ca. A.D. 1200. The region would also benefit from an increase in the number of investigated river valleys and segments. The overarching lesson from this dissertation is that the Río Sonora region contains an extraordinary amount of internal variation. This dissertation has made a significant contribution to describing one river valley and placing it in the context of specific, political, and ecological contexts. Hopefully research in the near future will enable a fuller understanding of how the dynamic qualities of this region impacted surrounding regions and how its particular qualities relate to broader trends in the development and character of middle range societies.

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APPENDIX A

Political Landscapes of Late Prehispanic Sonora, A View from the Moctezuma Valley

Submitted to Arizona State Museum Archaeological Series, Arizona State Museum, The University of Arizona

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Preface

Setting the Scene

This research is intended to redress long standing questions over the nature of social organization in eastern Sonora. As will be reviewed in detail in Chapter 1 previous research in this area argued for a high degree of political centralization and complexity. Influenced by the neo-evolutionary theory of the era, groups of eastern Sonora were identified with *chiefdom* like organization (e.g. Doolittle 1988; Pailes 1984, 1990; Reff 1985; Riley 1987), including long distance exchange, warfare, and management of surplus subsistence production. After the initial formulation and testing of this reconstruction U.S. researchers largely eschewed the region for the subsequent 35 years. Today many U.S. researchers would probably find descriptions of eastern Sonora both dated and implausible. For example, taking a comparative approach Steve Lekson (2009:215) describes the archaeology of Sonora as *unimpressive* relative to much of the U.S. Southwest. This view, though very rarely published, is probably common. A few U.S. researchers, such as John Douglas (J. E. Douglas and Quijada 2004, 2005) have made explicit attempts to draw eastern Sonora into modern theoretical paradigms. In general, though, the Río Sonora remains largely unknown and uncritically dismissed by most U.S. researchers. This is in stark contrast to the Paquimé area, which has been the subject of much revision since the 1970s work of Charles DiPeso (e.g. Bagwell 2006; R. J. Bradley 2000b; Pitezel 2011; C. S. VanPool and VanPool 2007; Whalen and Minnis 2001c, 2009).

In contrast to the declining interest of most U.S. scholars, Mexican archaeologists have greatly augmented the pace of work in the Río Sonora region over the last several decades. These researchers are not so quick to dismiss questions of scale and complexity. Cristina Garcia has conducted six seasons (at the time of writing) specifically seeking out evidence of trans-regional interaction. A forthcoming paper by Watson and García (Watson and García 2015) exemplifies the potential success of such directed efforts. César Quijada has been a significant contributor to the ever expanding site files of INAH Sonora, with much of his research focused on eastern Sonora. John Carpenter and his compatriots, following a strategy of working from the known-to-the-unknown, have traced interaction routes north and east from Culiacan through northern Sinaloa and southern Sonora and are actively pursuing their direction into central and eastern Sonora towards Paqimé (J. P. Carpenter and Vicente 2009). And a number of other individuals associated with INAH Sonora have likewise started to fill in gaps in knowledge with regional focuses (e.g. J. R. Martínez and Jaramillo 2013). Long time researchers in the region also recently reaffirmed the core tenets of their prior models in terms of scale and general models of complexity (Doolittle 2008; Riley 2005).

How can these two trends be rectified in the broad theater of archaeological theory? To be certain there is something to be said of disparate national traditions (Villalobos 2007). U.S. archaeologists have generally assumed baselines of minimal complexity (S. K. Fish and Fish 2000b), low connectivity, egalitarianism, non-differentiation, etc. This is undoubtedly owing to the out-size impact of early ethnographic work among Pueblo and other Native groups portrayed in this manner. As a result, with some notable exceptions (Lekson 1999, 2009; Wilcox, et al. 2008) U.S. researchers tend to assume low levels of complexity until evidence unequivocally proves otherwise, which it often does (e.g. Mills, et al. 2013). Terms frequently applied to the Río Sonora in the 1980s and before like *polity*, *statelet* (from *pequeños estados*), and even *elite* now seem antiquated and unjustified to many U.S. researchers, although they generally avoid saying so in print (with some exceptions McGuire and Villalpando 1989).

In contrast, U.S. researchers with substantial experience in Mesoamerica as well as many Mexican researchers likewise trained in, or heavily exposed to Mesoamerica, have tended to work from the other end of the continuum. The relative yardstick has often been unequivocal state societies and a significant amount of inter-connectivity, hierarchy, and complexity are assumed until demonstrated otherwise. Analyses are, of course, much more nuanced and, as noted, do not necessarily follow lines of nationality. All researchers acknowledge and employ understandings of many different dimensions of complexity that are not necessarily correlated (Mills 2000). Greater emphasis is also increasingly placed on the non-material exchanges that took place across this vast region, and there is much active discussion over the significance of such interaction (e.g. Hers 2001; B. A. Nelson 2004, 2006, 2007; E. C. Villalpando 2001). In the end, whether a society is described as being *x* degrees more complex than a Pueblo or *y* degrees less complex than Aztatlán, the same basic conclusions are reached.

Nonetheless, significant questions and disparities remain. Were the researchers of decades past misguided in their basic premises regarding eastern Sonora? Or, have recent U.S. researchers been too cautious in their reconstructions? If interpretations of past decades are in need of substantial revision, what impact does this have on macro-regional reconstructions? These issues were the genesis of the research program described by this monograph. Stemming from dissertation research, the goals of the project were fairly modest, and much more research is still severely needed in the Río Sonora region. Indeed one of the principal take away findings of this study is that the only constant in eastern Sonora is significant variation. What this project found to be true in the Moctezuma Valley is certainly not uniformly applicable in either the Sonora or Bavispe. Nonetheless, the following chapters offer a significant, if tentative, realignment of data and theory.

Course of Study

This project has taken several significant turns in focus since its original inception. The potential for exchange to be a significant factor in the political trajectories of eastern Sonora groups was the starting point of the research design. Since most research on this subject focused on endpoints in trans-regional interaction it made sense that a substantial contribution could be achieved by examining the space in-between. The basic goal, as originally envisioned, was to add to the minimal evidence regarding whether eastern Sonora was a suitable conduit for transmitting goods or ideas between Mesoamerica and the U.S. Southwest, and what impact, if any, facilitating such transactions had on local organization. Initially it was hoped models and methods from better known regions such as the Hohokam of the U.S. Southwest could be unproblematically imported and applied to eastern Sonora. This proved to be more difficult than originally planned.

Research began in 2008 with the collection of stream sands to evaluate the potential of a ceramic petrofacies model to provide a baseline of local exchange relationships. This proved feasible if not exactly easy. There was clearly a basis for at least a two part division on the landscape that would reflect local exchange relationships. In 2010 survey work was undertaken along an approximately 30 km reach of the Moctezuma Valley (Figure i.1). This research confirmed the presence of many sites but suggested only small scale integration based on the distribution of site sizes. Environmental parameters were also found to largely discourage larger scale integration, due to the patchy nature of arable land distributions. In contrast to the Sonora valley there was no evidence of *substantial* communal or public architecture. There were large sites, but they were primate only in the sense of size and in some cases richer material culture inventories. Interestingly, the surface collection of sherds seemed to suggest regular exchange in mundane goods between settlement communities. Although it was not realized at the time, the distribution of some rare goods, also hinted at larger patterns of regional exchange that linked some settlement communities while excluding others. In summary, the data seemed to contradict previous models that proposed large scale integration of political polities, heavy involvement in the exchange of exotic and rare items, and significant internal hierarchy. These observations led to the formulation of two hypotheses to be tested through excavation and intensive mapping at three sites: Teonadepa (Son L:1:23), Los Mineros, (Son L:2:22) and El Nogal (Son L:2:1) (Figure i.2).

Hypothesis One. Instead of large territorial polities the region was characterized by small settlement communities integrated both through the regular exchange in mundane commodities and exotic goods.

Hypothesis Two. The region was characterized by a lack of socially integrative mechanisms above the level of the household as indicated by the absence of any public architecture and the small scale of settlement communities. Assuming ethnohistoric documents that describe warfare as constant in the region were valid, *Hypothesis Two* further proposes that households forged ties exterior to their own settlement community that could be relied upon in times of stress as a means of risk management. This obviously assumed settlements in different communities would be less likely to undergo simultaneous depredations.

Specific lines of evidence sought to address these questions included the following:

1). Detailed mapping to reconstruct site structure by means of identifying groupings above individual households, evidence of architectural inequality, and examples of integrative features with minimal archaeological visibility.
2). A further elaboration and testing of the ceramic petrofacies model to better understand household exchange patterns in mundane goods.
3). Excavation of domestic contexts to seek evidence of material and other forms of differentiation between households.
4). Provenance analysis of rare and exotic items to reconstruct exchange patterns of potential aspirant leaders and other social connections.

One site, Los Mineros, although spatially expansive, proved to represent a less substantial occupation and is thus of less relevance to most conclusions. The goals regarding site structure also proved largely unachievable except for some indications at Teonadepa of what could be a plaza area. Comparisons between domestic structure assemblages within sites do not suggest substantial variation indicative of household vertical differentiation, but did highlight significant variation in a variety of material culture patterns. Substantial data was produced regarding local exchanges of brownware ceramics and to a lesser extent patterns in rare and exotic artifact provenance that permit a significant reformulation of previous models. Significant contributions are also made to improving the chronology for this region and providing descriptive accounts and baselines of material culture patterns.

Overall the data suggest small scales of social integration and a highly fragmented political landscape were the norm for this region. Material culture differences, subsistence strategy variation, and disparate rare goods access unequivocally indicate settlement communities are something more than just spatially proximate groups of sites. There are clear differences between settlement communities in this region that suggest alternative political, social, and perhaps ideological spheres of interaction. Notably the circulation of brownwares does support the hypothesis of regular exchange between households in different settlement communities. As to broader questions of social and political complexity, the inhabitants of the region fall into the large range of non-state organizational patterns known as transegalitarian (Hayden and Villeneuve 2010). In relation to prior reconstructions, the data suggest something well below what would classically be called a chiefdom.

Many of following chapters emphasize descriptive analysis and methods, a necessity for the area. Chapters 3 through 9, 12, and 13 present the material culture, feature and site descriptions and analyses. Chapter 10 presents a much-needed summary of chronological data and Chapter 11 focuses on provenance determination methods. Chapter 14 evaluates the scope, purpose, and character of exchange relationships in the region. The final chapter (15) provides a synopsis of both the results of this study, a broader cultural history of eastern Sonora, and some more speculative models to account for specific characteristics of social and political strategies inferred from the present data.

In the end, the arguments that are formulated are much more in line with a view of eastern Sonora characterized by low levels of regional connectivity and insignificant hierarchical differentiation. There are, however, indicators that the political and social strategies employed in the region are more akin to approaches taken by elites in neighboring Mesoamerica and northwestern Chihuahua. The political and social organization of these areas served as the inspiration for the aspirant leaders of the Río Sonora. It should also be stressed that the considerable variation evidenced in this region should not be ignored. While a fairly comprehensive, if tentative, reconstruction is offered in the Summary and Conclusions chapter, further research will be required to asses its applicability to even near neighbor river valleys. Hopefully the following pages will serve as a step toward bridging the gap in prior interpretations of this region.

1. Previous Research

This section provides a review of previous research in the Río Sonora region based on both ethnohistoric and archaeological research. Most of the pertinent research conducted by U.S. scholars is now several decades old and employs theoretical models no longer in vogue. It is not entirely possible to distill an atheoretical cultural history from this literature, so some weight will be given to the primary debates and discourses of decades past. Obvious issues of translating between theoretical paradigms will arise; effort will not be exerted pointing out well-worn criticisms of classificatory systems that employ terms such as *chiefdoms* versus *states* or shortcomings of the cultural area approach. Most critiques are limited to specific aspects of data interpretation. The utilized vocabulary will hew to that of the original researchers.

Regional Definition

The Río Sonora region encompasses a large portion of northeastern Sonora (Dirst 1979). As presently defined, it extends approximately from either the Bavispe Valley or the Sonora-Chihuahua border in the east (J. E. Douglas and Quijada 2004; J. Martínez and Jaramillo 2014) to the Río San Miguel in the west (Braniff 1992a). The international border and the confluence of the Río Moctezuma and Río Bavispe form approximate northern and southern boundaries respectively. In terms of cultural geography, the Río Sonora region is bounded by the Trincheras on the west (see Braniff 1978), Chihuahua/Casas Grandes to the east, the *Serrana* to the south and the Hohokam and Mogollon to the north. In the parlance of the cultural area approach, the region was originally defined by Amsden (1928) and further elucidated by R. Pailes (1973). R. Pailes interpreted the culture to extend throughout Sonora bordering on the Huatabampo and Aztátlan regions of Sinaloa to the south with an approximate geographical border at the Río Fuerte. The term *Serrana* was suggested as a more appropriate moniker for the region in the 1970s (Braniff 1976:46) and employed by some researchers. Current convention holds that the term *Serrana* now refers only to the southern portion of the region added by R. Pailes, while the original term *Río Sonora* is maintained for the northern portion of the region.

In keeping with the theoretical approaches of the day, R. Pailes (1973) described the region as a branch of the Mogollon but with obvious influences from peripheral Mesoamerican and West Coast Mexican cultures. Researchers continue to see a greater conformity with developmental sequences of the U.S. Southwest, as opposed to Mesoamerican or other broad cultural traditions (J. P. Carpenter and Vicente 2009). This is true at least as far south and east as the Loma San Gabriel complex with archaic traditions similar to the San Pedro phase followed by sedentary agriculturalists largely indistinguishable from their northern Mogollon contemporaries. However, a growing emphasis in the analysis of Río Sonora cultural history is placed on similarities with neighboring regional archaeological traditions, including Huatabampo, Tacuichamona, Aztatlán, and the Serrana (J. P. Carpenter and Vicente 2009; de la Isla González 2009:275). These groups, along with the Río Sonora, correspond roughly to the distribution of historically recorded Cahitan speakers[i]. As discussed below, how linguistic boundaries relate to archeological cultures remains contested by both linguists and archaeologists.

Ethnohistoric Accounts and Interpretations

Although the pace of research is increasing, northeastern Sonora essentially remains *terra incognita* in the archaeology of temperate North America. Despite this dearth of archaeological data, the region figures prominently in broad scale reconstructions of Northwest/Southwest pan-regional interactions (Lekson 1999, 2009; Riley 1987, 2005; Wilcox 1986; Wilcox, et al. 2008). Since archaeological data are presently sparse interpretive frameworks by necessity make heavy use of the sixteenth century, exploration chronicles of Cabeza de Vaca's, 1528-1536 (Adorno and Pautz 1999); Marcos de Niza, 1539 (Hallenbeck 1949); Francisco Vasquez de Coronado, 1540-1542 (Hammond and Rey 1940); and Francisco de Ibarra, 1565 (Obrégon 1928) and to a much lesser extent seventeenth century Jesuit accounts (e.g. Nentvig 1980[1764]; Pérez de Ribas 1999[1645]).

Much debate surrounds the accuracy and utility of these accounts (cf Doolittle 2008:306; McGuire and Villalpando 1989; Reff 1991a, 1997). For the most part, all researchers seem to agree later Jesuit accounts are of little utility (Reff 1985:18-19; 1997:174-175). In the intervening years between Ibarra's intrusion into the region and the earliest Jesuit accounts from the early seventeenth century there was a significant population decline, likely ascribable to European diseases. The decimation of populations renders observations from this period on political and social structure of little value. There are also substantial questions regarding the relevance of the four principal sixteenth century accounts. Political and economic circumstances certainly played a role in coloring what and how the northern Spanish frontier was portrayed. And to be sure, all of the early chroniclers had some ulterior motives, ranging from justifying the treatment of Natives and other conduct to personal financial interest. As Reff (1991a:644) points out the early chroniclers were also intentionally vague and likely misleading in their accounts so as not to provide too much aid to political competitors. As a result, even identifying the approximate location of the routes taken by these early excursions remains problematic.

Lastly, there is some question of whether even the earliest of accounts truly represent unperturbed indigenous conditions. References by Cabeza de Vaca, regarding curing of the sick (e.g. Adorno and Pautz 1999:257) may indicate European diseases already reached into the region at this early date.

The earliest text is that provided by Cabeza de Vaca (Adorno and Pautz 1999). This account chronicles the trials of the remnants of the shipwrecked Narváez expedition as they made their way from the Texas-Louisiana coast to the edge of the established Spanish Empire in Nuevo Galicia. This party likely crossed northern Chihuahua before turning south down one of eastern Sonora's major river valleys (Figure 1.1). The most notable description of the area is the town of Corazones[ii], so called for a gift of 600 hearts received there by the Cabeza de Vaca party. The location of this settlement is a point of common reckoning for distances in both the Cabeza de Vaca and Coronado accounts, making its location crucial for identifying the places discussed in the relevant chronicles. Most scholars (Bolton 1949; Reff 1981; Sauer 1932) have placed its location in the Ures Basin or further southwest, suggesting the principal route south for Cabeza de Vaca and north for Coronado was through the Señora (Sonora) Valley. A few scholars disagree (J. P. Carpenter and Sanchez de Carpenter 2007; DiPeso 1974b), placing Corazones near Yecora and the aforementioned routes in the Bavispe drainage. However, the weight of the evidence, including assertions made by most seventeenth century Jesuits (cf Hedrick 1978:231; Reff 1997:174) as to the location and relative spatial relationships between certain towns, seems to favor the former interpretation.

Prior to the transit of Cabeza de Vaca, slaving expeditions headed by Diego de Alcaraz, a future captain on the Coronado expedition, had already significantly impacted portions of modern day northern Sinaloa and southern Sonora. Alcaraz' activities resulted in the depopulation of a large portion in the modern area of the Río Sinaloa. This is an important point since it indicates that even the earliest records available pertain to a time in which the political territorial landscape was already impacted by Spanish activity. It is possible that this created a northward shift of populations, leading to increased resource competition that could explain the ubiquity of warfare described in most accounts. Cabeza de Vaca first met members of Alcaraz' party in this region after traveling down the Yaqui river.

Descriptions provided by Cabeza de Vaca's party upon their return spurred exploratory interest in the region. None of the three free members of the party could be persuaded to join a return expedition. As a result, the purchase of Estevan, an enslaved member of the party and apparent language savant was orchestrated. Estevan returned in the company of Fray Marcos de Niza to investigate the rumors of larger population centers with considerable wealth to the north, known as Cíbola. For reasons that remain unclear, this party apparently passed more to the west of the Cabeza de Vaca route (Hallenbeck 1949). Estevan, traveling as an advanced party, made it to the Pueblo town of Cíbola (Zuni), where he was killed. De Niza, hearing of the event, reportedly proceeded to within view of the pueblo and then returned. In retrospect, his report of the adobe town's size, architecture, and potential wealth rivaling that of Mexico city appears hyperbolic (for a contrasting view see Reff 1991a:639), but nonetheless led to Francisco Vázquez de Coronado's expedition.

Coronado was the first large scale excursion into modern day northern Sonora and the U.S. Southwest, and included several hundred Spanish and possibly several thousand native Mexicans as well as a substantial number of livestock. The Río Sonora valley again seems like the most likely corridor for the north bound journey, and the lesser described Río Moctezuma for the south bound return. It is clear that Coronado visited several of the same locations as Cabeza de Vaca, including the town or region of Corazones. The main documentary sources of this expedition are the Castañeda and Jaramillo accounts (Hammond and Rey 1940). Both of these records were given as evidence at Coronado's trial, which ostensibly was to judge his conduct of the expedition and treatment of Native subjects, but in reality had more to do with changing political fortunes and the failure of the expedition to achieve financial success. As such, these accounts were likely given with a variety of ulterior motives.

Most of the narrative in these accounts pertains to the period of time passed in what are now the U.S. Southwest and Plains. A few chapters of the Castañeda account do deal with the rear guard headed by the incompetent Diego de Alcaraz left at Corazones. This garrison was moved at least two times but the same name was retained for all three localities. The failure of the Coronado expedition discouraged further exploration for several decades. Francisco de Ibarra, having achieved marginal success in previous expeditions of modern day Zacatecas, mounted a final search for the fabled riches of Cíbola around 1563. This expedition likely followed a similar route as Coronado's through the Río Sonora or Moctezuma valleys but likely returned mostly through the Bavispe Valley. There appears to be little *a priori* reason to doubt the motives of Obrégon, the expedition's chronicler, but many descriptions do seem unlikely. For instance 6000 houses are reported for the valley of Guaraspi, likely along the northern Río Sonora.

All the relevant accounts describe large populations organized into territorial groups. Population centers were concentrated in the region's river valleys. Obregon (1928:174), describes settlements, located in the Moctezuma valley (Cumupa) with as many as 500 houses. Both Obrégon and Castañeda are clear on the point that Río Sonora groups were highly organized in regards to the near constant internecine warfare (Hammond and Rey 1940:250-251, 269). These local disputes were at times set aside to counter the presence of the Spanish. Coronado's forces were essentially driven out of their base camp in San Geronimo (Corazones III). Obregon (1928) gives a detailed account of specific warfare tactics involving a fixed command hierarchy. He likewise notes several occasions of organized war parties greeting the expedition in elaborate regalia (Obrégon 1928:155, 160, 162). Groups apparently made frequent use of smoke signals to communicate, including across linguistic boundaries (Obrégon 1928:178, 192), and a composite force of 2,000 is estimated for the most impressive confrontation at Caguripa (possibly modern day Sahuaripa) (Obrégon 1928:187).

Accounts of the Cabeza de Vaca, Coronado, and Ibarra expeditions all make note of the productive potential of the region. Cabeza de Vaca states several times that triple cropping was possible (Adorno and Pautz 1999:235,251). Jaramillo, of the Coronado expedition (Hammond and Rey 1940:297) and Obregón (Obrégon 1928:159, 160, 175) of the Ibarra expedition describe the use of irrigation throughout the region and its generally high productive potential.

Anecdotal evidence also indicates a fair degree of craft specialization and trade. Cotton mantas are mentioned by Cabeza de Vaca, as are transactions for what was possibly turquoise in exchange for feathers (Adorno and Pautz 1999:231). Marcos de Niza makes frequent mention of cotton and turquoises, but this account seems the least reliable (Hallenbeck 1949). Obregón (1928:161) also mentions caged eagles and parrots. Castañeda (Hammond and Rey 1940:250-251) notes the presence of chickens, which presumably were actually turkeys and likewise provided a source of feathers. Slaves, salt and alum are also mentioned as spoils of warfare (Obrégon 1928:161, 164), but presumably may have been exchanged as well. With the minimal exception of de Niza's mention of "*pretty bowls*" (see Reff 1991a:645) and frequent note of "*turquoises"* there are unfortunately no mentions of the types of durable exchange goods that preserve readily in the archaeological record.

The accounts are unfortunately even less informative at they relate to other pertinent anthropological questions of religious and political organization. There are very few mentions of leadership positions aside from war captains. Most descriptions of religious practices are heavily colored by estimations of the ease or difficulty of potential Christian conversion. Only passing mention is made of religious leaders such as shamans. There is also, some reason to doubt the estimation and descriptions of Native war fighting capabilities given both conquistador ethics and a desire to justify hostile and violent tactics. Despite these obstacles several elaborate reconstructions have been forwarded for the Río Sonora region based almost exclusively on exploration texts, most notably those by Carroll Riley (1987, 1999, 2005).

Riley, while acknowledging the paucity of data, has constructed a political model of the Río Sonora region based on the concept of *statelets* (Figure 1.2). Riley originally coined this term in a decidedly unsuccessful attempt to avoid theoretically laden terms, such as *chiefdom.* Statelets are political territorial units consisting of a primate town surrounded by smaller population centers. This term has an obvious affinity with the so called *pequeõs* *estados* (Mendizábal 1928) of West Mexico. Based on archaeological surveys discussed below, Riley believed statelets were integrated by some means of political religious infrastructure, akin to ballcourt communities, and generally allied in war fighting pursuits that were an outgrowth of economic competition and slave raiding (Riley 1999:197).

Drawing largely from accounts of the Ibarra expedition, Riley also argued for a larger macro level of statelet political integration in war fighting endeavors. These alliances, or *confederations*, cooperated regularly in military campaigns, but individual polities clearly maintained autonomy, leading to many internal disputes. Obrégon for instance (1928:193) claims a disagreement over how to divide spoils was the ultimate undoing of the organized attacks against the Ibarra expedition. The use of smoke signals to send word of hostile intentions provides circumstantial evidence of long distance alliances between what was likely the Sahuaripa region and the polity of Cinaro south of the Río Fuerte (Riley 2005:163). There are also several lists given to various chroniclers that specify the allies and enemies of various towns visited. The exploration era accounts were too episodic to evaluate the persistence of any of these alliances, but Riley suggests they were along linguistic lines (Riley 2005:163)[iii]. Many regional animosities were still present a century later when the Jesuits arrived in the region (Pérez de Ribas 1999).

The inferences drawn on war fighting by Riley have yet to be verified archaeologically but do seem to be well supported by the ethnohistoric record and are generally commensurate with interpretations of other regions of the Northwest/Southwest (Lekson 2002; Rice and LeBlanc 2003; Turner and Turner 1999). Much more controversy surrounds Riley's view of the protohispanic economy of the region, which he has described as akin to a free trade market (Riley 1987:90) dependent on long distance exchange. These ideas were commensurate with broader interpretations of the Mesoamerican frontier prescient at the time (DiPeso 1983; DiPeso, et al. 1974c; Foster 1999; J. C. Kelley 1986, 1992, 1995, 2000). As noted above, there are clear references to commodity exchanges in the region. Riley generally assumes the Pueblos of modern day New Mexico anchored the northern end of this system, mainly because no other large population centers remained after ca. 1450. Riley's model was originally formulated before the re-dating of Paquimé (Ravesloot, et al. 1995). Much is made of references from the Cabeza de Vaca expedition regarding how local hostilities ceased so that all could gain access to these peculiar visitors. Riley (1995:207) infers that this behavior represents a general pact that traders were not to be molested. If true, this would indicate the primacy of this sort of economy but the evidence is decidedly scarce and entirely anecdotal.

Riley also overlooks contradictory statements such as de Niza's that groups, possibly in the Yaqui, area bordered each other but did not maintain trade relationships (Hallenbeck 1949:35). The importance of this trade to macro scale political trajectories is also questionable. Riley believes the statelets served as an entrepôt for Mesoamerican goods to the U.S. Southwest. There are no commodities that are undeniably Mesoamerican mentioned in any of the exploration era texts, nor is there much evidence that the Southwest had much of interest to offer Mesoamericans. Turquoise, has long been assumed to be a valuable exchange good (Weigand 1977; Weigand and Harbottle 1993), but most ethnohistoric references reflect local consumption of this resource and suggest it was a widely accessible social valuable. Trade in other regionally available commodities, such as salt, cotton, hides, feathers, shells, and slaves are frequent in the ethnohistoric texts. Riley notes many of these items were transshipped long distances as well as locally, but as most of these items are perishable it would be hard to gauge the relative component of the economy focused on long distance versus regional exchange from present archaeological data.

Generally Riley should be commended for providing a comprehensive reconstruction on which to build and improve. While much of this review is critical, it is only because Riley provides the largest target. The most obvious shortcoming of his model is that it undeniably, selectively highlights aspects of social organization mentioned in the ethnohistoric record while downplaying others. In an attempt to provide some measure of replicability, translations of accounts of the four principal expeditions were coded for references to aspirant leader strategies (Appendix A). Figure 1.3 and 1.4 provide summaries of the results. Obviously some degree of subjective interpretation is still involved in this approach. To evaluate Riley's focus on exchange relationships as critical to aspirant leader positions Figure 1.3 presents on only those strategies that reflect material goods exchanges plus references to widely available social valuables (*sensu* Spielmann 2002). Social valuables are not necessarily a component of social ascendance strategies. In fact, they are often a means by which a populous contests emergent inequalities through the implementation of widely shared symbols that emphasize group membership and shared identity. They are included here as a heuristic comparison also relevant to material exchanges. As can be seen, this category outstrips all material transfer categories. Even among potential ascendant leader strategies, the categories that would fit most easily into Riley's model, such as wealth generation and prestige goods, are far surpassed by more inclusive strategies, such as feasting and generalized gifting.

Figure 1.4 highlights that warfare far outstrips any other behavior generally associated with social ascendance strategies. Obviously, too much should not be read into this observation, given presumed Spanish biases. However, the distribution of references does minimally suggest that if the ethnohistories are going to be a basis for social reconstructions then warfare and not exchange should be the predominant focus.

Prior Archaeological Research

Eastern Sonora was the target of several turn-of-the-century peripatetic surveys (Lange and Riley 1970[Bandelier 1884]; Lumholtz 1973[1902]; 1990[1923]; Sauer and Brand 1931). Among these Amsden (1928) is credited with first formally describing the *Río Sonora* culture. However, this effort was rather minimal and based on only a cursory inspection of ten sites in the Sonora and Moctezuma drainages. The first systematic attempts at conducting fieldwork in the region were not made until several decades later.

In the 1960s and 1970s there was a general increase in Northwest Mexico research, spurred largely by a desire to test a renewed focus on Mesoamerican-Southwest interactions. This was, in large part, based on the identification of supposedly Mesoamerican traits among archaeological cultures located in the U.S. (e.g. Beals 1944; E. W. Haury 1945; E. W. Haury 1976; Hedrick, et al. 1974; Pepper and Nelson 1927). The excavations at Paquimé by DiPeso (1974a, 1983) provided the most comprehensive model for Mesoamerican-Southwest interaction. DiPeso argued for a direct intervention in southwestern political trajectories by itinerant traders, or *pochteca*, who established an outpost on the Mesoamerican frontier following the collapse of Tula, the Toltec capital. Though this model is now largely discredited (Whalen and Minnis 1996, 1999, 2000, 2001b, 2001c, 2003), it heavily influenced interpretations of the whole of Northwest Mexico for decades (J. C. Kelley 1986, 1992, 1995, 2000).

R. Pailes (1973) first undertook systematic work in the Río Sonora area (now termed *Serrana*) in the southern portion of Sonora. This effort established a basic chronology for the region still utilized today and provided the first thorough description of the material culture. R. Pailes suggested that two diverging traditions were identifiable in this area. A lower foothills group represented the in place development of a Cahitan group from a widely shared Mogollon base. This group (Cuchujaqui phase) became culturally distinct at around A.D. 700 and was likely closely related to both the neighboring Huatabampo tradition and the prehispanic ancestors of the modern Mayo and Yaqui (Pailes 1973:363;371). R. Pailes (1973:394) believed a second group, representing the Río Sonora culture (Los Camotes and subsequent San Bernardo phases), migrated into the region, also around A.D. 700, and represented an intrusion of Taracahitan populations.

R. Pailes and a number of student collaborators (Dirst 1979; Doolittle 1979; Reff 1985) expanded research of the Río Sonora area to the north in subsequent years. A substantial portion of the Río Sonora Valley was systematically surveyed by Doolittle (1984b, 1988) between the modern towns of Banimichi and Mazocahui, and judgemental surveys were conducted of the far-upper Río Sonora, Río Bavispe, Río Moctezuma, Río Sahuaripa, and Río Fronteras. In general, Río Sonora Project researchers agreed that the archaeological record correlated with Riley's statelet model, but with several notable divergences in opinion over the local developmental sequence. Doolittle provides the more detailed model. His findings indicated large settlements with communal architecture occupied "*nodal*" locations in multi-settlement polities (Doolittle 1984b, 1988). Ballcourts and other large enclosure features (see Dirst 1979) located at these sites presumably provided communal edifices to facilitate polity integration in a manner similar to other regions such as the Hohokam and Casas Grandes. Doolittle (1984b, 1988) believed that differential land holdings with concomitant production benefits permitted the emergence of something akin to a staple goods redistribution economy (cf Pailes 1978:141-142). In this model local elites emerged via their privileged claim to the most productive parcels of land, often next to perennial springs that would remain reliable even in drought conditions. This preexisting class of privileged individuals then later appropriated trade networks when they developed in the 1200s and 1300s.

Alternatively, R. Pailes (Pailes 1984, 1990, 1997; Pailes and Whitecotton 1995) posits that control of long distance exchange networks was the basis of political standing and attendant social differentiation from the original emergence of large populations. R. Pailes (1997:187), also argues that the settlement system identified by Doolittle does not include the primate centers in the valley, which are now obscured by modern towns. This is an important point since it suggests the current reconstruction of maximum settlement size might be underestimated, and the nexus of polity integration slightly misplaced. There has always been an obvious but unstated disjunction between the scale of the communities envisioned by Riley's statelet model and the size of archaeologically visible communities (Figure 1.5). R Pailes' observation would also suggest that other, more substantial forms of communal architecture might be unrecorded.

Both researchers agreed there was unequivocal evidence of a substantial population increase in the area sometime around A.D. 1200 to 1350. Doolittle (1984b:21) cites a 450 percent increase in the number of houses ascribable to the transition between these two periods. To R. Pailes (Pailes 1997) this growth rate appeared to far surpass anything achievable through endogenous growth. Doolittle (1988:55) disagreed, arguing that an entirely endogenous growth rate of three percent could account for the observed pattern. Much of the growth rate may actually be explained by chronological imprecision (see Chapter 10).

Relatedly, based on the productive potential and the ethnohistoric documents Doolittle estimates a total Sonora Valley population in the range of 10,000 to 15,000. For the entire region population estimates for the town dwelling Ópata and Pima Bajo at this time range from 70,000 (Reff 1985) to 90,000 (Riley 1999:194; see also Sauer 1935:29) to 100,000 (Doolittle 1984a). Several authors (McGuire and Villalpando 1989) criticize various aspects of Doolittle's population models, as well as other small points, however, none of these authors actively work in the region and Doolittle (2008) recently reaffirmed most of his views on population estimates.

Reff (1985, 1991b, 1992) contributes an important element to the contact period cultural history of the Río Sonora region. Ethnographers have often remarked on the near total obliteration of Native identity and the relative quickness of assimilation once Jesuit missions and other edifices of colonization were established in the region (Johnson 1971; Radding 1997; Spicer 1962; Yetman 2010). Reff argues this ease of assimilation was an adaptive response on the part of Native cultural systems that were seeking to fill the vacuum of a disease induced political and social collapse. That is, the Jesuits, with their hierarchical organization, were able to effectively reconstitute the productive and organizational systems reflected in the exploration era accounts (Reff 1985:14-15). The Jesuit priests filled leadership voids left by the deaths of caciques and paramount chiefs by assuming purview over the organization of labor and the distribution of surplus (Reff 1985:325).

Reff's findings were in accordance with the theoretical trends of the day that focused on systems level processes and classification of political organization. Many of the specifics regarding how individual level decisions would manifest themselves as the emergent properties identified by Reff are left unspecified. For instance, would there be sufficient social memory to engender such a system wide response and longing for hierarchical structure; or was submitting to the process of *reducción* actually an economically wise decision from the vantage point of the individual small holder living in a *rancheria*? These theoretically anachronistic criticisms aside, Reff's documentation of population levels in the Jesuit period firmly established the impact of disease. His comparison of Jesuit and exploration era accounts also leaves little doubt (for a dissenting view see McGuire and Villalpando 1989) that a significant disruption occurred prior to the seventeenth century that renders Jesuit accounts of little use for reconstructing sixteenth century and earlier sociopolitical organization (see also Riley 1999:198).

R. Pailes provides the bulk of interpretations relevant to macro scale political processes in the Río Sonora region. Due to the sparseness of relevant data researchers across Northwest Mexico are forced to employ models in which a substantial portion of the supporting evidence is actually drawn from surrounding regions. In this approach the target research area (Northwest Mexico) is argued to posses some quality or serve some function based on circumstantial evidence of its impact or influence on the better known neighboring region. The most obvious example is the perennial question of Mesoamerican contact and influence in the Southwest U.S. Given Northwest Mexico's geographical location it must have served as a conduit of cultural transmission and actual migration, but the direct evidence is exceedingly sparse. R. Pailes and Whitecotton, (Pailes 1990; Pailes and Whitecotton 1979; Whitecotton and Pailes 1986) a Mesoamericanist collaborator, addressed this question through the application of World-Systems-Theory (*sensu* Wallerstein 1974, 1976). In this scenario the chiefdom like polities of the Southwest and Northwest Mexico developed as a result of their contact with Mesoamerica. Specifically, Mesoamerican groups plied their northern neighbors with preciosities in exchange for raw materials, such as cotton, salt, slaves, turquoise, etc. Local elites, by monopolizing ties to Mesoamerican goods and ritual knowledge gained prestige and soon entered into local elite exchange networks. The circulation of preciosities in time also led to the regular exchange of commodities, although the extractive nature of the relationship and the inherent disadvantage of the peripheral polities to the core Mesoamerican system remained constant.

In recent decades very little archaeological work has been carried out in either the Sonora or Moctezuma valleys. The *Instituto Nacional de Antropología y Historia* (INAH) conducted a salvage archaeology project in 2005 that included several sites in the Moctezuma valley (Blanquel 2010; Hinojo and Blanquel 2011). Three habitation sites were chosen for sample test excavations. This work provides a few more data points to the limited corpus of Río Sonora ^{14}C dated contexts. Detailed descriptions of ceramic types and thorough reporting of frequencies provide an invaluable data set for comparisons and hypothesis generation regarding diachronic changes in artifact assemblages. As this data is primarily descriptive it will be reviewed in more detail in the respective artifact class analysis chapters.

Research on the Edges of the Río Sonora

The work of Douglas and Quijada (J. E. Douglas 1997) in the upper Bavispe Valley (Huachinera-Bavispe) provides a contrasting view to interpretations of the Sonora Valley. A more secure, but still crude, chronology is available for this area based on a few ^{14}C dates and known dates of intrusive ceramics. An early phase, perhaps beginning around A.D. 500, suggests in place development of agricultural villages as opposed to a later migration model (J. E. Douglas and Quijada 2003:59; 2004:105). Settlements dating to this early phase were located on the floodplain, where it is typically difficult to identify sites due to deep alluvium. One site identified by R. Pailes (1984) in the Sonora valley, with a date of 500 B.C., indicates there is a substantial time depth to settlement in this setting and the later mesa focused settlement system was a relatively late phenomenon. The Bavispe researchers suggest ceramic assemblages with compositions in excess of 50 percent of types equivalent to Geronimo Brushed [Brownware] (Dirst 1979) are diagnostic of this early period.

Above ground structures appear roughly contemporaneously with those of the Río Sonora valley around A.D. 1000-12000. Ceramic sequences hint at parallel development with the Casas Grandes region, culminating with the Carretas and Huerigos types. Although cautious in their interpretations, this suggests to Douglas and Quijada that past interpretations of Paquimé hegemony over this region are likely overstated (J. E. Douglas 1997; J. E. Douglas and Quijada 2005). There are, unfortunately, many issues with discriminating middle period sites from late and protohispanic sites. In many cases there is continuity of occupation, which obscures counts of middle period sites. This precludes estimating the rate of population growth in this critical time period. There seems to be little doubt, though, that there is a continuous record from the prehispanic to the early historic period.

In contrast to the Sonora Valley pattern, there was much less variance in site sizes and no discernable nodal or centralized organization. The river valley was densely occupied and likely supported a population of equivalent size to the Sonora Valley, but the distribution of populations was substantially different (J. E. Douglas 1997:26). Public architecture was quite rare and not associated with the largest sites. In at least one instance public architecture occurs at neighboring sites. Douglas and Quijada suggest this may reflect competitive claims to floodplain land legitimated through ritual infrastructure The segmented nature of the area's settlement system indicates competition among groups and possibly intra-valley warfare (J. E. Douglas 1997:30). This could partially account for the dearth of very small, hamlet sized, settlements that are so common in the Sonora Valley. All of these qualities were taken as evidence against the statelet model as described by both Riley and Doolittle (J. E. Douglas and Quijada 2004:107-108). Minimally, it is clear greater variability existed in settlement patterns than that described by previous researchers.

Douglas and Quijada also offer a preliminary analysis of macro scale exchange systems, which are central to models of political organization in this region. They note very few precocities were recovered, such as shell and turquoise. Obsidian was much more common, but a preliminary sample subjected to EDXRF sourcing analysis indicates that nearly all of it was procured from a single unidentified location. Interestingly, the Río Huachinearas settlement system, which was smaller than most of the neighboring systems, apparently had the greatest access to nonlocal materials (J. E. Douglas 1997:30).

To the east in the Río San Miguel drainage limited surface survey and testing confirm this area is associated with the Trincheras region and remained largely out of the influence of the Río Sonora (Braniff 1978:81; 1990:170). There is evidence for the very late intrusion of Ópata groups into the area. In general there is very little evidence for exchange relationships between the Trincheras and Río Sonora area (Pailes 1978:140). Most sources suggest the Ópata were expanding against the O'odham at the time of contact, and it seems possible this was a contested and hostile frontier in the prehispanic era as well.

John Carpenter, Guadalupe Sánchez de Carpenter and their associates have conducted relevant work in the far north of Sinaloa. As described above this region was originally included in the regional definition of the Río Sonora (Pailes 1973). R. Pailes (1997:181-182) noted there were several distinct differences between this region and the northern manifestation investigated by research in the Sonora Valley. The southern area is now generally considered sufficiently distinct to warrant a separate regional label, the *Serrana* (J. P. Carpenter and Sánchez 2008:30; J. P. Carpenter and Vicente 2009:87). Carpenter and his compatriots do echo previous observations that both regional variants emerged from the same geographically expansive San Pedro archaic tradition along with the Huatabampo and other neighboring groups and continued to remain essentially materially indistinguishable from Mogollon groups into the first millennium A.D. (J. P. Carpenter and Vicente 2009). However, Carpenter and Vicente (2009) also argue for a middle tier of cultural classification that includes the Río Sonora, Serrana, Huatabampo, and likely the archaeologically ill defined areas of modern Yaqui inhabitance. This region approximates the historical range of Cahitan speakers.

Carpernter and his collaborators (J. P. Carpenter and Vicente 2009) have added a good bit of detail to the general outlines of Serrana culture through their excavations of the site of Rincon de Buyubampo. This site occupied between A.D. 1200 and 1700 was characterized by multiroom units with stone foundations and, relatively speaking by regional standards, large rooms up to 10 by 8 m in size. There was ample evidence of shell jewelry manufacture in a style similar to Trincheras, as well as evidence of at least regional exchange in the form of prismatic obsidian cores and a copper bell.

Lastly, Cristina García (2008, 2009, 2010, 2011, 2012, 2013) has led a multi-year project in southern Sonora specifically designed to locate evidence of U.S. Southwest-Mesoamerican connections. This region would likewise be included in the Serrana area by most estimations. The first several years were carried out in the Batacosa region of southern Sonora. More recently her team has undertaken substantial research in the Onavas Valley in the same area as Gallaga's (2006) previous investigations. The most impressive finds in this region have focused on the site of El Cemetario, which as the name implies is a low funerary mound. The internments of this region display a clear propensity for cranial modification more commonly associated with West Mexican and Mesoamerican proper contexts (Watson and García 2015). Curiously though, there is little material evidence of such links. Overall, the region is best characterized as reflecting many of the same settlement pattern and demographic patterns of the Río Sonora region (Gallaga 2006), but with a material culture that reflects participation in social networks that often did not reach much farther to the north.

Linguistic Affiliations

The gradual in place development of Cahitan groups argued for by Carpenter and Vincente is a stark contrast to the models proposed by earlier scholars. R. Pailes (1997:186; Phillips 1989:390; see also Wilcox 1986) argued the Ópata, and presumably other Cahitan speakers, were relatively late arrivals from a Chihuahuan homeland that were still expanding against the Lower Pima at the time of the Spanish *entrada*. This view estimates the age of the Cahitan intrusion of Sonora at approximately A.D. 1000, and is based on a glottochronology minimum age of 800 years for the divergence of O'odham (Pima-Papago) and Tepecano (Swadesh 1967:98) as well as other crude linguistic comparisons (Sauer 1934:82). Several scholars (Dirst 1979; Phillips 1989) place the arrival of Taracahitans in the region even later, arguing that they were the remnants of Casas Grandes groups after the fall of Paquimé, but these arguments relied heavily on the now discredited chronology of DiPeso.

More recent linguistic (Miller 1983) studies have tended to favor Carpenter's view of the antiquity of Taracahitan development from a Protosonoran branch of the larger classificatory group of Uto-Aztecan, which also includes Tepiman. In these reconstructions the division in the northern and southern branches of Tepiman is thought to reflect the migration of speakers, likely to the north but possibly to the south (cf Fowler 1983:245; Miller 1983:333-334). In short, debate remains over the arrival time of Cahita speakers in the region and the role of Piman or Tepiman speakers in the region's cultural history. Tepiman speakers may have been long time residents pushed aside by Cahita speakers, recent immigrants, or relatively static neighbors of Cahitan speakers for centuries.

There appears to be few if any salient cultural differences that can clearly be ascribed to group identities that were isomorphic with historic linguistic groups. This may simply be the result of the limited archaeological research done in the area. It is notable though that many of the brown/red/purple-on-brown ceramics of the Serrana and Huatabampo areas, such as Guasauve red-on-brown (J. P. Carpenter and Vicente 2009:92), and types recovered in recent excavations near Onavas bare an obvious semblance to Trincheras and Hohokam types. Conversely, textured types seem to largely be absent in much of the Serrana. Though not a primary focus of this dissertation there is clearly a need to investigate the potential for extending historic cultural and linguistic boundaries into the prehispanic period.

Conclusion

This section gave a basic overview of research in the Río Sonora region. Ethnohistoric research has emphasized the role of exchange in the development of political hierarchies in the region. Researchers relying principally on archaeological data have in contrast suggested a number of different basis for social inequality including, exchange, subsistence production, and warfare. These theories are not mutually exclusive. The refinement of chronologies in neighboring regions and development in archeological theory suggest substantial revisions are necessary to the basic outline of Río Sonora cultural history. Obvious avenues of future research are suggested by contradictory findings from the Sonora and Bavispe valleys concerning scale and mechanism of settlement community (polity) integration and the likely ramifications for aspirant leader strategies.

The remainder of this monograph will present data from a largely uninvestigated valley, thus providing an important additional case study of regional diversity. Emphasis will be placed on the scale at which material culture variations are apparent as a means to gauge integration in various spheres of interaction. Analyses will also attempt to elucidate what sorts of leadership ascendance strategies are visible in the archaeological record. In contrast to most previous studies, long distance exchange does not appear to be a paramount concern of leaders in the Moctezuma Valley. Most data are commensurate with the outline of social organization forwarded for the Bavispe Valley.

2. Environmental Setting

This section will provide basic data and descriptions on the environmental parameters of the study area. A fuller description of bedrock geology will be given than what is typical for an archaeological monograph due to its relevance to petrographic sourcing discussed in detail in Chapter 11. Given that the time frame of interest is relatively recent, in geological terms, modern conditions and distributions can generally be used as reliable proxies for prehispanic conditions. The discussion of topographic, hydrological, and climatic qualities is also of major importance since they are the primary limiting factors in subsistence production potential and related demographic distributions. Basic discussions of flora and fauna distributions also provide data relevant to subsistence concerns.

Geology

The study area lies on the western margin of the Sierra Madre Occidental between the ranges of Sierra El Carmen and Sierra La Cieneguita among others on the west and the Sierra La Madera on the east (Figure 2.1). The oldest substantial rock exposures in the study area are Cretaceous in age, with localized deposits of older Paleozoic sedimentary rocks present near Nacozari and significantly east southeast of Moctezuma (Figure 2.2). The Cretaceous aged deposits include outcrops of andesites and volcanoclastics that compose the Lower Volcanic Sequence with dates up to 60 Ma (Gans 1997:394; F.W. McDowell, et al. 2001). These are predominantly located on the eastern side of the valley in the project area. Other Cretaceous/Tertiary formations include rare deposits of limestone and the much more massive, intrusive, granitoid, batholithic bodies of the Laramide Pluton with an approximate cooling age as recent as 50 Ma (Gans 1997:395). An unroofed exposure of the later constitutes the Sierra La Madera. The Cretaceous aged sedimentary rocks closest to the project area include deposits in the upper reaches of the Agua Caliente and small deposits near the modern towns of Divisaderos and Tepache.

Most portions of the Moctezuma Valley and the Sierra Madre Occidental were subsequently covered by the Upper Volcanic Sequence, a thick rhyolitic tuff deposited between approximately 34 and 27 Ma during the late Eocene and Oligocene (F. W. McDowell and Keizer 1977:1485; Paz-Moreno, et al. 2003:440). An initial period of continental extension occurred 30 to 22 Ma. A period of volcanism associated with these events produced chemically variable (bimodal) deposits consisting of poorly welded ash-flow tuffs and perlitic dacitic to rhyolitic volcanic domes as well as trap (flowing) basalts (Demant, et al. 1989:739; Paz-Moreno, et al. 2003:440). A prolonged episode of continental extension occurred during the Neogene with the greatest portion corresponding to the Miocene (Gans 1997). This was a period of northeast southwest extension, resulting in the formation of basins with strike slip faults along their eastern margins. The ultimate cause of the extension is a topic of some debate and centers largely on the timing of the convergent to transform fault structural change of the Pacific/North American plate boundary, the subduction angle of the Guadalupe (Cocos-Farallon plate), and the resulting interaction of the athenosphere with the continental crust (Atwater 1970; Demant, et al. 1989:745-746). Presently, it appears for much of the period of extension a large portion of Northwest Mexico overlaid the subducted plate. This may have led to increased magmatism along a back arc that resulted in the weakening of the lithospehre and subsequent extension (Gans 1997:405-406). The opening of a slab window in the Farallon plate, allowing increased asthenospheric flow into the mantle wedge, may have augmented this process (Ferrari, et al. 2007:32).

It is clear that along the western margin of the Sierra Madre Occidental there was substantial extension, exceeding 90 percent in some areas. Extension proceeded by means of normal faulting along half-grabens that subsequently in filled with continental molasse (sedimentary alluvial and colluvial deposits ranging in composition from sand to breccia textures) (Demant, et al. 1989:739; Paz-Moreno, et al. 2003:440). In the Moctezuma Basin basaltic eruption events are intercalated in these deposits, which together form the Báucarit Formation (Gans 1997:394-395; King 1939). The formation is often strongly tilted and cemented by low temperature zeolitization (Cochemé 1994). Basaltic lavas of this formation, dating between 17 and 22 Ma (see refs in Cochemé 1994:218), are easily identified by the replacement of olivine with iddingsite and red clays and the infilling of amygdules with zeolites and/or calcite (Cochemé 1994-222). Such exposures are present a short distance south of modern day Jecori.

Volcanic activity ceased in most of western Sonora by the Quaternary. A rare exception are a series of basalt flow events as recent as the middle Pleistocene (Paz-Moreno, et al. 2003) in the far southern portion of the study area. This event altered the course of the Río Moctezuma south of modern day Moctezuma and temporarily dammed some of its tributaries, creating a short lived marsh. The associated sediments contain characteristic Rancholabrean fauna (Mead, et al. 2006; Mead, et al. 2007). Throughout the period of human occupance there has been no volcanism nor other significant landscape altering geological event.

Topograhpy

The topography of the study area is fairly diverse over the approximately 30 km reach of the project area. The quaternary basalt deposits in the far southern portion of the study area provide an erosion resistant barrier. As a result the mesas on the east side of the valley south of Moctezuma are somewhat higher in elevation relative to the floodplain. These mesas also tend to have steeper faces. This results from the erosion of less resilient alluvial deposits that underlie the lava deposits, resulting in collapses that leave relatively shear faces. To the north of Moctezuma the eastern side of the basin opens onto an expansive bajada zone before reaching the steep granitic slopes of the Sierra La Madre. This area is drained mostly by the Río Chino.

The western side of the river is characterized by low hills of mixed felsic and intermediate composition. These hills extend for some distance before reaching the more substantial elevations of the Sierra El Carmen. Immediately north of the town of Moctezuma the river runs between these hills, producing a very narrow reach inadequate for floodplain farming. Very few prehispanic sites are located in this area. The Río Moctezuma itself has a very small catchment in this zone, draining only the immediate hills. Most of the surrounding area is drained by arroyos and streams, such as the Río Chino that intercept the Moctezuma further south. The river valley widens at about 3.5 straight line km south of Jecori. North of this point the river is characterized by a floodplain of highly variable width as the river wends its way around low hills. Approximately 3 km north of Jecori, just south of La Colonia de Cumpas, the low hills on the eastern bank give way to the aforementioned expansive bajada. At this point arroyos on the bajada begin to flow perpendicular into the Moctezuma, as opposed to parallel and oblique. This topographical setting continues for some distance to the north before entering the narrow canyon south of Nacozari, well outside of the project area.

A fairly characteristic cross section of the valley would thus descend from the Sierra Las Palomas of the Sierra El Carmen on the far western edge of the valley, continue for approximately 20 km through rugged foot hills before reaching the narrow floodplain of the Moctezuma (Figure 2.3). The cross section would then quickly pass through low volcanic hills on the eastern bank of the river before entering the lengthy bajada leading to the Sierra. This project is focused within the narrow riverine corridor of the Moctezuma floodplain. The extent of prehispanic occupation of these much larger physiographic provinces remains largely unknown but nonsystematic survey suggests only periodic seasonal habitation.

Environment

Climate

The modern annual temperature of the study region varies from an average 12° C in winter to 30° C in summer with a minimum of -12° C and a maximum of 50° C. Frosts are uncommon, with usually less than 10 and only approximately 300 hours of freezing temperatures per annum in the valley (Gerardo 1985). Precipitation peaks in the summer months with an annual average of ranging from 300 to 500 mm (Figure 2.4). Approximately 65 to 70 percent of moisture is in the form of summer rains between July and September (Brown 1994c:101). Warm moisture laden air is brought to the region by west monsoonal winds coming from the Gulf of California. These storms generally progress south to north. Orographic uplift produces reliable and substantial precipitation in upland areas. In the wider parts of the valley storms are less predictable and more spatially variable. However, over the course of a standard summer rainy season all parts of the valley will reliably receive multiple showers. This seasonal pattern of precipitation is in stark contrast to neighboring regions such as the upper Sonoran Desert with its winter dominant pattern of precipitation (see Cordell 1984; J. S. Dean 1988:37-41). In both regions summer storms are spatially heterogeneous, but in the eastern Sonoran thornscrub they are sufficiently frequent to be treated as a reliable and predictable source for dry farming. The rains become less frequent and less predictable to the west and with an inverse pattern to the east. Winter rains are generally meager and constitute only ~ten percent of the annual total in the project area (Gerardo 1985:168). The infrequency of freeze events, though, may have made these rains more easily utilizable than larger synchronous events in the northern Sonoran Desert.

Flood events resulting from mountain runoff and local precipitation can be severe (see T. E. Sheridan 1988:54-55). The last such event occurred in the summer of 1994, inundating nearly the entire floodplain of the study area and causing considerable damage. Local residents claim a similar flood occurred sometime around 1912. Two slight terraces in the floodplain visible immediately south of Moctezuma, both less than a one m in height, indicate the extent of these events. Today precipitation and discharge from artesian aquifers is sufficient for the Río Moctezuma to flow perennially beginning just south of Cumpas. In the past, before significant ground water pumping, annual flow was undoubtedly higher and likely was perennial over a greater portion of the river's course. Pools along the Agua Caliente to the northeast of Cumpas support a small population of fish, including introduced bass and carp, indicating perennial water persists in some places relatively high in the headwaters of the Moctezuma drainage. These areas have higher surface bedrock and maybe less affected by well draw down. The Río Nacozari is also perennial until just north of its confluence with the Río Moctezuma. This is clearly the result of near surface bedrock in this region.

Paleoclimatic records for the western flank of the Sierra Madre that specifically include eastern Sonora are essentially non-existent. As a result, all inferences regarding prehispanic climatic conditions must rely on records from distant areas that may not provide entirely accurate proxies. The longest record currently available in Mexico is provided by the dendroclimatic study of Douglas Fir stands in Durango, Mexico, and stretches back to the late 1300s (Cleaveland, et al. 2003). This region is considerably south of the study area, but subject to the same macro scale climatic regimes. Several cautionary notes are warranted regarding this reconstruction. The oldest portions of the record rely on very few samples, one tree for the 1400s. The record is also based on early wood growth, which corresponds to winter precipitation (November to March). Comparisons with historical records indicate that these factors produce conservative estimations of deviance from the mean. The significant periods of deviation captured in the historical record are known to have had a similar effect across most of northern Mexico. The most significant period of drought in the record was between 1540 and 1579. At least five other periods of drought occurred between 1386 and the 1540 event, but none as severe or long lasting. There were also several wetter than average periods, some of decadal length, such as 1477-1486.

Alternative approaches to modeling large scale climatic trends at the continental to subcontinental scale produce results that are roughly synchronous with the Durango record. Stahle and others (2007) utilized tree ring records from across North America to generate a model that spanned to the early 1300s. Unfortunately, data from sites in Mexico are significantly under represented in the sample and none pertain to the earliest portion of the reconstruction. They place the sixteenth century mega drought in the period from 1559 to 1582. Another significant drought affected much of western North America from 1387 to 1402 that likely included northern Mexico.

The late 1500s drought stands out as exceptional for its longevity in the currently available climatic record of northern Mexico and western North America generally (Seager, et al. 2009). This drought had a pronounced affect across much of Mexico and is even speculated to have exacerbated Native population collapse in central Mexico by affecting vector rodent populations (Acuña-Soto, et al. 2002). It is noteworthy that the early expeditions of Coronado and Ibarra did not note any specific drought induced hardship in eastern Sonora at this time, but rather frequently noted the abundance of food in the region.

Hydrology

As is the case with much ecological data, the study of hydrology in the region is underdeveloped. Generally speaking, four north south trending rivers drain the sierra of eastern Sonora. These are, from west to east, the San Miguel, Sonora, Moctezuma, and Bavispe. The San Miguel and Sonora have a confluence near Hermosillo. The Moctezuma and Bavispe unite presently in the artificial Lago Novillo near the town of San Pedro de La Cueva. South of the lake's outlet the river is known as the Yaqui. Stream flow records are sparse for this region of Sonora. Essentially none exist that record the natural state of the San Miguel, Sonora, or Moctezuma over their courses through the sierra. A few records are available for the Sonora after its confluence near modern day Hermosillo, but this location is significantly removed from the research area. A number of records also are available for the Bavispe and presented in Table 2.1. These values provide a rough estimate of the amount of water available in the region, although the Bavispe undoubtedly has a significantly more substantial flow than the other relevant rivers owing to larger watershed and physical location more to the east and at a higher average elevation. The general pattern for large rivers is one of seasonal flows in northern reaches that become reliably perennial streams as they move south and pass through most of the Río Sonora region. In the more southern reaches of the Río Sonora region secondary and even tertiary level streams will flow near perennially. Springs and other discharges would also provide some additional water sources. One such point immediately south of modern day Jecori began flowing in November, an otherwise very dry period, presumably reflecting the time required for summer rainfalls in the Sierra La Madera to percolate through the aquifer.

Flora

The vegetation of the study area is characterized as Sinaloan Thornscrub (STS) (Brown 1994c) with the exception of the narrow riparian corridor and isolated pockets of Sonoran Savanna Grassland (Brown 1994d). Other descriptions are provided by Gentry (1942), Shreve (1937, 1951), Hardy, and Muller (1947). Today most of the hills and bajadas of the study area are heavily utilized to graze cattle, and plant communities have undergone significant changes from their prehispanic equivalents. Most notably buffel grass is widely planted on mesas and hills. These locations largely lack productive potential beyond their use as grazing land. Local ranchers will often employ heavy machinery to first strip the land of existing vegetation before planting this prolific grass species. Less disturbed areas continue to be dominated by thorn scrub communities that are, at times, quite dense and nearly impassable on foot.

Gentry (1942) reports densities for equivalent communities ranging from 1,600 to 2,000 plants per hectare. The essential characteristics of the flora community are deciduous, drought resistant, multi-trunked, thorny, pinnate leaved trees and shrubs between 2 and 7.5 m in height (Brown 1994c:101). Appendix B provides a list of species reported for the vicinity of the project area and neighboring regions of potential logistical exploitation. Super local conditions introduce some variation in the relative prevalence of species. Species such as *Sternocereus thurberi, Agave angustifolia, Bursera laxiflora, Celtis pallida* were much more abundant on rocky outcrops, whereas *Prosopis veluntina* and *Ambrosia ambrosioides* were generally limited to better watered runoff areas. Several species such as *Parkinsonia aculeate* were common on higher mesas but rare in other contexts. A few speices such as *Erythrina flabelliformis, Ipomoea arborescens* were never seen on site, but were noted in the general project area vicinity. Due to the extreme seasonality of precipitation the region undergoes significant annual transformations. In May, near the end of the dry season, the area appears to be a barren land of dry sticks and brambles. Over the course of only a few weeks a substantial transformation occurs as perennial plants quickly foliate and annual plants proliferate, producing an environment more akin to tropical settings. Due to the relative infrequency of frost, deciduous trees will often maintain their foliage through the winter months.

A variety of other plant communities are located in the near vicinity of the project area (Figure 2.5). To the south of the study area the Sinaloan Thornscrub gives way to the closely related Sinaloan Decidous Forest (SDF). These two biotic communities overlap significantly and fingers of the SDF can be found intruding into the general vicinity of the project area. The principal differences are a complete closing and increased height of the canopy with the addition of several decidous tree species such as *Conzattia sericea, Cochlosperum vitifolium, Ceiba auminata, Bursera inopinnata,* and *Lysiloma watsoni* (Gentry 1994:75). In comparison to the STS the SDF also lacks many of the scrub thorn and succulent species (Gentry 1994:73).

The region was also interspersed with noncontiguous areas of Sonoran Savanna Grassland (SSG). The distribution of such grasslands is not well understood. Overgrazing of the SSG quickly coverts it into thornscrub communities. Most of the isolated pockets of grassland in eastern Sonora were converted by the 1940s and many a century earlier (Brown 1994b:137). Tress, especially species of mesquite were always present in these areas, but in ungrazed sections grasses may have constituted upwards of 75 percent of cover (Shreve 1951).

At elevations as low as 880 m the Madrean Evergreen Woodland (MEW) begins (Brown 1994b). The transition can be abrupt with little intermixing of lower elevation biomes such as the STS. The MEW is dominated by a variety of oaks, with a shrub and grass understory. In higher elevations conifers become intermixed and at times dominant to the encinal woodland. In the range of 1850 to 2000 m the MEW gives way to the lower Madrean Montane Conifer Forest (MMCF). The MMCF is analogous to the Rocky Mountain Conifer Forest present in high ranges across much of the U.S. Southwest. At lower elevations it is dominated by Ponderosa pine (*Pinus ponderosa*). Few ranges on the Mexican side of the border reach elevations suitable for higher elevation biomes dominated by mixed conifers (Douglas and white) or aspens (Pase and Brown 1994).

Fauna

The fauna of the region is characteristic of the Sinaloan Thornscrub community and includes those animals listed in Appendix C. The predominance of modern cattle ranching makes it hard to estimate the density of prehispanic fauna of subsistence or economic interest. Ethnohistoric documents mention (Adorno and Pautz 1999:235) three species of deer being present in the region. These undoubtedly include the mule deer *Odocoileus henionus,* white tailed deer *O. virginianus,* and possibly pronghorn *Antilocapra americana sonoriensis*. Other potential species of subsistence interest in the immediate environs of the study area are several varieties of *Lagomorph* and other small mammals and a variety of fishes. The potential for *Ara militaris* is also secondarily hinted at in ethnohistoric accounts by way of describing the use of feathers in costumes. These, however, may have been imported, and there are rarely sightings of this species today anywhere in the Río Sonora region. A far more detailed discussion of many species is provided in the Faunal Analysis (Chapter 7). .

3. Settlement Survey: Results and Implications

Doolittle (1984b, 1988) provides the basic template for Río Sonora settlement patterns. As described in Chapter 1, Doolittle identified what he termed a "*nodal*" distribution of primate centers. In this pattern the two largest sites in the survey zone were spaced approximately equidistant from each other and from the ends of the arable limits of the valley. Subsequent research in the Bavispe Valley (J. E. Douglas and Quijada 2004; César A. Quijada and Douglas 2003) demonstrated that not all of eastern Sonora adhered to these patterns. In this valley, on the margins of the Río Sonora region, the settlement hierarchy was much less stark, large centers were not located in a nodal fashion, and communal or public architecture was not present at the largest sites. Located between these two study areas, the Moctezuma Valley offers an important point of comparison to both previous efforts as well as other large scale reconstructions such as those of Carroll Riley (1987; 1999; 2005) based on ethnohistoric texts.

The distribution of sites on the landscape is presumed to reflect organizational precepts of social organization. Most archaeologists working with agriculturalists have little objection to conceptualizing the household and settlement as basic building blocks of society. How these units are amalgamated to form larger social groupings is a principal concern of settlement pattern analysis (Kantner 2007; Peterson and Drennan 2005). Various researchers have pointed out that many different kinds of *"communities"* can be of central importance to the structuring of daily life and only some are universally encoded in spatial arrangements (S. K. Fish, et al. 1992b; Kolb and Snead 1997; Kowalewski 2008; Yaeger and Canuto 2000). Some relationships will specifically eschew spatially proximate relationships in favor of distant connections. Examples include culturally prescribed exogamy, resource sharing across heterogeneous production zones (R. L. Kelley 2007; Winterhalder 1990), reciprocal exchanges with foreign parties (Landa 1983; Strathern 1971), and ritual communities that crosscut spatially determined groups. While not denying the importance of these relationships, it can be safely assumed that physical proximity often implies cooperation and affiliation in many essential functions such as production, distribution, consumption, and reproduction (social if not physical). This is especially true in regards to the coordination of responsibilities that necessitate the shared use of fixed infrastructure such as many agrarian production tasks (e.g. Hunt 1988; Netting 1993). Other concerns, such as mutual defense, that require the rapid and quick dissemination of information will also universally rely in part on divisions based on spatial proximity. The inevitable need to delineate responsibilities and mediate conflicts within communities will encourage the formation of some leadership roles with sole or shared purview over interactions at this scale. As a result, arguments that settlement communities denote shared political affiliation are common (Abbott, et al. 2006; Drennan and Peterson 2006; S. K. Fish and Fish 1992, 2004; Wilcox 1991).

This chapter will employ settlement pattern analysis to provide a clearer approximation of the likely scale of political affiliation in the Río Sonora region. Commensurate with previous research in the region, the data indicate local reaches of river valley were the primary scale of integration above individual settlements. Uninhabited regions along non-arable portions of the valley impart a segmented quality to the region. The degree of integration within these settlement communities appears to be low in the Moctezuma Valley, but presumably still reflects some degree of sociopolitical affiliation.

These observations contrast with some previous models such as those of Carroll Riley. Although this scale of interaction was previously recognized it has not been emphasized as a determinant in larger scale patterns. Of course even if it is assumed a priori that settlement communities denote the largest regularly cohesive political unit (*sensu* Renfrew 1986) there is no simple isomorphic relationship to the boundaries of ideological, economic, and other domains of social interaction (Hutson, et al. 2008; Knapp 2003; Kowalewski 2008). Subsequent chapters discuss the degree to which these physical partitions of community coresidence correlate with various attributes of material culture relevant to other sorts of social relationships and to the nature of interactions between settlement communities.

Methods

The practical goals of the settlement survey were to locate all sites along the riverine corridor in a reach of river roughly equivalent to the most intensively surveyed portion of the Sonora Valley (Figure 3.1). A total of 30 km of the Upper Moctezuma river valley was surveyed. This represents approximately 50 percent of the river corridor wide enough to support irrigation. Above and below this region the river enters long stretches of steep canyons with minimal arable land. Sites were categorized as either habitation, seasonal, or special use (Appendix D). Any site that was both a habitation and some other type of site was classified as a habitation site. A total of 43 sites were identified in the sampled area, 33 of which were prehispanic habitation sites (Figure 3.2). Discussion with local ranchers led to the discovery of four additional sites outside of the Río Moctezuma corridor.

Landforms were individually surveyed one mesa or hill at a time. Transects were spaced approximately 50 m apart. The extreme density of vegetation in the riparian areas between mesas and hills and often shear sides of arroyos precluded alternative strategies. Generally, survey extended about 200 m inland from each side of the floodplain, unless an insurmountable landform was encountered. When a site was discovered it was investigated with transects spaced approximately 10 m apart. Survey proceeded at least 100 m past the suspected boundary of all identified sites.

A site was defined if one of three criteria were met: a prehispanic or historic feature was present (structure, rock art, horno, etc.), there was evidence of significant buried deposits or deposits that were recently present but disturbed or removed by blading or construction activity, or surface artifact densities exceeded five artifacts per one m^2 for an area at least 100 m^2. The location of less dense concentrations of artifacts, always lithics or ceramics, were also recorded but not assigned site numbers.

All instances of architecture, groundstone, rock art, miscellaneous features, significant artifact concentrations, and looting disturbances were recorded with a Tremble XH model Geographic Positioning System (GPS). This model of GPS is generally accurate to within one m. When possible the length and orientation of all architectural features were mapped. Due to disturbance and natural deposition, the maximum size of most architectural features could not be accurately determined from surface evidence. Rather only a few half buried cimiento stones were noted in a line, providing telltale indications of a buried or partially disturbed structure. Highly disturbed structures or structures that were buried completely, and for which no orientation or size data could be determined, were only point plotted. Nearly all, instances of architecture were photographed, unless the density of vegetation precluded the utility of a photographic record or the disturbance was so great as to preclude useful interpretive qualities. All artifact collection sites and locations of photos were also recorded with the GPS.

Site boundaries were determined through a Geographic Information System (GIS). Polygons were defined that encompassed all archaeological evidence and then extended with a 10 m buffer. The shape of mesas and other landforms effectively defined many sites. Sites with boundaries less than 20 m apart were amalgamated into a single site. The geographic center point of the site, as identified by the GIS) was utilized to determine the site's UTM coordinates. Topographic features (mesa edges, arroyos, streams etc.) were digitized within a GIS from satellite imagery. Large areas of disturbance, such as structures, parking lots, trails, and roads were also digitized from satellite imagery. The GPS and satellite imagery data were then combined to produce a site map (Appendix E). In addition to architectural elements, photos were taken of unusual features and artifacts. Attempts were made to take panoramic shots of most sites, but the density of vegetation prevented useful photos in many instances.

A random sample of five to ten brownware ceramic sherds was collected from all architectural features when possible. The scarcity of sherds at many sites often precluded a sample of this size. At highly disturbed sites or sites that were largely buried, obscuring all architecture, an amalgamated sample of sherds was collected from the site surface or back dirt piles that are not ascribable to a particular feature. All painted sherds were collected when encountered. Likewise, all obsidian flakes, minerals, and shell artifacts were also collected for provenance analysis. These items were all exceedingly rare.

Analysis

Settlement Distributions

Distributional data provides one of the most direct means to evaluate political structure on a landscape. How people are distributed relative to unoccupied spaces and the degree to which they are concentrated at primate centers provides insights on the likely degree of economic and political integration. The well used approach of rank-size correlation provides one means of estimating the number of autonomous multi-settlement units within a sample of sites and a means to gauge their relative interaction. There is a substantial literature on the rank-size approach (e.g. Berry 1961; Cavanagh 2009; Crumley 1976; Drennan and Peterson 2004; Hodder 1979; Paynter 1982; Whalen and Minnis 2001a). To assess rank-size relationships, the actual distribution is compared to an ideal straight line with a negative slope of one with both axes logarithmically transformed. A predictive equation of the value of a demographic variable at a given rank is provided by $P_i = P_I/i$, when values are arranged from greatest to least, P = demographic variable, and P_I is the size of the larges site (Zipf 1949). Ideally the demographic variable would be a direct measure of population. In practice archaeologists use proxies such as site areas or counts of structures. The ideal straight line predicts that the second largest site would be .5 the size of the first, the third largest .33 the first, etc.

Settlement systems that hew closely to the linear log-log plot are said to be *log-normal*,[iv] and suggest a system that is organizationally cohesive and interdependent (Johnson 1980). This scenario strongly suggests a distinct sociopolitical unit integrated both horizontally and vertically. That is, all sites frequently interact not only with the primate center (largest site) but also with other settlements of equal and lesser size. Why this interdependence is correlated with log-normal distributions is complex. What is actually being captured is a propensity for entropy in the system, meaning a higher volume and greater diversity of interactions (Berry 1961; Bettencourt, et al. 2007; Bettencourt, et al. 2010; Hodder 1979). Qualitatively stated, entropy is serving as a proxy for integration in that it is produced by a higher volume of interaction between all subunits. Many stochastic forces acting simultaneously (Simon 1955) and nonlinear emergent properties create these circumstances disproportionately in log-normally structured systems. In practice what constitutes the distribution on the landscape is a population gravity effect in which individuals preferentially attract to larger centers at the given proportion. Haas (2014) has demonstrated that these same processes can lead to similar patterns in diachronic contexts where individuals favor reoccupation of the same site.

Convex distributions above the log-log plot suggest weak hierarchical organization and likely the inclusion of multiple smaller scale, and largely independent systems, or conversely, a sample that failed to capture the highest echelon of population centers (Drennan and Peterson 2004; Johnson 1980:11; Peterson and Drennan 2005). This distribution corresponds to the largest sized site being closely matched by the second and possibly other near equals. Deviations below the log-normal line indicate a situation of primacy, in which one center overly dominates all interactions and thereby diminishes horizontal integration between centers of lesser size and importance (Hodder 1979; Johnson 1980; Whalen and Minnis 2001a). This is usually reflected by the primate center being several orders of magnitude larger than the second ranked site and lesser differences between subordinate sites. A summary statistic of Rank Sum Convexity, known as the *A* statistic was proposed by Johnson (1980:239) and refined by Drennan and Peterson

(2004). A settlement system in which all sites are the same size would produce a value of one. Log-normal distributions are indicated by values close to zero and increasing primacy by values nearing negative one.

The Moctezuma Valley sample is fairly small with 33 habitation sites of an estimated near contemporaneous age. Despite this small number the sample is likely representative and proportional. It seems highly unlikely that numerous small sites were missed on survey and even less likely that a larger primate center remains unknown within or exterior to the survey zone. Notably, four out of the five largest sites independently discovered on survey were previously noted in the site files of INAH Sonora. The A-statistic is calculated with *rsboot* (Drennan 2012*)* with 90 percent confidence intervals for each plot. As can be seen in Figure 3.3 the Moctezuma Valley presents a clearly convex pattern. This suggests multiple small scale units are present within the survey zone. For comparative purposes Figure 3.3 also presents data sets assembled from across Northwest Mexico and one example of a well understood Hohokam community (S. K. Fish, et al. 1992c) in southern Arizona. In the Hohokam example the pattern hews close to a log-normal distribution except at the tail where there is a lack of very small sites. This is likely a reflection of the minimum size of effective production units during this time or other processes discouraging autonomy of very small settlement units. The Trincheras (S. K. Fish and Fish 2004) and Paquimé (Whalen and Minnis 2001b) data clearly reflect situations of primacy. Within the Río Sonora region, the Sonora Valley (Doolittle 1979) comes closest to achieving a log-normal distribution but remains slightly convex. This is commensurate with Doolittle's analysis of multiple primate centers in the valley. The Bavispe data (J. E. Douglas 1997) is obviously convex. This is unsurprising since it represents noncontiguous survey, but also reflects the qualitative observations of Douglas and Quijada (J. E. Douglas and Quijada 2004; César A. Quijada and Douglas 2003) of minimal hierarchy in the settlement pattern data. The Onavas reach of the Yaqui valley (Gallaga 2006) is likewise clearly convex. A qualitative assessment of the Sahuaripa Valley (not in Figure 3.3) facilitated by John Carpenter and Julio Vicente's recent work (see also Ekholm 1939) reflects a similar pattern with the two largest sites discovered located in relative close proximity (tens of kilometers). In short, most settlement patterns of the Río Sonora region are convex, indicating multiple independent small scale units were captured within the limits of surveys.

Several scholars (Gallaga 2006; Pailes 1997) have suggested that the upper echelon of the site hierarchy is missing in survey work of the Río Sonora region due to modern development. In the Moctezuma Valley this seems unlikely since the modern towns of Cumpas and Moctezuma are mostly located on lower Holocene alluvial terraces generally eschewed by prehispanic settlements. Considerable utility trenching in the modern Moctezuma Plaza in 2010 also did not reveal any exposures suggesting substantial buried materials. The largest prehispanic sites are also located in close proximity to the modern towns. In regards to Cumpas, local folklore also holds that the prehispanic indigenous community inhabited Las Clavellinas (Son H:13:2) a large unusual hill site adjacent to Teonadepa (Son L:1:23). It seems unlikely these large sites would be located immediately proximate to obscured primate centers since such sites tend to grow at the expense of the immediate surroundings. Conversely, the Jesuits who selected the locations for missions, the focal point of what became the modern towns, likely located optimally next to population centers and easily accessible arable land.

The potential for obscured large settlements is somewhat more probable for other valleys, such as the Sonora where Banimichi and Baviacora are located on terraces. It is obviously extremely difficult to estimate the size of prehispanic sites that are no longer visible. Nonetheless, an attempt was made to account for such potential occupations in the Moctezuma and Sonora Valleys based on the distribution of level ground and the approximate size of towns in the 1970s when nonsystematic surveys were first made. These data are presented in Table 3.1. denoted as *altered*; they clearly do not substantially change the overall convexity of the distributions appreciably. This is hardly surprising since in both valleys there are two roughly equivalent sized locations towns added to the sample.

These patterns provide several important implications. Perhaps most importantly, the overwhelming majority of research on Northwest Mexico has clearly focused on settlement communities (Trincheras and Casas Grandes) with structures that do not typify the region. In regards to the Río Sonora region the data unequivocally indicate that the scale of political integration was likely quite limited and rarely reached more than 15 to 20 kilometers in any direction. This is not akin to the core zone patterns of Paquimé (Whalen and Minnis 2001b) where comparable distances are argued to reflect the extent of strong economic and political integration, but rather the maximum distances involved before entering into the territory of another equivalent political unit. These distances are more in keeping with communities seen in the Hohokam region. However, in this region there remains a distinct possibility for higher order consolidation of communities (Wilcox 1991; Wilcox, et al. 2008). .

The segmentation of the Moctezuma Valley is clearly visible in a cursory overview of site size distributions (Figure 3.4). There are likely moderate and small sites continuing to both the north and south of the survey area. As stated above, it seems extremely unlikely any other large sites are located within a close proximity of the terminus of the survey zone. None have been recorded in INAH site files and local individuals generally knowledgeable of such locations did not report any when queried. The recorded sample thus seems to adequately capture the prehispanic pattern. Much of the distribution is simply the result of access to arable land. Controlling for the artificial limits of the survey area, the relationship between arable land and amalgamated site size of the four areas highlighted in Figure 3.4 is $r^2 = .85$, $F = 11.2$, $df = 3$, $p = .079$. This relationship approaches significance despite the extremely small *n* and clearly suggests a determinant relationship. In short the character of Río Sonora settlement-communities is decidedly small scale, rarely extending across significant inhabited reaches of river. It is notable that Doolittle discovered a roughly similar scale in the Sonora Valley despite contiguity of arable land between the two primate centers. This suggests other social factors likely also constrained the maximum primacy achieved in the region. Conversely, the near log-normal character of the Sonora Valley may suggest this valley was moving towards scales of integration that were relatively unique for the region. Notably, the same basic political structure argued for in the prehispanic era is largely preserved in the modern *municipio* divisions of Sonora (Figure 3.5), and possibly even more divided. Populations are, of course, much more highly concentrated relative to the prehispanic era.

Settlement Density

In terms of site locations, the prehispanic period settlement pattern is similar to that of the Sonora Valley with a few important differences. As in the Sonora Valley, nearly all habitation sites appear to be located within the river corridor. Other localities, some distance from the main river, were occupied if alternative sources of water were available (e.g. Son L:1:11). In general, though, prehispanic populations exercised extreme selectivity in the location of habitation sites. Settlements in the Moctezuma Valley were only placed on landforms that met the following conditions: located on remnant Neogene age river terraces or overlying Pleistocene lava flows, at least 4000 m^2 in size, at least five m and usually more than 10 m above the bordering flood plain, a significant slope on the river side, virtually no slope on the landform surface, and adjacent to a substantial area of arable land <30 h^2. Several mesas that were ideal except for the arable land criterion were not occupied but did contain lithic scatters suggestive of resource extraction or seasonal use.

In stark contrast to the Sonora Valley, mesas were not occupied to their fullest capacity. Both R. Pailes (1997) and Doolittle (1988:42) are clear on the point that the predominant limiting factor for site sizes in the Sonora Valley was the size of the corresponding mesa. In the Moctezuma Valley large portions of mesas were often left unutilized. By employing a geographic information system (GIS) it was estimated that approximately 193.08 h^2 met most of the criteria relevant to habitation placement, but only 80.29 h^2 presented evidence of occupation. This would leave approximately 58 percent of the prime habitation land unoccupied; to say nothing of the subprime mesa lands that were vacant due to a lack of arable land or some other criterion. Insufficient population density most likely explains the failure to utilize this land. It is, of course, possible that significant populations resided in the river floodplain. However, this seems unlikely as flood events are common in the Moctezuma Valley. Very few modern structures are located in the floodplain. The most recent substantial inundation occurred in 1994 and local residents claim a similarly sized even occurred around 1912. Modern disturbance certainly covers some prehispanic habitation but as discussed above probably does not obscure major prehispanic settlements. This is also unlikely to affect this relative comparison since the Sonora Valley has more modern settlements in the survey zone than the Moctezuma Valley.

Communal Architecture

Important distinctions can also be made between the Sonora and other valleys in regards to communal features. The term "*communal*" or *"public"* architecture refers to any edifice constructed to serve an integrative purpose through legitimizing ritual or other public events. Usually such features are large and capable of facilitating a sizeable audience for special events. Examples from neighboring regions include platform mounds (Craig and Clark 1994; Di Peso, et al. 1974; DiPeso, et al. 1974e; S. K. Fish, et al. 1992b), ballcourts (Abbott 2009; Naylor 1995; Whalen and Minnis 1996), terraced hill summits (S. K. Fish and Fish 2004; McGuire and Villalpando 1993; E. Villalpando and McGuire 2009), and subterranean ritual rooms (Herr 2002). In the nearby Sonora Valley Doolittle reported several ballcourts and other large enclosures. Braniff (1992c) likewise tentatively identified a ballcourt in the upper San Miguel. Douglas (1997:11) found a series of small mounds and a semicircular platform, but was hesitant to label either as unequivocal examples of communal architecture. Ethnohistoric documents of the Río Sonora region mention small huts (Hammond and Rey 1940) that numerous arrows were shot into during times of war and sepulchers for deceased ruler (Las Casas 1951). Castañeda (Hammond and Rey 1940) also mentions *"little heights"* used by individuals described as town criers.

No ballcourt features were identified in the Moctezuma Valley and the identification of other types of communal architecture are tentative. Potential candidates include two natural prominences that were slightly altered, two circular enclosures, two potential plazas, and one small platform mound. The two natural prominences (Figure 3.6) were located at El Nogal (Son L:2:1) fairly close to the mesa edge. The placement of rocks on their talus slopes suggested a minimal amount of anthropogenic alteration. This site was capped by a Pleistocene basalt lava flow and prominences of this kind were common in the area. Each prominence was about 5 m high and had a small cleared space at the top. There was only a very limited viewing area in front of one of these areas but the other would have permitted a fairly large crowd. Very close to this site at El Corral (Son L:2:17) there was a small circular stone enclosure. On first inspection the construction appeared historic, but a local resident stated ranchers believed the feature was prehispanic. It is located next to several petroglyphs. The preserved wall is .9 m high by about .6 m wide and encloses an area 5.5 m across with a large entrance facing west toward the cliff edge (Figure 3.7). The closest habitation area is El Nogal, located 400 m to the north. The lack of domestic trash and the isolated nature of the feature adjacent to several rock art panels suggests some specialized use, but the relatively small size of the feature and unknown temporal affiliation make this identification very questionable. A large historic rock fence used to restrict livestock movements is located along the mesa edge and has a similar construction style. However, the circular feature does not have any apparent functional relationship to this historic construction.

Another circular feature was found on the east side of the river just south of Jecori at La Cruz (Son L:2:28). On initial inspection this feature looks as though it might also be a historic rock coral of some kind. But there is no evidence of manure deposition and an archaic projectile point was found on the surface within the feature, indicating the surface is not heavily disturbed. The features was constructed by placing a single course of large rocks (>.50 m) in what was probably originally a complete circle ~17 m in diameter. Smaller rocks are placed along the outer edge in a style reminiscent of standard river cobble cimientos (Figure 3.8). It is possible this was a very large structure made mostly of perishable materials. Its morphology is also somewhat similar to the *corrales* found on top of many *cerros de trincheras* (*sensu* S. K. Fish and Fish 2004). The closest habitation site is rather small and is located 100 m to the south and across a small wash. Local residents clearly perceive the feature as ancient as evidenced by recent looting activities that disturbed large portions of the wall.

At Son Las Clavellinas and Teonadepa post data collection processing of mapped wall alignments suggested potentially cleared areas that could serve as plazas. This is a clearer pattern at Las Clavellinas, where several sides of a clear rectangle can be discerned. This may reflect some kind of site structure if not an actual venue for communal rituals.

Lastly, a small probable platform mound is located in the Huashi region on the east side of the river at La Calera (Son L:2:34). It has measurements of 11 by 6 by 1 m (Figure 3.9). It was constructed by building an outer wall of large river cobbles probably four or five courses high. The interior was then filled with sediment. Presently this feature is deflating and the interior fill is eroding out where the cobble wall has collapsed. It is also feasible that this was a large structure with a substantial stone foundation. Excavation is required to answer the question definitively, but at present, interpretation as a small platform mound seems more plausible. Large rounded river cobbles would obviously be a poor choice if they were intended to be load bearing. Despite a thorough search, only a few sherds could be located associated with the feature. It is unclear if these were deposited in the course of using the feature or were included incidentally in the interior fill. The feature is isolated but located on the same landform as a habitation site 100 m to the north. There is an unutilized area and a rocky outcrop between the feature and the habitation area.

In all cases except the natural prominences at El Nogal the potential communal features were located alone on a landform that would otherwise be a prime location for domestic habitation. A lack of the usual suite of domestic trash is also notable, suggesting these spaces were kept free of refuse. These qualities suggest these features were enlisted in activities set apart from the mundane tasks of everyday life. However, despite these contextual suggestions all communal architecture candidates remain equivocal. Notably, none of the features, even assuming large perishable portions are now absent, would require substantial labor to construct. The fact that no two edifices in the Moctezuma Valley are even passingly similar likewise suggests a lack of standardization in any ritual activities or other events that may have taken place at these locations. The mostly isolated nature of the features would also seem to render them of lesser utility to aspirant leaders attempting to materialize ideologies of inequality by co-opting communal constructions. In short, if any of the Moctezuma examples are communal or public edifices they suggest only minimal investment and a lack of ideological conformity across the valley or wider region.

Resource Procurement Zones

In contrast to the previous sections, which focused on discerning specific evidence for integration from archaeological data, discussion now turns to general limits on scale in the Río Sonora region. Specifically, this section will consider the potential for settlement communities to control territory beyond parcels of near contiguous arable land. With the exception of the Central Sonora Valley extending control across these areas would be a prerequisite for the scale of territorial control implied by previous researchers (Riley 1987, 1999, 2005). Ethnographic data have conclusively demonstrated that non-sedentary groups rarely control resource access through territorial perimeter defense, preferring social boundary enforcement mechanisms (Cashdan 1983). Much of the literature for more complex societies that discusses common pool resources makes these same observations, only with a different lexicon (e.g. Bayman and Sullivan 2008). The common thread in all of these arguments is that the cost of defending a territory against incursions is usually higher than the benefits that can be gained by exclusive access (Eerkens 1999).

Social boundary defense offers an alternative approach to boundary enforcement and usually takes the form of placing a significant onus for boundary violation on the intruders. That is, the cost of violating the boundary is often extreme, i.e. violence, but the chance of apprehension is relatively low. In practice among hunter gatherer groups social mechanisms are usually in place so that access is always granted to foreigners as long as proper protocols are observed. Such theories are less elaborated in regards to how agriculturalists regularly control territory beyond immediate intensive production zones. Overlapping boundaries and the sharing of resource extraction zones is suggested by some ethnographies (e.g. Ferguson and Hart 1985) in the broader region. This is obviously commensurate with the hunter gatherer model cited above.

In the Río Sonora region these questions are pertinent to the inclusion of the expansive bajada and sierra regions within the political purview of riverine based settlement communities. Few primary data are available to address this question, so this discussion focuses on theory as opposed to empirical data. Surveys targeting these zones are mostly nonexistent with the exception of rare utility line projects. These efforts have not identified significant use of non-riverine areas (e.g. Blanquel 2010; see also J. E. Douglas 1997). INAH archaeologist Cesar Quijada (site files on record at INAH Sonora) located a few sites on the near river bajadas in the Moctezuma Valley. These are most likely small seasonal habitations that exploited summer flows in arroyos for farming. The most remote of these, Las Bagotas (Son L:2:37), was only 5.5 km from the main river corridor, and almost certainly associated with these larger settlements. There are also observations of check dams and other agricultural infrastructure in some portions of the sierra (see DiPeso 1984). DiPeso interpreted these as infrastructure created by regional centers to boost production and protect valley soils, but this interpretation would likely find few supporters today. Much more likely, the use of these upland areas represents independent communities of farmers akin to those seen in analogous ecological contexts with similar technologies in the U.S. Southwest (e.g. Cordell, et al. 1984). To date, there is no evidence of integration of variable topographic zones into a single settlement-community. These scenarios are common in neighboring regions, such as the Tucson Basin of Arizona (Fish, et al. 1992b).

If the ethnohistoric assessments of the reliability, and indeed surfeit, of subsistence production are credible then this is hardly surprising. The integration of ecological niches subject to non-simultaneous perturbations is a typical risk reduction strategy (Cashdan 1983:51; Winterhalder 1990; Winterhalder, et al. 1999); if risks to subsistence production are low, there is no impetus to engage in such practices, which often require higher investments in productive costs and certainly transportation (e.g. Goland 1993; McCloskey 1976). These interpretations are commensurate with similar observations of the hinterlands of neighboring Trincheras and Hohokam regions (Villalpando 2011).

In contrast to cultivated crops, animal and other collected resources were obviously procured at a distance in the Río Sonora region (see Chapter 7). The ethnohistoric documents clearly indicate that wild animal resources were abundantly harvested, most notably the 600 deer hearts presented to Cabeza de Vaca in what was probably the Sonora Valley (Adorno and Pautz 1999:235). Game, however, are a classic example of a resource whose density is often too low to make perimeter defense a viable strategy. Their value is further reduced by their own mobility, which will obviously not respect human boundaries. This later condition lessens the value of restricting access to their harvesting in one area. In sum, there are presently no known resources whose distribution and density would provide sufficient returns to offset the cost of exclusive territorial control. It thus seems highly likely that any potential political control of subsistence resources would effectively cease at the margins of the bajada zone. This observation, of course, does not preclude control of the individuals, such as hunters, who extracted resources from these uncontrolled zones. The essential point relative to the discussion of discerning political boundaries is that use does not indicate exclusive control. To a certain extent Riley (1987) presaged these observations but framed them in different assumptions. When discussing how traders apparently moved through the region unmolested he postulated a sort of traders protocol that allowed movement of these merchants through other's territory. Here this explanation is altered to argue that social boundary conditions permitted free access to these areas to all individuals because no single group exercised exclusive control outside of river corridors.

Demographics

At this point it is worth considering the absolute numbers of individuals that might be associated with settlement communities in order to set parameters on their likely internal organization. Various scholars have proposed a range of numbers from a low of 65,000 (Sauer 1935) to a high of 100,000 (Doolittle 1984a) for the entirety of the Río Sonora region. These would equate to densities of approximately 1.5 to 2.65 persons/km^2. Some extrapolation is required to produce these figures since the authors were not discussing the exact same area. For expediency the region clearly defined by Doolittle will be the focus of discussion. Most of this population would undoubtedly be concentrated in river valleys as discussed above, although historically (Radding 1997) the sierra also supported at least seasonal populations. This number would seem high by many standards. For instance, total peak Hohokam populations are estimated at only 40,000 and a regional Northwest/Southwest peak of 100 to 160 k (Hill, et al. 2004). These estimates supposedly include Sonora, however, since they clearly ignore every estimate made by any researcher to actually conduct work in the region they are of dubious relevance at best. They also openly acknowledge many individuals known to have existed at contact, such as the 17,000 reported in the Pimeria are invisible to their methods (Hill, et al. 2004:697). The figure of 100,000 may be high, but it will serve as a starting point for discussion. For reasons that will become apparent, it is also best to err on the side of overestimation in order to provide a stronger case regarding the scale of integration below. It is important to note that Doolittle's (1984a) research is also based on an evaluation of carrying capacity that demonstrates that the ethnohistorically recorded practices could have supported this many individuals.

Doolittle further estimates that approximately 10 to 15 k was present in the Sonora Valley (Doolittle 1980). This is close to the 14 k estimated by Reff (1985:300) from Obrégon's account (1928). The proportionality of this figure to the rest of the Rio Sonora region (as defined by Doolittle) can be compared against arable land. Utilizing Google Earth all river valley segments that were either recently or currently cultivated or located in a clearly flat portion of the valley floodplain were digitized (Figure 3.10). The goal was to record all contiguous parcels at least 20 h^2 in size. Incidentally recorded smaller parcels were retained in the analysis. The resulting proportional estimate suggests 11k should be allotted to the Central Sonora Valley, an impressive concordance considering Doolittle's work was accomplished without the aid of modern GIS. Dividing this number into two equally sized groups suggests settlement communities of approximately 5.5 k apiece. As noted above, the Sonora Valley is one of the largest contiguous arable reaches in the region and even when divided, both parts still rank towards the higher end of the distribution (Figure 3.11). By comparison the regions around Cumpas and Moctezuma would produce estimates of 4.9 and 4.1 k individuals. However, if the spacing of the Sonora settlement-communities and the spacing between Cumpas and Moctezuma regions is typical then it is likely the northern end of the Cumpas reach pertains to another settlement community, perhaps centered near modern day Los Hoyos.

At this point it is useful to compare these data based on Doolittle's estimates to the political landscape suggested by Riley (see Figure 1.1). In the Sonora Valley Son K:4:24 appears to be a good fit to the statelet of Señora and Son K:4:16 might be plausible for Guaraspi. However, this toponym has an obvious relationship to modern day Arizpe, and the valley is sufficiently arable in this region that another settlement community is certainly present. In the Moctezuma Valley Teonadepa near Cumpas could clearly relate to Cumupa. El Nogal near Moctezuma (previously Oposura) might plausibly be Batuco. However, as will be discussed in subsequent chapters, the substantial material cultural differences between these two primate centers suggests they might be culturally differentiated as well as politically. In this case Pinebaroca might be a better match. In either case if four of the seven statelets predicted by Riley for this area can be attached to only 20% of the estimated population and arable land there are clearly some incongruities of scale.

Clearly there are actually numerous settlement communities spread along the river valleys of eastern Sonora. Taking the spacing of the known groups in the Sonora and Moctezuma Valleys and applying it to other arable reaches along with a consideration of modern population distributions produces the more likely political landscape reconstructions presented in Figure 3.10. Notably, because most of these valley reaches are relatively small (Figure 3.11) a distribution of population relative to arable land leads to a mean settlement population size of only 2940. This figure, which as noted above is not likely to be an underestimate, is below thresholds typically associated with inherent managerial demands and the inevitable formation of hierarchical structure (Feinman and Neitzel 1984). This observation could potentially explain the lack of integrative features seen in most river valleys. Much more will be said of this in the Summary and Conclusions Chapter.

Conclusion

This section has demonstrated that the general scale of settlement community organization identified by Doolittle applies to the Moctezuma Valley as well. This scale does not match, in any way, the political landscape suggested by Riley. Instead of a handful of large territorial polities, locally autonomous communities characterize the region. At most 5 k people likely inhabited the largest of these groups. Populations, in terms of both relative density and absolute people, were likely much less in many settlement communities. The small scale of most settlement communities likely suggests few elaborate integrative mechanisms were necessary. This could explain the lack of unequivocal communal architecture in all but the Sonora Valley. The settlement size distribution of the Sonora Valley is also different compared to surrounding valleys. The Moctezuma Valley is likely much more characteristic of most of the Río Sonora region.

Taking these observations as a starting point the subsequent chapters will explore variation in material culture between the two primate centers of El Nogal and Teonadepa. Material from Los Mineros will also be discussed. This site was likely a second order site more closely intertwined with El Nogal than Teonadepa. Assuming the settlement pattern and demographic data accurately reflect political divisions the material culture analyses provide insights on what other sorts of variance follow similar divisions, i.e. economic, ideological, inter-marriage, warfare alliances, etc. The data suggest there were profound cultural differences between these two units. How representative these differences are of a general social as well as political balkanization of eastern Sonora is harder to discern with present data. Given the differences in scale suggested by this and the forthcoming analyses a substantial revision of macro scale processes and trajectories is necessitated.

4. Ceramics

Ceramics constitute the majority of the artifact assemblage with approximately 29,150 specimens. Accordingly, ceramic data plays a large role in the overall goals of this project to discern the scale and character of sociopolitical organization in the Moctezuma Valley. The analysis discussed in this chapter addresses spatial variation at several scales, utilizing distributions of mostly stylistic and some technological attributes. Other ceramic related analyses, including chronological and provenance studies are equally critical to the overall argument developed in this monograph and are fully addressed in Chapters 10 and 11 respectively. The focus on spatial variation in ceramics is driven by the ultimate goal of mapping sociopolitical affiliation in the archaeological record. Los Mineros (Son L:2:22) is shown to likely represent a less dense or intensive occupation than either El Nogal (Son L:2:1) or Teonadepa (Son L:1:23). More effort will be placed on discerning differences between El Nogal and Teonadepa. As discussed in previous chapters, these two sites are the likely primate centers of two separate settlement communities.

Obviously ceramics are only one line of evidence and cannot alone conclusively demonstrate that spatial variation in material culture indicates sociopolitical divisions. The data presented here correspond to both settlement pattern and other material culture analyses. Results demonstrate that there is a clear difference of kind in the frequencies of locally produced brownware and redware ceramics. This is especially visible in a comparison of El Nogal and Teonadepa. Comparisons of textured brownware design frequencies across the Río Sonora region suggest significant variation between settlement communities is common among locally produced types. Though, there are substantial differences in relative frequencies, these types clearly circulated freely or reflect traditions shared to some degree across settlement community boundaries.

The rarity of painted ceramics indicates that they are not indicative of endemic traditions in the Moctezuma Valley, but rather are reflective of exterior trade ties. There is an almost categorical exclusion in the kinds of painted types present at Teonadepa and El Nogal. The infrequency of these exchanges indicates only select individuals participated in their acquisition. Furthermore, once acquired it appears these items were very rarely exchanged between Teonadepa and El Nogal. Most types do minimally occur at some frequency at both sites confirming contemporaneity.

Analyses thus demonstrate that these two classes of ceramics (foreign painted ceramics and local brownware ceramics) did not circulate along the same lines of interaction within the study area. Some qualitative statements on the significance of these findings will be given, regarding the social networks of different segments of society that foreshadow arguments fully expounded in Chapters 14 and 15.

Basic Methods and Definitions

Ceramic analysis constrained to comparisons of groupings at the same level in a strictly hierarchical classification would produce uninformative results. The approach employed here violates standard conceptions of cladistics by mixing categorical groups normally placed at differing hierarchical levels (e.g. *ware, type, etc*). The reasoning for this will become apparent and is essentially a straightforward attempt to maximize potential for delineation through categorical comparisons of assemblage compositions. In regards to painted ceramics exacting definitions of ware/types are precluded by the extremely low counts of most ceramics, necessitating higher order groupings. These are formed in some analyses by lumping together what is loosely identified as a *tradition*. For obvious reasons of simplicity the grouping approach taken here is designed to be mutually exclusive (no sherd potentially counted twice). Table 4.1 presents a hierarchical schema and denotes the categories considered in most analyses in bold. Note that the number of *variants* could be exponentially increased by taking every possible combination of terms listed on this line under a given type designation and in some case across divisions, e.g. incised-red-sooted.

Analyses included several tiers of investigation. In the section on painted ceramics variants are often eschewed in preference of *styles.* This is a reflection of the small physical size of most sherds and an overall limited number of painted ceramics. Some divisions were clearly warranted among some painted types but it seems almost certain that the defining elements might later be found to co-occur on one vessel. As such it seemed more logical to label these variations as *styles,* which is a classificatory category that is at times viewed as orthogonal or crosscutting of hierarchical classification (e.g. Crown 1994). All artifacts were first sorted and then counted and weighed by categories, which included plain (brownware), redware, brushed (brownware), other textured (brownware or redware [excluding brushed]), unique paste (brownware), and painted (multiple wares). Category specific analyses were carried out for redwares, brushed, other textured, and painted ceramics.

Categorical Definitions

Unique paste denotes a very small number of otherwise plain sherds that expressed macroscopic qualities that clearly identified them as distinct in the assemblage. They were separated from the plain category so as not to over inflate the count[v]. Most of these were still brownish in color, but a few may have been made from kaolinte or other clays that would preclude them from the brownware category. Their count is so low that their classification is largely negligible.

Plain brownware ceramics is a self explanatory category. An effort was initially made to estimate the percentage of plain sherds with a polished surface, but was abandoned after it became clear that variable preservation and paste quality was overly influencing the successful categorization of whether or not these sherds had been subjected to a particular surface treatment. Sherds with a blackened surface were recorded as sooted. The blackened surfaces may result from either intentional surface treatment or use in cooking or other activities that exposes the ceramic surface to carbon residues. Very rarely unequivocally smudged vessels were polished over the carbon residue, but again the variable preservation of ceramic surfaces generally precluded distinguishing between these two possibilities. Due to this confounding factor sooted ceramics, not otherwise classified as redware, brushed or other textured, are included with plain brownwares in all analyses besides the basic count and weight.

Brushed brownware ceramics were quite easy to consistently identify. These ceramics take their name from a surface treatment in which a pliable, but resistant, fiber brush is used to texture the surface of the vessel after forming but before the paste is completely dry. This technique has variably been called *escobillado* or scoring. In some contexts these different terms may denote different techniques including both applications to the exterior of vessels through the means just described or alternatively scraped marks that are perhaps only remnants of the forming process on the inside of vessels. Both varieties were classified as brushed in this analysis, although the later is much more common relative to the former. The recording of the modified surface (*interior* or *exterior*) allows these two variations to be discerned in the brushed specific analyses.

Other textured ceramics includes all those that have any sort of formal design produced by altering the post forming/pre dry vessel surface. Common techniques included incising, tool punching, corrugation, and embossing/appliqués. These techniques, as well as brushing, and occasionally red slip/wash/paint were periodically utilized in combination. For the basic classification count analysis other texture was prioritized first, then brushing, then red coloration. For category specific analysis these sherds were analyzed multiple times for each categorical attribute.

The smectite clays of this region often fire to an orangish or reddish hue, making the category of *redware* somewhat arbitrary. Few of the samples were obviously slipped and even thin sectioned petrographic examination of sherds thought to be slipped could not reliably identify an applied surface treatment (Figure 4.1). The color of the red surface was estimated with a Munsell color chart to provide an estimate of the range of variation. Several of the color chips in the 10R range may arguably be better classified as simply polished plain brownwares.

Painted ceramics includes all style and color combinations and is an otherwise self explanatory category. The following sections will present distributional data that demonstrates substantial differences in the frequencies of virtually all variables between the three excavated sites and some potential patterns at larger and smaller scales of analysis.

Assemblage Level Analyses

Size Comparisons

All redware, brushed, other textured, unique paste, and painted ceramics were measured in their maximum dimension, producing a sample size of 3532 sherds with exact size measurement. There is no reason to believe plain brownware sherds also would not follow the same distribution of these sherds, but they were not measured individually. Instead, plain brownware sherds were passed through nested 1 and .5 inch screen and counted. Due to the inaccuracy inherent in identifying very small specimens, all sherds that passed through .5 inch screen were not classified but only counted. These two datasets both clearly demonstrate the highly fragmented nature of the ceramic assemblage. Only 29 percent of the measured sherds are greater than 3 cm in their maximum dimension, and only three percent are greater than five cm (see Figure 4.2). Non-anthropogenic factors, namely the use of all sites for some level of cattle grazing and concomitant trampling, can account for some amount of the fragmentation. These processes should mostly only affect the near surface sherds, whereas clearly the whole assemblage is highly fragmented. The only other apparent explanation is that continuous, intensive occupation by prehispanic human residents resulted in persistent trampling and other anthropogenic formation processes that fragmented the assemblages as they were being created. This project almost exclusively targeted domestic contexts, it would be worthwhile to compare the level of fragmentation to other contexts in future projects.

An ANOVA analysis (Figure 4.3) of the measured sherd data indicates there is a statistically significant difference between excavated sites n = 747, 2578, 219; df = 2; F = 34.6, p = <.01. All three sites produce 95 percent confidence intervals that exclude the other two means, but the biggest difference is clearly between Los Mineros and the other two sites. An identical pattern emerges if the distribution of plain brownwares is analyzed by means of a X^2 test (Table 4.2) on sites and the three categorical size classes n = 19,860, df = 4, X^2 = 320.6, p = <.01. Both approaches suggest that sherds at Los Mineros are appreciably larger. Building on the above statement it seems likely this site was subject to a different level of occupational intensity than the other two.

Categorical Distributions

Perhaps the most informative analysis explores the variable distribution of painted, brushed, redware, and other textured among the three sampled sites. Excluding surface collection due to variable collection conditions and unique paste due to a small sample size a X^2 test (Table 4.3) produces highly significant results n = 3105, df = 6, X^2 = 365, p = <.01. This result is driven by several important trends. Painted and redware sherds recovered from Teonadepa are significantly over represented whereas brushed and other textured are under represented. El Nogal presents essentially a mirror image pattern. Los Mineros with its smaller sample is more difficult to interpret with confidence but appears to be near the expected frequency or below in regards to every decorated treatment except brushed.

Ware/Type Specific Analyses

Plain Brownware

This type including potentially sooted sherds (~9 percent) made up the overwhelming majority of the assemblage at 87.9 percent. A number of these sherds are undoubtedly from untextured or undecorated portions of vessels properly belonging to another type or variant. The type is essentially indistinguishable from other regional plain brownwares. Major analogous types from surrounding regions would include Sonoran Brownware, Río Bavispe Brown (Braniff 1992b:291), Batacosa Brown (Pailes 1973), or Aconchi Brown (Dirst 1979)[vii]. Due to geographical proximity and antiquity of definition, Bavispe Brown is the technically appropriate label to apply to the plain brownware assemblage. This type is made by the coil and scrape method. Rare sherds identified as Bavispe Brown in southern Sonora (e.g. Domínguez, et al. 2009:139) have identifiable scrape marks made by a shell. Scoring marks are often present in the Moctezuma Valley assemblage but none were assignable to a particular instrument, and shell scraping seems unlikely given the paucity of shell recovered during excavation.

Contemporary researchers of Sonoran ceramics have taken a decidedly splitter approach to analyses. Plain brownwares are often divided into variants based on hardness, color, thickness, and macroscopic qualities of temper. In the Moctezuma Valley most of these qualities appear to be due to variance in the raw materials utilized or idiosyncrasies in forming techniques. As such, the plain category was not further divided. The ubiquity of local brick makers in the Moctezuma Valley to the immediate north of the project area suggests a wide availability of the necessary raw clay materials, and temper sand is of course almost always immediately available. Aplastics were classified for a sample of plain ceramics by microscopic inspection and will be discussed in Chapter 11, but again no type/variant divisions are based on these patterns. Paste colors of the region tend to be orangish, ranging to brown with hue values from 7.5YR to 10YR, and both color and chroma values varying continuously between three and six. The thickness of sherds varies between .4 and 2 cm with a few exceptional cases beyond these limits. The vast majority of sherds have a modal average between .7 and .9 cm. The oxidation state of sherd cores ranges from near complete oxidation to reduced—likely implying significant remaining organic carbon. It is possible that the high organic content of some sherds is indicative of intentionally added temper. Microscopic inspection of a large sample failed to identify manure temper, but small pieces of carbonized vegetation were rarely identified. At present, it seems likely the carbon content of these sherds is the result of using clays with naturally high organic carbon. This practice may yet prove to be temporally sensitive, as suggested by survey data, but the evidence at present remains inconclusive. As such, these sherds for the time being are not distinguished from other plain brownwares.

Plain rims. Plain brownware constitutes 87 percent of the rim assemblage, which is almost exactly in accordance with their overall frequency. Rims are overall under represented at only 2.4 percent of the assemblage. This is approximately half the value reported for Paquimé (DiPeso, et al. 1974d calculated from plainware totals pp108-110.) This is likely in part due to selective curation at Paquimé. Relative frequencies of bowls and jars for both plain brownware and all other types are extremely hard to estimate. The small size of the vast majority of specimens coupled with a lack of prior knowledge regarding vessel forms results in a situation where few rim sherds can be unequivocally assigned to a bowl, jar, or other form. Of the small sample of identifiable vessel forms, there is a near exact parity in the assemblage between bowls and jars—including tecomates. However, if a slightly less stringent approach is taken that assumes most *indeterminate outcurved* specimens are jars[viii] then this form would significantly dominate the assemblage. A predominance of large storage jars would help explain the apparently low percentage of rim sherds. Notably, of the 12 sampled domestic contexts only one storage pit was discovered, suggesting above ground systems were the norm.

The length of the rim portion was measured for all rim sherds. A length of 3.5 cm is not reached until the 9th decile in the plain brownware data n = 620 (Figure 4.4). Such small specimens obviously make inferring rim dimensions very difficult utilizing a standard concentric circle chart. However, the predicted distribution of vessel rim diameters stays remarkably constant even if the sample is constrained to sherds greater than 3 cm and 4 cm (Figure 4.5) with means, medians, and modes that stay relatively constant around 22 to 23 cm. There is no significant difference in the distribution of vessel diameters between sites.

Rims were classified into three major forms: *straight, outcurved,* and *incurved* (Figure 4.6 and 4.7). Straight was further divided into those with collars, or a point of deflection before a vertical section and those without collars *straight straight.* There was also one instance of a *vertical* rim (Figure 4.8, bottom). The outcurved sample potentially could be divided into subclasses based on the angle of deflection, but the small size of most specimens would have made this a highly subjective and complicated task. Few rims are everted to a degree to warrant a classification such as *flaring*. One exception is depicted in Figure 4.7 (row 2). Several rim modifications were also recorded, including *lipped, fillet,* and *internal beveling.* Fillet rims refer to specimens in which a layer of clay was folded over on the rim and partially obliterated. Beveled rims refer to specimens in which the profile takes on a triangular crosssection at the rim edge.

Figures 4.6 and 4.7 present rim profiles for a significant portion of the specimens over two cm in crosssection height. As can be seen from this sample and Figure 4.8, without a prior knowledge of the range of forms the point of inflection at a neck or rim can be plausibly oriented in a number of different relationships that would change the typological assignment. Figure 4.8 also provides a guide to the methodology of rim and collar measurements. Given these limitations the rim classifications should be regarded with caution. Specifically, the *straight* category almost certainly includes specimens that may be otherwise classified had a larger portion been preserved. Any rim, no matter how small, that lacked a point of inflection was recorded as *straight straight*. Despite these limitations a few differences in the assemblage are apparent. Considering all rims to increase the sample size[ix] (not just plain brownwares) a X^2 test (Table 4.4) indicates there is a statistically significant difference in the distribution of basic rim forms between sites that is largely driven by rare incurved bowls n = 689, df = 4, X^2 = 21.6, p = <.01. This form was over represented at Teonadepa and even more so at Los Mineros. Outcurved rims are conversely over represented at El Nogal. This site also has a greater proportion of straight collared forms, which, following from the discussion above, may include instances that were misclassified and should be outcurved. The only other observation on the differential distribution of vessel forms is qualitative. Handles of pitchers or ladles were observed only in the southern portion of the survey area (five instances at El Nogal and one at La Volanta [Son L:2:39]). A profile of one collected handle is presented in Figure 4.7, row 5, second from left; the specimens are approximately three cm in width. The diversity of rim forms is generally consistent with those reported from both Paquimé and the Sonora Valley. Only very rare forms are lacking from the Moctezuma Valley that are present in these locations, indicating the vagaries of sampling alone may account for their absence.

Redware

All those ceramics recorded as redware have hues between 10R to 7.5R inclusive. Color values range from three to five and chroma from four to eight. The combination of all three variables and transformation to the categorical values denoted by the Munsell system results in numerous categories with a small *n*, obfuscating statistical comparison. A simple examination of the data (Figure 4.9) shows a clearly trimodal pattern. This natural structure to the data was utilized to form larger groups with breaks between 10R-4/8 and 10R-5/3 and also between the 10R and 7.5R hue break. A X^2 (Table 4.5) of this sample excluding Los Mineros due to a low *n,* and again only considering the excavated sample presents a clear pattern (n = 510, df = 2, X^2 = 17.8, p <.01) with El Nogal over represented in regards to red ceramics with a hue of 7.5R and Teonadepa dominating the 10R categories. This likely does not reflect a meaningful preference in hue of red but rather subtle differences in techniques and available materials. The pattern is nonetheless potentially useful in future studies of ceramic exchange and the extent of raw material access.

Brushed Brownware

The basic physical description of brushed ceramics is identical to plain brownwares in regards to thickness, color, etc. Brushing was further classified by the direction of stroke application, *parallel*, *subparallel*, *crosshatched*, *no orientation, zoned directional, and manufacturing*. The last category refers to marks that are most likely unintentional products of manufacture and most often occur on the interior of a vessel. In many other regional analyses these sorts of marks are referred to as scoring. The execution style of brushing was recorded as *regular, obliterated, fugitive, fine, discontinuous, deep, or deep* *obliterated.* It is very likely that the orientation and execution style were variable across individual vessels. The large sample size should alleviate this to some extent by capturing the general trend in preferences but the presented stylistic traits should definitely be taken as rough approximations of the frequency of techniques.

Again a X^2 (Table 4.6) test of brush style reveals significant differences between sites $n = 1846$, df, 6, $X^2 = 45.9$, $p = .01$. Cells that were major contributors to this statistic are an over representation of no orientation for Los Mineros; parallel stroke sherds at Teonadepa; and a lesser magnitude, but still notable over representation of subparallel stroke sherds at El Nogal. The depth of the brush marks (Table 4.7) is also significant $n = 1835$, df = 8, $X^2 = 143.8$, $p < .01$, particularly in regard to Los Mineros with a surfeit of fugitive and obliterated sherds. Both of these analyses suggest Los Mineros brushed ceramics were generally of lower aesthetic quality and consistency. Note that the presence of statistical differences between sites does not rule out the possibility that many brushed ceramics may have been made at or near El Nogal and exported to the other excavated sites. This is because all sites predominantly contained sherds classified as subparallel and regular. Future studies might focus on tying specific characteristics to provenance data.

Regional Comparisons. Brushed or scored ceramics are present across a large swath of North America from San Luis Potosi to South Dakota (DiPeso, et al. 1974d:41-42) More locally they are common in the greater Mogollon region (E. Haury 1936) and are well described from work at Casas Grandes, where they were treated as a variant of textured ceramics (DiPeso, et al. 1974d). They are also described as Geronimo Brushed in the Sonora Valley (Dirst 1979). Descriptions of frequencies from the Sonora Valley are qualitative, but it appears that no orientation marks may have been more prevalent while the overall frequency of the brushed sherds was much lower at less than one percent (Dirst 1979:140). These Sonora Valley observations are made based on a sample predominantly from one feature at one site and may not be applicable throughout the Sonora Valley or temporal sequence. Brushed ceramics are also known from the Río Fronteras (upper Bavispe drainage) (Braniff 1992b) and the Bavispe Valley (J. E. Douglas and Quijada 2003) and also occur at a far lower frequency of the overall assemblage compared to the Moctezuma Valley sample. The technique appears to be relatively absent from parts of southern and central Sonora (Castillo 2012; Domínguez 2009; Domínguez, et al. 2009; Romero-Padilla 2010) despite similarities in other aspects of ceramic assemblages.

Scoring is clearly established at an early point in the Casas Grandes sequence, starting with Convento Scored (DiPeso, et al. 1974d:41) and maintained at a fairly constant proportion of the assemblage. Comparative frequencies of Medio period scored ceramics at Paquimé, other regional samples, and the Moctezuma Valley are provided in Table 4.8 and further discussed in the section on other textured ceramics. Again brushing in the Moctezuma Valley makes up a notably larger portion of the distribution of the total ceramic assemblage compared to Medio period Paquimé. There are some definite differences in the execution of brushed ceramics in these two regions. Approximately 22 percent of the Moctezuma Valley sample had no orientation markings while only 2.2 percent are reported at Paquimé (DiPeso, et al. 1974d:120). The nature of the sample precludes definitive statements about the design field of brushing, but generally marks did not proceed to the rim of vessels nor to the base, which is consistent with Paquimé scored jars. The Paquimé Medio period scored type is divided into several subcategories of CG Rubbed Scored and CG Patterned Scored. Roughly analogous types can be distilled from the Moctezuma Valley data by comparing the obliterated categories and the crosshatched/zoned categories respectively (see Table 4.9). This produces respective frequencies of 11 and 2.4 percent, which is similar to the Paquimé distribution of 10.4 and .3 percent. These comparisons suggest the technique of scoring/brushing was widely shared across northern Mexico and the southern U.S. Southwest, but was also subject to significant regional variation in its implementation.

Other Textured Brownware

The basic physical qualities of the ceramics with textured designs (not including brushed) found in the Moctezuma Valley are identical to the local plain brownware tradition. A very small number of redware sherds were also textured and are included in this discussion for consistency. Figure 4.10 presents profiles of the very limited sample of textured rim sherds of any appreciable size. Many of the techniques discussed here occur simultaneously on the same sherd. In order to avoid an exponential computation of variants two approaches were taken to design classification. The first simply lists one of the elements as the primary design and treats this as the variable of interest in relative frequency analyses. The hierarchical ranking of primary elements is as follows: *corrugation, tool punch, incise angled design, incise curvilinear, incise parallel straight, incise parallel wavy, tool incise, incise indeterminate, incise other, raised element, brushing, incise brushing*[x] (see Figure 4.11). The second approach treats each occurrence of a design element as a unique observation and tabulates frequencies irrespective of association, that is an individual sherd may be counted multiple times depending on the diversity of design elements employed.

Regional Comparisons. Ceramics with a variety of textured techniques occur across a large swath of the Northwest/Southwest and have a significant time depth. It seems likely the eastern Sonoran tradition has its roots in this shared tradition that also gave rise to early incised variants in the U.S. Southwest Mogollon (E. Haury 1936; Sayles 1945). Most of the types of textured designs seen in the Medio period at Paquimé had Viejo period antecedents. Several incised types of southern Sonora/northern Sinaloa, including Los Camotes and several variants of San Bernardo (J. P. Carpenter and Sánchez 2008) were established by ca. A.D. 700-750 have an obvious affiliation to the textured tradition present in the Moctezuma Valley. In this more southern region it is clear incising continued as a decorative technique into the historic period in the form of several variants of the San Miguel tradition. Due to differences in analysis approaches this southern Sonora area is not easily comparable to the Moctezuma Valley assemblage, but it appears incising sometimes nears five percent of the total assemblage, which far outstrips other available comparisons.

In most previous analyses of Sonoran materials brushing, or scoring, was considered another form of textured design. In this analysis this form of texturing was treated as a wholly different category. As such the data reproduced in Table 4.8 required some manipulation to make the values comparable. Both of the above described techniques to design element classification are also employed for the Moctezuma Valley data. The extremely well reported samples from Paquimé (DiPeso, et al. 1974d) and Ojo de Agua (Braniff 1992b), near modern Fronteras, Sonora, serve as primary comparisons as well as basic data from the Bavispe Valley. It should be noted that the Bavispe Valley data includes six sites with a significant amount of intra-sample variation.

The textured types identified by Rinaldo (DiPeso, et al. 1974d) with likely Sonoran analogs include CG Corrugated, CG Rubbed Corrugated, CG Broad Coil, CG Pattern Incised Corrugated, CG Armadillo, CG Incised, CG Rubbed Incised, CG Tool Punched. The typology of Braniff is much more complex with many more variants. Type variants listed on the same line of Table 4.8 are roughly analogous. The distinction between rubbed/*alisado* or *acanalado* and regular or unmodified techniques was subsumed in this analysis by recording the depth or finish of the treatment rather than designating separate variants or sub-variants. This data is available and could be used to more closely replicate the types employed by Rinaldo and Braniff. However, this seems like an unnecessary method of splitting the sample. The first three of Rinaldo's Casas Grandes types correspond to variations on corrugation, which was rare in the Moctezuma Valley, with only 24 recovered sherds, 50 percent of these were also incised, and thus would correspond to CG Pattern Incised. Several sherds that were recorded as clapboard (Appendix F) are akin to CG Broad Coil, but are not treated separately in this analysis. All varieties of corrugation were also extremely rare at Ojo de Agua (Braniff 1992b) and are even more rare in southern Sonora (not included in table), if present at all. Corrugation is clearly much more common in the Bavispe Valley and to a lesser extent Paquimé, suggesting these areas may have had closer ties with regions of the U.S. Southwest, Mogollon where the practice is common. Several of the corrugated sherds in the Moctezuma Valley were not actually created through the standard method of smoothing or otherwise altering clay coils, but rather from pressing a design into soft clay to mimic this pattern. This suggests a desire to emulate a known style without actually participating in the learning tradition of its native manufacture for at least some potters.

The Armadillo style of Paquimé is a peculiar type with heavy surface modifications. Only one sherd achieved something akin to this in the Moctezuma Valley sample, but four others with finger pressing could be less extreme variations. These sherds along with fingernail impressed sherds were all classified as *ad hoc* decorations. There is no apparent analog to these techniques at Ojo de Agua or other published assemblages.

Tool punching of some sort occurred on a total of 113 Moctezuma Valley sherds and was one of the better represented techniques[xi]. A significant portion (48 percent) of tool punching in the Moctezuma Valley occurred in combination with other design techniques, most often as a single framer row along the rim or margin of an incised or brushed field. Figure 4.12 presents the frequency of various tool punching shapes. Clearly, a variety of implements were utilized in the production of tool impressions. The *U-square* was the most regular in form and consisted of two basic iterations. The "U" refers to impressions in the form of an essentially hollow rectangular indentation that sometimes lacked one side; the utilized implement remains unclear. This U-square and the *dash* style were lacking from both Teonadepa and Los Mineros, the *lunate* style was also lacking from the latter. Most of these shapes have analogies with Paquimé iterations with the possible exception of the "U" form. The *spatulate* shape described by Rinaldo (DiPeso, et al. 1974d:142) would correspond to some iterations of squarish impressions. Precise quantification was not made of Moctezuma Valley tool punched sherds regarding the field of decoration, i.e. rim/neck band or larger fields. In general, though, the Paquimé version of this type seems to have more often employed wider fields of tool punching but also mainly restricted the decorative field to above the widest point of the vessel (jars) and often only to the neck and rim area. The tool punched type also has obvious similarities with Alma punched as well as with the earlier Casas Grandes type of Convento Punched. Tool punching is also recorded in far southern Sonora at the Batacosa site as the variant San Bernardo *Inciso Punzonado* (Domínguez 2009)[xii]. This wide distribution likely suggests a fairly significant antiquity to this basic approach to decoration. The obvious predominance of this technique at Ojo de Agua is interesting and perhaps suggests this region was a local progenitor of this technique with lessening popularity to the south and east. The few sherds depicted by Braniff (1992b:341 see figure) also suggest that wider fields of decoration were employed as well as the common framer approach. Specific details of the technique are not published for the Bavispe Valley, but its popularity is greater among textured types than in the Moctezuma Valley (J. E. Douglas and Quijada 2003), supporting the contention that this technique may be more popular to the north and east of the study area, or perhaps the Bavispe drainage generally.

Various forms of incising constitute a substantial majority of Moctezuma Valley other textured ceramics. These were divided into five broad categorizations. Incise parallel straight includes all sherds that contained multiple lines in a rectilinear design without intersecting. Incise parallel wavy sherds are identical to the previous classification except that the lines are somewhat sloppily executed with slight deviations from a perfectly straight execution. Incise angled design includes styles of lines executed in either a refined parallel or wavy fashion but with intersecting single, or more often, multiple lines. Although few large specimens were recovered, the available sherds suggest a woven appearance produced by different orientations of hachured triangular fields. Other variations were also definitely present. Incise indeterminate refers to examples in which there was at least one rectilinear line, but an insufficient amount of the design field was preserved to infer its relational context. Incise curvilinear were extremely rare and references all incising where lines followed non-rectilinear patterns. Incise Brush designates sherds where a fugitive series of parallel lines is superimposed by brushing/scoring marks. A brushing technique of some sort also may have formed the underlying parallel lines. Tool incising refers to patterns of parallel lines in which the morphology of the incising tool left distinctive impressions, usually a bifurcated topography in the incised line. The categorically recorded depth of incising (Figure 4.13) was relatively constant across incising types, with the exception of tool incising, which necessitates a shallow stroke to make the tool marks clear and incise brush, which are invariably shallow and often near obliterated.

In contrast to other techniques incising in the Moctezuma Valley appears to be over represented relative to all other comparative samples. Rinaldo (DiPeso, et al. 1974d) does not give precise counts of the various modes of incising, but his general discussion seems to agree with the distribution of incised styles observed in the Moctezuma Valley. Curvilinear designs are rare in both cases, parallel line and angled designs are present in both regions although the angled designs (pattern incised in Rinaldo's lexicon) (DiPeso, et al. 1974b-137) are more common than parallel incising. The reverse is true in the Moctezuma Valley, but this could partially be the result of the generally small size of most Moctezuma Valley sherds that precludes identifying larger patterns. Tool punching in a single band in conjunction with incising was noted to occur at Paquimé as in the Moctezuma Valley (DiPeso, et al. 1974d:137), but precise counts are not given. Lastly, Rinaldo notes the practice of incising over brushing marks, whereas the reverse was occasionally present in the Moctezuma Valley. It is unclear if there is an early version of incising in the Moctezuma Valley that could correspond to the Convento Incised in the Río Casas Grandes Valley.

Incising is much more common in the Moctezuma Valley relative to the sample from Ojo de Agua. Almost all of the specimens depicted by Braniff would fall into the Moctezuma sub-variant of incised angled design. It appears curvilinear designs are also very rare in the Ojo de Agua region (Braniff 1992b:329). As noted above, incising was common in southern Sonora and northern Sinaloa. The textured types of Los Camotes and San Bernardo were defined from research between the Río Fuerte and Río Mayo (Pailes 1973). In the Batacosa region incising rarely combined with tool punching on Los Camotes and San Bernardo types, was essentially the only texturing technique employed and constituted approximately five percent of the total assemblage from the 2009 season (Domínguez 2009:114). Los Camotes and San Bernardo incised both employ designs commensurate with the definition of incise angled used here. Notably, excavations in the Onavas Valley of the middle Yaqui Valley did not produce any incised sherds (Castillo 2012), suggesting an, as of yet, un-delineated temporal or cultural pattern to their distribution. As was the case with tool punching (*punzonado*) for the Ojo de Agua region, the relative frequency and diversity of incising seen in the Moctezuma Valley and regions to the far south may suggest this technique was most fully developed in north central Sonora or northern Sinaloa far southern Sonora. However, it seems likely incising began concurrently or in rapid succession across a very large region, including the better known Alma Incised of the Mogollon and several other varieties known from southern New Mexico. It is tempting to ascribe the apparent gap in texturing techniques in the Onavas region to historic linguistic patterns, linking textured designs with Ópata/Cahitans, but more research is clearly needed.

Another notable departure from both the Casas Grandes and Oja de Agua regions is the relative absence of textured redwares, most notably variations of Playas Red. Only 12 sherds were recorded as having both red paint or slip and a textured surface treatment. Six of these had either a zoned or framer layout, with red as a stripe or small area of color between textured designs or on the neck or rim of a textured vessel. Of the remaining sherds, three had designs executed over the red slip or natural color and two were red on the interior with a textured design on the exterior. Two of the previously mentioned sherds also had a red slipped interior. Almost all of these specimens came from Teonadepa. In contrast to this miniscule count an estimated 43.7 percent of Playas Red sherds at Paquimé and 23.4 percent at Ojo de Agua had some form of texturing[xiii].

Intersite Patterns. A X^2 test (Table 4.10) of the primary design elements by site approaches significance but fails to produce statistically meaningful results. In contrast to similar tests on other types there are almost no cells with significant deviation values in a comparison between El Nogal and Teonadepa, $n = 509$, df = 9, $X^2 = 15.3$, p = .08, with Los Mineros excluded due to too many cells with an $n < 5$. Notably only one pair of cells among the 10 considered design categories produced a deviation of greater than 3 sherds. This category incised parallel straight, is the broadest definitional category and likely captures halfhearted attempts at textured decoration. It is also a deviation of less than 10 sherds. These data thus suggest that despite the significant differences in the relative emphasis placed on textured ceramics at the two sites they remain extremely similar in regards to the distribution of design techniques. This likely supports the assumption of relative contemporaneity between these two sites and indicates they acquired textured ceramics either one from the other or from an identical third party.

Intrasite Patterns. Considerable effort was expended trying to derive some kind of chronological significance from the stratigraphic distribution of decorative techniques to no avail. Small sample sizes from any given context precluded reliable patterns in many cases. In the few locations where excavation produced an adequate amount of textured ceramics, changes in frequencies did not correlate with stratigraphic relationships in a consistent way. This would seem to suggest the relative popularity of the decorative techniques discussed here remained fairly constant for at least several generations. If the sample contained larger sherds, it is possible a more refined analysis of the relationship between elements or other chronologically sensitive stylistic patterns could be observed.

It is worth noting that the textured techniques utilized were generally not refined enough or were simply not employed to produce symbolically meaningful patterns in the same way as painted ceramics. There are no indications that textured ceramic artists employed even extremely stylized versions of any of the standard fare of meaningful symbols (see Crown 1994) such as macaws, feathered serpents, Tlaloc images, or even spirals. Designs on textured ceramics were therefore not subject to the same motivations that drove stylistic change among painted traditions. On one hand, this seems to have led to significant variation in the synchronic use of techniques, as there was apparently little limitation on the standard cannon. Conversely, a need to signal knowledge and adherence to pertinent ideological concepts that likely changed to some degree with every generation did not drive change among the mundane or secular design themes on textured ceramics. The limited visual contrast provided by textured designs probably greatly limited their utility in this role. If a large enough sample of sizeable sherds could ever be amassed they would be an excellent test case for stylistic drift in the absence of many complicating cultural factors.

Statistically significant patterns can be found in regards to space within El Nogal. No attempt was made to analyze other excavated sites due to the paucity of textured ceramics. The test (Table 4.11) considered only the excavated samples from the three domestic structures (features 1 through 3) $n = 406$, df = 16, $X^2 = 71.3$, $p < .01$. This test was performed on the total element data but is equally significant if performed on primary element data, it excludes categories with small *n.* Discernable patterns are less than manifest with the exception of corrugated ceramics being high in Feature 1 and tool punching being low, but high in Feature 2. Incise angled designs also appear high in Feature 1 but low in Feature 2. Despite the observations above, there is possibly some diachronic component to this distribution, but the fairly close ages of the sampled contexts suggest most variation is reflective of idiosyncratic design preferences of the corporate groups that deposited their trash in these structures. These data suggest one possible explanation for the rather unrestrained diversity seen in textured designs is related to particular households or other corporate groups preferentially employing certain techniques and approaches. More extensive sampling is needed to investigate this possibility.

Painted

The assemblage of painted ceramics is decidedly paltry with a total *n* of 174 (.6 %) including all sites and all recovery methods employed in the 2012 season. This situation severely limits the sorts of statistical analysis that can be run. Any division of the sample beyond the site level results in sample sizes that are too small for any meaningful comparisons. In addition the small size of most specimens severely limits their use. In most cases a given sherd can only be identified to a basic level of stylistic affiliation. The present classification schema employs two levels of hierarchical identifications plus a consideration of stylistic elements. The first level divides painted ceramics into two generic traditions. These include *Chihuahuan* with designs and usage of colors reminiscent of Casas Grandes types such as Ramos, Villa Ahumada, Huerigos, Babícora, and Carretas (DiPeso, et al. 1974d). Some of the sherds in this group that are not assigned to a more specific type may actually belong to one of these pre-established types. For the most part, though, *Chihuahuan* sherds are only reminiscent of predefined types, necessitating several new designations. Some of the sherds classified as Chihuahuan are arguably equally reminiscent of western Pueblo types such as Kechipauan Polychrome. Until whole, or at least larger sherds, are recovered that demonstrate a less equivocal relationship, it seems appropriate to follow the more conservative, Chihuahuan interpretation.

The other major macro type is *Sonoran,* which is assumed to represent ceramic traditions native to the Moctezuma Valley and/or neighboring river valleys. These sherds are unified by simple designs executed in hematite based paints. The vast majority are monochromes on unslipped backgrounds. A few more elaborate types were classified in this group due to characteristics that preclude their association with Chihuahuan types. A few sherds classified as *Unique,* or *Unknown* are generally excluded from analyses.

The second level of classification is more problematic. Despite the small size of most specimens it appears several previously undefined types were produced/utilized in the Moctezuma Valley. This assertion rests on the assumption that while any one sherd is generally too small to make definitive statements regarding larger design themes the assemblage as a whole should reflect the range of patterns and elements employed. The following sets out a basic description of these types. All of the suggested definitions should be taken as extremely tentative. Further research will certainly result in the amalgamation and splitting of some of the types suggested here.

The third level of analysis records the presence of specific patterns. The *styles* that are identified should not be considered as mutually exclusive; hence the reason they are not denoted as variants. There will almost certainly be future instances in which they co-occur. Rather these styles are intended only to provide a rough estimation of the relative frequency of elements and/or relationships.

Chihuahuan-Jecori. This type is named after the small town midway between Moctezuma and Cumpas. Jecori employs both red and black paints in oppositional arrangements that rarely allow the two paints to touch (Figure 4.14). Designs are executed on a white to grey slip present on both interiors and exteriors. In the Río Moctezuma sample these slips are mostly durable, but two chalky specimens are also present. These were not designated as Villa Ahumada, which also has a chalky slip, since the interior linework was much finer than what is common for this Casas Grandes type. Since paint/slip is present on both interiors and exteriors all specimens are apparently bowl fragments and cannot be classified as any other known Casas Grandes type. Surface polishing appears variable but may only reflect the durability of the slip and paints.

Jecori ceramics were coded for styles based on the types of elements present and the relative relationships of colors. Again, the examples described here and used to denote variants for this and all following examples could occur on a single vessel, but none were encountered in the sample. Jecori-1 had a red (above) and black (below) life line executed on the exterior of vessels offset from the rim and each other by about a centimeter. On one example the black life line was absent but a banding black element pattern took its place. The interiors of these bowls contained a variety of wide spaced black hachure and rectilinear black elements. Inverted triangles were a common element on interior rims. Jecori-1.1 is similar except that it presents a life line of red along the rim edge. Jecori-2 utilizes a broader array of red and black elements on the exterior in addition to simple line work. Interiors contain only wide spaced black hachure. Jecori-3 was characterized by red geometric elements and large stripes on the exterior and black geometric shapes on the interior. Jecori-4 contains similar red elements on the exterior but only wide spaced black hachure on the interior.

Chihuahuan-Teonadepa. Teonadepa, named after the small town that contains the site of the same name, seems to be a variant on the Casas Grandes Ramos style. There are a total of five specimens, three are bowls painted on the interior and exterior and two sherds are from vessels painted only on the exterior (Figure 4.15). The type is characterized by wide spaced black hachure and small red elements outlined in black executed on a white slip that is usually durable. Polishing is variable, and again possibly only reflects preservation. Designs seem to follow what Phillips (2012) describes as the Ramos rule, in which red is always bounded by black. In contrast to Ramos or other slipped imitation types the amount and size of red elements are much reduced. The style just described occurs with red elements only on the exterior of vessels and is designated as Teondepa-1. Teonadepa-2 consists of only one eroded sherd in which the red element may have been larger, and therefore approaching something more in line with an imitation Ramos design style. This one sherd could arguably be classified as Villa Ahumada as it also posses a fairly chalky white slip on the exterior. Teonadepa-3 also consists of only one sherd in which a red band was outlined in black on the interior of a vessel. This sherd is the only one in the assemblage in which red occurs on a white background on the inside of a vessel.

Chihuahuan-Santa Ana/Babícora. This previously defined type of ceramic is known from a large portion of Sonora and Chihuahua (J. H. Kelley 2009). It was originally defined by Larkin (Lakin, et al. 2004) as a precursor Viejo equivalent of the latter Babícora type with broader and cruder lines. It has been found in a variety of sites in southern Sonora and labeled locally as Ramos or Babícora (J. Carpenter 2014; Garcia 2014) and was originally thought to be Carretas in the present assemblage, before positive identification.

Since the context of these sherds would seem to securely place them significantly later than the Viejo period it may become desirable to re-label the specimens as another type in the future. Notably one of the sherds indicates a lead (Pb) subglaze paint, which is more in keeping with the definition of Carretas. The type present in the Río Moctezuma valley follows the same basic Babícora rules of red and black opposition (Figure 4.16), but only in the form of line work with rare solid rectilinear blocks of red. The designs are executed on an orange to buff colored unslipped surface. All 14 sherds of Santa Ana recovered were from vessels decorated only on the exterior. Santa Ana-1 contains only thick red and black lines in opposition that do not touch. Santa Ana-2 presents pinstriped, extremely close packed, and narrow black and red lines near a solid block of red. These sherds appear similar to one depicted from west central Chihuahua (see J. H. Kelley, et al. 2012). This variant also appears similar to several sherds collected in the Onavas Valley originally interpreted as a local version of Ramos (see Castillo 2012:182) and in the Río

Fuerte interpreted as Babícora. Santa Ana-3 is similar to Santa Ana-1 except the black and red lines are painted in parallel contact. This violates the typical expression of Sanata Ana, which usually follows the Babícora rule, as described by Phillips (2012), in which black and red elements do not touch.

Other Chihuahuan. Refers to any white slipped ceramic that does not fall into any other category (Figure 4.17). The slip ranges in quality from extremely chalky and poor to a durable brilliant white. Polishing is highly variable. There are a total of 63 sherds in this category: 32 with paint on exterior and interior sides, 16 with paint only on the interior, and 15 with paint only on the exterior. Almost all of these contain some amount of black linework and/or geometric elements. Red paint is not present on any of the specimens included in this category. The predominance of these specimens among the *Chihuahuan* tradition sample suggests red paint may have been employed much more sparingly compared to the eastern progenitor region of the tradition. Curvilinear elements also appear to be much sparser and appear almost exclusively on the interior of bowls. The thinness of black lines on all Chihuahuan types is also notable. Whalen and Minnis (2012) noted a trend towards increasingly thinner lines later in time among Casas Grandes types. Most of the present sample would fall into the range seen on later styles from this region.

Sonoran-La Volanta. This type, named after the small town south of Moctezuma, could be a poor, local imitation of Casas Grandes types, but is sufficiently distinct to not be included under the *Chihuahuan* classification. The type's most distinct characteristic is broad stripes executed with a chalky red paint (Figure 4.18). Thinner, but still relatively thick, black lines may also be present. The type is also characterized by a very poor, light colored slip, that at times seems to wear away leaving behind the other more durable red and black colors. There is no evidence of surface polishing. Only rectilinear designs are recorded presently. This type may seem well represented in the assemblage but the vast majority of sherds almost certainly come from a single vessel.

Sonoran-Moctezuma. This is a loosely defined type represented by sherds common in their poor execution of black lines on brown paste (Figure 4.19). Moctezuma-1 utilizes very broad lines, while Moctezuma-2 employs thinner lines. It is almost certainly local but may represent novice attempts at decoration as opposed to a distinct type. The type has similarities to simple types across the greater Mogollon region. The paint is often fugitive and there is no evidence of polishing.

Sonoran-Cumpas. This type was loosely defined by previous excavations at La Cuchilla (Son L:1:6) by INAH personnel (see Hinojo and Blanquel 2011). The basic definition is black linework and geometric elements executed on red, possibly slipped backgrounds (Figure 4.20). A curvilinear pattern was present on at least one sherd, which are relatively rare among decorated ceramics of the Moctezuma Valley. The variants identified here are Cumpas-1, which adheres to the original definition and Cumpas-2, which lacks a red slip and instead employs a natural orange background. Polishing was present on the Cumpas-1 sherds and variable on the Cumpas-2 sherds. This type may be found in future work to grade into either the Serrana or Moctezuma types. Currently it is distinguished based mainly on the quality of the black paint and durability of the ceramic surface.

Sonoran-Serrana. Refers to all ceramics that are executed with a paint presumed to be Hematite-on-brown, orange, or buff backgrounds (Figure 4.21). The actual colors of paint achieved include a range of purple, red, brown, and black variants. A few specular hematite specimens are also present. Serrana sherds were invariably quite small making element analysis near impossible, but minimally cherkerboard patterns, fishnet crosshatching, and other iterations of standard line width are present. These ceramics may be locally produced or might be imported from the Hohokam, Trincheras, or Serrana region, in essence the historical range of O'odham speakers, although suggesting historical continuity is beyond the presently available data. Sherds were generally not large enough to unequivocally discern the manufacturing process as coil and scrape, which would largely rule out the Hohokam region. If they are indeed long distance imports, as opposed to local imitations, than obviously they should be typed according to other classifications. One variant was noted in which fugitive black or purple is employed along with red paint, producing a polychrome. Aside from this variant, Serrana sherds listed in Appendix F are classified to style by the color of the paint. The quality of the paint was highly variable, ranging from good quality, to barely present fugitive, to thick flaky varieties. This inconsistency may suggest many different production zones. Discernable surface polishing was not evident on any of the sherds, but cannot yet be ruled out; as such techniques are common in the Serrana region with Purple-on-brown ceramics.

Sonoran-Other Local. This group is a catch all for miscellaneous ceramics that lack an obvious affiliation and are generally unrefined in execution. Many such examples are similar to Serrana ceramics in their general use of colors but the paints are even cruder or not applied in a style in keeping with the above definitions. One group deserves special note; the red on cream variant (Figure 4.22) may prove to be a coherent variant or type. This group is characterized by a brownish red paint often thickly applied over a cream to buff colored slip. One large example suggests curvilinear patterns. This subgroup may also prove to be nonlocal.

Notably lacking from the assemblage are imported Ramos polychrome ceramics, or even styles that closely imitate its tenets. A few (4) sherds collected on the initial pilot survey (not included in this analysis since they have since been curated at INAH Sonora) could be argued to represent slipped imitations (Figure 4.23). However, in general the type and its associated design imperatives are nearly completely lacking from the assemblage, including large black and red elements in opposition, anthropogenic or zoomorphic depictions, or elaborate geometric designs. The near complete lack of established Chihuahuan polychrome types is even more curious in light of their relative frequency at Ojo de Agua, approximately 100 km due north. At this site 3.7 percent of the assemblage was painted[xiv] and 67 percent of the painted assemblage were identifiable Casas Grandes types (see Braniff 1992b:439). This would seem to suggest a fairly strong interaction barrier between the headwaters of the Río Fronteras and Río Moctezuma, perhaps somewhat analogous to the same division between the Cumpas and Moctezuma reaches of the Río Moctezuma inferred from the present data set and more fully discussed below.

Chronological associations

The period of use for the various ceramic types can only be approached with caution. The already small sample size is drastically reduced when only those recovered from dated levels are considered. And as discussed in Chapter 10 (Chronology) and related appendices, several of these dates are problematic. Due to these issues the decorated sherd data is presented as histograms (Figure 4.24) based on point estimates of the various recovery contexts, as opposed to probability distributions. Even in this limited presentation several important relationships emerge. Santa Ana/Babícora appears to mostly predate Jecori by several decades. This relationship may be merely a reflection of the chance excavation of structures of certain ages at the respective sites where these ceramics were present. Both types actually may have a longer resident time in the Moctezuma Valley. The type Moctezuma appears to have a lengthy time span, which is no surprise given its broad definitional inclusiveness. The Volanta type also appears to predate most other painted ceramics in the region, but also apparently persists for some time. Sample sizes should again be stressed in this case as all of the A.D. 1260 sample likely came from a single vessel, including the sherd that produced the date. The distribution of the broad Serrana type is quite informative. With a date range that clearly surpasses 1300 the Trincheras region can be ruled out as a probable source for some of these ceramics since painted ceramic production ceased by ca. 1300 (S. K. Fish and Fish 2004) and perhaps as early as 1100 (Heckman 2000). If the few sherds dating post 1450 are to be trusted then the already unlikely Hohokam region can likewise be excluded. This leaves only the Serrana region to the south and local production as viable provenances for this broadly defined ceramic type. It is also worth noting that if the *Other Chihuahuan* type is considered a date range is suggested that surpasses the suggested date for the abandonment for Paquimé. This date is of course a point estimate of a probability. A more refined mathematical approach of one directly dated Chihuahuan sherd indicates a 93 percent chance of actually post dating 1450 and a 60 percent chance of post dating 1500.

Glaze Paint Analysis

The presence of glaze paints in Northwest Mexico is a subject of considerable speculation. A variety of Casas Grandes types are often reported as subglazes, but rarely are chemical assays undertaken to verify this identification. Fenner and others (DiPeso, et al. 1974d:93) reported qualitative data on ceramics subjected to archaeometric analysis but did not publish the original data. A number of scholars have discussed the potential importance of glaze technology in Northwest Mexico, given its geographical location between the Mogollon region and Mesoamerica and the potential it holds for a route of technological diffusion (Phillips 2012; Snow 1982). The stylistic similarities of some of the *Chihuahuan* sherds to polychrome types such as Kechipauan Polychrome was also noted above. If this relationship is demonstrated to be valid through further sampling, important questions will be raised regarding the source of these similarities.

To begin addressing some of these basic questions a small sample (n = 14) of sherds with potential glaze paint recipes were assayed with a scanning electron microprobe at the The Michael J. Drake Electron Microprobe Laboratory, University of Arizona. Sherds were selected based on macroscopic qualities of black paints that appeared at least somewhat vitreous. The samples were prepared as either polished thin sections or polished phenolic blocks with a stepwise reduction in abrasive sizes down to one micron. Multiple points were sampled on all sherds producing the 37 data points in Figure 4.25. The sherds tested here date too late in time to potentially fulfill any role as a precursor to Pueblo glazewares, which are obviously tied to earlier developments in glaze paint technology in the Mogollon Rim area ca A.D. 1250.

The elemental data are presented in Appendix G. As can clearly be seen, prehispanic potters had some knowledge of glaze technology and occasionally produced paints that were somewhat glassy, mostly with a lead (Pb) fluxing agent that produces a black paint. The reliance on lead as opposed to copper distinguishes these paint recipes from Paquimé (as reported by Fenner), and potentially suggests similarities with Río Grande and other New Mexico groups (see Bower, et al. 1986). One sample, FN 835, is a particularly telling example of the level of technological knowhow (Figure 4.26). This sherd apparently had a near pure manganese (Mn) layer applied over the base lead glaze. This was likely done in an attempt to impart a purplish hue to the glaze, but the recipe and firing conditions were insufficient to achieve this end and the Mn formed only a dull colored crust on the surface of the glaze (note the one sample to the far left on the triplot). This limited example, along with the other recipe data, suggests knowledge of glaze paint technology but not mastery of the technique. It is possible that only partial understanding of the technique penetrated to this part of Sonora along with a penchant for experimentation. Many more samples and finer chronological resolution will be required to discern if this is the result of a loss of cultural knowledge, potentially carried by immigrants from other glazeware regions. Conversely, it may suggest information decay resulting from non-direct transference of the technological knowhow, i.e. word of mouth instead of direct teaching. Minimally, it is clearly demonstrated that these ceramics are properly classified as subglazes. The high concentrations of lead in the samples also suggests they would be amenable to provenance studies of the sort carried out in the U.S. Southwest based on isotopic ratios (e.g. Fenn 2011; Huntley, et al. 2012).

Painted Inter-site Patterns

A comparison between sites suggests almost mutually exclusive painted ceramic traditions. A X^2 test (Table 4.12) of basic types of Chihuahuan and Sonoran affiliation demonstrates that Teonadepa and El Nogal interacted very little in regards to painted ceramics n = 157, df = 1, X^2 = 42.5, p = <.01. Los Mineros lacks a sufficiently large painted sample to be included in this analysis but generally adheres much closer to the pattern of El Nogal. Breaking the sample down further precludes further statistical analyses but a qualitative examination of the distribution of types is still informative. Specifically, it is clear that El Nogal only participates in the Chihuahuan stylistic tradition in so much as Santa Ana/Babícora type ceramics are present in the assemblages. As mentioned, recent work by Jane Kelley (J. H. Kelley 2009) indicates this style is actually centered in west central Chihuahua and its presence at El Nogal likely suggests affiliations or down-the-line connections to this region and not the Casas Grandes region proper. Conversely, the admittedly dubious type of Serrana appears to be fairly well represented only at El Nogal, suggesting connections most likely to the south that were largely lacking at Teonadepa.

Painted Intra-site Patterns

Again the small sample size is highly problematic for any detailed analysis of within site variance. Table 4.13 presents a break down at the type level by feature. There are hints of chronological patterning in this data, but it is far too small a sample to make anything but very tentative statements. At El Nogal the lower amount of Santa Ana/Babícora and a total lack of any other Chihuahua type may be reflective of Feature 3's slightly younger age, however, one Jecori sherd reworked as a spindle whorl was recovered from the floor of this house. All types do occur in multiple features, which minimally suggests that multiple vessels are included in all samples. Feature 1 at El Nogal and Features 31 and 32 at Teonadepa seem to stand out for their diversity in types present, but this is largely driven by sample size. Similarly the lack of specific Chihuahuan types (those lacking red paint) recovered from Feature 20/21 compared to Features 31 and 32 is possibly indicative of temporally correlated changes in ceramic styles.

Figurine

One non-sherd ceramic artifact is also worth note. A fragment of a figurine was observed in the collection of a local rancher. The rancher reported that the find was made in the general vicinity of ranchlands to the east of La Volanta, a small pueblo to the south of Moctezuma. The figure appears to have coffee bean eyes (Figure 4.27), and is thus noteworthy for its passing similarity to both Hohokam and West Mexican varieties (Alvarez 1990; Ekholm 1939). Based on comparisons with other regions the figurines age likely predates the period covered in this monograph. As a singular specimen little more can be said, but the presence of this figurine has obvious implications for the content of ritual activity. A subject that is almost wholly unknown for the region.

Conclusion

The ceramic data set provides substantial data on variation visible at several scales of analysis. There are clearly differences in the frequency of texturing techniques across the Río Sonora region. Some of these patterns may correlate to historical linguistic groups. At a smaller scale of spatial analysis, virtually every examined variable produces statistically significant differences between the sites of El Nogal and Teonadepa. Several of these differences were qualitatively observed as fieldwork was undertaken. Variation in painted ceramic frequencies is likely indicative of the predominant directionality of exterior exchange ties. Conversely, variation in the frequency of locally produced types, especially brushed and other textured types is likely reflective of cultural differences between settlement communities. It is particularly noteworthy that while the distributions of brownware types indicates substantial divergences in site level patterns; they also suggest some exchange in mundane ceramics between settlement communities. This topic is reviewed in much more detail in Chapters 11 on provenance data and Chapter 14 on the nature of exchange relationships. The fact that painted ceramics did not seem to flow along these utility ware links is potentially indicative that they circulated in fundamentally different networks. Discerning patterned variation within sites is much more problematic due to smaller sample sizes. In general, any variations appear slight. The one possible exception is the potential for some chronological patterning in the distribution of painted styles at Teonadepa.

5. Lithics

Lithics constitute the second most abundant artifact type recovered during the project with over 8,700 specimens collected. As with all material analyses for this project the principal aim of the lithic analysis is to discern the degree of variation between different segments of the Moctezuma valley to determine if groups with different cultural and/or political affiliations can be discerned. For practical reasons this section will primarily focus on inferences regarding economic practices and to a lesser extent on certain tool types as markers of group indentify. Lithics recovered from Neolithic contexts, such as those that were the focus of the current project, are often given only passing attention in reports. This is likely due to an assumption that the aspects of prehispanic economy best recorded by lithic assemblages are well understood and vary only marginally. As will be shown with the present assemblage, this is clearly not the case.

There are clear patterns in terms of flake size, presence of cortex, and raw material selection indicative of variable economic focuses. A specific argument is forwarded below that the site of Los Mineros (Son L:2:22) was characterized by subsistence activities such as agave processing not carried out onsite at either Teonadepa (Son L:1:23) or El Nogal (Son L:2:1). These observations fit with other contextual evidence that Los Mineros was a smaller and less intensively occupied site. There are also substantial differences in the raw material and tool type frequencies in a comparison of El Nogal and Teonadepa. This variation is tied to alternative emphasis in the subsistence economy of both sites. Lastly, differences in projectile points and bifaces suggest these artifacts can serve as markers of cultural affiliation. These proposed markers are essentially mutually exclusive between El Nogal and Teonadepa, matching other materials analyses that suggest distinct stylistic boundaries between the two sites and their respective settlement communities. These patterns are likely indicative of not only political boundaries but also other domains of interaction and affiliation. .

Methods

The artifacts were recovered using three separate collection methods at the three tested sites. Excavation of domestic contexts compose the largest subsample. Formal bifacial tools, obsidian debitage, cores, and nodules were collected as part of a systematic survey that recorded all artifacts within one m^2 squares placed at regular intervals across all three sites. Lastly, bifacial tools and all obsidian artifacts at El Nogal and Los Mineros were collected whenever encountered. Obsidian debitage was too ubiquitous at Teonadepa for complete collection, and the sample from the systematic survey collection was more than sufficient. Throughout most of the ensuing discussion only excavated materials are employed in the analyses, this is to avoid the bias of unequal survey coverage at different sites and the only partial collection of materials. The excavation sample is designated as *data set 1*. The excavation sample plus the systematic surface collection are designated as *data set 2*, and these two groups plus the judgmental collection as *data set 3*.

Analysis was carried out utilizing standard approaches that placed greater emphasis on artifact types that are potentially diagnostic as to cultural affiliation, temporal period, or functional purpose. The first stage of analysis included all lithic artifacts and recorded the technological classification, material type, quantity of retained cortex (categorical), size, and completeness (see Table 5.1). The technological classification utilized the categories of *flakes, shatter, core, core-tools, and tools*.

After the initial analysis cores, core tools, and tools were subjected to further investigation. Cores and core tools were weighed and categorized according to reduction strategy. This latter category included the categories of *multi-directional*, *core on flake*, *unidirectional*, *bidirectional*, and *discoidal*. The *multi-directional* category includes all cores that reflect no apparent reduction strategy beyond the simple expedient production of flakes from the most convenient platform surface. No preplanned template for an overall sequence is presently identifiable among this group. This reduction approach is also termed *rotating*, to reflect the frequent reorientation of the core to whatever direction provided the most easily utilizable platform. Many of the other categories of cores may also be the product of a similar convenience based approach and the apparent morphology merely the result of chance.

Tools were weighed and classified as to morphology and evidence of edge modification. Projectile points were subjected to yet another level of analysis that included a variety of morphometrics. Most of the following analyses take a hierarchical approach to discerning differences between assemblages and sub-assemblages. Site level analyses are discussed first followed by any evidence for internal site differentiation. Several attempts were made to elucidate potentially temporal differences by comparing different strata and levels of individual features, but no significant variation was found during this data exploration process. For clarity, analyses are divided by variables. A synthetic section follows that interprets the totality of the data. Following this a more detailed examination of the tools and to a lesser extent cores are presented. A final section places some of these data within identified regional trends that tie patterns in lithic artifacts to group identity and economic systems.

Data Analysis

Material Type.

All three of the analyzed assemblages are from sites located immediately adjacent to the Río Moctezuma. The streambed of this perennial river is the presumed source for much of the lithic material recovered, with the exception of obsidian and possibly as discussed below, some portion of the cryptocrystalline material. The Río Moctezuma wends its away from just north of Nacozari for 65 km before reaching the project area. Approximately 20 km north of the project area the stream is joined by a major tributary, the Agua Caliente, which extends northwest into mountainous terrain for 45 km. Along the course of these rivers an array of lithic facies contribute to the stream load, but the contribution is dominated by volcanics of diverse chemical and structural composition and a far lesser quantity of precipitate sedimentary rocks, namely limestone and chert. There is also a plutonic contribution to the stream load of little interest to the present analysis. The availability of cobbles of various lithological origins remains relatively homogenous within the approximately 30 km long project area. Qualitative inspection supports this contention with a general preponderance of volcanics and rare cryptocrystalline cobbles noted throughout the stream's course in the project area.

There is some relevant variance in the geological composition of the landforms on which the three excavated sites are located. Two sites, Teonadepa and Los Mineros, are situated on remnant, fluvial, Neogene terraces. Some cobbles are available immediately underfoot at these sites. The southernmost site, El Nogal, is located on a Pleistocene age basaltic flow that caps an otherwise similar fluvial terrace. The majority of this basalt is vesicular and unsuitable for flake stone production. Uncapped fluvial terraces, essentially identical to the locations of Teonadepa and Los Mineros, are present a short distance away (>2 km) from El Nogal.

Despite this relatively homogenous source environment there is obvious variation in the selection of appropriate tool stone at the three sites (Table 5.2). El Nogal and Los Mineros have very similar debitage assemblages with a predominance of volcanics, while Teonadepa reflects a much higher usage of cryptocrystalline materials. Curiously, this pattern is not reflected in the cores collected from the three sites (Table 5.3). Specifically, the predominance of volcanic debitage at El Nogal is hard to rectify with a predominance of cryptocrystalline cores. These patterns are likely the result of several trends. At Teonadepa there may be a tendency to more fully exhaust cryptocrystalline cores and/or emphasis on biface reduction strategies as opposed to simple flake production. Also, as discussed below, there is a pattern indicative of removing some volcanic cores from the site assemblages of El Nogal as core tools.

Due to significantly different sample sizes generated by different features it is more problematic to securely identify intra-site patterning in the distributions of material types. Confidence intervals of proportions calculated at the 95 percent α level do nonetheless indicate many non-overlapping distributions (Table 5.4). Whether these differences actually reflect meaningful behavioral patterns is another question. The assemblages of El Nogal seem to be rather undifferentiated in regards to domestic structure contexts. In contrast, Los Mineros has a much broader range. Among domestic structures, Feature 18, stands out for a notably greater proportion of cryptocrystalline materials. This structure was also unique in its use of masonry walls and likely postdates most other tested features at the site. The greater investment in both architecture and tool stone acquisition may suggest temporal patterns of note.

A cautionary note is necessary for the interpretation of Los Mineros. Numerous roasting pits were located across all sampled areas. Many of these postdate structures and intrude into habitation features. Conversely, in at least two sampled contexts structures were built on top of areas previously used for roasting pits. Feature 18 was less impacted by these activities, as the large volume of tumbled stone from the walls discouraged post abandonment use of the area. These roasting pits imply the repeated preparation of foods that require substantial processing. The most likely candidate is wild harvested agave, which grows in the immediate vicinity on rock outcrops. Several stages of agave preparation require the production of large, durable lithic tools that are often executed on volcanic materials (see Castetter, et al. 1938; S. K. Fish, et al. 1992a:83-84; Kowta 1969; Van Buren, et al. 1992). As will be demonstrated below, the production of these agave processing tools contributed significantly to feature assemblages. It is important to note that this pattern differs markedly from El Nogal, where there is little evidence for the *onsite* processing of such foods and a concomitant lack of these sorts of lithics despite a similar emphasis on volcanic materials.

Teonadepa reflects a fairly homogenous distribution of variation between domestic structures. The one point of obvious departure in this assemblage is the higher proportion of volcanics associated with Feature 31, the rock midden (see Chapter 13). This type of feature was common across the site, but their genesis and function remains a mystery.

They seem to be something more than just midden disposal piles but no internal structure was evident. Since their function remains unclear, few hypotheses can be offered as to why volcanic debitage might be more prevalent in associated assemblages. There are numerous volcanic rocks included in these piles, and many of them are fire altered, but it seems highly unlikely that numerous fire spalls were misidentified as volcanic flakes.

Raw material comparisons with excavations in other river valleys are hindered by a lack of reported data. Several reports from multiple seasons of work in the Onavas Valley and further south in the Batacosa region do allow for some comparison. These data suggest a range of variation that overlaps with that of the Moctezuma Valley. There is a pronounced emphasis on volcanics with values from 67 to 95 percent volcanic and cryptocrystalline ranges of 16 to 2 percent (Soto 2012). Further afield, at The Cerro de Trincheras non-volcanic components are less than four percent of the assemblage (Villalobos 2011). The Moctezuma Valley assemblage, and Teonadepa in particular, may be relatively unique in its heavy use of cryptocrystalline materials relative to many surrounding regions.

Retained Cortex

An analysis of retained cortex provides further insights on the acquisition and expenditure of lithic materials (Table 5.5). Analysis by site indicates a fare degree of variance with the most cortical and partial cortical debitage at Los Mineros, El Nogal in the middle, and Teonadepa last. This relationship easily achieves statistical significance $X^2 = 132$, $n = 8299$, df = 4, $p = <.0001$. Though significant, this variance is likely not behaviorally meaningful in and of itself, but rather a reflection of the correlation between retained cortex and material type, and also average size of debitage, as discussed below. That is, cryptocrystalline flakes tend to be less cortical and are also more predominant at Teonadepa, secondly at El Nogal, and least at Los Mineros, the reverse order of the relative presence of cortical materials. This relationship is also statistically significant $X^2 = 880$, n = 8299, df = 6, p = <.0001. Some caution is warranted, though, in that there are actually fewer cortical volcanic flakes at El Nogal, than what would be expected by simple proportionality. This relationship is also statistically significant $X^2 = 46.8$, n = 4759, df = 2, p = <.0001 (Table 5.6). Apparently, cortical volcanic flakes, much like volcanic cores are under represented at this site, although this pattern is slight.

Table 5.7 presents a more informative comparison of the ratio of cores to cortical and non-cortical flakes. It is clear that across all three sites there is a tendency for fewer cortical flakes to be associated with cryptocrystalline materials relative to cores. There is little *a priori* reason to predict this cortex/material relationship based on the availability of cobbles of given size classes. Cryptocrystalline cobbles are rarer in stream deposits and much of the locally available chert is of poor quality with many internal flaws, leading to if anything smaller available nodules. In contrast, volcanic cobbles of virtually all sizes up to the maximum size routinely transported by the Río Moctezuma are readily abundant. As a result if any relationship was to be expected, based on the anecdotal observations of material availability, it would be the inverse of the evidenced pattern. This is because cortex area scales as a square while volume scale as a cube. Presumably both volcanics and cryptocrystalline materials would be subjected to the same minimal testing when gathered at the most immediately adjacent gravel bar to a given habitation. Due to the negligible energy expenditure in walking these very short distances it would seem unlikely that either material type was being reduced more fully to lessen transport weight. The poor quality of some cryptocrystalline materials might lead to slightly more testing and offsite decortification, but this alone seems an unlikely factor to account for the pattern.

The fact that many cryptocrystalline materials apparently were subjected to decortification prior to transport suggests this model is insufficient for the collection of all materials. This leads to the informative, if not surprising, implication that much of the cryptocrystalline material was probably being collected at a sufficient enough distance that weight transport, or at least more thorough testing of materials, became concerns. This could have been accomplished as an embedded procurement strategy during hunting or other trips. It seems likely some tools may have been manufactured completely offsite. There seems to be few other motivations to preferentially remove cortex from cryptocrystalline materials outside of habitation areas. The overall greater emphasis on cryptocrystalline materials at Teonadepa may suggest this site had better access to such materials, either directly or through trade. Control over territory and/or regular trips north, closer to the source of the sedimentary rocks, is one likely scenario.

Some tentative suggestions can also be offered in terms of the slight differences in volcanic core/cortical flake usage between sites noted above. The fact that both volcanic cores and volcanic cortical flakes are well represented at Los Mineros is not surprising. Core tools and cortical flakes (Figure 5.1 and 5.2) are the primary forms for agave processing tools (S. K. Fish, et al. 1992a; Minnis, et al. 2006; Osborne 1965; Salls 1985) and their disproportionate presence on a site containing numerous roasting pits is hardly surprising. At Tenoadepa and El Nogal it seems likely these same activities were engaged in to some extent, but not immediately onsite. These data suggest a disproportionate, but not overwhelming exportation of cortical flakes from El Nogal as presented in Table 5.6. This is also unsurprising since the basaltic surface bedrock immediately surrounding El Nogal would facilitate the growth of this plant in the immediate vicinity. The overall very low number of volcanic cores at Teonadepa suggests that if these tools were required they were produced and utilized offsite. Table 5.8 summarizes the relationship suggested here in relative terms. It should be stressed though, that the overall abundance of volcanic flakes on sites, particularly at El Nogal and Teonadepa, is primarily indicative of production of domestic tools, i.e. flakes.

As a final observation, the very high percentage of cortical obsidian flakes is somewhat curious (50 percent of all debitage [data set 3]). One-third of the obsidian tools retained some amount of cortex, but this was most often incidental and not due to an apparent selection for cortical flakes. The relatively small size of most marekanites would undoubtedly lead to a disproportionate production of cortical flakes relative to other materials and frequent remnant cortex on even small tools. Again this is due to the relationship of volume scaling as a cube and area as a square. However, the long distance required to obtain obsidian, >70 km should encourage production at the point of material procurement, especially if the small size of nodules led to a higher failure rate. It is thus interesting that the data suggest transport of complete nodules. Two unworked nodules were recovered at Teonadepa in addition to the numerous cortical flakes.

Two hypotheses present themselves. 1) This material mostly arrived at the site via exchange and the transporting individuals found it economically more viable to simply transport the small marekanites in bulk rather than investing the time to produce finished products. 2) The nodules were directly procured and the procurers were time stressed, perhaps because of foraying into hostile territory, or the procurers lacked the high level of skill necessary to reduce such small nodules. Generally it is assumed that obsidian circulated through exchange (J. P. Douglas, et al. 1997; Shackley 1995), which would preference the first hypothesis. This also seems the most likely given what is generally inferred about territoriality in this region and argued for in Chapter 15. Both of the unworked nodules were sourced. The smaller of the two ~4cm (FN1217) came from the overwhelmingly predominant Selene source (Chapter 11) and is characteristic of marekanites from this source. The second specimen is much larger ~9cm (I0031 Son L:1:23), and was a singular example of an unknown source. It may have been retained in nodule form as a rare curiosity.

Size

The size data also reflects a clear variance between the three tested sites. An analysis of debitage (data set 1) clearly differentiates Los Mineros from El Nogal and Teonadepa (Figure 5.3). This site had a much greater preponderance of larger debitage, particularly in the 2-3 cm range. A Kolmogorov Smirnov test actually indicates a statistically significant variance between pair wise matchups of all three sites (Figure 5.4) Teonadepa-Son L:1:22 *ks .1383, D=max .2864, p>D <.0001;* El Nogal-Los Mineros *ks .0868, D=max .1922, p>D <.0001;* Teonadepa-El Nogal *ks .0462, D=max .0941, p>D <.0001.*

Much as with the cortical data, there are obvious issues of autocorrelation between material type and size. Not surprisingly, given the previously presented data, there is also a statistically significant difference between the material types of volcanic and cryptocrystalline (Figure 5.5 and 5.6) *ks .1138, D=max .2307, p>D<.0001.* This difference is even more pronounced within the site of Los Mineros. Table 5.9 provides summary statistics of debitage size classes.

The most notable differences in all comparisons are between the 1-2 cm and 2-3 cm category. This is likely reflective of both the more extensive shaping of cryptocrystalline tools, resulting in smaller flakes, and the greater conservation of cryptocrystalline cores and concomitant production of smaller flakes. A comparison of cores confirms this, with a difference of approximately 2.4 cm[xv] between cryptocrystalline and volcanic average core sizes (Figure 5.7). The unbroken tools (data set 3) evidence a similar trend with a difference of 2.6 cm (Figure 5.8). In summary, volcanics were consistently used to make larger (usually cruder) tools resulting in larger average debitage flakes and shatter and these flakes and tools were disproportionately retained on site at Los Mineros relative to the other two sites.

At the intra-site level of analysis there are few patterns of note (Figures 5.9, 5.10, 5.11). This in and of itself is somewhat notable given the diversity of sampled contexts and potential for chronological variation. Compare for example Feature 31, the rock midden, to the variable architectural styles of Features 20, and 32, and 33 at Tenoadepa or the different architectural styles of Features 01 and 02 and 03 to the extramural space of 00 at El Nogal. The exception is again Los Mineros. The histograms of Figure 5.11 reflect the increased diversity of debitage sizes at this site. Again Feature 18 stands out as atypical compared to the rest of the assemblage and is more akin to assemblages at either Teonadepa or El Nogal. Again this pattern is at least partly explained by the correlation between debitage size and material class.

Descriptive Data Summary

At this point it is useful to summarize the descriptive data. Previous research focused on debitage analysis noted that the Moctezuma Valley indicated more internal variation than that seen in the neighboring Sonora Valley (Buehler 1980:48). This analysis seems commensurate with these prior observations in that there appears to be significant variation evidenced in site level comparisons. There is an obvious correlation between several variables including material type, size of debitage, and retained cortex. Generally, volcanic materials are associated with size distributions skewed to the right relative to cryptocrystalline dominated assemblages and have a greater proportion of retained cortex. Volcanic tools and cores also tend to be larger, possibly reflecting their employment in different tasks, such as agave processing. Based on the distribution of variation present in the above analysis some general statements can be made about site level patterns.

Residents of Los Mineros engaged in activities that necessitated the production of large volcanic flakes and tools and these were produced and discarded, presumably after onsite use. This is concordant with observations that Los Mineros contained an inordinate number of roasting pits, and that nearly all domestic structures were built over or were intruded into by roasting pits. The steep rocky slopes that surround this site likely provided a greater supply of wild agave than that immediately available to either El Nogal or Teonadepa. It is also tempting to speculate that agave was encouraged at this site, but there is no evidence of cultivation and wild collection seems the most probable at present. The relatively smaller amount of arable riverine land along this reach of the Río Moctezuma may have provided some stimulus to engage in more diversified subsistence practices, or the roasting pits, and by implication many of the lithics inferred to be associated with their use might date to periods when the site was not heavily occupied. It does seem certain, based on both lithic and other data sets, that the intensiveness of occupation at Los Mineros was well below that of El Nogal and Teonadepa.

The data from El Nogal are similar to Los Mineros with the exception of the noted lack of volcanic cores. As explained above, it seems most likely these were exported as core tools along with some cortical tools and used in similar activities as those evidenced at Los Mineros. This indicates some aspects of subsistence production were more spatially segregated at El Nogal, which is not surprising given the inferred denser occupation.

Teonadepa also evidences a pattern distinct from the other sampled sites. At this site a preference for cryptocrystalline materials corresponds to the predictably smaller size of debitage. In contrast to the tentative explanations offered above, there are few obvious functional reasons for this disparity. Cultural identity and/or chronological differences may explain the pattern in part. However, such observations only raise the question of what ultimate causation underlies the variation in extractive technologies for two groups residing in the same environment, irrespective of cultural affiliation. There is the clear potential for some amount of complimentary production specialization in the region. This will be discussed more fully in the Summary and Conclusions chapter since it relies on the compilation of data from other chapters.

Tool Types

This data offers perhaps the clearest argument for alternative economic strategies employed at the three tested sites. The most extensive excavations were carried out at Los Mineros and the least extensive at Teonadepa. This would seem to make the raw tool counts presented in Table 5.10 all the more impressive for the high number of tools found at Teonadepa. However, the density and time depth of occupation was likely higher/longer at Teonadepa relative to Los Mineros, so a fare degree of caution is warranted. Despite these cautionary notes, some patterns are strong enough to reliably reflect different suites of functional needs that occurred at the three tested sites.

Purely qualitative analyses of the presence, absence, and relative abundance of tools (see Figures 5.12, 5.13, 5.14) is sufficient to identify certain patterns. The presence of planes, several of which were core tools, at Los Mineros reinforces the inferences made above regarding agave use at Los Mineros. The relative absence of such tools at El Nogal and Teonadepa also suggest this was not a major focus of onsite subsistence processing.

The general dearth of retouched lithic tools at El Nogal may also reflect economic specialties that did not require curated flaked stone technologies. It is possible that unmodified flakes fulfilled many of the roles more formal tools served at Teonadepa. The scarcity of tools is not a reflection of a lack of adequate recovery, as the absolute amount of debitage surpasses both other sites. The coarseness of the volcanic raw materials predominantly employed at El Nogal could potentially obfuscate the easy identification of lightly employed tools, namely utilized flakes. This durable material also may simply obviate the need for resharpening. These seem unlikely biasing factors, though, given that Los Mineros should be even more affected and the identification of more formal tools, such as scrapers, should still be readily achievable. In short, the low number of tools at El Nogal likely reflects a real scarcity of such tools employed in the investigated areas of the site. This contrasts markedly with other resource processing implements. Approximately 290 groundstone fragments were recorded on the surface survey of the site, compared to only tens at Teonadepa and Los Mineros. Notably the only three agave knives recovered on the project, typically used in fiber production, all came from El Nogal. The groundstone data thus overwhelmingly suggest sorts of specialized subsistence or commodity production at this site not seen at the other two. These observations would seem to suggest the lack of certain lithic tools at El Nogal is also an indication of a focus on alternative economic undertakings.

It is tempting to make the inverse argument in regards to Teonadepa. It was clearly established above that Teonadepa differed in important ways from both of the other tested sites. The Shannon diversity scores, provided in Table 5.10, actually give a somewhat false impression that Los Mineros and Teonadepa are quite similar, since they have comparable distributions of lithic tool types. But the tool classification does not adequately capture the difference in tool sizes (Figure 5.15), which is certainly related to different functional uses. As a result, it is unclear if the assemblage structure for Teonadepa reflects an alternative economic specialization from that followed by either El Nogal and Los Mineros or the profile of a population that lacked an economic focus and followed a generalist strategy. These patterns certainly have potential to indicate the sought after data of cultural variations in different reaches of the Moctezuma Valley. Conversely, the disparities might suggest an integrated subsistence system with each settlement community or particular sites specializing in the production of certain products. As will be discussed in other chapters there is no evidence for elite or any other form of hierarchical control or direction of the subsistence economy, so if such exchanges existed they likely took place on a household to household level. Since survey was not conducted further north and the excavation sample is limited to only three sites it is decidedly premature to speculate as to the directionality of any potential subsistence exchanges.

It is worth noting that much of the tool assemblage of Teonadepa is composed of points and point preforms (n = 34). This might lead to a proposition that the lithic industry of Teonadepa was driven by non-subsistence related concerns, such as manufacturing points for warfare purposes. There is some limited ethnographic evidence to suggest stone points, as opposed to wood (Pfefferkorn 1949:203), were primarily used in warfare. A tentative estimate of the overabundance of points relative to hunting purposes can be obtained by an index of killing implements, points, compared to processing implements, scrapers. There are obvious conflating issues. Different types of game will require different kinds of processing tools, and economic choices that impact the value of hide processing and other animal products can certainly skew the need for scrapers. However, it seems the measure might still have some value, Table 5.11 lists the ratio values. The Los Mineros sample is far too small to be interpreted with confidence and the El Nogal sample is of questionable size. Nonetheless the El Nogal to Teonadepa comparison does suggest the latter was not disproportionately involved in warfare activity. Given that these two sites are located in relatively close proximity it would be quite surprising if one engaged in regular warfare and the other did not. The difference between the reliably sized sample at Teonadepa and the comparatively much larger Paquimé, does suggest a notable divergence, possibly suggesting warfare was more of an issue in eastern Sonora relative to much of Northwest Mexico. However, these are very different sites and clearly other data points would be desirable in this comparison. The values, could of course, also suggest a greater emphasis on ensuring successful hunts through greater investment in killing technology.

The later would presumably be driven by a relative higher need to ensure success either due to fewer available game or a greater reliance on hunted resources and thus higher relative demand. More research is needed to discern between these possibilities.

Core Reduction Strategies

The identification of alternative *chaîne opératoire* remains an elusive goal among Neolithic societies of North America. The data set from the Moctezuma Valley is yet another example of why this is the case. At all sites *multi-directional* cores far outnumber all other categories combined (Table 5.12). There is some tentative hint that the lithic reduction sequences at Los Mineros and El Nogal include a more diverse suite of strategies. However, there is no available evidence that these alternative modes of reduction were employed in anything other than the expedient production of flakes. The second most represented category of *unidirectional* is actually dominated by specimens that were too small for effective multi-platform reduction, or that were only minimally exploited, obviating the need to alternate the platform direction. A discriminant function analysis based on flake scar patterning suggested to Buehler (1980:52-53) that there were differences in the reduction sequences between the Río Sonora and Río Moctezuma valleys. It is unclear how this would be reflected in the operational sequence beyond a slightly higher preference for multi-directional cores in the Moctezuma Valley. Buehler's sample included a collection from El Nogal as well as several other Moctezuma Valley sites.

The lower overall number of cores at Teonadepa is interesting and likely related to the use of more rare cryptocrystalline and obsidian materials. The tool to core ratio is nearly seven times as high for Teonadepa (4.44) as El Nogal (.66). This could suggest many more reduction sequences in which a core was completely reduced to form tools. This seems a probable sequence for the large bifaces (Figure 5.16) recovered from Teonadepa, a tool completely lacking at El Nogal. Biface reduction sequences are obviously in keeping with the generally smaller size of debitage at Teonadepa.

To summarize, the Río Moctezuma data are commensurate with a technology largely based on the expedient production of flakes and informal tools. This pattern is, of course, common to most sedentary Neolithic groups where tool stone is readily available and sites are easily provisioned (*sensu* Kuhn 1995). Numerous factors likely underlie the reliance on such expedient technologies including a lack of risk/time stressed activities (Torrence 1983), relaxed demands on preplanning for tasks preformed in lithic poor environments (Parry and Kelley 1987), and possibly even a shift in the gender (Sassaman 1992) or age of stone tool manufacturers. Despite the overall crudeness of the tools employed there is clear variance between the assemblages, with Teonadepa possessing a much greater diversity of tools, and more effort exerted in their manufacture and maintenance, particularly of bifaces and points. This may suggest that the lithic assemblage of Teonadepa was more focused on activities that had a high cost for failure. Two obvious examples are warfare and the regular reliance on the hunting of sizeable game. To the extent specialization or even focus was observable at El Nogal or Los Mineros it appears to be on the processing of plant resources. These low risk activities that can typically be performed with little to no risk of failure are entirely commensurate with the simpler, more expedient, lithic industries recovered from these two sites.

Lithics as Markers of Cultural and Chronological Affiliation

As is the case for all of temperate North America, projectile points are the most amenable for the identification of potential cultural and chronological index artifacts. Archaeologists have, of course, long realized that points may end up in sites by a variety of means. For the identification of index artifacts it is hoped that most points were made and lost on site. However, the ethnographic record suggests points were occasionally trade items and observations that a single quiver may hold multiple point are common (Seymour 2007; 2011:76). There is, of course, also the obvious potential for points to be lost at sites by foreign raiders during hostile actions. This does not hinder chronological assignments but certainly clouds cultural affiliations. As noted frequently in the prior research section, warfare was apparently endemic in this region at the time of contact and likely for some time prior in the prehispanic period. The presence of a walled site on top of the high mesa adjacent to Teonadepa lends some credence to the potential that some points were introduced to sites through hostile actions. A likely Apache site was also located in the Sierra La Madera to the immediate east of the project area, highlighting the diversity of cultural affiliations present in this region during the contact and preceding era.

During the initial 2010 survey only three projectile points were recovered, all archaic in age, including one each of San Pedro, Chiricahua, and Cortaro. All of these were recovered from sites dating to the post archaic, agricultural period and almost certainly reflect scavenging and reuse behavior. Two more archaic points were recovered from the surface during the 2012 excavation season, one at El Nogal and one from Teonadepa, a San Pedro and an undefined type respectively (Figure 5.17). These points indicate use of the region at least as early as the Middle Archaic, possibly as early ca 5500 BP, and continuing or reoccupation in the Late Archaic/Early Agricultural period. These point styles thus help to expand and confirm the presence of the broad archaic traditions of the southwestern U.S into the mountainous regions of Sonora. This has long been suspected but little supporting data were available.

As to the later periods that were the focus of data recovery, the lithic assemblages of El Nogal and Los Mineros provide little opportunity to identify index artifacts. There are only 14 points total from these two sites, most of which are only small broken fragments. Only seven points are from the correct time period and complete enough to be of use (Figure 5.18 and 5.19). Despite this small sample some distinct groups can be identified. The Los Mineros group is bifacially worked has broad triangular bodies and stemmed, side notched bases. These characteristics contrast to the small triangular points that dominate most of the Southwest U.S. in the period A.D. 1100-1500. Los Mineros points are also appreciably larger. Due to the high intra-group variation and small sample size, average measurements are not calculated but individual dimensions are provided in Appendix H. Three small triangular stemmed points from El Nogal may also suggest another typological category of small stemmed forms with narrow blades. These are not presently classified as their own group since there is clearly more internal variation than desirable (see Figure 5.18). Future work should expand the sample size sufficiently to make a more informed categorization. By comparison, only nine of the 98 points recovered from Medio Period Paquimé were small stemmed, notched points (DiPeso, et al. 1974f:395). Lastly the point from FN 116 is unique within the assemblage with its side notches and slightly concave base. A similar point was recovered in the Onavas Valley and identified as a Pueblo Side Notched (Soto 2012:122). The similarity to this point type is likely coincidental, but there may be a projectile point tradition that includes both the Onavas and portions of the Moctezuma Valley. Alternatively this point could be a crude example of the Casas Grandes, Medio Period Type 1A, which was one of the most common at Paquimé (DiPeso, et al. 1974f:392).

The assemblage of Teonadepa provides a greater opportunity for the identification of index artifacts, but also introduces questions of assemblage formation processes due to the obvious variation in artifact form (Figure 5.20). In contrast to most of the points discovered at El Nogal and Los Mineros, the points from Teonadepa were generated by slight modifications to unifacial flakes. Once the rough shape was completed, slight retouching was performed along the edges, at times on only one lateral edge, and always along the base. Occasionally, this retouching was significant enough that the finished point cannot be distinguished from products of a true bifacial reduction process, but these points are decidedly in the minority (~20%). With the exception of the one archaic point, all those recovered can be placed into the broad category of Western Triangular defined by Justice (2002). Subdivisions are more problematic. A superficial inspection of Figure 5.20 demonstrates many of the obsidian points differ from the other styles by the presence of a well executed basal notch. It is tempting to speculate these points arrived on site as trade items fully formed, since the closest obsidian source is located at some 70 km distance in the Bavispe Valley. The presence of ample amounts of obsidian debitage at Teonadepa does not support this interpretation. These points are similar to Huachuca points of the sedentary Sobaipuri O'odham of southern Arizona (see Masse 1981:40), and Soto points (see Phelps 1968) of nomadic groups such as the Jano, Jocome, Manso, and Suma, but neither is a perfect match. There does not appear to be any analogy to this form present in the Medio Period assemblage of Paquimé.

The cruder triangular forms with flat or slightly concave bases (no notch) can be found throughout the surrounding region, reaching well into southern Arizona. This point style is also most often attributed to Sobaípuri and other O'odham groups (DiPeso 1956; Justice 2002). This study demonstrates this basic form extends well into Sonora, further than the generally accepted limits of Sobaípuri occupation. Researchers in the Onavas Valley likewise identified a few points as Sobaípuri (Soto 2012:121; O. Vargas and García 2011). If this identification is valid, it would be an interesting corollary to the historic distribution of O'odham groups (Upper and Lower). In general though, given the broad geographic distribution that crosscuts accepted cultural boundaries presently small triangular points are of little diagnostic utility. Notably, though only a minority of the points from the Medio Period of Paquimé fit this description (23/98) (DiPeso, et al. 1974f:392-393). Perhaps in the future a more detailed regional analysis will be able to delineate more meaningful differences., The presence of at least three broken tips, corresponding to an obviously larger projectile point style, indicates the full suite of projectile point morphologies for this region is still unknown.

Lastly, Teonadepa stands out for the presence of five well made bifaces. All of these specimens were found on surface survey, two in 2010 and three in 2012. Four were executed on cryptocrystalline material and one on very fine grain basalt. No similar artifacts were found at either El Nogal or Los Mineros. The morphology of the bifaces is somewhat similar to the Canutillo Complex defined by Seymour (2009), and associated with non-Apachean nomadic groups. Their presence at this sedentary village site is curious and may indicate trade relationships or perhaps that the exclusive affiliation of well made bifaces with nomadic groups is erroneous or related to more general trends occurring throughout northern Mexico in the 1400-1700s. Notably bifacial knives were the most common tool at Paquimé (DiPeso, et al. 1974:Fig 423-7). Too much should not be made of this similarity as there are likely biasing factors produced by different artifact recovery methods and possibly confounding economic issues as well. Teonadepa bifaces also appear very similar to bifaces in the Soyopa collection purchased by Ekholm in the early 1940s in far southern Sonora (Gallaga no date). At present it seems ascribing such items to any one particular group may be premature, or at least necessitate a more refined analysis of characteristics. It is clear, though, that these implements do not have a uniform distribution across the region

To summarize, the index artifact data, several broad groupings of points are proposed for most of the assemblages of El Nogal and Los Mineros. The more consistent group is identified as Los Mineros points, the second group remains unnamed until further research supports its identification. At Teonadepa the basal notched obsidian points provide the strongest case for an index artifact. More research is needed to elucidate if this style reflects strictly local production, trade from exterior locations, or a broadly shared style across a more expansive region. Most of the other points from this site cannot be classified any further than ascription to the geographically expansive Western Triangular tradition. The completely exclusive point types found at El Nogal/Los Mineros and Teonadepa is undoubtedly significant. All potential biasing factors aside, it seems likely this denotes some sort of cultural boundary indicative of a salient social division. The presence of well made bifaces at Teonadepa may also indicate cultural ties not shared by El Nogal and Los Mineros or may simply be the reflection of some functional economic need specific to Teonadepa.

Conclusion

The lithic data provided another line of evidence to clearly delineate regions of the Moctezuma Valley. Much of the observed variation is indicative of alternative economic strategies. Some small portion of it may be ascribed to immediately local variance in production opportunities. The differing opportunities for agave collection and perhaps even cultivation are the most obvious example. However, there are manifest differences between assemblages that cannot be explained away by these associations. This is particularly true in regards to differences between Teonadepa and El Nogal. The assemblage of Los Mineros is less comparable as it pertains to a site with a much less dense occupational history. The differences between El Nogal and Teonadepa, particularly in regards to raw material selection and tool assemblages, indicate alternative economic focuses not driven by ecological variance. This situation could still arise in a context in which different settlements specialize in complimentary subsistence production. It may also simply be the result of differing cultural practices. If it was due to settlement level economic specialization the data are, unfortunately, not adequate at present to determine if El Nogal and Teonadepa households regularly engaged in exchange, had other exterior partners, or both.

The presence of starkly different projectile point and other formal tool assemblages, such as well-made bifacial knives certainly suggest El Nogal and Teonadepa had starkly different material cultural traditions. Projectile points are generally produced through a sequence of routinized steps indicative of specific learning framework. The fact that these learning frameworks apparently were not transmitted in any way between Teonadepa and El Nogal suggests a fairly stark exclusive social boundary between the two sites. As a singular example this is a thin case, but will be addressed more fully in the Summary and Conclusions section in the broader context of all analyses.

6. Groundstone

Due to obvious logistical limits only excavated groundstone and small rare items from the surface were collected during the project. Other groundstone items were photographed in place and their location recorded with a GPS. This short section will be organized by artifact type with notes made on the frequency or character of particular objects that are unique to a given site (see Table 6.1). As with ceramic and lithic data there are pronounced differences evidenced between sites. However, in the case of groundstone the evidence is largely simply presence or absence, with many implements being present at El Nogal (Son L:2:1) and only a few specimens present at with Teonadepa (Son L:1:23) or Los Mineros (Son L:2:22). As noted in the previous chapter on lithics, these distributions may hint at subsistence resource specializations, or at least emphasis.

Artifacts

Metates. No metates were collected during the project, so no metric data is available. The observations on metates are predominantly driven by the assemblage at El Nogal, which constituted over 75 percent of all metates recorded on survey or excavation. As a rule metates were always broken, sometimes in a manner that strongly suggested intentionality or a ritual killing of an artifact (Figure 6.1). Richard Pailes (personnel communication) made a similar observation in the Sonora Valley, and in at least one case a broken metate was included in a burial. The apparent uniformity of this pattern could also result from 200 plus years of local inhabitants scavenging whole metates for use in their households.

Most sites discovered on survey had few if any metates visible on the surface. The mapped groundstone assemblage from Los Mineros with 25 implements, and Teonadepa with 14 implements are likely fairly representative of large sites. These minimal counts make the 233 metate fragments found at El Nogal stand out as obviously reflecting a categorically different pattern. As discussed in the lithics chapter the ubiquity of groundstone at this site almost certainly suggests some kind of specialization but of what commodity remains mysterious. Several of the metates at El Nogal had such large vesicles that even maize seems like an unlikely grinding medium (Figure 6.2). Most metates with a sufficient portion remaining to infer shape suggested a closed trough form (see Adams 2002) to be used with a two-handed loaf mano. Basin forms were less common but also present in the assemblage. Many of the metates at El Nogal had a roughly trapezoidal shape to one or both ends. This was far from a standardized form, but suggests a similar manufacturing sequence. The same general form has been observed as far south as the Tepache area. This may reflect the distribution of similar rock types as the same Pleistocene basalt flows are present in this area.

Metates can of course be utilized as a trade item (Rathje 1972) but all the circumstantial evidence suggests this not was the primary motive at El Nogal. The exterior of metates were generally only minimally shaped through flaking and pecking, most metates had an irregular form, and they were much bulkier than necessary for the size of the grinding surface. All of these features suggest that they were utilized as rather immobile site furniture and certainly not intended for transport out of the habitation area. There was certainly no formal standardization in production, as is common with a regularly produced trade item (cf DiPeso, et al. 1974f:167-168; T. L. VanPool and Leonard

2002). In addition, most of the metates at El Nogal evidenced significant use wear, which would not be expected of items intended for trade. The vast majority of metates were executed on vesicular basalt but examples of felsic volcanics and even rare plutonics were also encountered. Notably, the ratio of surface finds of manos to metates is .082 at El Nogal and .142 for all excavated sites. It seems unlikely that formation processes alone, such as surface visibility can account for this discrepancy. Given the very deep troughs of many metates it might actually be expected that several expended manos should be found for every metate. Trough metates seem unlikely to be utilized with wooden or other perishable paired instruments.

Manos

Manos were equally rare at most sites. Even at El Nogal there were only 19 surface finds. Of the manos recovered from excavated contexts (n = 9) most were too fragmented to infer form, usually from thermally induced fracturing. Three manos were identifiable as two handed manos and three as one handed manos. The form of most metates suggests the two handed variety should be much more common. Perhaps manos were not subject to the same kind of *ritual killings* hypothesized for metates and thus have been more frequently collected from sites by later regional inhabitants. It is also possible given the obviously much smaller size of manos they were discarded with other trash over the edge of mesas whereas metates were abandon in place. Lastly, if manos were minimally altered from river cobbles, ubiquitous on the surface at Los Mineros and Teonadepa, some proportion might have gone unrecorded. This later possibility seems unlikely, and certainly does not account for the lack of manos at El Nogal were any smooth stone stood out manifestly from the background of surface basalt flows.

Grinding Slicks/Cupules

Grinding slicks were only encountered at El Nogal of the excavated sites and at several nearby sites also located on the basalt malpais during survey. This sort of ubiquitously present surface bedrock is not present at any other excavated site, so the absence of these features is hardly surprising. A total of 37 localities and 124 actual slicks were encountered at El Nogal. The ratio of manos to slicks at El Nogal is .153. Assuming most slicks were utilized in the manufacture of groundstone manos, this number again suggests that many manos are missing from the assemblage, either disposed of in areas not examined or perhaps exported from the site.

Cupules were decidedly rare with only six discovered at El Nogal one at Los Mineros. Several others were also present at nearby El Corral (Son L:2:17) and La Volanta (Son L:2:39) (Figure 6.3) and they are likely present at a low frequency along the malpais mesa edge between these sites and to the south. Their overall rarity, relative to neighboring regions, likely implies the lesser importance of mesquite and other leguminous tree pods in the Sinaloan Thornscrub relative to the Sonoran Desert.

Agave/Groundstone Knives

Three groundstone knives were found during the project, all from El Nogal (Figure 6.4). These are inferred to be utilized in the processing of agave leaves, most likely for fiber production. This assertion is based on similarities to better studied regions of the U.S.

Southwest (Bernard-Shaw 1984; Kisselburg 1987) and not on any direct associations discovered during the project. Their association only with El Nogal is interesting and perhaps suggests the water trapping properties of the near surface malpais was conducive to growing agave. In general, the vegetation of the malpais area is much denser compared to nearby mesas, highlighting this benefit. Agave plants are rare in the region today, due largely to over harvesting from *mescaleros* (N. T. Martinez and Pailes forthcoming), but are endemic to the region (Gentry 1982).

Axe

Only one axe head was found during the project at Los Mineros. It was left on the floor of an otherwise empty house. The size of the implement was relatively small at 13.5 cm in length by 5.4 cm in width (Figure 6.5). There was a ¾ groove around the implement, which is common to axe styles across an incredibly large geographical region of arid North America.

Polishing Stones

Unequivocal examples of polishing and/or ceramic shaping stones were found at El Nogal and Jamaica Vieja (Son L:1:17) (n = 2). The former is interesting since there does not appear to be any ceramics made at this site with immediately local temper (basalt+granite). Less clear, but probable examples were also found during excavation at Teonadepa and Los Mineros (Figure 6.6). This would seem to suggest at least some minimal amount of ceramic production took place at all sizeable sites.

Spindle whorls/Discs. Spindle whorl and probable spindle whorl blanks made of groundstone were only identified at El Nogal (Figure 6.7). Three of these came from Feature 3, the pithouse feature, along with several sherd spindle whorls. All were of the simple disc form with no modeled spindle whorls discovered during the project. Interestingly, ethnographies mention weaving was done predominantly in subterranean structures (Johnson 1971:175). The clear association at El Nogal lends some credence to this claim. Dirst (1979:123) also noted all the stone spindle whorls in her sample from the Sonora Valley were from pithouse contexts. Stone spindle whorls, as well as clay modeled and disc whorls were generally common in the Sonora Valley (Pailes 1980). It is tempting to draw a link between the spindle whorls at El Nogal and the inferred use of agave knives for fiber production. Cotton was likely also widely grown in the region, and this is the more probable association of most spindle whorls. Sherd spindle whorls were recovered at all excavated sites, again indicating some amount of fiber production was ubiquitous.

Arrow Straightner

One grooved stone fragment, possibly an arrow shaft straightener, was collected at Jamaica Vieja (Figure 6.8). These implements are notable for their general absence, as they were common in the Sonora Valley (Hinojo personnel communication; see also Dirst 1979:125-126).

Bowl

One fragment of a groundstone bowl was discovered at El Charco (Son L:2:27), made on vesicular basalt. The exterior diameter was approximately 20 cm.

Eccentric objects. A local antiquarian who resided next to the 2012 field house provided access to a collection from the region of La Volanta (south of modern day Moctezuma). Among the objects inventoried were several items of polished slate (Figure 6.9). One of these is best described as a palette, somewhat similar to those found in the preClassic Hohokam region (E. W. Haury 1976), but lacking any border embellishments. The center had a slight depression, presumably used for the mixing of pastes or liquids. A second object was an oblong semi-hemispherical object. It is roughly similar in size and shape to a computer mouse. No apparent functional interpretation could be discerned. Slate does not naturally occur anywhere in the immediate vicinity, suggesting these items were imports from outside the valley.

Conclusion

The groundstone assemblage data available is admittedly of limited utility since most specimens were not collected. However, even given its shortcomings it too serves to highlight several clear differences between portions of the Moctezuma Valley. El Nogal stands out for its prodigious production and use of metates and for its employment of agave knives and spindle whorls not seen at other sites. These differences definitely indicate variable approaches to subsistence sufficiency and likely also to non-subsistence economic specialization. This is a potentially critical observation since it may suggest some degree of subsistence and perhaps other commodity (cotton) specialization in the region. There are unfortunately no data collected on the project that can discern whether these resources were traded between El Nogal and Teonadepa. If they were it seems likely, based on contextual evidence presented in Chapter 14 that the exchanges would have taken place at the household level. That is, at present there is no evidence production was being orchestrated at a higher level of political oversight, but a more diverse sampling of proveniences would be desirable to explore this possibility. Woven cotton products might have been a particularly valuable commodity, as suggested by numerous ethnohistoric sources, with potential for significant value in exchange relationships.

7. Faunal Analysis

As in previous chapters the principal goal of the faunal analysis was to discern variation between the three excavated sites. There was also a secondary goal of comparing the assemblage at the valley scale to a well reported sample collected from previous excavation in the Sonora valley. Evidence was also sought in regards to what ecozones were regularly exploited by riverine groups. The faunal assemblage is relatively sparse with a total *n* of 942 specimens (excluding mollusks) from the three excavated sites. The assemblage is also highly fragmented, resulting in a predominance of specimens that cannot be identified beyond the class level.

Given the overall poor preservation of the assemblage and that the three excavated sites are located in an essentially homogenous environment (see Chapter 2) major site level differences seemed unlikely to emerge. It was thus surprising that El Nogal (Son L:2:1) and Teonadepa (Son L:1:23) evidenced some potentially substantial differences in their faunal assemblages. A wider array of species was present at Teonadepa as was a slightly higher prevalence of large bodied prey. The Teonadepa assemblage was also less fragmented. The assemblage from Los Mineros (Son L:2:22) was too small for most comparisons. This is consistent with evidence from other chapters that this site reflects a different density/duration of occupation. The difference in the El Nogal/Teonadepa data are indicative of what is likely a mix of simple preference and also differential access to variable ecozones and potentially trade connections. Several notable differences are also evidenced at the inter-valley level. The extremely high contribution of large bodied species relative to small bodied species suggest hunted resources were not in short supply. This is especially evident in the Moctezuma Valley. The high level of fragmentation evidenced throughout the assemblage is also informative, suggesting fairly intensive processing, possibly in order to produce a storable commodity. The assemblage thus provides valuable, if limited, data on variance in subsistence practices, prehispanic ecological conditions, and tentatively indicates variances in food ways and possibly other aspects of behavior sites and their respective settlement communities.

Analysis of the collection was conducted by Dr. Deanna Grimstead. In addition to species and element identification Dr. Grimstead recorded portion of element present, categorical size, side, age/fusion, percentage preserved, diagenic surface modifications, rodent and/or carnivore gnawing, cultural modification, and burning. A minimum of 18 species is represented in the data set. The following section provides a discussion of each.

Species List Summary

Phylum: Arthropoda

Class: Insecta

Order: Hymenoptera

Family: Sphecidae

Genus: *Sceliphron*

Provenience: Son L:2:1

The consumption of this genus is indicated by burned and cut mud nests (Figure 7.1) that exposed larva chambers. A total of three specimens were recovered, all from

Feature 2, a river cobble cimiento style house, at El Nogal. Insects as food have been reported in ethnographic literature of the greater Southwest, but this appears to be the first reported incidence of utilizing wasp larva in this region. It seems likely that other insects were also utilized for food but lost to a lack of preservation. Specifically, the ubiquitously available in late summer *Manduca* sp.-hornworm caterpillar (Figure 7.2) and abundant grasshoppers would seem like sources of easily collected protein unlikely to be overlooked. Non-vertebrate foods were generally common in arid North America (e.g. Madsen and Kirkman 1988; Russell 1975:81).

Phylum: Chordata

Superclass: Osteichthyes

Class: Actinopterygii

Provenience: Son L:1:23

The three specimens of Actinopterygii-boney fishes could correspond to virtually every freshwater fish that conceivably would live in the prehispanic Río Moctezuma. Data on native fishes is quite limited but a list of likely candidates minimally would include the *Ictalurus pricei*-Yaqui catfish (60 cm max[xvi]) (Minckley and Marsh 2009:219), *Catostomus bernardini*-Yaqui sucker (46 cm max) (Minckley and Marsh 2009:190), and *Gila eremica*-desert chub (22 cm max) (Minckley and Marsh 2009:132). Less likely candidates whose ranges do not currently include the middle Moctezuma are *Gila beani*-Yaqui chub (45 cm max) (Minckley and Marsh 2009:141) and *Gila minacaei*-Mexican roundtail chub (>62 cm max) (Minckley and Marsh 2009:135). The only specimens recovered all came from

Teonadepa. The river does not flow perennially in this reach today, but may have in the recent past before groundwater pumping. Today populations of sizable fish exist as close as 16 km to the north northeast in pools of the Río Agua Caliente, a tributary of the Río Moctezuma. Sizeable specimens feasibly worth the effort of catching are easily observed at this location although they are likely introduced bass and carp. Given the generally poor preservation of fish bones, their presence in the relatively small sample from Teonadepa may indicate fish were much more prevalent prior to the historic lowering of the water table. No fish bones are reported from the Sonora Valley (Olsen and Olsen 1981). A total MNI of only 4 is reported for the much larger Casas Grandes Project (DiPeso, et al. 1974b, table 301-8).

Class: Reptila

Order: Testudines

Provenience: Son L:2:1

One turtle carapace scute was recovered from El Nogal. Potential species include *Kinosternon sonoriense*, Sonoran mud turtle; *K. flavescens*, yellow mud turtle; *Terrapene nelsoni* and *Gopherus agassizi*, desert tortoise. The last species on this list seems like the most likely candidate given the environmental context. Non-native water turtles were witnessed on survey, indicating the riparian zone remains viable, despite what must be a significant loss of habitat. Several *G. agassizi* were witnessed on survey and excavation and are often maintained by local residents as pets. A large *G. agassizi* carapace pendant is reported from the Sonoran Valley (Olsen and Olsen 1981). In the Onavas valley a complete carapace was placed on the abdomen of an adult burial (C. M. García 2012:47). Both suggest ritual significance to the animal. *G. agassizi* is known to produce burrows of substantial length, suggesting its presence at an archaeological site can be misleading. In the Onavas valley Testudines made up a relatively high (four percent) of the overall assemblage and five percent of the NISP from excavations in 2012 at two sites (P. N. García and Campos 2012a). All land turtles obviously make for attractive subsistence targets since they are easily procured when encountered (Stiner 2001).

Class: Aves

Order: Falconiformes

Family: Accipitridae

Genus: *Buteo*

Provenience: Son L:1:23

A single coracoid from a *Buteo* sp. Indicates the use of hawks at Teonadepa. It is, of course, possible that this singular specimen could be the result of the incidental death and preservation of a hawk at the site. Potential species include *B. nitidus*-gray hawk, *B. regalis*-ferruginous hawk, *B. jamaicensis*-red-tailed hawk, *B. swainsoni*-Swainson's hawk, and *B. albonotatus*-zone-tailed hawk (Floyd 2008). Hawks are generally uncommon in the region today. Ethnographic accounts of utilizing hawks for food do exist from the Tepehuan region (Pennington 1969:115). More often, though, their body parts serve as components of ritual paraphernalia. Several exotic wing fragments including a snowy egret (*Egretta thula*) and a tern (*Sterninae*) were present at a hill top shrine near Paquimé (Pitezel 2011:157 table 6-5).

One hawk and three eagle (*Aguila chrysaetos*) bones were recovered from the Sonora Valley (Olsen and Olsen 1981).

Order: Accipitrformes

Family: Cathartidae

Provenience: Son:L:1:23

Three specimens of synsacrum represent this family. Today *Cathartes aura aura*-turkey vultures are ubiquitous in the region; *C. a. meridionalis* is much less frequent in modern populations. *Coragyps atratus*-black vulture is also a less likely, but possible candidate (Floyd 2008). The present ubiquity of turkey vultures is likely, at least in part, the result of significant livestock agriculture in the region, which provides a steady supply of carrion. The presence of Cathartidae bones at Teonadepa may be incidental. It seems unlikely that vultures would be considered a suitable prey species, but conceivably could have fulfilled some sort of ritual function.

Order: Galliformes

Family: Phasianidae

Provenience: Son L:1:23

A single distal humerus fragment indicates the presence of a member of the Phasianidae family. This group includes a wide variety of avifauna, but most do not have ranges that naturally occur in eastern Sonora. The most likely candidate is the turkey-

Melegris sp. This family also includes the domestic chicken-*Gallus gallus*, but the deeply buried and well dated context of this specimen makes such an identification unlikely. Turkeys were raised at Paquimé (DiPeso, et al. 1974e:268) and likely served important ritual functions (DiPeso, et al. 1974b:269).

Class: Mammalia

Order: Carnivora

Provenience: Son L:1:23; Son L:2:1; Son L:2:22

A total of 14 elements were not identifiable past the level of Carnivora. This very large taxonomic grouping almost certainly includes some instances of domesticated dogs. Common commensals, such as *Canis latrans*-coyotes and *Urocyon cinereoargenteus*-gray foxes are other likely candidates as are ubiquitous specimens such as members of the Mephitidae-skunk and Procyonidae-raccoon families (Wilson and Ruff 1999). Specimens of *Procyon lotor* as well as *C. latrans* and *U. cinereoagenteus* were recovered in the Sonora Valley (Olsen and Olsen 1981)[xvii]. One specimen recovered in the Sonora Valley was a likely *C. lobo mexicano* (Olsen and Olsen 1981). This species was likely native only to the Sierra Madre proper and was probably an import of ritual or ceremonial importance. There are of course other species of Carnivora that are not discussed here but that may be represented in this subassemblage.

Family: Felidae

Provenience: Son L:1:23

One specimen, a fragmented zygomatic was recovered from the third level of Feature 32, an adobe structure. The specimen could not be identified past the level of the family and therefore may be from a *Felis catus*, domestic cat, but its buried depth would seem to suggest it was of prehispanic age. Species with ranges that potentially overlapped mountainous Sonora include the *Puma concolor*-cougar, *Herpailurus yaguarondi*-jaguarundi, *Leopardus paradalis sonoriensis*-ocelot, *Panthera onca arizonensis*-jaguar, and the *Lynx rufus baileyi*-lynx or bobcat (Wilson and Ruff 1999). The latter of these is the most populous today and would seem to be the most likely. All potential species seem unlikely subsistence resources but could certainly be used in the production of items that served as prestige or ceremonial objects.

Family: Mustelidae

Provenience Son L:1:23

This singular specimen, represented by a single distal humerus, could correspond to a wide range of species including the genera *Mustela*-weasels, *Taxidea*-badgers, or other far less likely carnivorous mammals (Wilson and Ruff 1999). Since many of these species are burrowing, the presence of this specimen at an archaeological site is of dubious association.

Order: Rodentia

Family: Heteromyidae

Provenience: Son L:1:23

A single mandible specimen represents this family. The specimen most likely corresponds to some form of kagaroo rat. *Dipodomys merriami* is the most likely candidate, but *D. spectabilis* and *D. ordii* have ranges that could have potentially included the Moctezuma Valley in the prehispanic era (Wilson and Ruff 1999). Given the burrowing nature of all species this specimen is probably invasive, but as discussed below subsistence utilization of rodents and other small game is also recorded ethnographically.

Family: Cricetidae

Genus: *Sigmodon*

Provenience: Son L:1:23

Two bones of cotton rats were recovered from Teonadepa. This species is a common commensal and likely not utilized for subsistence. However, the Tepehuan hunted the similarly sized rodents as a subsistence resource (Pennington 1969:125) as did the O'odham (Russell 1975:80). The Zuni also reportedly utilized similar species (Cushing 1920: 599-600). A variety of rodent species were recovered in the Sonora Valley as well as in other neighboring valleys where rodents are occasionally the most frequent mammalian order encountered (e.g. P. N. García and Campos 2012a, 2012b). Even if the 24 specimens from the Moctezuma Valley identified only to the specificity of *small mammal* are included the relative frequency of rodent bones remains low. The paucity of rodent bones from the Moctezuma Valley is likely a peculiar function of preservation.

Family: Sciuridae

Provenience Son L:1:23

One squirrel bone was recovered from Teonadepa. Likely potential species include *Spermophilus tereticaudus* and *S. variegates* (Wilson and Ruff 1999). Both species are potential burrowers, thus making their association with archaeological contexts questionable. There is considerable ethnographic evidence of human subsistence use of ground squirrels (Pennington 1969:124). The relative ubiquity of S. *variegates* and its tendency to avoid the types of terrain that contain archaeological sites in the region led Olsen and Olsen (1981) to conclude it was a food resource in the Sonora Valley.

Order: Lagomorpha

Family: Leporidae

Genus: *Sylvilagus*

Provenience: Son L:1:23; Son L:2:1

The *Sylvilagus* assemblage includes five specimens. *Sylvilagus adubonii*-desert cottontail is the only likely species for this region of Sonora (Wilson and Ruff 1999). The only other possibility is *S. floridanus,* which inhabits the pine oak zone of the Sierra Madre Occidental. Cottontails follow a predator avoidance strategy of hiding in thick brush and thus prefer denser cover relative to members of the genus *Lepus* (Hoffmeister 1986; Vorhies and Taylor 1933). The species may thus indicate riparian zone hunting, which tends to be more vegetated relative to non-riparian zones (see Bayham and Hatch 1985).

Genus: *Lepus*

Provenience: Son L:1:23; Son L:2:1; Son L:2:22

The 17 specimens from *Lepus* sp. are likely predominantly *L. alleni.* This species, with a lesser number of *L. californius*, made up approximately 77 percent of the *Lepus* specimens identifiable at the species level in the Sonora Valley (Olsen and Olsen 1981). This was taken to indicate the Río Sonora zone had a vegetation cover of mesquite grassland. This is commensurate with the present conditions minus obvious recent anthropogenic alterations in the Moctezuma Valley. More in depth insights on the relative abundances of lagomorphs are offered below.

Order: Artiodactyla

Provenience: Son L:1:23, Son L:2:1, Son L:2:22

A total of 65 specimens were recorded as Artiodactyla. Most likely these are predominantly various species of deer, further discussed below. There is a chance that some correspond to *Ovis canadensis mexicana*-Mexican Big horn sheep or *Antilocapra americana sonoriensis*-Sonoran pronghorn. Today the *Pecari tajacu* collared peccary would also be a potential candidate, but most evidence suggests this species expanded its range in the historic period (Albert, et al. 2004; faunAZ 2014). Domestic animals including *O. aries* and *Capra aegagrus* cannot be categorically ruled out but were never major focuses of pastoralism in the area. *Bos taurus,* and *Bison bison* discussed below, would more likely be recorded as indeterminate *large mammal*.

Family: Cervidae

Genus: *Odocoileus*

Provenince: Son L:1:23, Son L:2:1

With 55 specimens *Odocoileus* constitutes the largest proportion of the assemblage identified to the genus level. More than likely the vast majority of those specimens coded as Artiodactyla, medium to large mammal, and medium mammal are also in actuality specimens from various species of deer. *O. hemionus*-mule deer and *O. virginianus*-white tailed deer are the most likely species. Both are still prevalent in the region today, although significantly overhunted and pressured by competition with domesticated species. The mule deer is perhaps better suited to surviving off the vegetation of the Sinaloan Thornscrub with its relatively marginal grasses and dominance of shrubs. Potential foods include ironwood, palo verde, agave (stalks), cholla, mesquite (beans) and catclaw (Leopold 1972:506). The relatively nearby oak woodlands (north of Nacozari) could potentially provide greater resources, but (Leopold 1972:504) notes that the desert subspecies of mule deer does not enter these areas even when the opportunity presents itself. Other variants do inhabit these regions.

Cabeza de Vaca (Adorno and Pautz 1999:235), the early accidental explorer, mentions the local inhabitants hunted three types of deer. In addition to the two already discussed the *Antilocapra americana sonoriensis*-Sonoran pronghorn seems like the most likely candidate, although this species would not be present in the immediate environs of the Moctezuma Valley. *Cervus elaphus*-elk is also a potential candidate. This species is not present in the Moctezuma Valley today and likely has not been for several millennia, but may have inhabited nearby upland regions. Today the closest range of elk is in northern Chihuahua where it was introduced historically. Two elk bones were recovered from a site in the Sonora Valley (Son K:4:24) (Olsen and Olsen 1981). The Moctezuma Valley being closer to the Sierra Madre Occidental, a potential prehispanic habitat zone, would seem likely to also occasionally have access to the resource. Only two sites contain prehispanic evidence of elk use in the entire state of Arizona, compared to 54 sites with evidence of pronghorn use (faunAZ 2014).

Family: Bovidae

Genus: cf *Bos, Bison*

Provenience: Son L:1:23, Son L:2:22

Specimens of cf *Bos, Bison* were present in buried deposits at both Los Mineros and Teonadepa. The Los Mineros sample makes up the vast majority with 32 out of 35 specimens. Almost all of these specimens come from the first level of excavated contexts with the exception of three pelvis fragments from a second level context. Today Los Mineros is utilized seasonally for cattle grazing but most contextual evidence suggests a historic age for this bone. At Los Mineros 12 specimens evidence burning, two present green bone breaks, and one evidences a butchering cut mark, many of these bones were clearly affected by onsite processing. Today the site is located at some distance from modern populations so it seems highly unlikely any modern butchering or consumption would take place on site. In contrast, the approximately 1890 to 1910 estimated period of historic use clearly contained domestic structures that would have processed animals on site. Both El Nogal and Teonadepa are also utilized today for seasonal grazing but did not produce the ubiquitously buried cattle bone seen as Los Mineros.

The three specimens from Teonadepa are much harder to explain. The bones are almost certainly from a singular proximal tibia. They were recovered from a well buried (level 3) deposit dated to A.D. 1430 +/- 60 (2 sigma). The midden fill was extremely rocky (~80% cobbles) and would likely prevent small burrowing animals and other disturbance processes. Given this context, is seems possible these specimens are *Bison bison.* Bison composed 5.6 percent of the species census at Paquimé with an MNI of 48 (DiPeso, et al. 1974b:248). Rare occurrences are also known from late period Hohokam contexts, such as University Indian Ruin in the Tucson Basin (Guo-Qin 1983).

Order: Perissodactyla

Family: Equidae

Genus: *Equus*

Species: *E. ferus caballus*

Provenience: Son L:2:1

Horse remains were recovered from what appears to be a pit that was intrusive to Feature 2, a cimiento structure at El Nogal. The edges were poorly defined and largely destroyed by the pits unfortunate location in the middle of a test trench placed across

Feature 2. The bones were mostly confined within this shallow pit. A total of 11 elements were present: two from a hind limb, one from a forelimb and the rest vertebral column elements. The bones were generally well preserved and appeared to be in situ. The diversity and context of elements suggest their intentional deposition. Five cut marks are visible on the sacral vertebrae, most perpendicular to the anatomical axis (Figure 7.3). Unfortunately no indications of cultural affiliation were present to suggest what group modified and deposited these bones. It is tempting to view them as resulting from Native practices, given a lack of evidence for any sort of Spanish or Mexican domestic occupation of the site. The location of the site very near the river valley suggests protohispanic Ópata, but Apache certainly cannot be ruled out.

Derived Indices

Although the assemblage is small, a number of standard indices still provide useful comparisons to better known regions, such as southern Arizona and the Mogollon of eastern Arizona. These indices are generally designed to provide a gross measure of subsistence practices. Due to a low *n* some analysis can only be performed at the project (valley) scale, when possible more specific site level comparisons are offered in the *inter-site* comparison sub-section.

Lagomorph Index

Because jackrabbits prefer more open terrain relative to cottontails a comparison of their frequencies is a useful indicator of landscape cover and potentially anthropogenic modifications of landscapes. This has given rise to many iterations of the Lagomorph Index (LI). A high number of *Sylvilagus* sp. suggests either little vegetative clearing or hunting in riparian zones with denser cover, which may include agricultural field areas. Alternatively a greater number of *Lepus* sp. suggests hunting in open terrain. A change over time to greater number of *Lepus* sp. is often interpreted to reflect increasingly cleared landscapes. The link between values of the LI and landscape modification maybe confounded by natural environmental variance, hunting techniques, or hunting preference for the larger *Lepus* (R. M. Dean 2007; Driver and Woiderski 2007). In the Sonora Valley the total assemblage[xviii] LI (*Sylvilagus*/*Sylvilagus*+*Lepus*) (*sensu* Quirt-Booth and Cruz-Uribe 1997) is .44 compared to .23 for the Moctezuma Valley. This figure potentially suggests a greater emphasis on non-riparian hunting (less densely vegetated areas), a preference for hunting the larger *Lepus* species, or alternative hunting methods compared to the Sonora Valley. It seems unlikely that there are significant natural differences in the actual frequency of the two species between the two valleys. In a pan-southwestern perspective both of these numbers are relatively low (cf Driver and Woiderski 2007). The long term sedentism of both river valleys could give rise to the sort of cleared and agriculturally controlled landscapes that are purported to favor *Lepus* (Szuter and Bayham 1989). The average height of vegetation and relative sparseness of ground cover brush outside of the riparian corridor of the Río Moctezuma would also likely favor *Lepus* without anthropogenic modification in most areas.

The relatively dense populations of the river valleys could also easily facilitate communal hunts, which tend to increase the capture rate of *Lepus* relative to *Sylvilagus* (Szuter 1991). There is of course an extensive ethnographic record on the hunting of all rabbit species in the Southwest that includes diverse methods such as traps, nets, snares, throwing clubs, dogs, and bows and arrows to name the most common (Pennington 1969:82, 123; Russell 1975). Dean (2007:20-21) also points out that due to their larger size and relative ease of capture *Lepus* sp. would be higher ranked resources. This interpretation is commensurate with data presented below that suggests the Río Moctezuma does not evidence a wide diet breadth. That is, there was little impetus to pursue a genus such as *Sylvilagus* with its marginal return rate.

Artiodactyl Index

The Artiodactyl index (AI) (Bayham 1979) provides a crude measure of the emphasis placed on large game relative to smaller, lower return rate animals. The index thus has the potential to provide a suggestion of resource stress, assuming lesser return rate animals are only collected once the encounter rate of higher ranked prey requires so much search time they become equivalent to more ubiquitous small prey (see Bayham 1977). The supposition that body size, especially on the order between deer and rabbits, correlates well with rank in the diet breadth has been repeatedly upheld (Broughton, et al. 2011). As with the LI, there are many potential confounding factors, for instance communal rabbit drives in which many animals are captured at once may provide return rates on par with capturing singular Artiodactyla. The curation and non-subsistence scavenging of large bones for tool stock is another potential cultural transformation processes that impacts assemblage composition (R. M. Dean 2005), but one that appears to affect the Moctezuma Valley assemblage very little. The AI is calculated by dividing the NISP of all Artiodactyls by all Artiodactyls plus all Lagomorphs (*Atriodactyla*/*Artiodactyla* + *Lagamorpha*)[xix]. For the

Moctezuma Valley assemblage the AI is .85. For the Sonora Valley it is the notably lesser figure of .66. The high AI for the Moctezuma Valley is not a function of disproportionate unidentifiable small mammal remains. Smaller vertebrate remains actually preserve better under many circumstances (Lyman 1994:397, 422). If specimens unidentified beyond the level of *medium* or *large mammal* are added to Artiodactyls and *small mammals* to Lagomorphs the ratio is even starker at .94[xx]. The apparently less dense human population (see Chapter 1) of the Moctezuma Valley, which would presumably entail less resource stress, may help explain this difference. The Moctezuma Valley is also spatially more proximate to higher elevations with presumably greater rainfall that could provide better habitat for Cervid species. The Moctezuma Valley index is also commensurate with the AI produced from two seasons of work in the Onavas area with a combined value of .95 (derived from data in Campos and García 2013; P. N. García and Campos 2012b). All indices are far above those reported for much of contemporaneous southern Arizona where Lagomorphs often constitute upwards of 80 percent of the NISP (R. M. Dean 2005:256). In the Mogollon region Dean (2001) interpreted AIs that increased across the Pueblo III/IV boundary, but of still lesser magnitude than those seen in the Río Sonora area, as indicating the emergence of social signaling through provisioning of communal events, such as feasting. In general, the AI of the Río Sonora region is well beyond that seen in the Mogollon region (e.g. Sanchez 1996).

Fragmentation Indices

Fragmentation indices indicate very intensive processing of the faunal assemblage. Tables 7.1 and 7.2 provides standard faunal counts for the entire assemblage and by site, including NSP, NISP[xxi], MNE, MNI. The summary fragmentation indices reflect substantial processing of remains (Figure 7.4), presumably for marrow extraction. There is a notable variance across the three sites. To some extent the low fragmentation at Los Mineros is the result of a small *n* and should be treated with caution. The differences between El Nogal and Teonadepa are likely reflective of true patterns in the intensity of processing. The MNE/NISP value approaches levels recorded for historic mission contexts in the Pimería Alta were grease rendering for tallow production was a critical component of the mission economy (Pavao-Zuckerman 2011). A slightly different method was utilized to calculate these values that produced figures of .12 and .10 for loci of Cocóspora and .32 for San Agustín; El Nogal would have a value of .095 and Teonadepa a value of .15 utilizing the same methodology[xxii]. This is a rather extreme level of breakage and suggests not only intensive marrow extraction but possibly grease rendering. Grease rendering is hardly a novel phenomenon, having been common since the Paleolithic (e.g. Manne 2014; Mateos 2005; Stiner 2005). However, it is not well documented in the Southwest U.S. or Northwest Mexico. The process is labor intensive (Lupo and Schmitt 1997), but is not necessarily associated with food stressed populations (Prince 2007). It is likely that most assemblages common to the broader region, which are often predominated by rabbits, as discussed above, simply did not provide resources that made grease rendering economically feasible under any conditions. While it makes intuitive since that the predominantly Artiodactyl assemblages of the Moctezuma Valley would provide a much more attractive target such speculation must be confirmed through further excavations and comparative studies. The storability of grease also may have made it an attractive resource, regardless of time investment.

The typical covariant markers of grease rendering, e.g. significant green bone breakage and many low utility elements are much more equivocal in the Moctezuma Valley assemblage. The practice of boiling for hours would have obscured much evidence of green breaks. Conversely, it may also be that some of the fragmentation of the assemblage is simply the result of the same post depositional forces that so highly fragmented the ceramic assemblage. This explanation is not preferred as a mechanism to explain the overall fragmentation of the assemblage, which is composed predominantly of dense artiodactyl long bones that would likely be much more resistant to fracture than most ceramic artifacts. The complete absence of any large specimens, aside from the historic horse remains, is also indicative of fairly systematic processing. Only 64 (6.7 %) of specimens in the total assemblage clearly evidenced indications of green bone or spiral break fractures (Table 7.3). A much greater proportion (57 %, *n* = 537) showed evidence of being exposed to heat/burning or other activities that induced discoloration. Of these 36 percent (*n* =341) evidenced some level of calcination. In general, these numbers also suggest a fairly high degree of processing. Burning is obviously not systematically associated with grease rendering, since it takes place through boiling, but refuse bone may have been regularly thrown into fires after processing.

Inter-site Assemblage Variation

There are fairly stark differences in the distribution and diversity of genera/species. Tables 7.1 and 7.2 present the MNI of the three sites together. Los Mineros has significantly fewer faunal remains overall with a density of only 1.16 identifiable non-historical, non-commensal specimens per m^3 excavated, compared to 18.1 for Teonadepa and 13.1 for El Nogal. There is no obvious biasing of excavated contexts that should produce this difference and it appears evident that more animals were procured, or procured in a manner that left their osseous remains at Teonadepa and El Nogal. Due to the low *n* it is hard to discern much more about Los Mineros. There are other notable differences between El Nogal and Teonadepa. The LI for Teonadepa is .18 and for El Nogal .30. The small *n* make these ratios of dubious relevance, but the numbers are inline with what might be expected. As described in previous chapters the region around El Nogal has extremely dense vegetation, owing to the surface bedrock that traps moisture near the surface. This would likely be a more conducive environment to *Sylvilagus* sp. and is a more likely explanation than variable anthropogenic modifications of the landscape. The AI is higher for Teonadepa, .88 compared to El Nogal with .78. Fragmentation is notably higher at El Nogal (see Table 7.2). There is less evidence of green bone breakage (Table 7.3) at El Nogal, but again this is likely due to the fact that the assemblage is so fragmented that such modifications were harder to consistently identify. Burning, which is easily identifiable on all but the smallest fragments is much more prevalent at El Nogal. The frequency of burning should scale proportionately regardless of fragmentation, suggesting there is a real difference in its frequency. A large proportion of the highly fragmented bone from El Nogal, and thus a disproportionate amount of the NSP, does come from a single test pit into terrace fill. However, this appears to be a midden context and if anything is likely more representative of disposed bone at the site. The deposit is also likely analogous in function to Feature 31 at Teonadepa, which did not produce such an assemblage. Of course, at all sites deposition of trash over the mesa edge was likely a common practice, especially for odor producing trash. This may give rise to the relatively small size of the assemblage overall.

Biomass indicators are much harder to discern given the relatively low *n* of all species except Artiodactyls. Table 7.2 provides an estimate based mainly off the early work of (White 1953); the split values provide estimates with and without the equivocal *B. bison* remains included. This approach has been heavily criticized (Grayson 1979), and obviously makes many assumptions about resource transport. At Paquimé (DiPeso, et al. 1974b) an iteration of this method was used to claim *B. bison* were the predominate source of protein. Any other method of faunal counting would not reach this same conclusion.

Table 7.4 provides a measure of Shannon's diversity index and the equitability or evenness index. As can be seen, there is some difference between Teonadepa and El Nogal. Typically this might be interpreted as indicating that Teonadepa had a broader diet and therefore was subject to more resource stress. However, what is actually driving these scores are the rare occurrences of species that were either rare and/or prestigious additions such as cf. *Bison* or species that were unlikely to be utilized as food, but may have served as the raw materials for important and valuable implements, e.g. *Felidae* pelts, or bird wings.

In actuality, the data suggest that Teonadepa was less pressed in terms of subsistence resources. This is indicated by the greater abundance of Artiodactyls, the greater overall density of faunal remains, and less fragmentation of the assemblage. Teonadepa may have also had a greater number of non-subsistence, potentially significant material items made from animal products as indicated by the diversity indices.

Some of these observations can be considered in light of the limited ethnohistorical accounts. Perhaps the most well known anecdote from the exploration era is Cabeza de Vaca's description of an offering of 600 deer hearts at the pueblo they subsequently dubbed *Corazones* (Adorno and Pautz 1999:235). Obviously, it is somewhat of a stretch to infer from the half dozen deer represented by the MNI's in this analysis that such practices were common. It is, of course, likely that if game such as deer were extremely prevalent then full carcasses may not have been transported back to sites. The data with its paucity of small hard to catch or otherwise low kcal return rate species suggests abundance or at least sufficiency was the standard and that deer and related species did indeed fulfill an abnormally high role in the diets of regional inhabitants. The fact that intensive marrow and perhaps grease rendering took place should not be taken as evidence of subsistence stress (Prince 2007).

Bone Tools

Curiously, bone tools were essentially absent from the assemblage. As indicated by Table 7.3, a handful of specimens were polished, or showed some other signs of use, but these were universally fragmented and in a generally poor state of preservation. Most were probably fleshing or scraping devices (Figure 7.5). Only one fragmented specimen from Teonadepa appeared to be a potential hairpin or awl fragment. Given the prevalence of Artiodactyls in the assemblage, ample tool stock must have been available. It seems likely the absence of tools in the assemblage is largely an oddity of sampling, rather than an indication of their true rarity.

Conclusion

The data set provides another case study in the variance within the Moctezuma Valley. Both Teonadepa and El Nogal both followed roughly similar procurement strategies, but there are some hints of differential access to Artiodactyls and other species, and perhaps even some indications of alternative food ways. In contrast to some other classes of material, the faunal assemblage more closely resembles that of the Sonora and other surrounding valleys. The overall low regional variance is unsurprising since faunal material is obviously much more constrained by the relatively homogenous environmental setting. There may be some differences, as suggested by AI comparisons, indicative of local variance in ecological conditions between valleys. When considered in conjunction with suggestions of higher populations in the Sonora Valley there is a potential that the Moctezuma Valley was relatively more flush with protein resources. Comparisons with regions such as Paquimé are largely obfuscated by variable analysis and faunal counting methods.

Within the valley Los Mineros is set apart, and was characterized by a much less dense occupation or had considerably less access to game resources. Based on the preponderance of evidence from this data set and previous chapters a less dense occupation seems like the larger factor. In regards to Teonadepa and El Nogal, the former appears to have had greater access to higher ranked resources and rare fauna. The use of wasp larva for food at El Nogal is also unique. There is also some further suggestion of differences in food ways as evidenced by variable levels of processing large prey. Specifically, there is less fragmentation and evidence of burning at Teonadepa. As stated above, these lines of evidence do not indicate variable amounts of food stress. Both sites had a very narrow diet breadth and relied almost exclusively on large prey. It is possible, though, that Teonadepa had access to some larger or better Artiodactyl hunting grounds or followed a strategy of more regularly pursuing such resources. Teonadepa residents also may have simply put less effort into producing the more storable products associated with grease rendering. These interpretations are consistent with the higher proportion and greater variability of chert stone tools found at Teonadepa, which may reflect more trips to extra-valley procurement zones. The presence of the one potential *Bison bison* element also indicates potential access to ecozones or trade contacts not shared by El Nogal. Further excavation to produce a larger sample size from more variable contexts would clearly be desirable.

8. Other Analysis

This brief section presents data on material classes not covered in previous chapters including shell, items of adornment, and historical artifacts. Both the shell and other adornment data, though limited, once again highlight the manifest differences between Teonadepa (Son L:1:23) and El Nogal (Son L:2:1). In contrast to many previous trends there is some evidence that El Nogal had more access to shell resources, although the very small *n* makes any assertions tenuous. The adornment data suggests cultural differences in styles of dress, a common signifier of both horizontal and vertical stratification (Feinman and Neitzel 1984), but again the low numbers of specimens are problematic. These data do provide a framework of associations to be tested in future research.

Shell

The shell assemblage is most notable for its sparseness. Only 19 specimens were collected, spanning five identifiable genera (Table 8.1). All of the shell specimens were likely items of adornment (Figure 8.1). Bracelet fragments are the most common, but two likely tinklers, one shell ring, and one bead were also recovered. Fragments of shell debitage of *Pecten* and other bivalve genera, not present in the identifiable finished products assemblage suggest some few other forms of jewelry were manufactured but not recovered. Given the lack of identifiable working on these pieces simple pendants or unworked raw materials are the most likely artifact type classification. The reuse of one *Glycemeris* bracelet fragment as a pendant suggests that shell material was rare enough that it retained value even in recycled form. A similar reused specimen is present in the artifacts recovered from the Sonora Valley.

Inter-regional Comparisons

Dress, including jewelry, is one of the most salient conveyors of social information (Feinman and Neitzel 1984:57). Unfortunately, few elements of dress or adornment survive in the archaeological record. As a result, despite the smallness of the assemblage some important clues to aspects of social identity are provided by the shell artifacts not available from any other material culture category. The sparseness of the Moctezuma Valley shell assemblage stands in direct contrast to nearly all surrounding regions. In the Onavas valley one season of excavation of one domestic structure produced more than twice the shell collected during the excavation in the Moctezuma Valley (P. J. G. Martinez 2012:145). This was in addition to over 200 pieces collected from a funerary mound. The prevalence of shell in the Hohokam and Trincheras regions is extremely well documented (e.g. McGuire and Villalpando 1993; E. Villalpando and McGuire 2009). Casas Grandes is also well known for its stockpiles of shell with nearly 4 million specimens (DiPeso, et al. 1974d:401), but sites in its near hinterland often contain little to no shell (Whalen and Minnis 2009:see Table 8.2). This pattern likely reflects poorly understood aspects of the Paquimé political economy.

The paucity of shell in the Moctezuma Valley is likely indicative of a general lack of participation of any appreciable significance in certain social networks. Together the Hohokam, Trincheras, and Serrana (heavy shell use regions) span the historic distribution of O'odham speakers, providing one possible indication of the potential social and economic boundaries that may have also existed in the prehispanic era. How shell was transported from these regions or others that border the Sea of Cortez is an open question. It would seem that the shell routes to Paquimé did not include the Moctezuma Valley. Some more thought will be given to this question in subsequent chapters. The remainder of this section will focus on the production and form of finished specimens as indicative of affiliations and the meaning ascribed to particular forms based on analogy with surrounding regions.

Several scholars have suggested that shell jewelry among the Hohokam may have been one marker of group identity or even religious affiliation (Bayman 1996; Gumerman 2007:145; Marmaduke 1993:651; McGuire and Howard 1987). The ubiquity of *Glycemeris* shell bracelets in particular seems to suggest a nearly universally accessible social valuable that served as a badge of membership. *Glycemeris* bracelets are also ubiquitous in the Trincheras region but it is unclear if the items carried the same indexical meaning in both areas. Minimally the use of similar forms of jewelry implies a deep connection between the Hohokam and their southern Trincheras neighbors (D.E. Doyel 1991:244). Much has been made of the differences in the *chaîne opératoire* of bracelet manufacture; grinding, chipping, grinding, as opposed to incising grinding for the Hohokam and Trincheras respectively (E. W. Haury 1976:306; McGuire and Howard 1987:120). This certainly demonstrates one area did not provision the other with finished products, but it is still possible that similar concepts were signaled by similar items of adornment. The production sequence of *Glycemeris* bracelets at Casas Grandes is less clear but may have made use of both techniques or a third that involved only grinding (DiPeso, et al. 1974d:494). Even less is known of the Serrana region, to the south of the project area, but it does appear a sequence similar to the Trincheras mode of manufacture was followed for shell bracelets (see Garcia-Sanchez 2010:218-219). None of the pieces classified as debitage from the Río Moctezuma assemblage are clearly the result of on site manufacture of shell bracelets and are equally likely to be fragmented pendants of whole shells or other items. At present it remains entirely possible, and maybe even likely, that shell bracelets were only imported as completed objects to the Moctezuma Valley.

Less can be said of the other recognizable forms in the Moctezuma Valley assemblage. Two specimens were identified as *Conus* tinklers that are similar in form to specimens known from throughout Northwest Mexico (cf DiPeso, et al. 1974d:467). However, the Moctezuma specimens lack thread attachment holes. The distribution of *Conus* at The Cerro de Trincheras suggests it may have been an elite controlled item (V. D. Vargas 2004). One *Vermetidae* bead is also present in the Moctezuma assemblage (cf DiPeso, et al. 1974d:410), but is generally unremarkable as an isolated find. Lastly, an intact shell ring is the singular example of an unbroken, non-recycled item of adornment. Such specimens are also known from across the surrounding region, but are mostly lacking from Paquimé with only one mosaic covered specimen recovered (DiPeso, et al. 1974d:511). The shell assemblage thus reflects a highly erratic composition of items from many surrounding traditions. It seems that local groups were happy to be afforded access to whatever pieces happened to be available but did not have any kind of regular access to shell producing areas or middlemen

Inter-site Comparisons

The assemblage is far too small to make any conclusive statements but a few patterns are worthy of note to test against future research. In contrast to most other classes of material culture that might be considered social valuables (Spielmann 2002), or even rare raw materials, El Nogal has a slightly larger assemblage than Teonadepa. This is true both in terms of genera of raw material and finished implement form. The exotic ceramic assemblage of El Nogal was more aligned with Trincheras or Serrana groups relative to Teonadepa (Chapter 4). This could indicate a greater connection, however tentative, to these areas of more prevalent shell consumption in the south and west.

Other Adornment Items

Again the sample size is far too small for definitive statements but there are hints at patterns that should be kept in mind for future research (Table 8.2). The site of El Nogal produced two beads, likely made of bone, that are somewhat unique (Figure 8.2). Both specimens were likely made out of dense portions of mammal long bone, are generally symmetrical and, biconically perforated in the center. In contrast, most bone beads in the wider Northwest/Southwest region are made from naturally hollow bird bone or perforated pieces of flat sections of long bones (cf DiPeso, et al. 1974b:49). One of the El Nogal specimens retains a luster and may actually be executed on tooth or fossilized bone. One other specimen (not pictured) also from El Nogal may have been a bead blank disc for a more standard form of perforated mammal long bone.

Excavation at El Nogal also produced what is most likely a lip or ear plug. The plug material could not be definitively identified due to its small size but it is either ceramic or bone. Such adornments are rare across the Northwest/Southwest.

Turquoise artifacts were extremely sparse with one bead each from Teonadepa and El Nogal. One other piece of turquoise debitage was also recovered on the initial site survey of La Cuchilla (Son L:1:6). The overall paucity of turquoise is itself interesting, given previous suppositions that all the major river corridors of Sonora served as conduits for this stone to Mesoamerica (Weigand 1977). The low amount of turquoise is also extremely odd given the proximity of the modern copper porphery mines of Nacozari and Cumobabi. Since turquoise tends to only form near the surface (~30m) it seems highly unlikely there were no accessible exposures of this material in the region. The only other groundstone adornments were a minimally altered pendant of red argillite from Teonadepa and a very small bead from El Nogal of unknown material that is similar to small beads from across the region.

Historic Artifacts

The project did not intentionally target historic period contexts with the exception of Feature 16 at Los Mineros (Son L:2:22). Sites recognized on survey of a known historic age are listed in Appendix D. Many of these are multicomponent, and a few were inhabited well into the 1900s. This obviously complicates not only the discernment of the prehispanic component, but also the establishment of the earliest historic occupance. The paucity of artifacts dating to the 1600 and 1700s suggests most sites were not occupied during this interval. This is hardly surprising, given that missions would have encouraged an alteration of the Native settlement pattern in order to concentrate labor under their purview (Radding 1997). Within the survey area the modern towns of Cumpas and Moctezuma almost certainly obscure most of the locations of 17th and 18th century settlements. However, there were probably scant few artifacts of diagnostic European origin present in eastern Sonora at this time, so too much should not be read into their absence from any given context. Figure 8.3 provides a sample of some of the recovered historic diagnostic items, mostly dating to the late 1800s and early 1900s (Table 8.3). By this time regional populations had clearly gained quasi-regular access to the global economy and European made goods begin to show up in even remote settlement locations.

A few of the more unique and/or diagnostic artifacts are worthy of some description. A Frozen Charlotte doll head was recovered from Feature 16 at Los Mineros and dates the structure to ca. A.D. 1860-1900. This is the likely date for all of the historic structures with stone foundations recorded at this site.

A polychrome Majolica sherd was found at Badehuachi (Son L:1:16) that dates as early as the first decades of the 1800s. The historic component of Badehuachi was likely an isolated rancheria. It is unclear if the prehispanic/protohispanic features at this site indicate continuous occupation.

The historic habitation site of La Galera (Son L:1:7) contained numerous pieces of both European porcelain wares and locally produced ceramics. Structure foundations at the site included continuous stone forms but also included lines of rocks not categorically different from prehispanic river cobble cimiento styles. A small collection of potentially diagnostic artifacts suggests an occupation primarily between the 1870s to 1910s. Deteriorated plastic flowers placed on a nearby mounded stone grave suggest the inhabitants remained in the recent living memory of local residents, but queried individuals had only a vague notion that the place was inhabited in the 1800s.

Three large, hand forged nails of different sizes were discovered at El Nogal. They appeared unused and likely reflect an accidental loss. As noted in the site description sections, some of the piled walls at the site are almost certainly historic in age.

European Materials in Native Contexts

There are three examples of materials that are of European origin repurposed in Native material culture industries. Two of these are flaked bottle glass recovered from the surface of Teonadepa (Figure 8.4) and El Nogal. In both cases several specimens were found within close proximity of each other in one localized area of the site. These specimens seem to suggest the arrival of European goods was likely a slow process at first, since they appear as recycled goods rather than used in their originally intended roles. However, flaked stone materials often remain in the tool kit of Native groups long after contact for a variety of social and economic reasons (Silliman 2003), so too much should not be made of the continued use of flaked glass for cutting relative to metal implements.

The last item of note is a metal pendant, probably of lead or zinc, found at Los Mineros. There is a slightly raised cross on the specimen (Figure 8.4). Metal objects would undoubtedly have been of some interest to local inhabitants whose only prior exposure would have been very rare copper items, such as a bells from West Mexico (V. D. Vargas 1996). When Cabeza de Vaca (Adorno and Pautz 1999) was nearing the northern limit of Spanish influence while heading south in the mid 1530s he witnessed a Native wearing a horse shoe nail as a pendant. The crudeness of the Moctezuma Valley pendant suggests the material and not the form were what delineated it as an item worthy of serving as adornment. The implement is fairly corroded so little can be said of its origin or method of manufacture. It was recovered from the first level of Feature 10, which dated significantly prior to contact, suggesting the specimen had been displaced or lost long after the structure was abandon. The nearby structure of Feature 18 possibly dates as late as the mid 16^{th} century and is commensurate with this find.

Conclusions

This limited data set provides some insights to local variation in access to a variety of materials. Most notably both shell and turquoise appear to be quite rare. The latter is rarely ubiquitous at any site, but given the proximity of modern mines the total collection of only three specimens seems odd. Similarly the fact that the Moctezuma Valley was apparently outside the major conduits of shell exchange is quite intriguing. This has some relevance to previously proposed exchange routes discussed in future chapters. The general distribution of artifacts is also noteworthy. In contrast to many other rare goods El Nogal actually had a greater access to shell than Teonadepa, but caution is warranted due to small sample sizes. The limited number of items of adornment also potentially suggests differences in the material manifestations of signaling aspects of cultural identity at these two sites. Further research will be required on this point. The historic artifacts serve as useful diagnostic markers for the arrival of European goods. The near complete absence of any items dating to the sixteenth to eighteenth centuries may be notable.

9. Rock Art

The study of rock art is an undeniably subjective process fraught with the potential for the interpreter's bias to unduly skew interpretations. This caveat aside, it is also one of the few windows provided into certain realms of behavior that are often difficult to elucidate from other material culture data. Rock art researchers often assume shamans and religious specialists were the principal creators of images (e.g. Whitley 1992, 2000). There are many pitfalls, however, with the assumption that meaning of major significance is inherent in all works. While shamans (or other religious specialists) may be responsible for a majority of depictions, imitation by children or other cultural novices may also be present in close proximity. The abstract nature of many symbols, regardless of the executer, also lends itself to many possible interpretations.

Deriving accurate interpretations of meaning from such culturally specific content is obviously not possible in many cases. Rock art researchers often argue abstract forms may be the result of phosphenes, possibly accentuated by psychotropic substances or other conscious altering stimuli (Lewis-Williams 2001), such as those often employed by shamans. There is strong evidence that the basic forms of phosphenes are biologically hard wired phenomenon shared by all humans. Obviously little information is gained by noting the presence of phenomenon that are a priori assumed to be shared by all humans. Substantially different emic meanings are ascribed to the universally common suite of phosphenes. Barring access to living informants any attempt at interpretation must rely on either ethnographic analogy with groups that shared in the same symbolic system (Layton 2001) or limit analyses to depictions that demonstrate obvious contextual relationships between elements and employ symbols that are directly representational of an ideational component and/or referent (*sensu* Saussure 1916). There are no available Ópata or Eudeve ethnographies that would be useful in this regard. Ethnographic analogies with surrounding groups are occasionally possible but obviously of questionable relevance. These conditions limit analysis to widely shared cultural elements and the few cases where the contextual approach is feasible.

Archaeologists can obviously also make use of the distribution of symbols to gauge participation in networks of shared symbol employment without understanding their intended meaning. Some caution is, of course, warranted even in this more simplistic analysis. Some symbols are near universal, perhaps stemming from biological universals such as the perception of phosphenes, and more problematically symbols can also be appropriated from contact with exterior groups and assigned a wholly different meaning. In such instances the employment of similar symbols suggests only exposure and not strong social interaction nor adherence to identical ideological concepts.

This brief section will attempt to elucidate both sorts of information, group affiliation and meaning of content, from the corpus of works discovered in the Moctezuma Valley. The first section will present a rather simple comparison of images seen in the Moctezuma Valley to surrounding regions as a means of gauging potential affiliations and sources of influence. The basic result of this study is that Moctezuma Valley groups did not substantially employ content also recorded in better studied regions. The second section presents a somewhat less grounded approach to deriving meaning from the content of a few of the more impressive works recorded in the Moctezuma Valley. This analysis is primarily focused on a few panels in which enough contextual information is provided by the relationship between elements that some tentative assessment of meaning can be attempted.

Appendix I contains an inventory of all rock art recorded on survey and should be consulted to compare the described imagery. A total of eight sites were recorded that had at least one petroglyph present. Three sites were located in arroyo settings La Cañada de la Cueva (Son L:1:9), Cajón de los Deargüelles (Son L:2:13), and La Cañada de los Gatos (Son L:2:38). These sites were all located through the aide of local ranchersLa Cañada de la Cueva and Cajón de los Deargüelles were previously recorded by INAH personnel who located them with an identical methodology. Two sites, La Presa (Son L:2:42) and Parababi (Son L:2:35), contain only a single panel. The discovery of all of these sites was fortuitous since they were not located on the landforms targeted by the survey. It seems likely that other isolated panels could be present in the region. The greatest concentration of rock art was located adjacent to a habitation area along the steep, high, basalt mesas south of modern day Moctezuma, and includes El Nogal (Son L:2:1), El Corral (Son L:2:17), and La Volanta (Son L 2:39). Similar landforms are located south of the survey area, and it seems likely more petroglyphs could be found if further survey work was conducted in this region (César Armando Quijada 2014). Basalt rocks are relatively rare in the survey region north of modern day Moctezuma. As a result, most petroglyphs found north of El Nogal are executed on rock that provides less visual contrast. The limited number of petroglyphs north of El Nogal is likely at least in part due to this lack of suitable mediums. The only other concentration of any appreciable size is La Cañada de Los Gatos, where petroglyps were executed on a soft ignimbrite deposit. This relatively scant distribution means few meaningful comparisons can be made between different portions of the survey area.

Regional Comparisons

Abstract geometric designs, especially spirals and concentric circles, are the most common art form present and reflect broad stylistic and symbolic repertoires common to much of arid North America including the southern United States. Some of these, such as simple dots, circles, and squares are not too dissimilar from the geographically broad Archaic traditions, such as the Chihuahuan Polychrome Abstracts (Turpin 2001:381). But the presence of other, clearly later depictions alongside such examples with no evident difference in patination suggests these similarities are coincidental. Generic forms, such as spirals, are also common throughout the Neolithic period of arid North America and little can be made of their presence in the Moctezuma Valley.

More elaborate geometric forms, particularly *blankets* appear to be a meaningful motif, as suggested by their repetition in the project area. This style is characterized by a rectangular shape with internal geometric designs usually in the form of nested chevrons or rectilinear spirals. Examples include (Son L:2:39-15; Son L:2:13-5; and Son L:2:38-13). The motif takes its name from a passing similarity to woven blanket designs. A smaller and more eroded example is present at Son L:2:1-81. Similarly, the very elaborate design of Son L:2:1-76 could fall into a more inclusive categorization of the blanket motif. Two more examples of this form were executed to either side of the depicted image, but were too eroded for accurate recording. Pictoglyphs of white and red pigment very similar to the chevron blanket style are present at a site in the San Miguel Valley near Cucurpe (Figure 9.1) and suggest an obvious shared artistic tradition. More geographically distant examples are far more tenuous, but a potential link could be made to the decorations on the square body portions of Tlaloc figures in the Jornada Mogollon region (Schaafsma 1992; 1999:Figure 12.10).

Another repeated symbol, here named the *washboard*, is present at both El Nogal (Son L:2:1-72 and -90) and La Cañada de los Gatos (Son L:2:38 -14 and -15). It consists of a rounded rectangle with internal divisions and usually with inward curving *ears* at the top. The referent of these depictions is unclear, but an item of clothing, such as a breastplate, seems possible. No examples are currently known outside of the Moctezuma Valley. Lastly, one depcition at El Nogal very loosely resembles an artistic style that could be taken as Mesoamerican (Son L:2:1-14-16) with flowing scrolls, but this is a highly speculative assertion. At most the depiction suggests familiarity with a style of design and not shared use of symbolic content.

Zoomorphic depictions in the Moctezuma Valley are decidedly rare. Quijada has noted a similar absence in the nearby Tepache area (César Armando Quijada 2014). Table 9.1 lists all 13 examples. Zoomorhps seem to be more common in all neighboring regions. The depictions from the Moctezuma Valley are passingly similar to those from the Trincheras, Mogollon, and Hohokam regions, but the similarities may result from nothing more than the same intended referents. The open mouth form, with a distinct lower jaw (e.g. Son L:2:1-83), of several Moctezuma examples does not seem to be commonly documented in other regions. The Moctezuma examples are clearly different from the Jornada Mogollon style, which often have a triangular head and a patterned body (see Bostwick 2001:424). Moctezuma examples likewise lack the distended stomachs common to many Trincheras area examples (see Bostwick 2001:420), but the use of simple parallel lines to represent antlers are similar to some examples from this region (see Son L:2:1-126).

There are good number more anthropomorphs in the Mocteuma Valley corpus, but again their form does not appear similar to better known regional styles. The most common anthropomorph style of the Moctezuma Valley is a blocky body form that lacks any elaboration, such as hands, feet, or facial features. Triangular or hourglass forms are completely lacking. Such hourglass forms are common from chronologically later by geographically overlapping nomadic groups, such as the Dine, and some rare semi-contemporaneous but geographically distant Hohokam figures (Bostwick 2001:416, 437). Equally lacking are stick figures or representationally accurate depictions (see Bostwick 2001:424, 430). This would seem to suggest little influence from other contemporary population centers, such as the Río Grande Pueblos or Jornada Mogollon. A blocky body form, very similar in style to Moctezuma examples, is present at the site depicted in Figure 8.1. A singular panel (Son L:2:1-50) in the Moctezuma Valley contains an apparent human-insect therianthrop or an individual in an elaborate headdress that is also extremely similar to the San Miguel example. Notably, two previously recorded pictoglyph sites much closer to the project area have wholly different styles. A rock shelter/cave site located in the low rugged foothills of the Los Hoyos Ejido is predominated by simple stick figures, many with pronounced phalluses (Figure 9.2). Alternatively an open air site located high in the Sierra La Madera, depicts a variety of forms, the most impressive executed in negative paint. This site is almost certainly historic as indicated by a quadraped that is likely a burrow and several Christian crosses (Figure 9.3).

Element Interpretation

Working on the assumption stated above that most rock art depictions are related to shamanisitic activities it might be expected that the roles shamans play in a society would be depicted. Obviously there is slim evidence for the character of prehispanic, Río Sonoran shaman roles. Historically the Moctezuma Valley maintained a form of Catholicism similar to the syncretic style described for the Yaqui and Mayo regions, which included some well documented elements of prehispanic ritual content. The Yaqui and Mayo areas are Cahitan speaking, which is the same larger family to which Ópata belongs, and thus a cultural connection is possible. Based on this admittedly slim evidence, one class of depictions does potentially stand out as indicative of religious specialists as suggested by ethnographic analogy. At least three such instances are identifiable of likely anthropomorphs with antlers protruding from their heads (Son L:2:1-34, Son L:2:39 -12 and-19). The morphology of these figures may represent a prehispanic or protohispanic version of a deer dancer. Deer dancers are ubiquitous in the ethnographically observed ritual ceremonies of Cahitan populations (T. J. Sheridan and Parezo 1996; Yetman 2010). Minimally, it seems likely these figures are representations of shamans or other ritually important persons wearing headgear adorned with horns or antlers or undergoing a therianthrop transformation.

Other seemingly obvious ideological content pertaining to the prehispanic period is limited to the few examples of anthropomorphs blended with seemingly animal features. Examples include Son L:2:1-50, mentioned above for its similarity to a San Miguel pictoglyph, both with apparent antennae; Son L:2:1-102 with a single horn appendage attached to the head, Son L:2:1-130 also with antennae and a proboscis and what appears to be a shield in hand, and Son L:2:1-146 with a very long tail and overall form reminiscent of a monkey, which are obviously not indigenous to the region.

Therianthropy, or human to animal transformation, are common elements in shamanisitic lore and appear in rock art as early the Upper-Paleolithic of Europe. The associated ideologies are diverse but often involve a shaman taking the animal form while in a dream state to facilitate the acquisition of important knowledge. It is of course also possible that the images do not reflect benevolent forces. The subject of Son L:2:1-130 obviously appears menacing with shield in hand, but whether the image depicts a benevolent warrior personification or enemy is wholly unclear. Notably much of the rock art including Son L:2:1-49 and -50 were executed in locations very difficult to access such as cliffs faces, adding an inherent air of dangerousness to the subjects.

Little can be said of the interpretation of most other anthropomorphs. Almost all of the subjects are standing or are in motion (Table 9.2). Dancing seems like a probable interpretation for many subjects, but others interpretations are certainly possible. Two figures from La Cañada de los Gatos (Son L:2:38-2 and -3) may be anthropomorphs of a different artistic, possibly temporally later, tradition. This is a very tentative suggestion and is particularly questionable for Son L:2:38-2. One panel, Son L:2:1-55-61, depicts what might be a formation of dancers. A single individual (61) stands apart, and may be playing a special role in the event. It is also possible some other type of event is taking place, ethnohistoric accounts make mention of troops moving in formation (Obrégon 1928:160), which seems plausible for the depiction if the unique figure is a leader of some type.

The one panel that depicts multiple zoomorphic (Son L:2:1-81 to -88) figures also contains two anthropomorphs. One of these figures is of the standard blocky type, but the other (81) is a relatively unique square bodied, thin limbed individual that may be holding an instrument, such as a staff. The individual (likely male) appears to be interacting with the diverse set of animal species in some manner. This panel may reflect some other aspect of a therianthropy experience or perhaps a shaman treating with animal spirits on the behalf of his people. Animal deities are of course common to many Native American traditions.

Overall the paucity of zoomorphs relative to other regions is curious. Explanations regarding zoomorphs as reflecting sympathetic magic are of course common (Grant 1968; Heizer and Baumhoff 1959). One possible explanation for the lack of depiction might be a lack of need for such mystic intervention. The ethnohistoric accounts suggest deer and game were extremely abundant and easily procured. If this was the case, and there was little subsistence risk of failure in regards to hunting, it might be expected that rituals involving hunting would become of lesser importance. In general, activities that are mundane or involve little chance of failure are less prone to becoming focal points of religious behavior (Malinowski 1926).

Lastly, a few symbols require no elaborate explanation as they clearly date to the Hispanic period and reflect Christian themes. Two crosses from La Cañada de los Gatos (Son L:2:38-18 and -21) are particularly impressive. Their execution in this remote location adjacent to prehispanic content, including blanket and washboard motifs, may reflect an unbroken continuance in the ritual saliency of the location and perhaps even in the cultural affiliations of the artists. A similar, but less clear case, could also be made for La Cañada de la Cueva, which is today a modern shrine, but also exhibits petroglyphs of probable prehispanic origin.

Conclusion

This analysis of Moctezuma Valley rock art took two overlapping approaches. The first was geared toward simply comparing the distribution of identifiable symbols and patterns as a means to gauge the breadth of certain social networks in which ideological content might be shared. Most likely to the extent that such a region could ever be discerned its borders will be decidedly fuzzy. At present, little evidence of any kind could be found that the symbols important to the artists of the Moctezuma Valley were shared beyond the already accepted boundary of the Río Sonora archaeological tradition specifically the San Miguel Valley to the west. And there was considerable variance even in this comparison. This is perhaps hardly a surprising find given that other artifact classes that often carry similar symbolic content also did not seem to penetrate the region. For instance, there are no Salado ceramics in the region and only very limited evidence of the Casas Grandes traditions, the few examples of the later lacking any of the elements that are taken to be indicative of ideological content, such as macaw or Quetzalcoatl imagery. Likewise, the rock art of the region contains no feathered serpents, Katsinas, nor Tlalocs. There are, however, indications that this region was not without its symbols. For the time being they remain largely the subject of pure speculation, but perhaps hint at some other geographically broad prehispanic belief system that is still unrecognized in the Northwest/Southwest. The region of modern day Yaqui and Mayo groups, fellow Cahitan speakers, seems like the most logical place to search for other exterior connections.

10. Chronology

This section outlines the current progress on establishing diagnostic markers of temporal affiliation in the Río Sonora region and discussing the chronological associations of the specific features targeted in the recent research. The first relevant chronological framework for the region was proposed by R. Pailes and based on data collected near the Río Fuerte. The relevant portion of the sequence began at around A.D. 700 with the appearance of incised wares. Doolittle working much closer to the current project area in the Sonora Valley proposed a simple Early, Transitional, Late chronology beginning around A.D. 1000 and with divisions around 1200 and 1350. This chronology is based principally on the presence of above ground architecture, which is problematic since houses-in-pits persist throughout the sequence. As such, later sites can be identified, but sites that were occupied in both the Late and Early period are hard to distinguish. A chronology has also been forwarded for the Bavispe Valley. In this region the presence of foreign, better dated trade wares aides the situation. Most other material cultural markers, such as surface structures and obsidian tools, are problematic for reasons of non-exclusivity. Table 10.1 presents the characteristics and relevant citations for these tentative chronologies.

These analyses will both provide a new corpus of dates based on ^{14}C and luminescence samples and apply new mathematical approaches to previously obtained dates from eastern Sonora. A more refined architectural sequence is provided, but this class of material culture remains problematic when used in isolation. Some tentative date ranges are also offered for a variety of decorative ceramic techniques in the region. Due to small sample sizes considerably more work will be required before these can be accepted as representing the entire date range of a given decorative technique or style. The ranges do, however, suggest that the southern Sonora chronology of R. Pailes is not entirely applicable in the central eastern Sonoran valleys. The general picture that emerges is that researchers in central eastern Sonora have mainly encountered occupations in the post A.D. 1100 period. A strong case is made that the three excavated sites in the Moctezuma Valley were near contemporaneous with the bulk of occupation between A.D. 1250 and 1550. Previous occupation presumably was predominantly located in areas subjected to more obfuscating formation processes that inhibit the identification of sites. Occupation in the active floodplain is the most likely explanation..

Methods

^{14}C

The four ^{14}C samples run from the current project were pretreated, combusted, and graphitized by the author at the University of Arizona Desert Laboratory before submittal to the National Science Foundation Accelerator Mass Spectrometry Laboratory, also at the University of Arizona. Pretreatment included soaking approximately 15 mg of carbon sample in 15 ml of six-molar HCL at 70° C for an hour to remove carbonate contaminate. Samples were then rinsed until neutral and soaked in two percent NaOH for an hour at 70° C. Subsequently, humates were decanted and the sample was again treated with HCL and allowed to sit overnight. The samples were then rinsed until neutral and dried.

Approximately three mg of the sample was then placed in a six mm O.D. quartz tube with 100 mg cupric oxide (CuO) and a strip of silver foil (Ag), vacuumed to approximately 10^{-4} mbar, and then combusted for four hours at 900° C. CO_2 was subsequently extracted and purified utilizing standard cryogenic techniques and split into two aliquots. The first aliquot was converted to graphite by means of catalytic reduction of CO (Sloata, et al. 1987). The second aliquot was used to measure ratios of ^{13}C and ^{12}C in order to correct the measured ^{14}C for fractionation.

Luminescence

The author collected all luminescence samples in the form of ceramic sherds or burned adobe. The standard protocol was to collect the soil and any other natural inclusions, such as rocks, within a five cm semi-hemispherical radius of the sampled sherd or burned adobe. Samples were sealed in plastic bags and shipped to the University of Washington Luminescence Laboratory shortly after the field season ended, once the appropriate export and import permits were granted. Laboratory methods of luminescence sample preparation, measurement, and interpretation are provided in a report prepared by Dr. Jim Feathers and included in this dissertation as Appendix J.

Interpretation

Architecture

In addition to the four ^{14}C dates analyzed as part of this research a total of 44 other dates from the region are provided in Table 10.2. Some of these have not been previously published and provide hitherto unutilized potential in delineating chronological variation in the Río Sonora region. The level of detail regarding the context and associations of recovery is variable but affiliation with the form of architecture or feature is generally possible, and thus has the potential to delineate this class of material culture into chronologically sensitive markers. Previous researchers in the Río Sonora Valley also identified architecture as the most sensitive marker available from surface survey data, but were confounded by the apparent persistence of houses-in-pits throughout the cultural sequence. Thus the simple presence or absence of above ground architecture was taken as the maker for placement in the Late period as opposed to the Early period (Doolittle 1984b, 1988; Pailes 1997).

The advent of statistical packages specifically designed for dealing with ^{14}C data makes possible analyses that were not practical at the time many of these dates were first generated. The most ubiquitously utilized of these is OxCal, currently version 4.2, with curve IntCal 13 (Bronk Ramsey 2009). In addition to simple calibrated probability distributions on individual dates, such applications make heavy use of Bayes (1763) theorem to establish posterior probabilities for events based on the liklihood of multiple observations. Due to the intractable multidimensionality of such data sets the Markov chain Monte-Carlo technique is utilized to build probability distributions of possible solutions. Greatly reduced error ranges can thus be produced from a set of dates corresponding to particular events or cultural phenomenon that are not obtainable from individual observations. The technique also allows for the estimation of cultural events not discernable from individual dates, such as the termination or cessation of certain temporally sensitive patterns. Presently, architecture is the only class of material with a suitable data set to be subjected to this sort of analysis.

Evidence from small scale excavations in the Río Moctezuma (Hinojo and Blanquel 2011) indicate that some forms of above ground architecture likely date as early as the earliest dated houses-in-pits. Fortunately, these have qualities that differ from later above ground architecture, oval form and larger areas, that make the later appearance of above ground architecture a useful temporal marker. However, a few assumptions must be stated explicitly to apply the requisite caution to interpret the data. Given the well known antiquity of agricultural societies in the much more exhaustively excavated U.S. Southwest it seems almost certain there are substantial occupations in the Río Sonora region that predate those currently demonstrable through absolute dating techniques (see Vierra 2005). One ^{14}C date with a 2 sigma cal age of 795-430 B.C. recovered from cultural fill on the floodplain of the Río Sonora confirms the presence of such occupations. The presence of presumably recycled Middle to Late Archaic points found during survey further indicate as of yet undocumented Archaic occupations in the Río Sonora area.

This analysis assumes the start of the ^{14}C sequence derivable from the presently available data does not actually denote the earliest occupation or even earliest sedentary occupation. What is likely being dated is the initiation of a particular form of settlement pattern in which mesa tops along river corridors became the almost exclusive choice of location for sites, ranging in size from hamlets to the largest villages. Given that almost nothing is known of what became before this boundary it would be inappropriate to model the likelihood of its time of emergence with anything other than a uniform probability boundary (Figure 10.1). That is the start point of the phase is assumed to correspond to the highest density in the distribution. As stated above, something is known of the end of the pithouse period, in that this form of architecture seems to have persisted at some low frequency essentially until the historic period (Doolittle 1984b:18). Given this persistence, but an assumed relatively rapid fall-off in frequency a *Sigma boundary* seems the most logical option for modeling the practical terminus of pithouse use. Following similar logic and the known early occurrence of at least some above ground structures a *Tau boundary* is used to model the onset of this phase, which assumes an exponential slope. Since the phases obviously overlap the end date and start date for houses-in-pits and above ground architecture respectively also must overlap. In actuality the OxCal model utilized here treats the data sets and their respective endpoints as independent, which is obviously not technically true since it is to some extent a zero sum game in the frequencies of the two types. However, this approach seems the most valid, as opposed to utilizing a contiguous phase model. There is obviously considerable variance in the form and materials utilized in above ground architecture that may in the future prove to vary chronometrically in a systematic way. For the present analysis no internal divisions are made among above ground structures. The utilized surface structure sample is composed only of rectilinear cimiento and coursed adobe structures. For pithouses/houses-in-pits, only unequivocal examples were included (see Table 10.2). Figures 10.2 through 10.7 demonstrate the still problematic nature of the sequence, however, a few implications of these distributions warrant further discussion.

As implied by Figure 10.2 the appearance of the mesa centered settlement patterns may be a relatively late phenomenon not developing until post 1100 in a significant form. The singularly previously dated site away from the main river corridor in the Moctezuma Valley, El Borbollon (see Table 10.2), with probability densities predominantly in the range of A.D. 650 to 900 is relevant to this observation. The fact that the site was not clearly occupied past A.D. 1100 provides minimal support that populations may have become aggregated strictly along the main river corridors at this time. It is of course also possible, and maybe even probable that some form of mesa top settlement existed substantially before A.D. 1100, but it is merely obscured by later use of these areas.

The fact that houses-in-pits apparently did not fall completely out of favor most likely until sometime post A.D. 1350 (see Figure 10.3 and 10.4) is also noteworthy in a pan-regional comparison. Generally the use life of these structures is not estimated to surpass 25 years, so it is unlikely these were simply maintained from earlier periods. Neighboring Hohokam, Casas Grandes, and Mogollon populations made this same transition centuries earlier. There is no immediately obvious functional or social reason why this region would have made the shift centuries later. The form did persist at a low frequency in all of these areas and may have even had undergone a resurgence very late in time in the Hohokam region.

The likely onset of predominantly above ground architectural forms would appear to be sometime before A.D. 1450 and most likely prior to 1400 (Figure 10.5). Previous estimations placed this overlap or transitional period from A.D. 1200 to 1350. In fact the co-appearance of the two forms may serve as a useful marker for a roughly 1300s occupation. More dates will be needed to confirm this proposition. Some researchers might be tempted to read the potentially very late emergence of a predominantly above ground architectural horizon as supporting immigration models that envision late period arrivals from exterior areas (Pailes 1997; Phillips 1989). There is little to no evidence, however, to link such architectural styles to extra-regional groups. As noted above the basic construction template of such structures was clearly present for many centuries before rectangular above ground structures became the norm. A stronger, but still largely unsubstantiated case, might be made for coursed adobe structures representing the importation of Casas Grandes ideas, but more data on the emergence of such architectural techniques is required. Presently it actually appears ephemeral cimiento structures might actually post date coursed adobe. ^{14}C dating is unfortunately probably inadequate for estimating the end of the various styles of above ground architecture (Figure 10.6). This is partly a result of the small data set at present, but secular variations (De Vries 1958) in the calibration curve also render these post A.D. 1550 transitions problematic.

Chronological Associations of Ceramics

Although establishing ceramics as a chronological marker was a primary goal of the project and considerable progress was made, the situation is still, at best, vague. A more specific accounting of the associations of excavated materials with particular dated contexts is given in the ceramics chapter. Here only the distributions of the directly dated ceramics are discussed[xxiii]. Not surprisingly, given the ^{14}C data on the architectural/settlement pattern sequence, there are few ceramic types in the current dataset that are currently evidenced to be older than A.D. 1000 (see Table 10.3). It should also be remembered that in most cases the trap emptying, or zeroing event that is dated by the luminescence method, was the firing of the ceramic. The deposition of the ceramic in the archaeological record may substantially post date this event. All luminescence dates are reported at 2 sigma

Brushed*.* Brushed ceramics are a possible exception to the A.D. 1000 boundary (Figure 10.8); the very early date for UW2831 of 230 +/- 280 seems most likely to be spurious, but it is not totally out of the range of possibility. The associated context suggests if the date is valid then the sherd must have been intrusive, or perhaps more likely, the structure from which it was recovered may have been intrusive to this early context. A similar story is likely true for UW2833, with an estimated age of 960 +/- 100. The recovery context, a true pithouse, would seem to date reliably to the early to mid 1200s. The latest date for a brushed ceramic is UW2829, and as noted in Appendix J may be underestimated, making the age of 1500 +/- 60 too recent. The miss-estimation is unlikely to be on the magnitude of several centuries though, indicating brushed ceramics enjoyed an extremely long period of use, perhaps commensurate with corrugated textured types in the broader Mogollon region. Brushed types were quite common at El Borbollon with its predominantly pre A.D. 1000 occupation (Hinojo and Blanquel 2011).

Other Textured. This form of ceramic seems to hold the most, as of yet, untapped potential for serving as a diagnostic marker. Unfortunately the vagaries of recovery and the need to prioritize the dating of floor levels resulted in the selection of only two textured sherds for direct dating. The distribution densities provided in Figure 10.9 tentatively suggest these ceramics may predominantly date to the early part of the sequence. The presence of textured ceramics in contexts dated beyond A.D. 1300 makes this somewhat of a tenuous link. It seems likely that more sampling will extend the terminal date of these ceramics at least into the 1400s and likely the 1500s as is true for San Bernardo incised in the Río Fuerte region (Pailes 1973).

Painted. The most that can be said about *Chihuahuan* ceramics is that they clearly date to the interval post A.D. 1300 (Figure 10.10). This is hardly a surprising finding given the known age ranges of closely related Casas Grandes, Medio period ceramic styles. The fact that one of the three dated specimens likely dates post A.D. 1500 (60%) is a potentially significant finding.

Unfortunately other dated ceramics: Volanta 1260 +/- 100, and one *Sonoran-Serrana* 1370 +/- 60, are inadequate as singular data points to infer any potential patterning. However, the direct date on the purple/red-on-brown sherd, presumed to be of nearby affiliation is still highly informative in that it demonstrates Hematite-on-brown styles were produced past the 1300 boundary that is the terminus for painted styles in the Trincheras region to the west.

Specific Dates and Feature Ages

Feature 1. The sample analyzed from Feature 1, UW2824 is based on an uncorrected TL and OSL estimated age of 1370 +/- 60. As discussed in the feature description section the sample comes from a context that is immediately subfloor. The best estimate for the age of this feature is probably in the 1400s, which is in agreement with the ^{14}C architectural sequence.

Feature 2. A large painted flat-lying La Volanta sherd was recovered from the well preserved, but un-prepared floor surface of this feature. The sample, UW2822, has an estimated age based on OSL and fading corrected TL of 1260 +/- 100. The sample may suffer from some small degree of anomalous fading, which would increase the age estimate, but it is likely insignificant (see Appendix J). The structure is therefore dated to approximately the mid to late 1200s. Another sample, UW2826 was collected from the fill of the structure and produced a date of 1080 +/-120. There is some concern with this sample that it is an underestimate of the age due to OSL fading (see Appendix J), but not more than 100 years. Regardless of this potential, the date is out of stratigraphic sequence and was discovered in fill that may have been subject to bioturbation. The sample is therefore discarded in regards to discerning the age of this structure.

Feature 3. More dates were drawn from this feature than any other due to the presence of numerous artifacts arguably associated with the structure's abandonment. A ^{14}C sample, AA100943, and a luminescence sample, UW2827, based solely on an estimated OSL age, are in general agreement with a respective cal age of 1261-1387 and estimated age of 1250 +/- 80. Two other luminescence dates UW2833 960 +/- 100 and UW2836 1130 +/- 60 appear too young, and do not agree with these ages. AA100943 was a burned post with an unquestionable relationship to the abandonment of the structure. The outer rings were dated in this sample. UW2827 and UW2833 were both in contact with a very clear, but unprepared floor. UW2833 is also based solely on the estimated OSL age. The sherd most likely was an intrusive artifact since there seems to be no other way to reconcile its estimated age. UW2836 is based upon the OSL and uncorrected TL estimated ages. The submitted sample was a large portion of burned adobe from the pithouse wall. This feature appears to have been a true pithouse. It is possible that the conflagration responsible for burning the posts in situ and oxidizing much of the floor and walls was not hot enough to completely zero the age of the adobe sample, resulting in an over estimation of its age. Figure 10.11 provides the probability distributions for AA100943 and UW2827. The most probable range of values are obviously those associated with the left peak of the ^{14}C distribution, suggesting a late 1200s or early 1300s age. This is commensurate with the architectural sequence offered above.

Feature 10. This feature is dated by a well fired fragment of adobe located very near the likely level of the floor surface. There was no evidence of a burned floor discovered during excavation but fragments of burned adobe of various sizes suggest a conflagration of some sort was associated with the termination of this structure. The dated sample is UW2837 with an estimated age of 1300 +/- 80 based on OSL and IRSL age estimates. A plain brownware sherd likely ascribable to a vessel with a fillet rim[xxv] was also luminescence dated and produced an age of 1130 +/- 100. This age was based solely on the OSL age estimation, but is likely accurate and simply displaced statrigraphically due to bioturbation or anthropogenic factors. The numerous roasting pits excavated across this site, including those intrusive to this feature, are one probable mechanism for dispersing older materials above younger. A date near A.D. 1300 seems plausible for this feature.

Feature 11. Although this feature number technically references a surficial cimiento structure, the extensive use of the area for roasting pits prior to, and possibly subsequent to its construction made discerning most feature boundaries impossible. Two samples UW2829 and AA100942 were analyzed from the test trench dug in this area. The first, UW2829, is a luminescence sample with an age estimate based on OSL and uncorrected TL. There is concern that the estimated age at 1500 +/- 60 may be an underestimate (see Appendix J). Recovered in the first level of excavation the sample is plausibly associated with the likely level of the structure floor, which is tentatively placed in the mid to late 1400s. AA100942 is a charcoal sample from approximately 30 cm below ground surface associated with the roasting pit fill that dates to 1042-1255 calibrated years. This is likely the age of one roasting event, but there are certainly others.

Feature 12/17. These features were conjoined surfacicial cimiento structure rooms. A third room may have also been present to the south. The fill stratigraphy of the structures was quite hard to discern and it was only after considerable excavation in

Feature 12 that the floor level was definitively identified. Artifact concentrations were extremely low in these excavations resulting in no suitable floor contact specimens. An additional test unit was placed in neighboring Feature 17 with the primary purpose of obtaining a datable sample. UW2830 was recovered from this context and produced an estimated age, based on OSL, corrected TL, and IRSL, of 1390 +/- 60. This age seems commensurate with available data.

Feature 15. This is a midden feature that was dated by means of both ^{14}C and luminescence. Prior to excavation it was not clear what the nature of the feature was, but it was the only undeflated feature in the area and clearly the best proxy available for the other nearby cultural materials, including Feature 14, an excavation tested cimiento structure. The ^{14}C date produced a calibrated estimate of 1268-1396. The luminescence sample has an estimated age of 1170 +/- 120 based on OSL. These samples barely overlap at 2 sigma. The probability distributions are depicted in Figure 10.12. Given the nature of gradual midden deposition and obvious bioturbation of the feature the spread in these dates is not surprising and provides a reasonable estimate for habitation on this terrace of the site in the late 1200s. Other periods of use are certainly possible.

Feature 18. This was a unique, partially masonry feature that while technically partially subterranean is best classified as a surficial structure. Among the few artifacts in contact with the floor was UW2834, a sherd with an OSL estimated age of 1500 +/- 100. This date seems to be a reasonable estimate. Future work may hopefully demonstrate other rare structures of this sort are either culturally or chronologically diagnostic.

Feature 20/21. These features are a pair of conjoined surficial cimiento structure rooms, although the majority of Feature 21 was no longer visible from surface remains. A clear floor level was never discernable, but the cultural fill was relatively shallow and the true floor was unlikely to be very far above the sterile boundary. A sherd recovered from near the center of Feature 20 produced the obviously spurious age association of 230 +/- 280 based on OSL and TL corrected fading, which was non-existent for this specimen. This date, as discussed above, suggests a very early start to the brushed style of ceramics but significant caution is warranted. The sherd may have been either associated with an older deposit prior to house construction or emplaced by a disturbance process, possibly a roasting pit excavation, which were common in the area. A much more feasible date for Features 20/21 was obtained from sample UW2823 of 1510 +/- 80 based on an estimated age derived from OSL, fading corrected TL, and IRSL. This sherd was not in direct contact with the floor and thus represents a minimum age for the structure. An estimate in the 1400s seems most likely for this feature.

Feature 31. This is a midden feature with an extremely high proportion of the fill composed of small rocks, approximately ~5 to 10 cm in diameter. The dated sample was collected near the base of the midden close to a very clear contact with sterile soil. The estimated age from UW2820 of 1430 +/- 60, based on OSL and IRSL, thus suggests a near-start date for the midden in the early to mid 1400s.

Feature 32. This feature is a well preserved coursed adobe structure. Two specimens were submitted for luminescence dating. The first UW2828 is noted as a particularly reliable date (Appendix J) and produced an estimated age based on OSL and fading corrected TL of 1100 +/- 100. This specimen was a ceramic in contact with the floor of the structure which was prepared, but disturbed by rodent activity over the majority of the area. A second luminescence sample, UW2821 produced an estimated age of 1390 +/-

60, based on OSL and uncorrected TL. The age is thought to be an underestimate due to OSL fading. The age in the late 1390s is thus not as inconsistent as it first appears. This sherd, which was recovered immediately sub-floor may also be intrusive due to bioturbation. A date in the mid 1100s seems most likely for this structure, which is early for surface structures but commensurate with its burial depth. This was the only coursed adobe structure excavated to any appreciable extent during the project, and it may well turn out that such structures date earlier than the more ephemeral river cobble cimiento style surface structures.

Feature 33. This feature was apparently also an adobe structure, although the small size of the test unit, a 1 by 1, makes more detailed description impossible. A luminescence sample, UW2835 collected from just above the well preserved, but unprepared floor produced OSL and fading corrected TL dates that are irreconcilable with the age of ceramic production in the region at 150 B.C. +/- 520. This is a clearly erroneous age. A ^{14}C sample, AA100941, recovered from the same context produces a bimodal age distribution that spans from 1436 to 1625. The early peak is more likely and thus the feature's age is estimated in the mid 1400 to early 1500s.

Site Contemporaneity

Establishing relative contemporaneity for the three excavated sites is critical to the arguments made throughout this monograph. Figure 10.13 provides age distributions by site. On first glance these distributions suggest that the occupation of El Nogal ceased a century before the last occupations at Teonadpa and Los Mineros. This is almost certainly an artifact of the chance excavation of slightly older features at El Nogal and unfortunate sampling conditions. As stated above in regards to Feature 1, the obtained date is a maximum age and the feature is actually younger. Conversely, the late date from Feature 21 at Teonadepa came from above floor fill and likely post dates the principal use of the structure. The other fairly late date from Teonadepa, the ^{14}C date with a primary mode in the late 1400s pertains to Feature 33, which was only tested with a single 1 by 1 and thus represents a very small portion of the total excavated assemblage. Taking these observations into account suggests most of the excavated sample from these two sites likely dates between A.D. 1250 and 1450, although other materials are undeniably included to roughly 1550.

Another informative observation is provided by comparison to the distributions of Los Mineros. This site, as described in the material analyses chapters, was far less impressive in terms of its archaeological deposits. The site clearly represents a lower density population than either El Nogal or Teonadepa. However, due to the vagaries of volunteer labor availability, more features were sampled at this site than either El Nogal or Teonadepa and as a result more chronological samples were collected and subsequently run. The result is a near unbroken distribution in dates from A.D. 1000 to 1600. Had the other two sites been subjected to the same level of excavation almost certainly they also would have produced more continuous distributions of dated samples.

Material culture evidence also supports a general contemporaneity of the three sites. For instance the one Jecori sherd found at El Nogal was unequivocally in a floor context (Feature 3), establishing general chronological equivalence between this feature and those of Teonadepa where this type was more common. Architectural similarities and other ceramic data, such as textured designs, further indicate equivalence at approximately the phase level. Based on first principles it also seems highly unlikely the most optimal location for settlement in the Moctezuma area would have been curiously abandon ca. 1400; especially given that it is well established substantial populations resided in the immediate area in the 1600s. The presence of protohispanic artifacts at all three sites further indicates continuous use of all three sites at least into the 1500s. The fact that the same mesas were occupied for upwards of 400 years, leading to many mixed deposits, contributes substantially to the present difficulties of further refining the chronology of this region.

Conclusion

The conclusions that can be drawn from this analysis highlight the amount of work that still needs to be done in refining chronologies for the Río Sonora region. The mesa centered pithouse/house-in-pit phase is argued to not begin substantially until approximately 1100 and last for approximately only 200 years. This is a later date than proposed by Doolittle (1984b). The distribution of pithouse ages also seems to suggest the tradition does not clearly end until the late 1300s at earliest. There is clearly an occupation that proceeds the identified pithouse period that is either largely obscured by later occupation or was focused in settings that have been subject to more destructive formation processes. Habitation in the active floodplain is the most likely scenario and has been confirmed by the chance identification of one very early site in this setting that was deeply buried (Doolittle 1984b). Above ground architecture predominates by the 1400s and lasts until the Hispanic period.

The tentative ceramic chronologies roughly match the outlines of previous work but some more specificity has been provided. Brushed ceramics are clearly the earliest of the tested decorated types. Currently there are no tested samples that place these or any other ceramics on par with the very early dates suggested by some previous work (see Table 10.2), but this may be a corollary of a general failure to sample early sites. Other textured types may also significantly post date the A.D. 700 initiation for this technique identified by R. Pailes in southern Sonora/northern Sinaloa. Perhaps this technique diffused to the area slowly either by emulation or small scale migrations. The inferred age of painted types are perhaps the most interesting result. There are few types that predate the 1300s through either direct dating or association. This suggests many Hematite-on-brown traditions that largely ceased in neighboring regions may have persisted in the Río Sonora. Similarly the post 1500 date for a *Chihuahuan* style sherd also suggests a post Paquimé collapse date. Augmenting the sample size of dated ceramics is clearly needed for more definitive statements. As a last note of critical importance to the overall goals of the project, it can be stated with some confidence that the three excavated sites have a significant overlap in their period of occupation. Occupation may have started approximately a century earlier at El Nogal, but this is likely due to simple chance sampling of earlier contexts. All sites clearly persisted into the 1400s and likely 1500s.

11. Provenance Analysis

This chapter provides descriptions, methods, and results of provenance studies for all sampled material classes. The focus is largely methodological with only a few comments on the most manifest patterns. A subsequent chapter (14) discusses the implications of the results.

Ceramics

Ceramics are a particularly useful means for exploring economic motives in the Río Sonora due to the apparent ubiquity of production potential. Excavations at all three tested sites yielded potting tools, namely polishing pebbles, as did surface finds at several other sites identified on survey. This distribution suggests ceramics were produced widely. Furthermore, there is no suggestion that the availability of raw materials would be sufficiently spatially heterogeneous to produce significant inequities in production potential. As insinuated in previous chapters, the quest for subsistence sufficiency was also likely unproblematic, indicating the adoption of craft production was likely not related to marginal household productive potential. Given this set of conditions the circulation of ceramics, at least the mundane sort, should be driven by simple need based motives with subsequent distribution through non-directed exchange (Renfrew 1975, 1977).

The ceramics in this region are amenable to the identification of production zones through the examination of sherd aplastics. Almost all ceramics in this region were likely intentionally tempered with sands drawn from steams. In accordance with global ethnographic data it is expected that such ubiquitously available material would be gathered from the nearest possible source (Arnold 1988). In the study area this distance is generally less than one km and universally less than two km. Clay acquisition locations are presently unknown, but the variation in pastes suggests many disparate localities are available. As a result, the lithological and mineralogical signature of sands used in temper and natural aplastic inclusions serve as a reliable fingerprint for where a vessel was made on the landscape. For the current project this geologic variance was classified utilizing a petrofacies model (Miksa and Heidke 2001; Miksa, et al. No date). The model is based on 34 sand samples drawn from secondary and tertiary tributaries of the Río Moctezuma (Figure 11.1).

The samples were impregnated with matrix, thin sectioned, etched with hydrofluoric acid (HF), stained with sodium cobaltinitrite $Na_3Co(NO_2)_6$ and barium chloride $BaCl_2$ followed by potassium rhodizonate $C_6K_2O_6$ to facilitate rapid identification of potassium feldspars (yellow) and plagioclase (pink) (Bailey and Stevens 1960). Once prepared as stained, covered, thin-sections the samples were point counted with the Gazzi-Dickinson method (Dickinson 1970; Gazzi 1966), utilizing a petrographic microscope. A grid spacing of 1.5 mm was selected as this was the largest size of sand grain typically encountered in thin section. The method thus eliminates most duplicate counts of a single grain. The Gazzi-Dickinson method counts all mineral grains occurring within larger host rocks as the identified mineral and not the rock. Due to the practicality of identifying very small inclusions 80 μm was selected as a rough cut off point for when a mineral was deemed to small to identify and the grain was counted as the overall lithological specimen instead. The underlying logic of this method is to produce similar counts for sands that vary only in the amount of mechanical weathering they have endured, which reduces a portion of lithological grains to constituent mineral fragments. In keeping with this logic the highly chemically weathered grains of many volcanic lithic fragments were counted as what was perceived to be the original host rock or mineral rather than the alteration product (see Figure 11.2). Rarely specimens were so weathered that this was deemed inappropriate , giving rise to a few counts of Fe/Mg oxides; smectite, e.g. $Ca_{.25}(Mf, Fe)_3((Si,Al)_4O_{10})(OH)_2*nH_2O$; gibbsite $Al(OH)_3$; sericite, i.e. $KAl_2(AlSi_3O_{10})(F,OH)_2$; and other secondary minerals.

Overall point counting provides an estimation of the component sand grains found in a local area that is far more accurate than simple comparisons to mapped geological provinces. Available geologic data (Aguirre, et al. 1993) were also utilized to provide insights on the likely composition of sands beyond the sampled environment. For example, it is predicted that the basaltic province, beginning on the southern edge of the survey area, should contribute a substantial amount to stream sands to the south of the sampled area. The results of the petrofacies model are provided in Figure 11.3. Some detailed discussion of this map is warranted.

The majority of the study area is identified as mixed volcanic composed of a range of felsic and intermediate rock types with various textures and stages of weathering (Figures 11.4 and 11.5). A few more matches to particular grain types visible in sherds can be made, but the replicable identification of these is less than satisfactory to warrant further subdivision into distinct petrofacies. Some further discussion of this point will follow below in regards to a potential subdivision in the region of Los Mineros (Son L:2:22) and its association with a fairly diagnostic intermediate rock type. Epidote

$Ca_2Al_2(Fe^{3+};Al)(SiO_4)(Si_2O_7)O(OH)$ (Figure 11.6), useful as a categorical marker in other parts of Sonora, was too ubiquitous in the present sample to delineate subdivisions in the mixed volcanic zone. Conversely other trace minerals were too rare to serve as distinct markers of provenance.

Other primary petrofacies are more distinct but do not regularly appear as aplastics in sherds. The extrusive mafic province is composed of a mixed felsic/intermediate sand with a smaller, but easily identifiable, basalt component. Figure 11.7 displays an example of this drawn from a point that is predominantly basaltic, but this would not be the case in most drainages in this zone. Note that this sand would be very distinct from those likely produced to the south of the project area, which would have a significant granitic component. Slide number ss1.1-2012, which was collected within a small rivulet of El Nogal (Son L:2:1) provides a baseline expectation for just such a sand composition (Figure 11.8).

The plutonic (granitic) petrofacies is easily distinguished from any predominantly volcanic sand (Figure 11.9 and 11.10). Sherds produced in this petroface would most likely be made in the un-surveyed sites along the tributary of the Río Moctezuma known as the Río Chino, and sites very near the eastern side of the modern town of Moctezuma. The major constituents of sands in this temper are quartz, plagioclase, and potassium feldspar. The sand is notable for its very low percentage of more mafic minerals (micas, pyroxenes, and amphioles), which typically make up approximately 15-20 percent of granitic rocks by volume. This may be partially due to preferential weathering, suggesting collection further down river, but this is a qualitative assessment. Further sampling and additional study could lead to a more refined subdivison of this petrofacies based on rare mineral components. Arfvedsonite $[Na][Na_2][(Fe^{2+})_4Fe^{3+}][(OH)_2|Si_8O_{22}]$ (Figure 11.11) and hornblende $(Ca,Na)_{2-3}(Mg,Fe,Al)_5(Al,Si)_8O_{22}(OH,F)_2$ (Figure 11.12) were noted to rarely co-occur in the present samples. The amount of other rare accessory minerals such as zircon $ZrSiO_4$ (Figure 11.13) might also lead to a greater discrimination of provenance zones, but such approaches would not produce differences manifest in hand samples or identification through the bincocular inspection of sherds. Notably, one thin sectioned sherd that was identified as unique due to the angularity of the granitic temper, suggesting alternative manufacturing techniques and a nonlocal provenance, also appeared to contain unique accessory minerals. This suggests other plutonic bodies in the surrounding area may be discriminated through thin section petrography.

Mixed component granitic and volcanic sands could feasibly come from several areas. The tertiary tributaries of the Río Moctezuma that drain both to the east into the Río Chino and west toward the Río Moctezuma cut across dissected Pleistocene terraces that contain sands of both rock types. The Río Chino area is again a likely setting for some habitation sites. Most of the region that drains toward the west is arid bajada and is not a likely habitation local. A granitic component is still discernable where these streams meet the Río Moctezuma near Jecori, but it is a decided minority of the total composition by this point. A second potential location is also suggested by one sample and geologic maps. This area is a significant distance to the north of the project area along a portion of the stream known as the Río Nacozari. The granitic emplacement is relatively small and is thus likely a minority contributor to stream sands even fairly near the source. Given both the distance from the project area and its relatively less granitic nature this sand can be excluded as a major contributor to those identified binocularly as mixed granitic volcanic in the current project. Mixed component sands are thus most likely representative on an area on the margins of the main granitic petrofacies with more diverse geological contributions. This area when considered in combination with the known settlement distribution would still suggest manufacture exclusively in the southern portion of the study area.

One other distinct sand was noted in the sample that contained a significant amount of volcano sedimentary grains. These grains are discernable by rounded lithological and mineral grains within a glassy to very aphanitic matrix. They are the result of a pyroclasitc flow event. Given the apparent limited spatial breadth of this sand it is not likely to be found in many sherd samples.

Subsequent to the initial characterization of geologic samples a total of 137 ceramic sherds (Table 11.1) were prepared as thin sections and point counted in an analogous manner to the geologic samples. In addition to point counting, a qualitative assessment of the predominant grain types present were recorded. This data, along with the primary point count data is presented in Appendix K. The thin sectioned sherds were chosen based on a variety of strategies. An initial thirty samples were randomly selected from surface survey collections. Subsequently 42 sherds from the excavated samples were selected to span the range of stylistic types, 50 plain brownware sherds were selected to span the range of variability of macroscopically observed aplastics, and 13 additional plain brownware sherds were chosen at random.

Exploratory statistical analyses of the thin sectioned ceramics were utilized to derive groupings plausibly identifiable through simple binocular microcopy. In order to reduce the number of categories with zero values, which is problematic for most statistical approaches, similar categories were combined and many categories with only a few counts in the entire sample were excluded. This grouping approach provides a more robust way to identify divisions in the sampled sherds but obviously washes out unique variation of sherds with both rare lithologies that are in excluded groups or that are dominated by a grain type that, though rare, was included in the test but grouped into a larger category. To avoid this loss of data these qualitatively different sherds are identified and excluded from the statistical analysis. These isolate sherds will be discussed below.

Appendix K provides the categories utilized in the point counting analysis. The sheets are modified from the classification system employed by Desert Archaeology Inc. Most of the expanded categories are sub-designations of extrusive volcanic rocks, since this lithology is ubiquitous in the Sierra Madre region, necessitating a more refined approach to make petrofacies divisions possible. It should be noted that the classification is based on qualities that are discernable with a petrographic microscope as opposed to technical definitional criteria. For instance, the difference between *felsic* and *intermediate* rock types is based on the mere presence or absence of visible quartz grains in the groundmass or as phenocrysts, as opposed to an exacting estimation of silica (SiO_2) content.

Several approaches to grouping the categories presented in Appendix K were explored. The most reliable and intuitively understandable are those that rely principally on textural, as opposed to compositional, differences. Figure 11.14 presents a loading, scree, and score plot of principal components analysis. The three categories utilized to produce these figures were a *combined mineral* category that includes counts of quartz, plagioclase in all stages of weathering, and K-spar that occur both as phenocrysts, isolated minerals, or as part of a plutonic rock; *lithic all felsic, vitreous, intermediate porphyritic/homogenous, and hypabyssal* that includes essentially all predominantly silica (felsic varieties) as well as intermediate grains that lack visible mafic minerals or Mg/Fe staining; and *heterogeneous intermediate and mafic mineral porphyritic and/or Mg/Fe oxide bearing intermediate*.

The first grouping is a relatively straightforward amalgamation of rocks that formed at a sufficient depth that crystals are observable through macroscopic inspection or low power binocular inspection, i.e. granites. Some phenocrysts, particularly of plagioclase, liberated from or present in groundmass matrix of volcanic rocks would also be subsumed in this category. The second category essentially captures volcanic grains with relatively homogenous groundmasses. Intermediate and felsic grains are both included in this category due to the inherent nature of the Ca and K staining to be less distinct as crystal size decreases, leading to homogenously stained grains of groundmasses and glasses that are actually predominantly silica. The un-weathered (no Mg/Fe oxide) porphyritic grains were also included because these rock types were obviously related to those grains classified as homogenous intermediates with only the chance fracturing of the lithic fragment determining the grain's categorization based on inclusion of felspar and quartz phenocrysts. Most of the grains included in this category are largely indistinguishable under medium to low power magnification with a white or otherwise light color. The last major grouping includes those with intermediate compositions and relatively heterogenous compositions that almost invariably included some mafic mineral grains, including opaque minerals such as magnetite. The grains range in texture from near completely aphanitic to porphyritic. This grouping would entail grains that appear grey to near black under low to medium power binocular magnification as well as many Fe oxide stained, reddish grains.

The resulting principal component analysis breaks these three classifications down into fairly intuitive groupings based on the first two components. Component one captures the manifest differences in textural qualities between plutonic and volcanic grains. Component two reflects the compositionally driven, and somewhat covariant textural differences in the two macro divisions of volcanic rock types. The plutonic dominant sherds fall directly in the middle of this component as a result of the inherent covariance of feldspars and quartz grains, the latter being a defining element of felsic identification and the former being a significantly higher component of the groundmass for all non-felsic types. It should be remembered that several manifestly unique sherds were not included in this analysis so as not to overly skew the results. A comparison to the qualitative categorization of sherds clearly matches closely to visible patterning in the score plot. The fact that there is some mixing at the center of the plot is not surprising and largely unavoidable. Since stream sands may mix in any proportion, depending only on stream course and relative contribution of petrofacies. Petrofacies data differ in this regard from many chemical characterization methods that are bound by physical laws to produce end members without continuous gradients. As such, these results are rather impressive for their ease of interpretation.

Prior to thin sectioning of the sherd sample qualitative binocular inspection of all sherds classified the temper according to granitic or volcanic, and if volcanic to a grouping based largely on the color of the observed grains[xxvi]. This same procedure was carried out for all sherds collected on the initial settlement survey, all sherds recovered through excavation from floor levels, and all sherds collected on excavation or systematic survey with any sort of decorative treatment. The point counted sample thus allowed a testing of the feasibility of identifying temper groups from binocular inspection alone. The results were overall very encouraging. Not surprisingly, sherds with blackened pastes proved somewhat difficult to discriminate into groups since temper grains often could not be viewed clearly due to residues adhering to their surfaces and the tendency of transparent quartz grains to appear the same color as the dark paste. These sherds will be excluded from most future comparisons. The division between plutonic and volcanic grains was made with a very high degree of success. Only one sherd was mistakenly identified as volcanic that was in fact granitic in nature, and this sherd was somewhat unique in that most of the grains were actually more of a hypabyssal character. This sherd may actually be foreign to the area. False positives were also relatively unproblematic, four sherds were identified to have mixed compositions of predominantly plutonic grains that actually had plutonic grains as a secondary type. This would not change the overall classification of the sherd. One of these was actually a metamorphic bearing rock foreign to the study area. A single sherd was falsely identified as plutonic, but was noted in the binocular inspection to be characterized by small grains, obfuscating classification. In short, the error margins associated with binocular divisions between plutonic and volcanic are entirely acceptable for the analysis of bulk materials although some caution might be exercised for the relative contributions of mixed temper component sherds.

Binocular identification of sub-groupings of volcanic rocks derived through principal components analysis proved more problematic. A marginal correlation (71 percent) between a point count predominance of the *heterogenous-intermedite and mafic mineral porphyritic and or Mg/Fe oxide bearing intermediate* grain counts and a binocularly observed classification of mostly dark colored grains was found. This is discernable in the

Appendix K tables as the qualitative categorization as *intermediate heterogeneous* dominant. The reverse correlation is a problematic 51 percent between dark colored binocularly observed grains and the point count verified categorization, suggesting that identification of this temper type will be significantly underestimated within the larger grouping of volcanic tempers. These data suggest that while thin section petrography can reliably identify this temper subgrouping (Figure 11.15) it is more problematic through binocular inspection alone. Nonetheless, the marginal success rate and an overall tendency to underestimate its frequency allow very cautious interpretations of relative frequency between assemblages based on binocular inspection. The source of this temper is likely located in the Tebisco region, which includes Los Mineros. Small streams sampled immediately adjacent to this site contained this rock type (Figure 11.16), but not at the levels present in many sherds.

Considering first only the easily identifiable division between granitic and mixed volcanic tempers, a higher than expected circulation of plain. brushed, and textured brownwares is evident in the project area. The relative percent of the assemblage assignable to the granitic provenance diminishes in a sharply linear manner (r^2 = .61, df = 24, p < .01) relative to distance from the southern survey boundary as depicted in Figure 11.17. This data considers both the surface collections samples, which are generally small n<100 and the much larger excavation samples. The correlation coefficients (%-granitic=.73 - .02 x km) indicate that the frequency of granitic sherds should drop to very near zero shortly beyond the limits of the survey if the linear pattern is maintained. The fact that plain ware vessels were traded at these frequencies is surprising based on first principles of economic theory discussed in subsequent chapters.

A comparison of basic type frequency data between the sites of Teonadepa (Son L:1:23) and El Nogal suggests textured brownwares were predominantly produced in the southern portion of the study area, concordant with the granitic temper zone. Accordingly the granitic temper component of textured wares constitutes an even greater proportion than plain brownwares in the assemblage of the northern site (52 compared to 37). The designs on these vessels may have made them more eligible for export, since they have qualities that are perhaps not as easily replicated at all production locals, namely artistic specialty. However, the crude nature of most textured designs makes this an extremely tenuous assertion. In total these data firmly establish regular economic interaction at the scale of the project zone that crosscuts settlement pattern and material culture stylistic boundaries.

These lines of evidence would seem to suggest separate settlement communities intertwined through regular economic activities in which items were exchanged directly in many instances within the 30 km space of the project zone. This observation will be discussed at length in Chapter 14. Notably, this pattern does not hold for the more problematically identified intermediate volcanic temper. The settlements likely closest to this temper source certainly made use of the corresponding stream sands, as indicated in the assemblage of Los Mineros (Figure 11.18). The ceramics were clearly not exported at the same frequency as vessels from the granitic production zone. Additionally several other potential temper types hardly appear at all in sherd samples. No sherds conclusively come from the basaltic province but several likely come from locations on its margins were basalt occurs as only a trace lithic component (Figure 11.19), and there were no instances of any kind that contained basalt and granite, which should be common immediately south of the project area. Excavation at sites in these areas would likely produce assemblages with many examples of these temper types, as did the excavations at Los Mineros in regards to the intermediate temper. These data thus firmly establish that certain mundane commodities such as plain borwnwares and other types of brownware were produced disproportionately in certain areas, but most regions produced some amount of brownwares. This is likely due to several factors including both unidentified economic motives that led to a greater emphasis of ceramic production in the granitic temper zone, and possibly simple demographics if more individuals lived in this region than other production zones. Settlement pattern data establish that sites in the intermediate volcanic zone were generally small and not densely populated. In accordance with the assumption of the stochastic nature of trade interactions the fewer potential exchange partners from this region would lead to a correspondingly lower export rate and diffusion through the system. The failure to discern other coherent groupings in the mixed volcanic sample likely is due to many other small sites also contributing stochastically to local exchange systems leading to a very mixed sample.

Ceramic data are less informative of middle and long range connections defined here respectively as outside of the project area and outside of the Moctezuma Valley. The general ubiquities of the rock types utilized in the petrofacies model make them inadequate for identifying more far ranging connections. It is entirely likely that nonlocal granite or extrusive volcanics would not be discriminated from local varieties through binocular inspection[xxvii]. Four of the 137 (three percent) sherds subjected to thin section analysis indicate more distant connections. There was one example each of a sherd with fossileferous limestone (Figure 11.20), a metamorphic component of sutured plagioclase and quartz (Figure 11.21), a near pure obsidian temper (Figure 11.22), and a painted sherd with crushed granite as opposed to stream sand (Figure 11.23). The fact that all four sherds are distinctly different and singular examples indicates that none are indicative of regular exchange conduits.

The petrofacies model is likely not applicable to other ceramic categories that are more prone to inclusion in medium and long distance trade networks. Painted *Chihuahuan* type sherds do have a predominance of mixed volcanic tempers and *Sonoran* type granitic. But both relationships are far from exclusive. These tendencies may simply be the result of chance similarity in rock types in the production zones of these types that are exterior to the Moctezuma Valley. Granitic and volcanic rocks subsume the vast majority of surface rocks present in the state of Sonora. The overall low frequency of all painted ceramics suggests they may mostly be imports and not the result of a regular endemic industry, but as noted in Chapter 4, the northern and southern reaches of the survey area clearly had exclusive access to only limited painted ceramic suppliers, as indicated by the very different stylistic traditions. The ceramic evidence for middle and long range exchange is thus indicative of the Río Moctezuma being an infrequent recipient of ceramic vessels produced outside of the valley.

Obsidian

Obsidian sourcing data is one of the most frequently used methods of reconstructing trade networks (e.g. Bayman 1995; Darling 1998; Shackley 1995). Many of the sources in Northwest Mexico remain unidentified, but a rough sketch of connections can still be made. The distribution of obsidian in the study area was extremely unequal. During the initial survey only five sites produced any obsidian artifacts. At three of these sites only one to a few obsidian artifacts were recorded, while at the remaining two La Cuchilla (Son L:1:6) and Teonadepa they were so ubiquitous that a complete collection was impractical. Excavation and a systematic surface collection produced two more small assemblages from El Nogal (*n* = 16) and Los Mineros (*n* = 12) and significantly augmented the sample from Teonadeopa (*n* = 123) where complete collection was again dismissed as impractical. The near total absence of obsidian at smaller sites and from El Nogal indicates it was not a material accessible by most of the population on a regular basis.

A total of 42 samples were submitted for quantification of trace elements to facilitate matching to geologic sources by means of X-ray fluorescence (Table 11.2). Ten samples were submitted to the Gila River Indian Community XRF lab and 33, in two separate batches, to the Archaeological X-ray Fluorescence Spectrometry Laboratory in Albuquerque. One sample was submitted to both labs. Characteristic methods utilized at these labs are excerpted from a report provided by the Albuquerque lab and included below. The Gila River methods would be substantially different only in their use of a portable XRF not set to register several high Z elements, such as Barium (Ba).

The first rounds of sampling choose specimens at random from survey contexts (*n* = 23) and then from excavation/systematic surface collections (*n* = 10). A full 85 percent of this combined sample had an identical provenance, known as the Selene source (Hinojosa-Prieto, et al. In prep), located 70 km to the east northeast of Teonadepa. Due to this very lopsided distribution nine more samples were submitted that were chosen due to macroscopic qualities that suggested possible alternative provenances other than Selene. Four of these (44 percent) sourced to two unknown location. In total five additional sources other than Selene are likely present in the total sample, four are unknown and the last is from Los Sitios del Agua (n = 1) (Martynec, et al. 2011) in far western Sonora (Figure 11.24). The unknowns generally have trace elements in the range of known Sonoran sources (Shackley 2005) (Table 11.2 and Figure 11.25) indicating they are likely also located in the Sierra Madre of eastern Sonora or western Chihuahua. One of the samples I0031 has trace element signatures that suggest it might be associated with a source very similar to Selene and likely located nearby (Shackley 2013). This assessment is based in part on the relatively high Sr composition (see Figure 11.25) that is characteristic of this source. The singular artifact from this source was a nodule (~9 cm) that is much larger than most marekanites known from the Selene source. Assuming larger nodules are more preferred due to increased workability and greater production potential, it is curious only one sample comes from this location if it is indeed located in close proximity to the Selene source. Some speculation can also be offered on the source labeled as *Unknown 1*[xxviii] in Table 11.2. This source has a relatively distinct, near opaque quality that is discernibly different from the Selene source and accounts for most of the success in targeting non-Selene samples in the final round of testing. These samples have a composition that is similar to Cow Canyon/111 Ranch in southeastern Arizona. Only the Ba composition is significantly different (Shackley 2013). As such the most likely source is somewhere in the vicinity of this better known deposit, perhaps somewhere near the international border in one of the headwater tributaries of the Río Bavispe. Again it should be stressed that the only reason this sample is represented by multiple specimens in the current analysis is due to its easily discernable macroscopic qualities.

The following is excerpted from reports prepared by M. Steven Shackley (2011, 2013) and describes the methodology utilized in EDXRF analysis of obsidian sources.

Laboratory Sampling, Analysis and Instrumentation

All archaeological samples are analyzed whole. The results presented here are quantitative in that they are derived from "filtered" intensity values ratioed to the appropriate x-ray continuum regions through a least squares fitting formula rather than plotting the proportions of the net intensities in a ternary system (McCarthy and Schamber 1981; Schamber 1977). Or more essentially, these data through the analysis of international rock standards, allow for inter-instrument comparison with a predictable degree of certainty (Hampel 1984; Shackley 2010).

All analyses for this study were conducted on a ThermoScientific *Quant'X* EDXRF spectrometer, located at the University of California, Berkeley. It is equipped with a thermoelectrically Peltier cooled solid-state Si(Li) X-ray detector, with a 50 kV, 50 W, ultra-high-flux end window bremsstrahlung, Rh target X-ray tube and a 76 µm (3 mil) beryllium (Be) window (air cooled), that runs on a power supply operating 4-50 kV/0.02-1.0 mA at 0.02 increments. The spectrometer is equipped with a 200 l min^{-1} Edwards vacuum pump, allowing for the analysis of lower-atomic-weight elements between sodium (Na) and titanium (Ti). Data acquisition is accomplished with a pulse processor and an analogue-to-digital converter. Elemental composition is identified with digital filter background removal, least squares empirical peak deconvolution, gross peak intensities and net peak intensities above background.

The analysis for mid Zb condition elements Ti-Nb, Pb, Th, the x-ray tube is operated at 30 kV, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity Ka-line data for elements titanium (Ti), manganese (Mn), iron (as $Fe_2O_3^T$), cobalt (Co), nickel (Ni), copper, (Cu), zinc, (Zn), gallium (Ga), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), lead (Pb), and thorium (Th). Not all these elements are reported since their values in many volcanic rocks are very low. Trace element intensities were converted to concentration estimates by employing a least-squares calibration line ratioed to the Compton scatter established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology (NIST), the US. Geological Survey (USGS), Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). Line fitting is linear (XML) for all elements but Fe where a derivative fitting is used to improve the fit for iron and thus for all the other elements. When barium (Ba) is analyzed in the High Zb condition, the Rh tube is operated at 50 kV and up to 1.0 mA, ratioed to the bremsstrahlung region (see Davis, et al. 2010; Shackley 2010). Further details concerning the petrological choice of these elements in Southwest obsidians is available in Shackley (1988, 1995, 2005) (see also Hughes and Smith 1993; Mahood and Stimac 1990). Nineteen specific pressed powder standards are used for the best fit regression calibration for elements Ti-Nb, Pb, Th, and Ba, include G-2 (basalt), AGV-2 (andesite), GSP-2 (granodiorite), SY-2 (syenite), BHVO-2 (hawaiite), STM-1 (syenite), QLO-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), TLM-1 (tonalite), SCO-1 (shale), NOD-A-1 and NOD-P-1 (manganese) all US Geological Survey standards, NIST-278 (obsidian), U.S. National Institute of Standards and Technology, BE-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France, and JR-1 and JR-2 (obsidian) from the Geological Survey of Japan (Govindaraju 1994).

The data from the WinTrace software were translated directly into Excel for Windows software for manipulation and on into SPSS for Windows for statistical analyses. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. RGM-2 a USGS obsidian standard is analyzed during each sample run of 20 for obsidian artifacts to check machine calibration.

Source assignments were made by reference to the Berkeley data base and Martynec, et al. (2011), Shackley (Shackley 1995, 2005), and samples from Selene submitted by Karl Kibler, of Prewitt & Associates, Tucson, Arizona (Hinojosa-Prieto, et al. In prep). Further information on the laboratory instrumentation can be found at: http://www.swxrflab.net/. Trace element data exhibited in Table [11.2] are reported in parts per million (ppm), a quantitative measure by weight.

Marine Shell

The shell assemblage is most notable for its sparseness. Only 19 specimens were collected: two during the original 2010 surface collection and the rest during the 2012 season. The assemblage includes five identifiable genera (Table 11.3). All of the shell specimens were likely items of adornment.

Six of the shell specimens were analyzed via mass spectrometry following the procedures described by Grimstead and others (2013) to measure $\delta^{18}O$ and $\delta^{13}C$ isotope ratios. These signatures vary predictably with temperature and fresh water pulses. Temperature and the local water environment are the primary determinants of delta $\delta^{18}O$ values (Goodwin, et al. 2001). Variables that can impact local water $\delta^{18}O_w$ values include local salinity variations, evaporation rates, and freshwater inflows (Dansgaard 1964; Rozanski, et al. 1993). Freshwater is more negative in delta $\delta^{18}O_w$ than marine water due to isotopic fractionation, which occurs during evaporation and condensation cycles. The isotopic composition of a mollusk will be in isotopic equilibrium with the ambient water as a function of Equation 1 (Goodwin, et al. 2001) where T is degrees Kelvin and α is defined by the ratio produced by Equation 2 (Dettman, et al. 1999; Grossman and Ku 1986).

Equation 1

$$1000 \ln (\alpha) = 2.559 (10^6 T^{-2}) + 0.715$$

Equation 2

$$\alpha \frac{aragonite}{water} = 1000 + \delta^{18}O_{arag(VSMOW)}/1000 + \delta^{18}O_{w(VSMOW)}$$

The result of Equation 1 produces a relationship of approximately 4.7° C resulting in a 1 ‰ reduction in delta $\delta^{18}O_{arag}$. Because mollusk shells grow though annual accretion, values will vary seasonally across growth bands, necessitating multiple samples from each specimen. The nature of variation in water surface temperature in the Sea of Cortez makes minimum values (reflective of maximum temperatures) the most useful as a geographical delineator.

Environmental dissolved inorganic carbon in water bodies $\delta^{13}C_{DIC}$ fluctuates primarily as a function of upwelling, which brings carbon from oxidized plant matter to the surface (R. S. Bradley 1999a) and the degree of primary productivity as driven by photosynthesis (Purton and Braiser 1997). The former is associated with more negative $\delta^{13}C$ values the latter enriches surface water concentrations of ^{13}C relative to ^{12}C. Values of $\delta^{13}C_{arag}$ are controlled primarily by the DIC of ambient water with the mollusk's diet contributing a lesser amount (Dettman, et al. 1999; Grossman and Ku 1986; Klein, et al. 1996; McConnaughey and Gillikin 2008). Water temperature does not greatly affect the value of $\delta^{13}C_{arag}$ (Dettman, et al. 1999).

Together $\delta^{18}O$ and $\delta^{13}C$ can identify archaeomollusks to one of three provinces in the Sea of Cortez (Grimstead, et al. 2013)(Figure 11.26): near the mouth of the Colorado River, between the Colorado River debouch and Isla Tiburon, and south of Isla Tiburon to an as of yet undetermined southern boundary. Modern damming significantly alters the provenance zone near where the Colorado River enters the Sea of Cortez. Significantly more negative values of $\delta^{18}O_w$ and $\delta^{13}C_{DIC}$ were the norm prior to this anthropogenic modification (Dettman, et al. 2004).

Samples were prepared by utilizing a .3 mm carbide drill to extract powdered samples from the exterior of shell surfaces. On bivalves samples were taken in a linear cross-section perpendicular to growth bands, on univalves locations spiraled around the shell to perpendicularly cross growth bands. $\delta^{18}O_{arag}$ and $\delta^{13}C_{arag}$ were measured at the Environmental Isotope Laboratory of the University of Arizona with an automated carbonate preparation device (KIEL-III) coupled to a gas-ratio mass spectrometer (Finnigan MAT 252) The samples were reacted with dehydrated phosphoric acid under vacuum at 70° C. Calibration of isotope ratio measurements were accomplished by repeated measurement of standards (NBS-18 and NBS-19) (Gonfianti, et al. 1995). Precision is estimated at .1‰ for $\delta^{18}O$ and .06 ‰ for $\delta^{13}C$ at one sigma.

Figure 11.27 displays modern, and in the case of the Colorado River debauch region historic values, as reported in Grimstead et al. (2013) as well as the six specimens from the Moctezuma Valley. All of the samples clearly have a provenance in the north of Isla Tiburon province (Table 11.4). These results are quite notable since previously it had been hypothesized that shell in this region moved north up the major river valleys from near modern day Guaymas with a major end point consumer at Paquimé (DiPeso 1974a:627-628; DiPeso, et al. 1974d:401). These results, in contrast, suggest that shell came from the nearest possible coast at approximately the same latitude.

Turquoise

Only three specimens of turquoise were recovered during the project, a piece of raw mineral on survey from La Cuchilla and two beads, one each from El Nogal and Teonadepa. The raw mineral fragment was analyzed in the development of a mass spectrometry lead (Pb) and strontium (Sr) isotope based method for the determination of turquoise provenance (Thibodeau 2012; Thibodeau, et al. 2012; Thibodeau, Ruiz, et al. 2007) (Table 11.5). Pb and Sr occur as trace elements in turquoise and vary predictably based on regional variations in the age, composition, and tectonic history of associated copper (Cu) mineralization, igneous rocks, and host geology (Thibodeau 2012:110). The technique can discriminate sources to geologic regions as depicted in Figure 11.28. This method has thus far focused on sources in Arizona, New Mexico, Colorado, and Nevada with limited testing of sources in California and Sonora. As such, the full range of turquoise sources utilized in the prehispanic era has not yet been characterized. Most notably, many sources in northern Mexico have yet to be sampled.

Samples are prepared by powdering and subsequent dissolution in concentrated HCL or stepped HF, HNO^3, and HCL. Pb and Sr are separated using Sr-Spec resin. A GV-instruments MC-ICPMS is utilized for Pb isotope analysis following Thibodeau and others (Thibodeau, Killick, et al. 2007). Sr samples were analyzed utilizing a VG sector 54 multi-collector TIMS in dynamic collection mode following Thibodeau (2012: 88). Details on $^{87}Sr/^{86}Sr$ fractionation correction, $^{87}Sr/^{86}Sr$ NBS standard comparisons, and Pb ratio 2 sigma measurement errors can also be referenced in Thibodeau (2012).

Based on the analyses of the tested sources Thibodeau (2012:126) suggests an $^{87}Sr/^{86}Sr$ ratio value of .710 serves as a useful categorical delineator of turquoise samples. Certain localities, such as the Sleeping Beauty mine, can also be categorically distinguished based on very high $^{87}Sr/^{86}Sr$ values in excess of .75. The $^{87}Sr/^{86}Sr$ (Figure 11.29) ratios alone can thus identify a sample to one of three broad geographic regions identified in the Northwest/Southwest and a few specific locations such as the Sleeping Beauty mine. The Moctezuma Valley sample had a value of .70815, which places it in Thibodeau’s Group 3, which mostly included mines in western New Mexico as well as the Eureka mine in the boot-heel region. Other regions with similar values also exist in portions of Nevada.

Further geographical refinement is provided by comparison of various ratios of lead isotopes within $^{87}Sr/^{86}Sr$ defined groups, most importantly $^{208}Pb/^{204}Pb$ versus $^{207}Pb/^{204}Pb$ (Thibodeau 2012:123, 127)(Figure 11.30) but also $^{207}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ and $^{208}Pb/^{206}Pb$ versus $^{207}Pb/^{206}Pb$. Note that Cananea, located in Sonora, was included on these plots for comparison even though it falls above the $^{87}Sr/^{86}Sr$ threshold. The Pb isotope data indicate the sample does not correspond to any region characterized to date. The sample can thus be excluded from essentially any provenance on the U.S. side of the international border and the porphyry deposits near Cananea, Sonora. No other Northwest Mexican sources have been tested as of yet. The nearby modern day copper sources of Nacozari or Cumobabi would seem like the most probable candidates, but characterization of these locations is necessary to test this proposition.

12. Site Descriptions

This section provides summary descriptions of all sites discovered or otherwise recorded on the 2010 survey. A more elaborate description is given of the three sites excavated in 2012. Refer to Appendix D for summary data on all sites.

Las Clavellinas (Son H:13:2)

INAH personnel previously recorded this site. The site is large for the area and is located on the high mesa to the north of the Teonadepa town dump. The site consists of a relatively narrow area along the eastern side of the mesa where occasional river cobble cimientos are noted (Figure 12.1). Most cimiento cobbles are partially buried and many certainly are completely obscured by soil deposition. After the site was mapped with a GPS, it was realized these sporadic cimientos formed a clear rectangle (see site map in Appendix E). It appears several domestic structures were arranged in a regular pattern around a plaza. This is the only such space demarcated in this manner discovered on survey or otherwise reported for the region except for one other less convincing example at Teonadepa (Son L:1:23). Vegetation prohibits visualizing the complete spatial layout of the plaza firsthand.

The majority of the site is characterized by less clear evidence for habitation. Numerous small mounds (Figure 12.2) are present across most of the mesa with the exception of the very western and southern margins. These mounds are composed of small and large river cobbles and dark soil characteristic of cultural deposits. Artifacts, including lithics and sherds, are invariably present. The interstitial spaces between the mounds have notably fewer artifacts. It seems likely these mounds are the remnants of adobe or some other kind of perishable structures. The presence of so much likely adobe architecture would be unique for this area. Several of the mounds have large looters pits, confirming that substantial cultural materials are likely present, but buried. Artifact densities across the site are generally high, several sherds with surface treatments including incising, cuneiform punctuates, and brushing were noted. Two pieces of obsidian were also found on the surface. Other lithic artifacts were made from a wide variety of chert sources. Numerous metate and mano fragments were also noted, executed on a variety of extrusive volcanic materials. As is common, none of the metate specimens were complete. The site's most interesting feature is a wall foundation composed of large stones that borders the entire western edge of the site (Figure 12.3). This side of the site affords the easiest summit, suggesting a possible defensive purpose to the wall. This is also the side that faces away from the river and thus towards the direction of groups that would not be in immediate and frequent contact with site inhabitants.

Intense cattle trampling disturb several portions of the site, but these areas tend to be rather small. There is a recently cleared tract of land crossing the southern margin of the site, likely for a planned barbed wire fence. A young local resident also explained the hill was a historic mine and pointed out the now collapsed entrance on the northeast side of the mesa. Supposedly the remnants of mining activity are also observable on the steep eastern face of the site that is not approachable on foot and currently obscured from view by vegetation. The mesa is a fluvial river terrace, so it is unclear what sorts of materials were being extracted if any. It seems most likely the location was simply prospected and quickly abandon. The mesa is much higher than most landforms used for habitation in this area.

There are two smaller hills located to the immediate southwest of the site with potentially novel architecture. Each of these hills have probable small structures on their summits indicated by stone foundations of large basalt cobbles. They could potentially be signal pyre locations, some kind of observation outposts, or some kind of historic feature of unknown function. No artifacts were associated with either locality and no temporal affiliation is discernable.

Local inhabitants claim the main site was the location of prehispanic Cumpas, meaning the Native population of the region at the time of the Spanish *entrada*. This obviously cannot be confirmed by surface survey, but if the site was temporally very late it might explain some of its unique features, including the plaza space, location on a higher landform than usual, defensive wall, and potential outposts. Many of these features are obviously suggestive of defensive concerns, perhaps suggesting warfare was more of a concern in the very late prehispanic period and that processes of aggregation were occurring that encouraged new site layouts. The arrival of Apache or other semi-nomadic raiding groups are certainly a potential impetus for these changes. The presence of mostly familiar artifact types and styles would suggest the site was occupied to some extent throughout what is taken to be the interval of mesa occupation, i.e. post A.D. 1100 to contact.

La Cuchilla (Son L:1:6)

La Cuchilla was previously recorded and is described by Blanquel (2010) and Hinojo and Blanquel (2011). A small number of ^{14}C suggested an occupation that include a post A.D. 1400 component (see Chapter 10), but an earlier occupation also seems likely. The site is large for this region. It is located on the west side of the river on a long but narrow mesa. It can be accessed from either end but is easier to summit from the south end. Approximately 50 meters of the far south end is disturbed by surface blading. Other substantial areas have been so heavily trampled by cattle and covered by manure that few surface indications remain. This sort of disturbance is especially pernicious along the southwest side (non-river side) on a lower plateau. Despite these disturbances numerous river cobble cimiento foundations are readily visible in the remaining areas of the site (Figure 12.4). Many of these cimiento foundations are two cobbles wide but three cobble and single cobble alignments are also present. Artifact densities are relatively high. Numerous broken manos and metates were observed, especially in the area of the bladed portion of the site. Lithic artifacts included one projectile point made on a yellow beige chert and numerous flakes of obsidian. This site along with Teonadepa (Son L:1:23) were the only sites that presented significant quantities of obsidian on the surface. Ceramics were either plane or red ware varieties. Exotic artifacts included a small Black-on-orange sherd a small black on white slip sherd, and a small piece of turquoise debitage. Sherds with textured decorations were noticeably minimal.

There are two clear areas of habitation and several other areas that may have been utilized in prehispanic times. The main habitation area, located on the south end of the mesa, makes fairly effective use of all available space. Many river cobble cimiento foundations were only partially exposed alignments, suggesting even more evidence of habitation structures is buried and that the total number of mapped structures is only a partial count of the actual preserved architecture. One rebar datum from the 1999 excavations was noted in this area. This main habitation area extends across a large portion of the undulating mesa, even in very narrow areas and at some distance from the river. Several lower plateaus on the southwest side appeared uninhabited and evidence of habitation ceases for a significant section on the northwest end of the mesa as it recedes from the river, despite suitable building surfaces. There is a small habitation area visible further to the west after the mesa turns away from the river. This area is highly disturbed by cattle and it seems likely the entirety of the level portion of the mesa, in this area, was used for habitation. A structure with very large walls that made use of a significant amount of stone is located between these two habitation areas. Several piled stone features (Figure 12.5) are located further along the mesa, past the second, smaller habitation area, but it is unclear to what era these constructions date. A mesa with similar morphology located to the south is uninhabited.

La Galera (Son L:1:7)

This is a large site of historic and possibly prehispanic age. The site is best reached by driving down the Jamaica/Teonadepa road and stopping at the given coordinates. The site straddles the boundary between Ejido Jecori and Ejido Cumpas with most of the site located on the Cumpas side. The site is bordered by the road that runs in front of the large mesas of the west side of the river and on the east by a smaller mesa located in the floodplain west of the present river channel. Further to the north, the eastern border of the site disappears into cultivated milpas and irrigation works. To the north the site is disturbed by a modern corral complex. To the south artifact densities slowly drop off to zero approximately even with the edge of the floodplain mesa. The site is on the floodplain, which suggests it is not associated with the standard prehispanic settlement pattern that appears to be almost exclusively located on mesas. Much of the site has been bladed and some portion may have been plowed. Due to the floodplain setting there is also significant vegetation over much of the site as well as disturbance from cattle grazing. Despite these obstacles artifacts are readily visible on the surface. Numerous plain brownware ceramics and lithics are mixed with porcelain and historic purple, dark green, and aqua glass. Several metal objects were also observed, most unidentifiable. A sample of these historic artifacts are discussed in more detail in Other Analysis (Chapter 8) and suggest an occupation in the early 1900s. It is not clear if the ceramic and lithic artifacts represent a prehispanic occupation before the historic component or the maintenance of traditional artifact forms into the historic period. Many of the ceramics have dark cores, possibly indicative of manure temper common in the historic period, but many ceramics also lack this quasi-diagnostic feature and are tempered with the standard local wash sands.

Several river cobble cimiento style foundations were noted where preservation permitted. These foundations differ to varying degrees from the prehispanic style in that they are generally more rectangular with no to minimal space between the cobbles used in their construction. It is possible these are not all coeval with the deposition of historic artifacts but the contexts relating the two seems fairly secure. Several other amorphous stone constructions were also present but are difficult to interpret due to the described disturbances (Figure 12.6). There appears to be at least one enclosed compound area, likely with several internal and attached external rooms. On the northern edge of the site is a large set of adobe wall foundations composed of locally available basalt (Figure 12.7). No cement was used in these foundations and the adobe brick superstructure is left standing to a short height in only a few places. Much of this area has been disturbed by modern construction activities. A local inhabitant of Jecori claimed this area was a stable, but had no suggestion as to the age. The internal portion of the site was not thoroughly mapped or collected due to time constraints and the dense vegetation and many modern disturbances.

A small cemetery was located to the west of the site on the slopes of a hill. This cemetery is likely associated with this settlement and was designated as locus two. The graves were identified by piled stones. Highly weathered plastic flowers were visible on one grave suggesting the age of the settlement remains within the recent historical memory of at least one local resident (Figure 12.8). No markers were present on the graves and their orientation was somewhat haphazard. No formal count of the graves were made but 50 to 70 seems like a plausible estimate. This site is registered in the records of INAH Sonora, but no additional information, such as the date of occupation is recorded. A more through effort of querying local residents would likely produce some insights.

Mesa de La Galera (Son L:1:8)

This is a moderate sized settlement located along the Teonadeopa road on the west side of the river. It can be reached from Teonadeopa or from La Colonia by the river road that crosses the valley south of town. The site is moderately deflated providing very good conditions for identifying river cobble cimiento style foundations (Figure 12.9). The site is located on a very gently sloping area with more significant slopes above and below. The mesa extends for a short distance to the south and a more significant distance to the north with this same topography, but only the central portion contains evidence of habitation. The preservation and visibility conditions likely allowed for almost complete recording on all structures located at the site at the time of abandonment, as opposed to most other sites were natural formation processes prevent identification of the complete population of structures. Many structures, however, were missing evidence for all but one wall, which suggests that some structures may be still unidentifiable, mainly due to cattle scattering the surface evidence of structures. Many of the river cobble cimientos were of the double row form. Artifact densities were very low and consisted almost entirely of plain brownware sherds, lithic debitage, and manos. This site was previously mapped and is reported in Blanquel (2010).

La Cañada de La Cueva (Son L:1:9)

This petroglyph site is currently used as a local religious shrine. There is a small overhang in the bedrock face of the arroyo that has been paved and currently contains candles and icons. Located on both sides of the very small alcove cave are rock art panels of unclear age. It seems likely that several of the figures were at least altered historically since they contain Christian style crosses. Some elements, including an anthropomorph, are more likely prehispanic in age. One panel is located to the right of the overhang at eye level, it is a geometric design of unclear temporal affiliation. A second pane contains an apparent prehispanic style zoomorph or anthropomorph and a design that looks like a very rounded "M". A third panel contains only geometrics of unknown age; several of the figures are similar to modern letters suggesting they may not be prehispanic. A fourth panel consists of a straight line and a series of at least five of the "M" figures. It is of unknown age. Local people claim that at least some of the rock art predates the present use of the area as a shrine.

El Borbollón (Son L:1:11)

This site, El borbollon, was previously reported by Blanquel (2010) and Hinojo and Blanquel (2011). Since the site was previously recorded and outside of the designated survey area only a brief investigation was made. This site is located to the north of the main house of the Alamo ranch. A local ranch hand serving as a guide claimed that the road that leads to this area was once the main thoroughfare between Hermosillo and Agua Prieta. There are two loci on the site. The first is a group of prehispanic structures located on both sides of the aforementioned road (Figure 12.10). The structures were identified by large stone footings. Most were disturbed to some extent by modern blading or erosion and the historic road. Sherds were the only artifacts readily identifiable. The location of the structures, some distance away from the mesa edge, is unique for this area, but previous excavations by the aforementioned authors firmly establish a prehispanic date of occupance, possibly as early as A.D. 900.

The second loci is located to the north northeast along the mesa edge. At least two structure foundations are located in this area. These structures likewise have stone foundations but in a layout more in keeping with protohispanic or historic period patterns. The first structure is a double room with one shared wall, the second is an isolated small structure. Several sherds were noted on the surface. A circular depression attached to a small linear depression may indicate either a pit house or some small water retention area was also present.

Tesotal (Son L:1:15)

This site is directly east of the Huashi area on the main river road. The site contains two very well preserved structures of the large river cobble foundation type. Both of these structures have been partially buried by mechanical machinery that stripped the nearby surface. The structures appear to share a common wall. It is likely other structures were present in the vicinity before stripping activities took place. There is also a large, deteriorated stone wall, likely of historic age running past these structures and around the edge of the mesa to the south and then east. This wall was likely intended to control livestock at some point in the recent past. A dirt road that passes along the eastern, backside of the mesa also produced several spoils piles. In one of these a metate fragment was located as well as numerous sherds and lithics. This would suggest the original site was much larger than the preserved surface remains. No features were discovered in between these artifacts and the described structures even though the area was largely undisturbed, suggesting a diffuse and minimal occupation.

Badehuachi (Son L:1:16)

This site is located near the Badehuachi spring and was reached by horseback, a poorly maintained dirt road does service the area. All the preserved architecture that was recorded is of the large stone foundation (Figure 12.11) type, most of it basalt cobbles. This suggests a predominantly historic age. The site is located on the flats immediately adjacent to an arroyo drainage. There is a large modern corral complex that divides the site in two. It is unclear if this modern installation destroyed any archaeological deposits. The walls of several of the clearly historic structures are quite well preserved standing over 70 cm tall. A large piled rock alignment runs up the side of a small hill with no apparent function (Figure 12.12). No structures were located on this hill or any of the other surrounding landforms. Minimal artifacts were located on the surface, and animal disturbances suggest substantial buried deposits may be present. It is unclear if this area is prehispanic in age, historic, or contains features from both eras. The presence of sherds, lithics, and groundstone, suggests at least some prehispanic/protohispanic use if not occupation.

Jamaica Vieja (Son L:1:17)

This site is located on the mesa above the historic settlement of Jamaica. It has been subjected to a variety of disturbances; including the construction of a historic homestead in the far north of the site, a family cemetery in the far south, substantial blading for buffel grass in the north half, construction of a road through the center, the dumping of historic trash on the western portion, and moderate disturbance by cattle across the site. Despite these disturbances several sections of the site remain relatively well preserved.

A compound, with several internal rooms is located in the western portion of the site. This compound and associated rooms are identified by large stone foundations (Figure 12.13). Isolated river cobble cimiento structures are located adjacent to this area and to the northeast and southeast. The northeast portion of the site is particularly well preserved and several unique artifacts were observed on the surface, including a polishing stone, an arrow shaft straightner, a possible piece of groundstone jewelry and a fragment of marine shell. Slag, from ore smelting and of unknown origin was also observed across the site in a roughly coterminous distribution with the presumed prehispanic artifacts. The presence of this material and many carbon core sherds suggests this site was occupied into the historic period. The material culture of the site indicates that if this was true the residents were likely indigenous. At least some protohispanic and prehispanic occupance also seems likely.

Dos Casas (Son L:1:18)

This is a small site reached by driving down the Jamaica road and stopping at the given coordinates. It is likely a small historic homestead site. Two well preserved basalt stone foundations (Figure 12.14) were present some distance from the mesa edge. The only artifact noted was a small sherd of aqua colored glass.

Fierros (Son L:1:19)

This is a small hamlet site located on a large mesa. Despite substantial open space on the mesa and minimal disturbance, only one small cluster of river cobble cimiento structures was located. Several very large stones were included among the more standard cimiento style architecture. At least three and possibly four structures were located in this architectural group. The preservation was very good. Two of the structures were free standing but apparently connected by an extramural wall that possibly produced more covered space. Despite an intensive search only one sherd could be located. Some distance to the north a well made lithic end scrapper was also found.

Las Peñitas (Son L:1:20)

This is a small site located on a fairly large mesa. Surface evidence of the site consists of a single row river cobble cimiento foundation (Figure 12.15) and an isolated alignment closer to the mesa edge, which suggests at least one more structure is present but largely buried. There is significant cattle disturbance in this area, but it seems unlikely that this was a substantial site given the lack of artifacts or any other indications of structure foundations. It is curious the noted structures are some distance along the mesa and not closer to the river. These seemingly more suitable areas were intensely searched for evidence of habitation to no avail.

Las Vacas (Son L:1:21)

This site has been completely bladed. The purpose of the blading is unclear. Several park benches and a large circular patio made of various colored flagstones are present, suggesting the area was intended to be an outdoor recreation area of some sort. However, the site is located on the top of a mesa and only serviced by an unimproved road that passes through a locked gate at a cattle coral and hay storage facility. Before surveying the area, a local rancher stated that during the building of the corral several small whole vessels were discovered that contained human bone. In addition to the blading disturbance the site is presently completely covered by knee high buffel grass. The area is clearly not presently used to graze cattle. Numerous sherd and lithic artifacts were noted in the occasional bare patches present in the grass. The site was likely a fairly large habitation area prior to disturbance. No evidence of structures currently remains. The site's boundary is estimated based on the distribution of artifacts but it is at best a very rough estimation since most of the soil on the site is clearly displaced to some degree.

La Boca (Son L:1:22)

This is a small site on a moderately sized mesa. It is the most northern habitation site noted along the mesas on the west side of the river south of Teonadepa. The visible site consists of an approximately 60 m square area. Well preserved river cobble cimientos were located on the northern and southern margins of the site (Figure 12.16). Cattle have heavily disturbed the area in between these preserved patches. There is one probable structure that appears to be disturbed by looting. On the eastern end of the site several groundstone items were located in a deflated area. This site does not contain many surface artifacts and clearly does not cover large portions of the available space on the mesa. The number of habitation structures is difficult to estimate due to the cattle disturbance, but settlement density was likely quite low, as suggested by artifact distributions.

Teonadepa (Son L:1:23)

This site may have been recorded by Wasley as Son L:1:3, but no useful records remain in INAH files, other than the name *Teonadeopa*. The site is very large and is located along the northeast edge of the mesa that overlooks the western side of the Rio Moctezuma from just north of Teonadepa. This is one of three sites that were tested through excavation in 2012. Las Clavellinas (Son H:13:2) is located to the immediate north on a more elevated landform and may be related to this site. The site likely originally extended to the southeast in the vicinity of the modern school and a fenced agricultural field.

More evidence of surface structures were recorded at this site than any other (Figure 12.17). This included a total of 90 stone alignments with a total length of 252 m. A fairly large gap in surface alignments or other architectural features may indicate a plaza or other maintained open space. Presently, very dense vegetation precludes identification of this area through on site inspection, and it is overall less convincing than the space clearly demarcated at nearby Las Clavellinas. It is nonetheless suggestive of some degree of site structure and planning. Excavation of various features including Feature 20/21, 32, and 33, indicate variable construction techniques. Most examples are likely the simple wattle and daub constructions typically associated with cimientos of river cobbles, but some, such as Feature 32, utilized coursed adobe. Coursed adobe is also visible in some looter's pits, which unfortunately are very common at the site (Figure 12.18). There is likely some degree of temporal variation associated with these techniques, but it is also clear they overlap to a significant degree. The site was likely occupied from at least A.D. 1000 to 1550 and perhaps both earlier and later. Several flaked glass artifacts were recovered from the surface. As demonstrated by the apparently overlapping architecture encountered in Feature 33, it seems many structures were torn down, remodeled, or otherwise altered over the course of the sites occupation.

In addition to the wall alignments there at least nine large midden piles (Figure 12.19), identified by the presence of much fire altered rock and dense artifact scatters. These features have a total area of 978 m^2, and include Feature 31, which was tested with a 4 m long trench that revealed no discernable stratigraphy. Most of these features are located in the western portion of the site, which has undergone some degree of deflation. It seems likely that prehispanically there must have been considerable architecture in this area, commensurate with the eastern portion of the site where such midden piles are associated with numerous wall alignments.

Artifact densities are quite high, especially in the midden rock piles. Obsidian was ubiquitous on the surface. This site and La Cuchilla are the only sites that contained significant amounts of this material. Chihuahuan style ceramics were also recovered from both the surface and through excavation. These are decidedly rare in the assemblage. A small, deflated area of calcined bone in the western portion of the site was the only evidence of a likely human burial discovered at any point during the project. Overall, due to its size, density of occupation, and unique artifact assemblage it seems obvious Teonadepa was the primate site of the northern settlement group.

El Salto (Son L:1:24)

This is a moderate sized site located to the south of the *piñitas* of La Colonia on the east side of the river. The site consists of three loci. Locus 1, the largest, is a prehispanic settlement located on the largest mesa within the site boundaries at the northern end. Several river cobble cimiento foundations (Figure 12.20) and two large, low mounds of likely melted adobe (Figure 12.21) were noted in this area. Rodent disturbances produced very dark, culturally modified soil in several areas of the site. Both sherds and lithics were ubiquitous. The site has been heavily disturbed in large sections by road construction, blading, and cattle trampling and manure deposition. A Black-on-orange sherd and a flake of obsidian were found in this area.

Locus 2 is a single line of river cobble cimientos and a few isolated artifacts located on a mesa to the north of Locus 1. Most of the river cobble cimiento structure was apparently removed by the construction of a dirt road. There was likely never a substantial settlement here since the level ground is quite limited and there does not appear to be a substantial number of artifacts. No other structure foundations were noted in the surrounding undisturbed area.

Locus 3 is located in between the other two loci on a mesa that extends westward into the river valley. Two large historic structure foundations were located in this area. One structure had a substantial stone foundation that is readily visible. The second structure was constructed of adobe brick on what is likely a single course of stones. The stones are visible only on the southeast corner. A very small portion of standing adobe brick is present on the southwest corner. Given the near complete deterioration of the structure it may be quite old. Several plain brownware sherds were recovered from the second structure. There is also an area of large scattered stones to the northwest of these structures that may be the remains of a third structure. Occasional sherds were seen across the site despite significant ground cover. There is also a more recent, but historic, adobe structure located just off the low mesa to the south.

La Colonia (Son L:1:25)

This site consists of three loci. Locus 1 is a heavily disturbed area adjacent to the *piñitas* of La Colonia. This is the largest locus of the site and is located immediately above the *piñitas* . This area has been completely bladed but a significant number of artifacts are present across the mesa and in the spoils piles on the sides of the mesa. One painted ceramic was collected that is similar to design styles of southern Arizona. The size of the mesa suggests a moderate sized settlement was once located here.

Locus 2 is located to the north. This area includes several small mesas that were apparently uninhabited, but occasional flakes can be found, suggesting the area was utilized for resource extraction or some other non-habitation activities.

Locus 3 is another habitation area located to the south of Locus 1 across a small arroyo. This area is also disturbed in portions by cattle trampling and manure deposition. Several looters holes were also observed. There also may have been some blading or other ground disturbance along the western edge of the mesa. Several river cobble cimiento foundations were noted *in situ* and artifacts including groundstone are present on the surface of the area.

Los Alamos (Son L:1:26)

This site was reached by driving down the ranch roads that leave out of Teonadepa. The site is located on the Alamo ranch. A local ranch hand served as a guide. The site is located directly above the corral of the Alamo ranch. Numerous small stone piles were present on the site (Figure 12.22). The guide, claimed these were burials but gave no specifics for how he came to such a determination. The piles do have the rough morphology of historic burials in the region but were generally too small to conceal a supine body. Several of the rock piles were clearly parts of larger structure walls, but this is not the case for most. Several metates were also recorded, which supports the supposition that this area was more than a cemetery. Very few sherds or lithics could be located. At the base of the mesa, in the corral area, several pieces of slag were present which suggest a historic occupation in the area.

El Nogal (Son L:2:1)

This site, El Nogal, is located on a bifurcated mesa to the southeast of Moctezuma. It was one of three sites excavated in 2012, so considerably more information is available relative to most other sites. El Nogal, is one of the largest sites located on survey and is interpreted as the primate center of the southern settlement group. The site is located on a fluvial terrace that was capped by basaltic flows during the Pleistocene. This impermeable layer of rock prevents infiltration, retaining water near the surface and creating salubrious conditions for very dense vegetation. The site can be divided into roughly three regions. There is a narrow finger of basalt capped mesa immediately adjacent to the river valley. This area contained many stone walls and several prominences discussed below.

To the west of this mesa is a lower, sheltered alluvial surface. There are only small pockets of surface bedrock in this area. This is the location of most preserved structure foundations (Figure 12.23) and the highest density of artifacts. Though it is lower than basalt capped landforms to both the east and west, it is still considerably above the elevation of the floodplain. Finally there is the basalt capped area to the east and south of the alluvial section. Habitation was likely less dense in this region, but there is still ample evidence of anthropogenic alteration and use. The relatively unique geologic setting is reflected in many anthropogenic features at the site. There are numerous (approximately 37) piled stone walls (Figure 12.24) at the site with a total length of 465 m. Some of these are clearly historic, but many more seem likely to have a prehispanic origin. This is particularly true of wall segments along the eastern margin of the site which do not have a morphology or arrangement that would make them useful for livestock management. Many wall segments along the western plateau finger of the site are clearly historically modified, but again their placement is curious and at least some probably were used prehispanicaly as a means to demarcate space. There are two locations on the site where natural prominences were apparently altered or cleared. These seem like probable analogs to the speaking platforms referenced in ethnohistoric texts from which leaders would address commoners.

The majority of habitation was likely in the central strip of non-surface basalt between the more elevated capped mesa formations. To be sure there is evidence of habitation in these areas as well, and there is ample evidence on the western talus slope in front of the mesa that domestic trash was routinely thrown over the edge all along the mapped site boundary. There are also numerous petroglyphs recorded at 27 locations along the basalt rock face of this western edge (see Chapter 9 and Appendix I). These petroglyphs continue to the south and are designated with several other site numbers.

The artifact densities of the central portion of the site were some of the highest noted on survey. This was also confirmed by excavation in this area that produced an almost copious amounts of sherds and other domestic refuse. Several locations in the central portion of the site, where there were small basalt outcrops, were clearly utilized as midden areas, and sherds nearly cover the surface in these areas. Over 300 instances of groundstone (portable and bedrock) also speak to the intensity of occupation at the site. There are only approximately ten instances of visible surface architecture in this area, producing a total of 69 m of visible river cobble cimiento alignments. This low total is the result of heavy use of the area for cattle, which have a very pernicious effect on river cobble cimiento alignments. Two nearly complete river cobble cimiento outlines were excavated as Features 1 and 2. Feature 3, located on the higher western portion of the site, presented only a few cimiento river cobbles as surface evidence. Excavation revealed this was actually a true pithouse that was very well preserved. There are likely many more such features completely buried on the site. Notably there was no depression visible on the surface prior to excavation. Only one depression was noted on the site as possibly being indicative of a pithouse. Due to the significant formation process issues little can be said of domestic architecture arrangements.

Limited chronometric testing suggests the site was inhabited as early as A.D. 900 to at least 1450. The presence of rare flaked bottle glass and an intrusive pit containing horse remains suggests continued use of the area into the historic period. This site corresponds to site numbers assigned by both Wasley and R. Pailes but no detailed records of this site could be located at INAH.

San Patricio (Son L:2:6)

This site is located adjacent Moctezuma River pedestrian bridge on the south (west) side of the river. The site consists of a singular well preserved river cobble cimiento foundation at the edge of the river terrace mesa. A large, partially completed, modern structure fills most of the remaining space on this small mesa. Sherds were observed on all sides of this modern structure in the construction spoil piles suggesting several more prehispanic structures were likely destroyed. This site appears to be the same as one recorded by Wasley in the 1960s, no additional information other than its location was recorded by Wasley.

Cajón de Los Deargüelles (Son L:2:13)

This is a small rock art site consisting of three closely spaced panels. The site is located in a small arroyo and the panels are situated well above head level. The first panel consists of one depiction similar to a *blanket* design. The second panel is composed of an anthropomorph and several geometrics. The third panel may not be temporally associated with the others; its figures are only fugitively pecked into the rock surface and are executed in a less refined style.

Mesa Abaja (Son L:2:16)

The site is reached by following the dirt road south from Moctezuma that runs in front of the large malpais mesa. There is a small habitation site located on top of this small river terrace mesa, which is below the higher and much larger basalt capped mesa. There are a number, at least three, very clear river cobble cimiento foundations with all four walls present, as well as a number of singular wall alignments and corners suggesting more structures are present. Artifact densities were very low. Sherds were extremely rare and could only be located with considerable effort. Only one mano was seen and no metates. Flakes were present but not ubiquitous. Vegetation was very dense and there are likely more structures present than what was visible at the time of survey. There was no sign of looting.

El Corral (Son L:2:17)

This site is located midway between sites El Nogal (Son L:2:1) and La Volanta (Son L:2:39) on the malpais mesa. The site consists primarily of petroglyps and a few mortars.

There is a circular stone structure present, that local ranchers believe to be prehispanic. No artifacts were associated with this structure. The feature is approximately five meters across with a large entry facing west toward the nearby mesa edge. There are many other stone walls in this area built by ranchers along the edge of the mesa, but none in the immediate area and none that do not clearly serve a practical function to restrict the movements of cattle. It is possible this small structure was a historic corral of some sort, but this seems unlikely.

Tebisco (Son L:2:18)

This small site is located in the Tebisco region. The site consists of several river cobble cimientos widely dispersed across the eastern edge of a long mesa. A fence divides the eastern and western half of the mesa and may have disturbed some prehispanic architecture. A singular, well preserved, river cobble cimiento, structure was the only archaeology observed on the west half of the mesa (Figure 12.25). Sherds and lithic densities are very low. More structures may be present along the eastern edge of mesa that are buried or presently obscured by vegetation.

Las Abejas (Son L:2:19)

This site is located to the north of the ore processing machinery readily visible on the west side of the river. There is a road that leads to the top of the mesa where the site is located. There is a modern warehouse structure on the mesa. The entirety of the site has been bladed or disturbed by modern construction. Sherds and lithics are visible in the back dirt piles that have been pushed to the mesa edge. Given the size of the mesa and its location it seems likely a small hamlet with a few structures existed here before the area was disturbed.

Nicroa Chica (Son L:2:20)

This site is located on a small mesa to the south of Nicora (Son L:2:41). The site can be reached by the road heading south from Moctezuma through San Patracio de La Mesa. It is on the east side of the road next to the river floodplain. The site has been bladed to increase cattle forage. Artifacts are visible in the spoils piles located in several areas on the mesa. The site was likely a small habitation before it was disturbed. A wash is present on the northern side of this mesa, a continuation of the landform to the south does not appear to contain archaeological materials.

Comachi (Son L:2:21)

This site is located in a narrow section of *barranca* with few level surfaces north of Moctezuma. This site is located on an ideal mesa for settlement in terms of its proximity to river elevation and size. There is, however, no adjacent bottomland and as a result no apparent substantial occupation. A small sherd scatter was noted in association with what is likely the remains of one small river cobble cimiento structure. The area contained many more lithic artifacts, some large and commensurate with agave processing. Most likely this locality represents a seasonal habitation, or a repeatedly used camp site.

Los Mineros (Son L:2:22)

Los Mineros is a very large site covering a series of stepped terraces with several occupation areas. The site is located in the Tebisco area on the west side of the river near a large bend and was one of the three sites selected for excavation. The site contains highly variable architecture in discrete clusters. The northeastern, lowest terrace and a very narrow 2nd terrace slightly to the west have several historic structure foundations built with large river cobbles. The careful placement of stones, width of the wall, and size of utilized cobbles distinguish this form of architecture. There are also several possible, mostly buried river cobble cimiento structures in this area as well as prehispanic artifacts. Vegetation is very dense, and more cimientos may be present. At least one of the historic structures has a looters pit in the center and the largest was apparently also used as a dump for more recent building material. One of the smaller structures was tested as Feature 16, it appears to date to the period around 1890 to 1910 based on diagnostic artifacts.

To the west and on a slightly more elevated remnant river terrace several cluster of river cobble cimiento style houses are present (Figure 12.26). These are in various states of preservation ranging from buried and very well preserved to mostly deflated. Excavated Features, 10, 18, 11, and 12/17 are located on this surface. These features date from the 1100 to 1500s. There is a long wall section in this area with cimiento cobbles much larger than standard that may suggest a unique feature was present in this area. A large enclosure or other demarcated space cannot be ruled out, but it is hard to discern much given the limited preservation. This area, as is true of the terrace above it, was frequently utilized for roasting pits. Fire cracked rock and ashy soil are quite ubiquitous across the area. Many other river cobble cimiento foundations were likely present, but have been displaced by cattle trampling, which is significant at this site.

The highest terrace (4th in this analysis) is the location of Features 14, 15, and 16. The eastern portion of this surface is highly deflated, leaving a fairly dense artifact scatter on the surface along with what are likely numerous displaced river cobble cimiento stones. This area is actively deflating presently and different alignments were recorded between the 2010 and 2012 seasons. One large roasting pit was also located in this deflated area (Figure 12.27), close to Feature 15, a midden and rock pile. To the west of this area are numerous roasting pits, identifiable on the surface by clusters of fire altered rock. Roasting pits of this nature were not regularly observed on survey. It seems likely their ubiquity at this site is due to both coincidental erosional contexts that made their identification easy and a greater emphasis placed on preparing foods such as agave, which are often prepared though pit baking. Agave plants are a common if not frequent species in the surrounding low hills. Their relative scarcity today is at least partially the result of modern mescaleros and not necessarily indicative of prehispanic conditions.

This site covers an impressive amount of area, relative to many others recorded on survey. However, the artifact and architectural feature densities suggest it was likely a fairly standard site, that is, not a primate center. Given the relatively small scale parcels of arable land available in the Tebisco region this area may not have had as large or as permanent a population as the northern or southern reaches of the valley. The limited chronometric dating does suggest a fairly continuous occupation from the 1100 to 1500s and beyond.

Tío Lugo (Son L:2:23)

This is a very large mesa on the east side of the river floodplain adjacent to a *milpa* in the Tebisco region. The mesa is some distance from the present river channel and has a lengthy slope. Despite ample room for settlement only one large artifact scatter ~100 m in diameter, several isolated sherds, and one possible river cobble cimiento structure foundation were identified. There was evidence for disturbance in the area of the large artifact scatter in the form of a berm of rocks likely created by mechanical leveling of the surface. It seems likely several prehispanic structures were located in this area prior to the disturbance. There is also very dense vegetation on the mesa that impeded the thorough investigation of several areas. Most likely there was a small settlement located on this mesa that did not grow to its full potential due to the slightly less than ideal setting and ample mesa land available on the other side of the river. A more thorough search of this mesa may reveal a slightly more substantial site, but the density of vegetation is a significant obstacle and is essentially prohibitive accessing some areas.

Las Geodas (Son L:2:24)

This is a small site located on a moderate sized mesa in the Jecori region south of the town and north of Huashi. It is on the west side of the river. The site is composed of a fairly small area of artifacts scattered about two probable river cobble cimiento structures. A few more structures may be buried in the area or otherwise deteriorated beyond surface recognition. It is somewhat peculiar that this site is so small given the size of the mesa, but a thorough search was made of the vicinity and no other evidence was found. The site was likely a small hamlet. Ceramic, lithic, and groundstone artifacts were noted. The structures were deflated. The rocks utilized as cimientos appeared out of place relative to the surrounding surface rock, suggesting they were imported for construction purposes.

El Leon (Son L:2:25)

This site is heavily disturbed by the river road. Many artifacts are located in the adjacent spoils piles. Artifacts also continue for some way up the adjacent hill to the west, but no signs of architecture were noted in this area. To the east several well preserved segments of a large river cobble foundation style structure are present. This structure is located in a small level clearing quite close to the low mesa edge and is likely historic in age. No artifacts were observed in the immediate vicinity of the structure foundation due to heavy ground cover vegetation and presumably minimal deposition. Most of this site was probably removed by road construction, but artifacts suggest a prehispanic occupance as well.

La Pitahaya (Son L:2:26)

This site is quite large and fairly well preserved. A large coral on the far eastern end may have disturbed some deposits and there is occasional natural destruction in the form of erosion and other fluvial disturbances. All the noted structures were of the river cobble cimiento type (Figure 12.28) associated with prehispanic occupance. Several of these were quite well preserved. The artifact density of this site is quite high suggesting it was heavily occupied. Due to evident sheet wash and other depositional formation processes it seems likely that many more structures are present than those that are observable at the surface. Many structures shared common walls. A painted sherd and two pieces of obsidian suggest this site may be unique either in its preservation or in the richness of its material culture assemblage.

El Charco (Son L:2:27)

This is the southernmost mesa in a series just south of Jecori on the east side of the river. The site is heavily disturbed by both the road and substantial blading of the mesa along its western edge. There is also a historic adobe structure with four rooms near the southern end. A local resident stated he believed the adobe structure was about 100 years old. There are areas of substantial artifact density located along the road in spoils piles. A good bit of this area is free of modern disturbance and the notable lack of surface evidence of structures is likely indicative of natural formation processes. Since most artifacts are only visible in the many disturbed areas it is likely that buried deposits are also present in many of the undisturbed areas. Only one structure was indicated by the presence of a river cobble cimiento foundation visible on the surface. Others buried cimientos are likely present in this area and to the southeast and east across the road. A small, broken groundstone bowl was found in this area. However, even taking these areas into account a large portion of the mesa showed no signs of habitation or prehispanic use. Two smaller mesas to the northeast were likewise devoid of habitation evidence, but these were located further from the river.

La Cruz (Son L:2:28)

This site is the northernmost mesa in a series of mesas just south of Jecori on the east side of the river. The site is of moderate size but contains only one unequivocal feature, a large circular enclosure defined by very large rocks bordered in parts by rocks of a more standard river cobble cimiento size. Many of the rocks have been recently removed, presumably by town's people looking for buried deposits. The area remains fairly well preserved and one Archaic projectile point was located within the feature. There is no sign of use of the feature by livestock, effectively ruling out some historic function. Some modern trash is present within the feature, and several cement fence posts are located nearby. A possible river cobble cimiento structure foundation is located to the northwest of the feature but it is hard to securely identify the feature due to numerous natural rocks and a lack of artifacts. Only one very small sherd was found within the feature. It appears this area was intentionally kept clean of prehispanic domestic trash and settlement was prohibited. The area is ideal by the typical standards of habitation sites. The large structure likely served a communal or ritual function of some sort. It is clearly different from any other feature observed during the survey.

Jecori (Son L:2:29)

This site is located on the west side of the river, near the Cerros Jecori. The site is situated on a large mesa ideal for settlement. Approximately 60 to 70 percent of the site has been disturbed by blading to plant buffel grass. The remaining portion of the site consists mainly of a large compound with several internal rooms. The compound apparently had a cimiento river cobble base several stones thick (Figure 12.29) and presumably a substantial adobe superstructure. At least three internal rooms were identified and more are certainly present. In the southern end of the compound there is a large mound composed of melted adobe and cultural fill (Figure 12.30). There are certainly several more rooms present in this location. Adobe burned at a sufficient temperature to vitrify was associated with the southeast most room in this compound. Several probable river cobble cimientos and other evidence for structures were found to the south of this compound, indicating isolated structures are also present. To the north of the compound, in the disturbed area, artifacts are ubiquitous. A large berm created by the ground disturbance along the western margin of the mesa also contains many artifacts. The entire mesa was likely covered by a moderately dense settlement.

Pingüino (Son L:2:30)

This site is located on the west side of the river, near the Cerros Jecori. It is on the same basic landform as Son L:2:21 but several small mesas in between the two areas appear to be unoccupied. The majority of the site has been removed by ground disturbance in the form of blading to plant buffel grass. Artifact densities in the bladed area remain high, suggesting a fairly substantial occupation and possibly more deeply buried deposits. Artifacts can also be found extending for some distance to the south. Several small rock covered mounds in this area are likely the remains of melted adobe structures. Cimientos were not present in most mounds, presenting a pattern similar to Son H:13:2. One isolated set of river cobble cimientos was readily visible on the surface but incomplete due to erosion. The mesa extends for some distance to the south beyond the habitation area. It is unclear why this portion of the mesa was not selected for habitation. Groundstone, ceramics, and lithics were all present in fairly high concentrations associated with the suspected adobe structure mounds.

El Campo (Son L:2:31)

This site includes several areas of artifact concentrations along approximately 600 meters of undulating mesa. Almost all of the mesa has either been bladed for buffel grass or disturbed by modern construction. The few areas that are free of disturbance either lack archaeological remains or are low density lithic scatters. Based on the density of artifacts it appears that there was a sizeable settlement in the middle portion of the site. Numerous sherds and lithics are present in this area extending approximately from the mesa edge to 50 meters to the east. A modern house and corral complex to the immediate north of this bladed area likely obscure more evidence of prehispanic habitation. There is a small strip of land, approximately 10 meters wide near the mesa edge that is not significantly disturbed but this area lacks significant evidence of prehispanic use. Several rocky outcrops to the north and south of this area are also undisturbed but contain only the occasional lithic artifact.

La Platería (Son L:2:32)

This is a historic mill site. A local resident reported the age to be approximately 100 years. It consists of the large, two floor mill structure (Figure 12.31), a second large one floor adobe building with three rooms, a single room adobe brick structure, a cement block outhouse, a well, and a second one room adobe brick structure. The mill has a basement, the roof is currently missing and the walls are deteriorating but still standing to their original height with much of the plaster preserved. Several internal walls are present in this structure. The large three room adobe structure is surrounded by two stone walls, the second inset in the first forming a two level terrace. The first one room structure is similar to the mill and three room structure but has no plaster. Both of these adobe structures are in a similar state of preservation as the mill and were likely contemporaneous with this larger structure. The outhouse and well appear to be more recent, and are in a better state of preservation owing to their concrete construction. The last single room adobe structure is significantly more deteriorated and likely predates the other structures. Several other small extramural walls are also present on the site. The informant claimed the mill was operated by a complicated water system that included a tunnel drilled through a mountain. This feature was not located in the immediate vicinity. The site was notably lacking in artifacts with the exception of broken window glass. A large area has been bladed for buffel grass in between the more deteriorated structure and the remainder of the structures.

Los Argüelles (Son L:2:33)

This site consists of four loci, a two structure compound with large basalt cobble cimientos of unknown temporal affiliation and very few artifacts; a fairly large historic settlement with adobe brick architecture and numerous historic artifacts; a significant prehispanic settlement; and a single adobe brick structure located at the far southern end of the mesa.

At least 14 adobe brick rooms (Figure 12.32) were present in Locus 2 and there are clearly similar structures present to the south and west of this loci in a more severe state of disrepair. Most rooms are part of larger room blocks. A dirt road bisects this portion of the site. A small arroyo to the north of this area is characterized by very dark soil and historic artifacts and was likely the settlement dump. A plaza area is located in the southwest portion of this locus. Most of the observed artifacts were located in this area including brownware ceramics, green glass, aqua glass, and porcelain.

The two cimiento structures of Locus 1 are located to the north of Loci 2 on the other side of the arroyo. Only a few plain brownware sherds were noted in this locus. It is possible these structures were coeval with the historic settlement and that the inhabitants chose to, or were forced to live apart from the rest of the settlement.

Locus 3 is located approximately 150 meters to the south of Locus 2. It appears to be of prehispanic age. Numerous dense artifact scatters are located across this locus as well as many partially visible river cobble cimiento foundations (Figure 12.33). No structures could be mapped in total due to the particular formation processes of this mesa that resulted in a mix of buried and deflated structure foundations. Most river cobble cimientos appeared to be arranged in rancheria habitation groups. No contiguous walls were observed, but the buried state of most habitation areas precludes any definitive statements. A single Archaic projectile point was recovered from the surface of one partially buried structure foundation. The density of sherds on the surface across the locus suggests substantial deposits are present. It seems certain that in addition to the recorded structures many to several more are likely completely buried and could not be identified by surface evidence.

Locus 4 is an adobe brick structure likely affiliated with Loucus 2, but located at some distance from the rest of the structures. The reason for its isolation is unclear.

La Calera (Son L:2:34)

This is a fairly large mesa in the La Galera region south of Jecori. The site is on the east side of the river some distance away from the modern river channel. The site has been mostly bladed, and, as such, most of the evidence of prehispanic habitation is removed. Along the western margin of the mesa several river cobble cimientos were not disturbed by the blading activity. Concentrations of artifacts and a few other sets of river cobble cimientos are also preserved largely in situ in small islands of undisturbed ground. The site was likely quite large, as suggested by the distribution of artifacts. There is an uninhabited area in the mid portion of the mesa to the south of the main occupation area. Gentle slopes and high surface bedrock that apparently discouraged habitation characterize this portion of the site. Occasional sherds and lithics are present on the surface in this area. On the far southern end of this site is a large stone feature that appears to be filled with relatively sterile earth. The stones are large river cobbles. It seems most likely this feature was a small platform mound of some kind associated with the prehispanic occupation. It is also possible it was a large structure of unknown age with an adobe superstructure. If this is the case it does not match the morphology of other historic or late period structures; the rocks are larger and piled higher and there is no preserved adobe overlying any of the stones. A few plain brownware sherds and lithics were associated with the structure, but could have been incidentally included in an adobe superstructure. One possible river cobble cimiento foundation was located to the south of the structure. Presently, this feature is interpreted as a small platform mound with dimensions of 11 by 6 by 1 m.

Parababi (Son L:2:35)

This is a single panel rock art site. The site is located on a large boulder on the west side of the river at a transition between wide floodplain and *barranca*. The petroglyphs appear to consist of several anthropomorphs and possibly several zoomorph or geometrics. The site appears undisturbed in its remote location, but was not well executed, making interpretation of the depictions problematic. No habitation sites are known to exist in the immediate area.

La Junta (Son L:2:36)

This site includes two loci. The first is located on a gentle sloping area on the west side of the river immediately above the Arroyo Jurahui and Rio Moctezuma confluence. There is a small possible foundation located on a level portion of this landform. The foundation was made of local river cobbles. This feature did not have the morphology of the standard prehispanic cimiento structures, as the cobbles were all located on the ground surface and were in an oval as opposed to the standard rectilinear pattern. Several flakes were noted in the area but no ceramics or other diagnostic artifacts were present. On the other side of the river there is a large mesa. There is a very light lithic scatter across the surface of this mesa (Figure 12.34). This region lacks suitable arable land and is located in an area mostly characterized by steep hill slopes. The artifact scatter and possible feature are suggestive of a campsite or at most a seasonal use area.

Las Bagotas (Son L:2:37)

This site is located to the east of the main highway on the open bajada. It is on Ejido Jecori land. A local informant claimed he had found a groundstone axe at the site. Three sets of river cobble cimientos were located in dispersed groups. To the south of this habitation area there is a fairly dense and extensive scatter of lithic artifacts almost all of which are executed on a fine grained, black, basalt (Figure 12.35) that does not appear to be present in the immediately local river deposits. Many of the observed lithics were large flake tools. Several areas of sherd concentrations were also present, also at a distance from the river cobble cimientos. There is a wash that runs along the southeast side of the site and there is a currently dry *charco* located to the south. A local resident stated water is naturally present in the *charco* for much of the year. It seems most likely this area was repeatedly utilized as a seasonal habitation and resource procurement locality (Figure 12.36).

La Cañada de Los Gatos (Son L:2:38)

This is a rock art locality located in an area locally known as the Arroyo de los Gatos. The main locus of the site consists of several highly eroded petroglyps executed in a soft tuft like stone. Several of the petroglyphs are located fairly high on the *barranca* wall well out of reach. Geometrics were the most common form, a blanket form was among those present. There are also several glyphs of modern or likely historic age, including one inscription of the number "1891", likely corresponding to a year. Several initials are also present both at this location and several hundred meters up the arroyo. The site is unusual in that it may contain a continuity of petroglyphs. Several designs contained images of

Spanish style crosses and were executed with metal tools but also bare some similarities in size and layout to the blanket style depictions. The site is also unique in that the petroglyphs are executed on a soft, light colored material instead of the usual dark basalt.

La Volanta (Son L:2:39)

This is a large site that spans both north and south of the modern settlement of La Volanta. The best preserved portion of the site is located on the narrow mesa south of the modern settlement. This part of the site contains numerous river cobble cimiento structures (Figure 12.37) and at least three structures that utilized large stacked river cobble foundations (Figure 12.38). These later structures do not appear historic and this is likely a fairly unique derivation of architecture. There are also several low mounds that are likely melted adobe architecture and that certainly contain large amounts of cultural material. The three river cobble structures are located along the western edge of this southern mesa. Most of the standard river cobble cimientos are located to the immediate north of the large cobble foundation structures. Continuing to the north, the site is destroyed by the modern town of La Volanta. Occasional cultural deposits can still be noted. A pot break and a river cobble cimiento foundation were located at the eastern limit of the site immediately south of the La Volanta access road that runs through the site. To the west of the modern habitation area there is a set of perpendicular walls that appear to be part of a historic structure. The walls are composed of melted adobe brick set atop large stone cobbles. Numerous sherds and other prehispanic artifacts are present as inclusions in the adobe bricks. Very few historic artifacts were present. On the other side of the access road (north side) a significant search for architecture was conducted to no avail, but several sherds were noted. Despite the lack of surface evidence there are probably at least a few buried structures in the general vicinity, likely obscured by vegetation and slope wash. The malpais mesa is located 30 m above this area. Several petroglyphs and a few mortars are present on these rocks.

Puente a Moctezuma (Son L:2:40)

This site is located to the west of the footbridge that connects Moctezuma to San Patricio. The mesa has been bladed and all the rocks that most likely were used as cimientos are now pushed into spoils piles along with considerable amounts of soil. Sherds are readily visible in most such piles. Only two plausible river cobble cimiento structures were located that had not been bladed. The site is relatively large and may have been one of the more substantial habitations in the area. Ceramics, lithics, and even occasional groundstone remain present in a patchy distribution across the mesa. The mesa edge facing the river is relatively steep and is actively eroding.

Nicora (Son L:2:41)

This site is located along a relatively low first terrace on the west side of the river south of Moctezuma. The site is a low intensity artifact scatter extending for a considerable distance. There are patchy areas of modern construction including roads, houses, and associated structures. Most of the site has been heavily used for cattle grazing. Trampling by cattle and significant dung deposition have obscured most surface evidence of the site. In the areas to the south where modern soil disturbance has taken place considerable artifacts are present. These include one backdirt pile along a driveway and a melted historic adobe wall with numerous sherds in the adobe. To the south the site rises several more meters above the adjacent flood plain. This area has been bladed to increase cattle forage. Most artifacts are located within spoil piles periodically placed along the mesa. Numerous rocks that may have been used as cimientos are also located in these piles. It seems likely this area was a moderately to sparsely populated settlement before it was disturbed. Considerable buried, but intact remains, are probably still located in the northern half of the site. Only sherds and lithics were noted on the surface.

La Presa (Son L:2:42)

This site consists of a single petroglyph located on a large boulder on the south side of the dirt road. The petroglyph is on the lower right hand side of the very large boulder as you one faces. The single petroglyph, likely prehispanic, somewhat resembles a sideways, lowercase, typeface “g”.

13. Feature Descriptions

El Nogal; Son L:2:1

(Figure 13.1)

Feature 1

This is a basalt cobble cimiento structure that measured 3.8 by 3 m, with the long axis oriented essentially north south (Figure13.2 and 13.3). The feature was located on the lower terrace between the major areas of basaltic talus approximately 1.5 m to the west of a tumbled perimeter wall that was likely prehispanic. The cimiento stones clearly demarcated all four walls, but no entryway was evident. An east west 2 by 1 test pit was placed first in the northwest corner of the structure and excavated to .3 mbgs before reaching a clear stratum change to a much harder sterile layer with a high clay component. Artifact densities of the fill were extremely high, especially in regards to ceramic sherds. The fill itself was extremely loose and contained many small inclusions of burned daub. Two more approximately 2 by 1s were placed in succession to the south of the first that followed the natural clay stratum. This expansion revealed the surface to be very undulating and an unlikely floor. A close inspection of the resulting profile indicted a slightly lighter in color, thin layer of fill overlay a lower cultural stratum (Figure 13.4). This layer ceased approximately even with the lower limit of the cimiento stones that were partially buried .1 mbgs. This layer likely consisted of melted adobe and was the best available marker of where a floor level may have once been. The remainder of the structure was excavated in a succession of 2 by 1 along the east half of the structure to this stratigraphic depth. Both root and rodent disturbance was significant. After the structure was completely excavated a 1 by 1 was placed in the eastern half to more fully investigate what was now presumed to be subfloor stratigraphy. A ceramic sherd FN 205 was recovered from the first few centimeters of this fill and provides a luminescence age estimation of 1370 +/- 120 (2 sigma), the structure should postdate this age, but presumably not significantly. The placement of a structure in an area that must have been an obvious midden context is curious. The almost complete lack of internal stratigraphy, i.e. wall fall or roof fall is noteworthy suggesting this structure was likely made from mostly perishable materials. This pattern was observed in most river cobble cimiento structures. These structures may pertain to the houses of *mats* noted in several ethnohistories.

Feature 2

This feature was likely quite similar in design and construction technique to Feature 1, but due to more fortuitous placement over sterile fill, was more easily discerned and interpreted. Three walls of the structure were clearly demarcated on the surface by cimientos of rounded basalt cobbles (Figure 13.5 and 13.6) and one instance of a reused metate on the east wall. The south wall was not present and a substantial amount of vegetation was growing in its presumed place. The structure dimensions are 3.6 by an estimated 5 m. No entryway was discernable. The feature was placed close (~4 m) to the same piled stone perimeter wall as Feature 1, and to the north (3 m) of another likely prehispanic collapsed wall that ran perpendicular to this wall. Excavation began by placing a east to west test trench across the structure that was .5 by 3.5 m. This trench quickly revealed the shallowness of the cultural deposit at .1 to .2 m thickness, which extended to the approximate base of the cimiento stones. The trench also encountered a poorly defined intrusive pit (Feature 4) that contained horse remains most likely utilized for subsistence (see Chapter 7). A series of approximate 2 by 1 were subsequently placed parallel along the north side of the trench and then the south side of the trench. One more east west 2 by 1 was placed along the west wall of the structure. The compacted layer was interpreted as a good approximation of the floor layer due to several instances of large, flat lying sherds, including 11 refittable sherds of La Volanta. One of these sherds was dated by luminescence and provides the age estimation of the structure at 1260 +/1 100 (2 sigma). The floor appeared to be unprepared, and no internal features were identified. As with Feature 1, there was almost no indication of construction material aside from the half buried cimiento stones. Artifact densities were reasonably high in relation to the overall project, but sparse compared to Feature 1. There was no evidence of burning or other intentional closure or abandonment aside from the lack of complete artifacts.

Feature 3

On the surface Feature 3 was indicated only by a single line of cimiento stones running roughly north south and a few more buried stones possibly indicating a southern wall (Figure 13.7 and 13.8). The cimiento stones were a mixed assortment of cobbles that included one reused mano. A 1 by 1 was placed in the corner formed by the identifiable cimientos. After approximately .30 m it became clear that the cimientos indicated a structure of the predicted orientation. The 1 by 1 was expanded to the north to become a 2 by 1. Due to the still uncertain dimensions of the structure two more 2 by 1s were placed parallel to the west and one more in line with the first to the north. Excavation revealed the structure to be a true pit house with the exterior above ground wall anchored by cimiento stones undistinguishable from those used in above ground architecture. There was a stepped in, plastered wall present on the interior of the structure. This wall extended to approximately .1 to .2 m above floor level and ceased an approximately equal distance below the ground surface and beginning of the cimiento wall. The feature was excavated into a naturally red oxidized soil that was turned a brighter shade of red by burning of the structure at abandonment.

The feature's boundaries were extremely clear. Portions of well preserved fired plaster remained in several locations. A sample was taken from the wall and submitted for luminescence dating, but appears too young relative to both a ^{14}C date from a burned post and a sherd recovered from the floor and also submitted for luminescence. These two more believable samples have respective date ranges of 1261-1387 and 1250 +/- 80 (2 sigma). This structure provided the only substantial intact floor assemblage that included a painted spindle whorl fragment, a stone spindle whorl, a utilized flake, a core, two polishing stones, three manos, a number of rocks, and several large ceramic sherds. Several other spindle whorls, including two more stone specimens were also recovered from the fill of the feature.

An unknown portion of the structure could not be excavated due to time constraints. A slight rise in the floor in the western most excavation unit may indicate the west wall was very near. There was a patch of extra fired soil that likely served as a hearth, but no evidence of plastering or other preparation was present. There was one storage pit, the only unequivocal example encountered during the project, which measured .45 by .4 by .85 m. A total of 11 post holes were identifiable arranged around the interior periphery of the structure. One was the source of the burned post submitted for ^{14}C analysis. No entry way was present, suggesting its location along either the west or north wall, which were largely unexposed or through the roof. The east (far wall) was placed only approximately 25 meters from the edge of the mesa. Rodent disturbance was moderate throughout most of the fill but disturbed little of the floor except in the northeastern most section. The floor was not prepared.

Feature 4

This feature is the above mentioned possibly protohistoric pit that was intrusive to Feature 3. Due to very little color or textural difference between the pit fill and surrounding house fill the edges were extremely hard to demarcate. The test trench through Feature 3 removed most of the feature, but it could be discerned that the feature extended below the level of the original floor some small amount (~.25 mbgs). The presence of the large horse elements was the clearest indicator of the features limits. A complete lack of carnivore gnawing suggests rapid burial of the elements. The purpose of the bones placement in the pit is unclear, there was no evident thermal alteration, but perhaps it served as a location for boiling of the remains in a container that was heated from within by the addition of heated stones. Several cut marks were visible on the sacral vertebrae (Chapter 7). The features estimated original surface dimensions are .40 by .35 m.

Los Mineros; Son L:2:22

(Figure 13.9)

Feature 10

This was a large river cobble cimiento structure with all four walls indicated by partially buried stones (Figure 13.10 and 13.11). The feature was located on the third terrace of the site. The structure measured 4.9 by 4 m and was oriented basically east west. The structure was attached to another room to the east, as indicated by the extension of the south wall line of cimiento stones in this direction. A test trench .5 by 4 m was placed north south across the feature. The stratigraphy indicated approximately 20 cm of cultural fill overlying a sterile strata (Figure 13.12). The feature was then excavated in a series of approximate 2 by 1's, ten in all. The first layer of all units was excavated before the second. There was no indication of a prepared floor, so excavation proceeded to the sterile layer as the best approximation of feature depth. It is possible the feature was excavated slightly below the living surface but not by any significant amount.

Several large and small pieces of burned daub or jacal were recovered, suggesting the structure burned. As with Features 1 and 2 of El Nogal, the superstructure appears to have been made of light, perishable materials that leave little evidence. The fortuitous preservation of one large burned section of jacal (Figure 13.13) indicates an earthen layer of approximately 8.5 cm applied over closely spaced branches approximately 2 to 4 cm in thickness. The structure is dated by a portion of burned adobe with a luminescence age of 1300 +/- 80 (2 sigma) and a plain brownware sherd that was lying flat near the suspected floor level with a luminescence age of 1130 +/- 100 (2 sigma) these dates slightly overlap at 2 sigma and provide a pooled mean age of 1233 +/- 62 (2 sigma).

Despite the near complete boundary of cimiento stones no doorway could be discerned. There was an off center break in the cimientos in the west wall, but its nonsymmetric location seems unlikely. There were no signs of a floor assemblage. A large intrusive roasting pit (Figure 13.14) was located in the eastern portion of the structure measuring .8 by .6 by ~.30 mbgs. The ubiquitous presence of fire altered rock throughout the fill of Feature 10 suggests the presence of other intrusive features without discernable boundaries. There was a small disturbance in the northwest corner that measured .60 by .25 by .08 m. This may have been a small pit or a natural disturbance of some kind. A slightly oxidized depression is slightly offset to the southwest from the center of the structure. This may have been an unprepared or informal hearth. This feature had a diameter of approximately .3 m and a depth of only a few centimeters. One likely posthole was visible along the west wall immediately inside and between two cimiento stones. The large piece of burned adobe described above was lying immediately adjacent to this posthole. Given the size of the structure it seems certain other postholes were present but could not be identified due to the homogenous color of the soil. The burned nature of adobe pieces recovered in the fill suggest the structure may have been partly burned at or post abandonment. The lack of any appreciable floor assemblage or burned organic materials suggests all possessions and some building materials, such as posts, were likely removed prior to this event.

Feature 11

Excavation in this area was intended to excavate a cimiento structure evidenced on the surface by a double line of stones along what should have been the south and west walls (Figure 13.15). The total size of the structure could not be reliably estimated based on surface evidence. The ground surface in this area was uneven, suggesting possible disturbances most likely related to recent vegetation growth. A 4 by .5 m trench was placed within the boundary of the inferred structure that terminated at the south wall. Excavation immediately revealed that the area had been repeatedly utilized as an area for roasting pits (Figure 13.16 and 13.17). A sherd from the first level dated to 1500 +/- 60 (2 sigma), but the estimate is known to likely be too young (Chapter 10). It seems likely this date is the best approximation for the cimiento structure, which was clearly placed without regard for the presence of the obvious previous use of the area as a roasting pit. The surface soil was not overly rocky, but fire altered rock was ubiquitous in excavated levels.

The uniformly dark ashy soil in conjunction with the numerous rocks precluded identifying any clear boundaries within the roasting pit(s) fill. After approximately .65 mbgs, as measured from the highest ground surface, the trench reached a sterile sub-strat and excavation in this area ceased. A ^{14}C date from the bottom .2 m level of the trench has a calibrated age of 1042-1255 (2 sigma), corresponding to an age that should predate the overlying structure. Several sequential uses of the area for roasting pits is highly likely. The placement of the cimiento structure directly over the area suggests it was a predominantly surficial structure. Double row cimientos were previously interpreted in the Río Sonora Valley as indicating multistory building (Doolittle 1988). This seems extremely unlikely in the present case given the soft unconsolidated soil on which the structure was placed and no evidence for any adobe melt or other substantial building materials.

Feature 12/17

This was another surface structure clearly demarcated by all four walls of river cobble cimiento stones (Figure 13.18). The feature was also located on the third terrace.

The structure was conjoined on the north and south walls to similar rooms, forming a three room alignment (Figure 13.19). The room blocks long axis was north northwest to south southeast. The interior of the structure measured 4 by 5.6 m. There was no doorway indicated by the cimiento stones, but there were several disturbed gaps along the south wall. A test trench was placed through the clearly demarcated structure .5 by 3.85 m. The trench began just inside the west wall and proceeded slightly passed the east wall (Figure 13.20). There was a very large river cobble on the ground surface within the room that had to be removed prior to excavation. The stone's size suggests it had to be placed in this location post use of the area, for some unknown reason.

The profile of the test trench presented a thin layer of slope wash originating from the fourth terrace toe edge to the immediate west followed by the house fill, which was only slightly darker than the underlying natural stratum. Excavation proceeded unit by unit (approximate 2 by 1s) on the north side of the trench down to approximately .2 mbgs, which seemed like the most likely level at which the floor was located. At this depth several artifacts were noted proceeding into the underlying stratum and the floor level was reevaluated. A further ~.1 m of excavation identified what was eventually determined to be floor. This level contained a ¾ grooved axe lying flat on the surface. Rodent disturbance was rather significant further complicating definitive of the floor level across the unit. Generally speaking, artifacts were extremely sparse throughout the feature fill. A last unit was placed parallel along the north wall of cimiento stones to investigate the relationship of the stones to the floor (Figure 13.21). In total, just over 50 percent of the room was excavated. The cimiento stones proved to be much larger than any others seen on the project and terminated at the same depth as the floor. No other structure followed this particular pattern of construction with long oblate stones proceeding several tens of centimeters into the ground surface.

Since the floor level was delineated in a somewhat haphazzard manner a single 1 by 1 unit was placed on the north side of the north wall in what was presumed to be another room of the same contiguous structure to investigate whether the stratigraphy was more easily discerned. This room was designated Feature 17 (Figure 13.22). Unfortunately, the stratigraphy was equally amorphous. A sherd collected from what was believed to be the near floor context provided an estimated luminescence age of 1390 +/- 60.

Feature 13

This is a presumed cimiento structure similar to Feature 10. It was located on the uppermost (fourth) terrace. A single, but very clear, row of stones suggesting a structure was visible running east west. Since no other wall was clear to discern which side was intramural space a 4 by .5 trench was placed perpendicular to the visible wall (Figure 13.23). This excavation revealed that essentially the entire area had been utilized for roasting pits, making discernment of any other stratigraphy impossible. This scenario is similar to that encountered in Feature 11. Most likely this area was somewhat deflated and the original ground surface was very near the original floor level of the structure. No further excavation was performed in this area and no dates are available.

Feature 14

This feature was also located on the upper mesa but in an area that was known to be somewhat deflated and apparently mostly clear of the roasting pits that had hampered excavation across much of the site. A single 2 by 1 was placed east west in the northeast corner of the perceived structure based on alignments of river cobble cimientos (Figure 13.24). Maps made in 2010 during survey indicated all four wall of cimiento structure were visible in the recent past. Only the north and east wall alignments of cimientos were preserved at the time of the 2012 season. The first level (~.2 m) produced only a handful of artifacts. The second level (~.05 m) quickly encountered large, natural river cobbles that clearly demonstrated the floor level must have been located above this point, but was completely indiscernible. This feature provides the best evidence that most cimiento structures at this site utilizing small river cobbles (~.2 m) were near completely surficial features that leave little to no evidence of their superstructures (Figure 13.25).

Feature 15

This feature was relatively close to Feature 14 located only a few tens of meters to the southeast. The feature stood out as a small topographic rise in the otherwise obviously deflated area. A large very deflated roasting pit was located to the immediate west of the feature. Prior to excavation it was unclear if the area was merely a midden or a decomposed structure. A 2 by 1 test unit placed in the feature and excavated to a depth of .25 m revealed a jumbled mix of large rocks that seem unlikely to be associated with a structure (Figure 13.26). The feature was relatively undisturbed and not intruded into or intrusive to any other features. A moderate amount of root disturbance was present. A large fragment of carbonized wood was recovered as well as a significant amount of artifacts relative to the density of other features at the site. The excavation evidence suggests this feature was a trash midden (Figure 13.27). A combined luminescence and ^{14}C

date date provided respective ages of 1170 +/- 120 (2 sigma) and 1268-1396 (2 sigma). This midden feature was likely utilized throughout the occupation of the site. A unique serrated, obsidian projectile point was found relatively close to the midden.

Feature 16

This feature was a well preserved stone wall foundation structure (Figure 13.28 and 13.29). The preserved footing was .7 m wide and likely two to three courses high, with each course about .1 m in thickness. All four sides were clearly discernable except for the southeastern corner. The doorway was presumably located in this area or perhaps the visible but collapsed southern wall. The feature measured 3.7 by 3.7 on the interior. A large *echo* or organ pipe cactus currently grows in the middle of the structure. This feature was thought to be historic prior to excavation, although local ranchers had no knowledge of its potential prior inhabitants or age. This structure was located on the second terrace, a large structure of similar construction technique was located on the lowest (first) terrace. This larger structure may have served a non-domestic purpose. Presumably all were occupied or utilized coevally.

A 2 by 1 was placed in the investigated structure along the west wall. A handful of prehispanic/Native artifacts were recovered but seem most likely to be incidental inclusions. The recovered ceramics did not differ in any noticeable way from those recovered on the rest of the site to suggest the adoption of diagnostically historic practices, such as manure tempering. Excavation also produced fragments of highly corroded thin flat steel, possibly from a bucket and a porcelain doll head to a *frozen charlotte doll* (bonnet style) dating to approximately 1890 to 1910. An extremely hard earthen floor was encountered at .15 m below ground surface. Having recovered temporally diagnostic artifacts that established these structures as late historic in age no more excavation was conducted in this feature.

Feature 18

This structure was perhaps the most unusual of all the tested features at Los Mineros. On the surface the feature was a large pile of sizeable rocks not extremely different from Feature 15, but with several promising looking alignments on the margins of the pile (Figure 13.30). A 2 by 1 was placed east west near the southern margin of the pile alongside one possible alignment. The alignment soon proved to be a well constructed, dry laid masonry wall with 4 preserved and buried courses of elongate stones (Figure 13.31). A reconstruction with the nearby wall fall suggested a maximum height of 7 courses or .81 m. Curiously, the west wall appeared to be of a standard cimiento, or mixed stone and adobe construction, suggesting an alternative construction technique (Figure 13.32). The floor was extremely well preserved and recessed from the west wall with a pit depth of approximately .2 m. The floor was not prepared or burned and no internal features, such as postholes were discernable in the test unit. Only a few incidental sherds and lithics were found on the floor. No more excavation was undertaken due to time constraints, but from surface evidence it appears that the east and north walls were also of masonry construction. The overall size of the structure is estimated to be 6.1 by 3.2 m. No entryway was discernable from surface remains or the small excavated sample. An entry in the west, non-masonry wall, seems most likely. This structure likely required a significantly higher labor investment than any other structure investigated during the project, with the possible exception of some forms of coursed adobe. A luminescence date on a sherd recovered from the floor level dated to A.D. 1500 +/- 100 (2 sigma).

Teonadepa; Son L:1:23

(Figure 13.33)

Feature 20

This feature was a river cobble cimiento structure with all four walls evident that measured 5 by 4.2 m (Figure 13.34 and 13.35). The west wall extended beyond the north wall, suggesting a conjoined room. No doorway was discernable from the remaining cimiento stones; an unpreserved portion was present along the north wall and possibly contained an entry into the hypothesized conjoined room. A test trench .5 m by 4 m was excavated across the structure east west in an attempt to discern the stratigraphy. Sterile soil clearly began ~.15 to .2 m below ground surface. The unit was excavated in ten 2 by 1's, with all units excavated to approximately .10 m below ground surface before excavating the remainder to the perceived likely floor surface. One very clear intrusive roasting pit was discovered in the northeast portion of the feature and it seems possible, due to significant scattered fire altered rock and diffuse charcoal flecking that there may have been another near the center of the feature. Artifact densities were moderate throughout the feature, but definitely lessened with depth. A luminescence sample was run on a sherd recovered from near the center of the feature, but believed to be in situ that returned a clearly erroneous date of A.D. 230 +/- 280 (2 sigma). This consistency of the luminescence measurements suggests the age estimation is accurate, but the sherd is certainly an incidental intrusion into the structure. No contemporaneous internal features were discernable in any portion of the feature, this is curious as rodent runs were quite visible, suggesting intrusions into the floor layer were easily identified. It may be the case that many cimiento structures were ephemeral and did not always require the sinking of posts.

Due to the clear soil demarcations in this area some effort was invested to discern the practice of placing river cobble cimientos. The original test trench was extended through both the east and west walls, and a portion of the cimientos along the east wall were pedestled. Although the results were not absolutely definitive, it appears this structure was excavated to a shallow depth from the original ground surface roughly coeval with the bottom of the cimiento stones (Figure 13.36). The stones were then placed along the margins and presumably formed an anchor or decorative element for a very ephemeral, most likely wattle and daub superstructure. A purely brush or mat structure is another feasible construction style.

A single 1 by 1 was excavated as Feature 21 in the southwest corner of the perceived conjoined room to Feature 20 The stratigraphy and perceived floor level were the same as for Feature 20. The upper layer of fill produced a decorated *Chihuahua* ceramic with an age of A.D. 1510 +/- 80 (2 sigma), this is the best estimate of the age of this structure, although it may slightly post date its usage.

Feature 31.

This feature was a large mound of rocks, many of them fractured by exposure to fire. The area of the feature was approximately 93 m^2. The approximate modal size of the rocks were ~.06 m diameter (Figure 13.37). The height of the feature was approximately .5 m above the surrounding ground surface. This is a characteristic height of these mounds. There were at least 8 other such rock mound features identified at the site from the 2010 and 2012 efforts. Close inspection of such mounds invariably revealed high artifact concentration. Prior to excavation it was unclear if these areas were very large roasting features, trash middens, or structures of melted adobe and stone. A trench .5 by 4 m was excavated north south through the feature, but did not extend beyond its borders in either direction. The feature was excavated in .10 m levels to a total depth of approximately .37 m (Figure 13.38 and 13.39). A high number of artifacts were recovered from every level. The soil in the interstitial space between the ubiquitous rocks was clearly cultural, dark brown, but did not appear overly ashy to suggest a roasting pit. The feature terminated atop an undulating surface of unmodified orangish sterile soil. There was no internal structure or any hint of architectural walls within the structure. Post excavation interpretation suggests these features are simply midden piles, but it is unclear where all the stone deposited in these locations originated. This mesa, like all others in the region is an alluvial terrace of poorly sorted deposits with numerous stones. However, a qualitative examination of the stones in the mounds suggests many more mafic and intermediate volcanics than those present in the natural terrace deposits. Unlike Los Mineros, this site also lacks the ubiquitous surface evidence for small roasting pits that might require and generate so much fire altered rock. These features obviously remain somewhat of a mystery. A decorated ceramic from the third level of the four excavated produced a date of 1430 +/-60 (2 sigma).

Feature 32

This feature was an adobe structure that also made use of river cobble cimiento stones. Excavation began to investigate an alignment visible on the surface that included a portion of what eventually became the south and east walls. These stones were actually displaced in part, resulting in the excavation units not being perfectly aligned with the walls once they became apparent. The structure's overall size could not be estimated. Excavation revealed that the walls of this structure were made of coursed adobe (Figure 13.40 and 13.41). The preservation of the walls below the ground surface was mostly excellent. Along the east wall cimiento stones not visible on the surface buttressed both sides of the adobe wall. Had this been visible on the surface it would have produced the double row pattern visible at many sites in the Moctezuma and Sonora valleys except that the stones were set very close together. The stones appeared to not serve any obvious structural purpose. Possible explanations include splash guards to prevent undercutting of adobe from rainwater run off, rodent deterrents, a guide for construction, or simply decoration or tradition. The south wall evidenced what may have been a repair or remodeling in which the same pattern of the east wall was followed for a short section before changing to what appeared to be a more standard adobe wall with cobble stones used as filler, presumably adding structural integrity. Wall abutments were visible midway down the excavated portion of the south wall, in the remodeled area and between this area and the east wall (Figure 13.42). The adobe was of a noticeably different hue in these different sections of walls. These lines of evidence suggest the structure was not built in a single episode and may have even grown through expansion. After the orientation of the structure was established through excavation a few cimiento stones witnessed on the surface were identified as possibly belonging to the west wall.

The fill of the feature was midden like, suggesting post domestic use as a trash deposition location. The presence of the cimiento stones at the base of the east wall on the exterior and interior that were completely buried suggests significant deposition in this area since the structure was occupied (~.25 m). There was no apparent evidence of burning. One potential post hole was recorded, but it was an uncertain identification. The floor was at one point well plastered, but was highly disturbed by rodents. A large flake stone tool, a ceramic disc spindle whorl, and a few sherds were the only artifacts unequivocally in contact with the floor surface. One of the ceramics, a brushed sherd, was dated by luminescence to 1100 +/- 100 (2 sigma). A black on white sherd recovered from immediately below the floor dated to 1390 +/- 60 (2 sigma), but is thought, based on fading responses, to be an underestimate of the age. The dating of the structure is thus somewhat unclear, but an age between A.D. 1200 and 1100 seems most likely.

Feature 33

This feature was investigated with a single 1 by 1 test unit in a river cobble cimiento corner perceived on the surface (Figure 13.43 and 13.44). The fill was a relatively homogenously dark brown with clear cultural modification, including charcoal flecking of various sizes. The area had several alignments in the immediate vicinity, indicating likely repeated use of the area. A south and east wall were discovered upon excavation made of coursed adobe, but these were of questionable relationship to the observed cimiento stones. It is possible the surficially visible cimiento stones corresponded to a temporally later structure that left no traces distinguishable in the already culturally modified soils. The south adobe wall was particularly confusing and included an outer wall of solid coursed adobe buttressed on the interior by a layer of adobe of a different composition with inset cimiento stones. It seems likely either one wall was built first and the second was added later as a structural buttress or that an adjoining structure was added subsequent to an initial construction event. The exterior wall, relative to the excavated space, was preserved at a higher elevation than the cimiento wall. The east wall abutted the interior wall and was constructed from a material that was indistinguishable. An unprepared but easily discerned floor was preserved in the small north west portion of the unit that was not covered by walls by the time four ~.10 m levels were excavated. A sherd recovered from this last level produced a luminescence date of A.D. 1060 +/- 200 (2 sigma). A radiocarbon sample on wood from the same level produced a date of A.D. 1426-1638 (2 sigma). This later date seems much more likely, the dated sherd was presumably intrusive to the trash that filled this structure post abandonment.

A Note on Architectural Variation

In total 14 structures were sampled. One of these was clearly historic in age and one clearly had an unusual, for the area, style of construction that utilized significant amounts of masonry. The remaining 12 structures all evidenced the same basic surface alignments of river or other immediately available cobbles set several 10s of cm apart. Three of these features were either deflated or placed directly on top of preexisting features such that they could not be clearly delineated. Of the remaining nine, one was a true pithouse; two clearly utilized significant amounts of adobe, one of these may have been partially subterranean as well, and the rest were wholly surface structures or excavated only .1 to .3 m into the surface soil. The most obvious take away lesson from these excavations is that surface alignments may denote a broad range of architectural forms. Notably one on the most ephemeral (Feature 11) and the most substantial (Feature 32) structures delineated by these surface alignments both had double rows. This suggests that this characteristic is undiagnostic as to the robusticity of the building method based on surface evidence alone.

The overall extremely high variation in architecture is also notable. Close parallels in form could be found with virtually all surrounding regions. The masonry structure of Los Mineros is not significantly dissimilar to techniques of the U.S. Mogollon tradition of eastern Arizona (Riggs 2001:55-56) or northern Sinaloa (J. P. Carpenter and Sánchez 2008). The basic technique of coursed adobe architecture seen at Teonadepa is akin to both Casas Grandes (DiPeso, et al. 1974a) and Classic period Hohokam (Wilcox and Shenk 1977). Surface river cobble cimiento structures are found from northern Sinaloa to southern New Mexico (Skibo, et al. 2002) and southern Arizona. The true pithouse of El Nogal has parallels in both the preClassic Hohokam (E. W. Haury 1976) and more predominantly earlier periods of the Mogollon (Cordell 1984). In addition houses-in-pits, some with raised floors, were reported from the Sonora Valley (Dirst 1979), which are also similar to preClassic Hohokam forms (DiPeso 1956; E. W. Haury 1976).

The previously established relative chronological difference between pithouses/houses-in-pits and surface architecture recorded in the Sonora Valley seems to hold true to the extent tested in the Moctezuma Valley. The many various forms of surface architecture may correspond to some chronological patterning. For instance, coursed adobe may predate surficial river cobble cimiento forms. However, it seems clear that most forms overlap to a significant degree and many more dates are required to test any hypotheses adequately. The presence of multiple forms of architecture at all habitation sites also seems to suggest significant synchronic variation.

14. Evaluating Exchange Relationships

The previous chapters presented environmental, settlement pattern, and material culture data that all indicate settlement communities were small in scale and largely autonomous. Numerous lines of evidence indicate the regions around El Nogal (Son L:2:1) and Teonadepa (Son L:1:23) were two distinct groups in the domains of political, social, and perhaps ideological interaction. This assertion is supported by the distribution of settlements, distinct painted ceramic traditions, the frequency of textured ceramics, projectile point traditions, lithic raw material access, and limited adornment assemblages. Countervailing evidence that suggests frequent interaction between these settlement communities consists of exchange in brownware ceramics and potentially complimentary subsistence focuses. This chapter will investigate what roles exchange played in the political machinations of the region. Discussion will address traditional questions of political economy, such as who had access to what goods as well as investigate the potential for certain material goods to materialize ideologies that supported or contested emergent inequalities (*sensu* Wells 2006; Wells and McAnany 2008). Focus will also be placed on commoner strategies of exchange that crosscut those of aspirant leaders. This approach allows a reconciliation of the above observations by arguing exchange served different ends for various segments of society. The data suggest the Río Sonora region is most notable for a near exclusive focus on regionally acquired goods and the minimal role rare goods play in aspirant leader strategies. This model contrasts significantly to previous reconstructions of the region.

Before materials specific analyses can be presented some amount of theoretical background is required regarding exchange studies. Because of the limited nature of Sonoran data the patterns observed in the Moctezuma Valley must be compared to better known regions and ideal patterns to facilitate interpretation. The latter approach will reference ideal distributions pertaining to *down-the-line/exponential, linear/supply zone,* and *multimodal/ directed* exchange (Renfrew 1975, 1977) (Figure 14.1). There are well known issues of equifinality with this classification schema (Hodder 1982; Hodder and Orton 1976; Stewart 1994). The ensuing analyses employ this terminology only sparingly to describe the gross qualities of material distributions relative to known source regions. Very succinctly stated, linear patterns are argued to reflect face to face interactions that are only marginally attenuated with increased distance from the source, before a rapid drop off to negligible quantities. Exponential patterns result from the repeated transmission of materials or other mechanisms that produce rapid attenuation across the full range of a distribution. Because exponential or power law relationships are ubiquitous under many circumstances (Pierpaolo and McKelvey 2009), exponential decay can be thought of as the default that arises under most stochastically mediated processes that move items away from a point source. Multimodal patterns arise from any number of mechanisms that sever the relationship between distance and rate of attenuation. Practically speaking, this usually equates to moving a large amount of goods a long distance in one of the first steps in a distribution chain. Table 14.1 presents several scenarios that might give rise to the above described patterns. The limited nature of patterns observed among materials in eastern Sonora along with contextual data will limit interpretations to only a few scenarios.

The distributional pattern of materials relative to their provenance provides one line of evidence useful in reconstructions. However, the analysis says very little about the motives for the transference of goods. In fact a principal criticism of the above approach is that it divorces goods from their role in materializing the ideologies that dictate their value (Hodder 1982). While the above described approach focuses on essential *how* questions of material transference it offers few clues as to *why* goods circulated in a particular manner outside of circumstances with fixed economic values that render all items interchangeable. Substantial research on the political economies of transegalitarian societies demonstrates that assuming economic maximization strategies for all goods is an ineffective approach. In transegalitarian societies rare and costly items are employed most often in various ritual economies in which their principal value is their efficacy in materializing particular ideologies (DeMarrais, et al. 1996; Wells 2006). Most research has focused on the ways in which aspirant leaders attempt to monopolize meanings that become indexically associated with particular rare goods whose access or production they control (Costin 1991; Inomata 2001). Conversely, some social valuables may be widely accessed by the population and serve as effective checks on the materialization of inequality affirming values. Such items often gain their associations primarily through employment in public ritual activities ostensibly undertaken for the good of all group members (Spielmann 2002). Subsequently, such social valuables may be extracted from this limited theater of employment to become more generalized markers of group affiliation. Emphasizing shared membership, and by association shared responsibility for group welfare, may act as a leveling mechanism under many circumstances. Evidence for ideologies that support inequality and those that oppose it will be sought in the following analyses.

The utilized approach will rely on multiple lines of evidence including distribution relative to source, distribution in the region of employment, ubiquity of access, and theater of implementation. This approach will allow not only a tabulation of the exterior connections suggested by the presence of certain goods but also offer insights on the motives that underlay their acquisition, consumption, and entry into the archaeological record. The following discussion will quickly review the evidence for the various material classes discussed in Chapter 10 before presenting summaries of various aspects of the ritual and political economy.

Material Specific Analyses

Ceramics

Ceramics were likely employed in a wide range of social strategies by all echelons of Río Sonoran society. Mundane brownware ceramics are indicative of patterns relevant to most all households. Their circulation on the landscape would not, under most circumstances, be expected to produce supply zones that crosscut social and political divisions unless there was heterogeneous production potential. This seems unlikely to be the case in the Moctezuma Valley since ceramic production tools were found at all excavated sites and local modern residents report clays to be widely available. Ceramics, of course, may also only circulate in a functional role as containers for other commodities. However, given the homogenous subsistence production of the region this only leads to the same observations regarding the expected range of exchange.

In contrast, painted ceramics and other rare forms may circulate in more restricted networks. Such vessels, due to high visual acuity, are also exceptionally suited to implementation in materializations of specific ideologies. Their role as signaling media in feasting events is one notable example (Mills 2007). Many design elements on painted ceramics have also been linked to specific ideological belief systems in the Northwest/Southwest (Crown 1994; C. S. VanPool and VanPool 2007). In keeping with these observations the ceramic data from the Moctezuma Valley provide insights on a diversity of social strategies.

Brownware ceramics clearly circulated beyond otherwise mostly impermeable cultural barriers. Local potters produced ceramics with granitic aplastics in the southern end of the project area and transferred them to households in the northern portion of the project area. Numerous households likely engaged in ceramic production in the southern portion of the project area. The significant range of variation in paste colors as well as some diversity in granitic accessory minerals support this interpretation. The rate of attenuation in grantitic sherd assemblage contributions as distance increases from the source was noted as decidedly linear in Chapter 11 (Figure 11.17). This pattern denotes exchange that almost certainly involved face to face interaction. There is no contextual or ethnohistoric evidence for more complex distributional mechanisms, such as markets. These would be expected to lead to clear peaks in frequencies away from the production center (i.e. a multimodal pattern). All other portions of the project area likewise produced their own pots. This is reflected by the local abundance of intermediate temper around Los Mineros (Son L:2:22) and likely also explains the intractable diversity seen in the *mixed volcanic* petroface. These observations reinforce the statement that there seems to be no simple resource access explanation for the exchange of brownware ceramics and further suggests social motivations for the regular exchange of this mundane good.

It is notable that textured brownwares were traded at an even higher frequency than plain brownwares. These designs are sufficiently crude that it seems unlikely they were imported at a higher frequency simply for aesthetic reasons. There are also sufficient instances of textured ceramics with local mixed volcanic tempers to demonstrate that artistic ability was not exclusively practiced in the southern portion of the project area. Although the visual acuity of textured designs is low it may have been sufficient to indicate affiliation to a particular group or household of potters. Producers may have developed local styles for the purpose of encoding an indexical reminder of a specific relationship to an intended consumer. As was pointed out in Chapter 9, most textured designs appear to be contemporaneous. Numerous potters adhering to general tenets of design while also attempting to distinguish products could account for the exceptional range of variation witnessed in this ceramic type. This practice may reflect patterns of nested identity as suggested by the gross stylistic analysis of textured types presented in Chapter 4 with different regions emphasizing various texturing techniques (incising, corrugation, punching, etc.) and individual households selecting particular design and layout approaches.

Painted ceramics in contrast suggest only rare exchange between the Teonadepa and El Nogal regions. White slipped ceramics are extremely rare at El Nogal, occurring only with enough frequency to indicate general contemporaneity. Inversely, Hematite-on-brown and Santa Ana/Babícora Polychrome ceramics are rare at Teonadepa. Santa Ana/Babícora like ceramics of El Nogal are part of a larger Chihuahuan tradition and indicate affiliations to the east, whereas Hematite-on-brown suggest ties to the south among the little understood Serrana traditions. The white slipped wares of Teonadepa are related to Casas

Grandes or possibly even U.S. Pueblo styles, but do not indicate direct importation from these areas. The overall very low counts of painted ceramics at both sites suggest these are not endemic traditions, but rather reflect disparate exterior ties. In both cases, particularly El Nogal, the frequencies are sufficiently low that regular exchange relationships are not suggested. El Nogal and Teonadepa appear to be near the tail end of separate down-the-line networks and apparently had little interest in passing these rare objects on once acquired. It is notable that painted ceramics only occurred at a handful of smaller sites (four). This suggests that only primate centers effectively procured these items and that they were subsequently distributed predominantly within the large sites. The four unique temper sherds identified though thin section petrography, are also indicative of down-the-line acquisition. Had any of these sherds represented routinized exchange there would be more than singular examples.

Obsidian

Obsidian was found at only five sites during the initial settlement survey. All five of these sites were in the northern half of the study area. Three sites presented only one or two surface finds of obsidian Las Clavellinas (Son H:13:2), El Salto (Son L:1:24), and La Pitahya (Son L:2:26). Two other sites Teonadepa and La Cuchilla (Son L:1:6) contained so much obsidian that a complete surface collection was impractical. Excavation and systematic surface collection produced a total of 16 obsidian artifacts at El Nogal and 13 at Los Mineros as well as adding 123 artifacts to the Teonadepa assemblage. Complete surface collection at Teonadepa was again dismissed as impractical. Clearly within the project area only the northern settlement community surrounding Teonadepa had regular access to this commodity. Within this settlement community access was also extremely limited with only two of the largest sites containing any appreciable amounts of obsidian.

As discussed in Chapter 10 the vast majority of obsidian came from a single source, Selene (Hinojosa-Prieto, et al. In prep). This source is located fairly close to modern day Aribabi. Based on the distribution of arable land as a proxy for populations, settlement communities based near modern day Oputo and Huachinera would likely have direct access to this source. Notably, a settlement community centered around Teonadepa would likely share some sort of border or frontier with Oputo. It is unlikely a similar boundary would be shared with El Nogal. Individuals resident at Teonadepa thus would have the ability to interact with individuals who had direct access to this source. Equivalent individuals at El Nogal would have had to rely on middle men or at least maintain an extra range of contacts to facilitate movement through the territory of multiple settlement communities to access this same source. It seems that this extra step greatly increased the attenuation of obsidian procurement.

These observations likely reflect the potential for local alliances in the region. Keeping in mind the very rough approach imparted by the Thiessen polygon method of Figure 3.10, some tentative suggestions for alliance relationships can be made. As noted, the potential for Teonadepa to have direct contact with Oputo seems likely. An equivalent El Nogal to Oputo link seems unlikely. More tentatively, the fact that obsidian did not take an alternate route to El Nogal through Huasabas suggests another potential alliance segmentation. Either the Huasabas region was excluded from access to the Selene source despite a Thiessen polygon boundary that reaches into the near vicinity of the source, or El Nogal lacked connections with settlement communities in the Huasabas region.

Rare Goods

Other rare materials are most notable for their extreme scarcity. The minimal count of only 19 pieces of shell recovered are perhaps the most notable example. In all surrounding regions including the Hohokam (northwest), Trincheras (west), Serrana (south) Casas Grandes (northeast), and to a lesser extent Mogollon (north) shell is a much more ubiquitously common item. In most of these regions there are varieties that are extremely rare and possibly served as markers of prestigious office (McGuire and Howard 1987; Mills and Ferguson 2008) and ubiquitously available genera that are widely accessible that served as markers of group or ideological affiliation (Bayman 1996; Marmaduke and Martynec 1993). In the Moctezuma Valley there are no examples of the truly rare forms, such as *Strombus* trumpets and more common varieties are far too rare to functionally serve as a marker of group membership. For comparison sherd/shell ratios for the entire Moctezuma Valley are 2082 compared to .20 for Paquimé (DiPeso, et al. 1974d), 65 for Pueblo Grande (Hohokam) (Gross and Stone 1994), and 184 for Trincheras (V. D. Vargas 2011). Vagaries of collection strategies aside, the Moctezuma Valley clearly had access to categorically lesser amounts of shell. Individuals in the Moctezuma Valley also apparently were content with almost any genera that made its way to the region. The SD/*n* ratio for the Moctezuma Valley is .11 compared to .17 for Paquimé, .19 for Casa Grande, and .08 for Trincheras. In the Trincheras region the close proximity to source zones likely allowed for more experimentation and subsequent importation of a highly diverse range of species at low energetic cost. In the other two comparison samples trade connections clearly had to be established to serve specific local demands through some mechanism of directed exchange. In the Hohokam region this was likely first through middle men (preClassic) and perhaps later mostly through direct acquisition forays (Classic) (Marmaduke and Martynec 1993). In contrast, the Moctezuma Valley assemblage is most in keeping with a system that randomly delivered only very small quantities of whatever was circulating in neighboring regions. This is commensurate with being on the tail end of down-the-line distribution networks. This interpretation also fits with the provenance data that suggests shell came directly across the Sonoran Desert from the closest possible source region. This is particularly notable since it counters previous suggestions that large amounts of shell were moving north up river valleys, such as the Moctezuma, to supply Paquimé and the rest of the Mogollon region (R. J. Bradley 1993, 1996, 1999b, 2000a).

Similarly turquoise and other items of adornment are extremely rare in the Moctezuma Valley. This may simply be a recovery problem; as turquoise is mentioned frequently in exploration era accounts, particularly by Marcos de Niza (Hallenbeck 1949). For the most part these documents reflect use of turquoise as a fairly widely available item, rather than something controlled by a select class of individuals. There is even some hint that jewelry styles utilizing turquoise were regionally specific as de Niza notes contrasts between groups. Despite this suggested potential, the Moctezuma Valley assemblage can only be described as paltry with only three specimens. The provenance of the one tested piece suggests an as of yet, uncategorized source. Somewhere near modern Nacozari is a likely guess. These data qualitatively suggest acquisition from the nearest source is the most likely procurement strategy. This also contrasts to previous models that suggested this region was a primary conduit for the transmission of turquoise out of the U.S. Southwest to Mesoamerica (Weigand 1977, 1994; Weigand and Harbottle 1993). This reconstruction was admittedly already significantly questioned by prior turquoise provenance research (Thibodeau 2012; Thibodeau, et al. 2012).

Political Economy Summary

Long-distance Political Economy

The majority of evidence suggests the political organization of eastern Sonora would not be particularly amenable to facilitating long distance exchange. The small scale of settlement communities would necessitate numerous local agreements to pass through the region unmolested. Local aspirant leaders apparently had little interest in materializing ideologies to underpin their positions through the manipulation of foreign symbols or the acquisition of exotic goods. If such desires did exist, they apparently left few markers in the archaeological record to demonstrate their efficacy. In total there is no evidence presently available that any sort of directed exchange relationships that moved goods long distances to predetermined consumers existed in eastern Sonora.

Down-the-line exchange (exponential falloffs) was the apparent dominant form of transmission in the region. This pattern was operative at the level of settlement communities, and is most easily observable by comparison of primate site assemblages. Given these observations it is worth considering the potential conductivity of eastern Sonora. To model this question some rate of local consumption has to be assumed. For heuristic purposes the very low proportion of .25 will be used. Meaning, that if in an item arrives in a Thiessen polygon (Figure 3.10) there is a .75 proportionality of continued transmission. Stochastic directionality of transmission as determined by shared Thiessen polygon boundaries is also assumed. Taking Figure 14. 2 (based on Figure 3.10) as a model for the political organization of the region and assuming objects moved in increments at this scale (between settlement communities) the estimated proportion surviving to a particular step and terminating in specific Thiessen polygons can be estimated. It is assumed only shared Thiessen edges of at least five km in length allow for transmission between settlement communities. Starting all transmissions in the Onavas polygon and calculating the total proportion that reaches any of the three most northern Thiessen polygons, Bacocahci, Fronteras, or Morelos, in one to ten steps produces a proportion of only .0017. In actuality this system would not be bounded to either the east or west and true Mesoamerican goods would begin much further to the south, suggesting if anything this is a significant overestimation. Calculating beyond ten steps is superfluous due to the exponential nature of the decrease. In short these numbers suggest that stochastic down-the-line processes alone would be very inefficient for moving goods through this region.

These observations could partly explain why true long distance exchange played such a small role in the political economy of the region, but it also raises the question of how significant quantities of rare goods ever moved through the region. Examples such as nearly four-million items of shell at Paquimé or the relatively common discovery (e.g. Gallaga 2014) of rare West Mexican and Mesoamerican objects in Hohokam contexts demonstrate that some other mechanisms must have been operative in this broader region at some points in the prehispanic period. One possible explanation is that the movement of these goods was explicitly tied to a broadly respected ritual economy that was deemed inappropriate for local levying. Pilgrims, or some other form of non-economically motivated itinerants, are one plausible mechanism of transference. Such individuals may not have been subject to material extractions that would make their archaeological identification possible in regions they simply transited. In fact, they may have even been supported through ritually sanctioned norms of hospitality. Northwest Mexico has a strong tradition of such ritually motivated journeys (Griffith 1992; Myerhoff 1974) and it would not be surprising if some aspects of these traditions had prehispanic forbearers (Wells and Nelson 2007). Investigations in modern pilgrimage destinations, such as Magdalena, may provide some insight on these proposals. Undoubtedly, though, the most logical next step would be to apply a wide diversity of provenance techniques to known deposits at plausible pilgrimage offering sites. An obvious target for such research would be the immense quantities of materials discovered at Paquimé. Establishing the diversity of origins would provide insights on methods and means of delivery.

Regional Political Economy

The obsidian data does strongly suggest some manipulation of regional exchange economies as a component of local power machinations. Individuals at Teonadepa and La Cuchilla (both in the Teonadepa settlement community) were undeniably interested in acquiring obsidian from the Selene source. Given the assumed fractious nature of the political landscape and that there were certainly settlement communities much closer to this source that likely controlled access, exchange as opposed to direct acquisition seems the most probable procurement strategy. The fact that only individuals at large sites were able to regularly procure this resource indicates that only select member of society possessed the necessary contacts, likely through benefit of differentiated social status. It is hardly surprising that these individuals would be located at the largest sites, which typically house the upper echelons of transegalitarian societies. Few other specifics can be offered in terms of acquisition strategy, the relationships between aspirant leaders in settlement communities may have been mostly focused on exchange, but it seems more likely they also reflect other social responsibilities. Warfare alliances are one possible relationship that may have included embedded exchange relationships, but exchange may also crosscut such alliances (e.g. Berndt 1964).

Clearly once obsidian was obtained it was predominantly employed within the local settlement community and mostly only within the procurers' settlement. This likely reflects concerns with holding the allegiance of spatially proximate, essentially co-resident individuals that cooperated in productive tasks. If the goal were to cement commitments or aspects of a social contract not specifically tied to production, obsidian would have presumably circulated to smaller settlements inhabited by independent subsistence producers. Similarly, if obsidian was obtained predominantly as a means to forge contacts only among aspirant leaders in some sort of prestige goods model, its absence at El Nogal would be difficult to explain. Presumably in such a scenario at least one of the surrounding settlement communities relative to El Nogal with access to the Selene source would have sought out alliances, even if there were open hostilities between El Nogal and Teonadepa. The distribution of obsidian only makes sense if it was a relatively minor strategy appended on to other interactions and put mostly to local use when acquired.

All of the other investigated material classes are relevant to this scale of interaction only in terms of negative data. There is no material recovered that suggests exchange relationships were ever forged that regularly moved beyond neighboring settlement communities. Shell, turquoise, and rare ceramics all suggest only rare and minimal acquisition from surrounding areas. Many of these down-the-line systems, particularly painted ceramic, suggest the potential for intentionally exclusive networks. However, at present the data are too slim to demonstrate that the observed distributions were not the result of simple stochastic processes reflective of rapid attenuation. In circumstances where a settlement community possesses only a low quantity of an item its absence in a neighboring settlement community may arise from chance alone, as opposed to intentional exclusion.

Local Political Economy

The above observations seem hard to reconcile with what was clearly a substantial amount of interaction between commoner households at Teonadepa and El Nogal. Brownware ceramics most clearly demonstrate this sustained level of interaction. Evidence of potentially complimentary subsistence emphases at El Nogal and Teonadepa also may indicate regular reciprocal exchange agreements. This is reflected by respectively more elaborated groundstone and flaked stone tool assemblages at these two sites. As noted throughout this monograph there is unlikely to be any ecological or environmental variance that would give rise to local specialization in either subsistence production or crafts. In the case of ceramics it is unknowable at present if the ceramics themselves or their contents were the intended item of exchange.

Regardless, the question remains why these relationships were sought. Assuming need based economic factors were not the motivation then an impetus grounded in social relationships seems most likely. Anthropologists have long been aware that most material exchanges are rarely about the material, but rather about establishing relationships of indebtedness (Mauss 1924). Accordingly, the exchange of mundane goods likely reflects attempts by commoner households to bank social capital in neighboring settlement communities. Presumably such exchanges also occurred on more local scales but are simply not visible due to the sensitivity of the provenance techniques utilized to record the movement of material goods. The proportion of exchanges that crossed settlement community boundaries may reflect a desire to buffer against social risks in a manner analogous to inter-group sharing tied to heterogeneous subsistence resources (*sensu* R. L. Kelley 2007) (see Figure 14.3). In this scenario it is imagined that El Nogal and Teonadepa would be subject to non-simultaneous social perturbations, making ties between households associated with these different groups desirable. The most obvious source of such non-synchronous social perturbations would be the frequent internecine warfare described for this region. If warfare alliances followed the exchange of rare goods, as proposed above, and if the topology of these alliances placed El Nogal and Teonadepa in different groups then the observed exchange in mundane goods would be expected as an effective buffering mechanism. At present there is no indication El Nogal and Teonadepa were openly hostile towards each other. Their relationship may have been more appropriately characterized by low grade animosity, indifference, or low level competition for labor and local resources.

The proposed relationships would also be commensurate with several other observed patterns in material culture. The highly variable textured ceramic traditions seem to not convey any important symbolic content and also do not appear to be the result of diachronic stylistic drift. As described in Chapter 4 there are identifiable regional emphasis on particular techniques, but all approaches seem to always be present across most of eastern Sonora. If the purpose of these designs was to serve as a unique indexical marker of a relationship to a particular household the high degree of variation would be explained. That is each household, and perhaps each potter, would develop specific repertoires that served to remind the recipient of the relationship. This motivation would lead to local diversification on regionally dominant themes. Occasionally actualizing these relationships to facilitate migration or further solidifying relationships through intermarriage would facilitate the mixing of styles noted on the regional scale. Many of these ideas might be testable with larger samples of textured brownwares and more refined approaches to measuring the nature of stylistic variance observed in the region.

Some observations on the local ritual economy are also clearly warranted by the data. Much like the observations on rare goods above, the data are most notable for the absence of evidence to suggest materializations of integrative ideologies. The near complete absence of shell or other markers of group affiliation has already been noted. These items often first gain their status as symbolic referents in the execution of communal ritual only to be exported to more generalized contexts (Spielmann 2002). The complete lack of standardized edifices of communal ritual in the region may suggest such theaters were rare and potentially highly variable at the regional scale. It follows that the associated regalia tied to events at such edifices might also be rare relative to surrounding regions.

In addition, the very low frequency of painted ceramics in this region indicates that many models developed in surrounding regions are not applicable in the Río Sonora. For instance, painted ceramics are far too rare to effectively serve as purveyors of routinized symbolic content in feasting events. This is not to argue that such events did not take place, only that due to the dearth of appropriate signaling media their character must have been substantially different from reconstructions effected in the U.S. Southwest (Mills 2007) or

Mesoamerica (LeCount 2001). All of these disparate lines of evidence indicate models concerning materializations of ideological power and its contestation cannot be easily imported from surrounding regions. Local strategies in the Río Sonora apparently were much less concerned with wielding symbolic content from foreign regions as a means to legitimization. One tentative suggestion to build upon in the future is that the emphasis placed on warfare prowess dampened other more elaborate social machinations. That is, the manifestly observable success or failure of aspirant leaders may have limited the extent to which more Machiavellian means could be employed.

Conclusion

This chapter has reviewed the provenance data presented in Chapter 10 in light of the evidence for small scale settlement communities being the dominant political form in the region. A significant reevaluation of prior models is clearly called for. There is essentially no evidence that long distance exchange played a major role in the political economy of the region. Aspirant leaders did apparently engage in exchange in some rare goods. Once acquired, these goods were apparently utilized mostly for leverage in the local political economy. This is most evident in the case of obsidian, which had a very limited distribution. Individuals regularly acquired this resource at only two of the largest sites in the northern portion of the project area. The fact that obsidian was only distributed within these sites in any appreciable quantity suggests it was enlisted to garner or maintain support of immediately spatially proximate and potentially co-resident individuals. Presumably this reflects concern with maintaining cooperation within corporate groups with shared interest in production. Very little obsidian was exported to satellite settlements, which presumably were independent producers, but likely still members of larger social groups organized at the settlement community level. Maintaining these relationships apparently did not rely on the exchange of any archaeologically identifiable rare materials.

Notably, none of the rare goods recovered suggest concerted efforts to materialize specific ideologies to either support or contest emergent inequalities. Most rare items were valuable simply by benefit of their natural scarcity and do not exhibit considerable investment in specialized manufacturing to augment their value. There is definitely no evidence that any aspirant leader ever orchestrated production of socially required materials or exerted any effort in the monopolization of specific symbolic content. In general, the rare goods in the region were either too variable, lacked symbolic content, or were simply raw materials, thus obviating any potential to serve as signifiers of widely recognized concepts or beliefs.

Exchange of mundane goods, most clearly brownware ceramics and potentially subsistence resources, point to strategies employed by commoner households in the local political economy. These exchange relationships appear to crosscut the directionality of ties observable among aspirant leaders. Tentatively it is assumed that exchange among aspirant leaders reflects the topology of warfare alliances and was possibly embedded in the establishment and maintenance of such relationships. If this were the case it would be expected that allied groups might undergo simultaneous social perturbations, encouraging commoners to form ties to groups subject to non-synchronous perturbations. The lack of evidence for exchange in rare goods or even access to the same exterior rare goods at Teonadepa and El Nogal and the high rate of exchange in mundane goods clearly reflects this proposed pattern. On a larger scale, certain highly variable aspects of material culture, such as textured ceramics, may reflect efforts of households to develop media intended to serve as indexical reminders of pledged indebtedness. Many of these observations obviously require further verification.

15. Summary and Conclusion

The project that is the focus of this monograph had two principal goals: 1) to carry out archaeological investigations in eastern Sonora to facilitate a reconstruction of sociopolitical organization based on local data, and 2); to utilize this data to evaluate previous models of macro scale trajectories that incorporate eastern Sonora. The resulting models posited for local organization are substantially different than prior reconstructions in regards to political control, overall level of complexity in political systems, and basis and means of maintaining differentiated status by aspirant leaders. Significant implications are also provided regarding larger reconstructions with respect to interaction with the Mesoamerican frontier. The demographic and political landscape of Sonora undoubtedly impacted how Mesoamerican ideas and concepts both reached and were implemented in political strategies of groups in the U.S. Southwest. Sonora was not amenable to the transmission of goods and ideological content would likely be significantly diluted if transmitted across the balkanized landscape of eastern Sonora. The reconstructions offered in this research also suggest the implications of ethnohistoric texts should be reconsidered in regards to the relative degrees of political complexity inferred for eastern Sonora.

This last chapter is divided into three parts. The first section addresses results relevant to the specific hypothesis of the original research proposal, as discussed in the Preface. The second section provides what is intended to be an uncontroversial cultural history of central Sonora, as it is now understood. The final section takes up the more theoretically challenging questions and presents several speculative models to be evaluated through future research.

Project Background and Goals

The project was carried out in two stages, an initial survey to establish the presence and density of indigenous occupation along a 30 km reach of the Moctezuma Valley and subsequent excavations at three large settlements. The survey effort confirmed the presence of numerous habitation sites located in close proximity to the riverine corridor. Unsystematic survey of bajada zones revealed the presence of a few, very small sites with some evidence for habitation. These sites are presently thought to represent seasonal occupation or very small perennial occupations near oasis like settings that allowed small scale cultivation.

The availability of arable land constrained substantial settlement to the riverine corridor. In narrow sections of the valley, there were no or only very small sites. In areas where the valley was wider settlements were ubiquitous. Topography mediated the density of habitation, giving rise to local settlement communities of a relatively small scale. Within the 30 km stretch of the surveyed valley two clear settlement communities were apparent. Survey recorded the primate centers of both settlement communities, but there may be more, smaller satellite settlements continuing to both the north and south of the survey area. Several kilometers of steep *barranca* separated the identified settlement communities.. Notably, possible examples of communal or public architecture in the valley were very minimal and not associated with large habitation sites. Determination of ceramic provenances through the comparison of aplastic inclusions to bedrock geology indicated fairly regular exchange in mundane commodities between settlement communities. Analysis of this survey and preliminary provenance data generated a set of hypothesis to be tested through excavation at three of the largest sites encountered on survey.

Hypothesis One Instead of large territorial polities the area was characterized by small settlement communities integrated both through the regular exchange in mundane commodities and exotic goods.

Hypothesis Two. The region was characterized by a lack of socially integrative mechanisms above the level of the household as indicated by a lack of appreciable public architecture and the small scale of settlement communities. Assuming ethnohistoric documents that describe warfare as constant in the region were valid, *Hypothesis Two* further proposed that households forged ties exterior to their own settlement community that could be relied upon in times of stress as a means of risk management.

The subsequent excavations revealed that two of the selected sites were likely primate centers in their respective settlement groups. The third site, Los Mineros, (Son L:2:22), seems more likely to be affiliated with the more southern settlement community and likely did not serve as a center in its own right. As a result it will largely be omitted from much of the ensuing discussion.

Findings

Scale of Organization. The scale of political organization was addressed by previous researchers, but largely only indicated through delineations depicted on maps produced for the region. This led to a situation in which researchers claimed to be supporting and/or refuting previous models (cf Doolittle 1984b, 1988; Riley 1987, 2005) without acknowledging that at times they were almost certainly discussing processes occurring at substantially different scales with attendant implications for social complexity and hierarchical organization. Distributional analyses of settlement patterns in the Moctezuma Valley as well as legacy data from the Sonora and Bavispe Valleys demonstrate that the scale of political organization was decidedly local (~<50 km). Expanding these observations would give rise to at least 34 separate polities in the region generally considered as the Serrana or Río Sonora, a stark contrast to the seven or so identified previously in ethnohistorical analysis. These settlement communities are envisioned as equivalent to those delineated in better known regions where they are equated with political territorial control and likely some level of shared investment in production and possibly distribution (David E. Doyel and Fish 2000; P. R. Fish and Fish 2007; S. K. Fish and Fish 2000a). Borrowing from Renfrew (1986:2-3), they are argued to be the largest (*regularly*) cooperating sociopolitical unit. Delineating the exact functions of these units and the likely demands they placed on members will continue to be an area of active research. Unlike neighboring regions, many eastern Sonora settlement communities apparently lack integrative communal or public architecture. This suggests the specific methods of materializing the ideology of shared membership in these social units may be substantially different from extant models in the Northwest/Southwest.

A lack of communal edifices also obfuscates easy delineation of community boundaries. This research relied on a combination of settlement pattern analysis, exclusive access to certain rare goods, material culture patterns, and subsistence patterns to identify distinct settlement communities. Virtually every analysis undertaken of the Teonadepa (Son L:1:23) and El Nogal (Son L:2:1) assemblages suggest clear differences indicative of distinctive groups. The social and or cultural differences suggested by these patterns would be unlikely to occur in a single, politically consolidated territory. Basic ceramic ware/type frequencies were substantially different. El Nogal had many more brushed and other forms of textured types compared to Teonadepa, which in turn, had many more painted ceramics than El Nogal. At a finer scale, the variation in painted types at the two sites was near mutually exclusive. El Nogal apparently received most of its exotic ceramics from traditions associated with south central Chihuahua and southern Sonora, whereas Teonadepa painted types were similar to Casas Grandes styles. An analysis of texturing techniques drawn from previous research indicates high ceramic assemblage diversity is the norm for this region. Lithic industries were also substantially different at El Nogal and Teonadepa. This is true both in terms of categorical styles such as projectile point forms and variation that is likely more indicative of purely functional concerns, such as raw material choice, decortification, and frequency of various tool types. Though limited in the number of recovered artifacts, items of adornment also appear to be near mutually exclusive between the two sites, suggesting the possibility for fairly profound variances in important mediums of signaling social standing and affiliations. There were even apparent divergences in food ways, or, at least, in the various extractive industries undertaken within habitation areas. This may be the result of preference or participation in an economic system that gave rise to differing local specializations at primate centers.

These disparate lines of data firmly establish that a significant social boundary existed between El Nogal and Teonadepa in regards to exterior affiliations, decorative styles, and cultural norms. This social boundary corresponds to a political division as suggested by the settlement patterns analysis, and as will be discussed below, only minimal evidence for exchanges in social valuables between the two settlements. The extreme heterogeneity and small scale at which variability was expressed partially explains the frustration encountered in previous efforts to delineate the essential characteristics of the Río Sonora region from neighboring traditions (Dirst 1979). The *a priori* assumptions will obviously be substantially different in a model that takes as its starting point political consolidation over entities that controlled entire river valleys compared to models that only seek mechanisms for control over local valley segments by politically homologous but socially heterogeneous units.

Exchange Networks. Previous researchers hypothesized that Sonora served as a natural conduit for goods, people, and ideas to flow from Mesoamerica to the U.S. Southwest. These models mostly relied upon data available from both ends of the presumed corridor with little understanding of the qualities of the intervening regions. The few research projects conducted in Sonora came to substantially different viewpoints, mostly based on circumstantial data that did not directly address the movement of materials, i.e. provenance analysis. R. Pailes (Pailes 1980, 1990) believed that local elites were reliant on long distance trade to legitimize their power. Doolittle (Doolittle 1984b, 1988) in contrast argued that local exchange of staple resources was more important with long distance exchange only becoming an added interest once the political landscape of Sonora had been cast.

The analyses presented in this research provided one of the first systematic attempts to address how objects actually moved around the Sonoran landscape. Three basic levels of movement relevant to the political economy are discernable: local, regional, and long distance. Locally produced commodities passed freely between distinct settlement communities. This was demonstrated by an analysis of aplastics in brownware ceramics that indicated a linear decrease in their frequency as distance from the source increased. This pattern is indicative of a *supply zone* in which exchanges are face to face interactions between producer and consumer. The 30 km of distance and crossing of a sociopolitical boundary involved in the transference of a ubiquitously available good is surprising. Most households participated in these exchanges. These interactions were likely not carried out for purely mundane economic goals. Assuming ethnohistoric accounts of warfare in the region are accurate, households and settlements may have been subject to sudden depredations. A lack of communal architecture or any large scale labor projects in the region suggests few integrative mechanisms above the level of the household to provide potential social buffering mechanisms in times of stress. In these contexts it would be expected that households might forge many exterior ties that could be called upon in times of need. Households subject to non-synchronous political fortunes would be especially desirable social connections, explaining the frequent crossing of an otherwise distinct boundary in settlement communities.

Ceramics are the only material that was suitable to explore these relationships via provenance analysis. However, the apparent differing emphasis placed on variable subsistence resource extraction activities at El Nogal and Teonadepa may also suggest an intricate web of household based exchanges of locally produced commodities. Of course such ties would be of little use if they were not at least occasionally actualized. Evidence for the frequent movement of households and individuals between polities would be hard to demonstrate with the best of datasets. A few circumstantial lines of evidence do suggest such practices are plausible. The extreme diversity of architectural forms (Chapter 13) seen at excavated sites may indicate individuals frequently did migrate between local communities, bringing with them their distinct styles (cf Burmeister 2000; Stone 2003). A similar argument could be made for locally produced brownwares decorated with textured designs. The frequency of these designs varies greatly as noted above, but all techniques seem to be present at some level in all areas, giving rise to an extremely heterogeneous decorative tradition across the Río Sonora region.

Acquisition of rare goods on the regional level is indicative of aspirant leader strategies. Evidence at this scale of interaction is limited to painted ceramics, a few identifiably unique plain-ware ceramics, and obsidian artifacts. As noted the painted ceramic types recovered at Teonadepa and El Nogal are nearly mutually exclusive. This indicates access to regional exchange networks were not shared by these two sites. Obsidian was virtually absent at El Nogal but ubiquitous at Teonadepa and La Cuchilla—another northern site. Again this suggests individuals in the Teonadepa region had access to exterior relationships not available to El Nogal. The very limited distribution of obsidian within the Tenoadepa settlement community only within the two noted sites is reflective of a controlled access social valuable. It appears only select individuals had the necessary connections to procure this resource from the source approximately 70 km away and located in another local settlement community's territory. It was perhaps procured as part of an embedded strategy in the formation of warfare alliances. The fact that it was only apportioned out within two of the largest sites suggests the select maintenance of local support networks (*sensu* McGuire 1986:257), as opposed to further transference to other aspirant leaders at a greater distance from the original source.

Taken together, these lines of evidence suggest aspirant leaders were indeed very interested in the acquisition of foreign goods but constrained by the inefficiency of regional networks to move goods a significant distance. Additionally, it appears aspirant leaders had little interest in actively supporting anything but immediate neighbors. It is unclear how the aspirant leaders of Teonadepa and El Nogal viewed each other. There is no archaeological evidence that they ever codified an alliance through material exchanges, but this may be a result of preservation, or the relationships may have been reified in some other manner. Neither group had access to naturally rare materials or presents other evidence for the regular production of social valuables, so there is no way to measure interaction of this type. This project also did not investigate the commoner households near the source of Teonadepa's obsidian contacts in the Huachinera area. As such, it cannot be unequivocally demonstrated that commoner household regularly countered aspirant leader relationships..

The social valuables perhaps relevant to true long distance exchange, such as turquoise and shell are most notable for their sparseness. The relative absence of these items and the overall sparseness of other common signaling media hint at larger themes regarding leadership ascendance strategies. Relative to other regions there seems to be a lack of effort on the part of aggrandizers to materialize supporting ideologies through the manipulation of widely shared symbols, rare/costly items, or items with intrinsic relations to ideologically charged origins. There is no substantial evidence in ceramics or rock art of attempts to emulate aspects of Mesoamerican ideology as is common in surrounding regions. There is likewise little evidence of attempts to monopolize symbology to shade interpretations and meanings in the context of public ritual, including feasting and other high visibility ceremonies. And perhaps, not surprisingly, there is little evidence of resistance to aggrandizer strategies through the use of widely available social valuables that emphasize collectivism and shared identities. Widely accessible shell adornments serve this end in neighboring regions. Tentatively, it is argued this is a reflection of aspirant leaders mainly focusing on warfare as the predominant social ascendance strategy.

Research Question Summary

Returning to the hypothesis originally forwarded at the start of the project some fairly clear statements can be offered. In regards to Hypothesis One: yes settlement communities did engage with each other in exchange relationships. However, aspirant leader and commoner household versions of these networks were not coterminous, reflecting their disparate motivations. Additionally, it can be stated that these networks were not expansive but almost exclusively regional or local in character. It is clear that there were multiple settlement communities in relatively spatially constrained areas, but the relationships between these groups reflects both tendencies of horizontal integration and, less clearly, hierarchical competition. In regards to Hypothesis Two, this assertion seems to be largely supported. It appears most households did forge many extra-settlement community relationships. This almost certainly was not done for purely functional reasons, but rather as a means to cement relationships that could be called upon in times of need. This gave rise to the rather unique scenario in which rare exchange goods denote clear material culture boundaries whereas mundane goods reflect more diffuse patterns.

Cultural History Outline

At this point it seems useful to provide a basic sketch of what is *known* of the prehispanic period of eastern Sonora. This brief overview will constrain itself to established, *archaeological* data supported observations. The next section will provide much more ambitious reconstructions of several themes relevant to the late prehispanic period that draw heavily from ethnohistoric texts.

Thus far the oldest date in eastern Sonora obtained for what is believed to be an agricultural occupation is ~2650 B.P. (see Chapter 10 Table 10.2), recovered from a deeply buried deposit in the Sonora Valley. The discovery of this deposit was fortuitous and insinuates that most agricultural deposits of this age and older may be buried in river floodplains. Rare cave sites provide another location worthy of investigation for early maize and other cultigens, but well dated examples have not yet materialized.

As discussed in Chapter 10 the story of Río Sonora occupance really only comes into view around A.D. 1100. In some valleys, such as the Sonora, there is a fairly clear transition from exclusively pithouse (house-in-pit) to a mixed pithouse/above ground architecture phase at around 1300. Dates obtained on a variety of structures indicate some non-floodplain occupation a early as 900 (Blanquel 2010; Doolittle 1979). As a general marker, though, intensive mesa occupation does not begin until around A.D. 1100 (Chapter 10). Broad demographic patterns across the Northwest/Southwest (Hill, et al. 2004) and research in other Río Sonora valleys besides the Sonora suggests the appearance of stark increases in population are due to a lack of chronological precision and obfuscating formation processes. These contextual clues imply considerable settlements dating prior to ca. A.D. 1100 remains archaeologically invisible due to location primarily in active floodplains. As for later period growth ca. A.D. 1300, significant upswings in population are not visible in all valleys. Previously, an inferred sudden appearance of large populations was the source of intensive speculation regarding immigration and rates of internal population growth (e.g. cf Doolittle 1984; 1988; Pailes 1997). There are no indications of massive immigrations from a depopulation of southern Arizona. Large influxes from Paquimé also seem unlikely given currently accepted chronologies. This is not to say that no immigration occurred, only that no site level intrusions or other large pulses of population can be detected in most valleys at present. This refined view of the Río Sonora region unfortunately does little to unravel what must be a complex story of migrations, intrusions, and intermingling of various peoples that gave rise to the complex linguistic landscape of the region recorded at contact. There remains very little archaeological indication of whether O'odham groups were displaced by Ópata speakers or the other way around. Both scenarios have been proposed (Chapter 1). There are, however, a few hints in the distribution of certain ceramic patterns of textured and perhaps some painted forms (Chapter 4) that correlate to historic linguistic distributions and suggest avenues of future research.

Several chronological patterns in material culture are now becoming clearer. Brushed ceramics became a common decorative/functional treatment early in the sequence and persisted until its termination. Other texturing techniques are potentially equally old in southern Sonora with ages of ~A.D. 700 (J. P. Carpenter and Sánchez 2008; Pailes 1973:399), but perhaps did not become fully established across central Sonora until later in time. Local painted traditions do not become apparent until the 1200s (based on Moctezuma Valley data). Hematite-on-brown appears to date to periods after its demise or lessening importance in other neighboring regions (Chapters 4, 10). Chihuahuan styles infiltrated the area quickly after their development and persisted in some manner post 1500. Populations likewise remained relatively high but distributed in a patchy manner mostly tied to arable land at least until the early 1500s. Material cultural differences and settlement patterns reflect a dynamic political and cultural situation at this time that undoubtedly placed many small polities in competition with one another. At present, though, there is no suggestion of resource or subsistence stress.

Aspects of material culture were likely intentionally manipulated to make emerging political boundaries more manifest. A lack of conformity in public architecture suggests considerable experimentation with integrative forms, while its small character suggests only local (several km radius) settlement communities were the target of integrative mechanisms. Some households likely developed economic specializations in this period. They were likely drawn into these roles by the potential for economic and social gain, as opposed to pushed through subsistence marginality. Positions of authority are virtually absent in terms of archaeological evidence other than those suggested by site level inequalities expressed in access to exotic materials such as obsidian. There is some minimal evidence for a processes of aggregation and retreat to more defensive positions possibly near the end of the sequence (see Chapter 12 Son H:13:2). This may represent the intrusion of Apache and other groups or merely the results of a continuation of internecine warfare characteristic of the region. Old World diseases apparently had a tremendous impact on settlement patterns and virtually every other aspect of Río Sonora culture prior to the arrival of the Jesuits (Reff 1985, 1991b, 1992). Some settlement communities did survive this period and may have even undergone a consolidation of political power in contrast to prior reconstructions. Missionization, beginning in earnest, in the mid 17th century led to rapid acculturation and loss of Native life ways, especially as gauged against neighboring groups (Spicer 1962).

Speculative Models

While the above summaries provide a revised description of certain interaction patterns and suggestions of the scale at which they should be considered they also pose several deeper questions. The available data set is obviously most suitable for focusing on questions of social organization in the late prehispanic and protohispanic periods. Issues addressed in this section include: Why did the pattern of exclusively small scale settlement communities emerge in this region and why is it different from neighboring areas where larger scale political integration was achieved? What specific leadership strategies were employed in this region, and where they ever very successful? What implication does the character of social organization hold for larger trends in western North America and middle range societies generally? And finally, what is to be made of the apparent disjoint between previous ethnohistoric text based interpretations and this archaeological record based interpretation? Several of these topics will now be taken up. The following reconstructions should be understood as a first approximation based on the presently available data. Substantial revisions will undoubtedly be required.

Balkanization

The general picture that emerges of eastern Sonora in the fifteenth to sixteenth centuries is one of a politically fractured, balkanized landscape. This scenario was undoubtedly partially the result of environmental topographic restraints. Large tracts of arable land, and thus production potential, had a very patchy distribution across Sonora. Carrying capacity had apparently reached a point that intensification was necessitated within river valley corridors (Doolittle 1988:50-51), giving rise to irrigation of most all flood plains and at least double, if not triple cropping (Riley 1987:65[see also Adorno 1999:235]). However, there is no evidence of any appreciable sort for the kinds of small holder intensification seen in global ethnography (Netting 1993) nor even examples of techniques utilized in neighboring regions, such as Hohokam or Casas Grandes intensive bajada cultivation of agave (S. K. Fish, et al. 1992a; Minnis, et al. 2006). Wild resources also contributed substantially to diets. The ubiquity of large game in faunal assemblages suggests these resources were also relatively unstressed (Chapters 7). Population density does not appear to have surpassed a point requiring the regular incorporation of marginal and or risky production areas under the exclusive purview of individual production units (households). There are not even any clear mentions of *temporal* fields in the ethnohistoric documents, which could be placed adjacent to the riverine corridor. This is especially surprising given that rainfall and temperature conditions would have permitted such practices in many areas. This lack of subsistence pressure would provide very little motivation for an increase in exclusively held community territories beyond the confines of local river valley reaches. In other words, demographic factors largely precluded colonization of anything other than riverine corridors, effectively limiting the degree of control exercised over hinterlands.

In addition, the scale of most subsistence infrastructural investments would not have required large scale labor mobilization efforts, providing little opportunity for the emergence of managerial roles or subsequent monopolization of production potential (*sensu* Wittfogel 1957). Even today many irrigation ditches are dug straight off of the main river channel and rarely exceed several kilometers in length (T. E. Sheridan 1996). Households likely maintained almost complete autonomy in their production decisions, although how land tenure was established, transmitted, and renegotiated are open questions. All ethnohistoric reports seem to agree that there was an abundance of food in the region (e.g. Nentvig 1980[1764]:22-24; Hammond and Rey 1940[~1560]:297; Adorno and Pautz 1999[1542]:235) . This is despite what must have been a considerable drain on local resources by the early Spanish expeditions (Riley 1987:66-67), which may have taken place in drought years (see Chapter 2). These descriptions counter any argument that ties the emergence of managerial leaders to the exclusive management of subsistence surplus. The region seems to have had a surfeit of food resources and most households likely had no need of exterior subsistence assistance under most circumstances. Furthermore, the maximum estimate for individual polities sizes ~5000 (Chapter 3) is well under the suggested threshold associated with managerial constraints necessitating the developments of hierarchical political organization (Feinman and Neitzel 1984)..

What then was the driving force behind incipient leadership positions if any? And what motivated households to forge exterior connections, presumably as a means of risk aversion? Statements in ethnohistoric documents suggest internecine warfare was the primary underpinning of leadership offices in the region. War leaders are essentially the only positions that can be regularly identified in these documents and it is the only position that remained in collective social memory long enough to be recorded ethnographically in some detail (Johnson 1971). Internecine warfare would clearly suffice as a motivation for seeking safety nets outside one's own sociopolitical affiliation. Connections that crossed war leader mediated alliance networks prone to simultaneous depredations would be particularly desirable. Local warfare thus provides one possible explanation for the incongruent directionality of exotic and mundane exchange patterns.

Another notable feature of ethnohistoric accounts of warfare is the stated goal of slave acquisition. Riley (1987:90) argues many of these captives were female. Such behavior is more commensurate with a population operating well below carrying capacity in which available labor, not resources are limiting factors to economic success. These conditions would also be conducive to groups willingly accepting outsiders who had elected to vote with their feet by actualizing previously established ties among neighboring groups. Drawing on analogies from similar demographic conditions in African frontier zones, access to, and control of reproductive potential through the manipulation of marriage alliances may have been a common method to attract outsiders (Kopytoff 1987; see also Donham 1999). Notably, in the 1540s the inhabitants of Corazones tolerated Alcaráz' demand for two-thirds of subsistence production but quickly revolted when he forcibly took daughters (see Riley 1987:66). Alcaráz apparently unwittingly, or uncaringly, run afoul of local leaders by depriving them of a principal commodity leveraged in local alliance formation (see also Radding 1997:107-108). The Ópata region was also noted as exceptional for the rapidity at which inter-cultural marriages were sought after Spanish contact (Radding 1997; Spicer 1962). This perhaps reflects long held cultural mores and strategies of alliance formation. Inducements that rely on the manipulation of marriage and land to increase the number of farmers co-resident in a group quickly blur the lines of founder, newcomer/immigrant, and slave (Nyerges 1992:867). Such frequent population movements and fluid alliance formations give rise to open competition for positions of authority, a surfeit of would be leaders, political instability, and small scale integration.

In eastern Sonora in the fifteenth and sixteenth centuries aggrandizing behaviors channelized into only a few lines of social ascension to leadership positions. There was apparently little scarcity and attendant risk to exploit in the subsistence economy, leading to high household autonomy. The distribution of populations further limited the scale of potential political unification. Aggrandizing individuals likely sought access to social valuable through regional exchange, but few settlement communities had direct access to materials of scarcity based intrinsic value. Warfare and other means of augmenting wealth-in-people through the manipulation of reproductive rights and labor availability became the predominant concerns of aspirant leaders. More complex systems to the north and south may have provided some inspiration to these aggrandizers but had little if any direct influence. On the macro-scale, warfare created labor and reproductive risk and scarcity for aspirant leaders to manage in demographic and ecological conditions that did not offer resource limited conditions. This scenario would have been the emergent property of individual aggrandizing agents cajoling local population bases to support them in their pursuits through all the traditional means of persuasion. In such systems the size of one's dependent network is one of the principal measures of differentiation and augmentation in subsistence production is only a means to this end. Patronage is not necessarily exclusive and obviously prone to instability. This would be particularly true if potential warriors could freely export their talents (*sensu* Kristiansen 2010).

Such a fractured landscape and competition for adherents would inevitably lead to motivations to differentiate one's own group from surrounding competitors.

Simultaneously there would be a motivation to foster a social setting with sufficiently familiar components that captured individuals lessened their resistance and potential recruits were attracted. Social valuables apparently fulfilled only an ancillary role in this scenario. They were likely only rarely obtained by aspirant leaders and when acquired apportioned out to socially and spatially proximate individuals to maintain their support in matters of production and warfare (Chapter 14). This was undoubtedly accomplished as a corollary to other relationship maintaining strategies, as the low absolute number of such goods would render them an otherwise inadequate enticement. Admittedly there are many other mechanisms that could explain the patterns observed in eastern Sonora aside from this reconstruction, a result of the still overall data poor contexts that will only be rectified with significantly more research. However, as a working model this argument meets the basic criteria of explaining the presently observable data in a more comprehensive manner than previous attempts.

The proffered reconstruction could potentially explain the diverse nature of the rare edifices of communal integration observed in the region. The Sonora Valley purports several possible ballcourts (Doolittle 1988), and the upper San Miguel one (Braniff 1992c), but with varying morphology. The Río Moctezuma produced one small platform mound at La Calera (Son L:2:34), two possibly modified natural prominence at El Nogal, possible plazas at Las Clavellinas (Son H:13:2) and Teonadepa, and one isolated walled clearing at La Cruz (Son L:2:28) (Chapter 12). The Río Bavispe contained one small possible platform mound (J. E. Douglas 1997). The ethnohistoric documents would also add ritual structures of at least two varieties: small huts into which numerous arrows were shot and sepulchers for deceased leaders. This is the pattern of a region subjected to many competing ideational concepts. There was clearly no normative, exclusive conceptualization regarding the appropriate form of communal interaction and thus no monopolization over claims to understanding its appropriate materialization. There is undoubtedly a degree of chronological imprecision in regards to these features. Such diversity may also represent unconstrained attempts to cope with massive population loss caused by European disease through religious and social experimentation.

Mixing of the familiar and the foreign/unique as a political tool was likely a much more common strategy than is generally acknowledged in the broader region. The Cerro de Trincheras open dance ground/ballcourt (O'Donovan 2002; E. Villalpando and McGuire 2009) area as well as the ritual summit precinct is one example. At Paquimé there was a high diversity of public, presumably ritual architecture, in close proximity (DiPeso, et al. 1974a), including ballcourts and mounds. In the Hohokam preClassic to Classic period transition some Tucson Basin settlement communities contained both platform mounds and cerros de trincheras (Downum 1993, 2007). Hohokam platform mounds also show a considerable variation in their morphology and the structuring of ritual space (Elson 1996; Elson and Abbott 2000; Gregory 1987). The co-appearance of elements from disparate ideological traditions likely reflects aspirant leaders' attempts to both appeal to an existing acceptance of inequalities through association with established materializations of leadership while simultaneously seeking to set their relationship to certain ritual theaters apart from close competitors. In the Río Sonora region it simply appears there were far fewer constraining parameters on this behavior.

Returning to the Río Sonora area, it is also worth noting that ceramic styles, frequent purveyors of symbols charged with ideational meaning, appeared to avoid such content (Chapter 4). *Chihuahuan* types for instance contain none of the symbology present at Paquimé (see C. S. VanPool and VanPool 2007), but rather only similar line work and color palette norms. These designs allude to concepts of important centers and personages without employing content that might be more effectively wielded by competitors with a closer physical proximity to the center. Additionally, if the ideological landscape was too volatile for consensus to converge on the meaning of symbols it is hardly surprising that they would not be painted on ceramics intended for export or imported by aspirant leaders who had little ability to shade the meanings associated with their (McAnnay and Wells 2008). Rock art research may provide indications of locally monopolized symbolic repertories (Chapter 9). Presently it appears there is a high degree of variance in rock art over relatively short spatial distances, but more research is needed.

Had the scale of settlement communities and attendant political integration been larger these middling attempts at integrative mechanisms would have been inadequate. But as Yoffee (2005) points out, integration only becomes necessary after a society develops institutionalized mechanisms of differentiation. It is argued here that populations were subject to many efforts of recruitment by local aspirant leaders, giving rise to populations with diverse regional backgrounds and perhaps variable linguistic and other social identities. However, there is presently no evidence of conflicting structural dominance or competing hierarchies within settlement communities that gave rise to situational authority. Such heterarchical contexts (McGuire 1983; Rautman 1998) foment the development of strong integrative institutions to reify and delineate the contested purviews of diverse social institutions.

The degree of hierarchical inequality achieved in Río Sonora groups also appears to be quite low. This may simply be the result of inadequate research, but at present there is no evidence for stark social rankings beyond competing war leaders. If there are no structural economic inequalities then there is little need to develop mechanisms to disguise motives as oriented toward collective benefit (Hayden and Villeneuve 2010). Again, this would provide little impetus for the creation of elaborate venues to carry out rituals that materialize ideologies supportive of the status quo while ostensibly serving the interest of communal welfare. Ideology undoubtedly still played a central role in underpinning any ascendance strategy, as it does in all transegalitarian societies (e.g. Aldenderfer 2010; Potter 2000). However, as stated in Chapter 14 the results of warfare based competition may often have been manifest, obviating the need for elaborate Machiavellian attempts to disguise motives and sway supporters.

Characterizing Leadership

At this point it is worth summarizing some of the essential characteristics of apparent aspirant leader strategies to facilitate a contrast with better known neighboring groups. In terms of scale, the Río Sonora region appears to rank below the magnitude of demographic and concordant spatial consolidation that was achieved in most surrounding areas (Chapter 3), including Trincheras, Hohokam, and Casas Grandes. If more marginal settings in these larger macro traditions are considered this comparison becomes less stark. This is particularly true outside of the core area of Casas Grandes (e.g. Bagwell 2006; J. R. Martínez and Jaramillo 2013). These regions are unfortunately as equally poorly studied as the Río Sonora.

The degree of hierarchical structure present in most Northwest/Southwest societies is far from a settled matter. Minimally, though, the sorts of entrenched positions of authority insinuated by domestic architecture on top of Late Classic Hohokam Mounds (Wilcox 1991), "*elite* "precincts near the summit of the Cerro de Trincheras (McGuire and Villalpando 2011; McGuire and Villalpando 2007), and the conspicuous labor consumption of some Paquimé rooms (Pitezel 2011; Whalen and Minnis 2001a) certainly has no parallel in the Río Sonora region. Other lines of contextual evidence, such as the richness of burials, can speak to both the degree of hierarchy in these regions and to some extent the diversity of positions of authority (Mitchell and Brunson-Hadley 2001; Ravesloot 1988). At present, though there is no comparable dataset for the Río Sonora region.

Perhaps more informative than a relative measure of scale or hierarchy are the disparate strategies of elite/leader ascendance and control. Following the dual-processual approach of Blanton, Feinman, and others (Blanton, et al. 1996; Feinman 2001) many of the societies of the Southwest U.S. (not including Paquimé) are identified as more *corporate* in their orientation (Abbott 2003; Feinman 2000; Gallaga 2004; Graves and Spielmann 2001) as opposed to *network*. This axis of description is independent, or orthogonal to those already discussed. Qualities of both patterns will invariably be present in any society. Drawing from the previous references, the end points on this continuum are characterized as follows.

Corporate: Emphasis is placed on staple food production, communal ritual, public architecture, and shared power structures with integrative ideological and ritual mechanisms. Differentiation is often subdued with little personal aggrandizement of leaders.

Network: Emphasis is placed on the manufacture of status enhancing crafts, prestige goods and exchange. Differentiation is more pronounced with personal aggrandizement accepted and supported by lineal inheritance, long distance networks, aggrandizing burials and an ideology that emphasizes the unique importance of power figures.

Both the neighboring Hohokam and Trincheras appear to lean more corporate in their orientation through most of their respective sequences. They both obviously relied on edifices of monumental architecture as a means of integration. What we know of the specific character of ritual at these edifices mostly conforms to *corporate* strategies. In the Trincheras area ceremonies were replicated at surrounding communities, presumably to facilitate integration into the larger system (S. K. Fish and Fish 2004). At the primate site of Cerro de Trincheras, there were also various communal venues (O'Donovan 2002), which likely permitted shared power structures, sanctioned, delineated, and integrated through ritual events. Hohokam platform mounds with their clear necessity for community wide orchestration in construction also are a hallmark of *corporate* systems, but may have become more *network* in orientation during the Late Classic ca. A.D. 1300 (Abbott 2003:220). Similarly, the overall low occurrence of extremely rich burials and the only rare association of any burials within the edifices of communal power are again strong signs of a *corporate* orientation. Lastly, the systematic duplication of domestic units in both regions, compound groups in the Hohokam and terrace groups in the Trincheras are indicative of tightknit, exclusive kinship groups and effective pooling of domestic production. Evidence for *network* organization can certainly be found as well, particularly among the Hohokam and increasingly later in time. The extensiveness of trade networks, for instance, clearly demonstrates that long distance connections were leveraged in some political theaters.

The data on the Casas Grandes region is much more equivocal, but clearly indicates a more *network* approach. There are many communal edifices at Paquimé, including ballcourts, which large audiences could observe. However, the size of most platform mound surfaces, including the one attached to a ballcourt, are indicative of events that focused attention on a limited number of individuals. The role of exchange, although still debated, seems unequivocally linked to patronage relationships and may have led to the finance of hinterland staple goods production (Whalen and Minnis 2001b). There is the possibility for elite attached craft specialization and the production and concentration of wealth was clearly a concern (T. L. VanPool and Leonard 2002).

The Río Sonora data are much more equivocal and the search for any direct parallels seems *a priori* hindered given that political systems in this region were both smaller in scale and likely achieved less stark degrees of inequality. As such, evidence for either *corporate* or *network* strategies must be sought with the expectation that they will be manifested at different magnitudes proportional to the sociopolitical context. Blanton and others (Blanton, et al. 1996:5) in their original formulation of the *network* mode stressed the importance of *patrimonial rhetoric*. This strategy places emphasis on the manipulation of group membership and interaction through marriage alliances that legitimate the appropriation of surpluses and establishment of partnerships. This practice grows out of the need to curtail free entrance into the preeminent levels of the political economy among local competitors. This is in keeping with the above observations on apparent aspirant leader strategies as distilled from a mix of ethnohistoric and archaeological data. Perhaps more important to this argument, though, is the implied difficulty in achieving a monopoly on exchange or other mechanisms of ascendance. Specifically, it is predicted that those successful at monopolizing local systems will be drawn into larger competitive networks, akin to a peer polity frameworks (Renfrew 1986). However, in contrast to producing an homogenizing emulation induced feedback typical in peer polity interaction, *network* strategies tend to fracture the macro regional sociopolitical landscape, leading to "fluidity, competitiveness, and an emphasis on individual skill" (Blanton, et al. 1996:5). Many of these characteristics obviously mesh well into a warfare centric model of social ascendance.

Blanton and others further predict that at the regional scale aspirant leaders will be drawn into a symbolic vocabulary denoted as the "international style" to facilitate the formation of cross boundary relationships. It is difficult for any single political unit to dominate the symbolic content of this style. This scenario has obvious corollaries to the artistic/stylistic heterogeneity observed in the Río Sonora region in regards to rock art, the limited painted ceramic traditions, and possibly even textured ceramic designs. In short, nascent *network* strategies appear to characterize the Río Sonora region. Emulation of Casas Grandes leaders possibly fomented these strategies but they were executed in a system characterized by a much lower level of political complexity.

Physical and demographic constraints precluded expansionism through the merging of independent settlement communities. If such control was achieved it was likely unstable as upcoming aggrandizers could readily draw from unconstrained symbolic repertoires to undercut any emerging ideologies that justified exclusive leadership positions. Due to relative size parity in settlement communities, long term uncontested success in warfare was unlikely. These factors also constrained both the efficacy and feasibility of dominating regional exchanges of social valuables. As a result, most eastern Sonora groups never reached a truly recognizable *network* character even though this was the directionality of their strategies. Some groups, such as those in the Sonora Valley, may have been more successful than others.

These observations have relevance to global cross cultural comparisons. Various analyses made frequent note of the patchiness of the landscape in terms of productive potential. Based on first principles this might be expected to give rise to systems in which aspirant leaders could easily monopolize productive potential and consolidate the power of local population bases. This scenario characteristically gives rise to fairly clear cut inequalities and strict social ranking (Kristiansen 2010). However, the relatively close spacing of productive patches and the apparent lack of demographic pressure had the effect of producing a pattern of leadership ascendance more in line with *Germanic social formation* (Gilman 1995). This model predicts diffuse and widespread productive potential will gives rise to decentralized political landscapes. Political ascendance in these sorts of environments is often stunted. Had the Spanish and attendant native population crashes not intervened it is entirely likely that the *longue durée* of Sonoran prehistory would have led to continued demographic packing that played out in a manner more familiar to other examples of peer-polity interaction in production limited landscapes. The reconstruction offered here does not argue that competition resulted in a sort of isostacy of political complexity, only that political systems were presently at a state that expansion was difficult when witnessed in the sixteenth century.

How these loosely organized groups interacted with the limits of the northern Mesoamerican frontier or even with obviously more complex societies in the Greater Northwest/Southwest prior to Spanish contact remains a fairly open question. It is entirely possible that elites in these more complex regions saw it to their advantage to discourage the formation of more stable hierarchical institutions in eastern Sonora so that they remained in a dependent and easily exploitable status. Such dynamics appear to have had very little if any direct impact on the interior regions of Sonora that generated the data set discussed here.

Mind the Gap

The above discussion placed emphasis on explaining why the Río Sonora region exhibits the qualities observed based on a consideration of both pre-existing social and physical landscapes. Discussion will now focus on macro level processes impacted by the fact that eastern Sonora was organized in this manner. Before proceeding, though, a major note of caution is warranted. Unlike much of the U.S. Southwest where early expeditions seemed to be fairly effective at noting the impressive achievements of Native American material culture long before professional archaeologists, most finds in Sonora have only been made through directed archaeological effort. Before the Río Sonora project of the 1970s and 1980s ballcourts and the other large clearings were not recorded. Similarly, the small mounds of the Moctezuma and Bavispe valley were equally unknown prior to formal survey. The most impressive *ballcourt* located in the region (San Jose Site) has now been partially bulldozed in the process of clearing for agriculture, and sites that were recorded in the 1970s are now completely under modern development. Such depredations are not uncommon and few local people make note of the destruction. There is no way to estimate what sorts of unique features may be completely lost to modern and historical development. Additionally, many objects of material culture and attendant cultural practices can be highlighted as examples of things that were previously thought to be absent in the region. A notable example is the frequency of dental and cranial modification found in the Onavas region (Watson and García 2015) that was hitherto thought to be restricted to West Mexican and properly Mesoamerican contexts. An anecdotal example can also be given from the current project. A local avocationalists who lived across the street from the field house in Moctezuma brought over a few of his better finds, including a large figurine with coffee bean eyes (Chapter 4) and an object best described as a palette (Chapter 6). Neither of these objects had ever been recorded in eastern Sonora previously and would still be unknown if not for this chance encounter. In short, any assumption that Sonoran research has reached a point at which it can be stated with confidence that *x* practice or *y* trait is wholly absent is demonstrably premature.

These caveats aside, it is equally clear that Sonora is not possessed of the same frequency of Mesoamerican stylistic traits, symbology, and rare material goods known among some U.S. Southwest (Hohokam)(R. S. Nelson 1986) and Northwest Mexican (Paquimé)(DiPeso, et al. 1974c) groups. This Sonoran gap likely had profound implications for how items of Mesoamerican affiliation were employed in what is now the U.S. Southwest (Ekholm 1942; B. A. Nelson, et al. In press). The cultural cache of objects with Mesoamerican connotations, by benefit of actual provenance or indexical qualities, would likely be raised by the implication of connection not only to Sonora but rather directly to outposts of Mesoamerican influence, possibly in Sinaloa, Durango, and Zacatecas. Undoubtedly these objects were principally employed in a ritual economy (*sensu* Spielmann 2002) in which their exoticness and association with conceptions of Mesoamerica enhanced their value as implements in ceremonial performances (e.g. Mills and Ferguson 2008). Perhaps more importantly, though, it is an inevitable outgrowth of the

Sonoran gap, that familiarity with the method of implementation of such objects in Mesoamerican contexts would become increasingly restricted. This is true in regards to both items that served as indexical references to Mesoamerican origins and actual rare objects with Mesoamerican provenance. The efficacy of these objects in local ritual economies may have partially derived from the inability of most people to easily question the correct method of implementation and associated meanings vis à vis easy comparison with near neighbors.

The frequency of trans-regional contact passing through or around eastern Sonora remains a rather open question. There are very few known examples in which a mercantile system spans a region the size of Sonora and leaves no evidence of either the wares traded or some other form of compensation. The clear exceptions being areas that are essentially unoccupied, which clearly does not apply. In contrast, other forms of economy such as ritual exchange with attendant religious devotees such as pilgrims and other itinerants remain as a plausible mechanism. Individuals carrying items for ideological purposes might not be materially levied in a manner to leave a clear record of their paths. Accepting *a priori* that such a ritual economy would leave little trace except at the potential endpoints of interaction will necessitate new models to discern this form of material and ideational delivery from other mercantile based mechanisms. The substantial deposits at Paquimé would seem to be the most obvious focus for such attention in the future. Excavations at sites with modern Catholic pilgrimage rituals with potential prehispanic roots should be another focus, i.e. the Magdalena region (Griffith 1992).

Also relevant to this discussion are models of information sharing. Some scholars such as Steve Lekson (2009) have made provocative cases for assuming that there were essentially no impediments to information exchange. A salient example is the case of Alarcón, who attempted to supply the Coronado expedition by sea. The main force of the expedition was located in the western Pueblos at the time. Alarcón managed to receive word of Coronado's whereabouts from local inhabitants along the Colorado River. Such cases make for impressive anecdotes, but ignore the non-uniform topological qualities of information networks across the Greater Northwest/Southwest (Mills, et al. 2013). Demographic blank space, such as much of the Papagueria at the time, is often easier to cope with than recalcitrant populated areas.

Of course, very different constraints are applicable to how material and immaterial things move through a network. The sociopolitical landscape of Sonora produced a high attenuation of physical goods moving through down-the-line trade. This made the region an extremely poor conduit for material transfers. Likewise, the diffuse branching network structure imparted by the scale and distribution of settlement communities (Chapter 14) would slow the arrival of information. The frequent replication of information as it is passed through numerous nodes (settlement communities) would also significantly increase the potential for its dilution or alteration. However, this same branching, which provides many alternative paths, would also be highly effective at guaranteeing the eventual transmission of most ideas and some material items even if many specific routes were blocked (see Borgatti and Everett 2006). That is, if the speed or purity of transmission is the variable of concern, Sonora is a bad conduit, if probability of eventual transmission is the concern, than it is a good conduit. If eventual transmission of information that is guaranteed to be diluted and arrive in multiple incongruent versions is desirable, it is an excellent conduit. Such observations are only applicable to things that are replicable and divisible with each passing, i.e. material things like agriculture crops and non-material things like ideas.

The Limits of Ethnohistoric Texts

This discussion has offered many interpretations at odds with prior reconstructions based largely on ethnohistoric texts. As such, it is worth considering how this analysis might be accommodated with these past interpretations. Broadly speaking, the standard corpus of documents relating to sixteenth century Sonora has been interpreted in two ways. A distinct minority opinion holds that early Spanish chroniclers were duplicitous or exaggerated to such an extent that no meaningful assessment of social organization or demographic patterns can be discerned (J. H. Kelley and Villalpando 1996; McGuire and Villalpando 1989). In this view ethnohistoric documents are reduced to little more than a font for ideas regarding interpretations of material culture and idiosyncratic cultural practices at contact. Conversely, the majority opinion holds that they are a good faith rendering of Native populations and practices. They are inaccurate principally only in that they are filtered through Eurocentric biases with overemphasis on the characteristics that were relevant to the immediate goals of exploitation and colonization (see Chapter 1). If they are the former than there is no need to express concern over whether the archaeological record matches expectations. If, however, as most researchers believe, they are the latter it is important that archaeological interpretations and ethnohistoric data are reconcilable.

Researchers who have spent considerable time attempting to match these accounts to the archaeological record can also be divided into two groups. On the one hand there are

Riley (1976, 1979, 1987, 1995), Reff (1981), R. Pailes (1973, 1978, 1980), Carpenter (2014), Doolittle (1984a, 1984b, 1988), DiPeso (DiPeso, et al. 1974c), and Wilcox (Wilcox, et al. 2008) among others. These researchers have all come to the general conclusion, with considerable variance on the details, that the accounts describe a society exhibiting considerable complexity relative to most of the Northwest/Southwest, save for Paquimé. At times pains are taken not to invoke a specific stage in cultural evolution, but clearly what many of these researchers envision are chiefdom like entities. Sonoran groups are seen as the final apogee of cyclic periods of cultural fluorescence and reorganization across the Northwest/Southwest. On the other hand, there is Steve Lekson (2009), who notes what is probably a widely held but rarely published belief that the archaeological record of Sonora does not seem to match the sorts of complexity insinuated by the ethnohistories as presently interpreted. Lekson's solution is to argue that their was a disconnect between legacy institutions and the realities of societal organization. Such a scenario resulted, in Lekson's view, from elite rulers who convinced commoners to continue tolerating offices for which there was little managerial need and even less structural support. This was accomplished by appealing to long developed social memories for the utility and persistence of such roles.

This dissertation has argued that there is indeed little reason to infer either vertical or horizontal complexity from the archaeology of Sonora. This is in direct contrast to many of the researchers identified above. The above discussions also argue, in contrast to Lekson, that the proffered reconstruction can easily be fit to the ethnohistoric texts. References have been provided throughout this monograph to highlight points of obvious similarity between ethnohistoric texts and the archaeological record. For instance, the exploration era texts do not generally mention stable positions of leadership[xxix] or insinuate that any leadership role spanned multiple purviews of authority, i.e. religious, economic, and political. This kind of consolidation is an essential quality of more politically complex groups (Earle 1994, 1997; Feinman and Neitzel 1984; Hayden and Villeneuve 2010; McGuire 1983). What the ethnohistories do suggest is a lot of warfare, significant variability in authority held by local war leaders, few to no edifices of public architecture, an abundance of subsistence resources, trade in regionally available rare goods, and generally porous social boundaries. All of these characteristics obviously fit quite nice into the models offered above. Admittedly, some amount of selective reading is required to reach this conclusion, but far less than is required to argue politically complex groups ever developed in the region.

These observations should not be taken as an indictment of previous work. The 35 year hiatus in research that separates this work from many previous investigations allows for easy critiques of past theoretical models. And many previous interpretations remain as fundamental elements in the current model. Several of the above researchers, for instance, discussed the role of warfare in shaping the political landscape of the region. However, it is worth considering why many previous researchers were drawn toward interpretations of complexity. Discussion presented in the Preface suggested this tendency is in part a reflection of the Mesoamerican backgrounds of some early researchers and/or their home institutions. Theoretical constructs drawn from the Mesoamerican frontier were the obvious genesis for some models. For instance, Riley's term *statelet* has an obvious link with the *pequeños estados* (Mendizábal 1928) of West Mexico.

Conversely, many contemporaneous southwestern processual archaeologists were thoroughly entrenched in paradigms of exclusively endogenous development. References to exterior warfare, exchange, and immigration as mechanisms of change were generally avoided. Lekson (2009) would also add, even longer held assumptions originating with Lewis Henry Morgan produced a systematic bias of underestimating degrees of hierarchical organization and other dimensions of complexity in U.S. archaeology. In this academic milieu it is hardly surprising that many of the references in ethnohistoric texts, such as organized formations of warriors, long distance communication, and frequent movements of itinerants were seen as incommensurate with extant interpretations of U.S. Southwest groups. As a result, interpretations of Sonora were constructed to elevate political complexity above the level currently accepted for the U.S. Southwest. Doolittle (2008) has argued researchers uncomfortable with the implications of ethnohistoric texts should reevaluate overly timid interpretations of the U.S. Southwest, not try to deny the legitimacy of the texts. Obviously much has changed in U.S. southwestern archaeology in the last 35 years. Most of the characteristics described in ethnohistoric documents would no longer seem heretical if applied to Mogollon or Hohokam groups. There are undoubtedly still holdouts, and some, such as Lekson, would argue the pendulum has not swung nearly far enough. However, U.S. researchers now regularly accept evidence of large scale interaction and a significant diversity of political formations. Meanwhile, the legacy of interpreting Sonoran groups as more complex than many U.S. southwestern groups has remained largely unaddressed in English language research. They clearly were not. This monograph aimed to partially rectify this situation by providing original data and new ideas regarding the how and why of prehispanic/protohispanic Sonoran political structure. Future planned work and increased collaboration between Mexican and American colleagues will undoubtedly continue to improve our shared understanding of the variation in sociopolitical organization exhibited across this vast region.

Notes

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[i] In order to maintain logical consistency this approach will have to account for the wide distribution of Pima Bajo speakers in the region at the time of contact.
[ii] This town became the first base camp established by Coronado on his return trip and was given the name San Gerónimo. Two other iterations of this town were later established but kept the same pair of names, causing much confusion in the historic record.
[iii] There are a variety of references to bilingualism in this area suggesting linguistic boundaries may have been of minimal import.
[iv] Note that the term log-normal used by archaeologists does not relate to how this same term is used generally in mathematics.
[v] In retrospect the extremely small number of unique paste sherds relative to the ubiquity of plain sherds makes this a rather insignificant concern.
[vii] Technically, the original definition of Aconchi brown included the Moctezuma River Valley, but Bavispe Brownware, first identified, but unpublished, by Wasley would seem to have precedence.
[viii] This seems likely given the reported rim forms from neighboring regions, particularly Paquimé (see DiPeso et al 1974: 111 Table).
[ix] This test considers only the categories of incurved, outcurved, and straight, all others have an insufficient *n.*
[x] Note that the category of *incise-brushing* denotes a particular design style in which the elements are not divisible, in practice *incise-brushing* did not occur with any other techniques so its last place status is irrelevant.
[xi] Rinaldo would also count the six finger nail impressed sherds that are left out of this count, but perhaps not the six dashed line tool punched that were included.
[xii] Counts by variant are not provided, so further quantification is not possible.
[xiii] A small fraction of the total Playas Red count at both of these sites would likely not be counted as red-wares in the RMP analysis. Nonetheless, the pattern is very clear.
[xiv] This count excludes red-wares and monochrome black wares, which are included in the painted category by Braniff.
[xv] Again these values are based on size class data so the magnitude is not precise but the relationship is clear.
[xvi] Lengths reference “standard length”, which excludes the caudal fin.
[xvii] The *Canis latrans* specimens could not unequivocally exclude identification as other members of the *Canis* genus.
[xviii] This figure is based on tabulating site totals of NISP in the appendix provided by (Olsen and Olsen 1981).
[xix] Specimens coded as indeterminate artiodactyl were included but the categories of medium to large mammals and *Bos tarurus* were excluded.
[xx] This value is seen as less reliable since it probably includes a few intrusive domestic animals among the artiodactyls.
[xxi] Indeterminate cranial fragments were considered as identified, indeterminate long-bone and flat-bones were not. The utilized horse remains from El Nogal were considered modern, the questionable Cf *Bos, Bison* remains from Teonadepa were considered non-modern. All carnivore remains not identified to a specific non-canid species are considered

commensals, only *Sigmodon* sp.-cotton rats among the rodents were considered commensals.
[xxii] This method considers only medium and large mammals and considers a specimen identified if it can be placed to anatomical region, axial, limb, cranial, historic animals were included since the method makes their exclusion from the denominator impractical.
[xxiii] Note that because luminescence dating produces errors that are normally distributed the densities associated with a given date can be easily replicated with simple statistical software that includes graphing capabilities. The figures utilized here and the calculus functions described were executed in *R*.
[xxv] This assertion is based on the similarity in all observable qualities between the dated sherd and a nearby rim sherd.
[xxvi] Due to the aphanitic composition of most volcanic grains precise mineralogical compositions cannot be attained through simple binocular inspection but color obviously correlates to some degree to composition.
[xxvii] This is actually fairly unlikely for the granitic sherds as detailed thin-section analysis revealed very little variance in rare accessory minerals, hornblende and arfvedsonite being the only regularly identified mafic components.
[xxviii] Note that these *Unknown* identification numbers were produced solely for this dissertation and do not denote labels shared by any laboratory.
[xxix] There is a substantial discussion of the cacique Sisibotari (Pérez de Ribas 1999[1645]) in seventeenth century documents, but this is at least one hundred years after the period discussed here. Even this impressive individual still had to rely on persuasion rather than accepted authority.

Figures

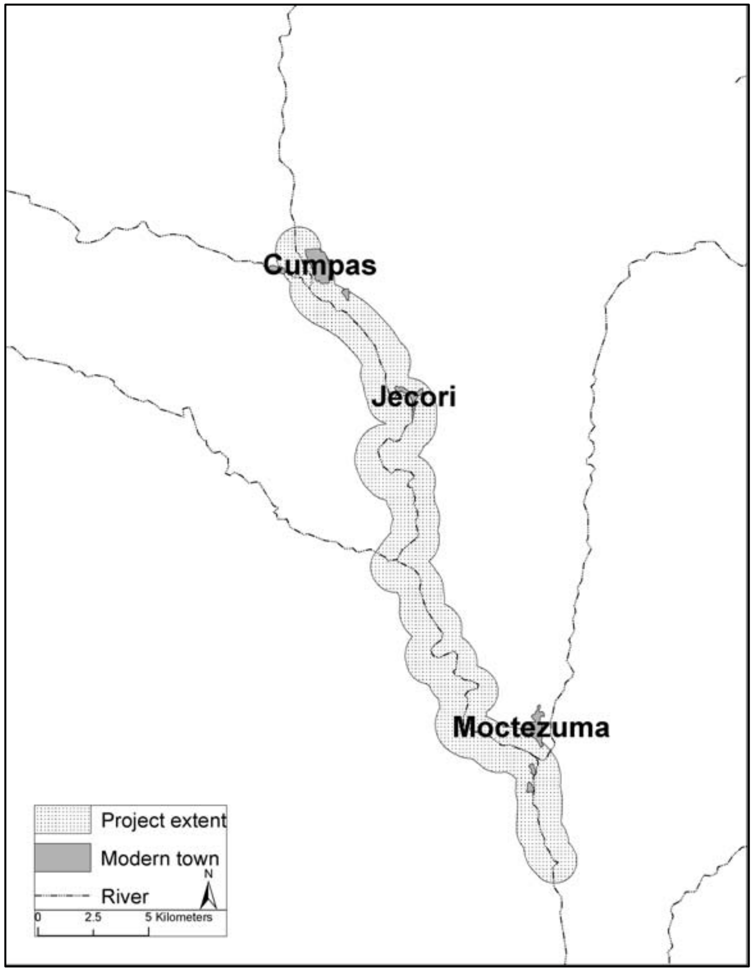

Figure i.1. The portion of river valley subjected to survey.

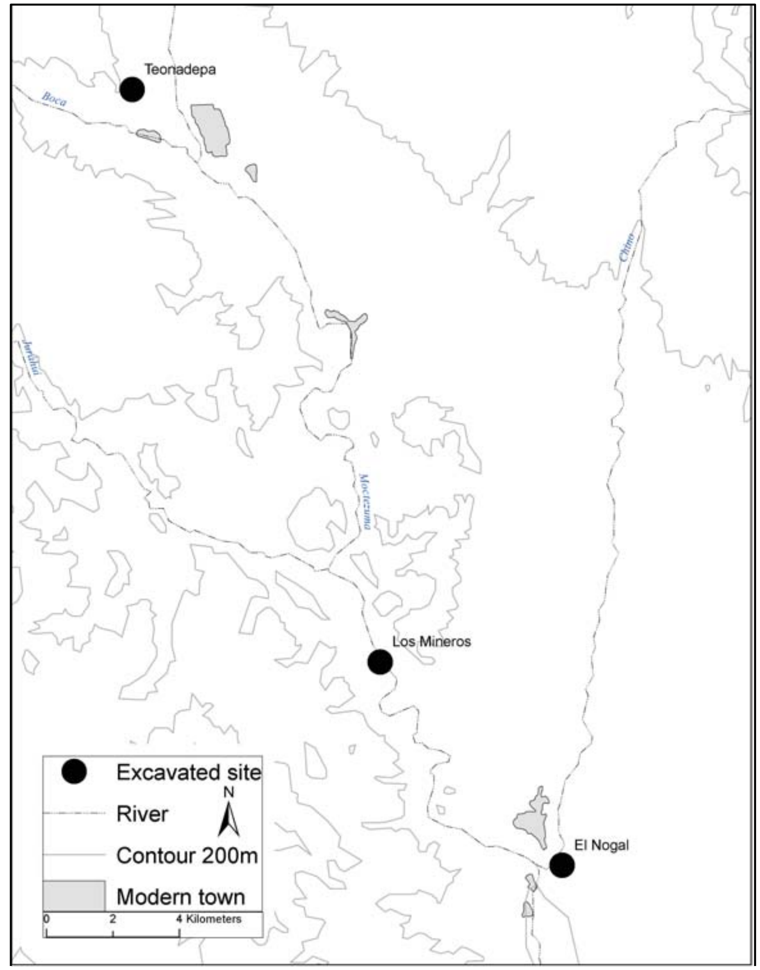

Figure i.2. Location of the three excavated sites.

Figure 1.1. Approximate routes taken by early explorers.

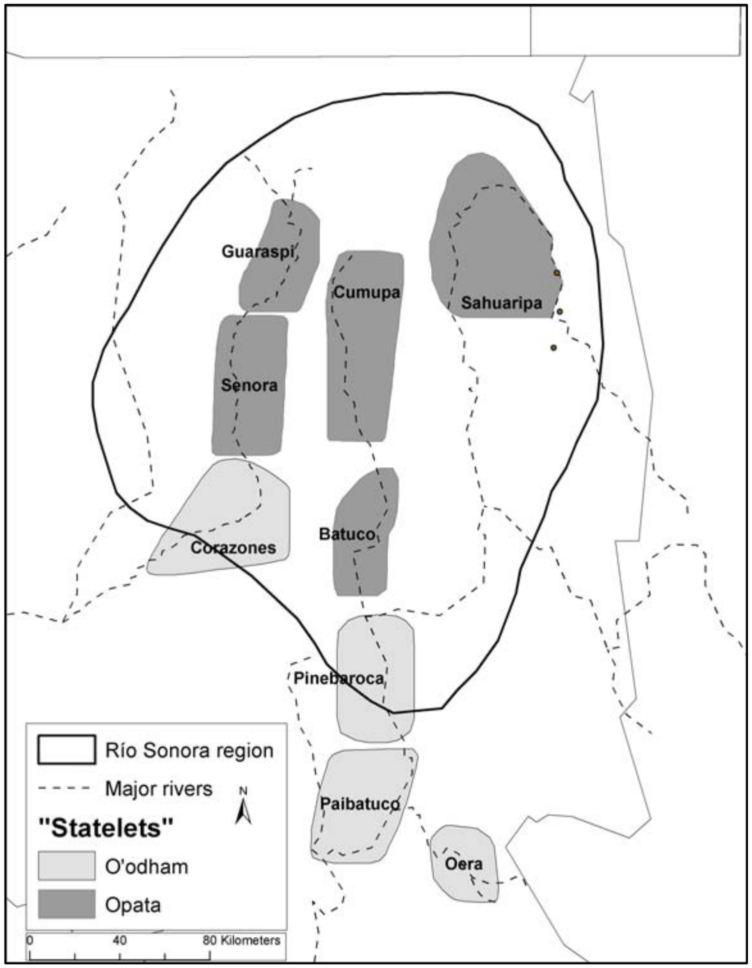

Figure 1.2. Statelets after Riley, solid line is area defined as Río Sonora by Doolittle.

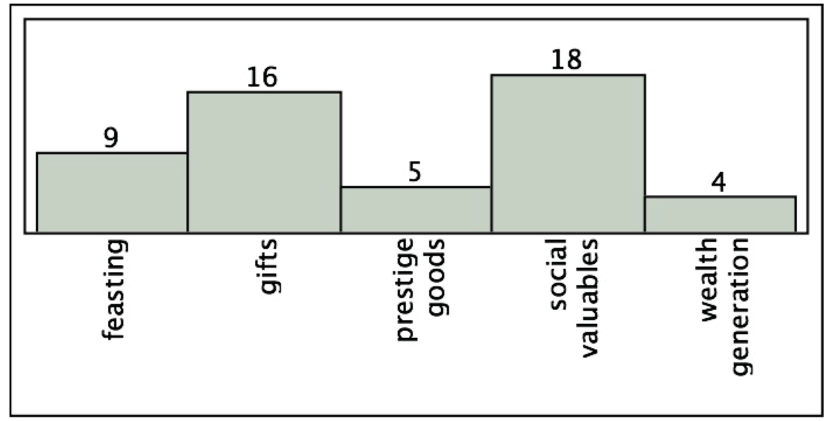

Figure 1.3. Count of ethnohistoric references to exchange.

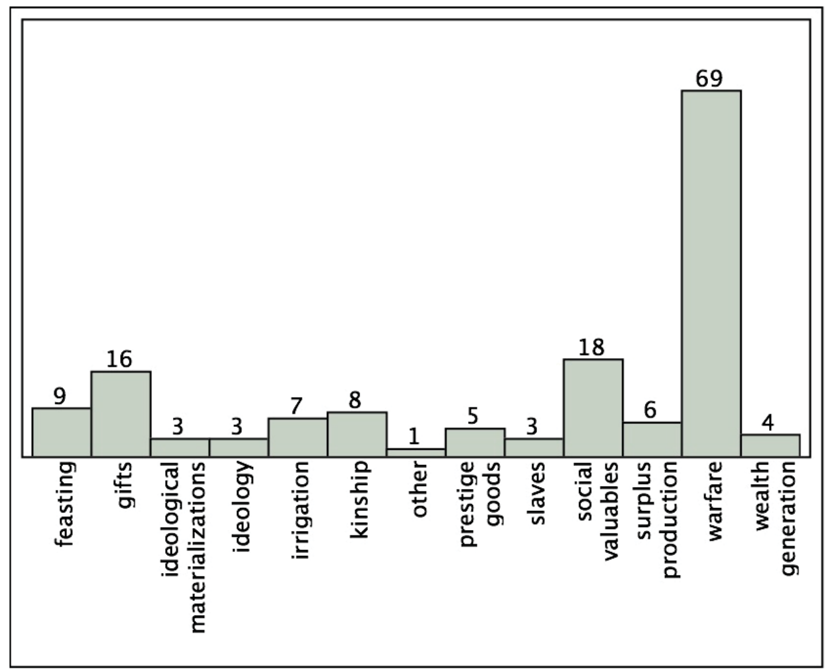

Figure 1.4. Count of ethnohistoric references to possible leadership ascendance strategies.

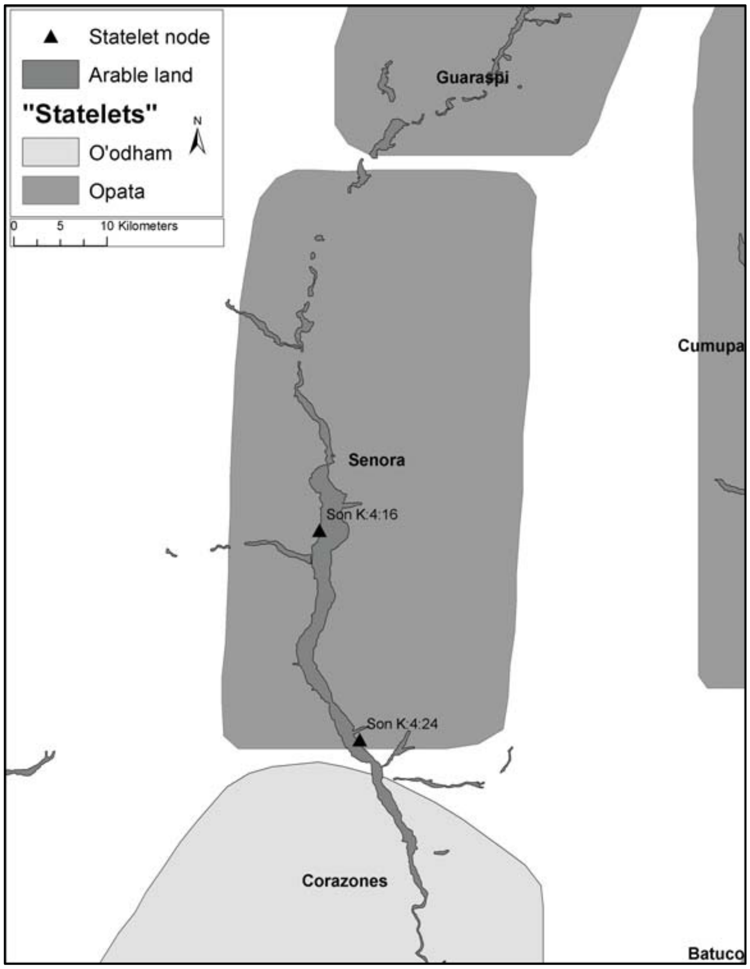

Figure 1.5. Nodal villages identified by Doolittle as confirmation of statelets.

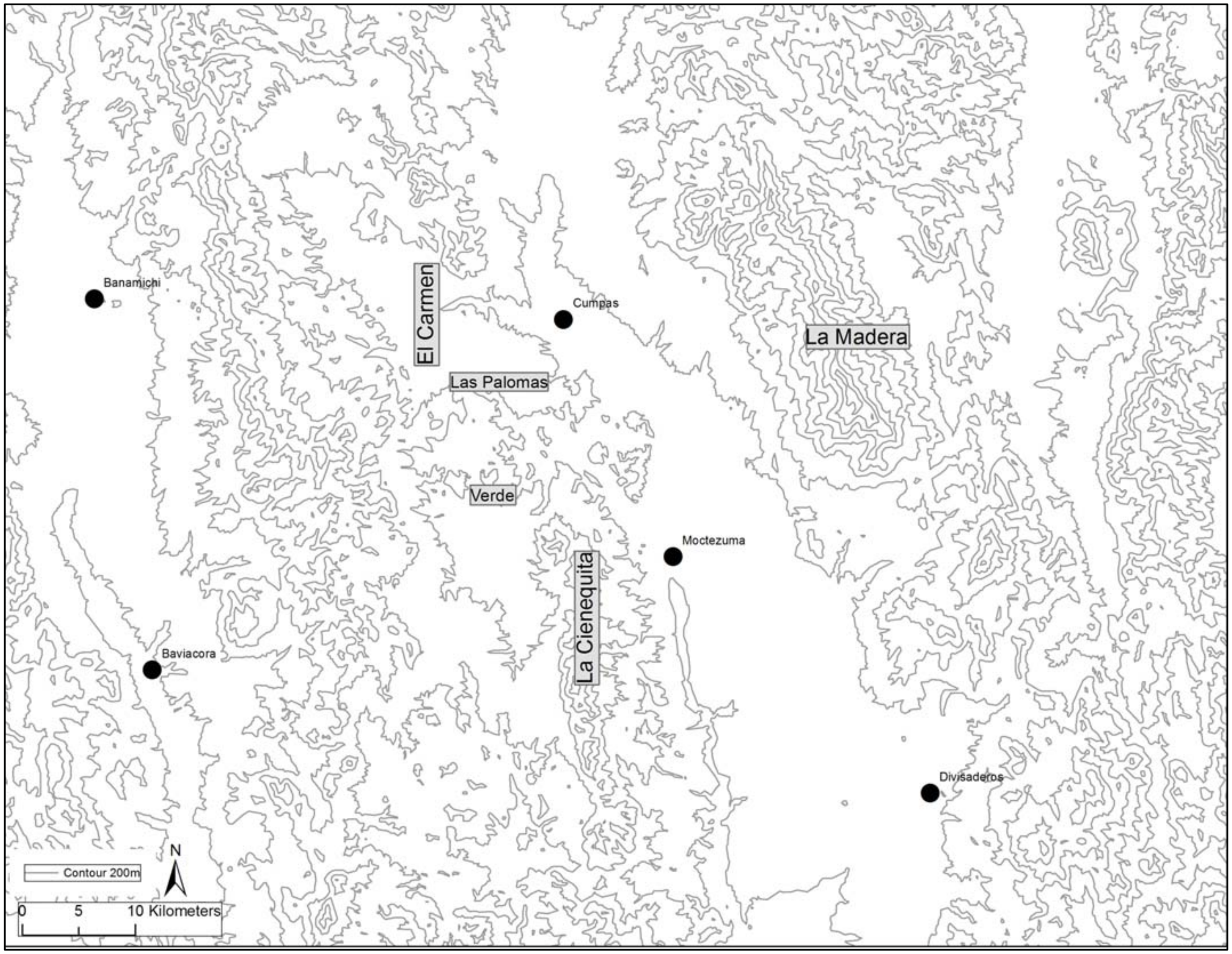

Figure 2.1. Topographic map of the region. Base data from INEGI.

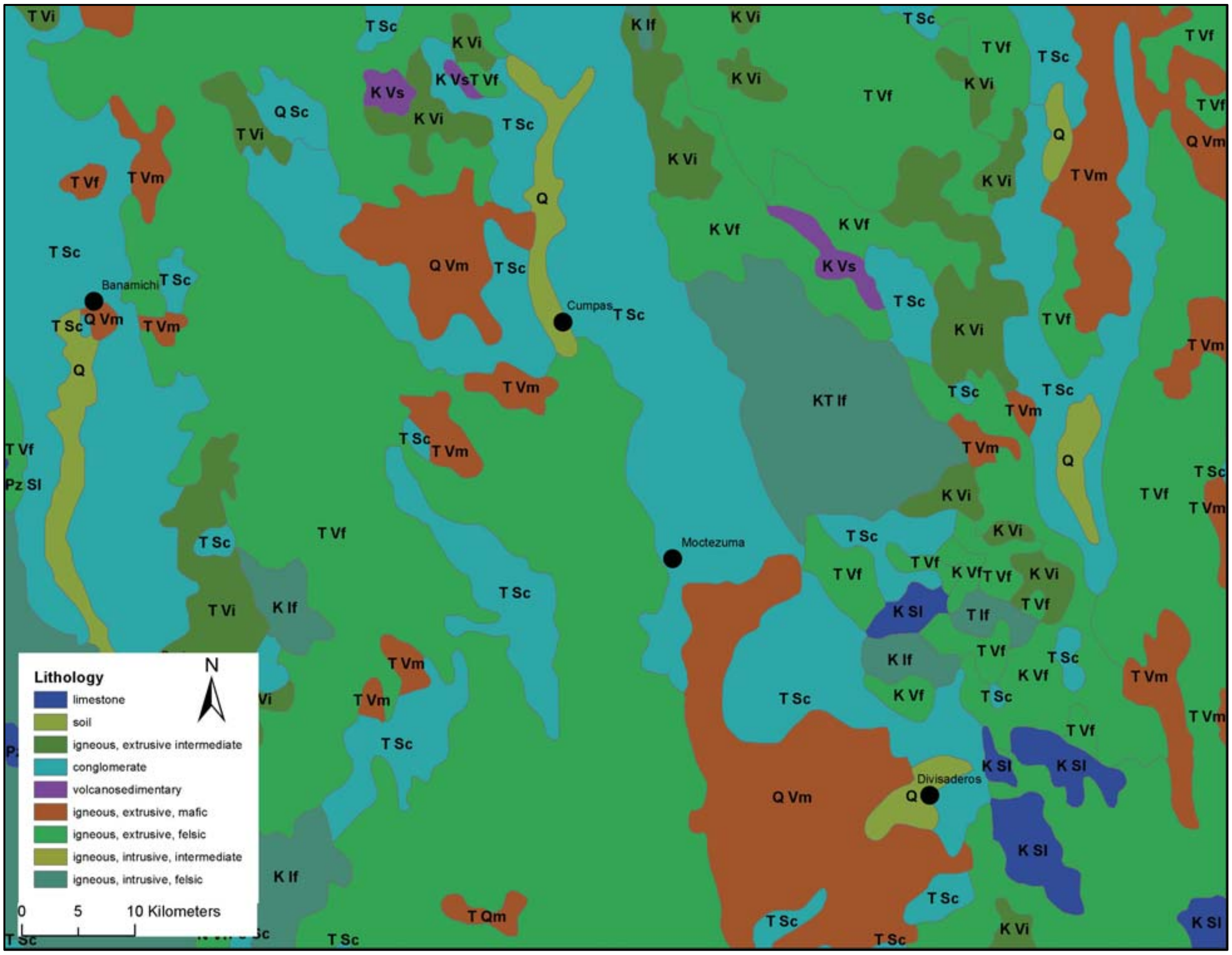

Figure 2.2. Rock types and ages of the region. Data from INEGI and Aguirre et al (1993).

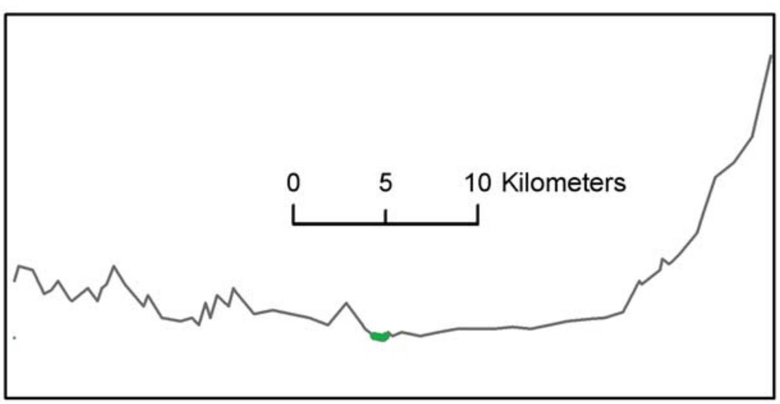

Figure 2.3. Cross section of valley near Jecori with elevation exaggerated 10 x, green stripe indicates riparian zone.

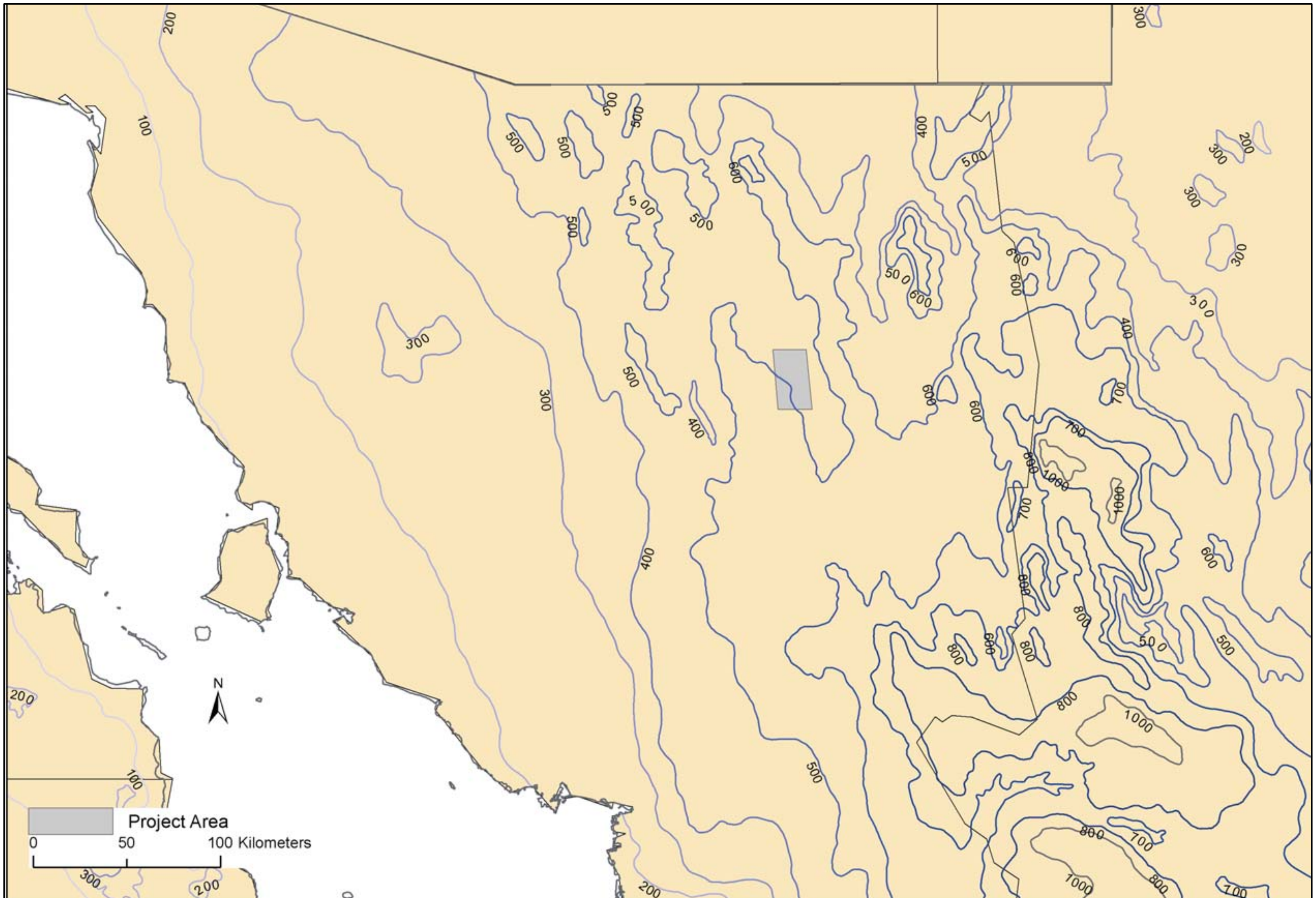

Figure 2.4. Isomap of precipitation in the region. Data from INEGI.

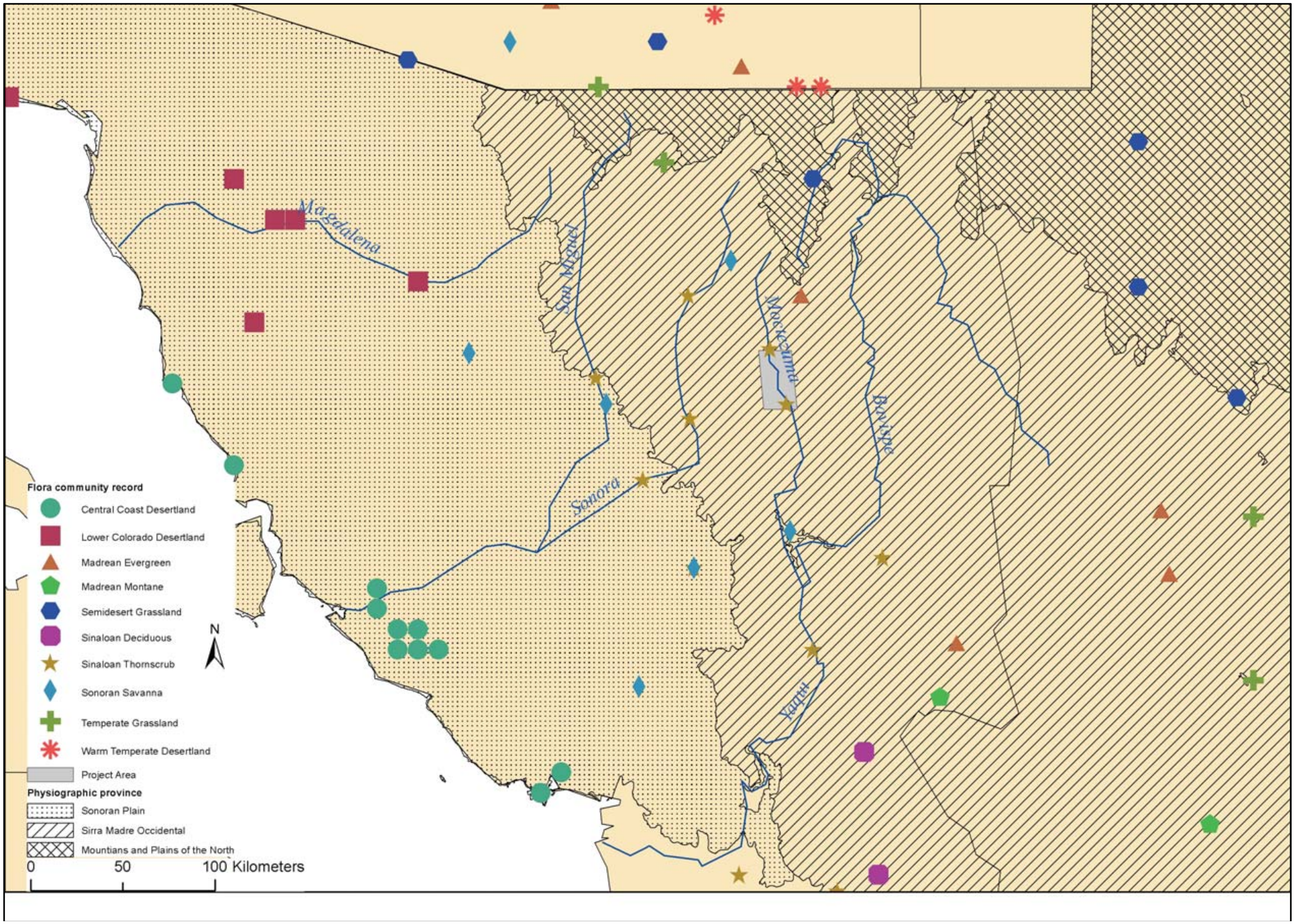

Figure 2.5. Recorded flora communities at various locations in the region. Data from Brown (1994).

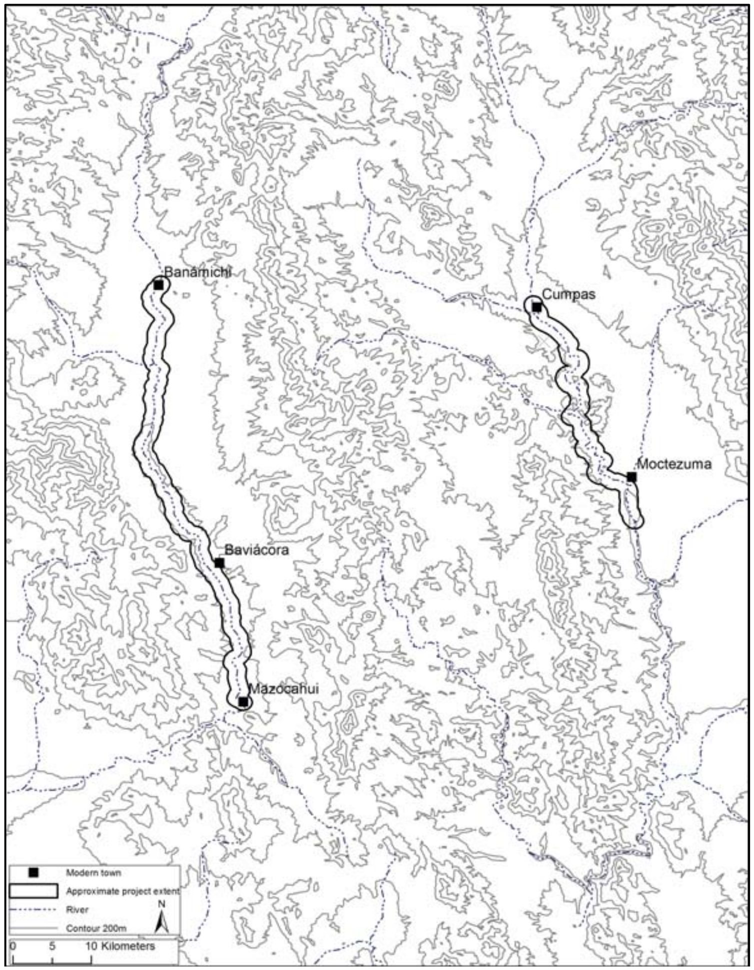

Figure 3.1. Survey zone in relation to research in Sonora Valley.

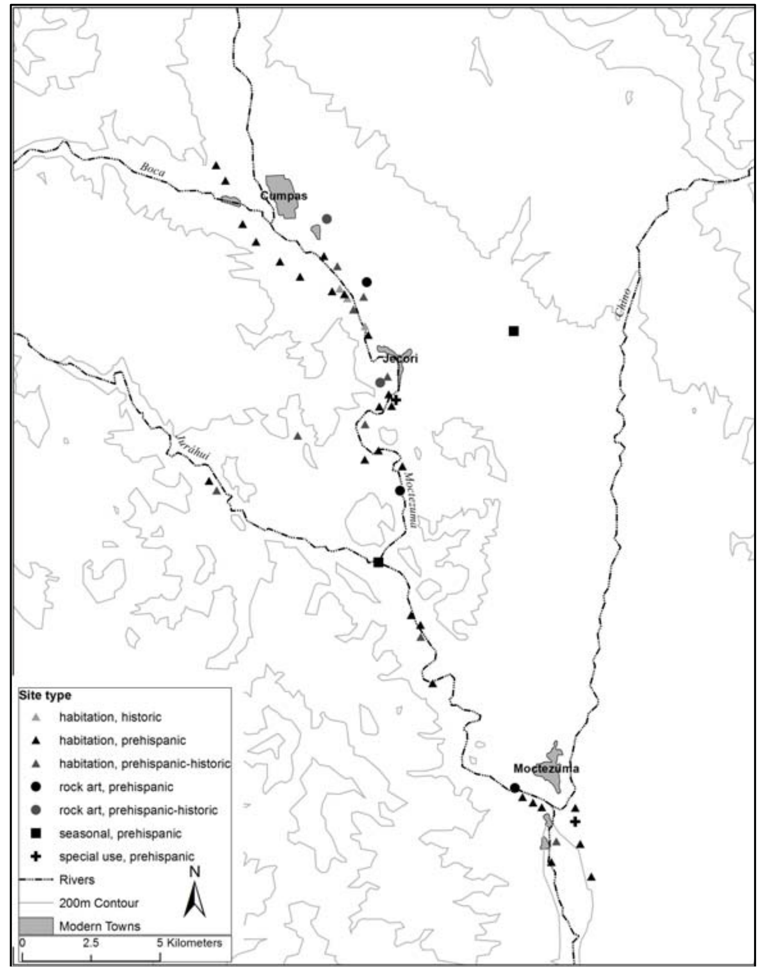

Figure 3.2. Sites identified on survey by primary designation.

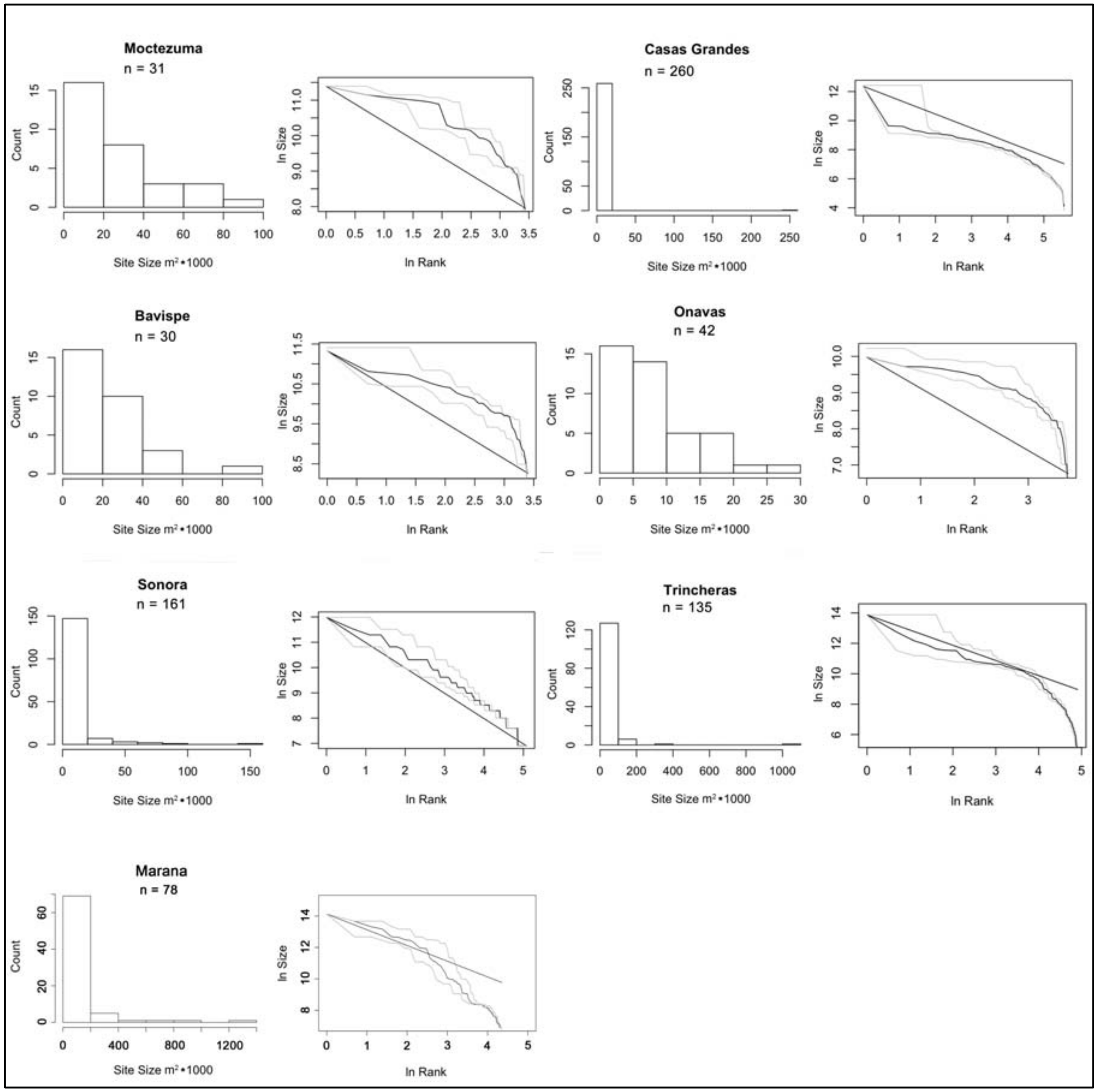

Figure 3.3. Log-log plot of settlement patterns in the Northwest/Southwest.

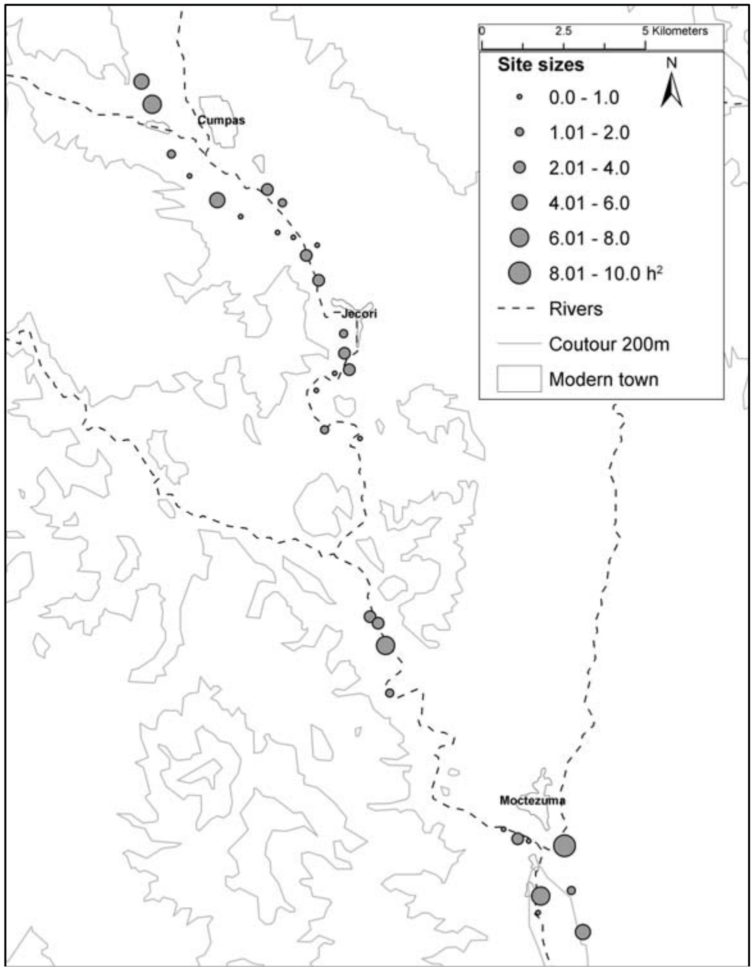

Figure 3.4. Habitation sites by size.

Figure 3.5. Modern *municipios* of Sonora.

Figure 3.6. The natural prominence platforms at El Nogal.

Figure 3.7. Circular basalt stone feature at El Corral.

Figure 3.8. A portion of the large circular wall foundation at La Cruz.

Figure 3.9. A small platform mound (heavily vegetated) at La Calera.

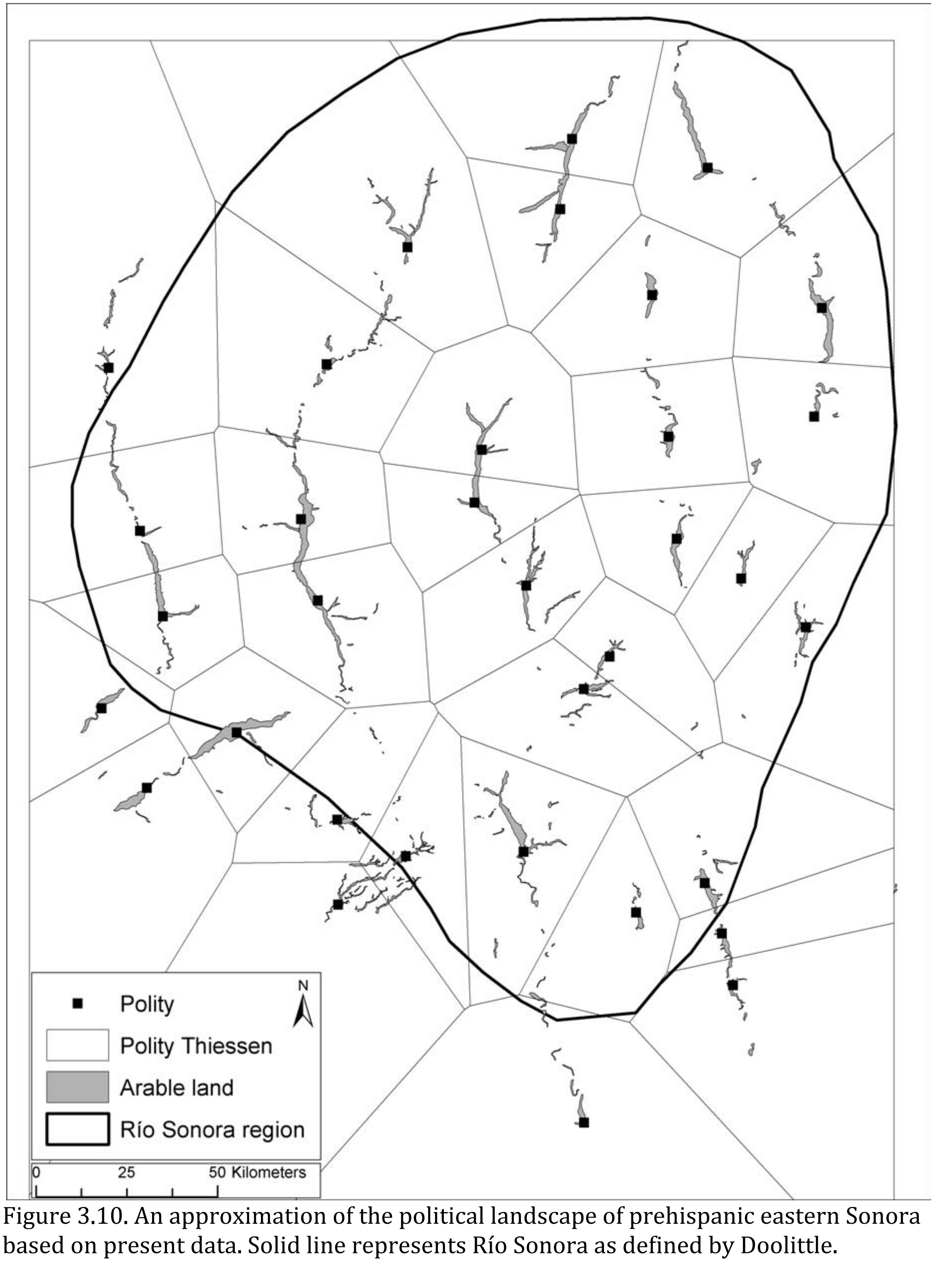

Figure 3.10. An approximation of the political landscape of prehispanic eastern Sonora based on present data. Solid line represents Río Sonora as defined by Doolittle.

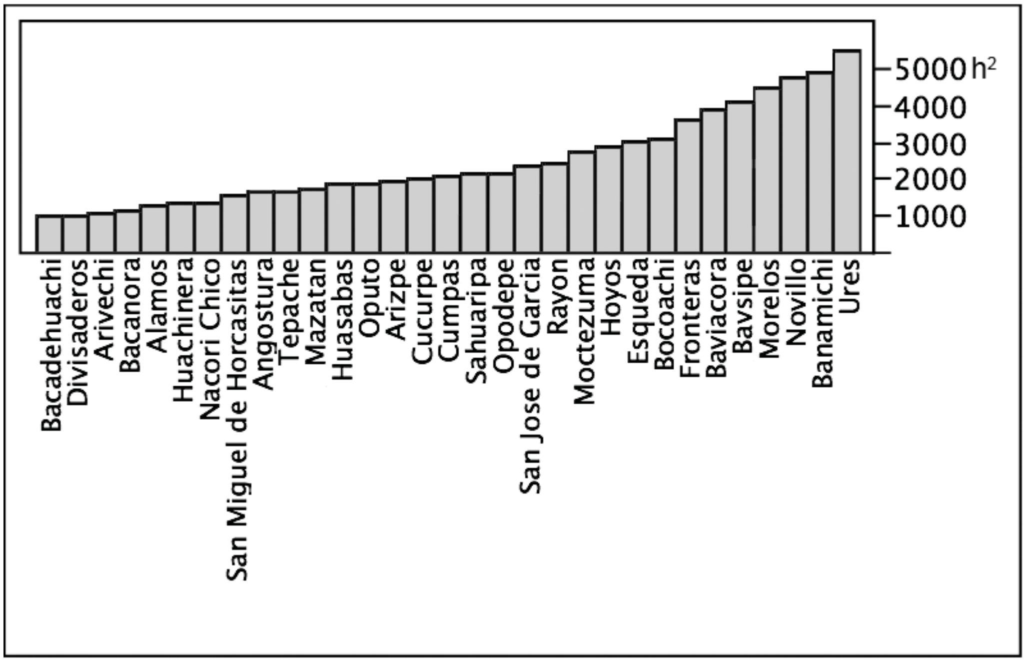

Figure 3.21 The distribution of arable land among hypothesized settlement-communities.

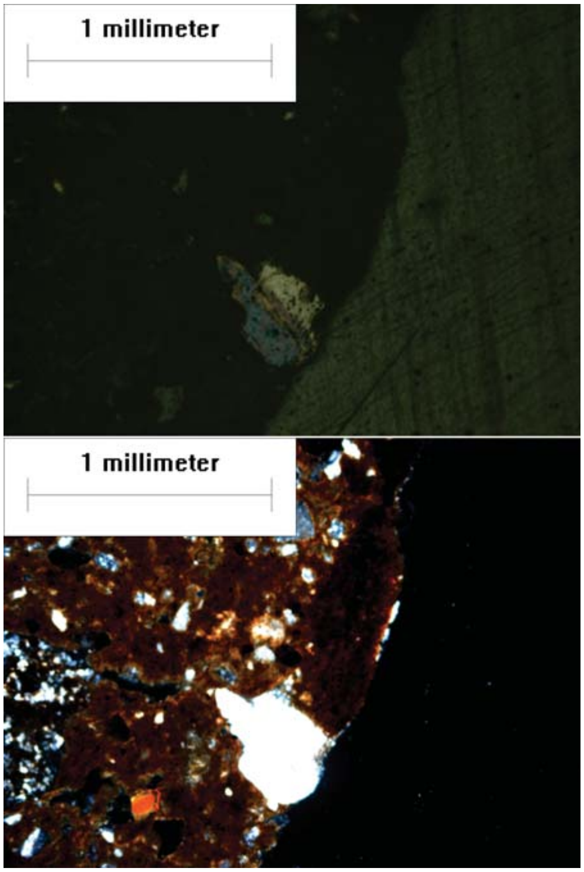

Figure 4.1. XRL and XPL of redware sherd margin showing polished but unslipped surface.

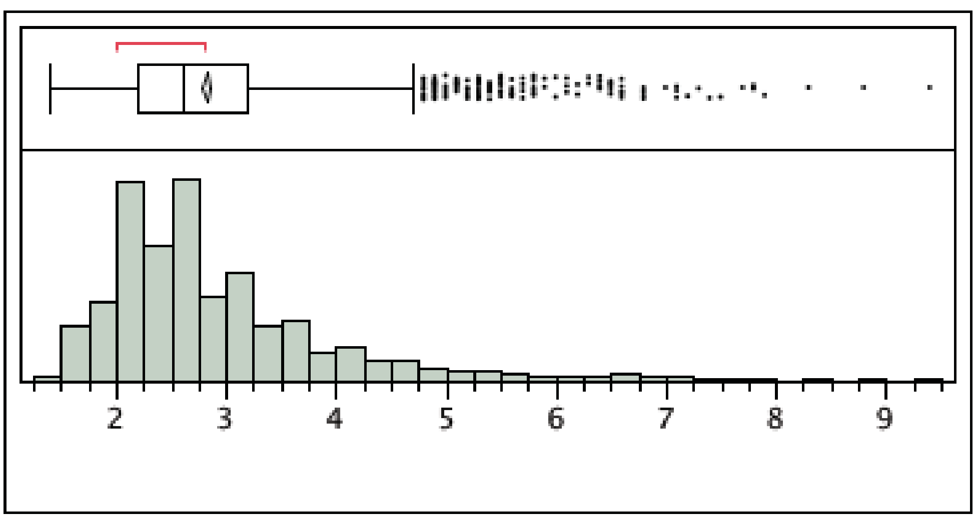

Figure 4.2. Distribution of measured (decorated) sherds.

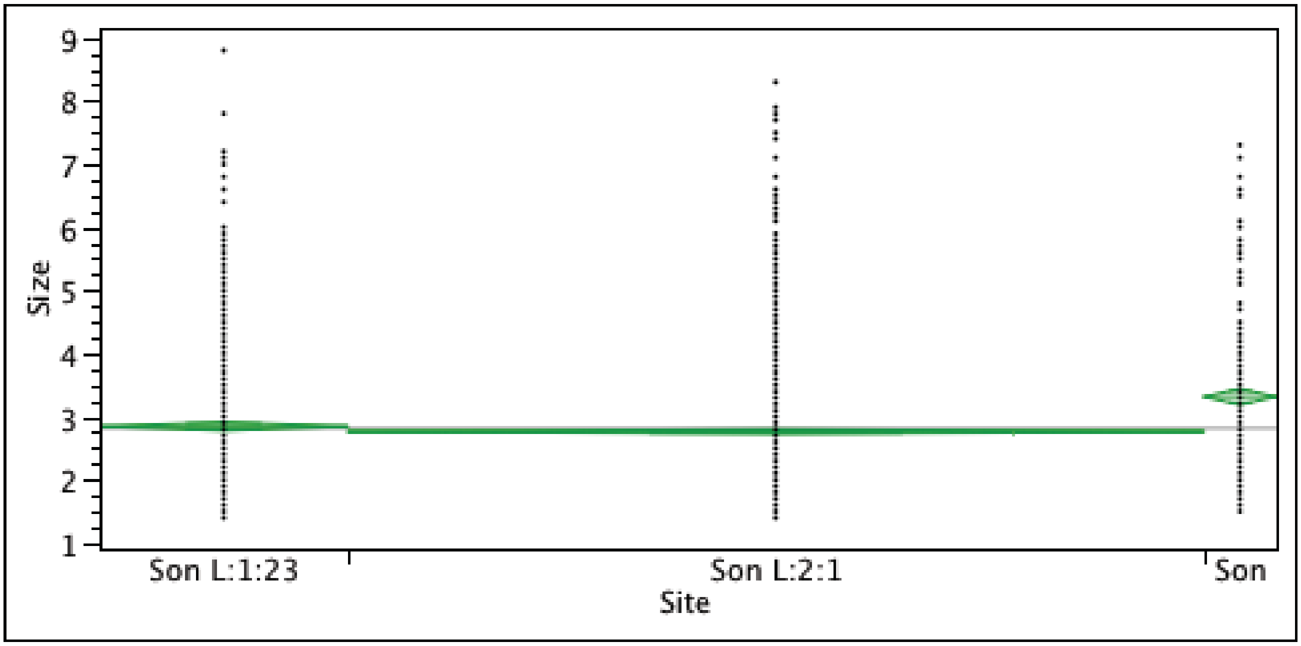

Figure 4.3. Distributions of measured ceramic sherds by site.

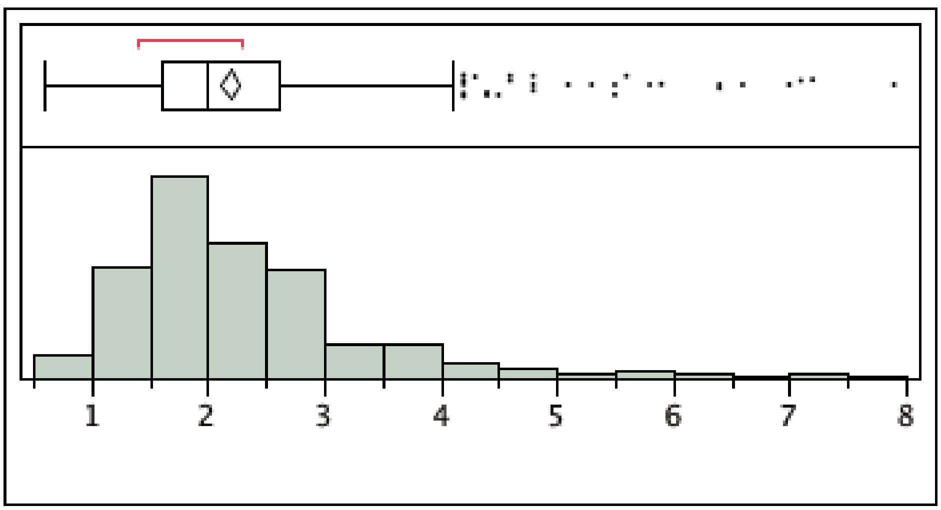

Figure 4.4. Rim sherd lengths.

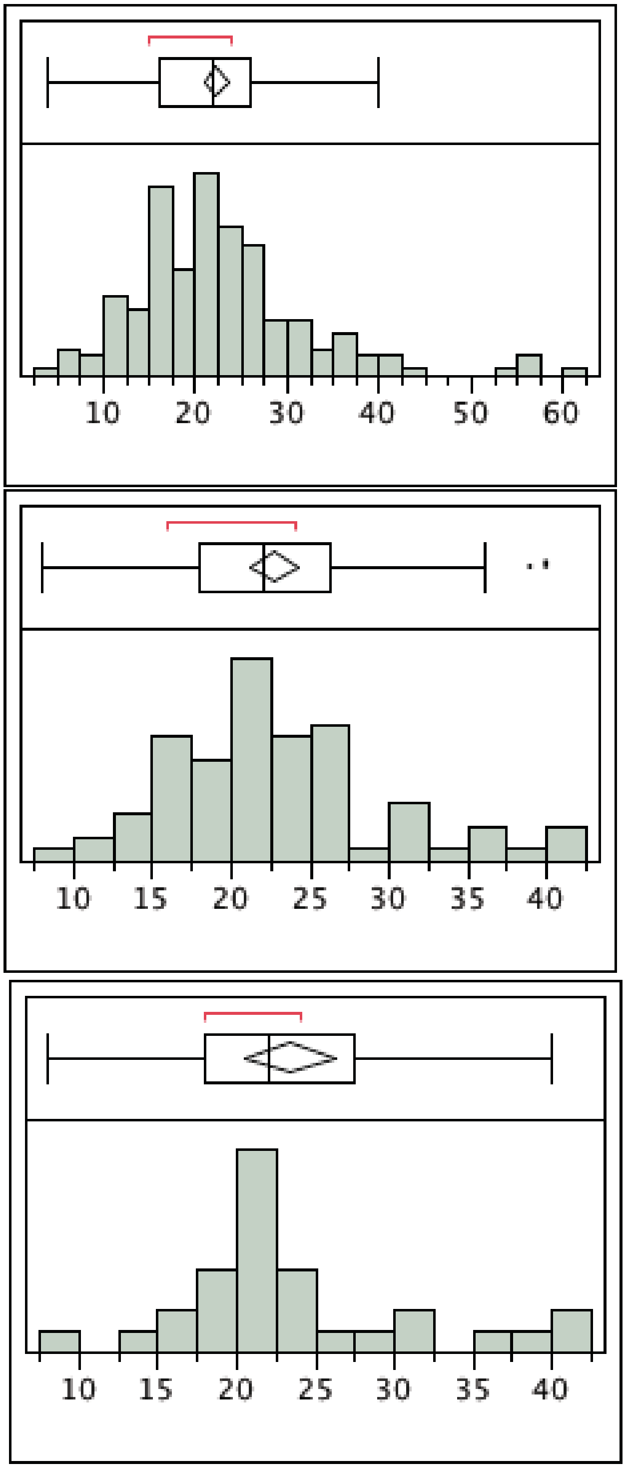

Figure 4.5. Rim diameters with all rim lengths *n* =204 $\bar{x}$ = 22.3; rim length >3 *n* = 82, $\bar{x}$ = 22.8; rim length >4 *n* = 30, $\bar{x}$ = 23.4

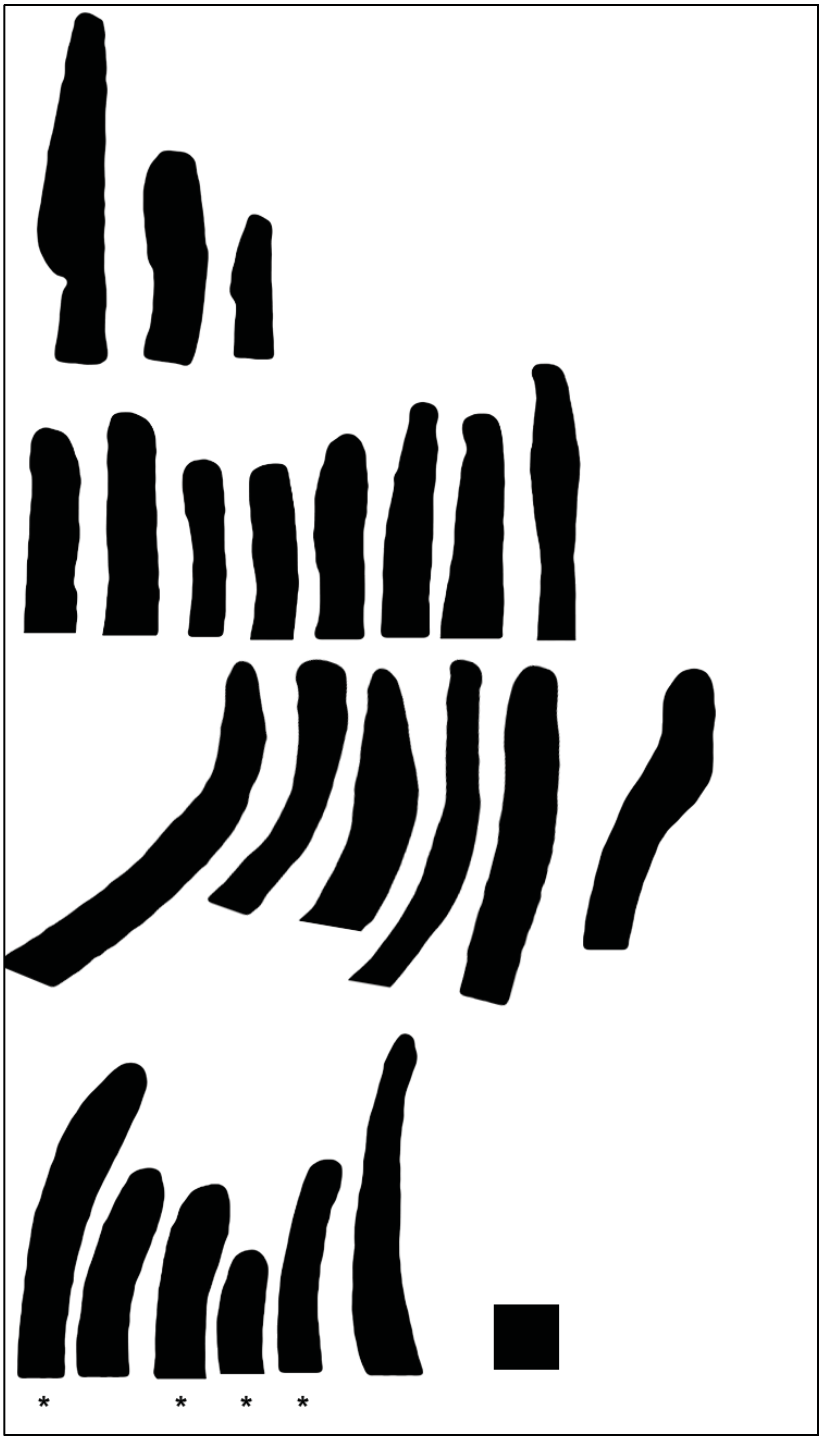

Figure 4.6. Rim profiles: top row *straight fillet,* second row *straight straight,* third row *straight collar* (furthest left *straight vertical*), fourth row *incurved*. Asterisks denote redwares, scale is one cm.

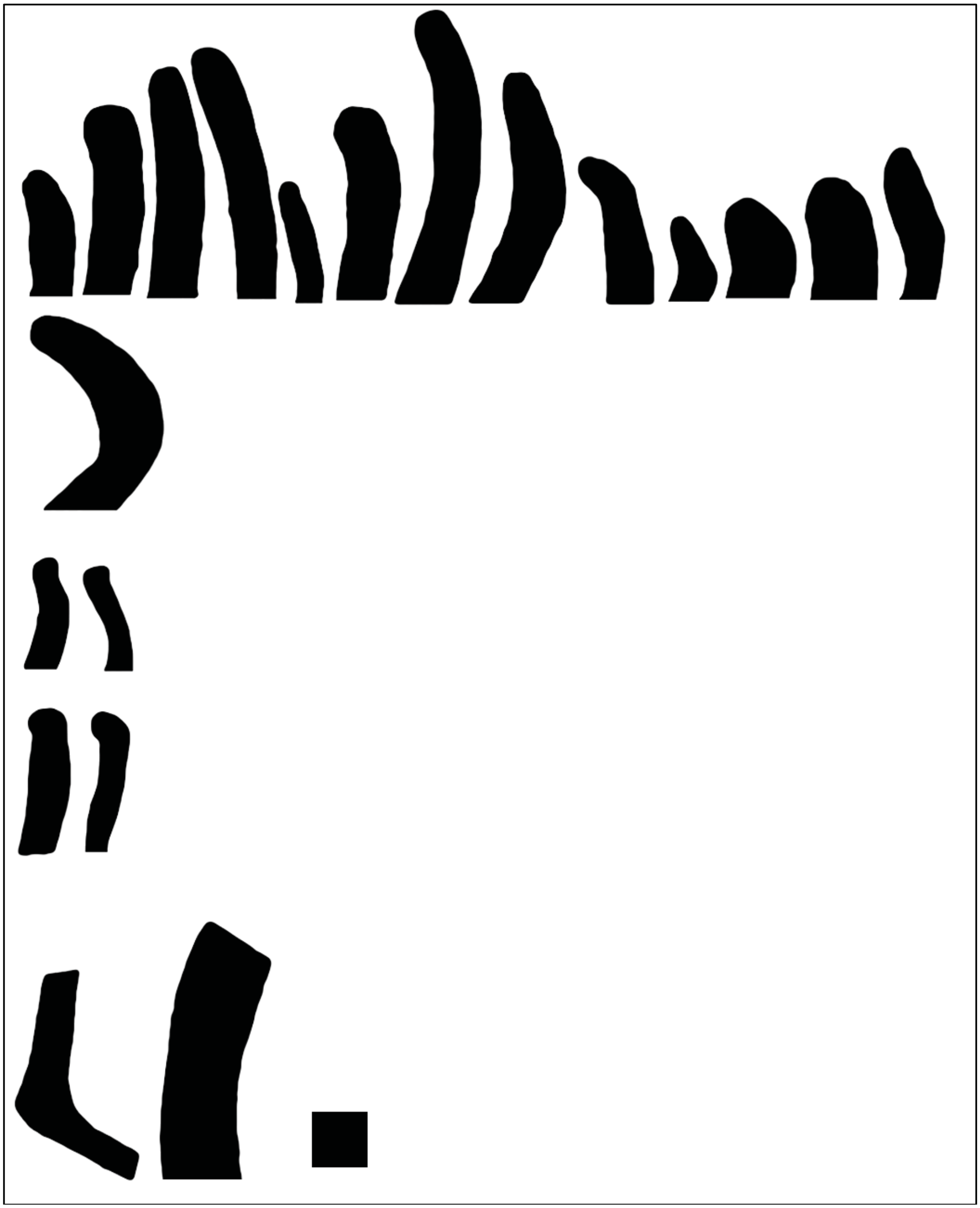

Figure 4.7. Rim profiles: top row *outcurved,* second row *outcurved flaring,* third row *double curved,* fourth row *straight lipped,* fifth row jar shoulder (left) and handle profile (right), scale is one cm.

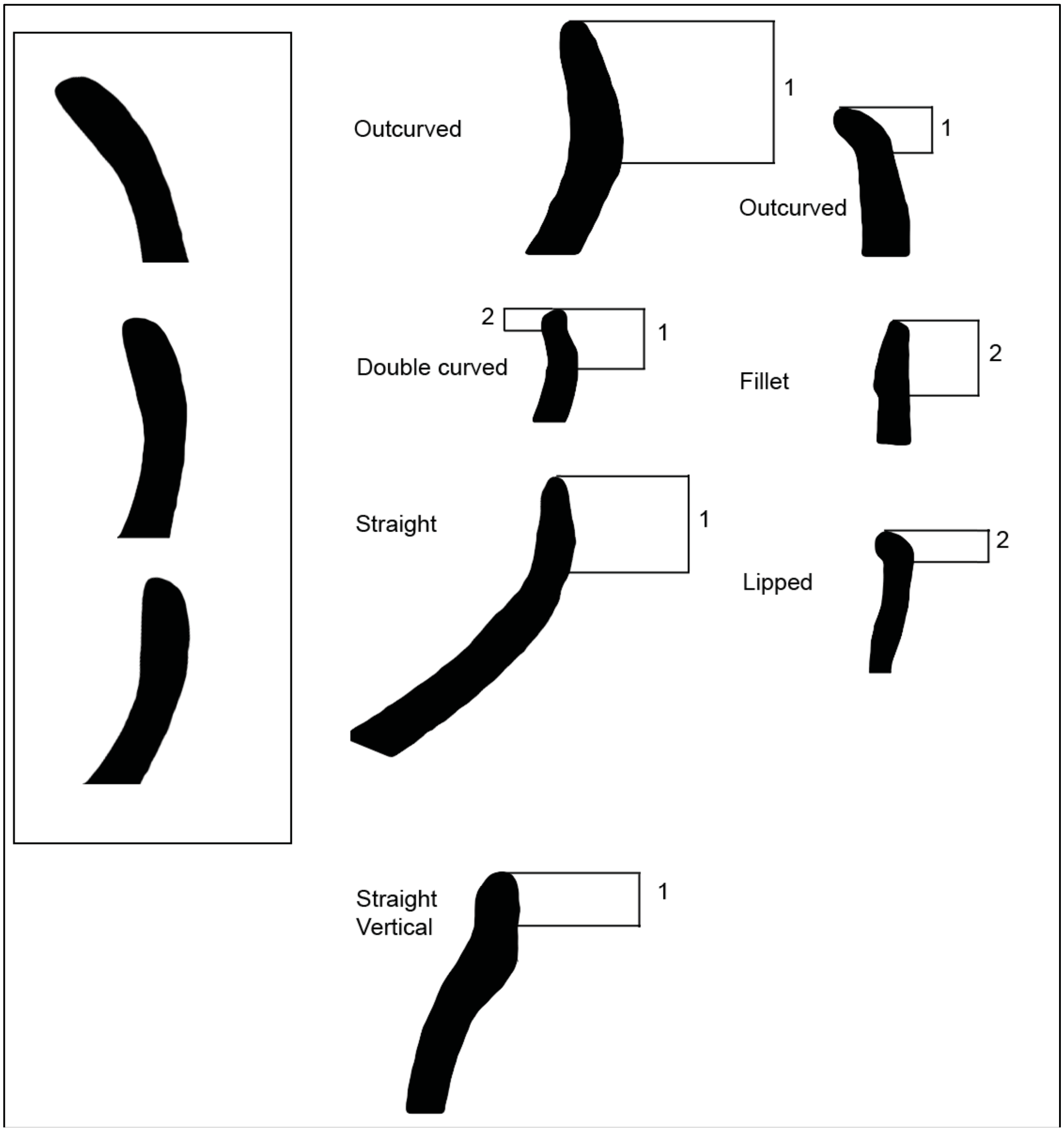

Figure 4.8. Rim profiles; inset on left demonstrates effect of orientation on classification, remaining profiles demonstrate primary and secondary rim/collar measurements.

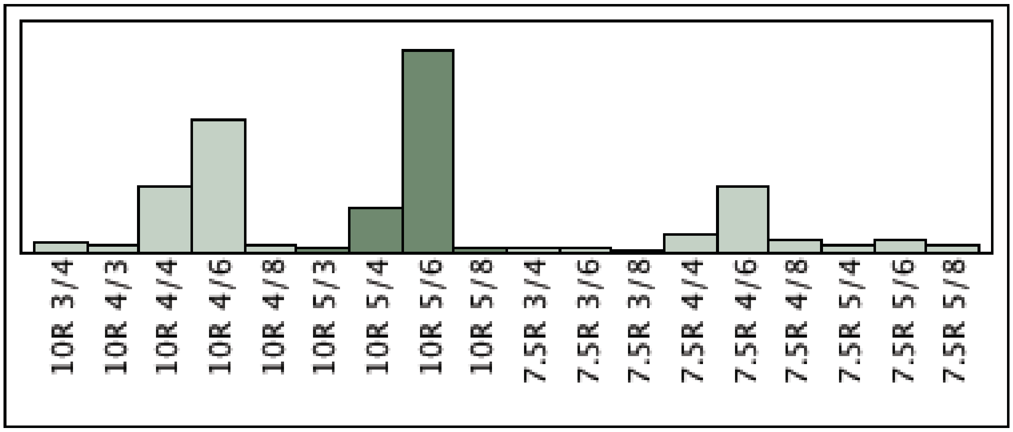

Figure 4.9. Distribution of redware by Munsell divisions.

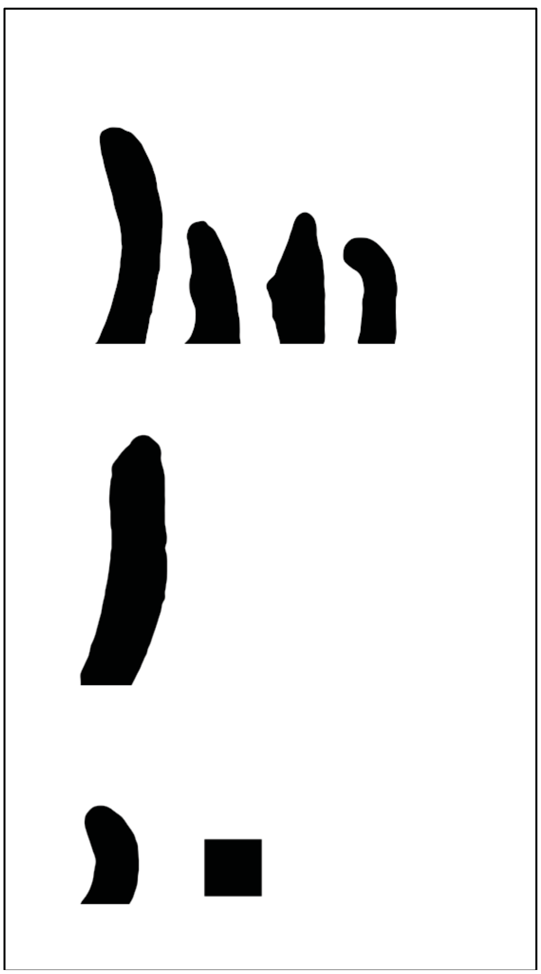

Figure 4.10 Non-plain rims. Top row, textured; middle row, brushed; bottom row, redware (see also Figure 6 row 3), scale is one cm.

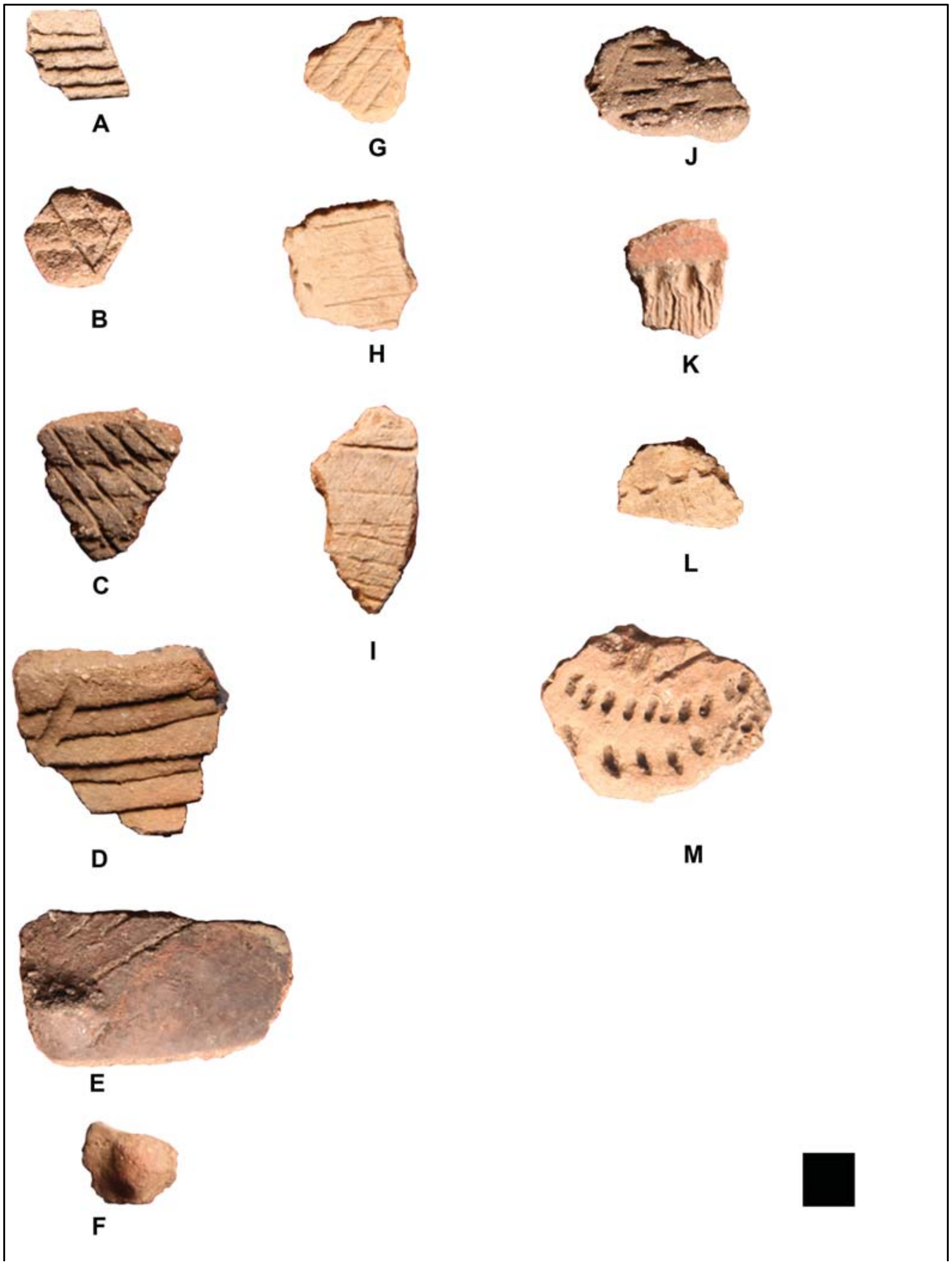

Figure 4.11. Examples of textured ceramics: A corrugated, B incised corrugated, c incised (clapboard) corrugated, D raised element (also incised), E raised element, G-I incise brush, J tool punch, K-L tool punch (also brushed), M tool punch (also incised), scale is one cm.

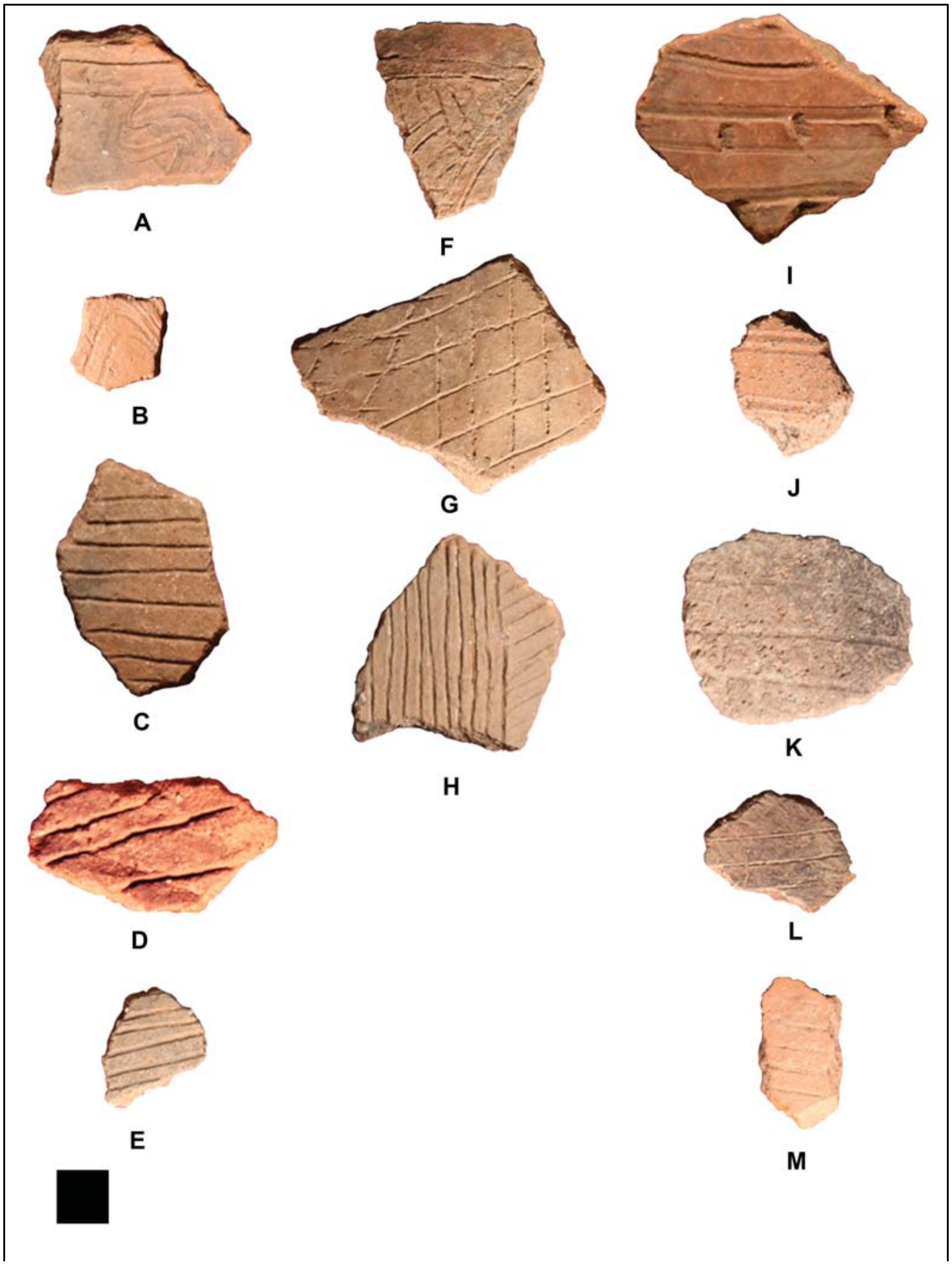

Figure 4.11 (cont). Examples of textured ceramics: A-B incised curvilinear, C-E incise parallel wavy, F-H incise angled design, I-J tool incise (I also tool punched), K-M incise parallel straight, scale is one cm.

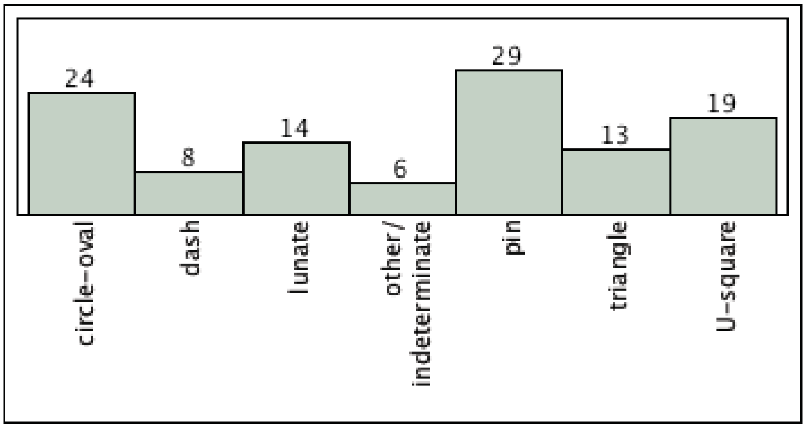

Figure 4.12. Frequency of tool punch shapes.

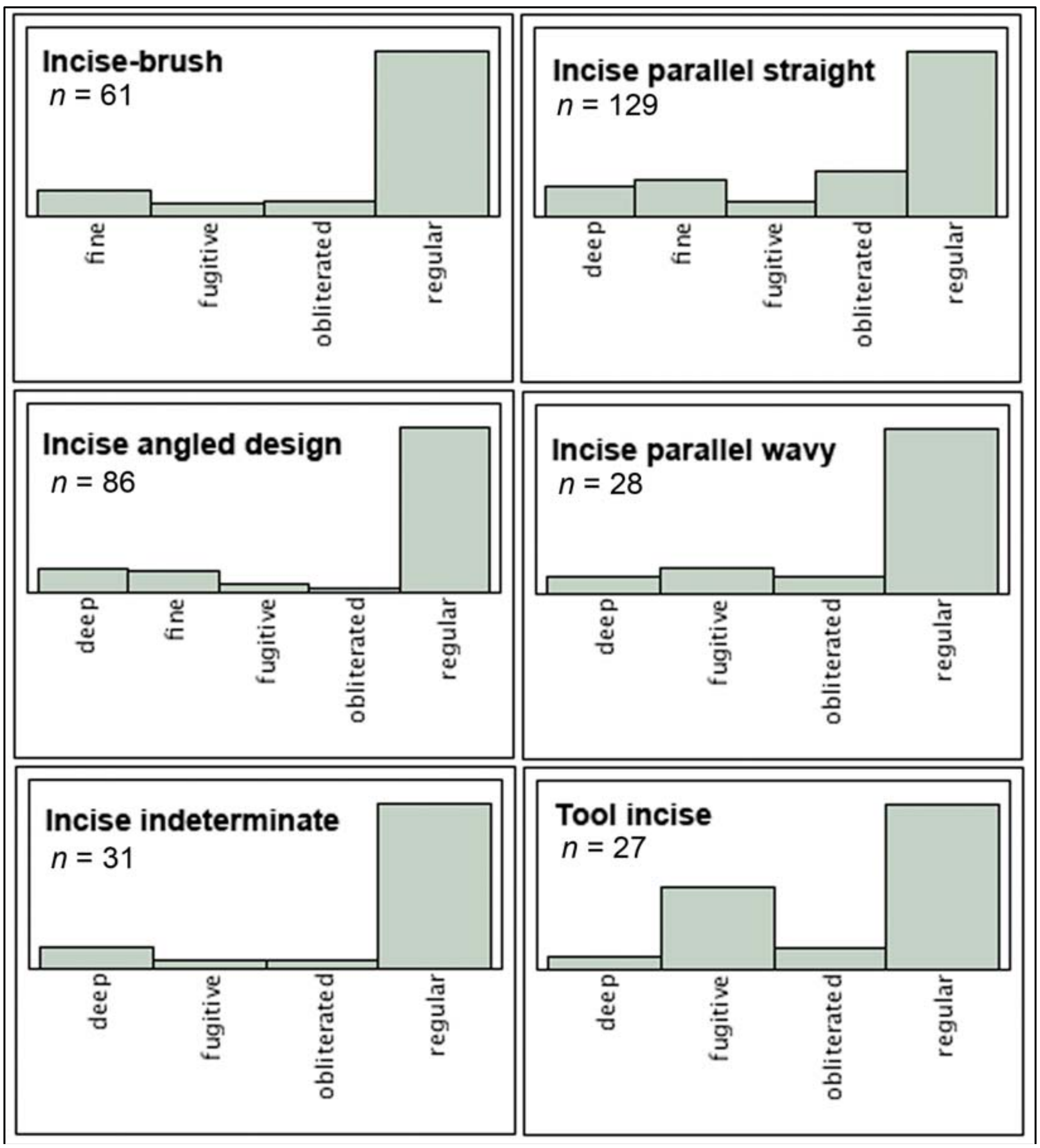

Figure 4.13. Categorical execution style/depth of incising by technique.

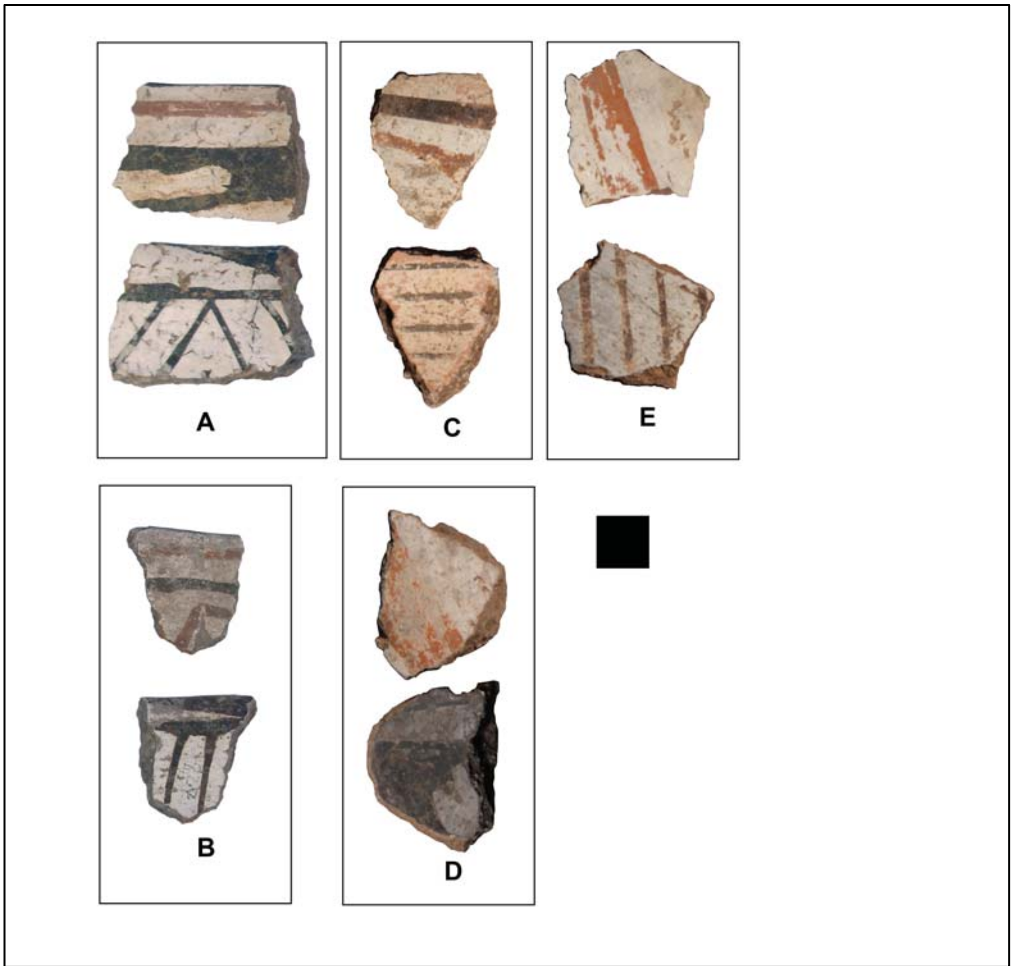

Figure 4.14. Jecori type ceramics: A, B style 1; C style 2; D style 3; E style 4, scale is one cm.

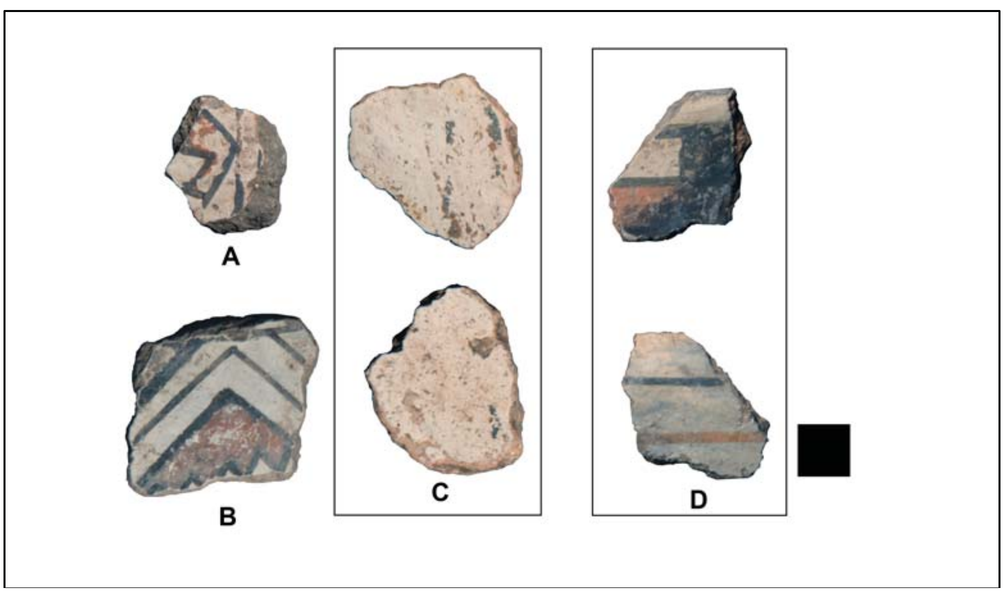

Figure 4.15. Teonadepa type ceramics: A, B style 1, C style 2, D style 3, scale is one cm.

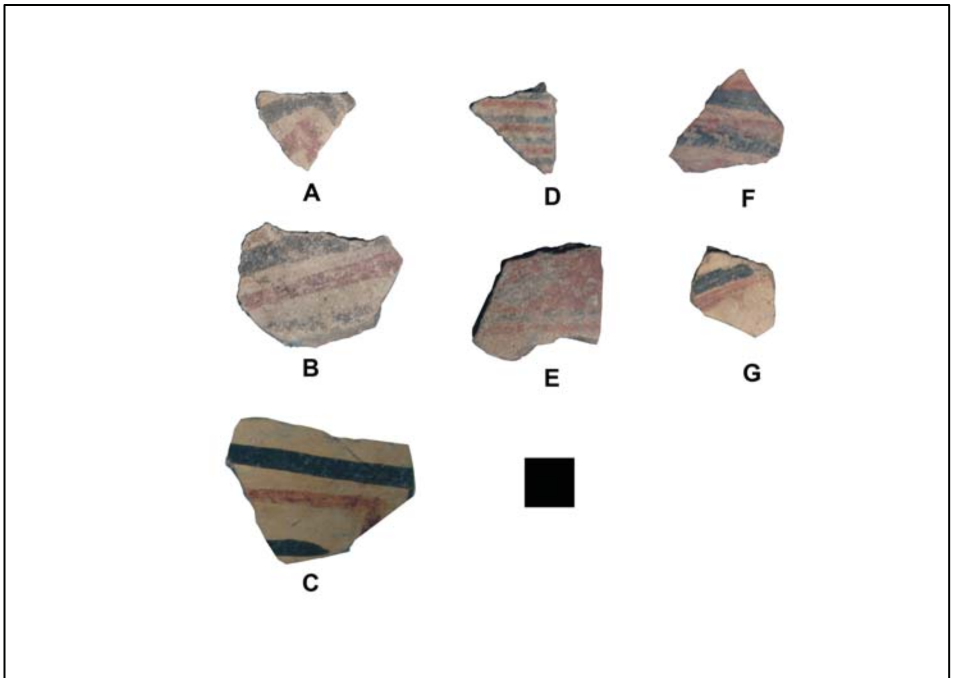

Figure 4.16. Santa Ana/Babícora type ceramics: A, B, C style 1; D, E style 2, F, G style 3, scale is one cm.

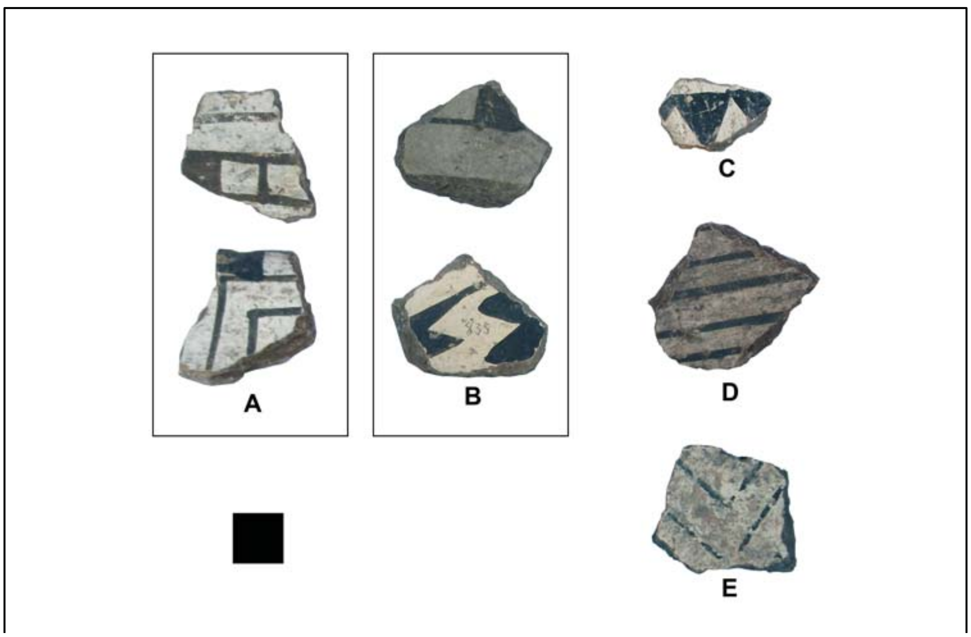

Figure 4.17. Other Chihuahuan type ceramics A, B painted both sides; C exterior only; D, E interior only, scale is one cm.

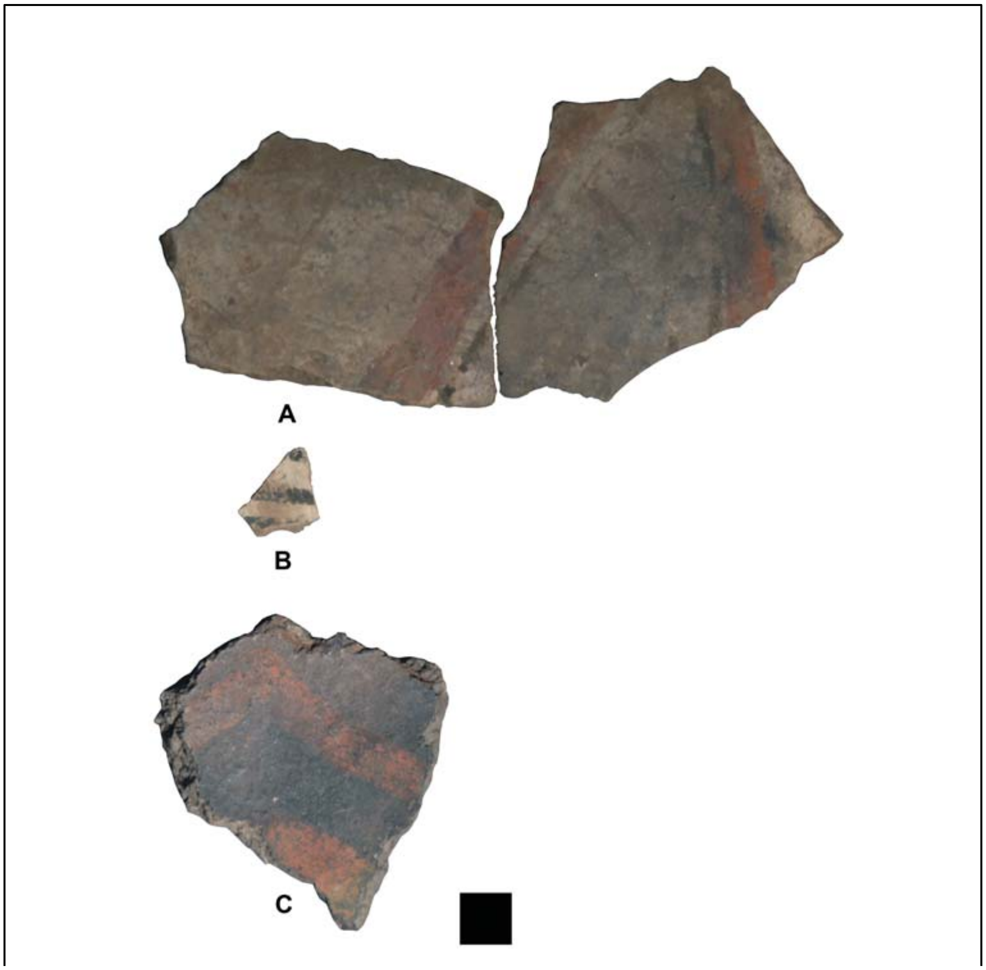

Figure 4.18. La Volanta type ceramics: A, B exteriors, C interior, scale is one cm.

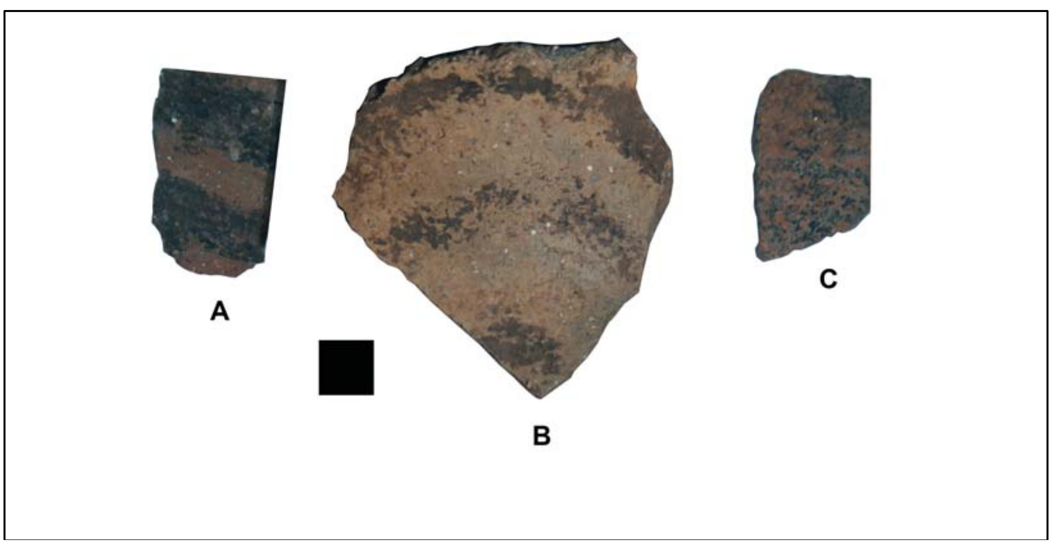

Figure 4.19. Moctezuma type ceramics A, B style 1; C style 2, all samples are exterior, scale is one cm.

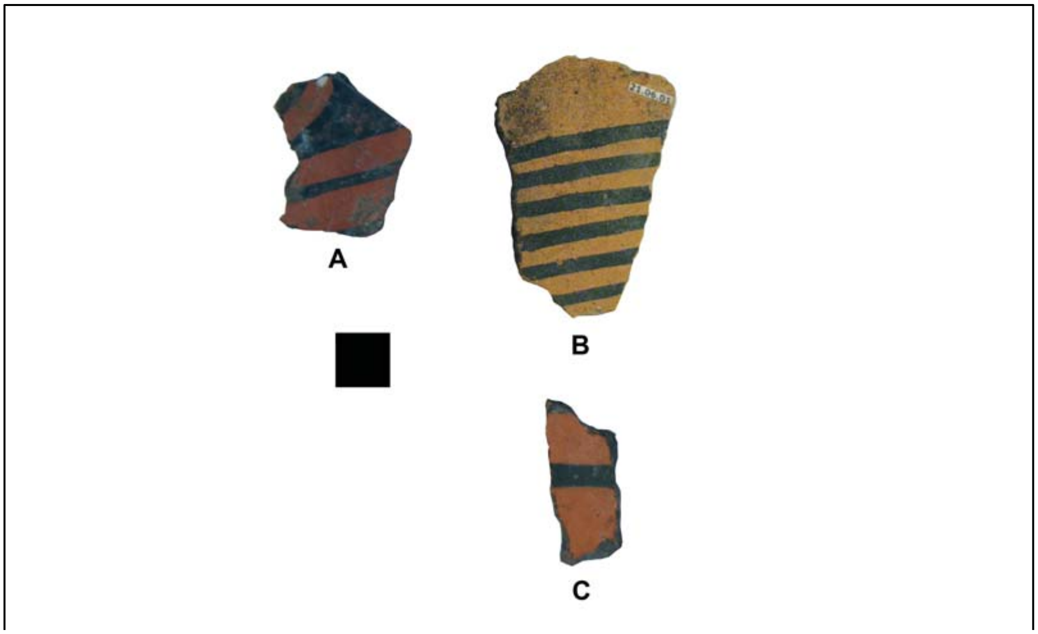

Figure 4.20. Cumpas type ceramics: A (exterior) style 1, B (exterior), C (interior) style 2, scale is one cm.

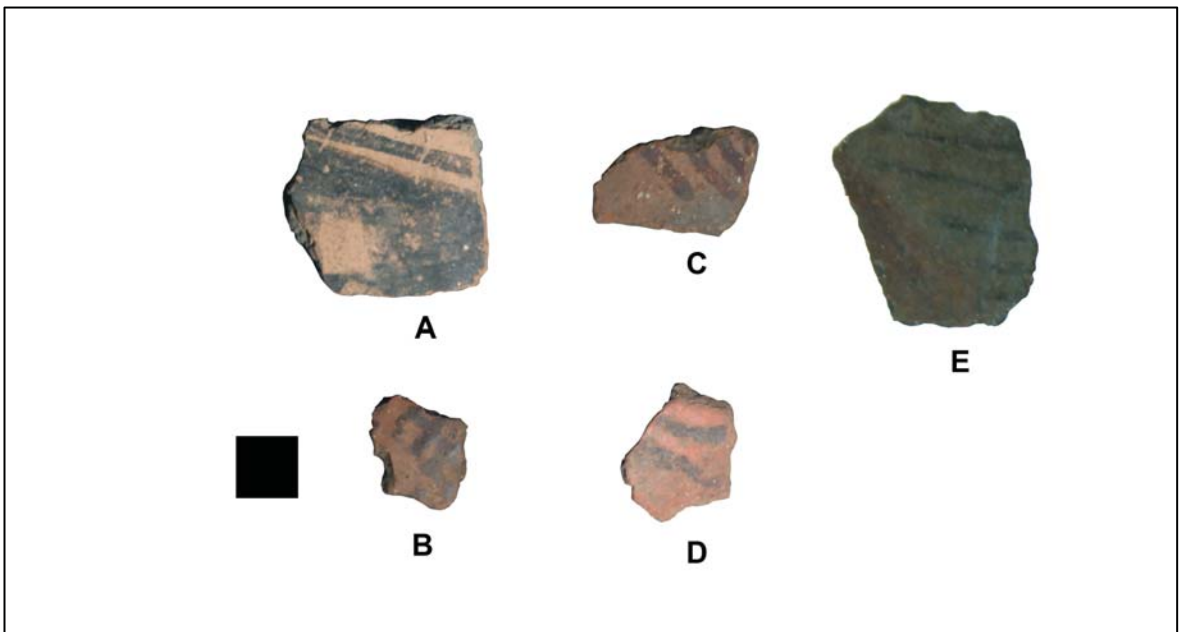

Figure 4.21. Serrana type ceramics: A, B (exterior), C (interior), D specular (interior), E polychrome (exterior), scale is one cm.

Figure 4.22. A Red-on-cream ceramic sherd (exterior), scale is one cm.

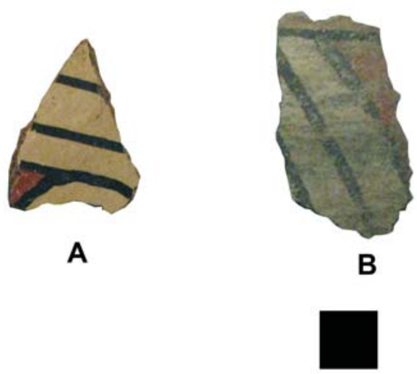

Figure 4.23. Possible imitation Ramos Polychrome (technically Villa Ahumada) sherds (exterior), scale is one cm.

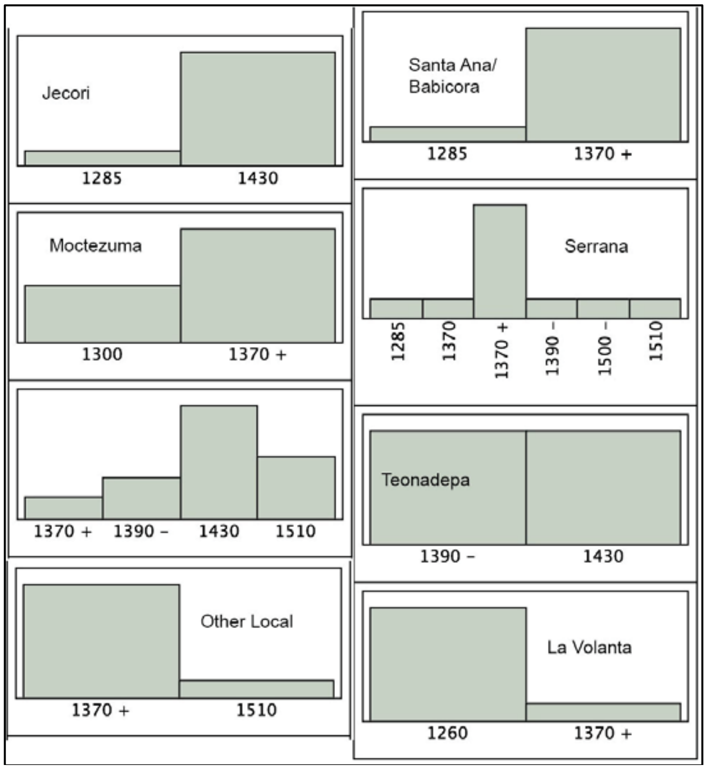

Figure 4.24. Histogram of sherd associations by dates.

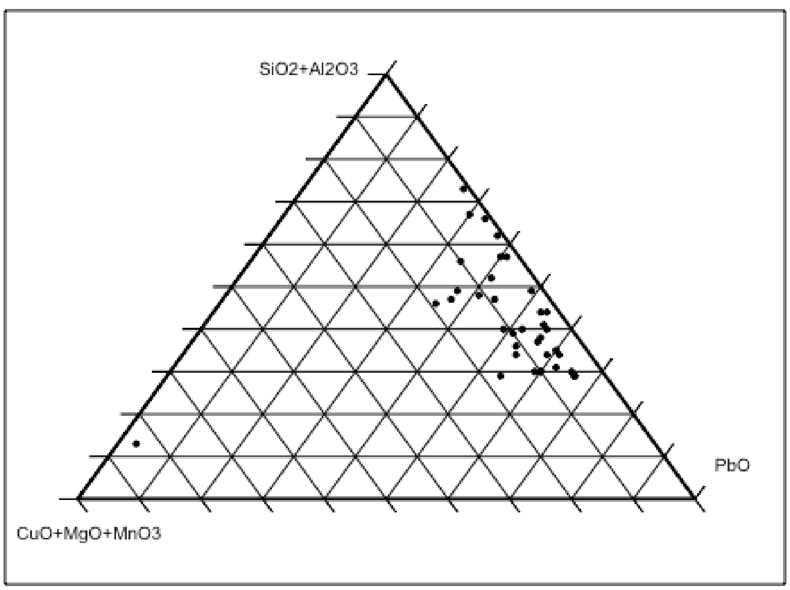

Figure 4.25. Triplot of percent oxide weights measured in glaze paints.

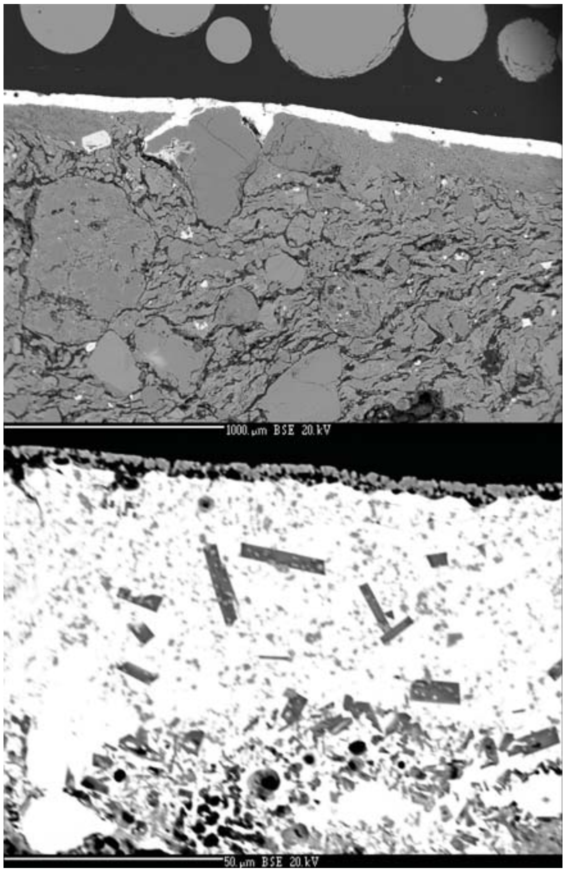

Figure 4.26. SEM image of glaze paint sample at different scales, lower image demonstrates crust of near pure Mn recorded on FN 835.

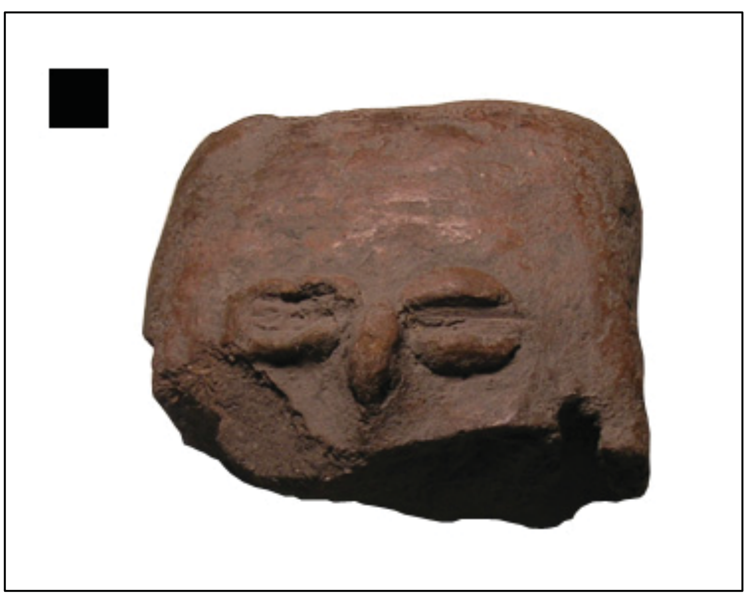
Figure 4.27. A figurine in the collection of a local Moctezuma resident, scale is one cm.

Figure 5.1. Large volcanic flake tools from El Nogal, cortex present on all samples but not visible, scale is one cm.

Figure 5.2. Large volcanic tools from Los Mineros. Top row, core tools; bottom row, large cortical flake tool, scale is one cm.

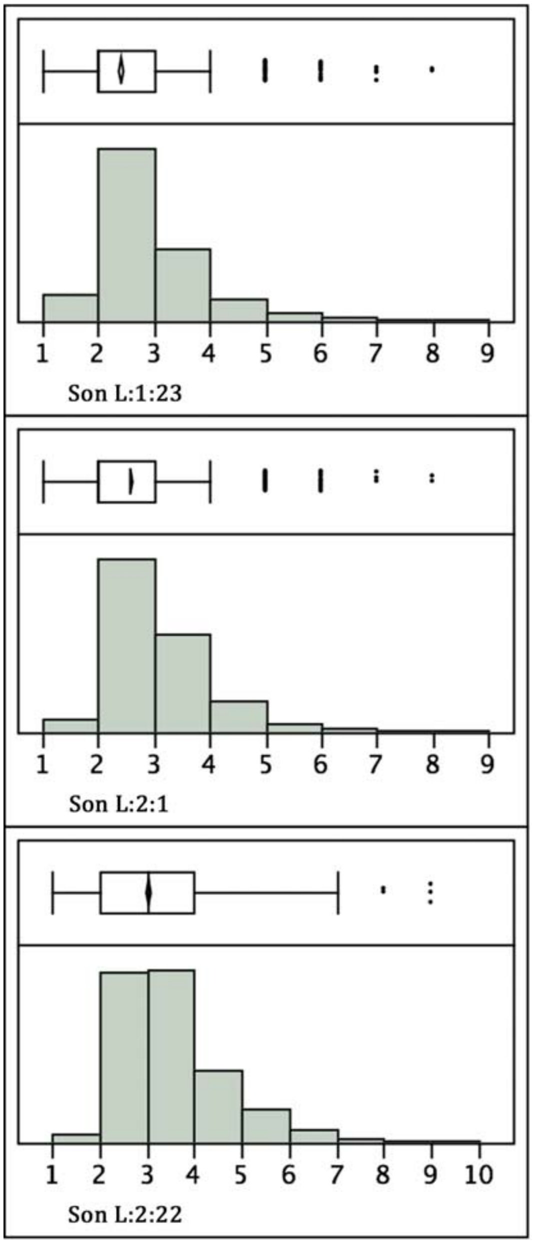

Figure 5.3. Size distribution of debitage size by site.

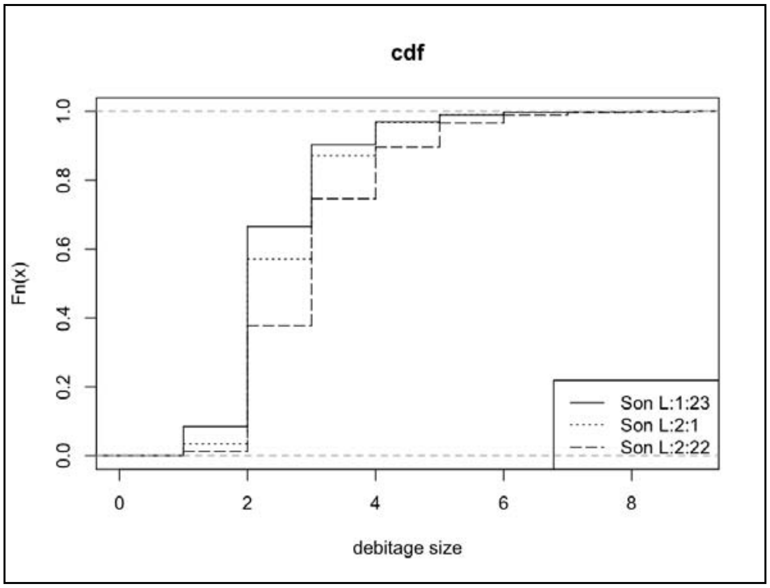

Figure 5.4 Cumulative distribution plots of debitage size by site.

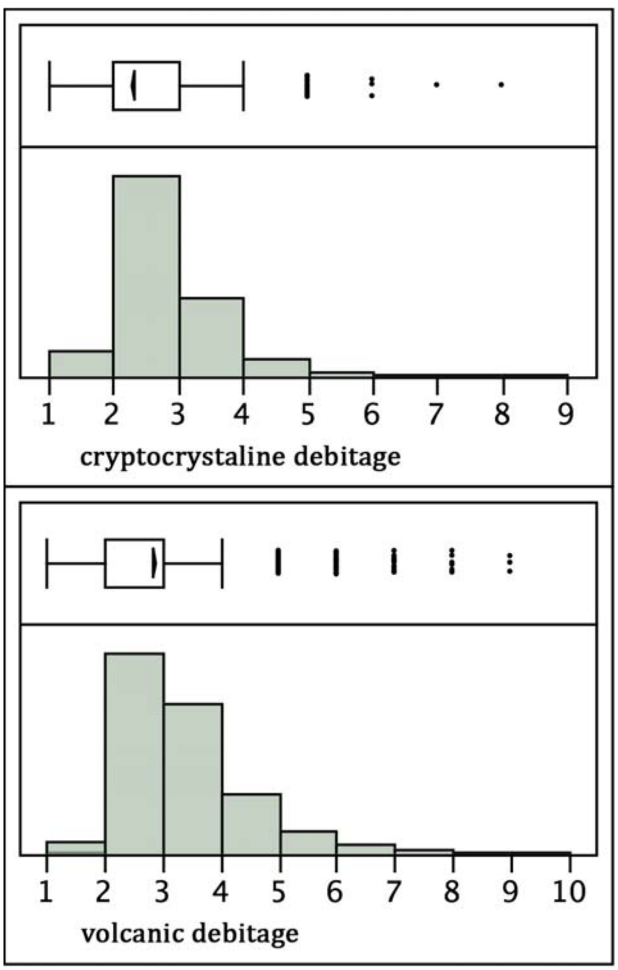

Figure 5.5. Size distribution of debitage size by material type.

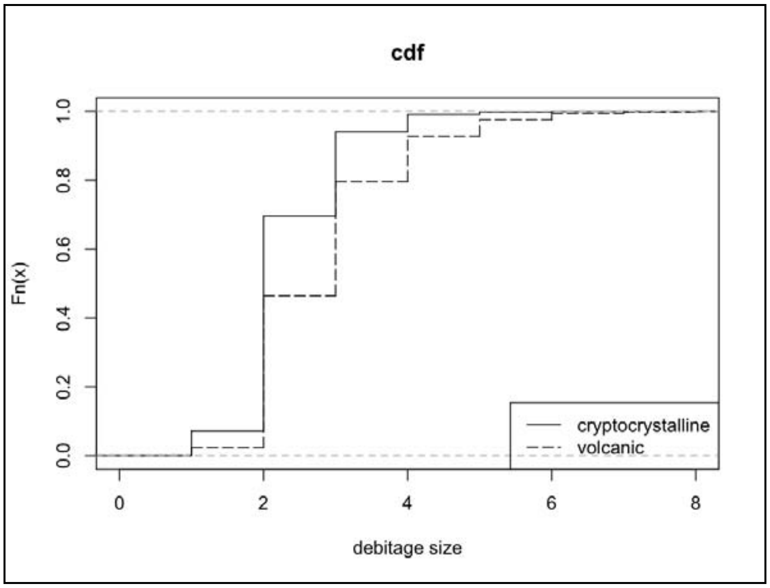

Figure 5.6 Cumulative distribution plots of debitage size by material type.

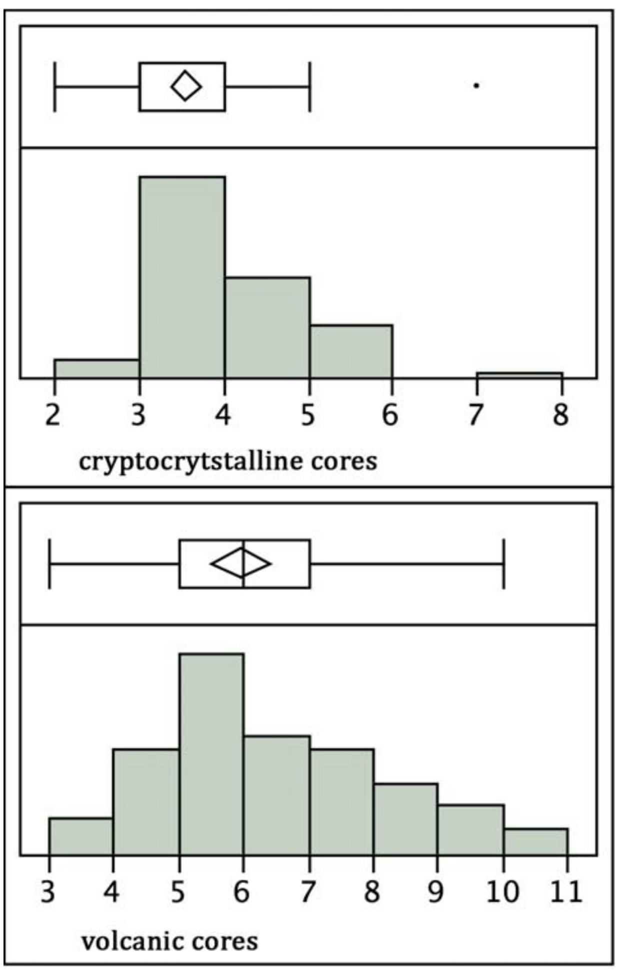

Figure 5.7. Distribution of core sizes by material type.

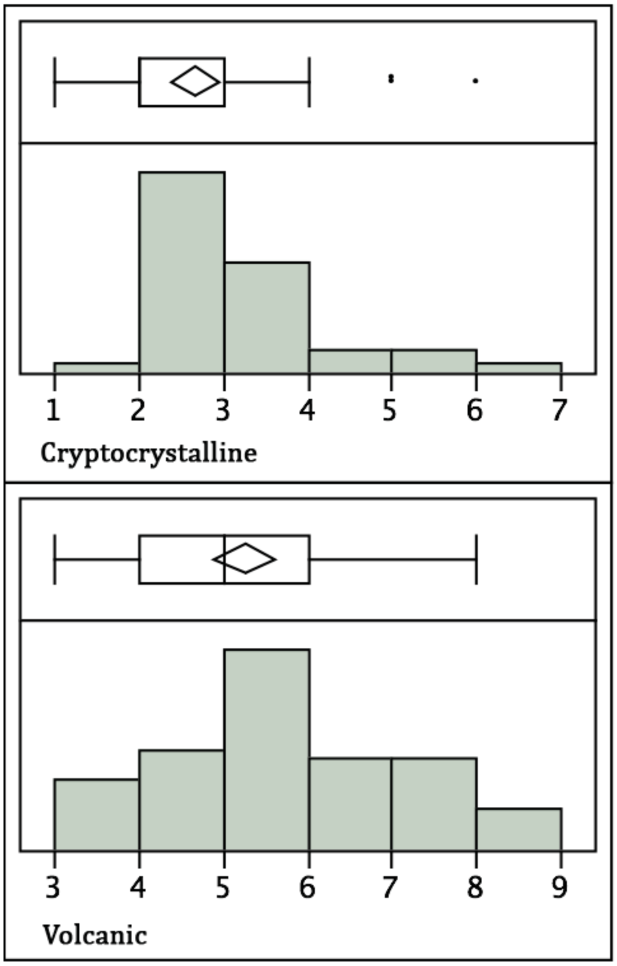

Figure 5.8. Distribution of unbroken tool sizes by material type.

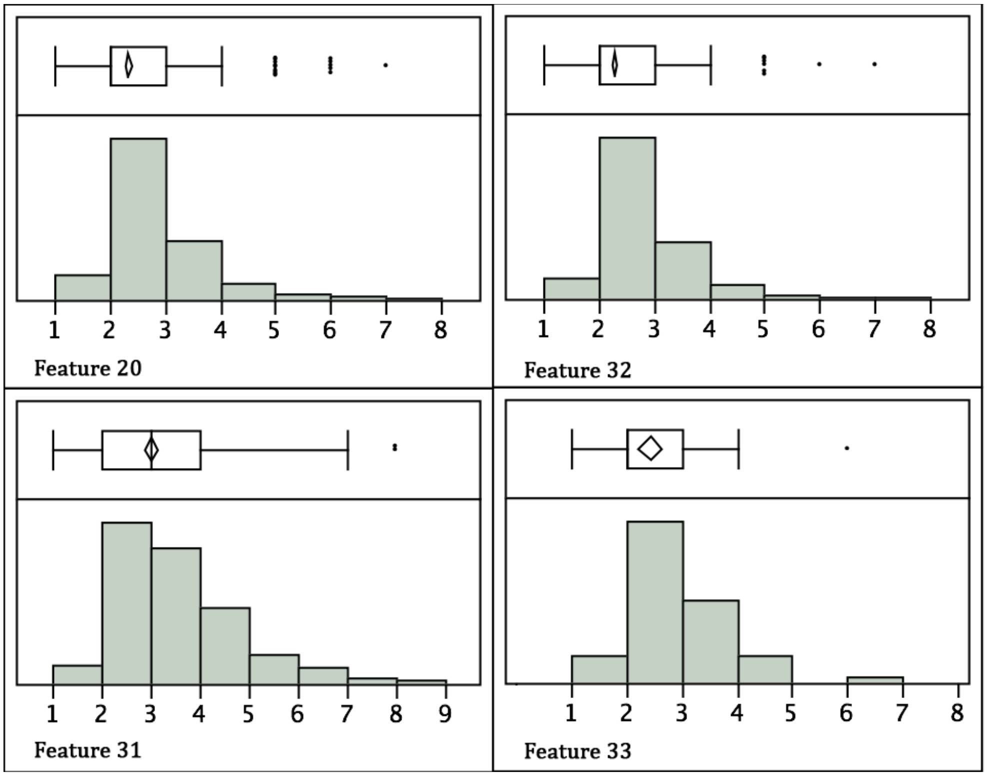

Figure 5.9. Teonadepa feature lithic size distributions.

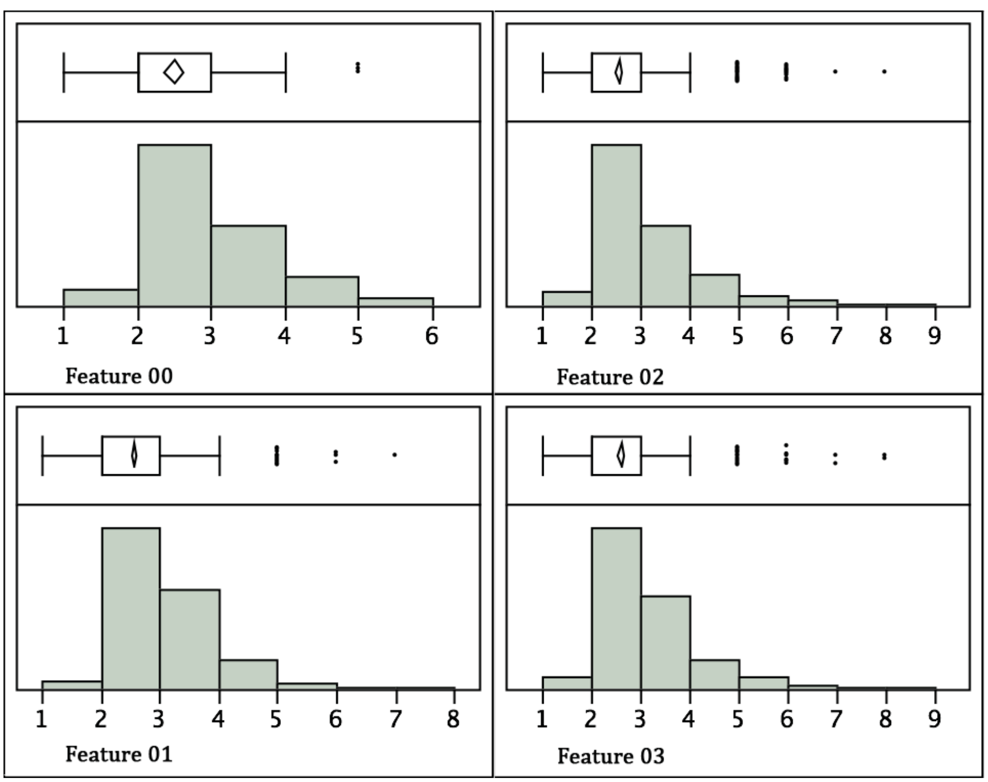

Figure 5.10. El Nogal feature lithic size distributions.

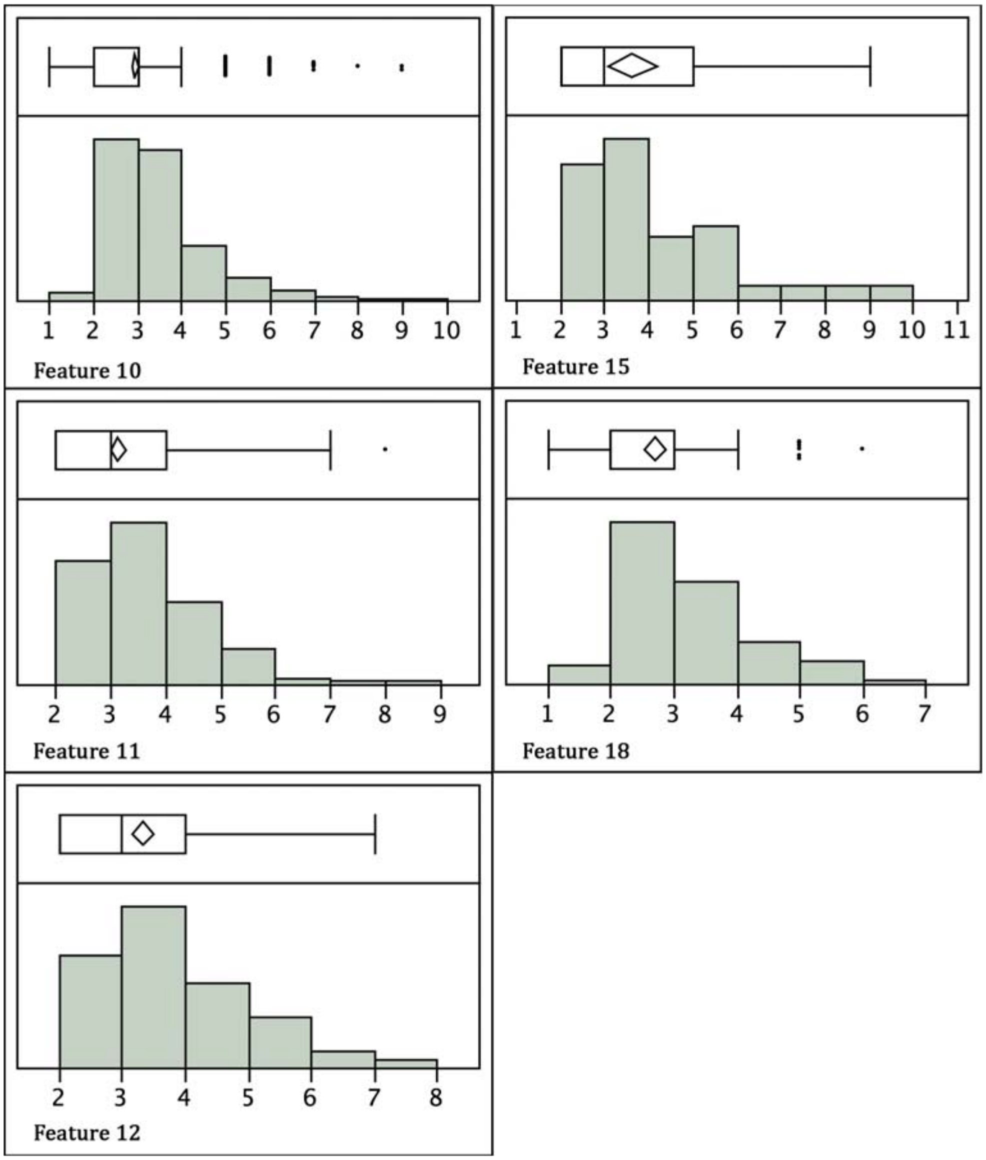

Figure 5.11. Los Mineros feature lithic size distributions.

Figure 5.12. Lithic tools from Teonadepa. Left to right: top row, biface, denticulate, double side scraper, multitool (side scraper perforator), multitool (side scraper end scraper); second row, double side scraper, double side scraper, double, side scraper, end scraper, end scraper; third row,side scraper, side scraper, side scraper, side scraper; scale is one cm.

Figure 5.13. Lithic tools from El Nogal. Left to right: top row, end scraper, end scraper, end scraper, end scraper (core tool); second row, end scraper, end scraper, end scraper, side scraper; third row, serrated side scraper, utilized flake, utilized flake; scale is one cm.

Figure 5.14. Lithic tools from Los Mineros. Left to right: top row, double side scraper, side scraper, side scraper, end scraper; middle row, end scraper, end scraper, end scraper, serrated side scraper; bottom row, denticulate, denticulate, denticulate, notch; scale is one cm.

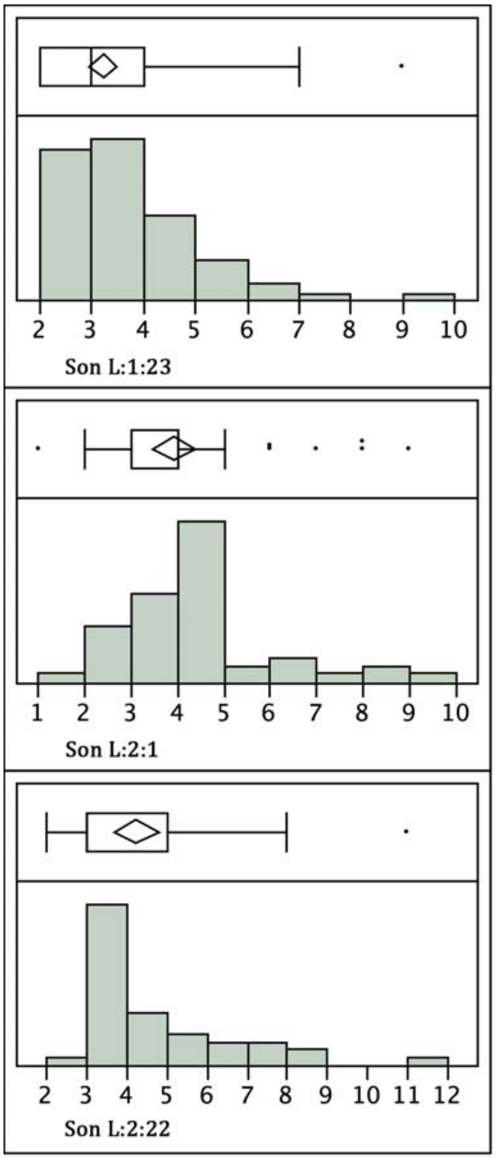

Figure 5.15. Distribution of tool sizes.

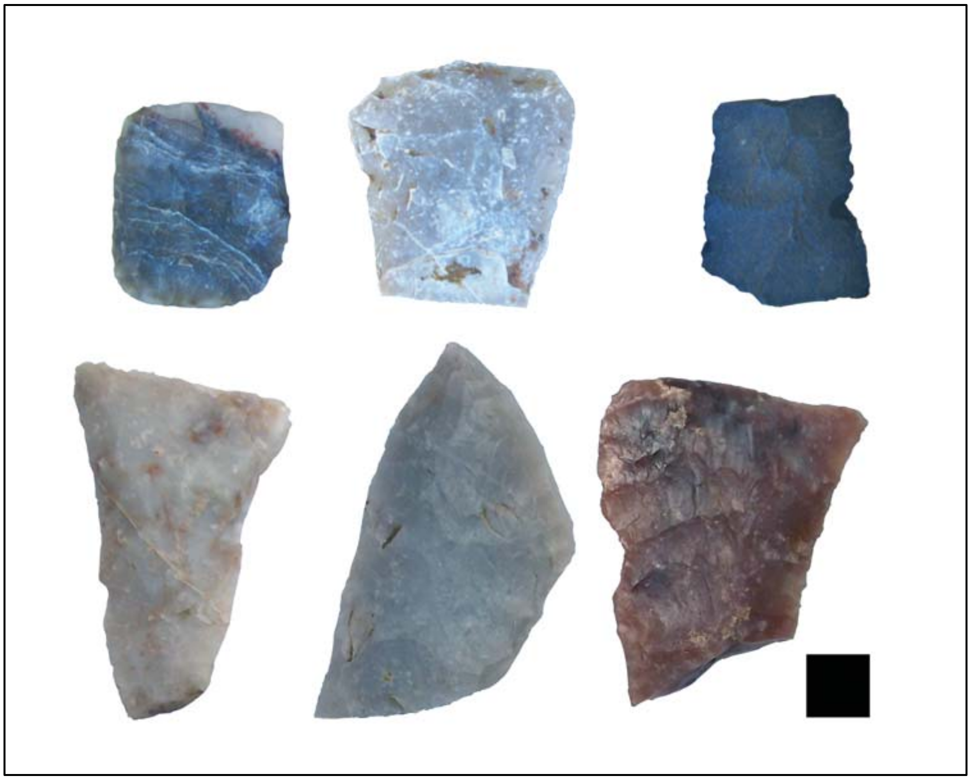

Figure 5.16. Large lithic bifaces recovered from Teonadepa, scale is one cm.

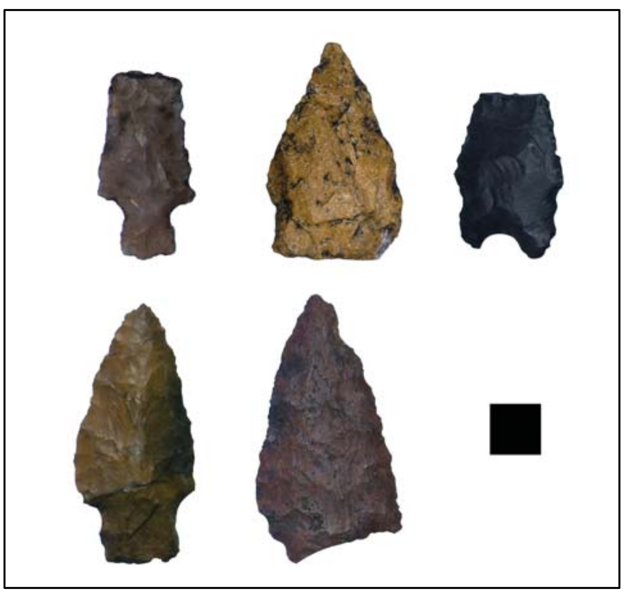

Figure 5.17. Archaic projectile points, clockwise from top left: San Pedro, Cortaro, Chiracahua, Undefined, San Pedro, scale is one cm.

Figure 5.18. Projectile points from El Nogal. The two points on the left are grouped with the Los Mineros style. The point on the bottom right is similar to Casas Grandes Type 1A; scale is one cm.

Figure 5.19. Projectile points from Los Mineros. The point on the left is grouped with the Los Mineros style. The other points are too broken to be defined, scale is one cm.

Figure 5.20. A sample of the points from Teonadepa. All are Western Triangular, with possible exception of three broken tips (left three, fourth row). Top row, three left points are similar to Sobaipuri, scale is one cm.

Figure 6.1. Broken metate with substantial utility remaining.

Figure 6.2. Metate fragment with very large vesicles, sections on arrow are 10 cm.

Figure 6.3. Cupules on bedrock near the mesa edge at La Volanta.

Figure 6.4. Agave knives from El Nogal, scale is one cm.

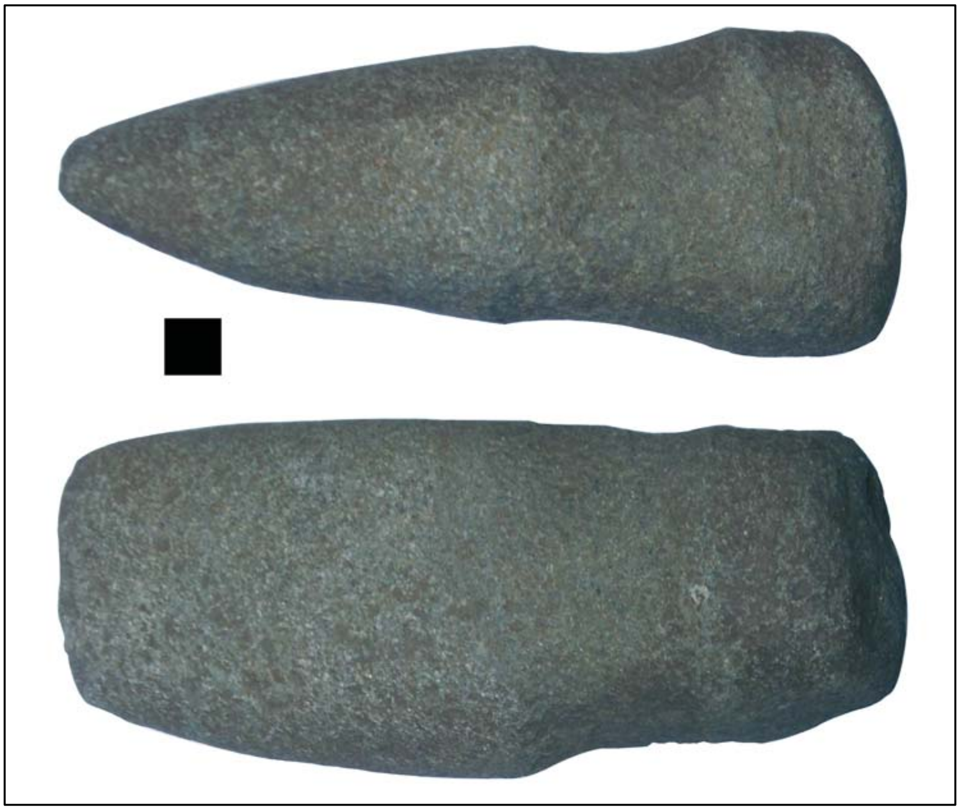

Figure 6.5. ¾ grooved axe from Los Mineros, scale is one cm.

Figure 6.6. Polishing pebbles from left to right: El Nogal, Los Mineros, Teonadepa, and Jamaica Vieja, scale is one cm.

Figure 6.7. Stone spindle whorls/discs from El Nogal, all but second from left are from Feature 3, the pithouse, scale is one cm.

Figure 6.8. Possible arrow shaft straightner from Jamaica Vieja, scale is one cm.

Figure 6.9. Eccentric groundstone objects from near La Volanta, scale is one cm.

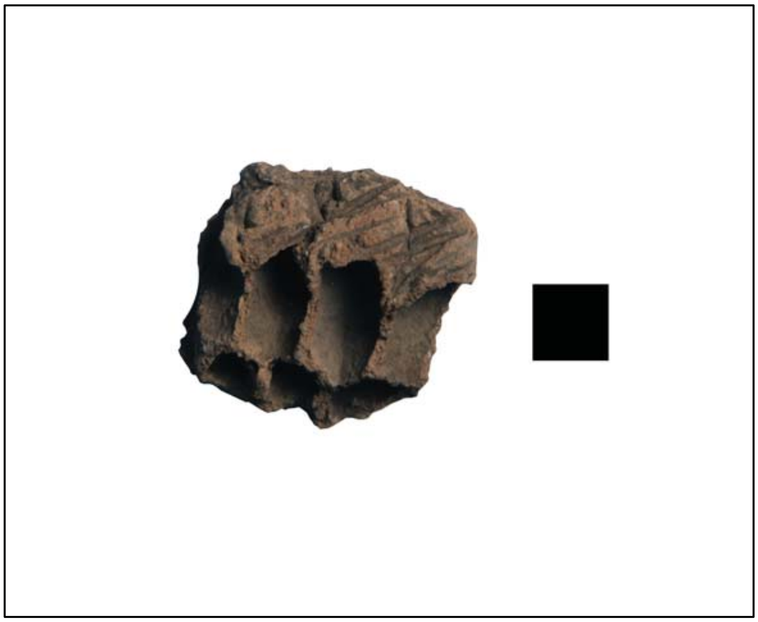

Figure 7.1. *Sceliphron* wasp nest evidencing cut marks to remove larvae, scale is one cm.

Figure 7.2. A *Manduca* tobacco hornworm collected during excavation in 2012, GPS screen is 8.5 cm long.

Figure 7. 3. *E. ferus* sacrum with several visible cut marks, scale is one cm.

Figure 7.4. Typical level of breakage in the assemblage, this sample from El Nogal, scale is 1 cm.

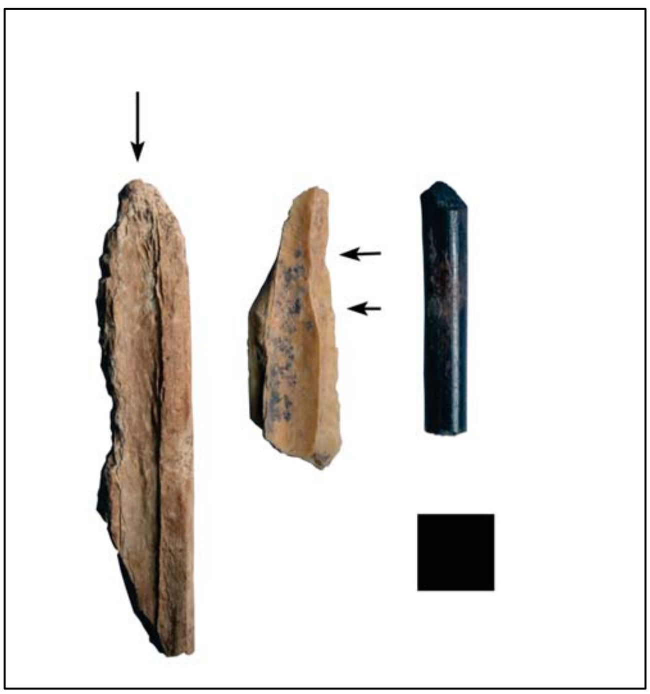

Figure 7.5. Examples of bone tools, arrows indicate locations of polish, scale is one cm.

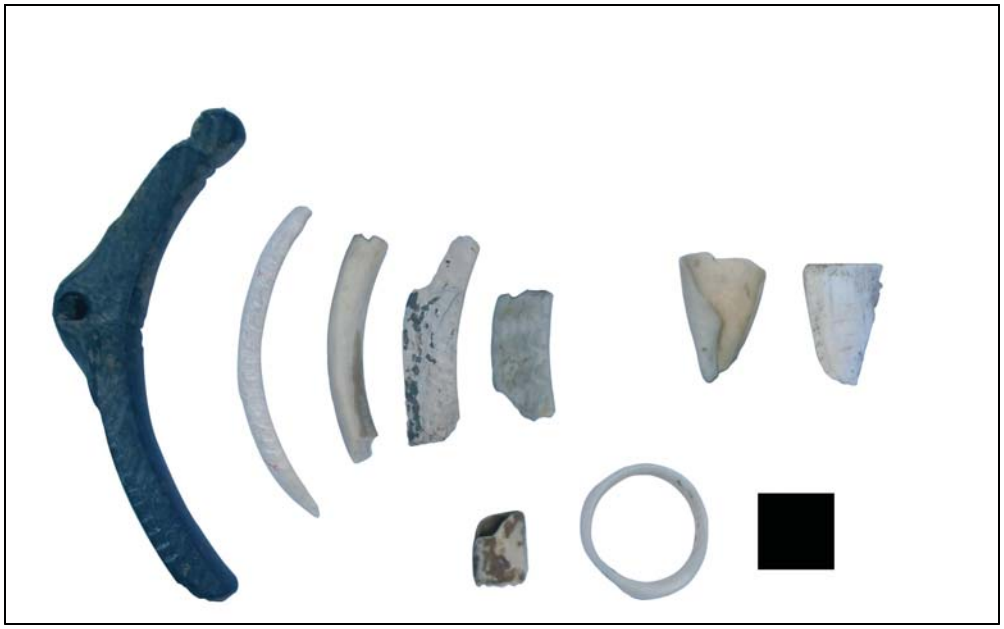

Figure 8.1. Top row left, five examples of broken *Glycemeris* bracelet fragments, far left is reworked as a pendant; top row right, two possible tinkler blanks, bottom row left, *vermetidae* bead; bottom row right, *conus* ring; scale is one cm.

Figure 8.2. Items of adornment. Left to right, top row, three sides of a lip or ear plug (box), argillite pendant; bottom row beads: turquoise, turquoise, bone, bone or tooth, unknown; scale is one cm.

Figure 8.3. Historic artifacts: left to right, top row, Frozen Charlotte doll head (Los Mineros), polichrome Majolica (Badehuachi), Gaudy Dutch Anuular Ware; middle row, amethyst glass, transfer print porcelain, milk glass La Galera; bottom row, hand forged nail (El Nogal); scale is one cm.

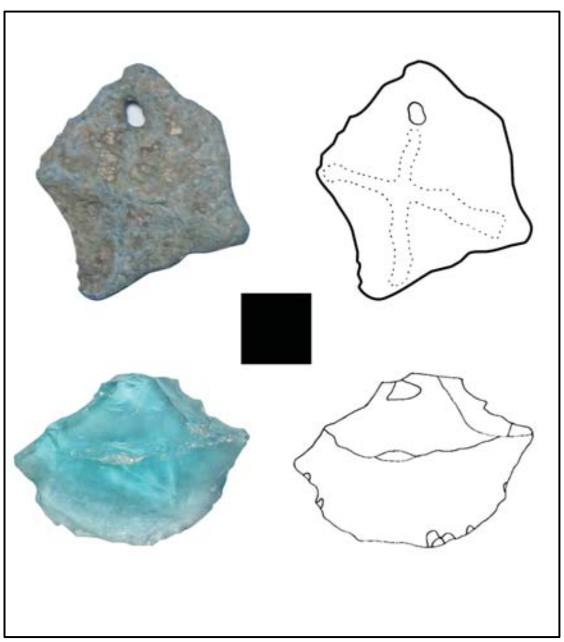

Figure 8.4. Metal pendant from Los Mineros and utilized bottle glass flake from Teonadepa, scale is one cm.

Figure 9.1. Pictoglyph panel near Cucurpe in the San Miguel Valley.

Figure 9.2. Pictoglyphs of anthropomorphs in region of Los Hoyos Ejido.

Figure 9.3 Pictoglyphs of anthropomorph, cross, and zoomorph *Equidae* in the Sierra La Madera.

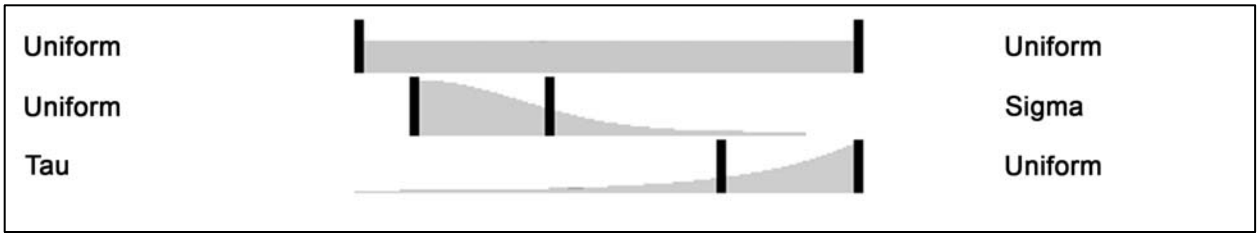

Figure 10.1 Distributions showing parameters of distributions used to model the architectural sequence (modified from http://c14.arch.ox.ac.uk/oxcalhelp/hlp_analysis_oper.html).

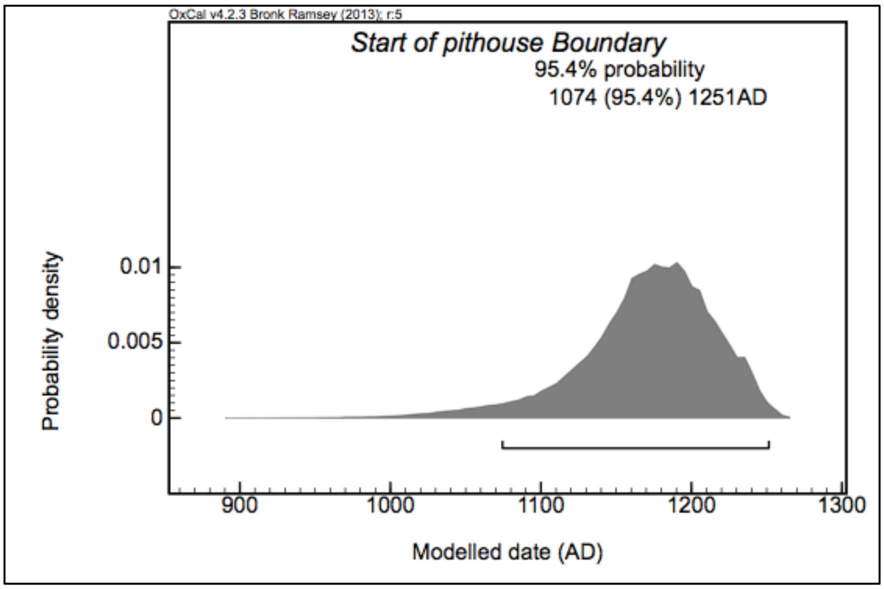

Figure 10.2 Start of pithouse boundary, and by association the mesa focused settlement pattern. A best estimate from this distribution suggests a start date in the mid to late 1100s.

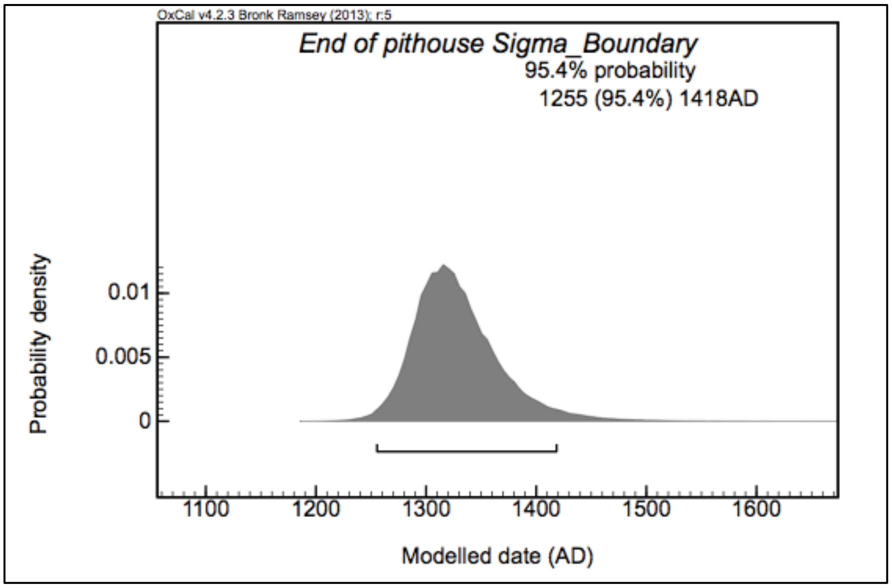

Figure 10.3 End of pithouse boundary. This figure indicates an end date of ca. A.D. 1350 for most households to transition to above ground architecture.

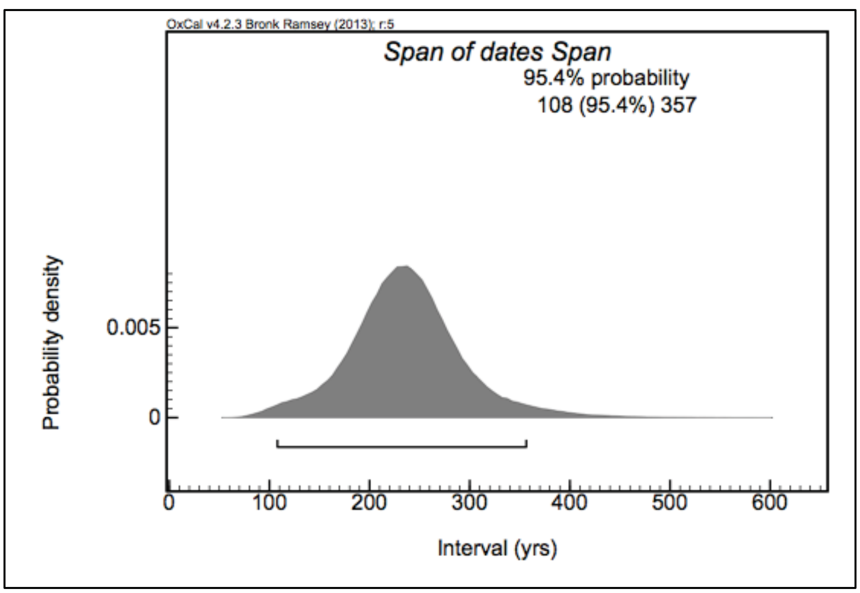

Figure 10.4. Span of pithouse (on mesas) period. This figure suggests a relatively standard phase interval of approximately 200 to 300 years.

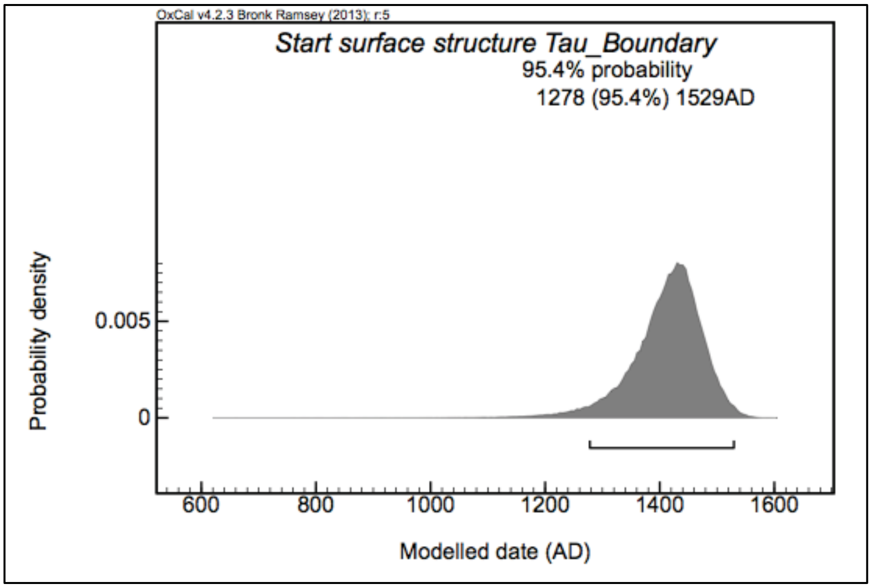

Figure 10.5. Start of surface structure period. While surface structures were likely around before the mesa focused settlement pattern developed this distribution suggests a start date for a predominant surface structure settlement pattern begins between ca. A.D. 1350 and 1500.

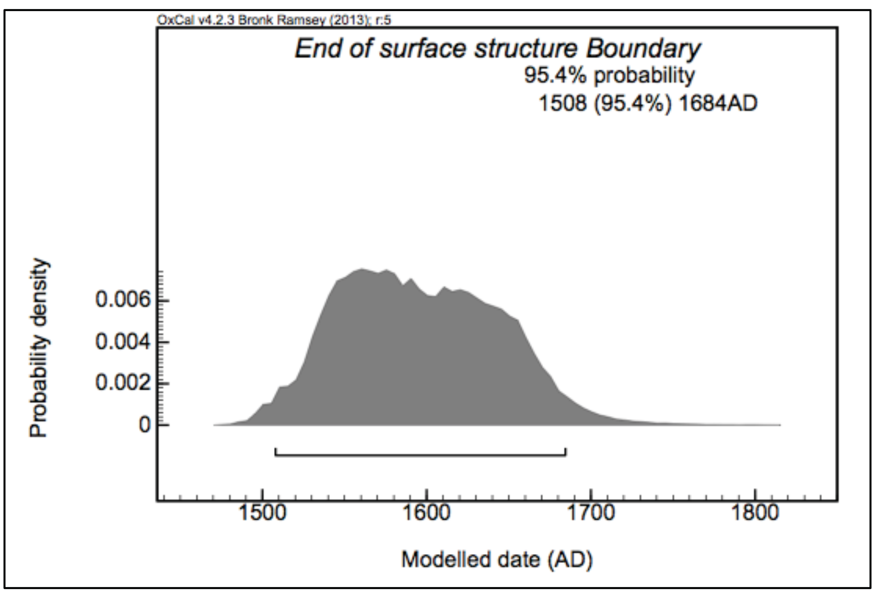

Figure 10.6. "End" of surface structure period. This figure indicates the arbitrariness of determining an end point to the surface structure phase, which obviously continued in some form well into the protohispanic to historic period. Much of the ambiguity is actually the result of secular variation in the calibration curve for this period.

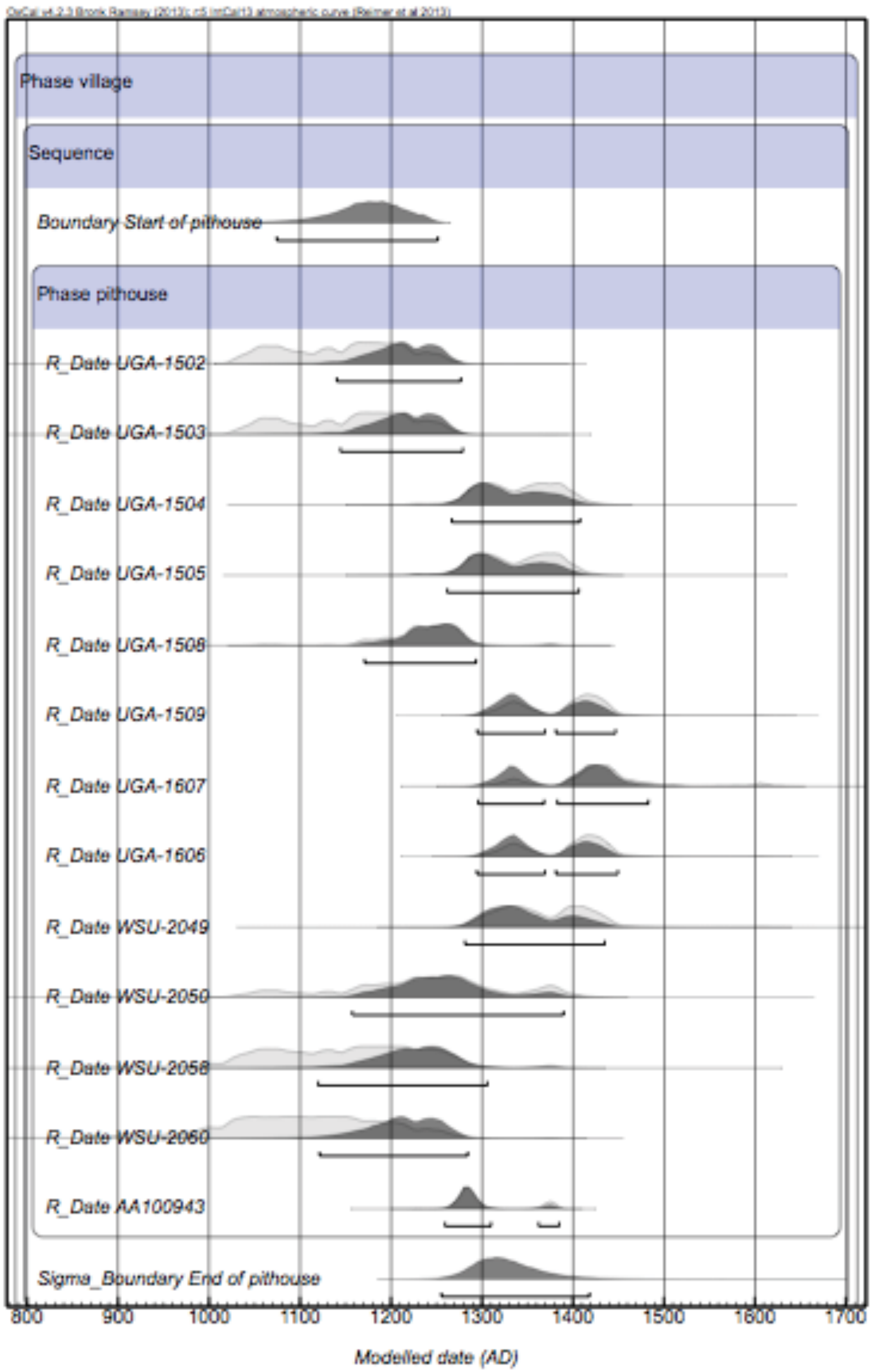

Figure 10.7. Probability distributions of dated structures used in the analysis. Note that light gray are distributions prior to the application of the Bayesian methods.

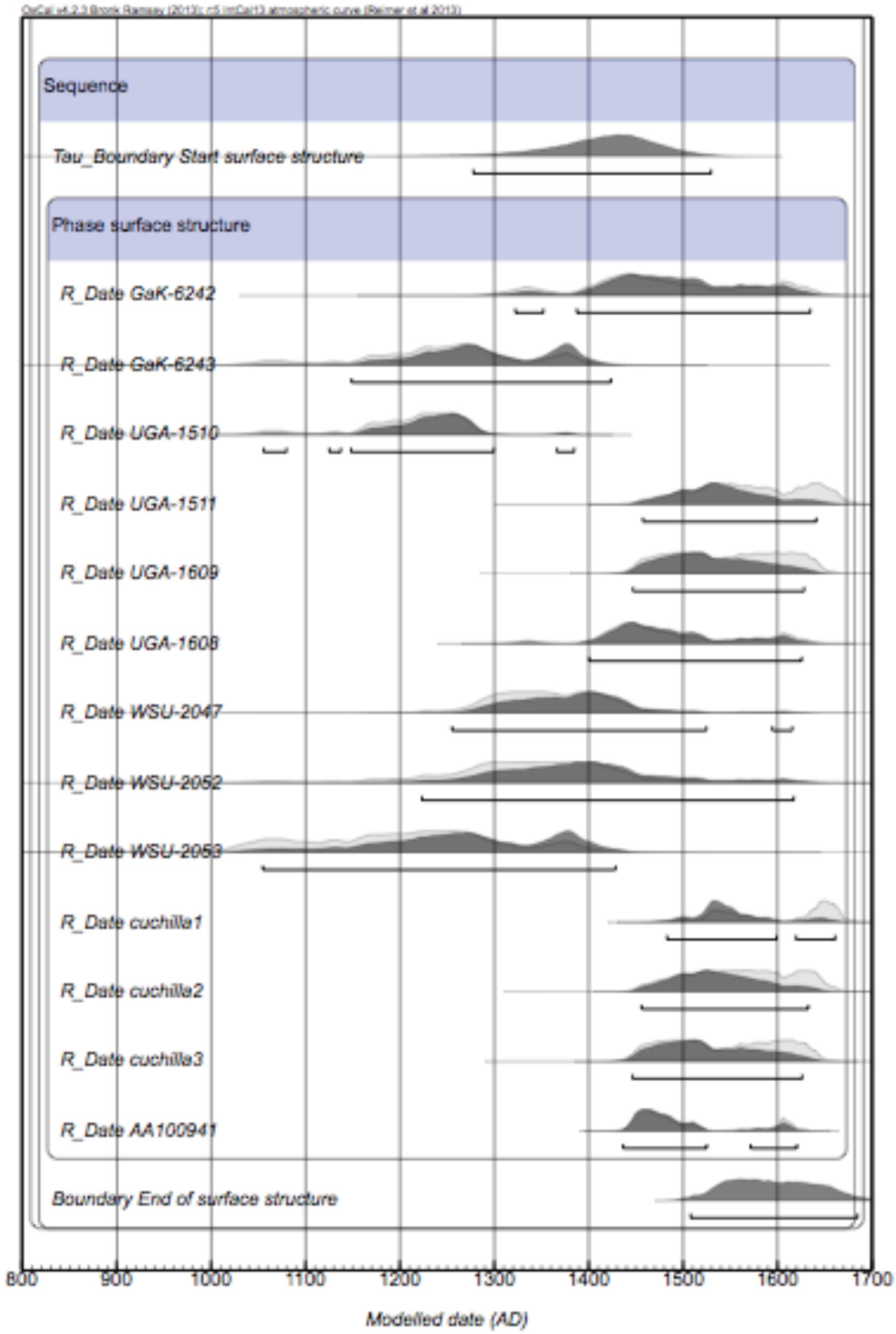

Figure 10.7 (continued). Probability distributions of dated structures used in the analysis. Note that light gray are distributions prior to the application of the Bayesian methods.

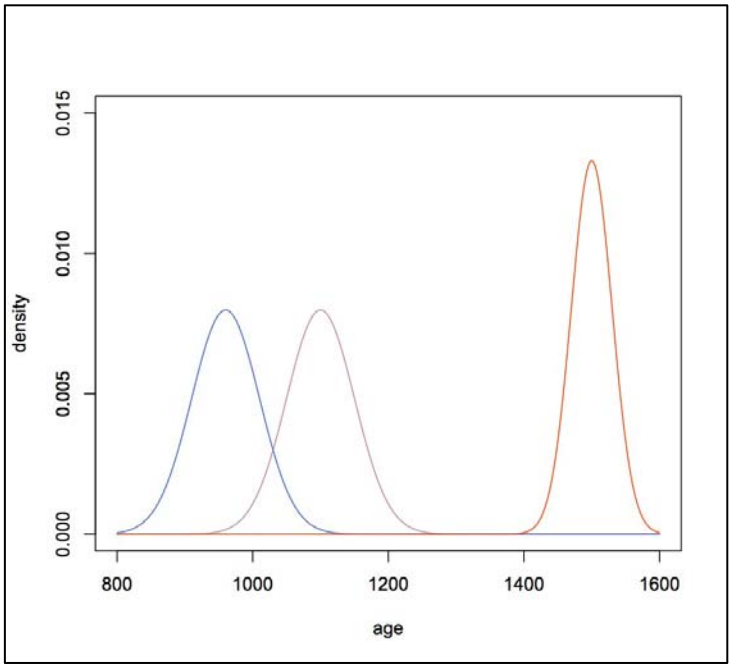

Figure 10.8. The distribution for likely valid dates on brushed ceramics.

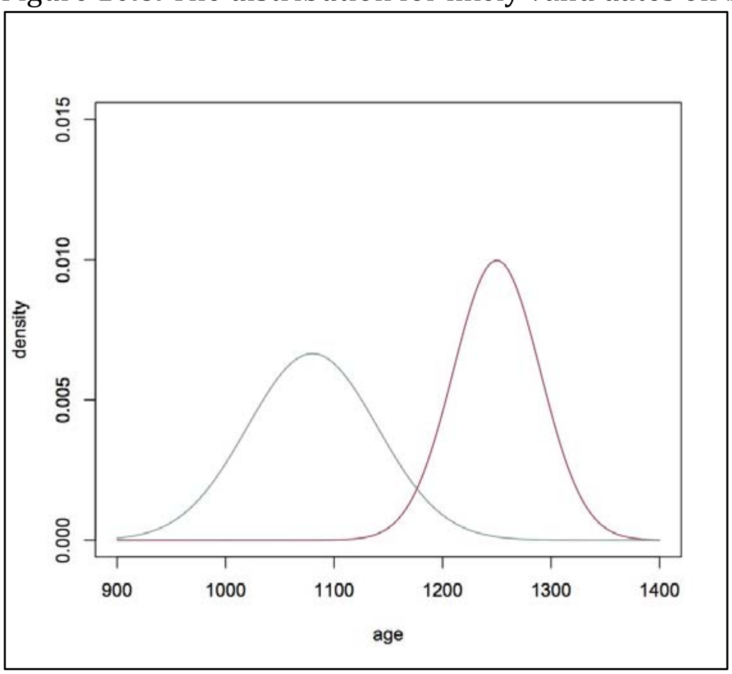

Figure 10.9. The distribution of dates for textured ceramics.

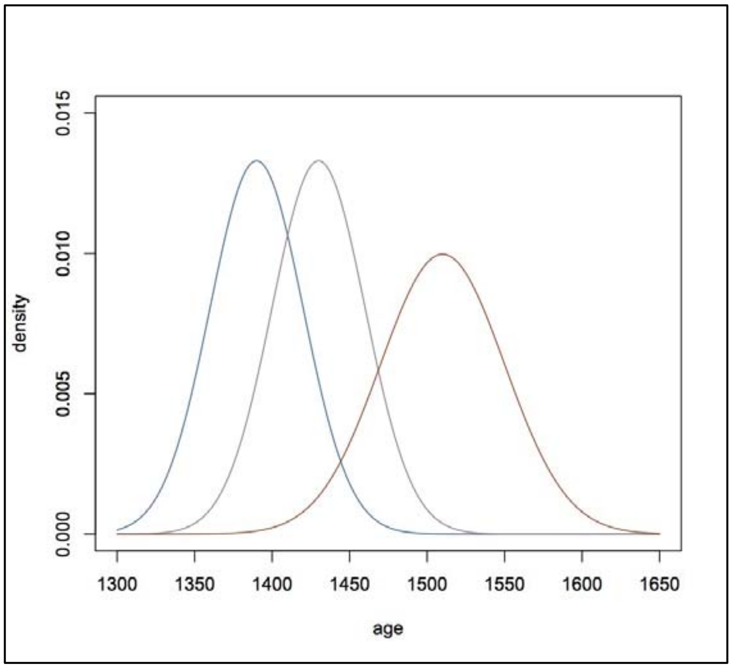

Figure 10.10. The distribution of dates for painted *Chihuhuan* ceramics.

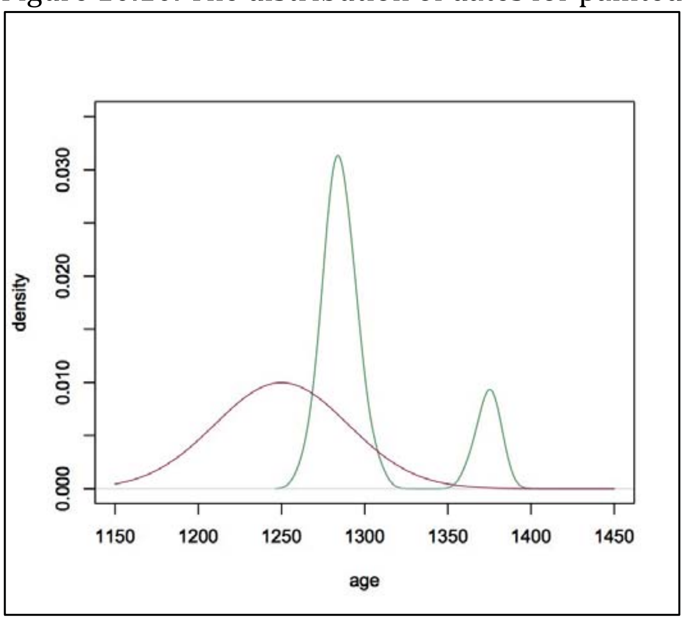

Figure 10.11. Feature 3 probability distributions, single peak on left is luminescence, double peak is ^{14}C.

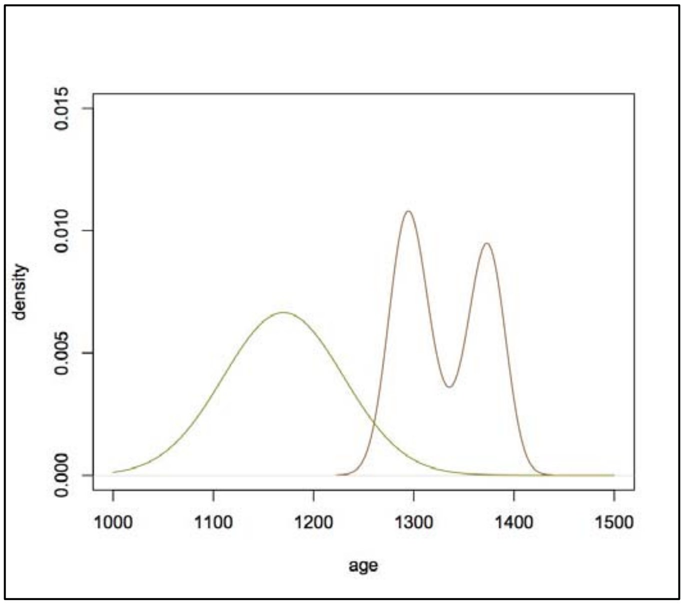

Figure 10.12 Feature 15 probability distributions, single peak on left is luminescence, double peak is ^{14}C.

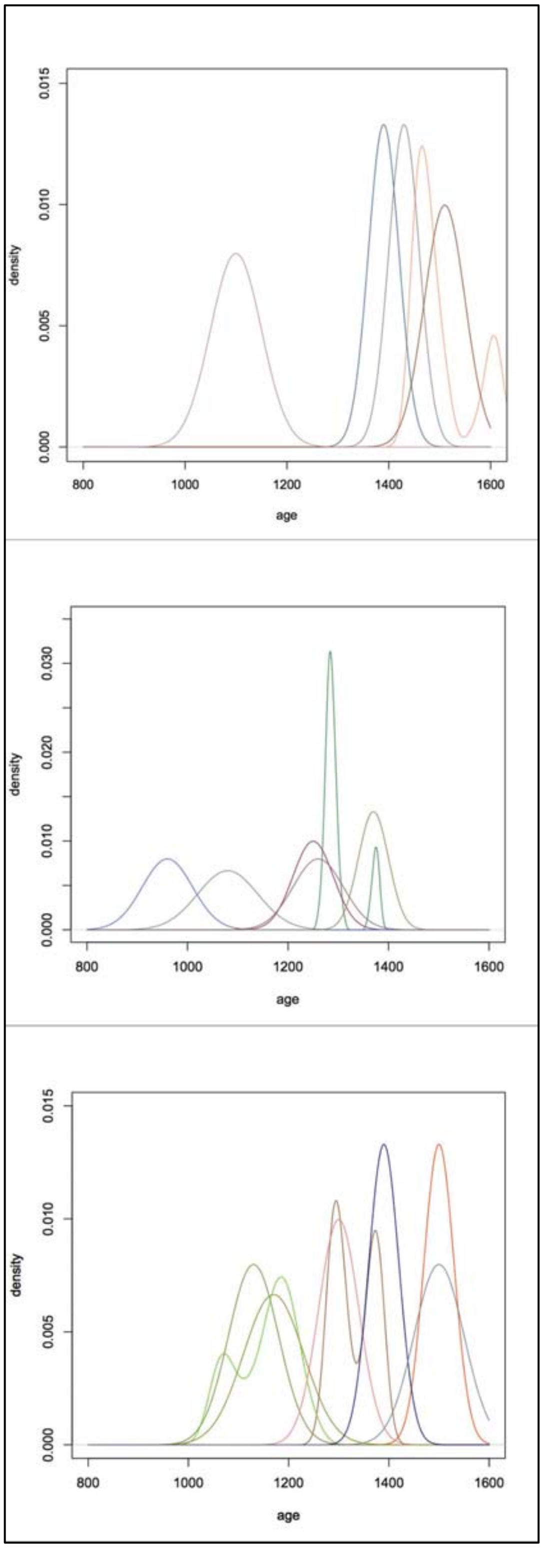

Figure 10. 13. Comparative date distribution by site; top, Teonadepa; middle, El Nogal; bottom, Los Mineros.

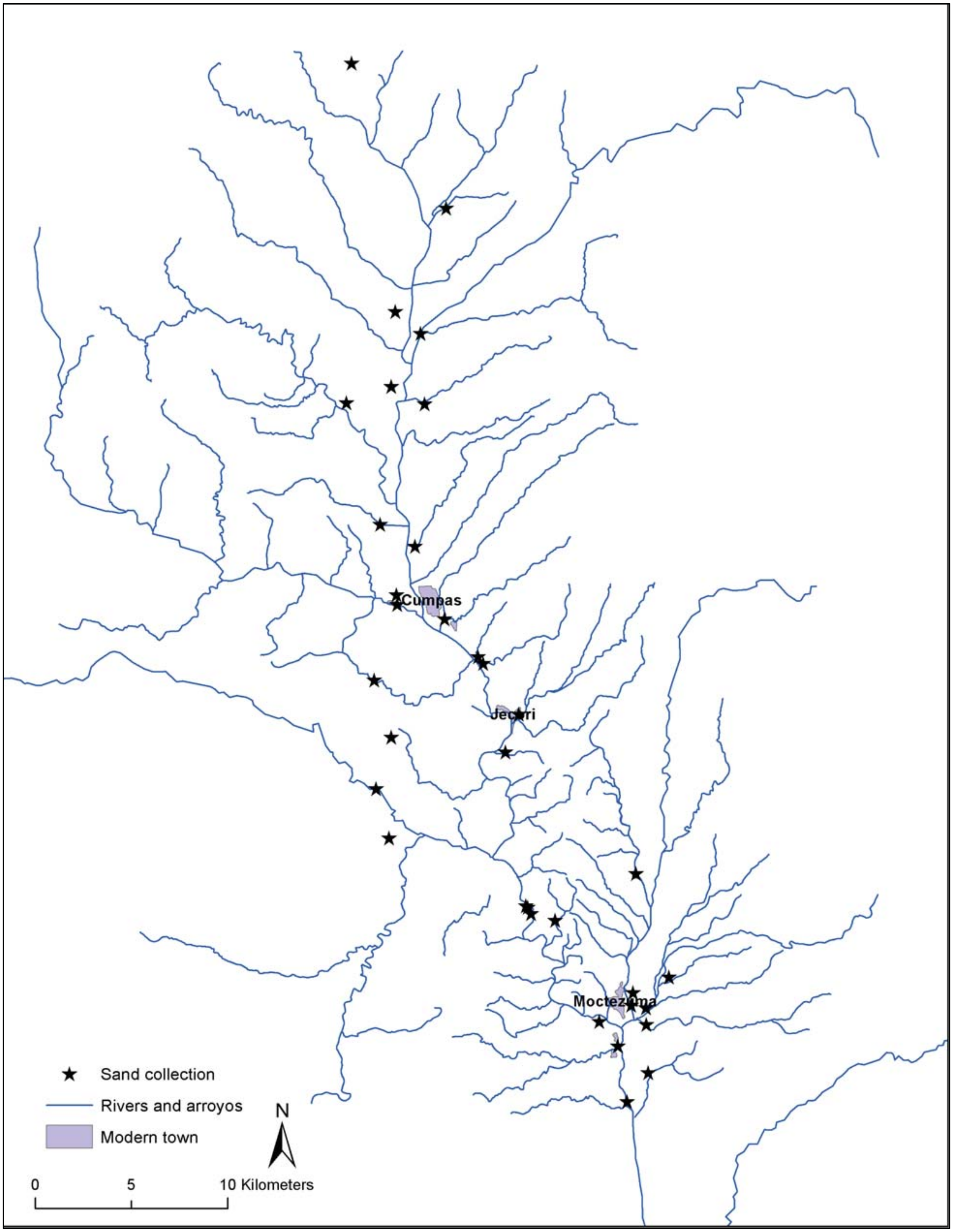

Figure 11.1. Map of the project area showing the location of sand sample collections.

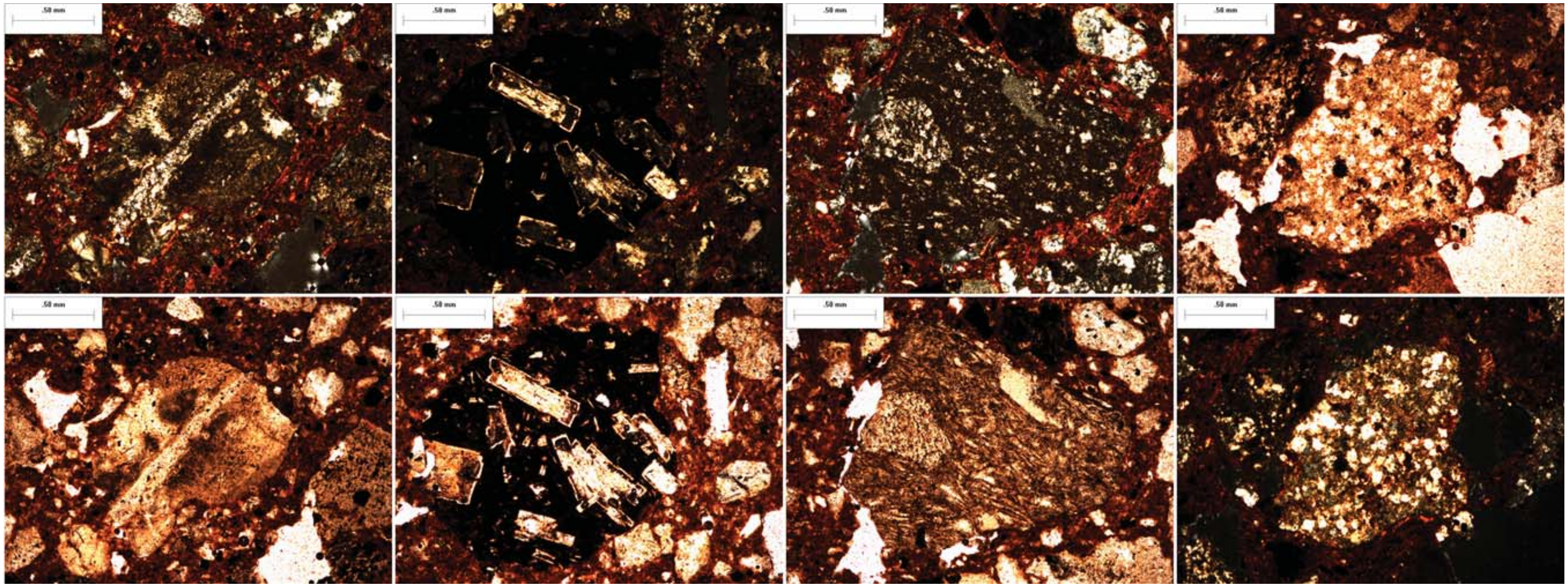

Figure 11.2. A compilation of weathered grains from FN 114 at 50 x, top row xpl, bottom row ppl.

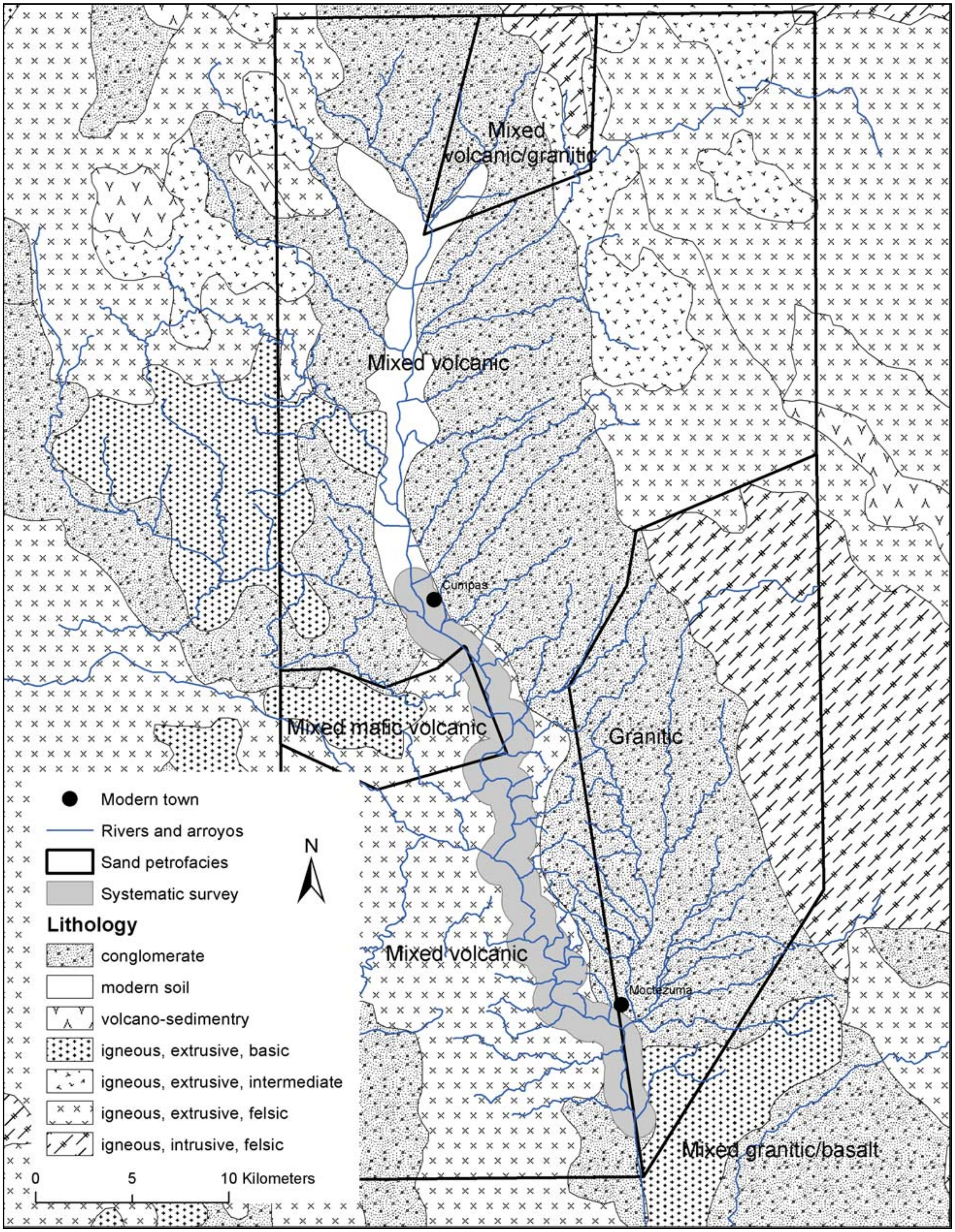

Figure 11.3. A map of petrofacies based on an analysis of point counted sand grain mounts.

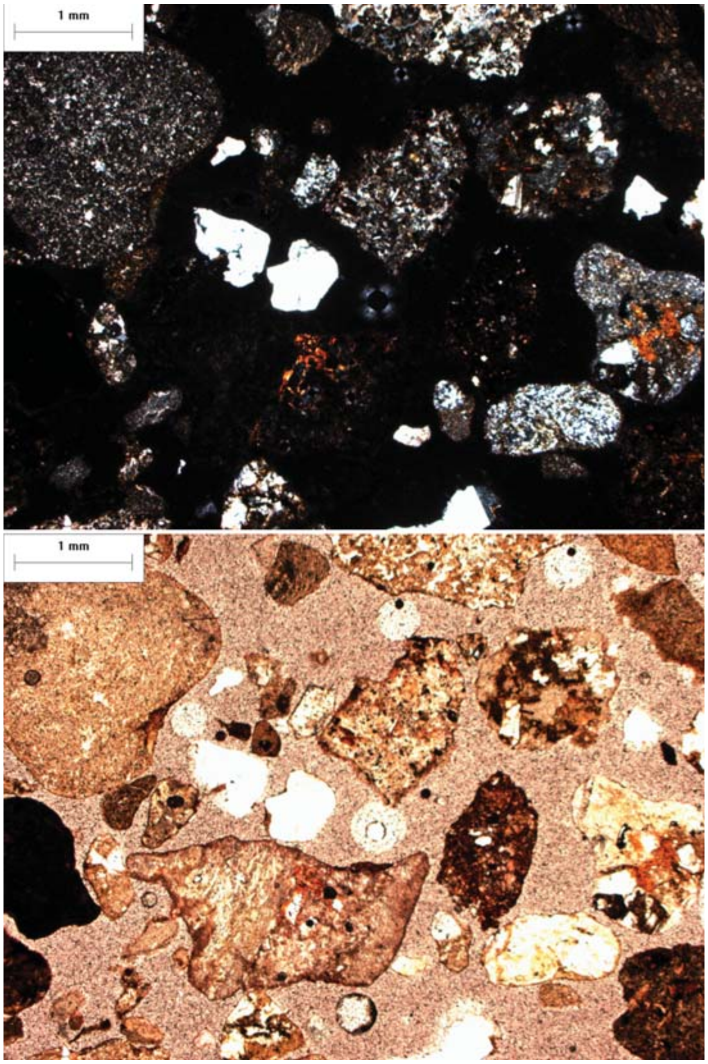

Figure 11.4. Example of mixed volcanics in a sand grain mounts, top xpl, bottom ppl, ss30-2010 at 20 x.

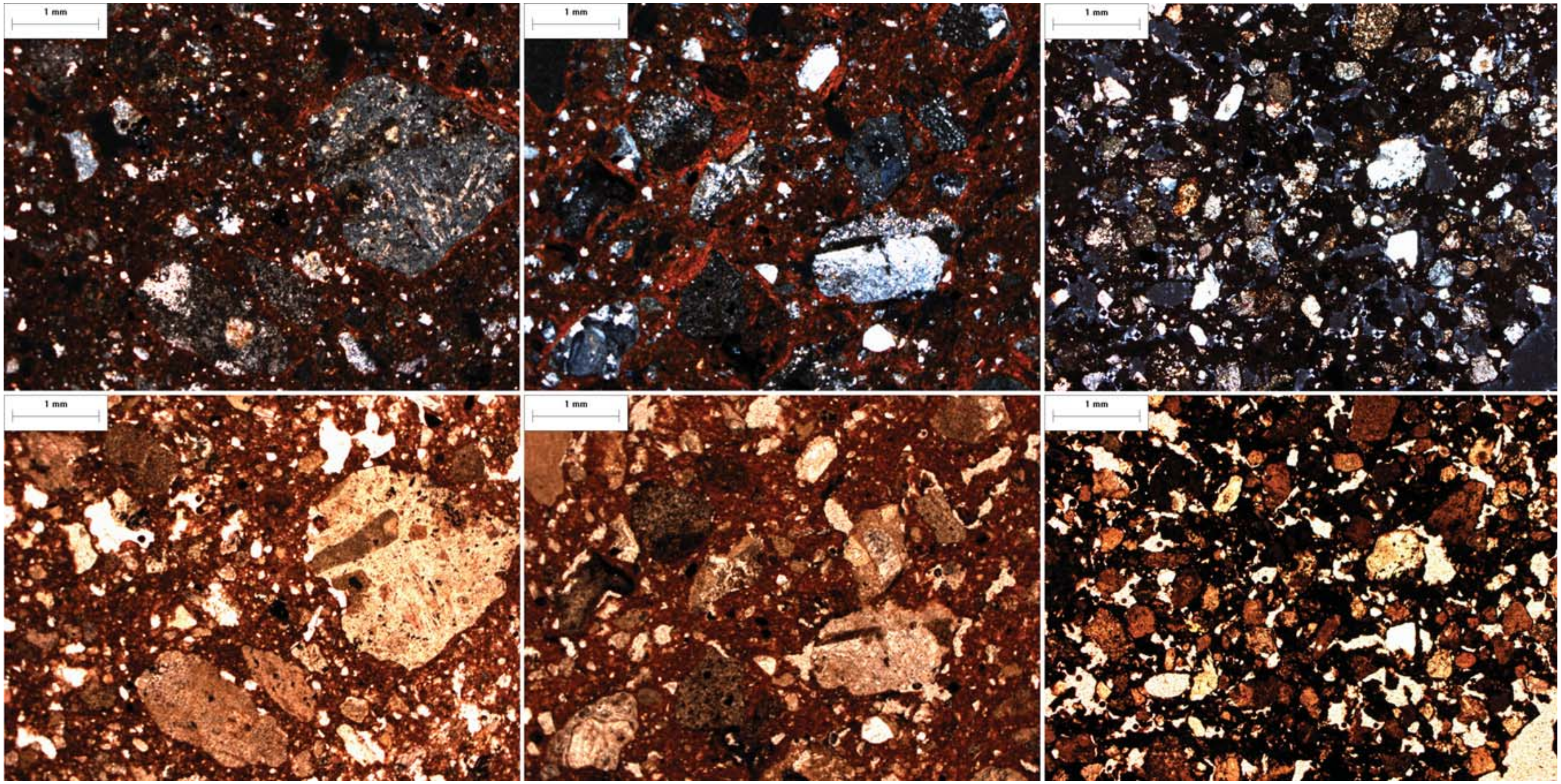

Figure 11.5. Examples of mixed volcanics in sherd tempers top row xpl, bottom row ppl, from left to right SC-35-04-03 at 100 x, FN 724 at 20 x, and FN 1003.3 at 20 x.

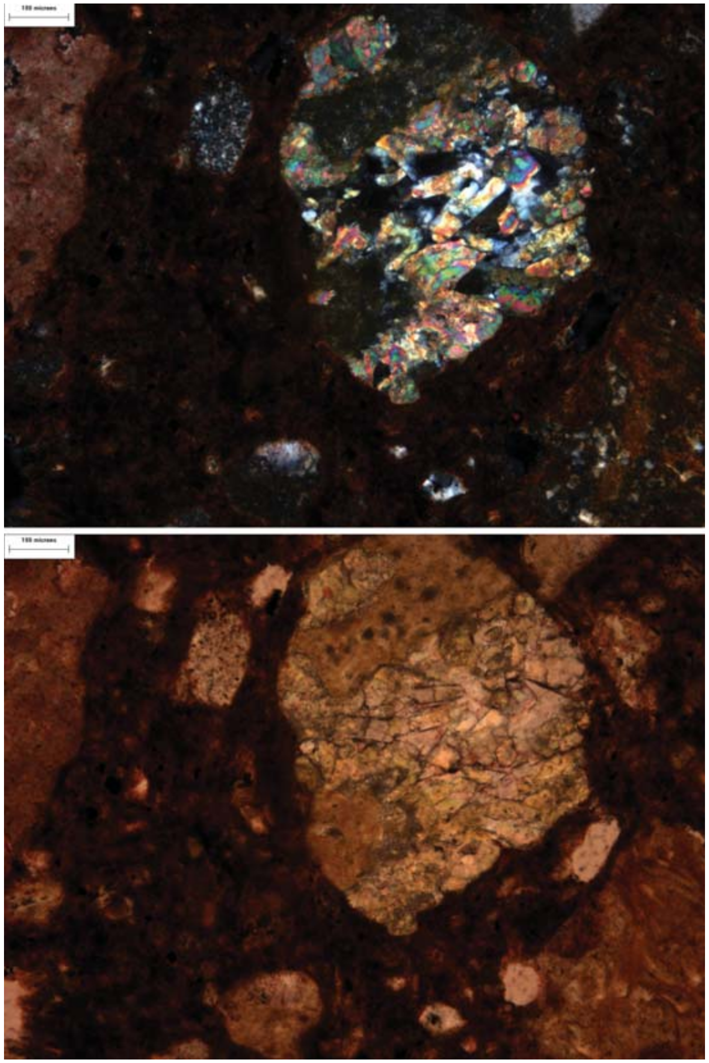

Figure 11.6. An example of epidote, a common accessory and sometimes secondary mineral, in plutonic and volcanic petrofacies in which plagioclase and other Ca heavy minerals are ubiquitous, top xpl, bottom ppl, SC-43-08-05 at 100 x.

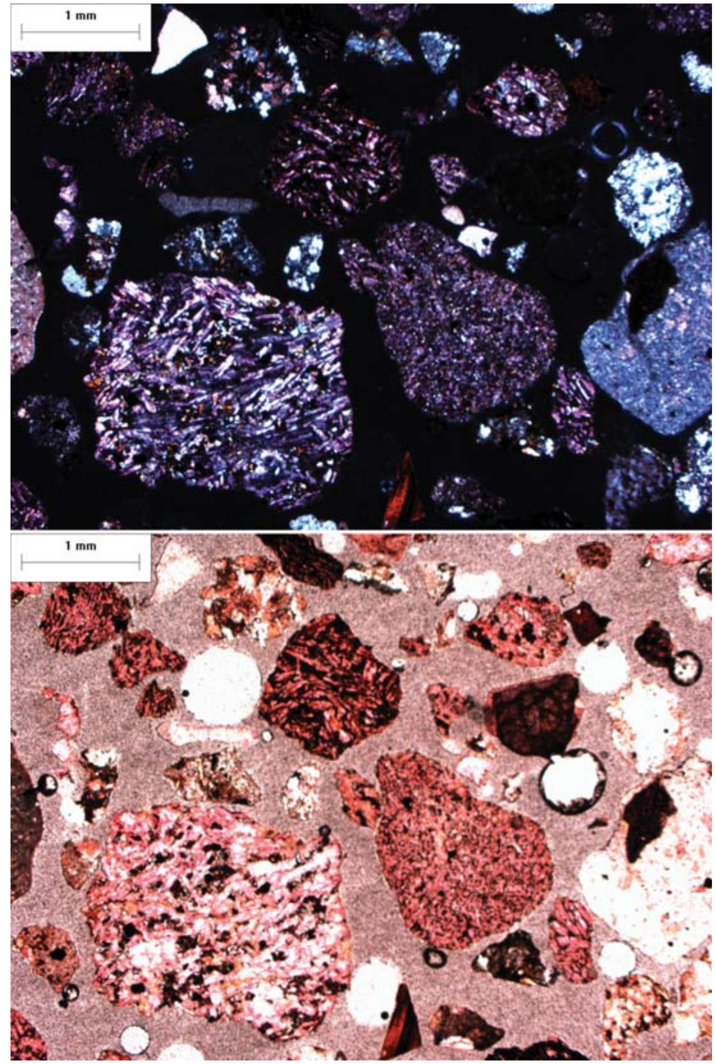

Figure 11.7. An example of a primarily basaltic sand, top xpl, bottom ppl, ss16-2010 at 20 x.

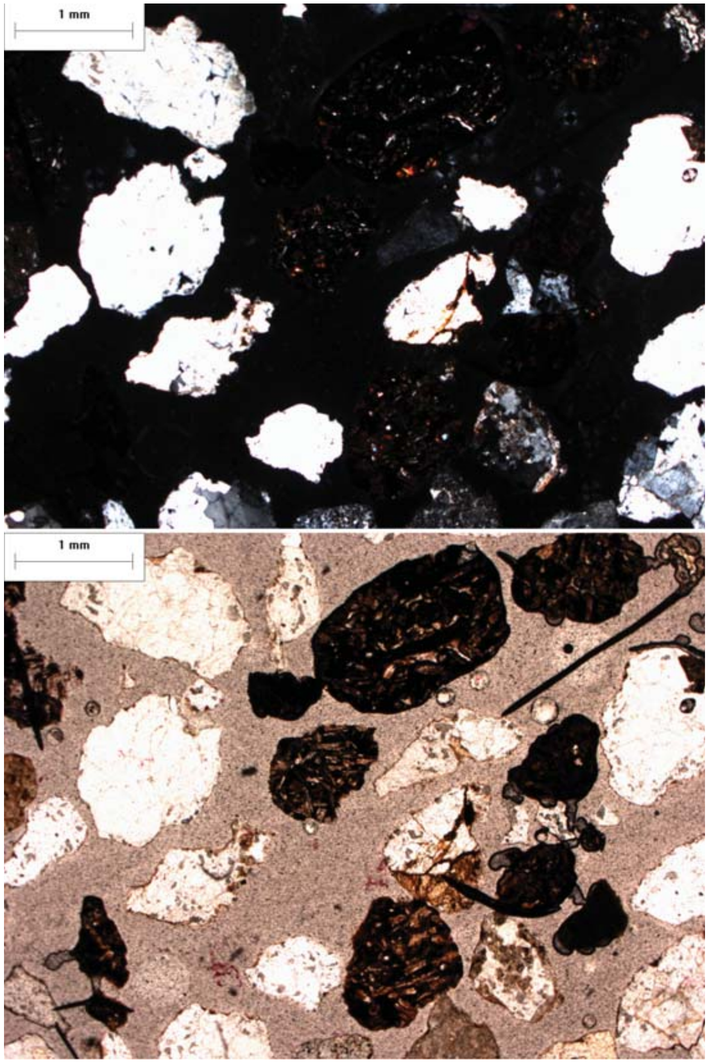

Figure 11.8. An example of a mixed basaltic/plutonic sand, top xpl, bottom ppl, ss1.1-2012 at 20 x.

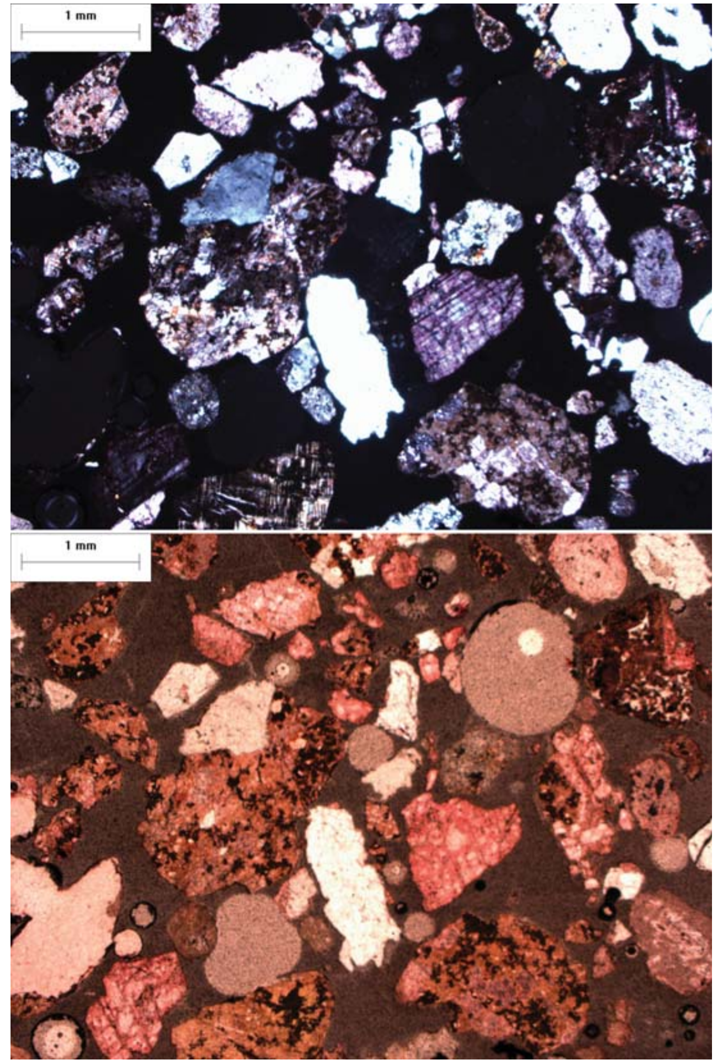

Figure 11.9. Examples of plutonics (granitic) in sand grain mounts, top xpl, bottom ppl, ss2-2010 at 20 x.

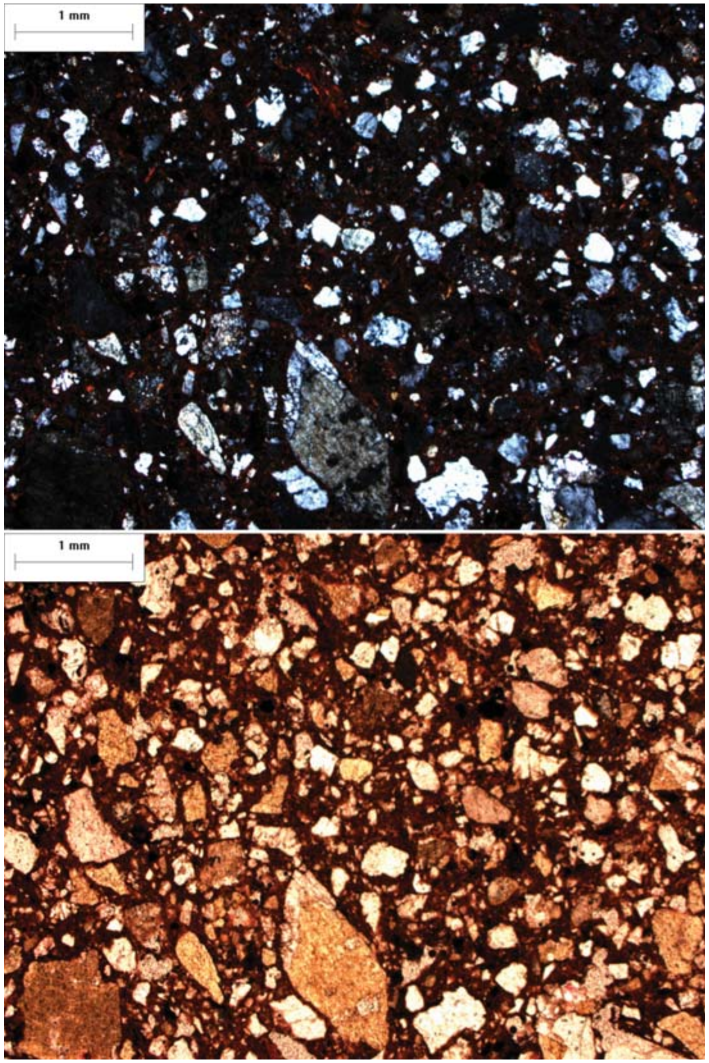

Figure 11.10. Example of plutonics (granitic) in sherd tempers, top xpl, bottom ppl, FN 159 at 20 x.

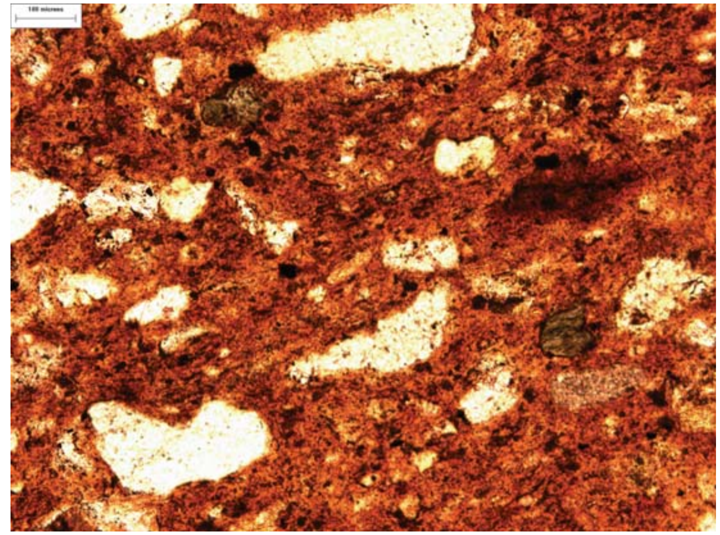

Figure 11.11. Example of small arfvedsonite crystals in a granitic temper sherd, ppl, FN 308 at 20 x.

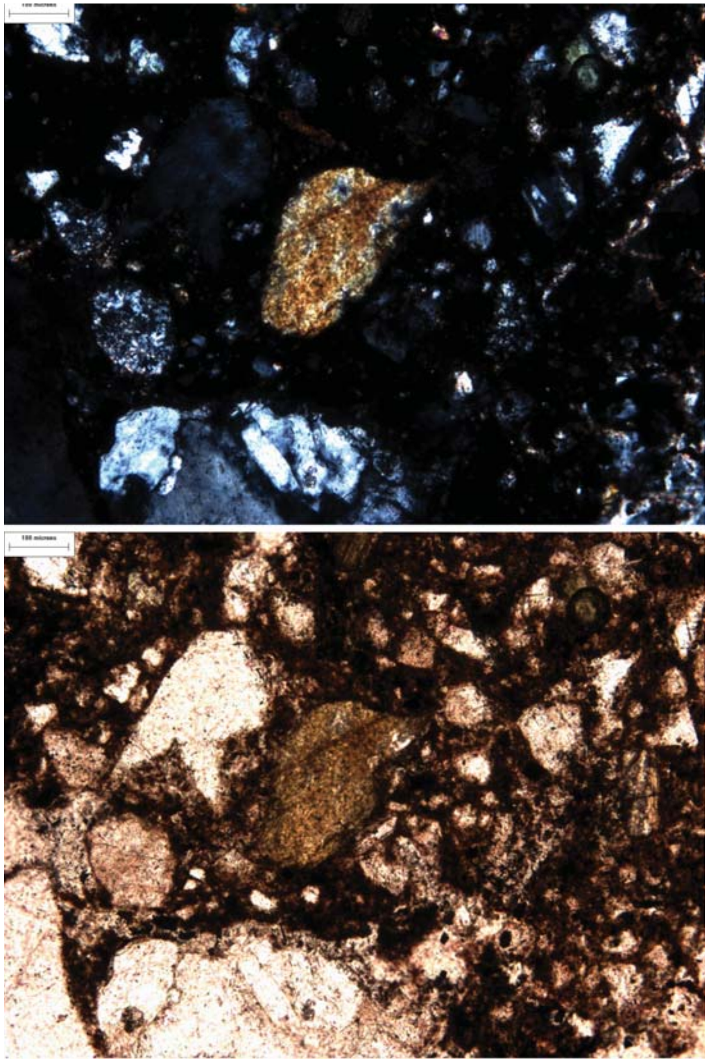

Figure 11.12. Example of a small hornblende crystal with characteristic amphibole cleavage, top xpl, bottom ppl, FN 934 at 100 x.

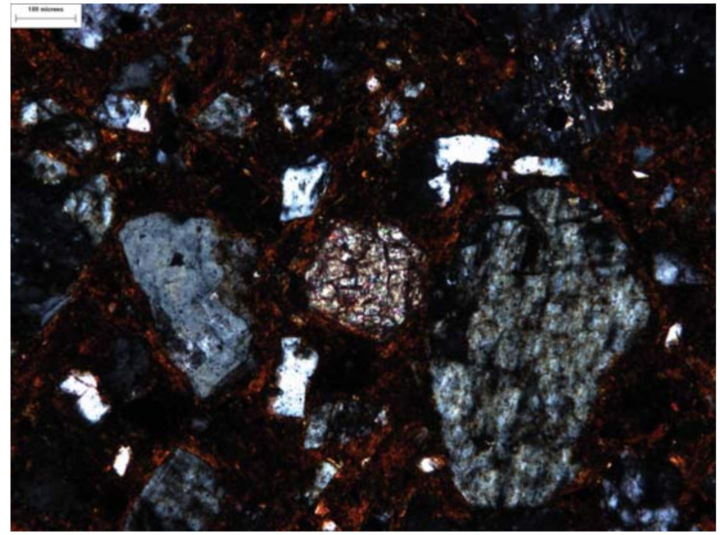

Figure 11.13. Example of a small zircon crystal in a granitic temper, with characteristic very high birefringence, xpl, FN 159 at 100 x

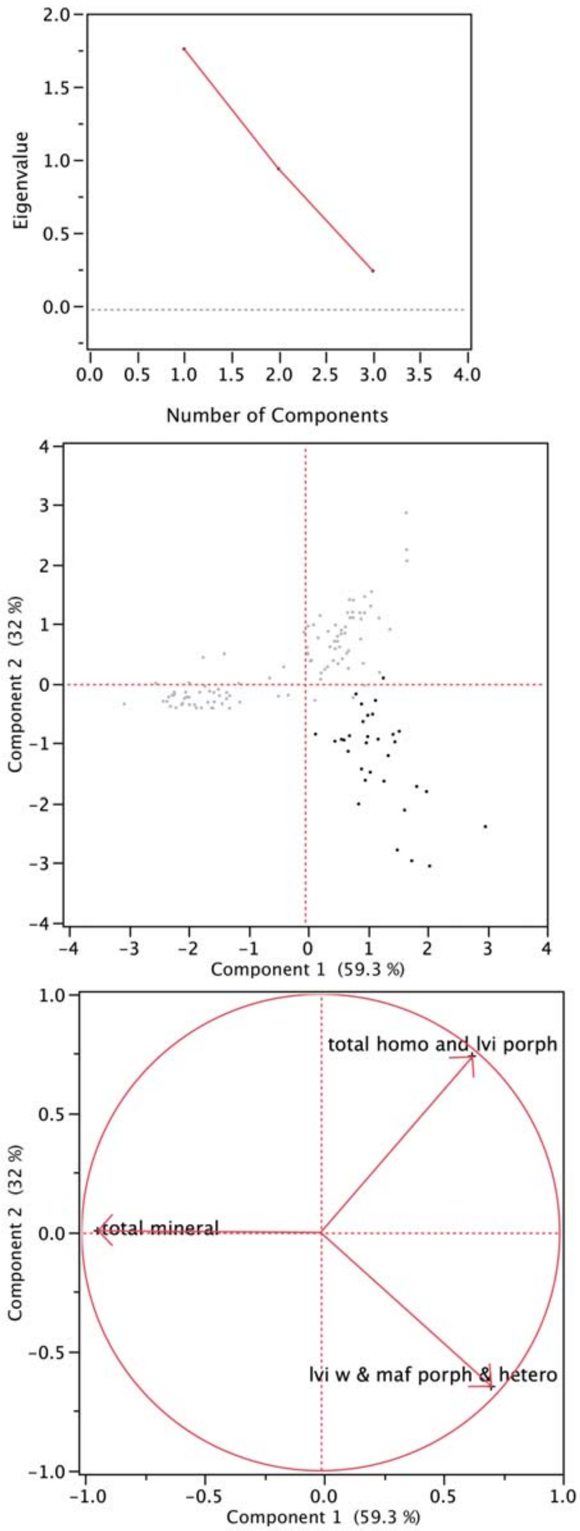

Figure 11.14. A scree, score, and loading plot of a three variable principal components analysis. Categorically identified *heterogeneous intermediate* tempers highlighted on score plot.

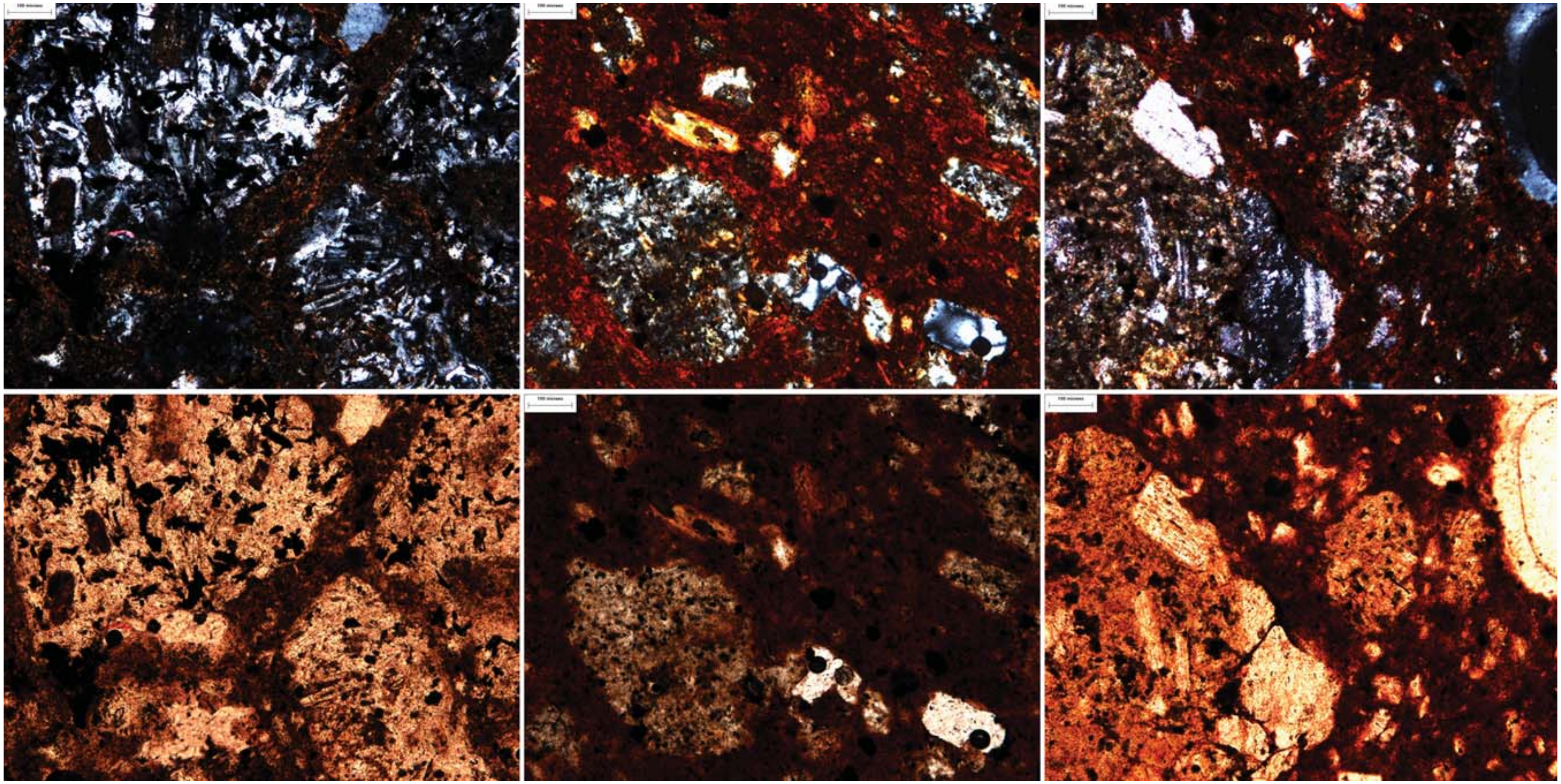

Figure 11.15. Examples of heterogeneous composition, intermediate, lithic grains in sherd tempers, top xpl, bottom ppl, from left to right FN 148, FN 408, and SC-16-15-01 all at 100 x.

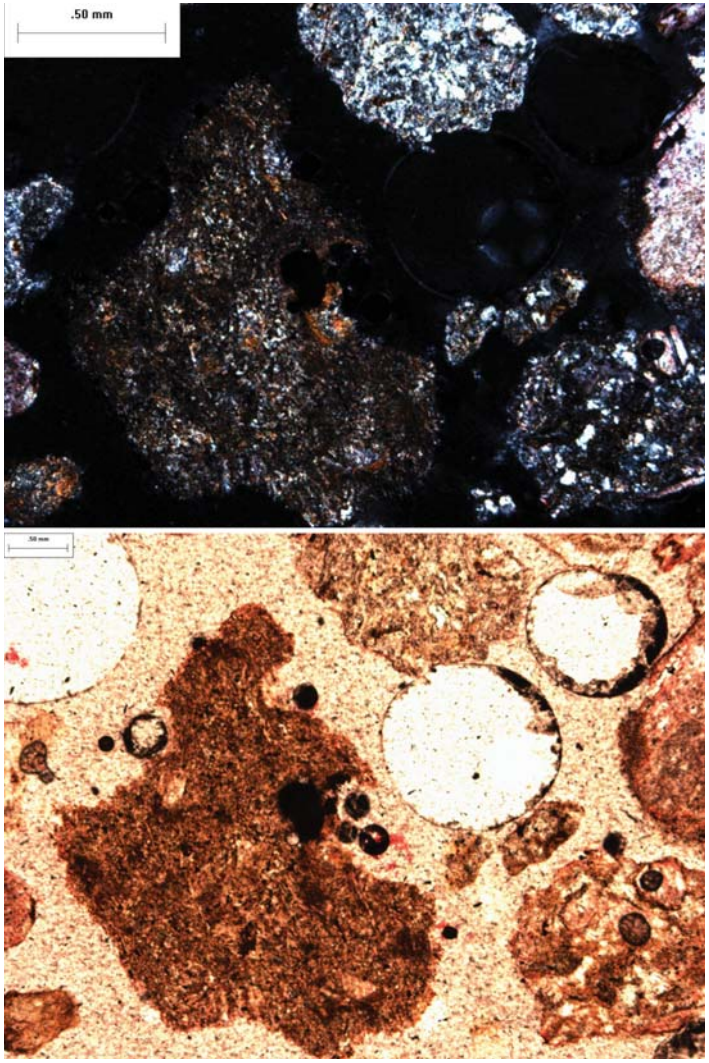

Figure 11.16. Example of a heterogeneous composition, intermediate lithic grain in a sand grain mount ss2.4-2012.

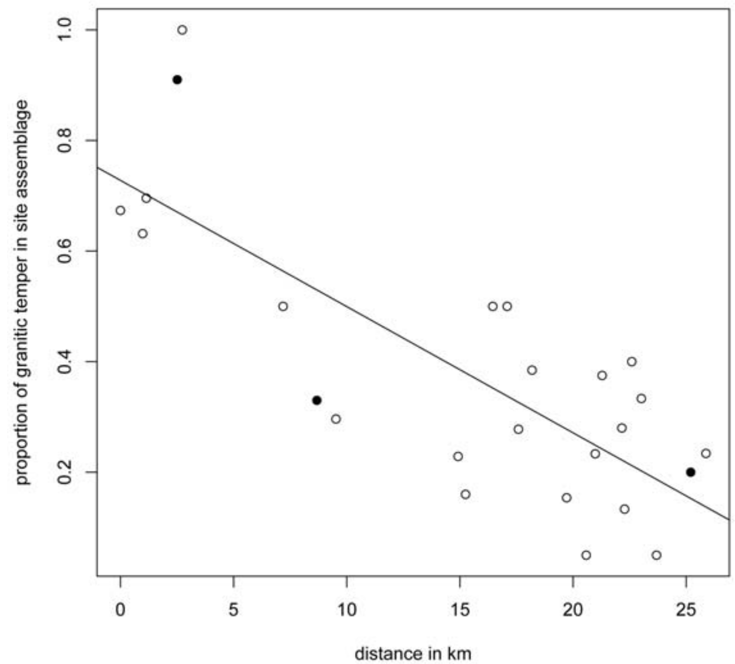

Figure 11.17. Linear relationship between plutonic temper and distance from southern survey boundary, the approximate zone of likely production. Solid points are excavation samples.

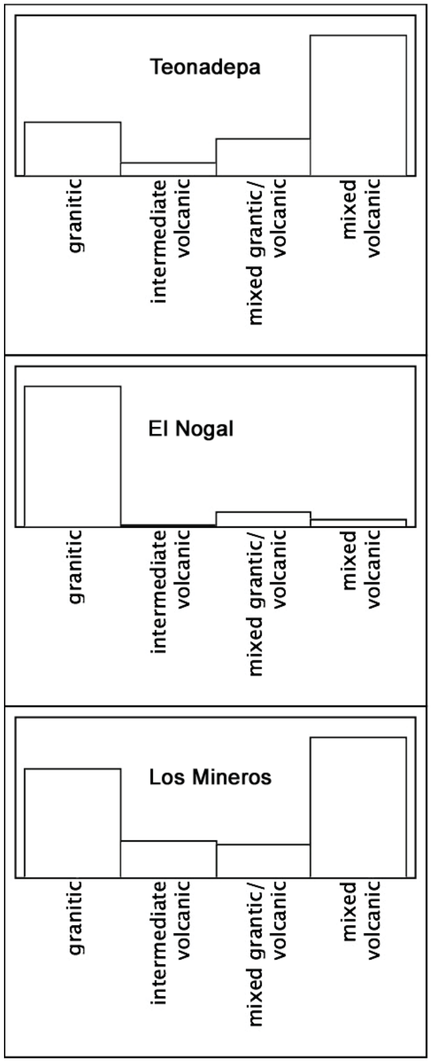

Figure 11.18. Histogram of binocular temper groups of plain brownwares, note highest frequency of intermediate temper at Los Mineros, dark paste specimens excluded.

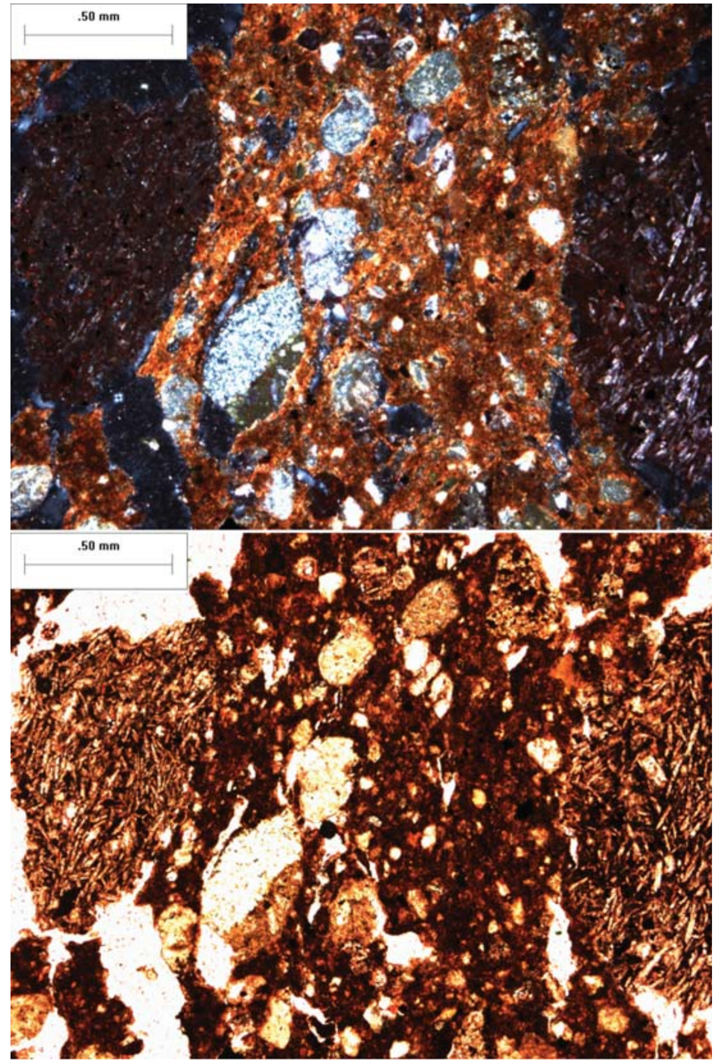

Figure 11.19. Basaltic sand grains in an otherwise mixed volcanic sherd temper, top xpl, bottom ppl, SC-43-08-05 at 50 x.

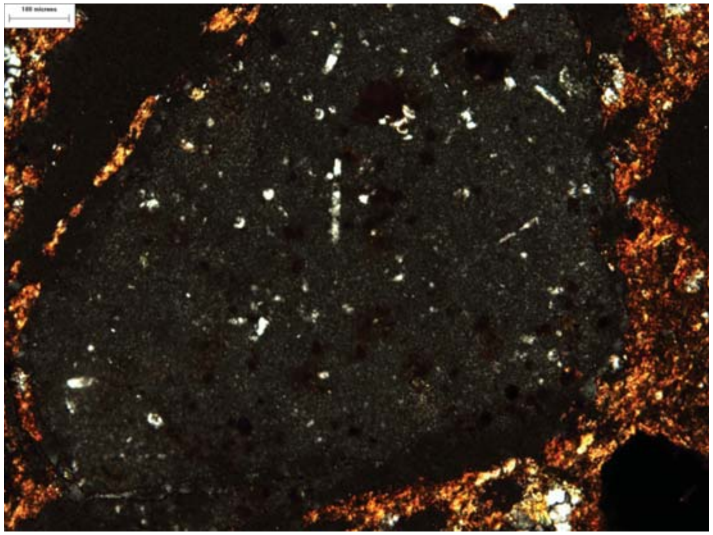

Figure 11.20. A grain of fossileferous limestone, demonstrating non-localness and likely a provenance near Nacozari, FN 819 at 100 x.

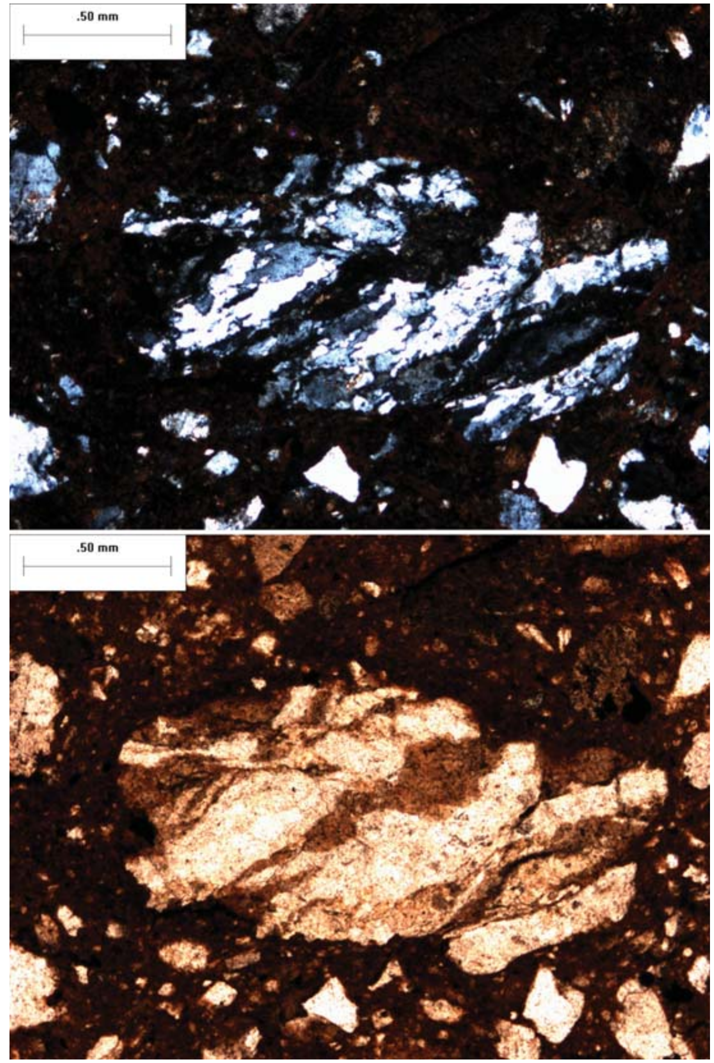

Figure 11.21. A metamorphic, sutured grain, likely of schist, demonstrating non-localness, FN 903.1, at 50 x.

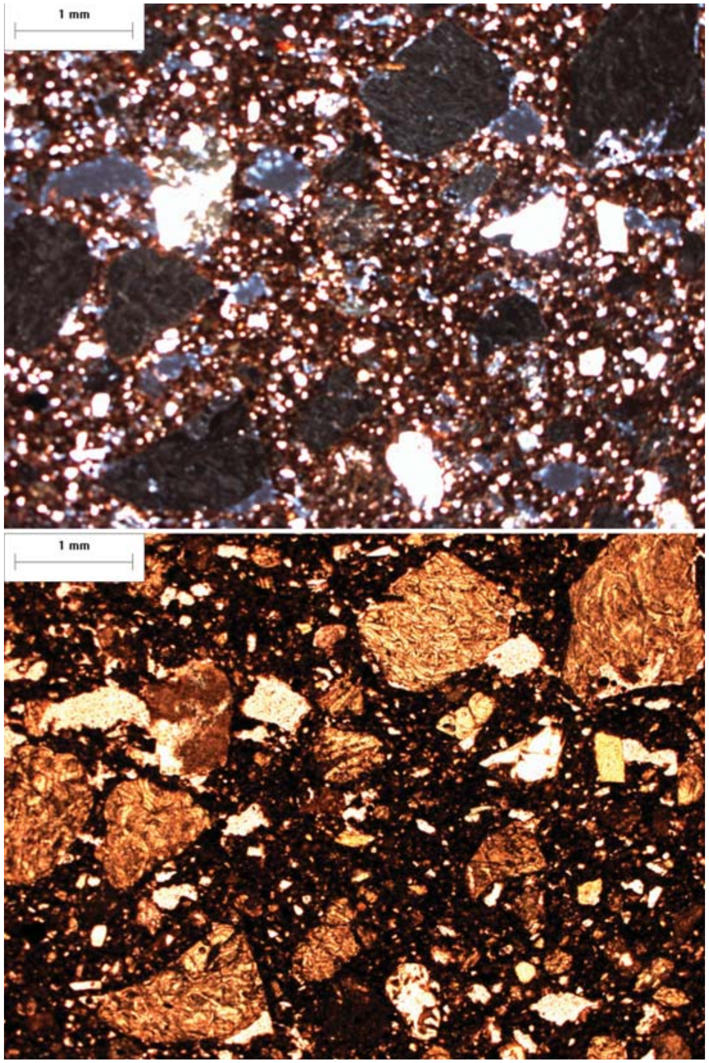

Figure 11.22. Grains of obsidian, demonstrating non-localness with a possible but not absolute provenance near Oputo/Huachinera, top xpl, bottom ppl, FN 110, at 20 x.

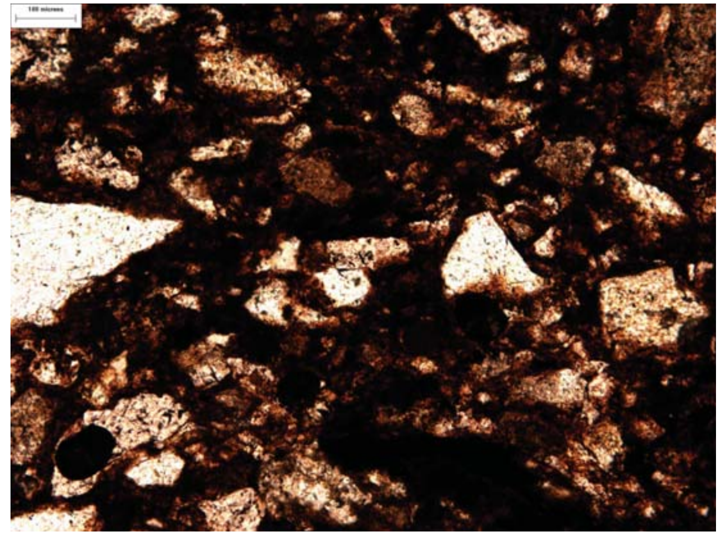

Figure 11.23. Grains of crushed plutonic rock, suggesting alternative manufacturing techniques to local styles. Accessory minerals also appeared different from local granites but were too small for definitive identification, ppl, FN 208, at 100 x.

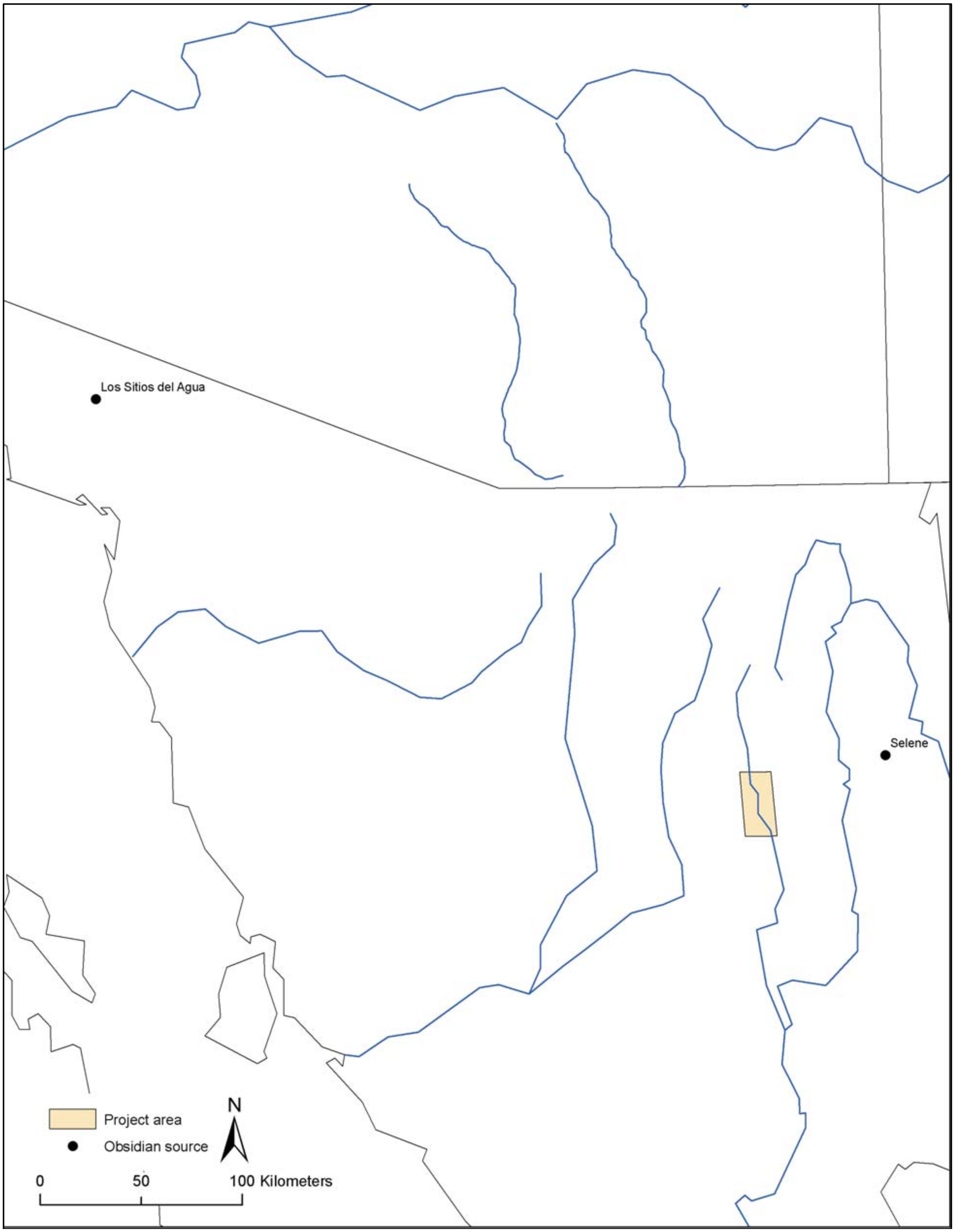

Figure 11.24. Map of known obsidian sources recovered in the project area.

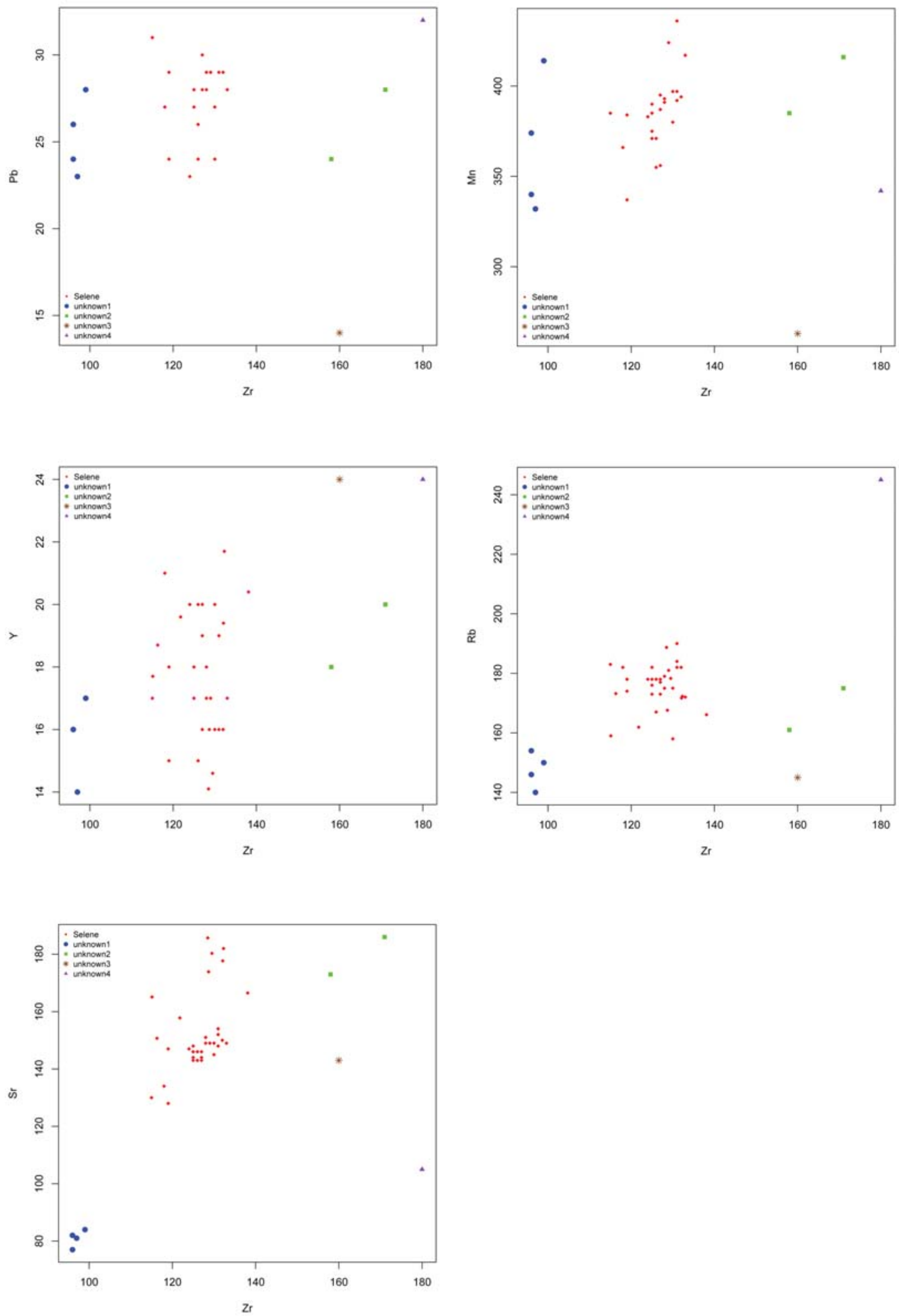

Figure 11.25. Characteristic trace element biplots of the Selene and unknown sources. Note due to variable lab techniques not all element were recorded for all specimens.

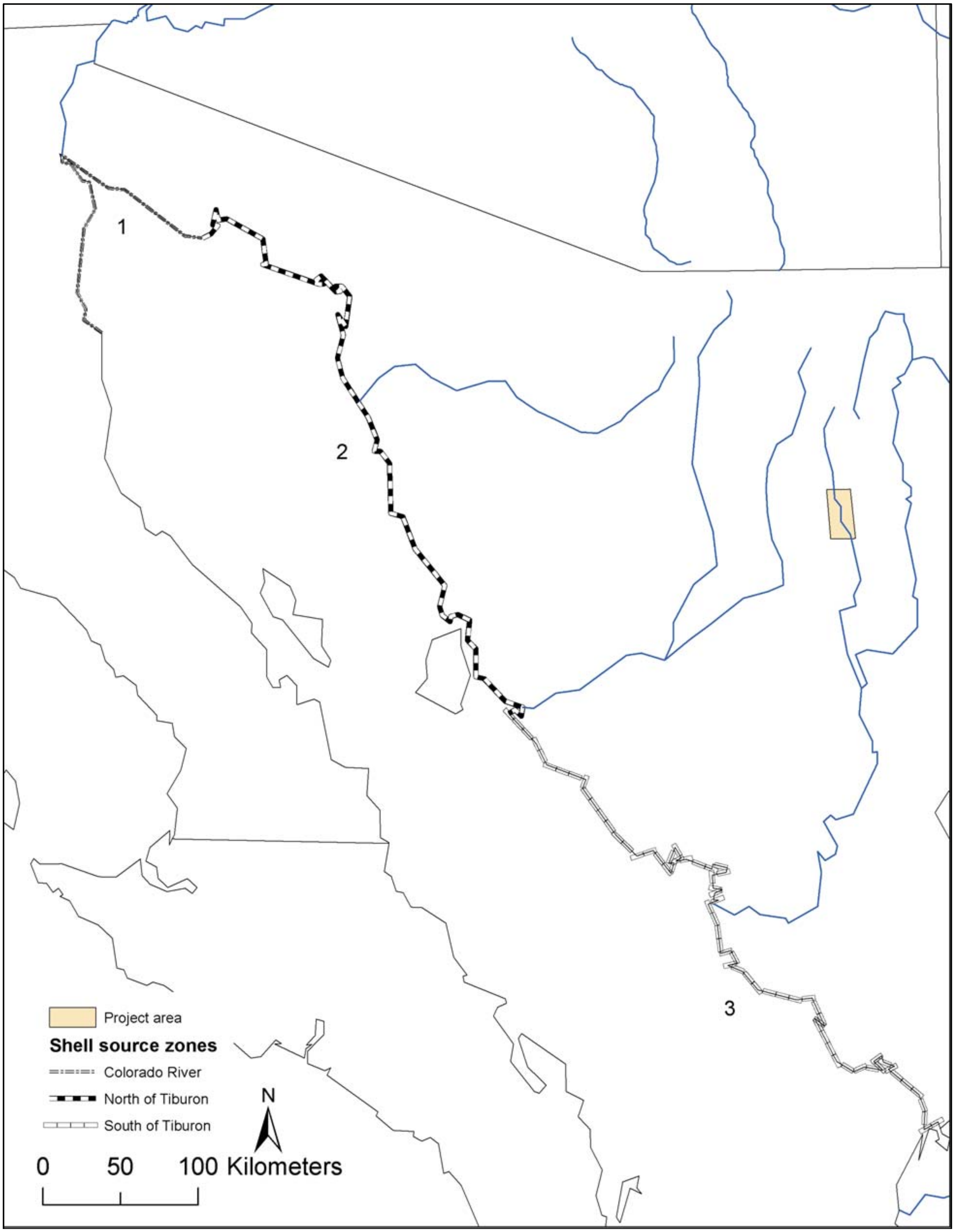

Figure 11.26. Source regions for shell in the Sea of Cortez based on ^{18}O and ^{13}C isotope ratios, after Grimstead et al (2013).

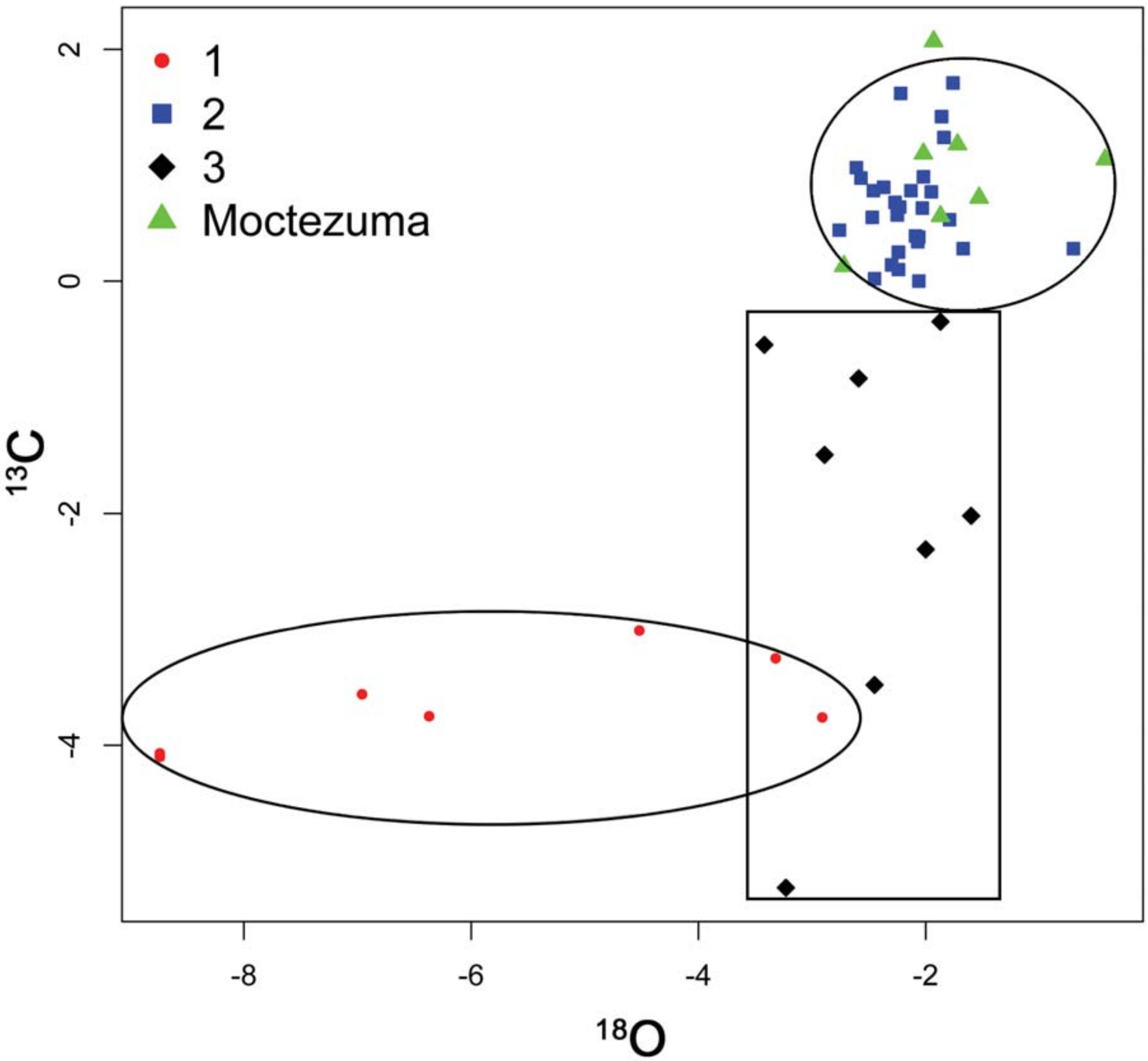

Figure 11.27 ¹⁸O and ¹³C values of baseline samples of modern shell and the Río Moctezuma specimens after (Grimstead et al, 2013). Source 1 is near Colorado River debouch, Source 2 is north of Isla Tiburon, Source 3 is South of Isla Tiburon. All archaeological specimens from Río Moctezuma clearly correspond to Source 2.

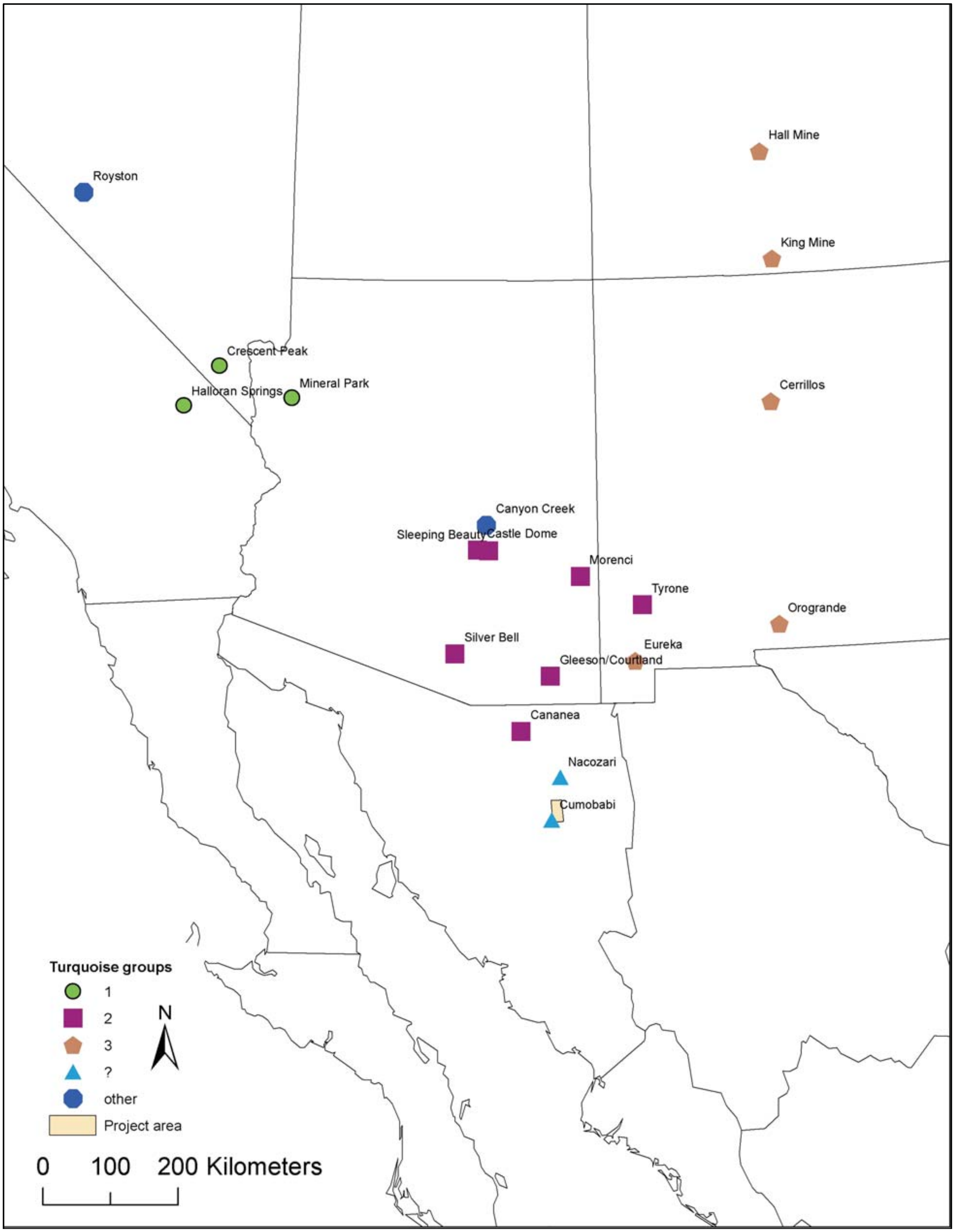

Figure 11.28 Turquoise source regions in the U.S. Southwest/Northwest Mexico, after Thibodeau (2012).

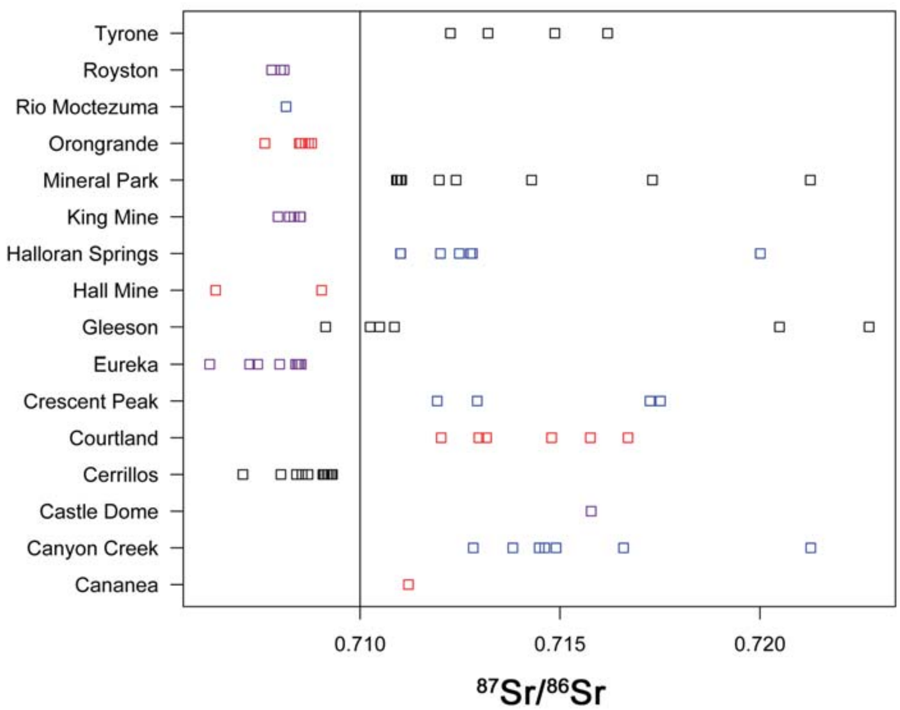

Figure 11.29 Strip plot of Sr values, excluding Sleeping Beauty Mine, which has values in excess of those plotted, after Thibodeau (2012).

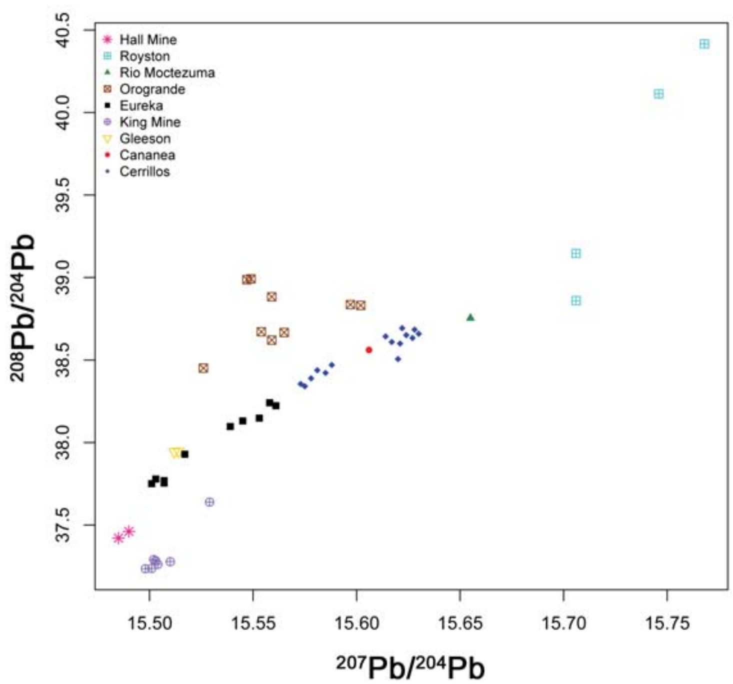

Figure 11.30 Biplot of Pb isotope values of those sources with Sr values below .710 and, for comparative purposes, the Cananea source, after Thibodeau (2012).


Figure 12.1. A river cobble cimiento alignment at Las Clavellinas.


Figure 12.2. A deteriorated structure likely of adobe and river cobbles at Las Clavellinas.

Figure 12.3. The large wall foundation at Las Clavellinas on the edge of the mesa (mostly obscured by vegetation).

Figure 12.4. A river cobble cimiento alignment at La Cuchilla.

Figure 12.5. A structure foundation composed of numerous river cobbles of unknown form and age at La Cuchilla.

Figure 12.6. A likely historic structure of partial masonry at La Galera.

Figure 12.7. A historic adobe wall footer of river cobbles at La Galera.

Figure 12.8. An historic grave at La Galera.

Figure 12.9. A river cobble cimiento alignment at Mesa de La Galera.

Figure 12.10. A cimiento foundation at El Borbollón.

Figure 12.11. A likely historic structure at Badehuachi.

Figure 12.12. A large wall foundation of uncertain age at Badehuachi.

Figure 12.13. A large river cobble cimiento alignment, likely to a compound wall at Jamaica Vieja.

Figure 12.14 A likely historic structure foundation of basalt stones Dos Casas.

Figure 12.15. A river cobble cimiento alignment at Las Peñitas.

Figure 12.16. A river cobble cimiento alignment at La Boca.


Figure 12.17. A river cobble cimiento alignment at Teonadepa.


Figure 12.18. Looting pits at Teonadepa.

Figure 12.19. A likely midden pile composed mostly of fire-altered-rock at Teonadepa.

Figure 12.20. A river cobble cimiento alignment at EL Salto.

Figure 12.21. A mound of likely melted adobe and other construction material at El Salto.

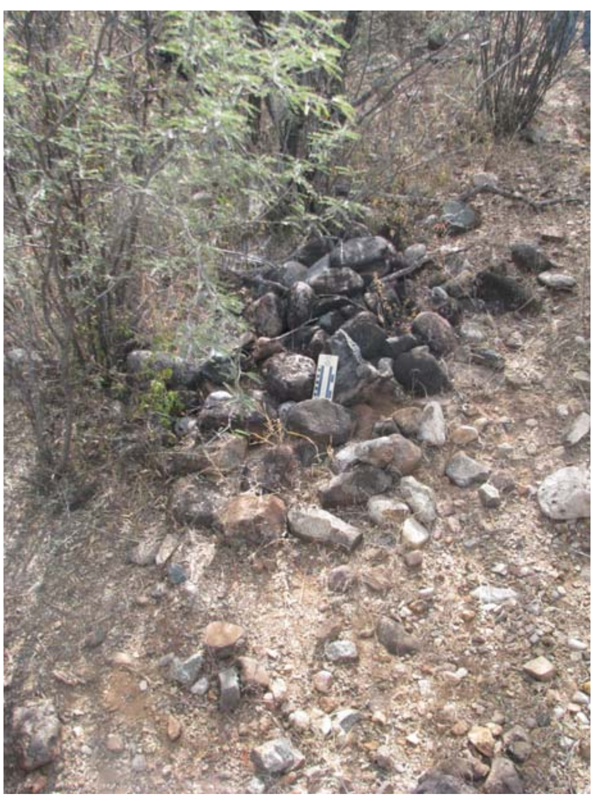

Figure 12.22. A rock pile, possible grave, at Los Alamos.

Figure 12.23. Basalt cobble cimientos in alignment at El Nogal. A broken metate is also visible.

Figure 12.24. A piled stone wall of possible prehispanic age at El Nogal.

Figure 12.25. A very well preserved rive cobble cimiento outline at Tebisco.

Figure 12.26. A well preserved double row river cobble cimiento alignment at Los Mineros.

Figure 12.27. A deflated roasting pit at Los Mineros.

Figure 12.28. An alignment of river cobble cimiento stones of La Pitahaya.

Figure 12.29. A large river cobble cimiento alignment, likely to a compound wall at Jecori.

Figure 12.30. A mound of likely melted adobe at Jecori.

Figure 12.31. The largest historic structure at La Platería.


Figure 12.32. Melted historic, adobe-brick, structure at Los Argüelles.


Figure 12.33. A double row alignment of river cobble cimientos at Los Argüelles.

Figure 12.34. Otherwise optimal mesa land in at La Junta except for a lack of arable land.

Figure 12.35. A sample of the ubiquitous volcanic lithics at Las Bagotas.

Figure12.36 The bajada lands of Las Bagotas.

Figure 12.37. A double row river cobble cimiento foundation at La Volanta.

Figure 12.38. A foundation of large river cobbles, likely stacked several courses high at La Volanta.

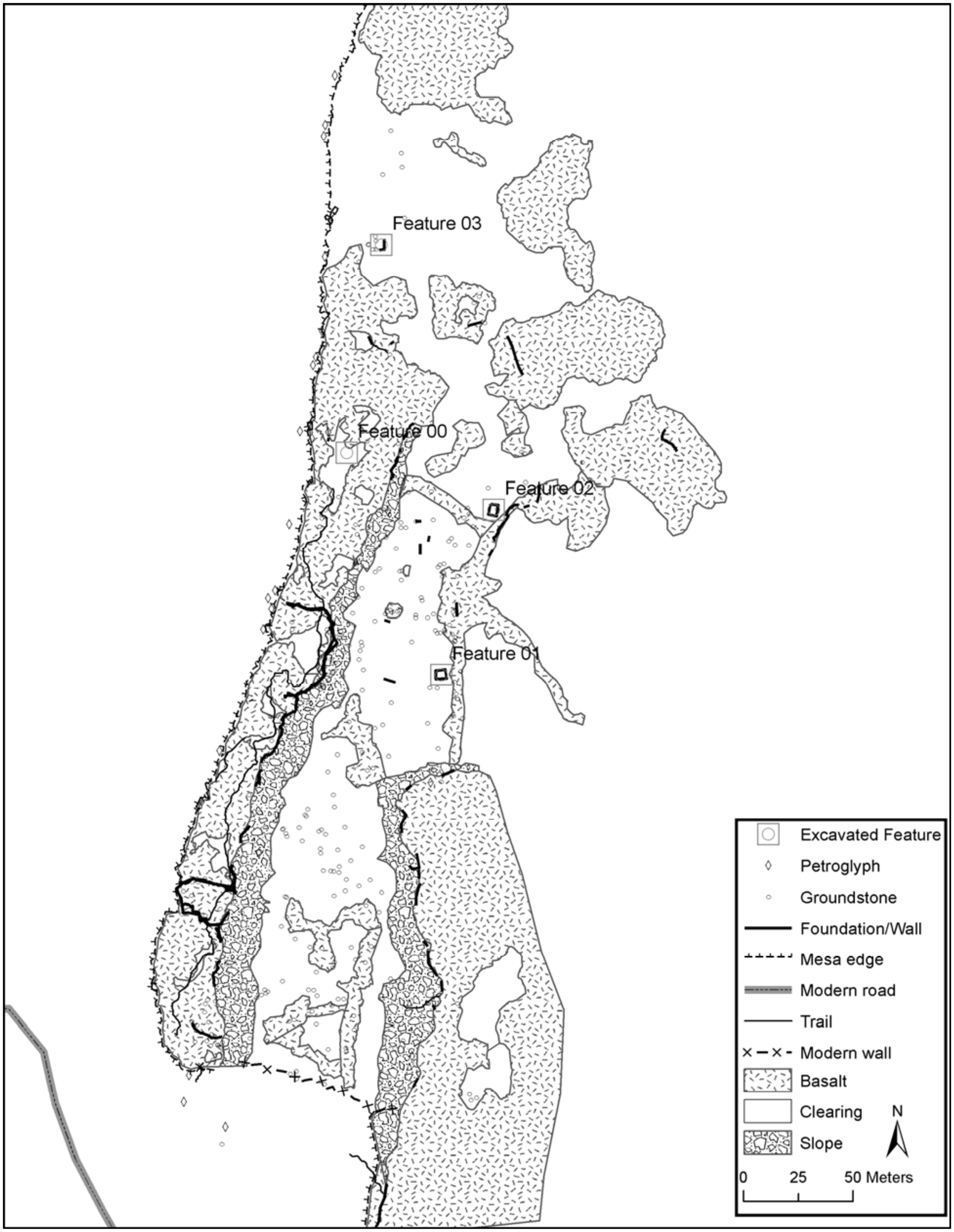

Figure 13.1. Site map of El Nogal with feature locations noted.

Figure 13.2. Plan map of Feature 1.

Figure 13.3. Overview of Feature 1, post excavation.

Figure 13.4. Profile photo of Feature 1, note thin layer of adobe melt at surface.

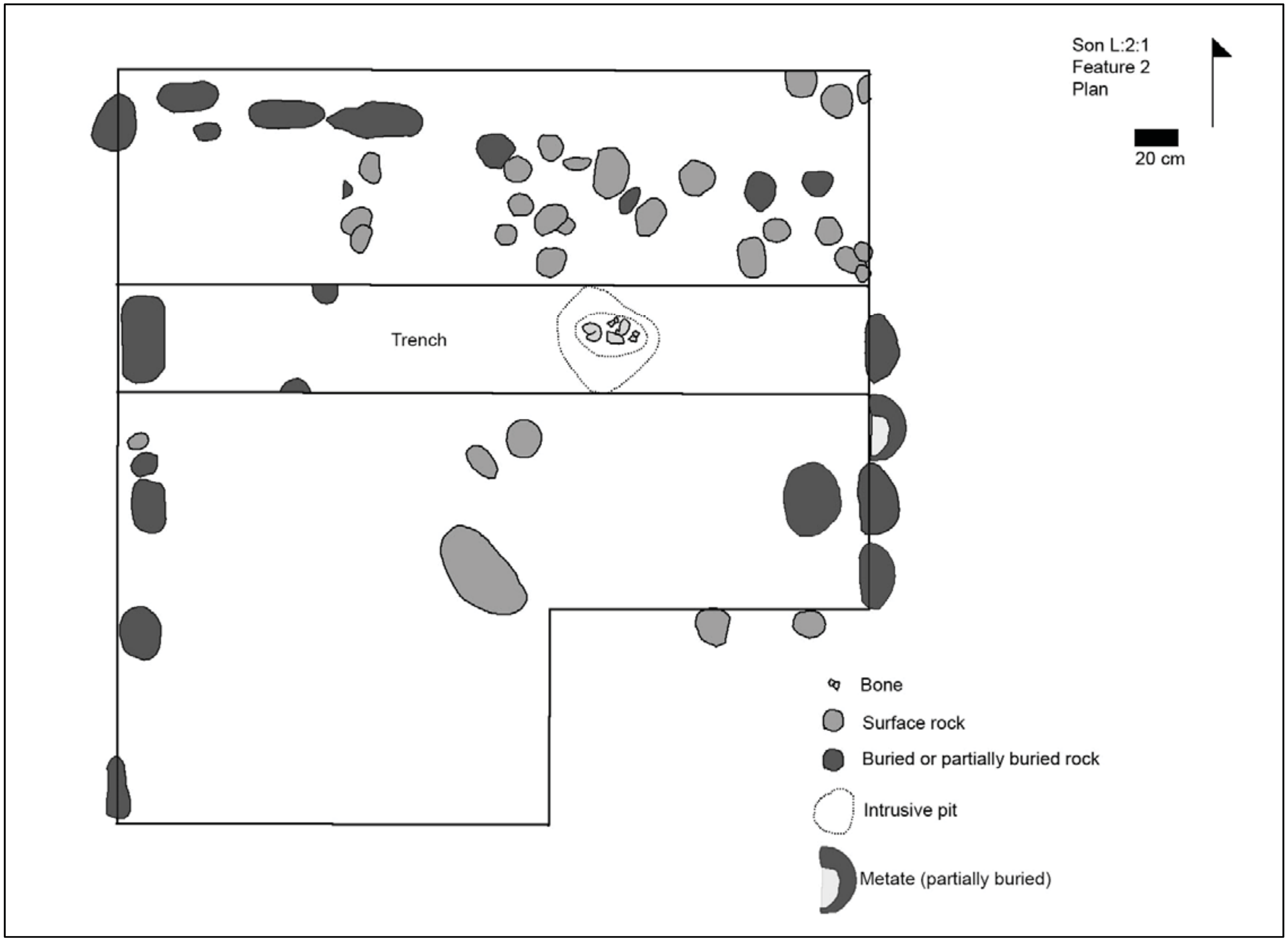

Figure 13.5. Plan map of Feature 2.

Figure 13.6. Overview of Feature 2, post excavation.

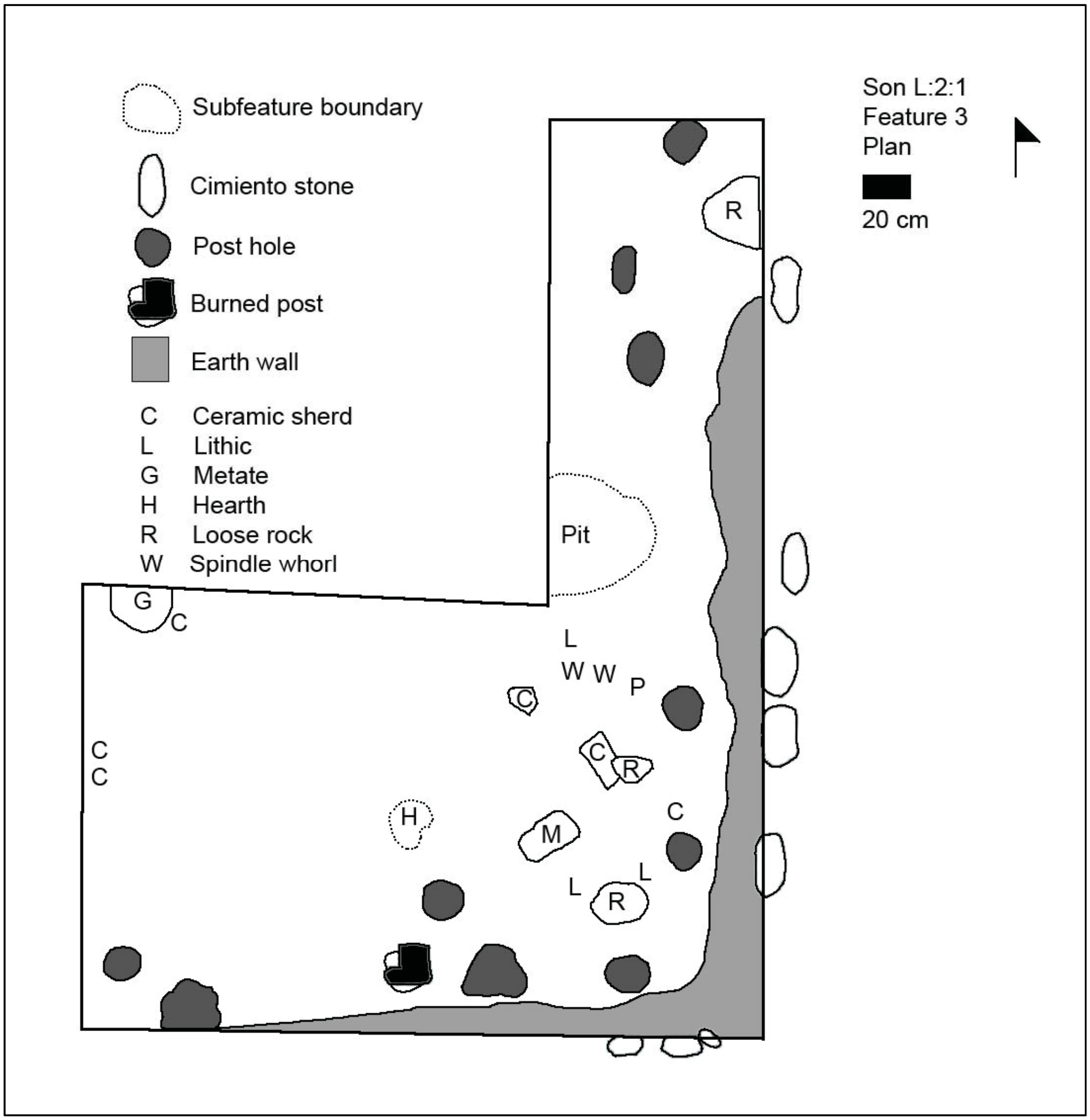

Figure 13.7. Plan map of Feature 3.

Figure 13.8. Overview of Feature 3, post excavation, note white lines added to demarcate edge of excavation units.

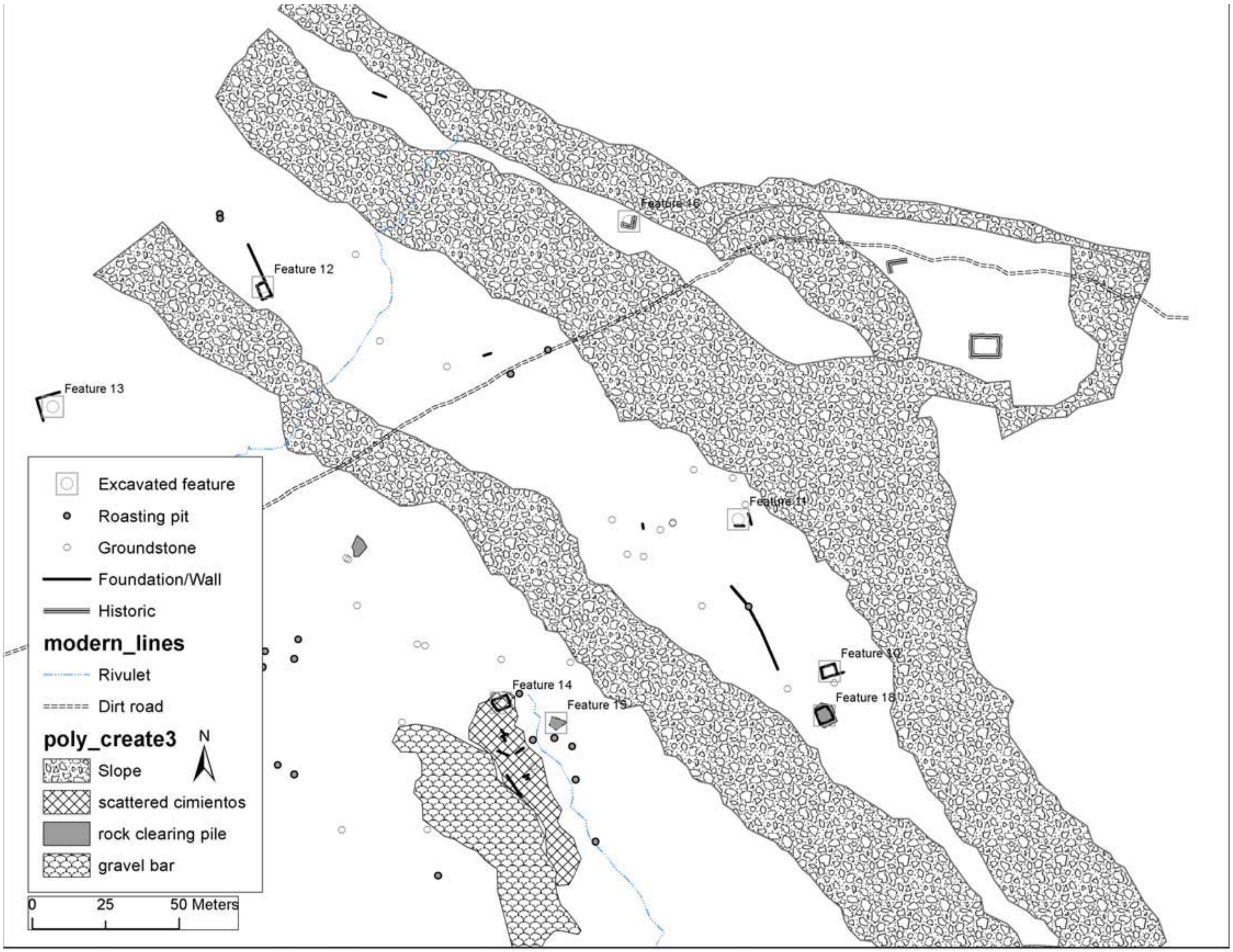

Figure 13.9 Site map of Los Mineros (Son L:2:22) with feature locations noted.

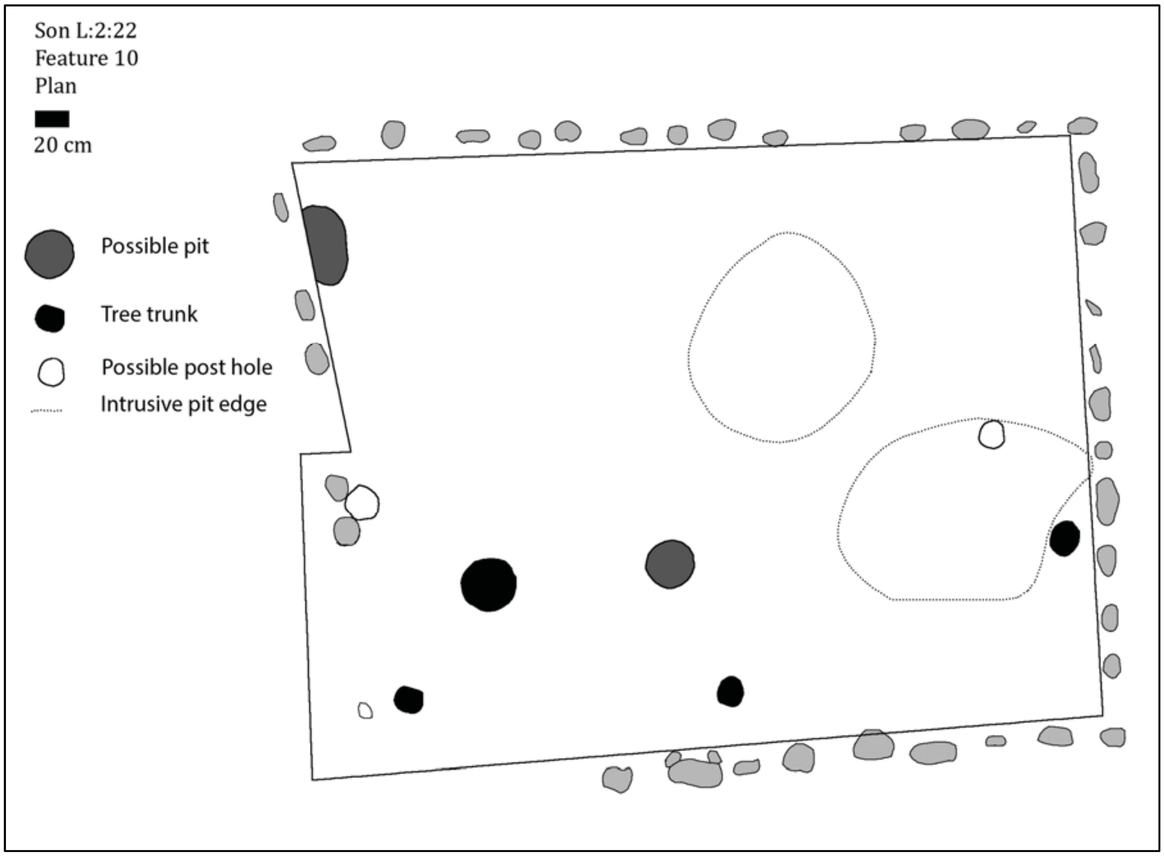

Figure 13.10. Plan map of Feature 10.

Figure 13.11. Overview of Feature 10, post excavation.

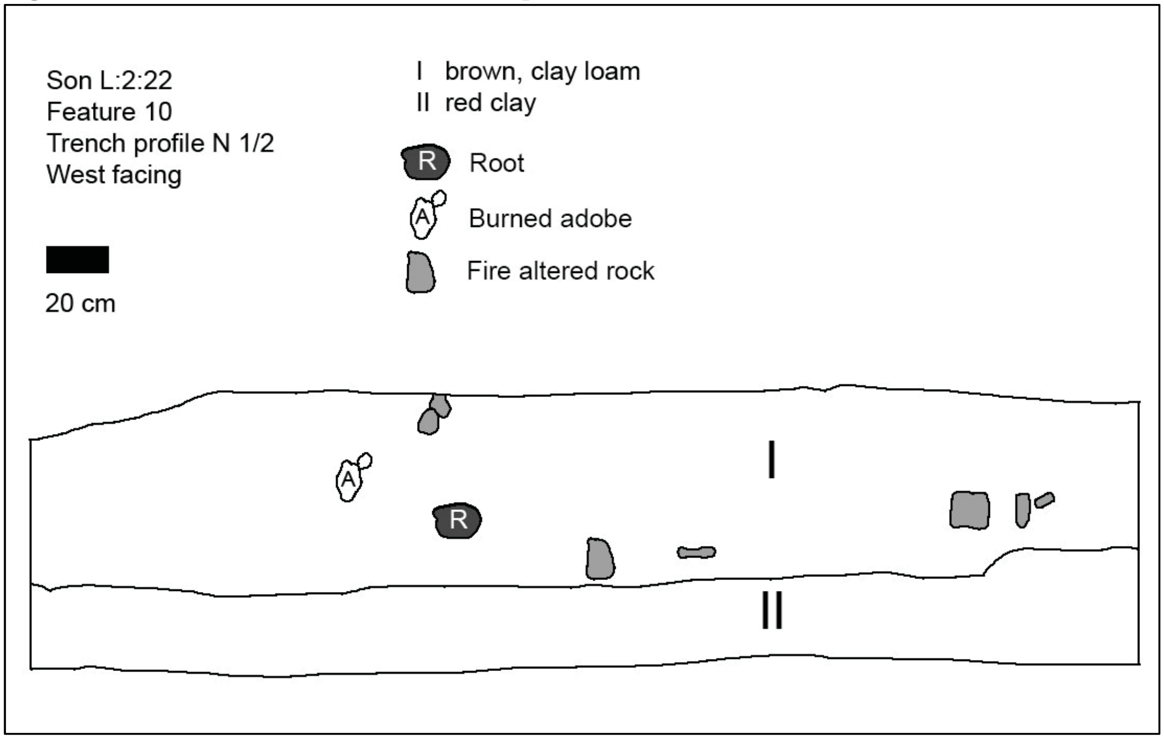

Figure 13.12. Profile of Feature 10 deposits.

Figure 13.13. Burned jacal with impressions recovered from the floor of Feature 10.

Figure 13.14. Intrusive roasting pit in Feature 10.

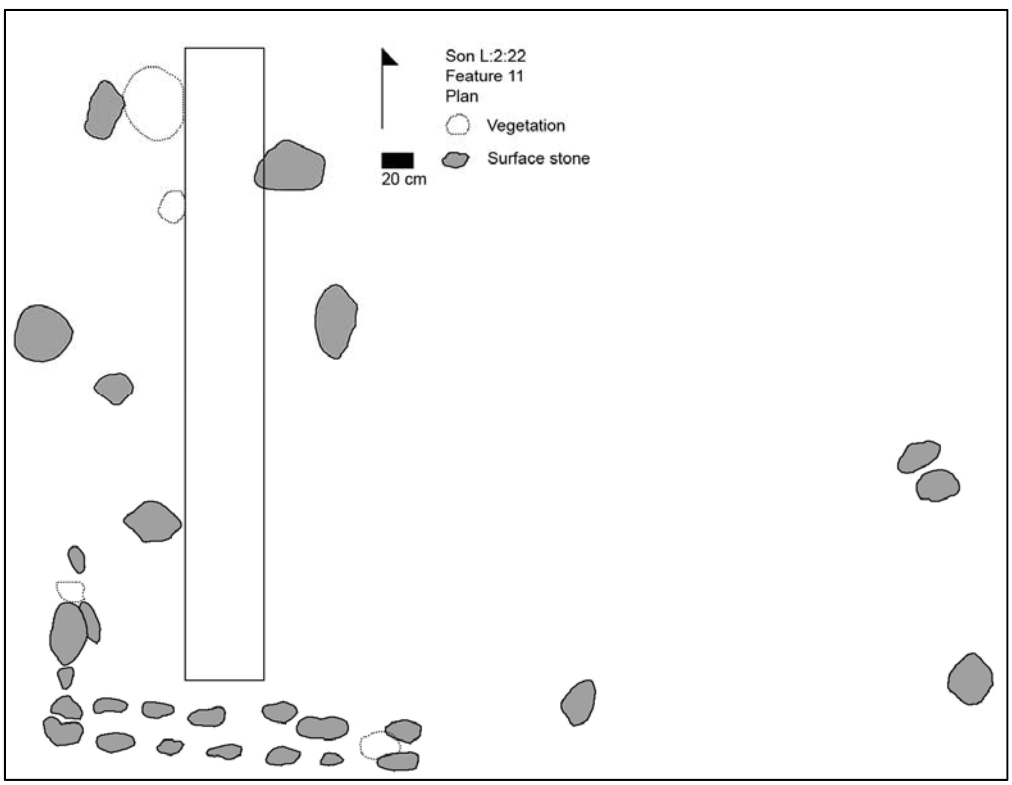

Figure 13.15. Plan map of Feature 11 river cobble cimientos and test trench.

Figure 13.16. Overview of test –trench excavation showing large amounts of fire altered rock present throughout the ashy fill.

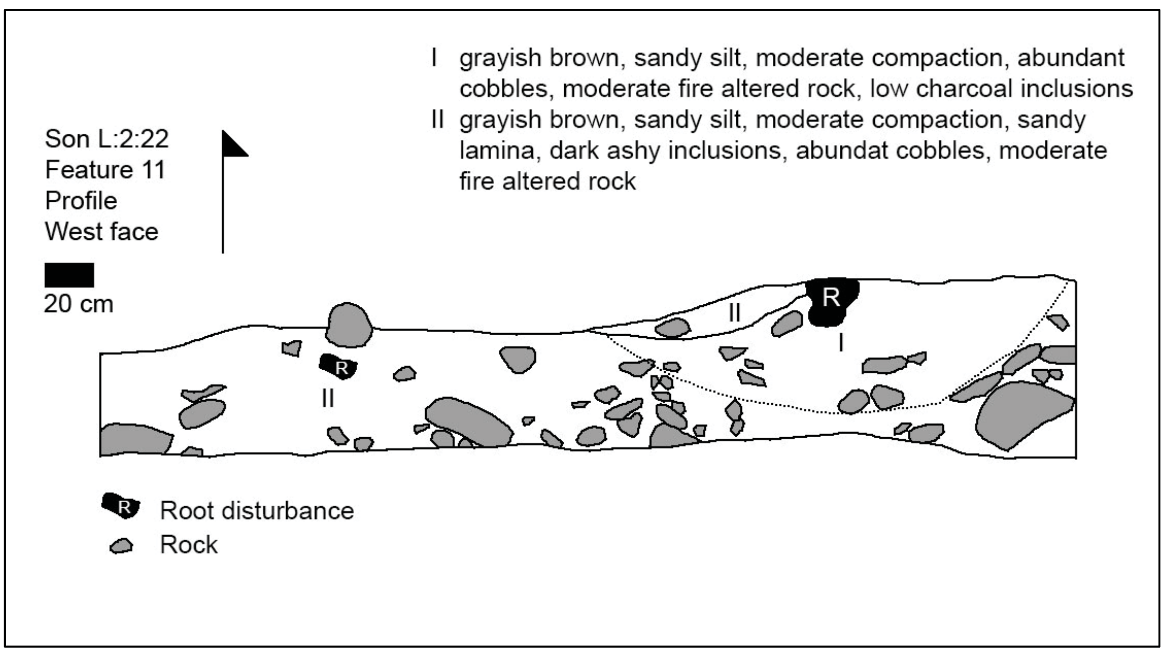

Figure 13.17. Profile of the Feature 11 test trench.

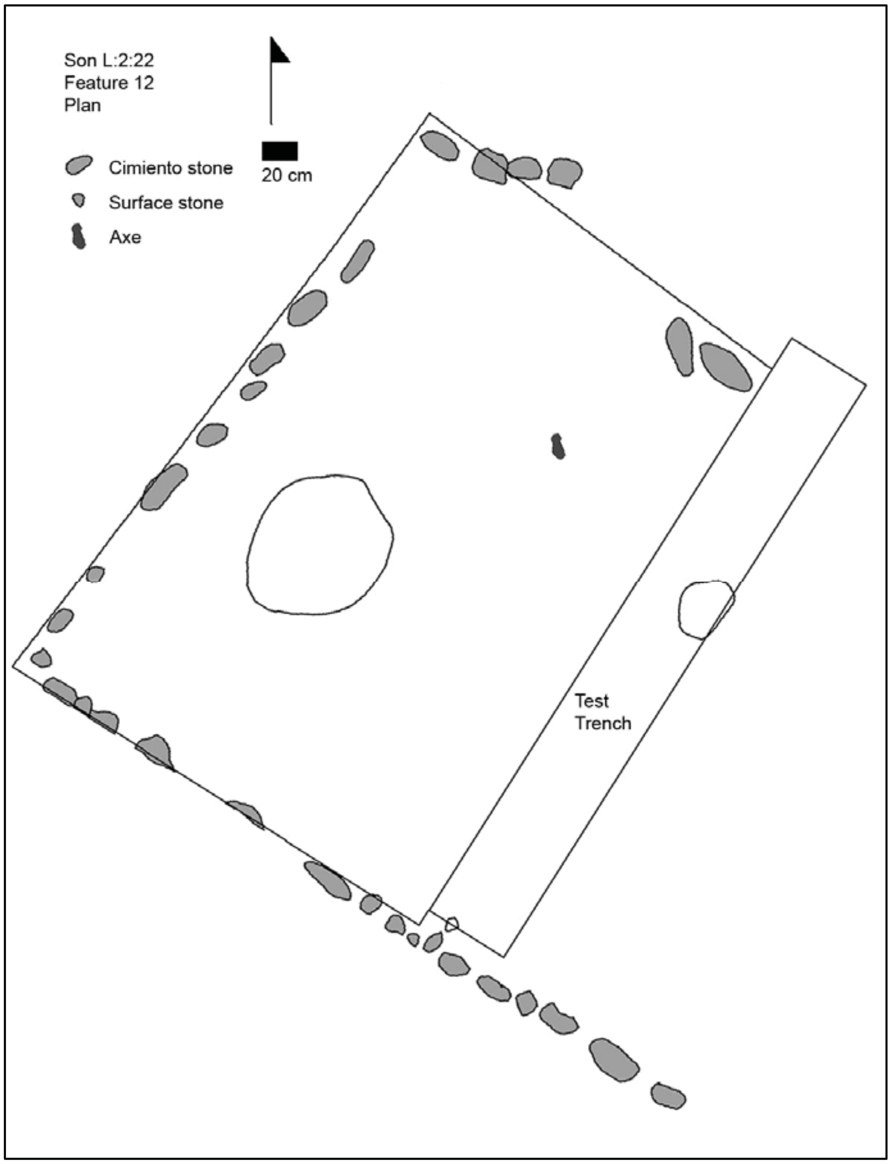

Figure 13.18. Plan map of the excavated room of Feature 12.

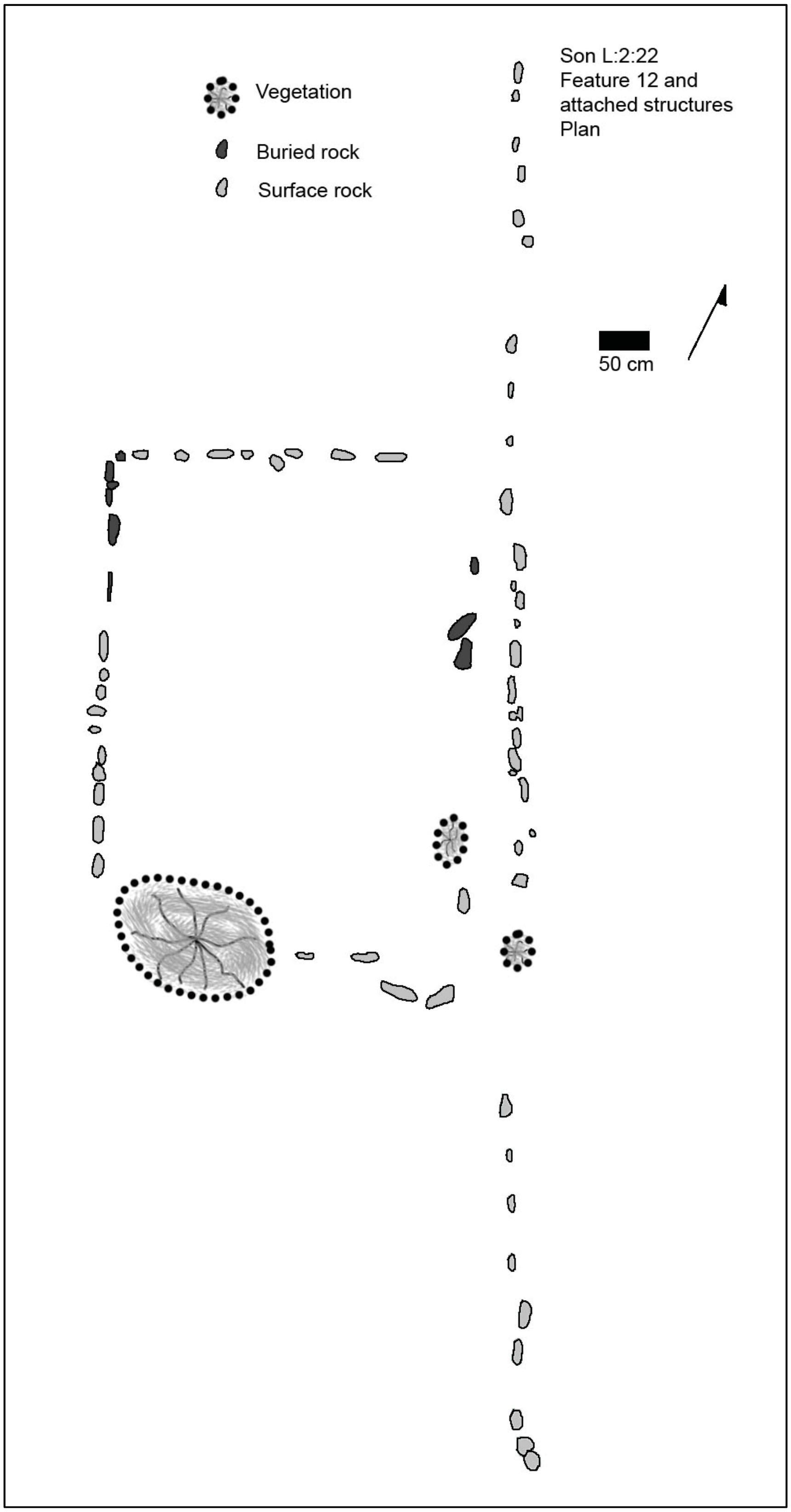

Figure 13.19. Plan map of the larger contiguous visible river cobble cimiento stones.

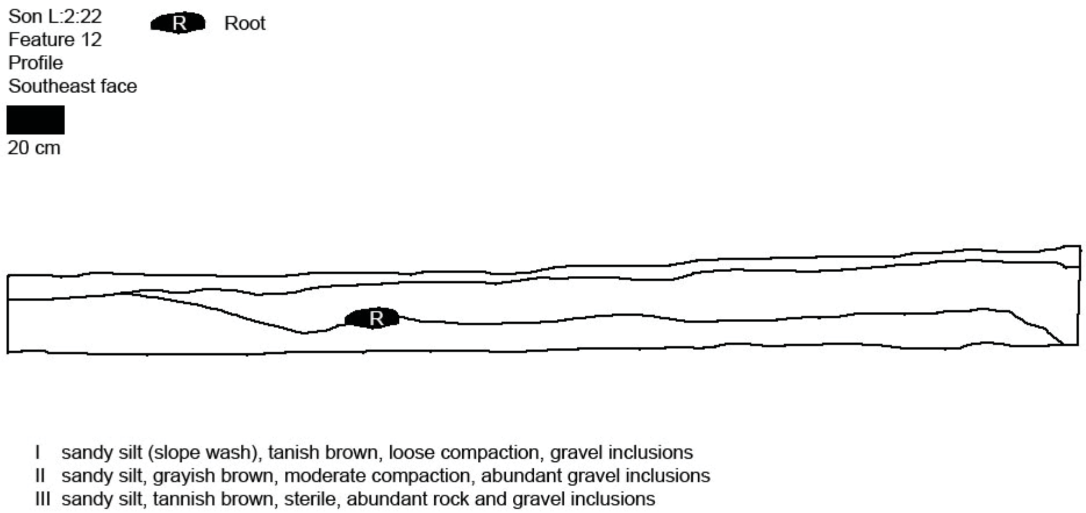

Figure 13.20. Profile of the test trench through Feature 12.

Figure 13.21. Overview of Feature 12, post excavation, note the ¾ grooved axe on the floor and large size of cimiento stones.

Figure 13.22. Overview of the 1 by 1 excavated in Feature 17.

Figure 13.23. Overview of test trench placed through Feature 13.

Figure 13.24. Overview of Feature 14, post excavation, note cimiento stones to right.

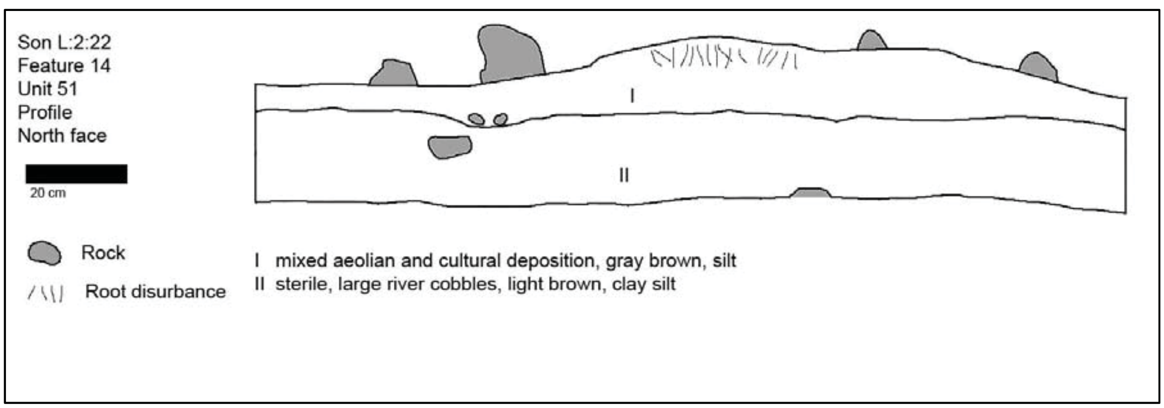

Figure 13.25. Profile of Feature 14.

Figure 13.26. Overview of Feature 15, post excavation.

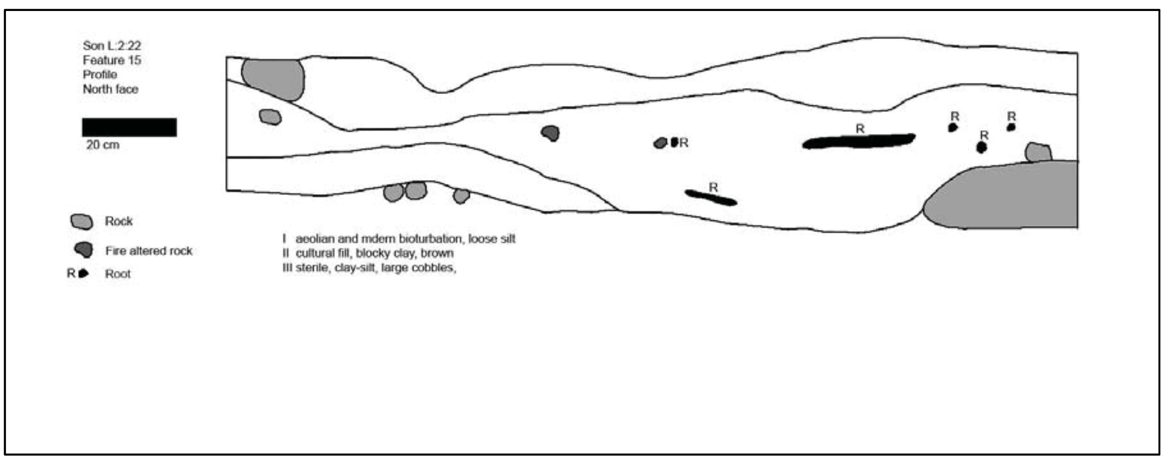

Figure 13.27. Profile of Feature 15.

Figure 13.28. Overview of Feature 16, post excavation.

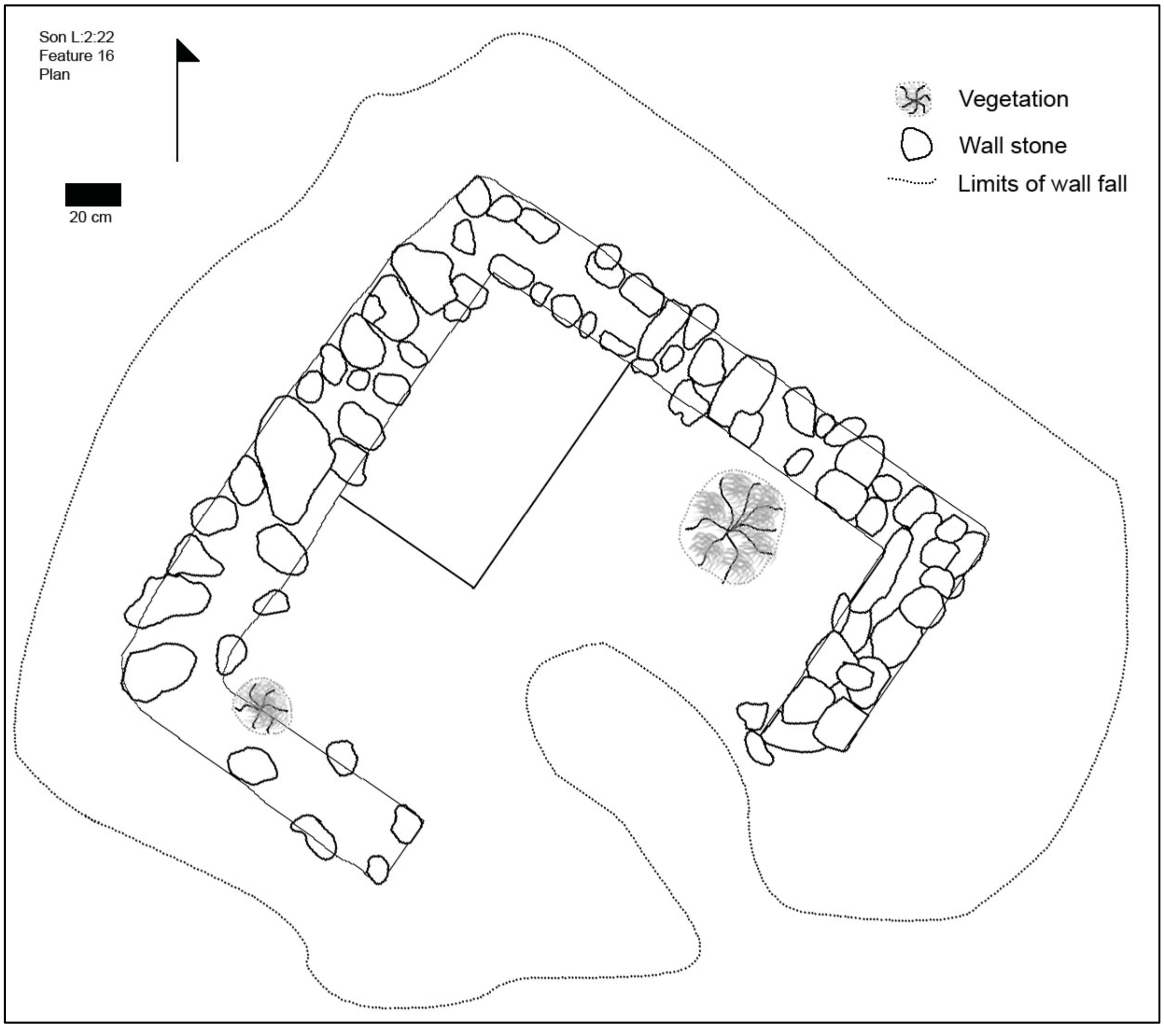

Figure 13.29. Plan map of Feature 16.

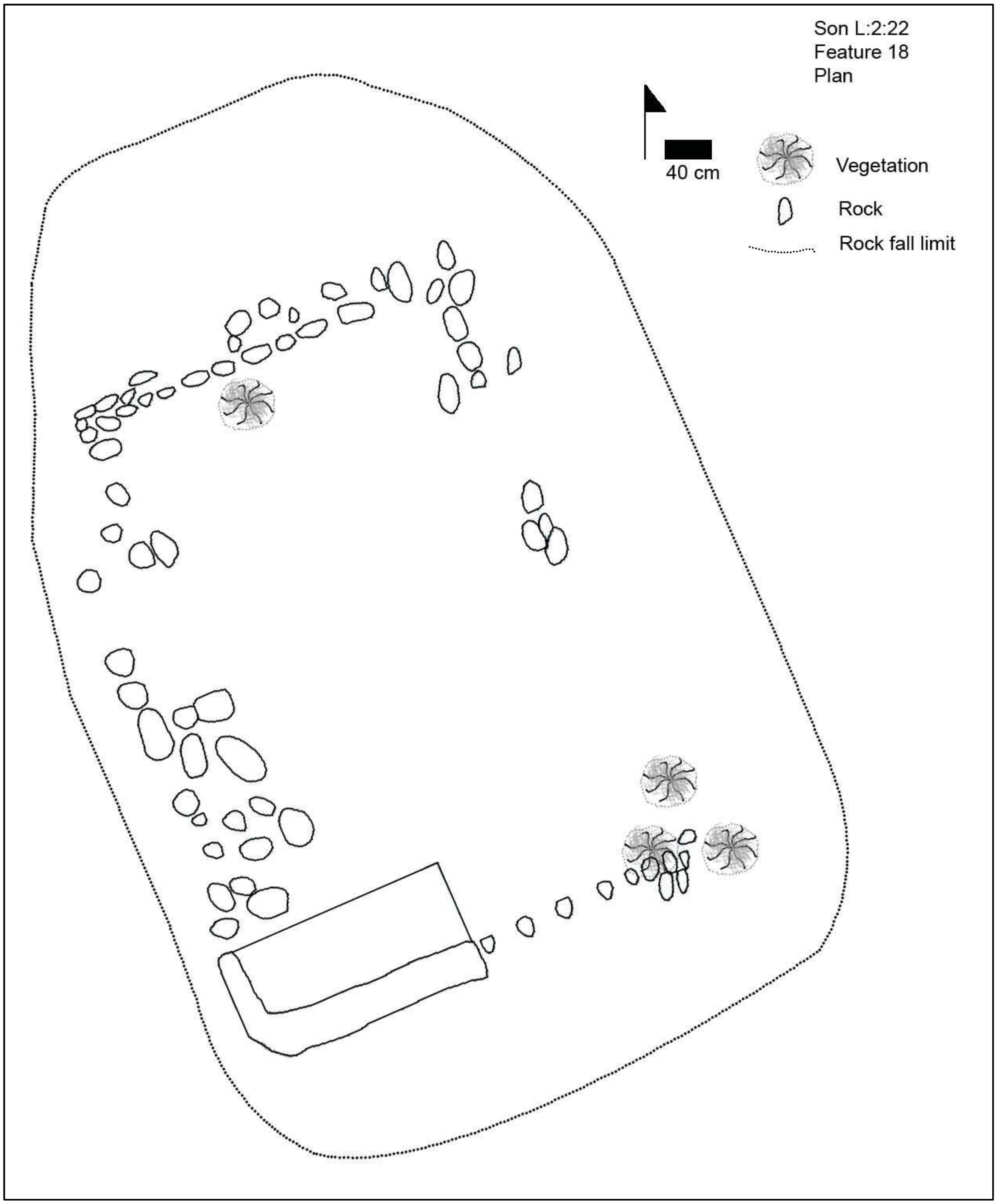

Figure 13.30. Plan map of Feature 18

Figure 13.31. Coursed masonry wall of Feature 18.

Figure 13.32. Overview of excavation in Feature 18, note sunken nature of floor relative to west (right) wall.

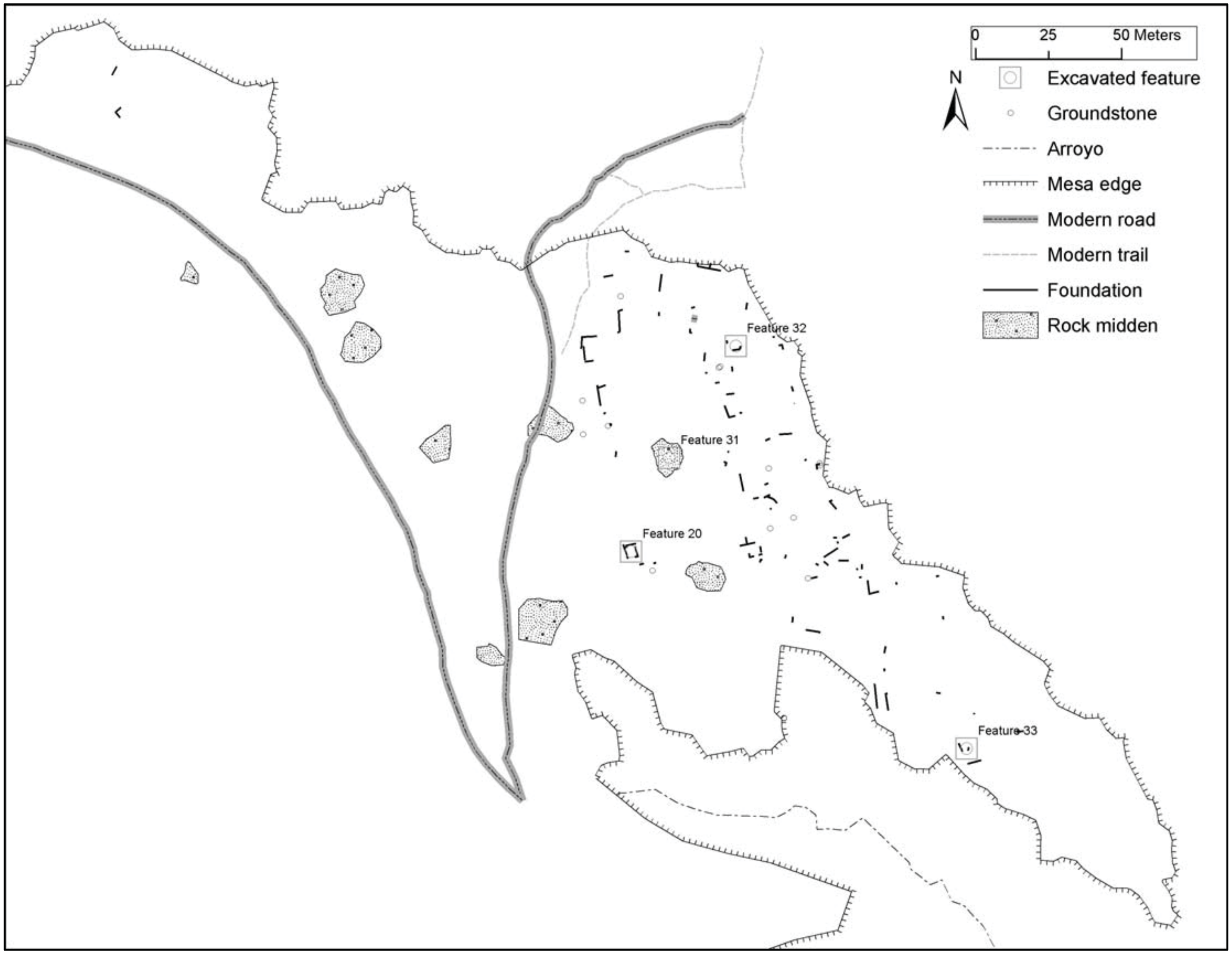

Figure 13.33. Site map of Teonadepa (Son L:1:23) with feature locations noted.

Figure 13.34. Overview of Feature 20, post excavation.

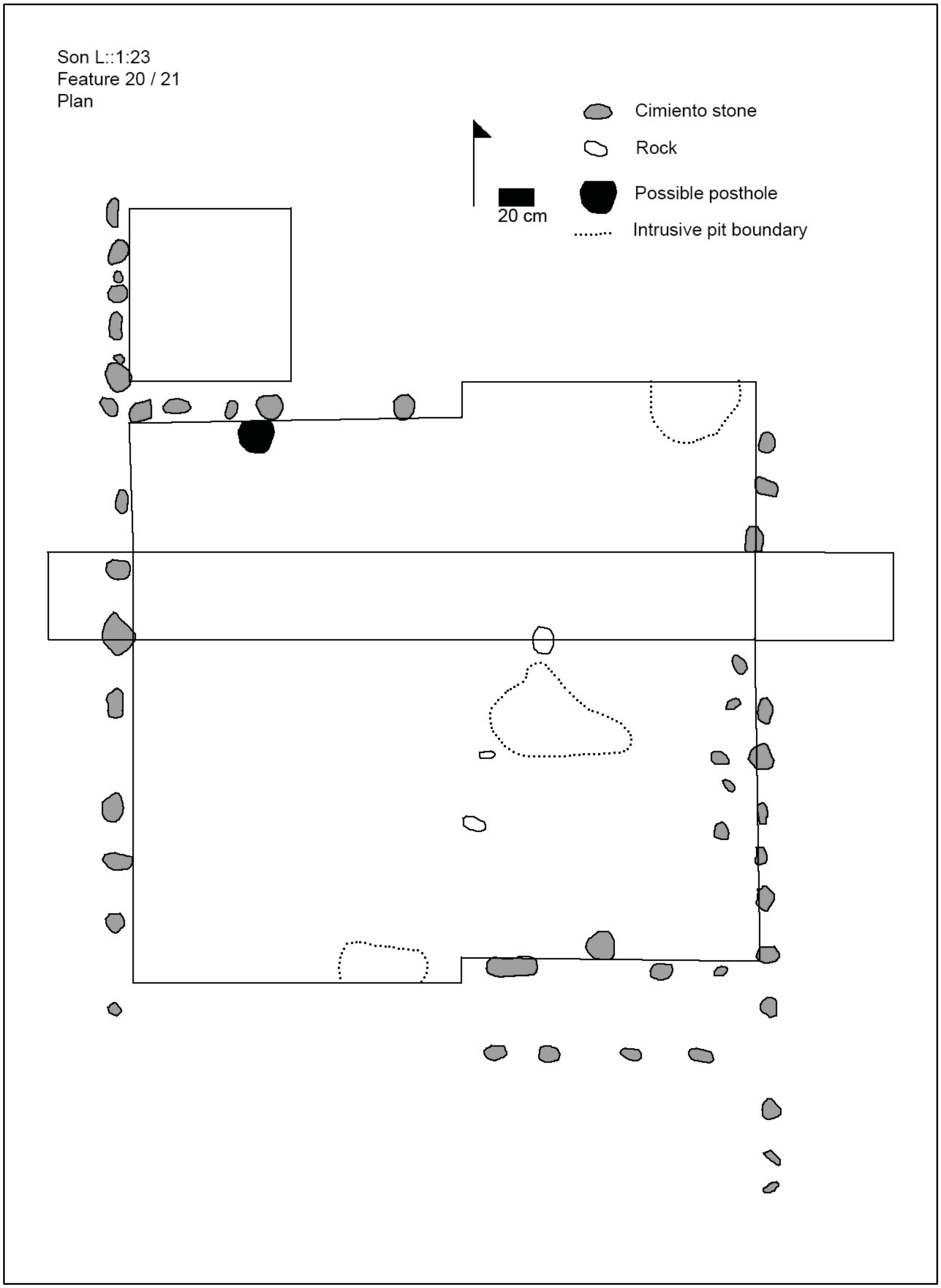

Figure 13.35. Plan map of excavation in Feature 20.

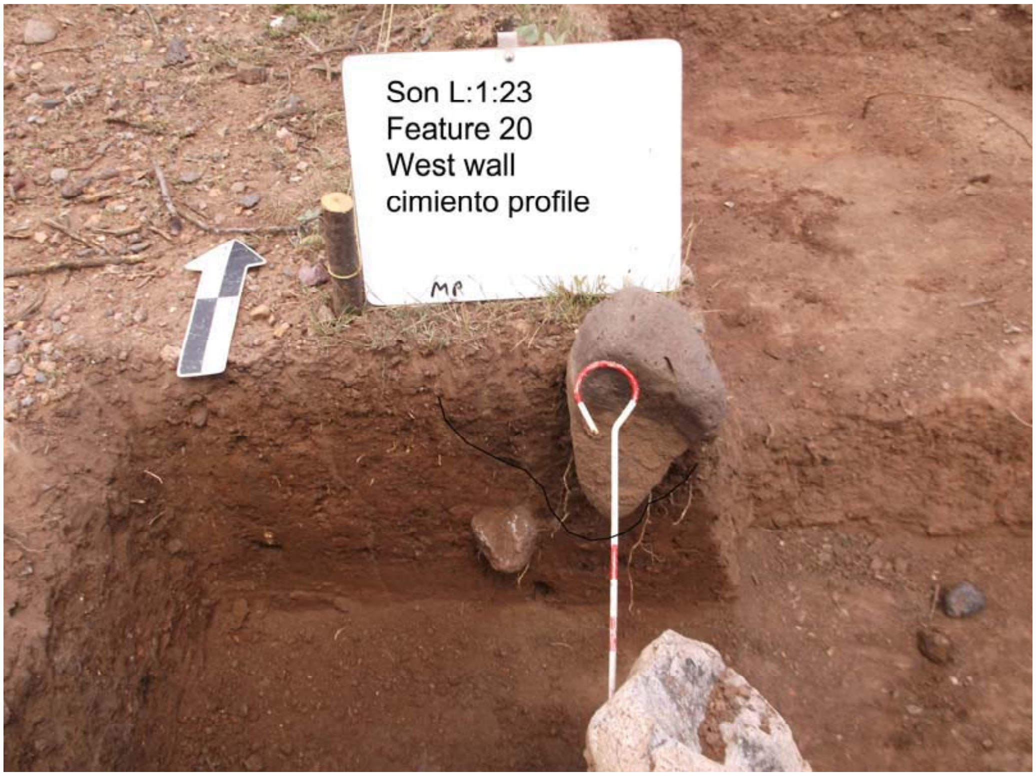

Figure 13.36. Profile of cimiento stone with wall trench demarcated.

Figure 13.37. Rocks recovered from the fill of Feature 31.

Figure 13.38. Profile photo of excavation in Feature 31.

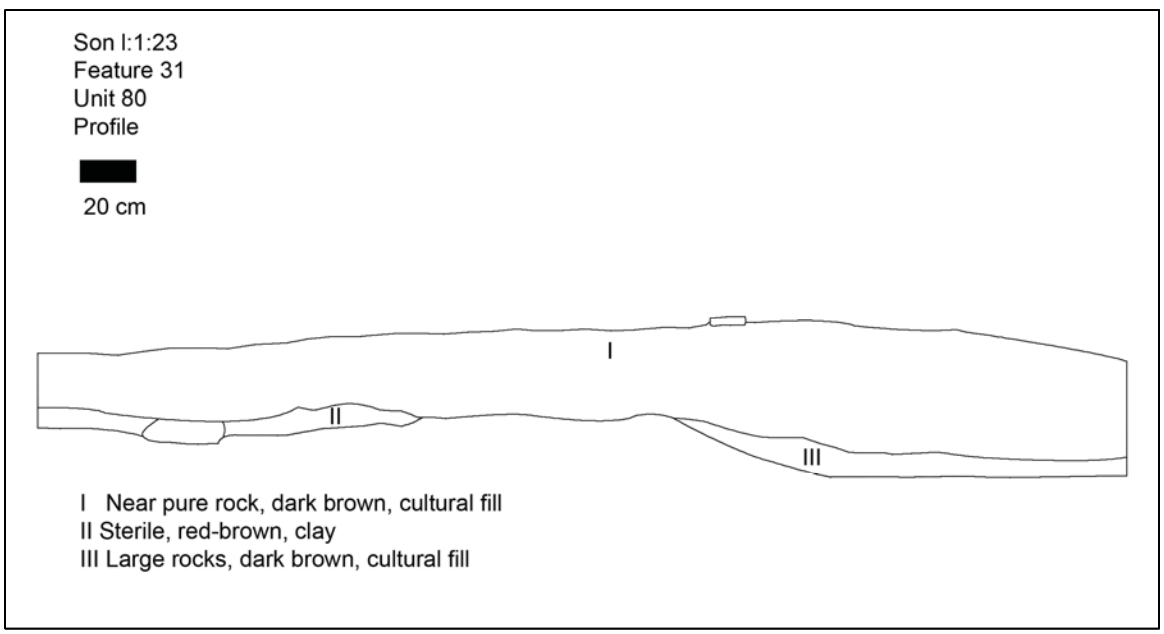

Figure 13.39. Profile of excavation in Feature 31.

Figure 13.40. Overview of Feature 32, post excavation.

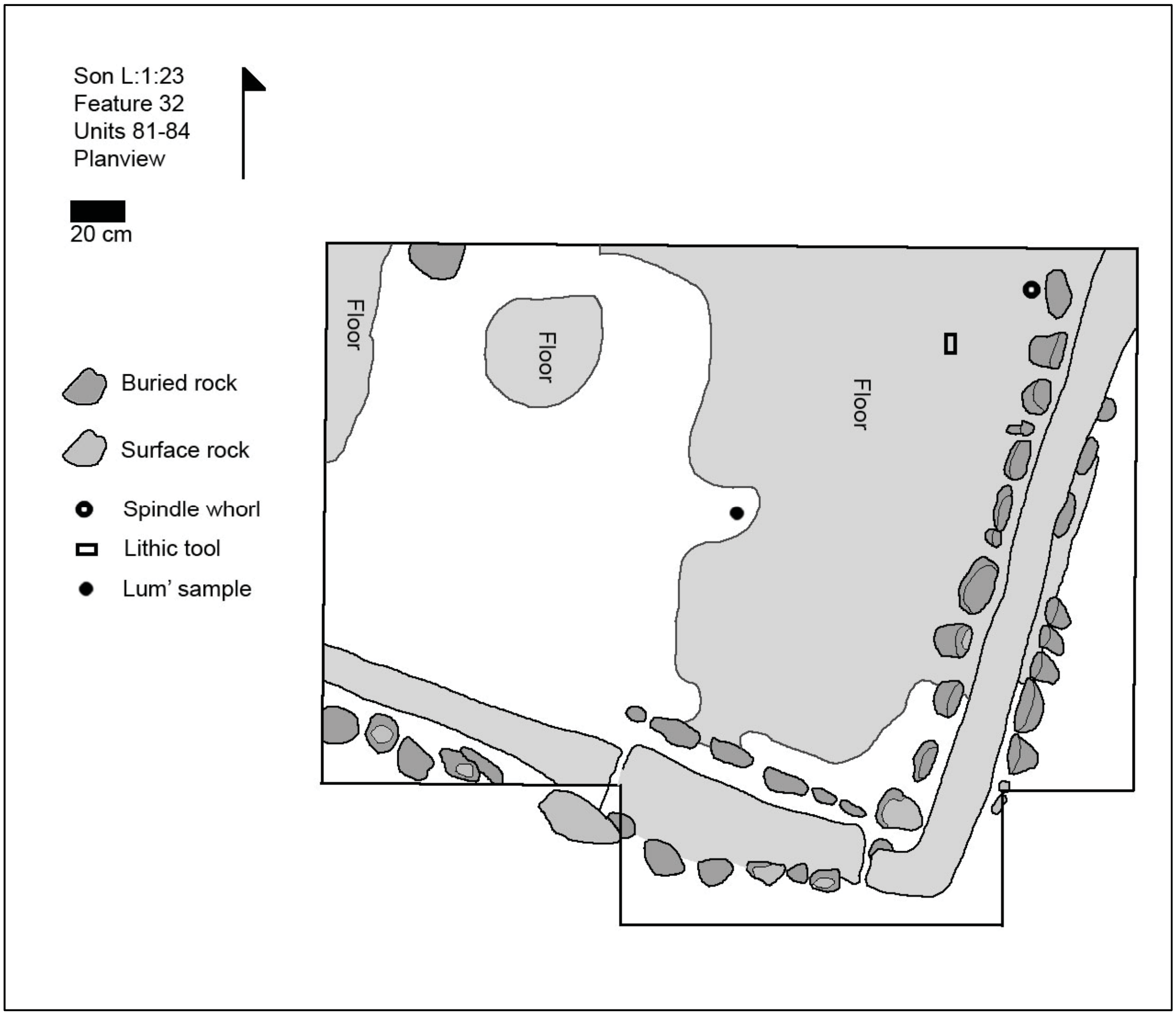

Figure 13.41. Plan map of excavation in Feature 32.

Figure 13.42. Low angle view of walls, note multicolored adobe courses, wall abutments, and possible repair/remodeling (wall at top).

Figure 13.43. Overview of Feature 33, post excavation.

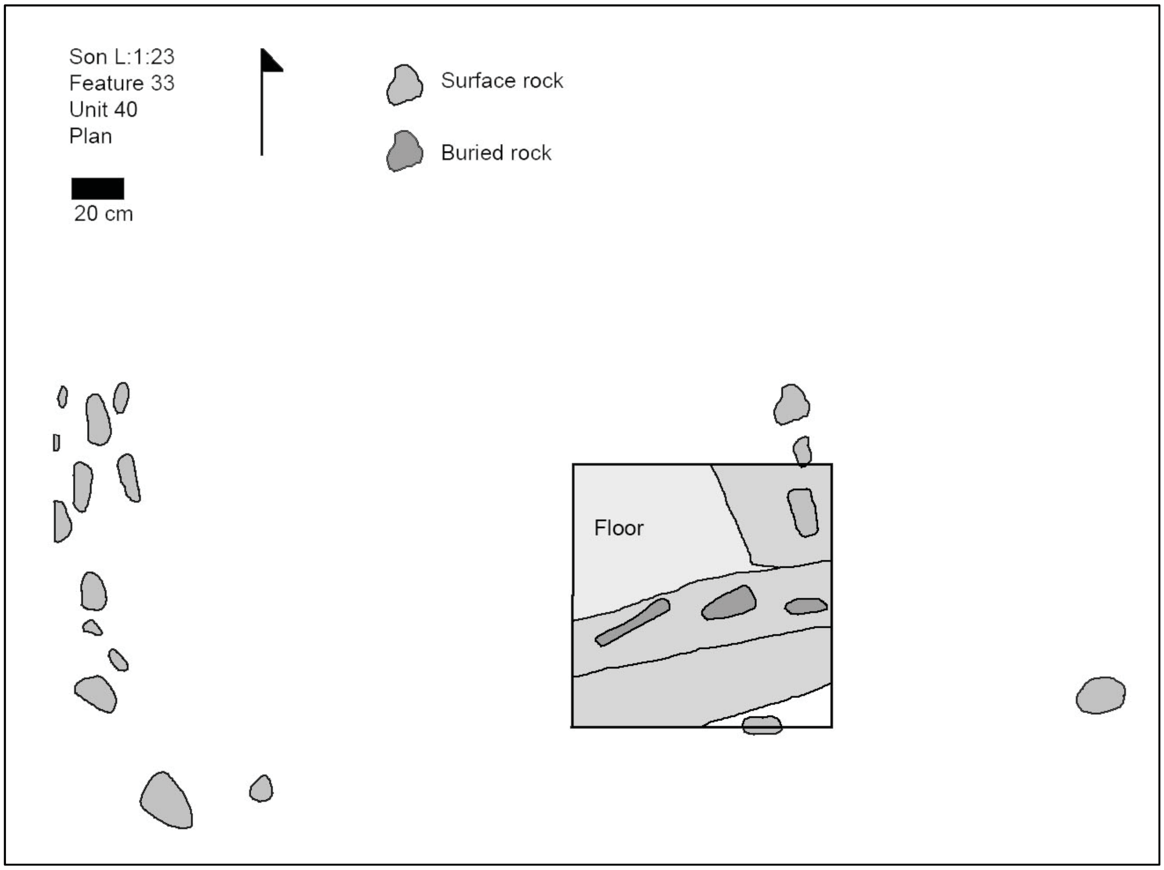

Figure 13.44. Plan map of Feature 33.

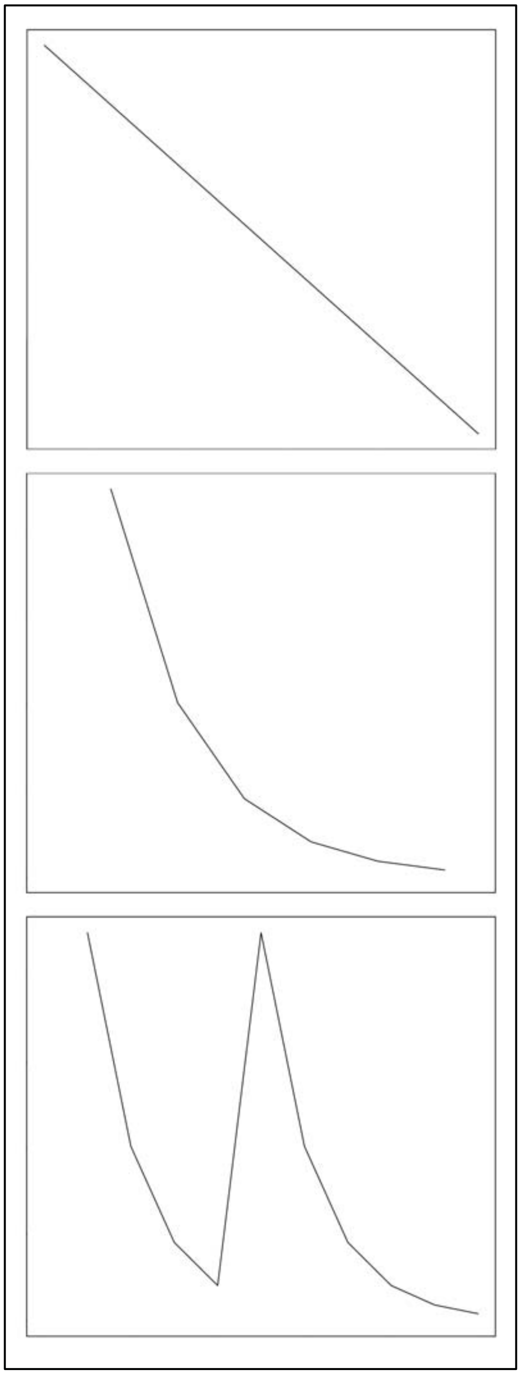

Figure 14.1. Ideal distributions: top, linear; middle, exponential; bottom, multimodal.

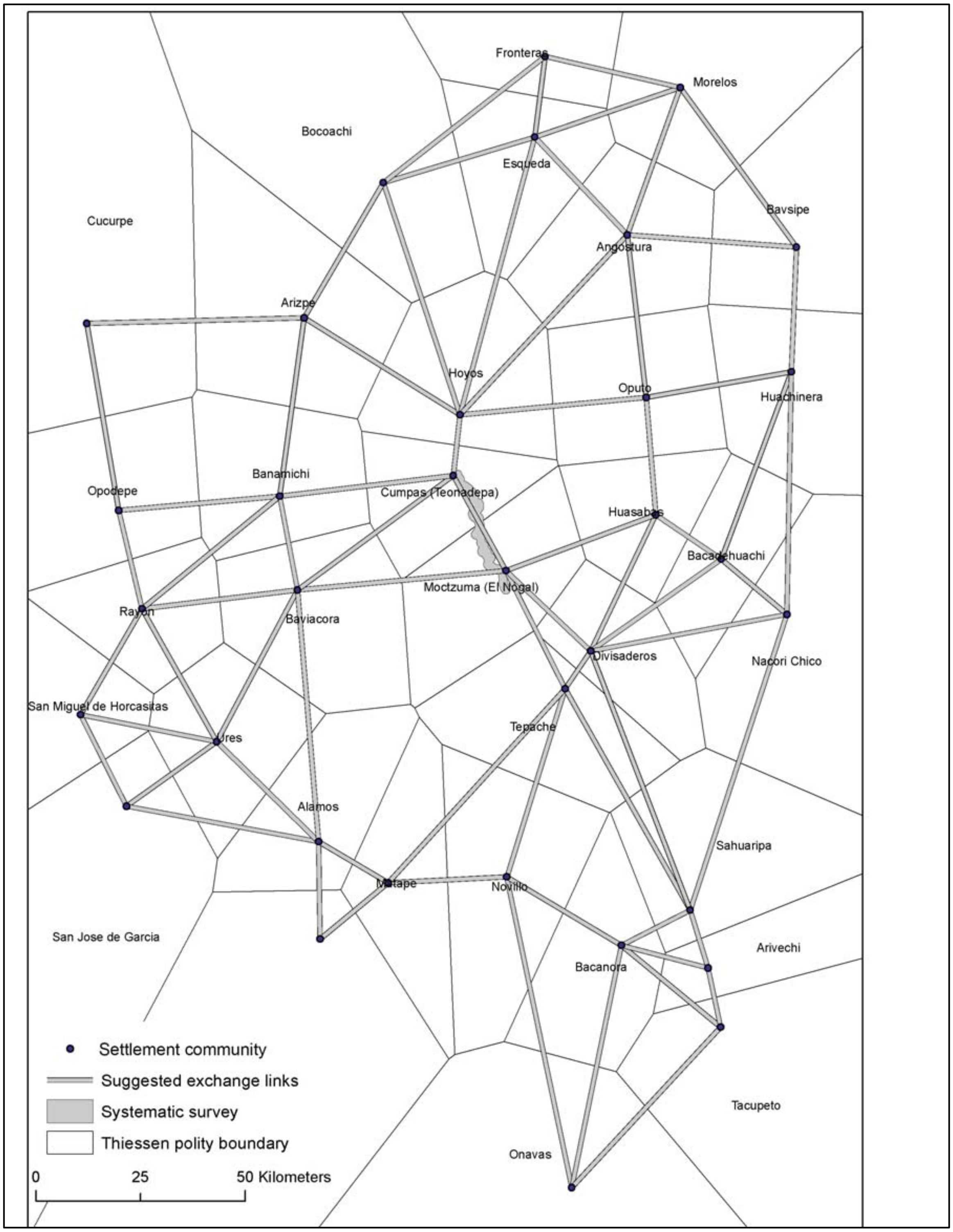

Figure 14.2. Thiessen political model with exchange links based on shared borders.

		Inter Settlement Community Correlation	
		High	Low
Intra Settlement Community Variance	High	Intra-settlement-community relationships	Mixed strategies
	Low	Within household or non-local solutions (migration)	Inter-settlement-community relationships

Figure 14.3. Risk/variance relationship, adapted from Kelley 2007.

Tables

Table 2.1. Available stream flow data from the Río Sonora region. Data derived from http://www.conagua.gob.mx/CONAGUA07/Contenido/Documentos/Portada%20BANDAS.htm

Name	Drainage	Stream size	Yearly Average m/s	Highest recorded monthly volume 1000s of m3	Lowest recorded monthly volume	Highest recorded monthly flow rate m/s	Lowest recorded monthly flow rate m/s
Las Lanchas	Upper Bavispe	Primary	no data	119253	0	49.3	0
Angostura I	Upper Bavispe	Primary	8.94	173798	96	64.9	0.04
Nacori	Arroyo Nacori	Tertiary	.42 (16 years data)	14522	0	11.6	0
El Cubil	Lower Bavispe	Primary	73.5	1720838	4812	660	1.9
Cándido	Lower Sahuaripa	Secondary	4.2	93448	2	34.9	0.2
Rastra	Lower Bavispe	Primary	75.6 (1 year data)	786900	6203	293.8	2.4
El Aguila	Upper Yaqui	Primary	79.4	2238767	6322	835.9	2.4
El Novillo II	Upper Yaqui	Primary	71.3 (4 years data)	1693787	2705	632.4	1

Name	Modal Low Month	Modal High Month	Secondary Modal High	Years of observation	UTM northing
Las Lanchas	June	February	August	1	3387333
Angostura I	June	August	December	3	3368837
Nacori	June	August	February	17	3260309
El Cubil	June	August	December	43	3233283
Cándido	June	August	February	9	3229565
Rastra	June	August	December	2	3221035
El Aguila	May	August	January	22	3217011
El Novillo II	May	August	January	5	3200450

Table 4.1. Hierarchical classification used in this study. Bold letters indicate utilized category in most analyses. Textured typically excludes brushed and is labeled as other textured in text.

Non-Painted/Painted			**painted**		
Tradition			Chihuahuan		Sonoran
Ware	Brownware	Redware	Chihuahuan Whiteware	Chihuahuan unslipped polychrome	Hematite-on-brown
Type	**plain, textured,** smudged **brushed,** incised, tool-punched, embossed,	**redware**	Huerigos, Villa Ahumada, Jecori, Teonadepa	Babicora, Carretas, Ramos	Trincheras H/br, Hohokam H/br, Serrana H/br, Moctezuma, La Volanta
Variant	sooted	sooted			

Table 4.2. X^2 Categorical plain brownware sherd size by site.

Site		**<.5**	**>1**	**1-.5**	**Total**
Son L:1:23	Count	979	356	3607	**4942**
	Expected	926.7	294.9	3720.4	
	Deviation	52.3	61.1	-113.4	
Son L:2:1	Count	2272	438	8163	**10873**
	Expected	2038.8	648.8	8185.4	
	Deviation	233.2	-210.8	-22.4	
Son L:2:22	Count	473	391	3181	**4045**
	Expected	758.488	241.4	3045.2	
	Deviation	-285.49	149.6	135.8	
Total		**3724**	**1185**	**14951**	**19860**

Table 4.3. X^2 Decorated types by site.

Site		brush	painted	red	other-textured	Total
Son L:1:23	Count	278	88	233	70	**669**
	Expected	419.5	32.7	115.7	101.05	
	Deviation	-141.5	55.3	117.3	-31.1	
Son L:2:1	Count	1523	53	278	388	**2242**
	Expected	1405.9	109.8	387.7	338.6	
	Deviation	117.1	-56.8	-109.8	49.4	
Son L:2:22	Count	146	11	26	11	**194**
	Expected	121.6	9.5	33.6	29.3	
	Deviation	24.4	1.5	-7.6	-18.3	
Total		**1947**	**152**	**537**	**469**	**3105**

Table 4.4. X^2 basic rim form by site.

Site		incurved	out curved	straight	Totals
Son L:1:23	Count	5	27	123	**155**
	Expected	2.7	28.8	123.5	
	Deviation	2.3	-1.8	-0.5	
Son L:2:1	Count	1	87	304	**392**
	Expected	6.8	72.8	312.3	
	Deviation	-5.8	14.2	-8.3	
Son L:2:22	Count	6	14	122	**142**
	Expected	2.5	26.4	113.1	
	Deviation	3.5	-12.4	8.9	
Totals		**12**	**128**	**549**	**689**

Table 4.5. X^2 simplified Munsell color distribution by site.

Site		1	2	3	Totals
Son L:1:23	Count	65	121	46	**232**
	Expected	86.4	100.1	45.5	
	Deviation	-21.4	20.9	0.5	
Son L:2:1	Count	125	99	54	**278**
	Expected	103.6	119.9	54.5	
	Deviation	21.4	-20.9	-0.5	
Totals		**190**	**220**	**100**	**510**

Table 4.6. X^2 brush style by site.

Site		crosshatch	no-orientation	parallel	subparallel	Totals
Son L:1:23	Count	11	49	34	163	**257**
	Expected	6.3	58.8	19.6	172.4	
	Deviation	4.7	-9.8	14.4	-9.3543	
Son L:2:1	Count	34	318	103	998	**1453**
	Expected	35.4	332.2	111	974.4	
	Deviation	-1.4	-14.2	-8	23.6	
Son L:2:22	Count	0	55	4	77	**136**
	Expected	3.3	31.1	10.4	91.2	
	Deviation	-3.3	23.9	-6.4	-14.2	
Totals		**45**	**422**	**141**	**1238**	**1846**

Table 4.7. X^2 brush depth by site.

Totals		**deep**	**fine**	**fugitive**	**obliterated**	**regular**	**Totals**
Son L:1:23	Count	15	14	33	21	173	**256**
	Expected	9.2	27.6	17	29.6	172.6	
	Deviation	5.8	-13.6	16	-8.6	0.4	
Son L:2:1	Count	49	178	67	147	1012	**1453**
	Expected	52.3	156.8	96.6	167.9	979.5	
	Deviation	-3.3	21.2	-29.6	-20.9	32.5	
Son L:2:22	Count	2	6	22	44	52	**126**
	Expected	4.5	13.6	8.4	14.6	84.9	
	Deviation	-2.5	-7.6	13.6	29.4	-32.9	
Totals		**66**	**198**	**122**	**212**	**1237**	**1835**

Table 4.8. Regional data of brushed and textured types.

Paquimé Sample				**Ojo de Agua Sample**			
CG Type	**% of textured**	**% excluding scored**	**% of total Medio Period Sherds**	**Ojo de Agua Type**	**% of textured**	**% of textured excluding escobillado**	**% of total assemblage**
Corrugated	3.1	6.5	0.2	2.2.1 Corrugado Simple	0.8	0.8	0.1
Rubbed Corrugated	2.8	5.9	0.2	2.2.4 Corrugado Alisado	0.8	0.8	0.1
Broad Coil	3.6	7.6	0.2		0.0	0.0	
Pattern Incised Corrugated	0.8	1.7	0.1	2.2.5 Corrugado Inciso con Diseño Simple	0.3	0.3	0.0
				2.2.2 Corrugado Indentado	0.7	0.7	0.1
				2.2.3 Corrugado Escobillado	0.1	0.1	0.0
				2.2.6 Corrugado Inciso con Diseño Indentado	0.1	0.1	0.0
All Corrugated	**10.3**	**21.6**	**0.7**	**All Corrugado**	**2.8**	**2.9**	**0.4**
Armadillo	0.2	0.4	0.01		0.0	0.0	
Incised	20.8	44.0	1.3	2.3.1 Inciso Esgrafiado	16.7	17.0	2.3
Rubbed Incised	4.8	10.1	0.3	2.3.3 Inciso Alisado	2.8	2.8	0.4
				2.3.2 Inciso Acanalado	3.0	3.1	0.4
All Incised	**25.6**	**54.1**	**1.6**	**All Inciso**	**22.5**	**22.9**	**3.1**
				2.3.4 Inciso y Punzonado	4.3	4.4	0.6

				2.4.1 Punzonado	68.5	69.8	9.6
Tool Punched	**10.9**	**23.8**	**0.7**	**All Punzonado**	**72.8**	**74.2**	**10.2**
Scored	42.4		2.6	2.1.1 Escobillado simple	0.6		0.1
Pattern Scored	0.3		0.02	2.1.3 Escobillado con diseño	0.2		0.0
Rubbed Scored	10.4		0.6	2.1.2 Escobillado alisado	1.1		0.2
All Scored	**53.1**		**3.22**	**All Escobillado**	**1.8**		**0.3**

Table 4.8. Continued

Río Bavispe Sample (six sites)				**Río Moctezuma Sample**				
Bavispe Type	**% of textured**	**% of textured excluding brushed**	**% of total assemblage**	**RMP Type**	**% of textured by primary (n=2824)**	**% of textured by primary excluding brushed (n=538)**	**% of textured elements excluding brushed (n= 617)**	**% of total assemblage**
				Corrugated	0.4	2.2	3.9	0.04
				Incised Corrugated	0.4	2.2	NA	0.04
Corrugated	**7.7**	**50.0**	**1.1**	**All Corrugated**	**0.8**	**4.5**	**3.9**	**0.1**
				Angled Design	3	16	15.7	0.3

				Straight Parallel	4.6	24.2	25.6	0.4
				Wavy Parallel	1	5.2	4.7	0.1
				Curvilinear	0.1	0.7	0.6	0.01
				Indeterminate	1.1	5.8	7.6	0.1
				Tool Incised	1	5	5	0.1
				Incise/Brushed	2.2	11.3	9.9	0.2
Incised	**4.5**	**28.0**	**0.6**	**All Incised**	**13**	**68.2**	**69.1**	**1.3**
Tool Punched	**3.5**	**34.0**	**0.5**	**Tool Punched**	**4**	**21.2**	**18.5**	**0.4**
				Ad-Hoc	0.4	2.2	1.9	0.04
				Raised Element	0.6	3.2	3.1	0.1
				Other	0.1	0.6	0.5	0.01
Brushed	**84.2**		**12.0**	**Brushed**	**80.9**			**7.8**

Table 4.9. Brushed ceramics by site, style, and depth.

Son L:1:23	**deep**	**deep/obliterated**	**fine**	**fugitive**	**obliterated**	**regular**	**Totals**
crosshatch	2	0	0	2	0	10	**14**
manufacture	1	0	5	1	0	15	**22**
no-orientation	4	0	1	7	6	43	**61**
parallel	1	0	5	6	2	22	**36**
subparallel	9	1	8	20	22	133	**193**
vertical subparallel	0	0	0	0	0	1	**1**
zoned direction	0	0	0	0	0	1	**1**
Totals	17	1	19	36	30	225	**328**

Son L:2:1	**deep**	**discontinuous**	**fine**	**fugitive**	**obliterated**	**regular**	**Totals**
crosshatch	2	0	0	0	2	36	**40**
manufacture	3	1	30	0	12	43	**89**
no-orientation	13	0	28	24	56	268	**389**
parallel	7	0	37	5	9	62	**120**
subparallel	35	0	147	51	95	832	**1160**
Totals	60	1	242	80	174	1241	**1798**

Son L:2:22	**deep**	**discontinuous**	**fine**	**fugitive**	**obliterated**	**regular**	**Totals**
manufacture	0	0	3	0	2	5	**10**
no-orientation	0	7	2	6	26	15	**56**
parallel	0	0	1	2	0	5	**8**
subparallel	2	3	3	15	21	42	**86**
Totals	**2**	**10**	**9**	**23**	**49**	**67**	**160**

Table 4.10. X^2 Textured design element by site.

		ad hoc design	**corrugation**	**incise / brush**	**incise angled design**	**incise indeterminate**	**incise parallel straight**	**incise parallel wavy**	**raised element**	**tool incise**	**tool punch**	**Totals**
Son L:1:23	Count	4	2	12	11	5	12	6	5	7	20	84
	Expected	1.98035	3.96071	10.0668	13.8625	4.78585	20.7937	3.96071	2.64047	4.12574	17.8232	
	Deviation	2.01965	-1.9607	1.9332	-2.8625	0.21415	-8.7937	2.03929	2.35953	2.87426	2.17682	
Son L:2:1	Count	8	22	49	73	24	114	18	11	18	88	425
	Expected	10.0196	20.0393	50.9332	70.1375	24.2141	105.206	20.0393	13.3595	20.8743	90.1768	
	Deviation	-2.0196	1.96071	-1.9332	2.86248	-0.2141	8.79371	-2.0393	-2.3595	-2.8743	-2.1768	
		12	24	61	84	29	126	24	16	25	108	509

Table 4.11. X^2 Textured (including brushed) design element by feature at El Nogal.

Feature		brush	corrugation	incise / brush	incise angled design	incise indeterminate	incise parallel straight	incise parallel wavy	tool incise	tool punch	Totals
1	Count	0	16	19	38	9	45	3	3	22	**155**
	Expected	4.2	7.6	15.7	27.5	10.7	44.7	6.1	7.6	30.9	
	Deviation	-4.2	8.4	3.3	10.5	-1.7	0.3	-3.1	-4.6	-8.9	
2	Count	4	4	16	17	9	56	7	6	40	**159**
	Expected	4.3	7.8	16.1	28.2	11	45.8	6.31	7.8	31.7	
	Deviation	-0.3	-3.8	-0.1	-11.2	-2	10.2	0.79	-1.8	8.3	
3	Count	7	0	6	17	10	16	6	11	19	**92**
	Expected	2.5	4.5	9.3	16.3	6.3	26.5	3.6	4.5	18.4	
	Deviation	4.5	-4.5	-3.3	0.7	3.7	-10.5	2.4	6.5	0.6	
Totals		**11**	**20**	**41**	**72**	**28**	**117**	**16**	**20**	**81**	**406**

Table 4.12. X^2 of painted traditions by site.

		Chihuahua	Sonora	
Son L:1:23	Count	79	19	**98**
	Expected	59.92	38.08	
	Deviation	19.08	-19.08	
Son L:2:1	Count	17	42	**59**
	Expected	36.08	22.92	
	Deviation	-19.08	19.08	
		96	**61**	**157**

Table 4.13. X^2 of painted traditions by feature (features with no painted sherds excluded).

Feature	Cumpas	Jecori	Mocte-zuma	Other Chihua-hua	Other Local	Santa Ana	Serrana	Teona-depa	Volanta	Totals
0	0	0	0	0	1	0	0	0	0	**1**
1	0	0	2	2	8	9	9	0	2	**32**
2	0	0	0	2	0	0	1	0	13	**16**
3	0	0	0	0	0	2	2	0	0	**4**
10	0	0	3	0	0	0	0	0	0	**3**
11	0	0	0	0	1	0	1	0	1	**3**
15	0	0	1	0	0	0	0	0	0	**1**
20/21	0	0	2	7	1	0	2	0	0	**12**
31	1	10	0	20	0	0	0	2	0	**33**
32	3	4	1	22	1	0	5	3	0	**39**
33	0	0	0	1	0	0	0	0	0	**1**
Totals	**4**	**14**	**9**	**54**	**12**	**11**	**20**	**5**	**16**	**145**

Table 5.1. Basic lithic analysis data types

Technological classification	Raw Mat	Cortex	Size	Completeness
Categorical	Categorical	Interval	Interval (1 cm increments)	Binary

Table 5.2. Percent of debitage material types from data set 1 in site assemblages.

%	Cryptocrystalline	Obsidian	Quartz	Volcanic	*n*
Son L:1:23	61	2	<.1	36	2714
Son L:2:1	33	<.1	1	66	3991
Son L:2:22	29	0.2	0	71	1594

Table 5.3. Percent of core material types from data set 1 in site assemblages.

%	Cryptocrystalline	Petrified Wood	Volcanic	*n*
Son L:1:23	81	3	16	32
Son L:2:1	60	0	40	89
Son L:2:22	39	0	61	33

Table 5.4. Proportions and confidence intervals of feature assemblages.

Site	**Feature**	**Type**	**Volcanic %**	**Volcanic 95% interval**	**Cryptocrystalline %**	**Cryptocrystalline 95% interval**	**Other %**	***n***
Son L:2:1	0	extramural fill	61	62-60	37	38-36	2	174
Son L:2:1	1	structure	64	64-64	35	35-35	1	1534
Son L:2:1	2	structure	68	68-68	32	32-32	1	1373
Son L:2:1	3	structure	69	69-69	30	30-30	1	890
Son L:2:22	10	structure	73	73-73	27	27-27	0	915
Son L:2:22	11	disturbed roasting pit	72	72-72	28	28-28	0	213
Son L:2:22	12	structure	66	66-66	34	34-34	0	209
Son L:2:22	13	disturbed roasting pit	75	77-73	25	27-23	0	36
Son L:2:22	15	midden	64	66-62	36	38-34	0	39
Son L:2:22	18	structure	63	64-62	37	38-36	0	133
Son L:1:23	20	structure	33	33-33	64	64-64	3	960
Son L:1:23	21	structure	28	29-27	71	72-70	2	112
Son L:1:23	31	rock midden	43	43-43	56	56-56	1	389
Son L:1:23	32	structure	31	31-31	66	66-66	3	914
Son L:1:23	33	structure	42	43-41	54	55-53	4	69

Table 5.5. Categorical cortex categories on debitage by site and material type.

Site	None %	Partial %	Cortical %	*n*
Son L:1:23	79	16	5	2714
Son L:2:1	73	20	7	3991
Son L:2:22	64	29	7	1594

Material	None %	Partial %	Cortical %	*n*
Cryptocrystalline	84	13	3	3246
Obsidian	46	37	17	71
Quartz	72	19	9	43
Volcanic	66	25	8	4759

Table 5.6. Relationship of volcanic flakes to cortex by site.

		not cortical	**partial or fully cortical**	**Total**
Son L:1:23	Count	652	351	1003
	Expected	658.116	344.884	
	Deviation	-6.116	6.11598	
Son L:2:1	Count	1870	832	2702
	Expected	1772.91	929.089	
	Deviation	97.0893	-97.089	
Son L:2:22	Count	680	495	1175
	Expected	770.973	404.027	
	Deviation	-90.973	90.9734	
Total		3202	1678	4880

Table 5.7. Relationship between material sites, material types, cortex, and cores.

Site	material	cortical flakes	shatter	total debitage	cores	ratio core/cortical
Son L:1:23	cryptocrystalline	145	37	182	25	0.14
Son L:1:23	volcanic	299	42	341	5	0.01
Son L:2:1	cryptocrystalline	199	65	264	52	0.20
Son L:2:1	volcanic	717	82	799	35	0.04
Son L:2:22	cryptocrystalline	90	18	108	11	0.10
Son L:2:22	volcanic	434	34	468	17	0.04
All	cryptocrystalline	433	120	553	88	0.16
All	volcanic	1445	158	1603	57	0.04

Site	material	non-cortical flakes	shatter	total debitage	cores	ratio Core/cortical
Son L:1:23	cryptocrystalline	1254	228	1482	25	0.02
Son L:1:23	volcanic	519	122	641	5	0.01
Son L:2:1	cryptocrystalline	720	318	1038	52	0.05
Son L:2:1	volcanic	1464	389	1853	35	0.02
Son L:2:22	cryptocrystalline	268	85	353	11	0.03
Son L:2:22	volcanic	580	82	662	17	0.03
All	cryptocrystalline	2242	631	2873	88	0.03
All	volcanic	2563	593	3156	57	0.02

Table 5.8. Suggested *relative* relationship for use of large durable core tools and cortical volcanic flakes in agave processing like activities.

	Son L:1:23	Son L:2:1	Son L:2:22
produced	off site	on site	on site
used/discarded	off site	off site	on site
distance to use area	far	near	immediate

Table 5.9. Summary statistics of debitage size.

Site	*n*	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Son L:1:23	2714	2.39	0.91	0.02	2.36	2.43
Son L:2:1	3991	2.57	0.88	0.01	2.54	2.6
Son L:2:22	1594	3.02	1.13	0.03	2.96	3.07

Table 5.10. Tools from data set 3.

	Son L:1:23	Son L:2:1	Son L:2:22
Biface	5	0	2
Core scraper	0	2	2
Denticulate	6	0	2
Double side scraper	10	0	3
End scraper	18	6	7
Multi tool	5	0	0
Notch	5	1	7
Perforator	8	3	3
Plane	1	0	6
Projectile	34	8	6
Serrated scraper	0	6	1
Side scraper	24	3	11
Utilized flake	26	29	11
Total	**142**	**58**	**61**
Tool/Debitage Index	**.052**	**.015**	**.038**
Shannon Diversity Index	**2.09**	**1.58**	**2.27**

Table 5.11. Informative ratios.

Site	Son L:1:23	Son L:2:1	Son L:2:22	Paquimé
Point/ Scraper	0.61	0.73	0.26	.38
Tool/Core	4.44	0.66	2.03	5.04
Excavated Tool/Debitage	.05	.01	.04	.28

Table 5.12. Proportion of core reduction strategies at the three tested sites.

	n	Informal	Unidirectional	Bidirectional	Core-on-Flake	Discoidal
Son L:1:23	32	74	3	0	11	1
Son L:2:1	88	68	13	3	9	7
Son L:2:22	30	73	17	0	3	0

Table 6.1. Counts of groundstone recorded on the project

	Surface/Excavation			
Site	Teonadepa	El Nogal	Los Mineros	All other Sites
Metate	9/0	233/0	12/0	48
Mano	6/0	19/7	12/4	39
Slick	0/0	124/0	0/0	2
Cupule	0/0	6/0	1/0	2*
Other GS	0/0	10/0	0/0	5
Agave knife	0/0	0/3	0/0	0
Axe	0/0	0/0	0/1	0
Polishing stone	0/2	1/2	0/1	2
Spindle Whorl/Disc	0/0	1/4	0/0	0
Shaft Straightner	0/0	0/0	0/0	1
Bowl	0/0	0/0	0/0	1

* count of locations, several cupules present

Table 7.1 MNI calculations.

Taxon	common name	Son L:1:23		Son L:2:1		Son L:2:22	
		count	counted element	count	counted element	count	counted element
Actinopterygii	boney finned fish	1	3 options				
Arttiodactyla (in addition to Odocoileus)	deer, sheep, pronghorn			1	TBSH 600-24	1	many options
cf Bison	bison	1	PTIB 600-25				
Bos sp.	cow					2	PHUM 600-3 (left)
Buteo sp.	hawk	1	Cor 500-16				
Carnivora	carnivore	1	CAUD 500-8	1	3 options	1	3 options
Equus sp.	horse	0		1	7 options		
Cathartidae	buzzard family	1	SYN 500-25				
Felidae	cat	1	ZYG 100-30				
Heteromyidae	kangaroo rat	1	MAND 400				
Lepus sp.	jack rabbit	2	DFEM 600-23	3	FEMSH 600-21 (left)	1	RIB 500-11
Mustelidae	weasal family	1	DHUM 600-4				
Odocoileus sp.	deer	2	DTIB 600-26 or CAL 600-41 (right)	2	FEMSH 600-21 (left)		
Phasianidae	turkey	1	DFEM 600-23				
Sciuridae	squirrel	1	IN 500-20				
Sceliphron sp.				1	N/A		
Sigmodon sp.	cotton rat	1	2 options				
Syvilagus sp.	desert cotton tail	1	DHUM 600-4	1	IL 500-21		
Testudines	tortoise/turtle			1	CAP 500-17		

Total MNI	16	11	5
Non-Historical MNI	16	10	3
Non-Historical/Non-commensal MNI	14	10	3

Table 7.2. Summary counts and fragmentation indices. Most biomass statistics drawn from (White 1953) and are provided only as a heuristic for comparison to Paquimé data.

	Son L:1:23	Son L:2:1	Son L:2:22	Assemblage totals
m^3 excavated	6.3	8.32	11.15	25.78
NSP	259	516	167	942
Total NISP	120	126	48	294
Non-historical NISP	120	116	16	252
Non-historical/Non-commensal NISP	**114**	**109**	**13**	**236**
Total NISP/NSP	0.46	0.24	0.29	0.31
Total MNE	53	44	31	128
Non-historical MNE	53	36	13	102
Non-historical/Non-commensal MNE	50	31	10	91
Non-historical/Non-commensal MNE/NISP	**0.44**	**0.28**	**0.77**	**0.39**
Total MNI	16	11	5	32
Non-historical MNI	16	10	3	29
Non-historical/Non-commensal MNI	14	10	3	27
Total Non-historical MNI Biomass (with/without Bison)	410 / 115	150	54	614 / 319

Table 7.3. Prevalence of bone modification.

	Son L:1:23 n	**Son L:1:23 %**	**Son L:2:1 n**	**Son L:2:1 %**	**Son L:2:22 n**	**Son L:2:22 %**	**All sites n**	**All sites %**
Green/Spiral break	40	15.4	18	3.5	6	3.6	64	6.8
Cut marks	12	4.6	11	2.1	5	3.0	28	3.0
All burning	85	32.8	338	65.5	114	68.3	537	57.0
Calcined	8	3.1	109	21.1	45	26.9	162	17.2
Worked	12	4.6	4	0.8	1	0.6	17	1.8
Polished	6	2.3	2	0.4	0	0.0	8	0.8
NSP	259		516		167		942	

Table 7.4. Shannon and Evenness indices.

	All Valley	Son L:1:23	Son L:2:1
Shannon	1.54	1.5	1.27
Eveness	0.58	0.61	0.79

Table 8.1. Shell artifacts collected in 2010 and 2012.

Site	Provenience	Length	Width	Artifact type	Taxonomy
Son L:1:17	26.14	2.6	2.3	debitage	bivalve
Son L:1:23	I0037	1.4	0.4	bracelet fragment	bivalve
Son L:1:23	31:19	2.3	2	debitage	bivalve
Son L:1:23	47.38	1.6	1	tinkler	*conus*
Son L:1:23	924	3.5	3.3	debitage	*laevicardium*
Son L:1:23	2004	2.1	0.5	bracelet fragment	*laevicardium*
Son L:1:23	47.28	2.8	1.2	debitage	*laevicardium?*
Son L:2:1	311	1.7	1.1	tinkler	*conus*
Son L:2:1	I0202	1.8	1.6	ring	*conus*
Son L:2:1	22	2.7	0.9	bracelet fragment	*glycemeris*
Son L:2:1	132	6.3	1.1	pendant (broken bracelet)	*glycemeris*
Son L:2:1	22:04	1.3	0.6	bracelet fragment	*glycemeris*
Son L:2:1	311	1.4	0.7	indeterminate	indeterminate
Son L:2:1	17	4.2	2.1	indeterminate	indeterminate
Son L:2:1	143	2.6	1.8	debitage	*pecten*
Son L:2:1	233	2.6	1.5	debitage	*pecten?*
Son L:2:1	118	1	0.7	tube bead	*vermetidae*
Son L:2:22	I0024	2.3	0.4	bracelet fragment	*glycemeris*
Son L:2:22	I0021	4.1	0.3	bracelet fragment	*glycemeris*

Table 8.2. Items of adornment (non-shell).

Site	Provenience	Form	Material	Length	Width	Thickness
Son L:1:23	I0036	bead	turquoise	1.6	1.6	0.8
Son L:2:1	14:35	bead	shell/stone?	0.5	0.5	0.2
Son L:2:1	152	bead	bone	1.2	1	0.7
Son L:2:1	3	bead	bone/tooth?	1	1	0.4
Son L:2:1	218	bead	turquoise	0.9	0.9	0.5
Son L:2:1	39	lip/ear plug	ceramic/stone ?	1	1.6	0.9
Son L:1:23	1108	pendant	argillite	2.6	2.1	0.8

Table 8.3. Approximate manufacture dates for notable historic artifacts.

Site	Item	Description 1	Description 2	Age
Son L:2:22	porcelain doll head	Frozen Charlotte-bonnett type	white	1860-1900
Son L:1:16	polychrome glazeware	polychrome Majolica	green, yellow, brown, white	early 1800s
Son L:1:7	amethyst glass			1881-1917
Son L:1:7	polychrome glazeware	Annular ware, Gaudy Dutch?	blue, yellow, black, brown, white	1800 to early 1900s
Son L:1:7	milk glass			post 1900
Son L:1:7	blue transfer print porcelain	curlique design	blue white	1850-1870s
Son L:2:1	hand forged nails			pre 1900

Table 9.1. Zoomorphs recorded in the Moctezuma Valley.

Site	Intersite no.	Interpretation
Son L:2:1	7	quadraped, coati?
Son L:2:1	73	quadraped, unknown
Son L:2:1	105	serpent
Son L:2:1	109	quadraped?, unknown
Son L:2:1	121	serpent
Son L:2:1	126	deer?
Son L:2:17	3	dog
Son L:2:1	83	dog
Son L:2:1	84	quadraped, dog?
Son L:2:1	85	quadraped, feline?
Son L:2:1	86	deer
Son L:2:1	88	quadraped, dog?

Table 9.2. Anthropomorphs recorded in the Moctezuma Valley.

Site	Intersite no.	Style	Arms Raised	Action	Implement association	Sex	Therianthrop	Note
Son L:2:1	87	block	no	standing	none	indeterminate	none	
Son L:2:1	82	u-legs	yes	dancing	staff?	male	none	animal interaction
Son L:2:1	43	u-legs	no	standing	none	indeterminate	none	
Son L:2:1	50	u-legs, tall	no	standing	none	indeterminate	insect?	large hands/feet
Son L:2:1	49	u-legs, tall	no	standing	none	indeterminate	none	large hands/feet
Son L:2:1	51	block	no	sitting?	none	indeterminate	none	none
Son L:2:1	52	block	no	unclear	flute, bow?	indeterminate	none	none
Son L:2:1	53	block, u-legs	yes	standing	none	indeterminate	none	
Son L:2:1	54	block, u-legs	no	unclear	unclear	indeterminate	unclear	
Son L:2:1	61	v-legs	no	standing	none	indeterminate	none	spread legs
Son L:2:1	60	block, u-legs	no	standing	none	male	none	leading formation?
Son L:2:1	59	block, u-legs	no	standing	none	indeterminate	none	in formation
Son L:2:1	58	block, u-legs	no	standing	none	male?	none	in formation
Son L:2:1	57	block	no	standing	none	indeterminate	none	in formation
Son L:2:1	56	block, u-legs	no	standing	none	indeterminate	none	in formation
Son L:2:1	55	block, u-legs	no	standing	none	indeterminate	none	in formation
Son L:2:1	66	bent legs	yes	dancing?	none	male	possible	
Son L:2:1	67	bent legs	yes	dancing?	none	male	none	
Son L:2:1	68	block, u-legs	indeterminate	standing?	none	indeterminate	none	
Son L:2:1	77	block	yes	indeterminate	none	indeterminate	none	
Son L:2:1	78	block	no	running?	none	indeterminate	none	
Son L:2:1	80	block, bent legs	no	dancing?	none	indeterminate	none	
Son L:2:1	79	block	no	indeterminate	none	indeterminate	none	
Son L:2:1	91	block, v-legs	no	indeterminate	none	indeterminate	none	
Son L:2:1	96	block, u-legs	yes	standing	none	indeterminate	none	
Son L:2:1	102	unique	no	standing	possible	male	possible	
Son L:2:1	116b	block, u-legs	no	standing	none	indeterminate	none	intentional defacement?
Son L:2:1	117	block	no	standing	possible	indeterminate	none	next to square
Son L:2:1	124	v-legs	no	standing	none	indeterminate	none	
Son L:2:1	125	staight legs	no	standing	none	indeterminate	possible	very long arms
Son L:2:1	129	block	no	running	none	indeterminate	none	

Son L:2:1	130	u-legs	no	defensive	shield	male	insect?	
Son L:2:1	131	block, u-legs	no	standing	none	indeterminate	none	
Son L:2:1	132	stick, v-legs	no	standing	none	indeterminate	none	very long torso
Son L:2:1	133	block, v-legs	no	walking	none	indeterminate	none	
Son L:2:1	134	block, v-legs	no	walking?	none	indeterminate	none	
Son L:2:1	142	u-legs	yes?	standing	none	indeterminate	none	
Son L:2:1	146	unique	no?	indeterminate	possible	indeterminate	possible, long tail	ropey appendages with circle hands/feet
Son L:2:1	3	block, bent legs	yes	dancing	none	indeterminate	none	
Son L:2:1	6	block, bent legs	yes	dancing	none	indeterminate	none	
Son L:2:1	8	block	no	standing	none	indeterminate	none	
Son L:2:1	11	block, u-legs	no	standing	none	indeterminate	none	
Son L:2:1	27	u-legs	indeterminate	standing	none	indeterminate	none	
Son L:2:1	33	block, v-legs	yes	standing	none	male	none	
Son L:2:1	34	block	yes?	indeterminate	possible	indeterminate	possible, antlers	
Son L:2:39	4	block, u-legs	yes	standing	possible	male?	none	
Son L:2:39	12	unique	no	dancing?	possible	indeterminate	antlers	historic? (cross association)
Son L:2:39	19	unique	no	dancing?	none	male?	antlers	
Son L:2:13	4	block, u-legs	yes	standing	none	indeterminate	none	
Son L:2:35	5	block, u-legs	no	standing	none	indeterminate	none	
Son L:2:38	3	unique	no	standing	none	indeterminate	none	historic?

Table 10.1. Previous chronologies proposed in region.

Range	Name	Characteristics	Sub-location	References
Southern Sonora				Pailes 1973; Carpenter and Vicente 2009
A.D. 1-200	Batacosa	initial occupation		
A.D. 700-?1550	Cuchujaqui	trade pottery and shell from coast, overhanging manos, trade pottery from Guasave later	lower foothills	
A.D. 700-?1250	Los Camotes	small isolated settlements, single-unit dwellings, on topographic rises, crude stone masonry, incise-cross hatched ceramics	upper foothills	
A.D. ?1250-1550	San Bernardo	stone foundations with perishable super-structures, incised parallel-hatched ceramics, trade items from Tacuichamona; late in phase punctated and corrugated ceramics		
Sonora Valley				Doolittle 1984
A.D. 1000-1200	Early	houses-in-pit		
A.D. 1200-1350	Transitional	transitional mixed architecture		
A.D. 1350-1550	Late	mostly above ground architecture		
Bavispe Valley				Douglas and Quijada 2003; Quijada and Douglas 2003; Hinojo and Blanquel 2011
500 B.C.-A.D. 500	Early-Early	cremation, dart points, houses in pits?, brushed ceramics (late)		
A.D. 700-1000	Early-Late	red on brown ceramics?, occupation of terraces		
A.D. 1000-1200	Middle	trade wares from Mimbres and Chihuahua area, larger sites, plazas?		
A.D. 1200-1500	Late	surface structures, Chihuahuan polychromes, obsidian tools		

Table 10.2. ^{14}C dates from the Río Sonora region with those included in the architectural analysis noted.

Site	Provenience	Context	Utilized	Cat-no	Lab-no	RC yBP	1-sigma	Reference	Notes
L:1:10	room block	surface structure	yes	La Cuchilla	-	260	40	Hinojo and Blanquel (2011)	
L:1:10	room block	surface structure	yes	La Cuchilla	-	320	50	Hinojo and Blanquel (2011)	
L:1:10	room block	surface structure	yes	La Cuchilla	-	360	50	Hinojo and Blanquel (2011)	
H:13:10	large oval tructure, feature 8	surface structure-?	no	San Cristóbal de los Hoyos	-	950	40	Hinojo and Blanquel (2011)	
L:1:11	oval structure	surface structure-?	no	El Borbollón	-	1060	60	Hinojo and Blanquel (2011)	
L:1:11	oval structure	surface structure-?	no	El Borbollón	-	1230	60	Hinojo and Blanquel (2011)	
L:2:22	level 2	midden	no	MCP_03	AA100940	670	40		
L:1:23	structure floor	surface structure	yes	MCP_02	AA100941	400	30		
L:2:22	level 3-test trench	roasting pit	no	MCP_01	AA100942	870	40		
L:2:1	feature 3, burned post	pithouse	yes	MCP-04	AA100943	700	30		
K:4:24	roasting pit 1	roasting pit	no		GaK-6240	580	100		
K:4:34	roasting pit 2	roasting pit	no		GaK-6241	280	80		
K:4:24	test 1 0-10 cm	surface structure	yes		GaK-6242	450	90	Dirst (1979:99)	too young?
K:4:24	test 1 60-70 cm	surface structure	yes		GaK-6243	750	90	Dirst (1979:99)	out of sequence
K:4:32	test 1, Wall sq	pithouse?	no		GaK-6244	600	110	Dirst (1979:113)	
K:4:20	subfloor in center of room sample 1	surface structure	no		GaK-6245	modern		Dirst (1979:110)	
K:4:20	subfloor in center of room sample 2	surface structure	no		GaK-6246	modern		Dirst (1979:110)	
H:2:2	casa 1	surface structure	no	Ojo de Agua	UA1909	500	100	Braniff (1992:685)	corrected age, sigma ?
K:4:24	B-II-I, entry (west)	pithouse	yes	11	UGA-1502	875	60	Dirst (1979:94)	
K:4:24	B-II-I, Floor, N quad	pithouse	yes	21	UGA-1503	865	60	Dirst (1979:94)	
K:4:24	B-II-I, Floor, E quad	pithouse	yes	29	UGA-1504	635	60	Dirst (1979:94-95)	
K:4:24	B-II-I, Feat 48	pithouse	yes	32	UGA-1505	645	60	Dirst (1979:94-95)	
K:4:24	A-I-19, Feat 10, 55 cm	plaza, subplatform	no	33	UGA-1506	950	60		
K:4:42	pit oven 1, surface	roasting pit	no	34	UGA-1507	365	55		
K:4:41	A-I-I, unit 6, floor	pithouse	yes	35	UGA-1508	775	55		
K:4:41	A-I-I, unit 6, floor	pithouse	yes	36	UGA-1509	525	55		
K:4:24	A-III-I, floor, 40cm	surface structure	yes	37	UGA-1510	800	60		

K:4:20	subfloor in center of room sample 2	surface structure	yes	1975-burned post	UGA-1511	290	60	Dirst (1979:110)	
K:4:41	combined sample from two postholes	pithouse	yes	38	UGA-1606	520	55		
K:4:41	post hole	pithouse	yes	36	UGA-1607	485	60		
K:4:24	2-5 cm above floor, roof fall	surface structure	yes	16	UGA-1608	445	65		
K:4:24	5 cm above floor, roof fall	surface structure	yes	15	UGA-1609	350	55		
K:4:24	1-2 cm above floor, 23 cmb surface	surface structure	no	1	UGA-1610	110	60	Dirst (1979:99)	too young
K:8:17	II, test 1	surface structure	yes	2	WSU-2047	590	100		
K:4:24	feature 48, 50 cmbg	structure indeterminate	no	39	WSU-2048	760	90		
K:4:24	platform test 32, 70 cmbg	pithouse	yes	40	WSU-2049	560	70		
K:4:24	platform test 32 70 cmbg	pithouse	yes	41	WSU-2050	760	100		
K:4:24	platform test 70 70 cmbg	surface structure-?	no	42	WSU-2051	960	100		
K:4:99	A-I-I, tst 1 20cmbg	surface structure	yes	44	WSU-2052	615	130		
K:8:34	I-1, tst 1, 20cmbg	surface structure	yes	48	WSU-2053	790	125		
K:8:25	test 19, 100-110 cm	pithouse?	no	49	WSU-2054	690	100		
K:8:25	Test 16 50-60cm	pit?	no	52	WSU-2055	850	100		
K:8:25	test 2, Grid A, 10-20 cm, floor?	?	no	54	WSU-2056	940	100		
K:4:25	grid C, tst 1, 98 cmbg	fill	no	56	WSU-2057	2500	70		
K:4:24	B-III-I, N/7-E/3, 70 cmbg	pithouse	yes	60	WSU-2058	860	100		
K:4:24	C-II-I, S/20-E/14, 40cmbg	pithouse	no	63	WSU-2059	30	125		bad date
K:4:24	B-II-1, west quad, floor	pithouse	yes	67	WSU-2060	930	95		200 yr 13C/12C correction for corn

Table 10.3. Dates obtained for this dissertation.

Sample Type	U #	Feat. #	Lvl #	FN	Deposit	Project Sample #	Lab #	UW lab notes	cal Age	14C age	Error 1 sigma	primary mode	% included
painted Sonoran	7	1	1	205	sub floor	03	UW2824		1370		30		
textured	15	2	1	157	floor fill	104	UW2826	under-estimate < 100yrs	1080		60		
painted Sonoran	19	2	2	165	floor contact	105	UW2822		1260		50		
textured	14	3	4	207	floor contact	09	UW2827		1250		40		
brushed	14	3	4	208	floor contact	10	UW2833		960		50		
charcoal	17	3	3	91	burned post	MCP_04	AA100943		1261-1387	700	30	1261-1310	77.5
adobe	20	3	2	211	house fill	22	UW2836		1130		30		
adobe	36	10	2	429	floor fill	202	UW2837		1300		40		
plain	60	10	1	453	house fill	206	UW2832		1130		50		
brushed	40	11	1	665	roasting pit/ house fill?	407	UW2829	under-estimate	1500		30		
charcoal	40	11	3	662	roasting pit/ house fill?	MCP_01	AA100942		1042-1255	870	40	1117-1255	72
plain	52	15	1	604	midden fill	300	UW2825		1170		60		
charcoal	52	15	2	622	midden	MCP_03	AA100940		1268-1396	670	40	1268-1328	51.7
plain	47	17	2	561	floor fill	406	UW2830		1390		30		
plain	54	18	4	634	floor contact	308	UW2834		1500		50		
brushed	72	20	2	739	floor fill	1002	UW2831		230		140		
painted Chihuahuan	77	21	1	913	house fill	940	UW2823		1510		40		
painted Chihuahuan	80	31	4	813	base midden	1011	UW2820		1430		30		
brushed	81	32	4	848	floor contact	920	UW2828		1100		50		
painted Chihuahuan	81	32	4	938	sub floor	922	UW2821	under-estimate	1390		30		
charcoal	90	33	3	857	floor fill	MCP_02	AA100941		1436-1625	400	30	1436-1522	76.4
red-ware	90	33	3	861	floor fill	931	UW2835		1060		100		

Table 11.1 Sherds thin sectioned for point count analysis

Site	FN	Reason selected	Type
Son L:2:1	001	random sampled	plain
Son L:2:1	004	type diversity	painted
Son L:2:1	01.04.04	locational diversity	plain
Son L:2:1	01.11.05	locational diversity	plain
Son L:2:1	01.18.05	locational diversity	plain
Son L:2:6	06.01.01	locational diversity	plain
Son L:2:6	06.01.03	locational diversity	plain
Son L:2:6	06.01.04	locational diversity	plain
Son L:2:1	019	type diversity	textured
Son L:2:1	029	type diversity	plain
Son L:2:1	033	type diversity	brushed
Son L:2:1	040	random sampled	plain
Son L:2:1	083	type diversity	textured
Son L:2:22	16.05.05	locational diversity	plain
Son L:2:22	16.13.03	locational diversity	plain
Son L:2:22	16.15.01	locational diversity	plain
Son L:2:1	107	type diversity	brushed
Son L:2:1	011	type diversity	textured
Son L:2:1	114-1	temper diversity	plain
Son L:2:1	114-2	temper diversity	plain
Son L:2:1	114-3	temper diversity	plain
Son L:2:1	114-4	temper diversity	plain
Son L:2:1	114-5	type diversity	red
Son L:2:1	136	type diversity	textured
Son L:2:1	137	type diversity	textured
Son L:2:1	148-1	temper diversity	plain
Son L:2:1	148-2	temper diversity	plain
Son L:2:1	148-3	temper diversity	plain
Son L:2:1	157	type diversity	textured
Son L:2:1	159	random sampled	plain
Son L:2:1	177	type diversity	red
Son L:2:26	21.01.04	locational diversity	plain
Son L:2:26	21.05.02	locational diversity	plain
Son L:2:26	21.07.03	locational diversity	plain
Son L:2:29	24.01.02	locational diversity	plain
Son L:2:29	24.01.05	locational diversity	plain
Son L:2:29	24.03.01	locational diversity	plain
Son L:1:17	26.01.05	locational diversity	brushed
Son L:1:17	26.04.03	locational diversity	plain
Son L:1:17	26.06.01	locational diversity	plain
Son L:1:17	26.07.01	locational diversity	plain
Son L:1:17	26.12.01	locational diversity	plain
Son L:1:17	26.13.03	locational diversity	plain
Son L:2:1	208	type diversity	brushed
Son L:1:6	35.04.03	locational diversity	plain
Son L:1:6	35.09.02	locational diversity	plain

Son L:1:6	35.10.03	locational diversity	plain
Son L:2:22	39:12	type diversity	textured
Son L:2:1	308	type diversity	handle
Son L:2:1	315-1	type diversity	textured
Son L:2:1	315-2	temper diversity	plain
Son H:13:2	43.05.01	locational diversity	plain
Son H:13:2	43.07.03	locational diversity	plain
Son H:13:2	43.08.05	locational diversity	plain
Son H:13:2	43.14.03	locational diversity	plain
Son H:13:2	43.15.01	locational diversity	plain
Son H:13:2	43.20.03	locational diversity	plain
Son L:2:22	406	type diversity	smudged (plain)
Son L:2:22	408-1	temper diversity	plain
Son L:2:22	408-2	temper diversity	plain
Son L:2:22	408-3	temper diversity	plain
Son L:2:22	408-4	temper diversity	plain
Son L:2:22	408-5	temper diversity	plain
Son L:2:22	419-1-1	temper diversity	plain
Son L:2:22	419-1-2	temper diversity	plain
Son L:2:22	419-1-3	temper diversity	plain
Son L:2:22	419-2-1	temper diversity	plain
Son L:2:22	419-2-2	temper diversity	plain
Son L:2:22	419-2-3	temper diversity	plain
Son L:2:22	419-3	type diversity	plain
Son L:2:22	446	type diversity	painted
Son L:2:22	449	random sampled	plain
Son L:2:22	453	type diversity	plain (fillet rim?)
Son L:2:22	458-1	temper diversity	plain
Son L:2:22	458-2	temper diversity	plain
Son L:2:22	458-3	temper diversity	plain
Son L:2:22	458-4	temper diversity	plain
Son L:2:22	458-5	temper diversity	plain
Son L:2:22	461	type diversity	plain
Son L:2:22	500-1	type diversity	textured
Son L:2:22	500-2	random sampled	plain
Son L:2:22	505	type diversity	brushed
Son L:2:22	52:04	type diversity	textured
Son L:2:22	538	random sampled	plain
Son L:2:22	557	type diversity	textured
Son L:2:22	561	type diversity	plain
Son L:2:22	604	type diversity	plain (fillet rim?)
Son L:2:22	609-1	type diversity	painted
Son L:2:22	609-2	random sampled	plain
Son L:2:22	627-1	type diversity	plain
Son L:2:22	627-2	random sampled	plain
Son L:2:22	631	type diversity	textured
Son L:2:22	635-1	temper diversity	plain
Son L:2:22	635-2	temper diversity	plain
Son L:2:22	635-3	temper diversity	plain

Son L:2:22	635-4	temper diversity	plain
Son L:1:23	700	random sampled	plain
Son L:1:23	724-1	type diversity	painted
Son L:1:23	724-2	random sampled	plain
Son L:1:23	731	type diversity	textured
Son L:1:23	737	temper diversity	plain
Son L:1:23	800-1	random sampled	plain
Son L:1:23	800-2	type diversity	textured
Son L:1:23	802-1	type diversity	textured
Son L:1:23	802-2	type diversity	painted
Son L:1:23	809	type diversity	plain
Son L:1:23	819	type diversity	textured
Son L:1:23	827	type diversity	red
Son L:1:23	832-1	type diversity	painted
Son L:1:23	832-2	type diversity	textured
Son L:1:23	838-1	temper diversity	plain
Son L:1:23	838-2	temper diversity	plain
Son L:1:23	838-3	temper diversity	plain
Son L:1:23	841-1	temper diversity	plain
Son L:1:23	841-2	temper diversity	plain
Son L:1:23	844	random sampled	plain
Son L:1:23	858	temper diversity	plain
Son L:1:23	900-1	temper diversity	plain
Son L:1:23	900-2	temper diversity	plain
Son L:1:23	903-1	temper diversity	plain
Son L:1:23	903-2	temper diversity	plain
Son L:1:23	903-3	temper diversity	plain
Son L:1:23	903-4	temper diversity	plain
Son L:1:23	903-5	temper diversity	plain
Son L:1:23	906-1	temper diversity	plain
Son L:1:23	906-2	temper diversity	plain
Son L:1:23	910	type diversity	brushed
Son L:1:23	919-1	temper diversity	plain
Son L:1:23	919-2	temper diversity	plain
Son L:2:1	93-1	temper diversity	plain
Son L:2:1	93-2	temper diversity	plain
Son L:1:23	930	type diversity	painted
Son L:1:23	934	random sampled	plain
Son L:1:23	1003-1	temper diversity	plain
Son L:1:23	1003-2	temper diversity	plain
Son L:1:23	1003-3	type diversity	smudged (plain)
Son L:2:22	I0027	type diversity	textured

Table 11.2. Obsidian trace element data

Site	FN	Pb	Rb	Sr	Y	Zr	Source ID	Lab	Strategy
Son L:1:23	702	24	178	147	18	119	Selene	ABQ	targeted
Son L:1:23	811	24	178	146	15	126	Selene	ABQ	targeted
Son L:1:23	823	24	154	82	16	96	unknown 1	ABQ	targeted
Son L:1:23	824	28	179	149	17	128	Selene	ABQ	targeted
Son L:1:23	830	23	140	81	14	97	unknown 1	ABQ	targeted
Son L:1:23	1217	24	158	145	16	130	Selene	ABQ	targeted
Son L:1:23	1219	23	178	147	20	124	Selene	ABQ	targeted
Son L:1:23	1320	26	146	77	16	96	unknown 1	ABQ	targeted
Son L:1:23	46:34	29	182	148	19	131	Selene	ABQ	random
Son L:1:23	47:24	24	161	173	18	158	unknown 2	ABQ	random
Son L:1:23	47:25	25	135	6	68	611	Los Sitios del Agua	ABQ	random
Son L:1:23	47:26	32	245	105	24	180	unknown 4	ABQ	random
Son L:1:23	47:27	30	177	144	16	127	Selene	ABQ	random
Son L:1:23	47:28	29	175	151	18	128	Selene	ABQ	random
Son L:1:23	47:29	28	173	144	18	125	Selene	ABQ	random
Son L:1:23	47:30	28	173	143	19	127	Selene	ABQ	random
Son L:1:23	47:32	27	182	134	21	118	Selene	ABQ	random
Son L:1:23	47:37	27	175	149	20	130	Selene	ABQ	random
Son L:1:24	50:09	29	190	152	16	131	Selene	ABQ	random
Son L:1:6	35:14	26	167	143	20	126	Selene	ABQ	random
Son L:1:6	35:15	31	183	130	17	115	Selene	ABQ	random
Son L:1:6	35:16	29	182	150	16	132	Selene	ABQ	random
Son L:1:6	35:17	29	174	128	15	119	Selene	ABQ	random
Son L:1:6	35:20	27	178	143	18	125	Selene	ABQ	random
Son L:1:6	35:22	28	172	149	17	133	Selene	ABQ	random
Son L:1:6	35:23	29	181	149	17	129	Selene	ABQ	random
Son L:1:6	35:24	28	178	146	20	127	Selene	ABQ	random
Son L:1:6	35:25	27	176	146	17	125	Selene	ABQ	random
Son L:1:6	36:19	29	184	154	19	131	Selene	ABQ	random
Son L:2:1	6:28		172	182	22	132	Selene	GRIC	random
Son L:2:1	23:19		172	178	19	132	Selene	GRIC	random

Son L:2:1	26		178	180	15	130	Selene	GRIC	random
Son L:2:1	147		173	151	19	116	Selene	GRIC	random
Son L:2:1	313		159	165	18	115	Selene	GRIC	random
Son L:2:1	I0010		166	167	20	138	Selene	GRIC	random
Son L:2:1	I0031	14	145	143	24	160	unknown 3	ABQ	targeted
Son L:2:22	I0010		168	174	16	129	Selene	GRIC	random
Son L:2:22	I0020		189	186	14	129	Selene	GRIC	random
Son L:2:22	I0025		162	158	20	122	Selene	GRIC	random
Son L:2:22	I0030		144	94	19	99	unknown 1	GRIC	random
Son L:2:22	I0030	28	150	84	17	99	unknown 1	ABQ	inter lab comparison
Son L:2:26	21:11	28	175	186	20	171	unknown 2	ABQ	random
Son L:2:26	21:12	27	182	148	18	125	Selene	ABQ	random

Table 11.3 Marine shell artifacts.

Site	Provenience	Length	Width	Artifact type	Taxonomy
Son L:1:17	26.14 (surface)	2.6	2.3	debitage	bivalve
Son L:1:23	I0037 (surface)	1.4	0.4	bracelet fragment	bivalve
Son L:1:23	31:19 (surface)	2.3	2	debitage	bivalve
Son L:1:23	47.38 (surface)	1.6	1	tinkler	*conus*
Son L:1:23	924	3.5	3.3	debitage	*laevicardium*
Son L:1:23	2004	2.1	0.5	bracelet fragment	*laevicardium*
Son L:1:23	47.28 (surface)	2.8	1.2	debitage	*laevicardium?*
Son L:2:1	311	1.7	1.1	tinkler	*conus*
Son L:2:1	I0202 (surface)	1.8	1.6	ring	*conus*
Son L:2:1	22	2.7	0.9	bracelet fragment	*glycemeris*
Son L:2:1	132	6.3	1.1	pendant (broken bracelet)	*glycemeris*
Son L:2:1	22:04 (surface)	1.3	0.6	bracelet fragment	*glycemeris*
Son L:2:1	311	1.4	0.7	indeterminate	indeterminate
Son L:2:1	17	4.2	2.1	indeterminate	indeterminate
Son L:2:1	143	2.6	1.8	debitage	*pecten*
Son L:2:1	233	2.6	1.5	debitage	*pecten?*
Son L:2:1	118	1	0.7	tube bead	*vermetidae*
Son L:2:22	I0024 (surface)	2.3	0.4	bracelet fragment	*glycemeris*
Son L:2:22	I0021 (surface)	4.1	0.3	bracelet fragment	*glycemeris*

Table 11.4 ^{13}C and ^{18}O maximum and minimum isotopic values and source region.

Site	FN	Max^{13}C	Max^{18}O	Min^{13}C	Min^{18}O	Source Region
Son L:1:23	924	1.636809939	-0.719448702	0.555761724	-1.866595047	South of Tiburon
Son L:1:23	31:19	1.460929875	-0.123819488	0.130578651	-2.717140364	South of Tiburon
Son L:2:1	22	2.096456833	0.143178261	1.103093825	-2.023150837	South of Tiburon
Son L:2:1	132	2.449335274	-0.320675829	1.183860353	-1.722494119	South of Tiburon
Son L:2:1	143	1.789348148	1.141443035	1.045066781	-0.423964449	South of Tiburon
Son L:2:1	I0202	1.417822469	-0.479187798	0.721267073	-1.53377707	South of Tiburon
Son L:2:22	I0021	2.729876669	0.150159766	2.067817682	-1.930015589	South of Tiburon

Table x.5 Sr and Pb isotope date from the tested turquoise specimen.

Lab ID	$^{87}Sr/^{86}Sr$	$^{208}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$
RM1	0.70815	2.0297	0.81994	19.093	15.655	38.754

Sub-appendix A
Ethnohistoric Document Data

Reference	Original	Reporter	Page	Category	Notes	Location
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	229	gifts	"...they gave us a great quantity of it, as well as of flour and squash and frijoles, and mantles of cotton…"	Chihuahua or Bavispe?
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	231	gifts	"...and they gave us many deer and many robes of cotton…"	Chihuahua or Bavispe?
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	231	ideology	Repeatedly asked for blessings	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	231	prestige goods	In regards to emerald arrowheads, "they had bought them in exchange for plumes and parrot feathers."	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	231	prestige goods	"...they also gave us many beads and some coral that is found in the south sea and many very fine turquoises that they acquire from the north…"	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	233	gifts	"...those who were at war with one another later made friends in order to come recive us and bring us everything they had…"	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	233	warfare	"...those who were at war with one another later made friends in order to come recive us and bring us everything they had…"	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	235	feasting	"...in the village where they gave us the emeralds, they gave Dorantes more than six hundred open hearts of deer, of which they always have great abundnace for their sustenance…"	Corzazones
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	235	surplus production	"And they are well provided because they sow frijoles and maize three times a year…"	Corazones
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	237	social valuables	"During this time Castillo saw, around the neck of and Indian, a buckle of a sword belt, and sewn to it a horseshoe nail…"	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	237	warfare	Arrow poison	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	239	gifts	"...they brought to us beads and robes…and they gave them to us."	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	241	feasting	"...they gave us more than two thousand loads of maize that we gave to…."	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	241	warfare	"...the ones who held the frontier agains the Chrisitians and were at war with them."	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	247	gifts	"...because they always took care to bring us all they could…"	Sinaloa
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	248	gifts	"...and they brought us everything else they had, but we refused to take any of it except the food…"	Sinaloa

Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	251	gifts	Long discussion about how natives liked them because they returned the gifts given to them, while the Chrisitians took everything	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	251	surplus production	"...they sow three times a year…"	Sinaloa
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	257	ideology	"...the sick people we had cured…"	Serrana
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	257	prestige goods	"...and they brought us beads and turquoises and plumes…"	Sinaloa
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	261	warfare	"...to come out and receive them with the crosses in their hands, without their bows and without weapons…"	Sinaloa
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	262	prestige goods	"And they brought us beads and plumes…"	Sinaloa
Adorno and Pautz 1999	The 1542 Relación	Cabeza de Vaca	229-231	surplus production	"...and we always found permanent houses and many stores of maize and frijoles…"	Chihuahua or Bavispe?
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	63	gifts	Gifts to de Niza of food, roses, and other such things	Petlatlan province
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	64	other	Receptions and triumphal arches	north of San Miguel
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	64	social valuable	Shells that de Niza associates with pearls	north of San Miguel
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	64	warfare	From Christians of San Miguel	north of San Miguel
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	65	feasting	"...where they gave me a fine reception and much food, which they had in abundance."	Vacapa
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	65	irrigation	"...as this was all irrigated land…"	Vacapa
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	65	social valuables	Speaking of cotton, but more interesting to him gold in rumors of an area to the west beyond the cordillera	Vacapa
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	67	gifts	"...inhabitants of the islands have little food and that they trade with one another by means of rafts…"	speaking of island people
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	67	social valuable	"...they wore shells on their heads and said that they contain pearls…"	speaking of island people

Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	67	warfare	"...indians from coast brought me shields made of hides of the cattle..."	speaking of island people
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	69	gifts	"...they gave me some hides of the cattle so well tanned and worked….from Cibola."	north of Vacapa
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	69	social valuable	"...traveled for five days, always finding settlements, good lodging….many turquoises…"	north of Vacapa
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	70	prestige goods	Cotton, hides, vases, turquoises, offered to de Niza and worn	north of Vacapa
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	70	social valuable	Cotton, hides, vases, turquoises, offered to de Niza and worn	north of Vacapa
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	71	social valuables	Turquoises suspended from their noses and ears	despoblado
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	72	irrigation	"...all is irrigated…"	north of second despoblado
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	72	social valuables	Wear wool in Totonteac	speaking of Totonteac
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	73	social valuables	Two thousand hides and turquoises	Serrana
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	74	social valuables	Wearing turquoise necklaces, some with five and six loops.	Serrana
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	80	social valuables	Same reference as above to valley with much gold	Serrana
Hammond and Rey 1977	Report of Fray Marcos de Niza, November 1538	Marcos de Niza	80	warfare	"...these people do not allow those from this region of the valley to trade with them, they could not tell me why…"	Serrana
Hammond and Rey 1977	Castañeda's History of the Expedition Part 1,	Castañeda	212	feasting	"...there were large quantitie of prickly pears…They brought much of this preserve as a present…"	Serrana

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Hammond and Rey 1977	Castañeda's History of the Expedition Part 1, XVII	Castañeda	232	warfare	"...natives of that province had killed a solider with a poisoned arrow."	Senora
Hammond and Rey 1977	Castañeda's History of the Expedition Part 1, XVII	Castañeda	232	warfare	"When the Indians found themselves free they rose in arms….If the soliders had not taken along allies from Corazones, they would have fared still worse."	Valle de Vallacos
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, I	Castañeda	248	feasting	"Sometimes the natives held great drinking orgies…"	Culican province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, I	Castañeda	248	ideological materializations	"...they worship carved stones and are great wizards and sorcerers…"	Culican province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, I	Castañeda	248	kinship	"One custom among them was that when women got married their husbands bought the from their parents and relatives at a high price…"	Culican province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, I	Castañeda	248	kinship	"...Pacaxes…They take many wives, even though they are sisters."	Culican province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, I	Castañeda	248	social valuables	"...the women adorned her with clothes and bracelets of fine turquoises…"	Culican province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, I	Castañeda	248	warfare	"Acaxes… go out to hunt men as well as deer."	Culican province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, I	Castañeda	248	warfare	"...he who has the most human bones and skulls hanging around his hut is the most feared and respected…"	Culican province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, I	Castañeda	248	warfare	"...500 men will gather at a single call…"	Culican province

Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, II	Castañeda	250	ideological materializations	"...the dignitaries…stand on some terraces which they have for that purpose…instructing the people in what they are to do."	Petlatlan province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, II	Castañeda	250	warfare	"...they have temples in small houses into which they drive numerous arrows…when war is about to break out."	Petlatlan province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, II	Castañeda	251	feasting	"They drink the juice of the pithaya…They become stupefied with this drink…"	Petlatlan province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, II	Castañeda	251	ideological materializations	"Royal eagles were seen in this land, The native dignataries have them as an emblem of power."	Petlatlan province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 2, II	Castañeda	252	warfare	"...for the natives are ever at war with one another…"	Petlatlan province
Hammond and Rey 1977	Castañeda's History of the Expedition Part 3, III	Castañeda	269	warfare	"On their way some of their people [Suya defectors] were killed in some pueblos."	south of Suya
Hammond and Rey 1977	Castañeda's History of the Expedition Part 3, III	Castañeda	269	warfare	"...some gold veins had already been discovered…but being located in warring country …were not worked."	Suya
Hammond and Rey 1977	Castañeda's History of the Expedition Part 3,III	Castañeda	269	warfare	Attack on Alcaraz	Suya
Hammond and Rey 1977	Castañeda's History of the Expedition Part 3, V	Castañeda	272	kinship	"...rejoiced in keeping some of our people…it is believed that it was nto to harm them…"	Serrana
Hammond and Rey 1977	Castañeda's History of the Expedition Part 3, V	Castañeda	272	warfare	"...the reinforcements had endured considerable hardship…having had daily skirmishes with the Indians of that region…"	Serrana
Hammond and Rey 1977	Castañeda's History of the Expedition Part 3, V	Castañeda	273	warfare	"At some places there were outbreaks by the Indians, and some horse wounded and killed."	Serrana

Hammond and Rey 1977	Castañeda's History of the Expedition Part 3, V	Castañeda	273	warfare	Arrow poison	Serrana
Hammond and Rey 1977	Castañeda's History of the Expedition Part 3, VII	Castañeda	275	warfare	Account of Gallego being attacked	Serrana
Hammond and Rey 1977	Jaramillo's Narrative	Jaramillo	297	irrigation	irrigation	Serrana
Hammond and Rey 1977	Jaramillo's Narrative	Jaramillo	297	warfare	Arrow poison	Serrana
Obregon 1928	Book 1, XXIII	Obregón	154	warfare	One Native fends off five soldiers and 100 more make threats	Sinaloa
Obregon 1928	Book 1, XXIII	Obregón	155	social valuables	"...from it we could see five hundred men wll arraoyed, bearing arms and adorned with feathers bead, conchs, and pearl-bearing shells…"	Sinaloa
Obregon 1928	Book 1, XXIII	Obregón	155	warfare	"...from this point they could perceive large numbers of smoky fires by means of which it is the custom and practise here to call and warn their friends to prepare for war."	Sinaloa
Obregon 1928	Book 1, XXIII	Obregón	155	warfare	"...from it we could see five hundred men wll arrayed, bearing arms and adorned with feathers bead, conchs, and pearl-bearing shells…"	Sinaloa
Obregon 1928	Book 1, XXIII	Obregón	156	gifts	"...the natives thanked the governor…and giving some things which they had in their country…"	Sinaloa
Obregon 1928	Book 1, XXIII	Obregón	157	warfare	"Indians could hinder our passage and departure and kill us by rolling stones down from the heights and shooting arrows at us…"	Sinaloa
Obregon 1928	Book 1, XXIII	Obregón	157	wealth generation	"...they were paid in goods..."	Sinaloa
Obregon 1928	Book 1, XXIV	Obregón	159	gifts	"...pleasing them with gifts of glass beads which they esteem very highly…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	159	gifts	"...making them a gift of some shirts…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	159	irrigation	irrigation	Oera
Obregon 1928	Book 1, XXIV	Obregón	159	warfare	"...bold and versed in the use and practise of war…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	159	warfare	"...warriors to annihilate and destroy their enemies in the valleys of Cinaro."	Oera
Obregon 1928	Book 1, XXIV	Obregón	160	gifts	"...bringing as presents quantities of corn, beans, fruits, and game…" (also shirts in next line)	Oera
Obregon 1928	Book 1, XXIV	Obregón	160	irrigation	irrigation	Oera

Obregon 1928	Book 1, XXIV	Obregón	160	social valuables	"...they also wore elegant and showy feather crests, beads, conchs, pearl-bearing shells, bows, spears of brazilwood or shields and clubs…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	160	surplus production	"...they gather a great deal of corn, chick-peas,…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	160	warfare	"...they arrived in two squadrons with good discipline…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	161	kinship	"...they have four and five wives…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	161	slaves	"...they have many slaves imprioned in wooden stocks…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	161	social valuables	"...they have large numbers of parrots and eagles…in cages…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	161	warfare	"...they are pugnacious warriors and enemies of those of the valley of Cinaro, Corazones, Guaraspi, and Cumupa."	Oera
Obregon 1928	Book 1, XXIV	Obregón	161	warfare	"They …carry on war for it with the people of Batuco…"	Oera
Obregon 1928	Book 1, XXIV	Obregón	161	wealth generation	"...they exchange these slaves and sell them for blankets, salt, feathers, and provisions."	Oera
Obregon 1928	Book 1, XXIV	Obregón	161	wealth generation	Barter foodstuffs for glass and iron articles.	Oera
Obregon 1928	Book 1, XXIV	Obregón	162	warfare	Arrow poison	Señora
Obregon 1928	Book 1, XXIV	Obregón	162	warfare	"A town of 100 settlers had been destroyed there" (Alcaraz's story)	Señora
Obregon 1928	Book 1, XXIV	Obregón	163	gifts	"...they presented the governor with a quantity of provision as they had in their country…"	Señora
Obregon 1928	Book 1, XXIV	Obregón	163	kinship	"...said that they had killed them because they took their wives and daughters for dishnorable purposes…"	Señora
Obregon 1928	Book 1, XXIV	Obregón	163	kinship	Mestizo children of Alcaraz group now living in Caguaripa	Señora
Obregon 1928	Book 1, XXIV	Obregón	163	social valuables	"...showing great desire for the equipment and trappings of the Chrisitians…(iron for cutting)"	Señora
Obregon 1928	Book 1, XXIV	Obregón	163	warfare	"...there 400 Indians equipped with arms of all sorts such as…came to meet him…"	Señora
Obregon 1928	Book 1, XXIV	Obregón	163	warfare	"Said that they had killed them because they took their wives and daughters for dishnorable purposes…"	Señora
Obregon 1928	Book 1, XXIV	Obregón	164	feasting	Drinking cactus fruit alcohol	Señora
Obregon 1928	Book 1, XXIV	Obregón	164	kinship	"...to get it [salt] and to obtain women slaves and wives they carry on wars with their neighbors…"	Señora
Obregon 1928	Book 1, XXIV	Obregón	164	surplus production	"...they are good growers of corn, beans, calabashes, and melons…"	Señora
Obregon 1928	Book 1, XXIV	Obregón	164	warfare	"...they are enemies of and carry on wars with the peoples of Oera, Uparo, Yaquimy, and those of the coast."	Señora
Obregon 1928	Book 1, XXIV	Obregón	164	warfare	poison arrows	Señora
Obregon 1928	Book 1, XXIV	Obregón	164	warfare	"...to get it [salt] and to obtain women slaves and wives they carry on wars with their neighbors…"	Señora

Obregon 1928	Book 1, XXIV	Obregón	165	warfare	Speaking of coastal groups: "They quarter those whom they kill in war and distribute and hang them in their houses and terraces…"	Uparo?
Obregon 1928	Book 1, XXV	Obregón	166	warfare	Long diatribe about "bloodthirsty butchers"	Señora
Obregon 1928	Book 1, XXV	Obregón	167	warfare	"They again assembled in a council of war…"	Señora
Obregon 1928	Book 1, XXV	Obregón	168	kinship	More on Alcaraz' party	Señora
Obregon 1928	Book 1, XXV	Obregón	168	warfare	More on Alcaraz' party	Señora
Obregon 1928	Book 1, XXV	Obregón	173	irrigation	irrigation	Guaraspi
Obregon 1928	Book 1, XXV	Obregón	174	social valuables	"...200 good looking men, well equipped with arms, clothes, and feather adornments, came to meet the army…"	Cumupa
Obregon 1928	Book 1, XXV	Obregón	174	warfare	"They are a warlike people as was to be expected from neighbors of the Querechos."	Cumupa
Obregon 1928	Book 1, XXV	Obregón	174	warfare	"They are greedy….and versed in the art and practise of war."	Guaraspi
Obregon 1928	Book 1, XXV	Obregón	174	wealth generation	"In these towns the natives came to meet the army with provisions, and to barter for what we had."	Guaraspi
Obregon 1928	Book 1, XXV	Obregón	175	irrigation	"...a valley one league in extent entirely given over to irrigated fields."	Cumupa
Obregon 1928	Book 1, XXV	Obregón	175	slaves	"...took away the booty, spoils, and slaves…"	Cumupa
Obregon 1928	Book 1, XXV	Obregón	175	warfare	Reference to their plan to attack Ibarra	Caguaripa
Obregon 1928	Book 1, XXV	Obregón	175	warfare	Dead bodies, heads, arms, legs, tongues, and ears were hanging in the streets and prominent places	Cumupa
Obregon 1928	Book 1, XXV	Obregón	175	warfare	Describe a battle three days ago between natives	Cumupa
Obregon 1928	Book 1, XXVI	Obregón	177	warfare	Reference to their plan to attack Ibarra.	Caguaripa
Obregon 1928	Book 1, XXVI	Obregón	178	warfare	"...they signaled one another from the different towns and provinces…"	Caguaripa
Obregon 1928	Book 1, XXVI	Obregón	178	warfare	Attack on the horses.	Caguaripa
Obregon 1928	Book 1, XXVI	Obregón	179	warfare	"These people are very skillfull, warlike, and better versed in the use and practise of war than all the other…"	Caguaripa
Obregon 1928	Book 1, XXVI	Obregón	180	warfare	"They had placed their women and children on top of the fortress and supplied them with qunatities of stones, clubs…"	Caguaripa
Obregon 1928	Book 1, XXVI	Obregón	185	warfare	Summary of battle of Caguaripa and how brave the Spanish are.	Caguaripa
Obregon 1928	Book 1, XXVII	Obregón	188	feasting	planned in advance to celebrate victory over Spansih	Caguaripa
Obregon 1928	Book 1, XXVII	Obregón	188	warfare	Natives attack with 2000 Indians in three divisions.	Caguaripa
Obregon 1928	Book 1, XXVII	Obregón	192	warfare	Another war council called with smoke signals.	Caguaripa
Obregon 1928	Book 1, XXVII	Obregón	192	warfare	Cinaro kills Spanish settlers.	Caguaripa

Obregon 1928	Book 1, XXVII	Obregón	193	warfare	Confederation ends because Spanish reach limites of their territory.	Serrana
Obregon 1928	Book 1, XXVII	Obregón	195	ideology	"They have preachers and exhorters of their idolatry and wars."	Serrana
Obregon 1928	Book 1, XXVII	Obregón	195	warfare	"They are aggressive warriors…"	Serrana
Obregon 1928	Book 1, XXVIII	Obregón	198	warfare	"He fought until his strength and arrows gave out…"	Chihuahua or Bavispe?
Obregon 1928	Book 1, XXXVII	Obregón	256	warfare	"...which had been hostile in the past, and who showed their unfriendliness by killing some of the horses upon our arrival."	Señora
Obregon 1928	Book 1, XXXVII	Obregón	257	social valuables	"They wore their typcial dress, decorated with bright feathers, conches, beads, and sea-shells. They were will equipped with weapons…"	Yaquimi
Obregon 1928	Book 1, XXXVII	Obregón	257	warfare	"It seems they are enemies of the people of the Señora valley and those of Yaquimi."	Pinebaroca
Obregon 1928	Book 1, XXXVII	Obregón	257	warfare	"They are enemies of the people in the valley of Señora and those of Yaquimi"	Uparo
Obregon 1928	Book 1, XXXVII	Obregón	258	gifts	"The natives presented the Christians with gifts of fish, game, and other food…"	Yaquimi
Obregon 1928	Book 1, XXXVII	Obregón	259	feasting	Description of a communal hunt: "This hunt was the most showy and brilliant I ever saw…"	Yaquimi
Obregon 1928	Book 1, XXXVII	Obregón	259	warfare	"The Indians entered that region with much determination and courage, killing the people and plundering and destryoing the houses and fields of their enemies."	around Mayonbo
Obregon 1928	Book 1, XXXVII	Obregón	259	warfare	"At the same time they intended to go attack their enemies of Mayonbo"	Yaquimi
Obregon 1928	Book 1, XXXVII	Obregón	260	slaves	"...as a sign of friendship he (Ibarra) returned the captives that had been taken in war (by the Yaquimi)."	around Mayonbo
Obregon 1928	Book 1, XXXVII	Obregón	260	surplus production	"The river region is fertile, having good lands well planted with corn, beans, and calabashes."	Mayonobo
Obregon 1928	Book 1, XXV	Obregón	169-170	warfare	Ambush plan on Ibarra	Señora
Obregon 1928	Book 1, XXV	Obregón	171-173	warfare	Arrow poison	Serrana
Obregon 1928	Book 1, XXVI	Obregón	180-183	warfare	the battle of Caguripa	Caguaripa
Obregon 1928	Book 1, XXVII	Obregón	187-188	warfare	Native war council makes plans.	Caguaripa
Obregon 1928	Book 1, XXVII	Obregón	188-191	warfare	Summary of second battle of Caguaripa.	Caguaripa

Sub-appendix B
Flora Species List

Madrean Evergreen Woodland

Lower Elevation

Quercus chihuahuensis	Chihuahua Oak
Quercus oblongifolia	Mexican Blue Oak
Quercus albocincta	
Quercus emoryi	Emory Oak
Quercus arizonica	Arizona White Oak
Quercus santaclarensis	Santa Clara Oak
Pinus cembroides	Mexican Pinyon
Cupressus arizonica	Arizona Cypress
Arbutus arizonica	Arizona Madrone
Arbutus texana	Texas Madrone
Cactus and other plants	
Echinocereus pectinatus	Rainbow Cactus
Ferocactus wislizeni	Barrel Caactus
Opuntia spinosior	Cane Cholla
Opuntia phaeacantha	Engelmann Prickly Pear
Opuntia violacea	Purple Prickly Pear
Yucca schottii	Schott Yucca
Yucca baccata	Thornber Yucca
Agave palmeri	Palmer Agave
Agave parryi	Parry Agave
Nolina microcarpa	Beargrass
Mammillaria gummifera	Cream Cactus
Mammillaria orestera	Pincushion
Echinocereus triglochidiatus	Red Hedgehog Cactus
Echinocereus ledingii	Hedgehog Cactus
Coryphantha recurvata	Hens and Chicks Cactus

Higher Elevation

Pinus engelmannii	Apache Pine
Pinus leiophylla	Chihuahua Pine
Pinus ponderosa	Arizona Pine
Pinus lumholtzii	Pino Triste
Pinus durangensis	Durango Pine
Quercus viminea	
Quercus hypoleucoides	Silver-leaf Oak
Quercus pennivenia	Hand Basin Oak
Quercus epileuca	
Quercus fulva	
Quercus rugosa	Netleaf Oak

Chaparral

Arctostaphylos pungens	Mexican Manzanita
Cenothus huichagorare	Buckbush
Cerocarpus montanus	Alderleaf Mountain-mahogany
Cowania mexicana	Cliffrose
Garrya wrightii	Wright Silktassel
Quercus toumeyi	Toumey Oak
Rhamnus betulaefolia	Birchleaf Buckthorn
Rhus choriophylla	Mearns Sumac
Rhus trilobata	Squawbush
Vauquelinia californica	Rosewood
Erythrina flabelliformis	Southwestern Coralbean
Eysenhardtia orthocarpa	Kidneyweed
Cassia leptocarpa	Slimpod Senna
Dodonaea viscosa	Hopbush
Mimosa biuncifera	Wait-a-Minute
Mimosa dysocarpa	Velvet-pod Mesquite
Understory Grasses	
Muhlenbergia emersleyi	Bullgrass
Muhlenbergia torreyi	Ring-grass
Muhlenbergia porteri	Bush Muhly
Elyonurus brbiculmis	Wolfspike
Bothriochloa barbinodis	Cane Bluestem
Lycurus phleoides	Woltail
Schizachyrium scoparium	Little Bluestem
Eragrostis intermedia	Plains Lovegrass
Bouteloua gracilis	Blue Grama
Bouteloua curtipendula	Sideoats Grama
Bouteloua hirsuta	Hairy Grama
Heteropogon contortus	Tanglehead
Leptochloa dubia	Green Spranglestop
Brickellia spp.	Bricklebush
Salvia spp.	Sage
Dalea spp.	Indigo-bush
Eriogonum spp.	Buckwheat
Artemesia ludoviciana	Louisiana Sagebrush
Cyperus spp.	Flatsedge
Hibiscus spp.	Rose-mallow
Oxalis spp.	Woodsorrel
Phaseolus spp.	Bean

Madrean Montane Conifer Forest

Canopy

Pinus ponderosa	Ponderosa Pine
Pseudotosuga menziesii	Douglas Fir
Pinus strobiformis	Southwestern White Pine
Abies concolor	White Fir
Pinus engelmannii	Apache Pine
Quercus fulva	
Quercus pennivenia	
Quercus arizonica	Arizona White Oak
Quercus grisea	Gray Oak
Quercus viminea	
Quercus hypoleucoides	Silver-leaf Oak
Quercus rugosa	Netleaf Oak
Ceanothus huichugore	Fendler Ceanothus
Arbutus arizonica	Arizona Madrone

Understory

Ceanothus fendleri	Fendler Ceanothus
Berberis repens	Creeping Mahonia
Rhus glabra	Smooth Sumac
Ribes aureum	Golden Currant
Ribes viscosissimum	Sticky Currant
Ribes pinetorum	Orange Gooseberry
Rosa arizonica	Arizona Rose
Sambucus cerullea	Blue Elderberry
Sambucus velutina	Velvet Elder
Symphoricarpos longiflorus	Longflowered Snowberry
Symphoricarpos oreophilus	Mountain Snowberry
Symphoricarpos utahensis	Utah Snowberry
Symphoricarpos rotundifolius	Roundleaf Snowberry
Holodiscus domosus	Bush Roskspirea
Physocarpus mongynus	Ninebark
Muhlenbergia montana	Mountain Muhly
Muhlenbergia virescens	Screwleaf Muhly
Blepharoneuron tricholepis	Pine Dropseed
Bromus anomalus	Nodding Brome
Bromus ciliatus	Fringed Brome
Festuca arizonica	Arizona Fescue
Koeleria cristata	Prairie Junegrass
Muhlenbergi minutissima	Littleseed Muhly
Panicum bulbosum	Bulb Panicum
Poa fendleriana	Fendler Bluegrass
Poa pratensis	Kentucky Bluegrass
Sitanion hystrix	Bottlebrush Squirreltail
Stipa pringlei	Pringle Needlegrass
Carex geophila	Dryland Sedge
Cyperus fendlerianus	Fendler Flatsedge

Sinaloan Thornscrub

Ubiquitous

Acacia angustissima	Whiteball Acacia
Acacia constricta	Whitethorn Acacia
Acacia cymbispina	Espino
Acacia farnesiana	Sweet Acacia
Acacia pennatula	Feather Acacia
Aloysia palmeri	Lippia
Ambrosia cordifolia	Chicurilla
Bursera odorata	Torote
Caesalpinia pumila	
Ceiba acuminata	Pochote
Celtis pallida	Desert Hackberry
Cercidium sonorae	Sonoran Paloverde
Dodonaea viscosa	Hopbush
Encelia farinosa	
Eysenhardtia orthocarpa	
Fouquieria macdougalii	Tree Ocotillo
Guaiacum coulteri	Giauacán
Haematoxylon brasiletto	Brasil
Ipomoea arborescens	Tree Morning-glory
Jacquinia pungens	San Juan
Jatropha cardiophylla	Limber Bush
Karwinskia humboldtiana	Coyotillo
Lantana velutina	Lantana
Lysiloma divaricata	Lysiloma
Mimosa laxia	Gatuña
Olneya tesota	Ironwood
Piscidia mollis	Palo Blanco
Randia obcordata	Papachillo
Sapium biloculare	Yerba de la Flecha
Stenocereus thurberi	Organ Pipe Cactus
Pachycereus pecten-aboriginum	Hecho
Opuntia comonduensis	Prickly Pear
Opuntia fulgida	Jumping Cholla
Lophocereus schottii	Senita
Agave schott	Schott Agave
Agave ocahui	Ocahui

Slopes

Acacia willardiana	Palo Blanco
Coursetia glandulosa	Chino
Bursera confusa	Torote
Brongniartia alamosana	Vara Prieta
Erythrina flabelliformis	Southwestern Coralbean

Bottom lands

Pithecellobium sonorae	Uña de Gato
Pithecellobium mexicanum	Palo Chino
Acacia occidentalis	Desota
Prosopis juliflora	Mesquite
Forchammeria watsoni	Jito
Lycium berlandieri	Cilindrillo
Zizyphus obtusifolia	Gray-leaved Abrojo
Condalia spathulata	Knife-leaf Condalia
Karwinski parviflora	Coyotillo
Jatropha cinerea	Zapo
Atamisquea emarginata	Sonoran Caper
Guazuma ulmifolia	Guacimilla
Acacia cymbispina	Espino
Bumelia occidentalis	Gum Bumelia
Cassia emarginata	Mora Hedionda
Cordia sonorae	Palo de Asta
Hymenoclea monogyra	Burrobush
Parthenium stramonium	Ocotillo
Pithecellobium dulce	Guamuchil
Plumeria acutifolia	Frangipani
Sapindus saponaria	Soap Berry
Stegnosperma sp.	Ojo de Anate
Vitex mollis	Obalamo
Albizzia sinaloensis	Bolillo
Caesalpinia platyloba	Palo Colorado
Celtis iguanaea	Garabato
Jacobinia ovata	Espuela de Caballero
Pisonia capitala	Garabato Prieto
Pithecellobium mexicanum	Palo Chino
Randia echinocarpa	Papache
Solanum amazonium	Mala Mujer
Vallesia glabra	Cacarahue
Zizyphus sonorensis	Jujube

Sinaloan Decidous Forest

Slopes

Acacia coulteri	Coulter Acacia
Arundinaria longifolia	Longleaf Cane
Bursera fragilis	Tacamahaca
Bursera grandifolia	Chutama
Bursera epinnata	
Bursera stenophylla	Torote Blanco
Caesalpinia platyloba	Palo Colorado
Caesalpinia standleyi	
Callinandra rupestris	
Cassia biflora	
Cassia emarginata	Palo de Zorillo
Ceiba acuminata	Pochote
Cephalocereus alensis	Billygoat Cactus
Stenocereus thurberi	Organ Pipe Cactus
Conzattia sericea	Navío
Coutarea latiflora	Palo Amargo
Cassia pterosperma	Caparche
Croton fragilis	Vara Blanca
Haematoxylon brasiletto	Brasil
Hybanthus mexicanus	Green Violet
Ipomoea arborescens	Tree Mogning-glory
Jatropha cordata	Copalillo
Jatropha platanifolia	Ensangregrado
Lemaireocereus montanus	
Lysiloma divaricata	Mauto
Lysiloma watsoni	Tepeguaje
Pachycereus pecten-aboriginum	Hecho
Pisonia capitata	Garabato Prieto
Tabebui chrysantha	Amapa
Tabebui palmeri	Amapa
Willardia mexicana	Nesco
Wimmeria mexicana	Cedilla

Bottom lands

Ambrosia ambrosiodes	Bursage
Baccharis salicifolia	Seep Willow
Caesalpinia pulcherrima	Red Bird of Paradise
Cassia emarginata	Palo de Zorillo
C. occidentalis	Coffee Senna
Celtis iguanea	Garabato
Cochlospermum vitifolium	Palo Brazil
Ficus cotinifolia	Amate Prieto
F. padifolia	Nacapuli
Guazuma ulmifolia	Guacimilla
Haematoxylon brasiletto	Brasil
Hymenoclea monogyra	Burrobush
Leucaena lanceolata	Bolillo
Lysiloma divaricata	Mauto
Montanoa rosei	Batayáqui
Opuntia spp.	
Pachycereus pecten-aboriginum	Hecho
Piscidia mollis	Palo Blanco
Pisonia capitata	Garabato Prieto
Pithecellobium dulce	Guamuchil
Pithecellobium mexicanum	Palo Chino
Pithecellobium undulatum	Palo Fierro
Platanus racemosa	Sycamore
Randia echinocarpa	Papache
Sassafridium macrophullum	Lauretón
Solanum madrense	Sierrra Madre Nightshade
Solanum verbascifolium	Cornetón del Monte
Stemmedenia palmeri	Baraco
Taxodium mucronatum	Ahuehuete
Tithonia fruticosa	Mexican Sunflower
Urera caracasana	Ortiguilla
Vitex mollis	Obalamo

Sonora Savannah Grassland

Grasses

Bouteloua rothrockii	Rothrock Grama
Aristida hamulosa	Poverty Three-awn
Aristida wrighti	Wright Three-awn
Aristida ternipes	Spider Grass
Aristida californica	
Bouteloua aristidoides	Needle Grama
Bouteloua radicosa	
Bouteloua filiformis	Slender Grama
Bouteloua parryi	Parry Grama
Bouteloua barbata	Six-weeks Grama
Cathestecum erectum	False Gama
Heteropogon contortus	Tanglehead
Hilaria belangeri	Curly Mesquite Grass
Panicum obtusum	Vine Mesquite Grass
Bouteloua curtipendula	Sidoats Gama
Shrubs	
Ambrosia	Ragweed
Portulaca	Purslane
Euphorbia	Spurge
Boerhaavia	Spiderling
Janusia gracilis	Janusia
Isomeris	Bladderpod
Croton sonorae	Croton
Amaranthus palmeri	Palmer Amaranth

Trees

Prosopis velutina	Velvet Mesquite
Olneya tesota	Ironwood
Cercidium microphyllum	Little-leaf Paloverde
Cercidium floridum	Blue Paloverde
Cercidium praecox	Palo Brea
Parkinsonia aculeata	Retama
Guaciacum coulteri	Guayacan
Atamisquea emarginata	Sonoran Caper
Acacia angustissima	Whiteball Acacia
Acacia farnesiana	Sweet Acacia

Sub-appendix C
Fauna Species List

Mammals

Madrean Evergreen Woodland

Species	Common Name
Antrozous pallidus	Pallid bat
Bassariscus astutus	Ringtail
Bison bison	Bison!
Canis latrans	Coyote
Chaetodipus baileyi	Bailey's pocket mouse!
Chaetopidus intermedius	Rock pocket mouse
Chaetopidus penicillatus	Desert pocket mouse
Choeronycteris mexicana	Mexican long-tonqued bat
Conepactus mesoleucus	Western hog-nosed skunk!
Corynorhinus townsendii	Townsend's big-eared bat
Didelphis virginiana	Opossum!
Dipodomys merriami	Merriam's kangaroo rat
Eptesicus fuscus	Big brown bat
Euderma maculatum	Spotted bat
Eumops perotis	Western mastiff bat
Idionycteris phyllotis	Allen's big-eared bat
Lasiurus borealis	Red bat
Lasiurus cinereus	Hoary bat
Lasiurus ega	Southern yellow bat
Leptonycteris curasoae	Southern long-nosed bat!
Lepus californicus	Black-tailed jackrabbit
Lynx rufus	Bobcat
Mephitis macroura	Hooded skunk
Mephitis mephitis	Striped skunk
Mormoops megalophylla	Ghost faced bat
Myotis auriculus	Southwestern myotis
Myotis califorinicus	California myotis
Myotis ciliolabrum	Western small-footed myotis
Myotis thysanodes	Fringed myotis!
Mytois velifer	Myotis velifer!
Mytois yumanensis	Yuma myotis
Nasua narica	Coati
Neotoma albigula	White-throated woodrat
Neotoma mexicana	Mexican woodrat
Nyctinomops femorosaccus	Pocketed free-tailed bat
Nyctinomops macrotis	Big free-tailed bat
Odocoileus virginianus	White-tailed deer
Pecari tajacu	Javelina*
Peromyscus leucopus	White-footed mouse
Peromyscus merriami	Mesquite mouse
Pipistrellus hesperus	Western pipistelle
Procyon lotor	Northern raccoon
Puma concolor	Cougar
Reithrodontomys fulvescens	Fulvous harvest mouse
Reithrodontomys megalotis	Western harvest mouse
Reithrodontomys montanus	Plains harvest mouse
Sciurus nayaritensis	Apache squirrel
Sciurus nayaritensis	Mexican fox squirrel
Sigmodon arizonae	Arizona cotton rat
Sigmodon fulviventer	Tawny-bellied cotton rat
Sigmodon hispidus	Hispid cotton rat
Sigmodon ochrognathus	Yellow-nosed cotton rat
Spermophilus variegatus	Rock squirrel
Spilogale gracilis	Western spotted skunk
Sylvilagus audobonii	Desert cottontail!
Sylvilagus floridanus	Eastern cottontail
Tadarida brasiliensis	Brazilian free-tailed bat
Taxidea taxus	American badger
Thomomys umbrinus	Southern pocket gopher
Urocyon cinereoagenteus	Common gray fox
Ursus arctos	(Mexican) Grizzly bear

Madrean Montain Conifer Forest

Species	Common Name
Antrozous pallidus	Pallid bat
Bassariscus astutus	Ringtail
Callospermophilus lateralis	Golden-mantled ground squirrel
Canis latrans	Coyote
Canis lupus	Gray wolf
Cervus elaphus	Elk*
Chaetopidus intermedius	Rock pocket mouse
Chaetopidus penicillatus	Desert pocket mouse
Didelphis virginiana	Opossum!
Dipodomys merriami	Merriam's kangaroo rat
Eptesicus fuscus	Big brown bat
Erethizon dorsatum	Porcupine
Euderma maculatum	Spotted bat
Eumops underwoodi	Underwood's mastiff bat
Idionycteris phyllotis	Allen's big-eared bat
Lasiurus borealis	Red bat
Lasiurus cinereus	Hoary bat
Lasiurus ega	Southern yellow bat
Lepus californicus	Black-tailed jackrabbit
Lynx rufus	Bobcat
Mephitis mephitis	Striped skunk
Microtus longicaudus	Long-tailed Vole!
Microtus mexicanus	Mexican vole
Microtus montanus	Montane vole!
Mustela frenata	Long-tailed weasel
Myotis auriculus	Southwestern myotis
Myotis califorinicus	California myotis
Myotis ciliolabrum	Western small-footed myotis
Myotis evotis	Long-eared myotis
Myotis volans	Long-legged myotis
Mytois velifer	Myotis velifer!
Mytois yumanensis	Yuma myotis
Nasua narica	Coati
Neotamias canipes	Gray-footed chipmunk!

Species	Common Name
Neotamias cinereicollis	Gray-collared chipmunk!
Neotamias quadrivittatus	Colorado chipmunk!
Neotamias umbrinus	Uinta chipmunk!
Neotoma albigula	White-throated woodrat
Neotoma mexicana	Mexican woodrat
Odocoileus hemionus	Mule deer
Odocoileus virginianus	White-tailed deer
Peromyscus boylii	Brush mouse
Peromyscus maniculatus	Deer mouse
Procyon lotor	Northern raccoon
Puma concolor	Cougar
Reithrodontomys fulvescens	Fulvous harvest mouse
Reithrodontomys megalotis	Western harvest mouse
Reithrodontomys montanus	Plains harvest mouse
Sciurus aberti	Abert's squirrel
Sorex merriami	Merriam's shrew!
Sorex nanus	Dwarf shrew!
Spermophilus variegatus	Rock squirrel
Spilogale gracilis	Western spotted skunk
Sylvilagus floridanus	Eastern cottontail
Sylvilagus nuttallii	Nuttall's cottontail!
Tadarida brasiliensis	Brazilian free-tailed bat
Tamiasciurus hudsonicus	Red squirrel!
Taxidea taxus	American badger
Thomomys umbrinus	Southern pocket gopher
Urocyon cinereoagenteus	Common gray fox
Ursus americanus	American black bear
Ursus arctos	(Mexican) Grizzly bear

Sinaloan Decidous Forrest

Species	Common Name
Antrozous pallidus	Pallid bat
Baiomys taylori	Northern pygmy mouse
Bassariscus astutus	Ringtail
Canis latrans	Coyote
Chaetodipus pernix	Sinaloan pocket mouse!
Choeronycteris mexicana	Mexican long-tonqued bat
Conepactus mesoleucus	Western hog-nosed skunk
Corynorhinus townsendii	Townsend's big-eared bat
Dipodomys merriami	Merriam's kangaroo rat
Eptesicus fuscus	Big brown bat
Eumops perotis	Western mastiff bat
Eumops underwoodi	Underwood's mastiff bat
Herpailurus yaguarondi	Jaguarundi
Idionycteris phyllotis	Allen's big-eared bat!
Lasiurus borealis	Red bat
Lasiurus cinereus	Hoary bat!
Lasiurus ega	Southern yellow bat
Leoparadus paradalis	Ocelot
Leptonycteris curasoae	Southern long-nosed bat
Lepus alleni	Antelope jackrabbit!
Liomys pictus	Painted spiny pocket mouse!
Lynx rufus	Bobcat
Mephitis macroura	Hooded skunk
Mephitis mephitis	Striped skunk
Mormoops megalophylla	Ghost faced bat
Myotis auriculus	Southwestern myotis
Myotis califorinicus	California myotis
Myotis ciliolabrum	Western small-footed myotis!
Mytois yumanensis	Yuma myotis
Nasua narica	Coati
Neotoma albigula	White-throated woodrat
Neotoma mexicana	Mexican woodrat
Nyctinomops femorosaccus	Pocketed free-tailed bat
Nyctinomops macrotis	Big free-tailed bat

Species	Common Name
Odocoileus virginianus	White-tailed deer
Onychomys torridus	Southern grasshopper mouse
Oryzomys couesi	Coues' Rice Rat!
Panthera onca	Jaguar
Pecari tajacu	Javelina*
Peromyscus eremicus	Cactus mouse
Peromyscus leucopus	White-footed mouse
Peromyscus merriami	Mesquite mouse
Pipistrellus hesperus	Western pipistelle
Procyon lotor	Northern raccoon
Puma concolor	Cougar
Reithrodontomys fulvescens	Fulvous harvest mouse
Reithrodontomys megalotis	Western harvest mouse
Sciurus colliaei	Collie's squirrel!
Sigmodon arizonae	Arizona cotton rat
Sigmodon fulviventer	Tawny-bellied cotton rat
Spermophilus variegatus	Rock squirrel
Spilogale gracilis	Western spotted skunk
Sylvilagus floridanus	Eastern cottontail
Syvilagus cunicular	Mexican cottontail
Tadarida brasiliensis	Brazilian free-tailed bat
Taxidea taxus	American badger
Urocyon cinereoagenteus	Common gray fox

Sinaloan Thornscrub

Species	Common Name
Ammospermophilus harrisii	Harris' antelope squirrel!
Antrozous pallidus	Pallid bat
Bassariscus astutus	Ringtail
Canis latrans	Coyote
Chaetodipus pernix	Sinaloan pocket mouse
Chaetopidus intermedius	Rock pocket mouse
Chaetopidus penicillatus	Desert pocket mouse
Choeronycteris mexicana	Mexican long-tonqued bat
Conepactus mesoleucus	Western hog-nosed skunk
Corynorhinus townsendii	Townsend's big-eared bat
Dipodomys merriami	Merriam's kangaroo rat
Eptesicus fuscus	Big brown bat
Eumops perotis	Western mastiff bat
Eumops underwoodi	Underwood's mastiff bat!
Herpailurus yaguarondi	Jaguarundi
Idionycteris phyllotis	Allen's big-eared bat!
Lasiurus borealis	Red bat
Lasiurus ega	Southern yellow bat
Leoparadus paradalis	Ocelot
Leptonycteris curasoae	Southern long-nosed bat
Lepus alleni	Antelope jackrabbit
Lepus californicus	Black-tailed jackrabbit
Liomys pictus	Painted spiny pocket mouse
Lynx rufus	Bobcat
Mephitis macroura	Hooded skunk
Mephitis mephitis	Striped skunk
Mormoops megalophylla	Ghost faced bat
Myotis auriculus	Southwestern myotis
Myotis califorinicus	California myotis
Myotis ciliolabrum	Western small-footed myotis
Mytois yumanensis	Yuma myotis
Nasua narica	Coati
Neotoma albigula	White-throated woodrat
Neotoma mexicana	Mexican woodrat

Species	Common Name
Nyctinomops femorosaccus	Pocketed free-tailed bat
Nyctinomops macrotis	Big free-tailed bat
Odocoileus hemionus	Mule deer
Odocoileus virginianus	White-tailed deer
Onychomys torridus	Southern grasshopper mouse
Oryzomys couesi	Coues' rice rat!
Panthera onca	Jaguar
Pecari tajacu	Javelina*
Peromyscus eremicus	Cactus mouse
Peromyscus leucopus	White-footed mouse
Peromyscus merriami	Mesquite mouse
Pipistrellus hesperus	Western pipistelle
Procyon lotor	Northern raccoon
Puma concolor	Cougar
Reithrodontomys fulvescens	Fulvous harvest mouse
Reithrodontomys megalotis	Western harvest mouse
Reithrodontomys montanus	Plains harvest mouse
Sigmodon arizonae	Arizona cotton rat
Sigmodon fulviventer	Tawny-bellied cotton rat
Sigmodon hispidus	Hispid cotton rat
Sigmodon ochrognathus	Yellow-nosed cotton rat
Spermophilus spilosoma	Spotted ground squirrel
Spermophilus variegatus	Rock squirrel
Spilogale gracilis	Western spotted skunk
Sylvilagus audobonii	Desert cottontail
Sylvilagus floridanus	Eastern cottontail
Syvilagus cunicular	Mexican cottontail
Tadarida brasiliensis	Brazilian free-tailed bat
Taxidea taxus	American badger
Urocyon cinereoagenteus	Common gray fox

Sonora Savannah Grassland

Species	Common Name	Species	Common Name
Ammospermophilus harrisii	Harris' antelope squirrel!	Odocoileus virginianus	White-tailed deer
Antilocapra americana sonoriensis	Sonoran pronghorn	Onychomys torridus	Southern grasshopper mouse
Antrozous pallidus	Pallid bat	Pecari tajacu	Javelina*
Bison bison	Bison!	Perognathus flavus	Silky pocket mouse!
Canis latrans	Coyote	Peromyscus eremicus	Cactus mouse
Chaetopidus penicillatus	Desert pocket mouse	Peromyscus merriami	Mesquite mouse
Choeronycteris mexicana	Mexican long-tonqued bat	Pipistrellus hesperus	Western pipistelle
Conepactus mesoleucus	Western hog-nosed skunk	Procyon lotor	Northern raccoon
Corynorhinus townsendii	Townsend's big-eared bat	Puma concolor	Cougar
Dipodomys merriami	Merriam's kangaroo rat	Reithrodontomys fulvescens	Fulvous harvest mouse
Eptesicus fuscus	Big brown bat	Reithrodontomys megalotis	Western harvest mouse
Eumops underwoodi	Underwood's mastiff bat!	Reithrodontomys montanus	Plains harvest mouse
Lasiurus borealis	Red bat	Sigmodon arizonae	Arizona cotton rat
Lasiurus ega	Southern yellow bat	Sigmodon fulviventer	Tawny-bellied cotton rat
Leoparadus paradalis	Ocelot	Spermophilus spilosoma	Spotted ground squirrel
Leptonycteris curasoae	Southern long-nosed bat	Spermophilus tereticaudus	Round-tailed ground squirrel!
Lepus alleni	Antelope jackrabbit	Spermophilus variegatus	Rock squirrel
Lepus californicus	Black-tailed jackrabbit	Spilogale gracilis	Western spotted skunk
Liomys pictus	Painted spiny pocket mouse!	Sylvilagus audobonii	Desert cottontail
Lynx rufus	Bobcat	Sylvilagus floridanus	Eastern cottontail!
Mephitis macroura	Hooded skunk	Tadarida brasiliensis	Brazilian free-tailed bat
Mephitis mephitis	Striped skunk	Urocyon cinereoagenteus	Common gray fox
Mormoops megalophylla	Ghost faced bat		
Mustela nigripes	Black-footed ferret!		
Myotis auriculus	Southwestern myotis		
Myotis califorinicus	California myotis		
Myotis ciliolabrum	Western small-footed myotis		
Mytois yumanensis	Yuma myotis		
Neotoma albigula	White-throated woodrat		
Neotoma mexicana	Mexican woodrat		
Nyctinomops femorosaccus	Pocketed free-tailed bat		
Nyctinomops macrotis	Big free-tailed bat		

! Reported in neighboring region; * possibly a recent introduction

Fish

Species	Common English	Distribution
Agosia sp.	Mexican longfin dace	all
Campostoma ornatum	Mexican stoneroller	all
Catostomus bernardini	Yaqui sucker	Bavispe, Moctezuma
Catostomus leopoldi	Bavispe/Fleshylip sucker	Bavispe
Catostomus wigginsi	Opata sucker	San Miguel, Sonora
Codoma ornata	Ornate minnow	Bavispe
Cyprinella formosa	Beautiful shiner	Bavispe, Moctezuma
Gila eremica	Desert chub	all
Gila minacae	Meek Mexican roudtail chub	Bavispe
Gila purpurea	Yaqui chub	Bavispe
Ictalurus pricei	Yaqui catfish	all
Onocorhynchus sp.	Yaqui Trout	Bavispe
Pantosteus plebeius	Río Grande sucker	Bavispe
Poeciliopsis monachaoccidentalis		all
Poeciliopsis prolifica	blackstripie topminnow	Bavispe
Poeciliopsis sonoriensis	Yaqui/Sonora topminnow	all

Birds

Species	Name	Residence	Species	Name	Residence
Accipiter cooperii	Cooper's hawk	w	Botaurus lentiginosus	American bittern	w
Accipiter striatus	Sharp-shinned hawk	w	Bubo birginianus	Great horned owl	w & b
Actitis macularius	Spotted sandpiper	w	Bucephala albeola	Bufflehead	w
Aeronautes saxatalis	White-throated swift	w & b	Buteo jamaicensis	Red-tailed hawk	w & b
Agelaius phoeniceus	Red-winged blackbird	w	Buteo nitidus	Gray hawk	b
Aimophila botterii	Botteri's sparrow	w & b	Buteo regalis	Ferruginous hawk	w
Aimophila carpalis	Rufous-winged sparrow	w & b	Buteo swainsoni	Swainson's hawk	b
Aimophila ruficeps	Rufous crowned sparrow	w & b	Butorides virescens	Green heron	w & b
Aimphila quinquestriata	Five-striped sparrow	w & b	Calamospiza melanocorys	Lark bunting	w
Amazilia violiceps	Violet-crowned hummingbird	b	Calcarius ornatus	Chestnut-collard longspur	w
Ammodramus savannarum	Grasshopper sparrow	w	Calidris minutilla	Least sandpiper	w
Amphispiza belli	Sage sparrow	w	Callipepla gambeli	Gambel's quail	w & b
Amphispiza bilineata	Black-throated sparrow	w & b	Calypte anna	Anna's hummingbird	w
Anas acuta	Northern pintal	w	Calypte costae	Costa's hummingbird	w & b
Anas americana	American wigeion	w	Camptostoma imberbe	Northern berdless-tyrannulet	b
Anas americana	Redhead	w	Campylorhynchus brunneicapillus	Cactus wren	w & b
Anas clypeata	Northern shoveler	w	Caprimulgus vociferus	Whip-poor-will	b
Anas cyanoptera	Cinnamon teal	w	Cardellina rubrigrons	Red-faced warbler	b
Anas discors	Blue-winged teal	w	Cardinalis cardinalis	Northern cardinal	w & b
Anas platyrhynchos	Mallard	w & b	Cardinalis sinuatus	Pyrrhuloxia	w & b
Anas strepera	Gadwall	w	Carduelis psaltria	Lesser goldfinch	w & b
Anths rubescens	American pipit	w	Carpodacus mexicanus	House finch	w & b
Anthus spragueii	Sprague's pipit	w	Cathartes aura	Turkey vulture	w & b
Aphelocoma ultramarina	Mexican jay	w & b	Catherpes mexicanus	Canyon wren	w & b
Aquila chrysaetos	Golden eagle	w	Ceryle alcyon	Belted kingfisher	w
Ara militaris	Military macaw	r	Charadrius vociferus	Killdeer	w & b
Ardea alba	Great eagret	w	Chlorocerlyle americana	Green kingfisher	w & b
Ardea herodias	Great blue heron	w & b	Chondestes grammacus	Larck sparrow	w
Athene cunicularia	Burrowing owl	w & b	Chordeiles acutipennis	Lesser nighthawk	b
Auriparus flaviceps	Verdin	w & b	Chordeliles minor	Common nighthawk	b
Aytha affinis	Lesser scaup	w	Circus cyaneus	Northern harrier	w
Aythya collaris	Ring-necked duck	w	Cistothorus palustris	Marsh wren	w
Aythya valisineria	Canvasback	w	Coccyzus americanus	Yellow-billed cuckoo	b
Bombycilla cedrorum	Cedar waxwing	w	Colaptes auratus	Northern flicker	w
Colaptes chrysoides	Gilded flicker	w & b	Larus delawarensis	Ring-billed gull	w
Colins virginianus	Northern bobwhite	w & b	Limnodromus scolopaceus	Long-billed dowitcher	w

Columbina inca	Inca dove	w & b	Loxia curvirostra	Red crossbill	w & b
Columbina passerina	Common ground dove	w & b	Megascops kennicottii	Western screech-owl	w & b
Contopus sordidulus	Western wood-pewee	b	Melanerpes uropygialis	Gila woodpecker	w & b
Coragyps atratus	Black vulture	w & b	Melospiza lincolnii	Lincoln's sparrow	w
Corvus caurinus	Northwestern crow	w & b	Melospiza melodia	Song sparrow	w & b
Corvus corax	Common raven	w & b	Micrathene whitneyi	Elf owl	b
Crytonyx montezumae	Montezuma quail	w & b	Mimus polyglottos	Northern mockingbird	w & b
Cynanthus latirostris	Broad-billed hummingbird	b	Molothrus aenus	Bronzed cowbird	b
Dendrocygna autumnalis	Black-bellied whistling duck	b	Molothrus ater	Brown-headed cowbird	w & b
Dendroica coronata	Yellow-rumped warbler	w	Myadestes townsendii	Townsend's solitare	w & b
Dendroica graciae	Grace's warbler	b	Myiarchus cinerascens	Ash-throated flycatcher	w & b
Dendroica petechia	Yellow warbler	b	Myiarchus tuberculifer	Dusky-capped flycatcher	b
Egretta thula	Snowy eagret	w	Myiarchus tyrannulus	Brown-crested flycatcher	w
Empidonax fulvifrons	Buff-breasted flycatcher	b	Myioborus pictus	Painted redstart	b
Empidonax wrightii	Gray flycatcher	w	Numenius americanus	Long-billed curlew	w
Eugenes fulgens	Magificent hummingbird	w & b	Oreoscoptes montanus	Sage thrasher	w
Euphagus cyanocephalus	Brewer's blackbird	w	Oxyura jamaicensis	Ruddy duck	w & b
Falco columbarius	Merlin	w	Parabuteo unicinctus	Harris's hawk	w & b
Falco peregrinus	Peregrine falcon	w & b	Passerculus sandwichensis	Savannah sparrow	w
Falco sparverius	American kestrel	w & b	Passerina amonena	Lazuli bunting	w
Fulica americana	American coot	w & b	Passerina caerulea	Blue grosbeak	b
Gallinago delicata	Wilson's snipe	w	Passerina versicolor	Varied bunting	b
Gallinula chloropus	Common moorhen	w & b	Petrochelidon pyrrhonota	Cliff swallow	b
Geococcyx californianus	Greater roadrunner	w & b	Peucedramus taeniatus	Olive warbler	w & b
Geothylpis trichas	Common yellowthroat	w & b	Phainopepla nitens	Phainopepla	w & b
Glaucidium brasilianum	Ferruginous pygmy-owl	w & b	Phalaenoptilus nuttallii	Common poorwill	w & b
Icteria virens	Yellow-breasted chat	b	Pheucticus melanocephalus	Black-headed grosbeak	b
Icterus bullockii	Bullock's oriole	b	Picoides arizonae	Arizona woodpecker	w & b
Icterus cucullatus	Hooded oriole	b	Picoides scalaris	Ladder-backed woodpecker	w & b
Icterus parisorum	Scott's oriole	b	Pipilo maculatus	Spotted towhee	w & b
Junco phaeonotus	Yellow-eyed junco	w & b	Piplio chlorurus	Green-tailed towhee	w
Lampornis clemenciae	Blue-throated hummingbird	b	Piplio fuscus	Canyon towhee	w & b
Lanius ludovicanus	Loggerhead shrike	w & b	Piranga flava	Hepatic tanger	w & b
Species	Name	Residence	Species	Name	Residence
Piranga rubra	Summer tanger	b	Tyrannus vociferans	Cassin's kingbird	b
Podilymbus podiceps	Pied-billed grebe	w & b	Tyto alba	Barn owl	w & b
Polioptila caerulea	Blue-gray gnatcatcher	w & b	Vermivora celata	Orange-crowned warbler	w
Polioptila melanura	Black-tailed gnatcatcher	w & b	Vermivora luciae	Lucy's warbler	b
Porzana carolina	Sora	w	Vireo bellii	Bell's vireo	b

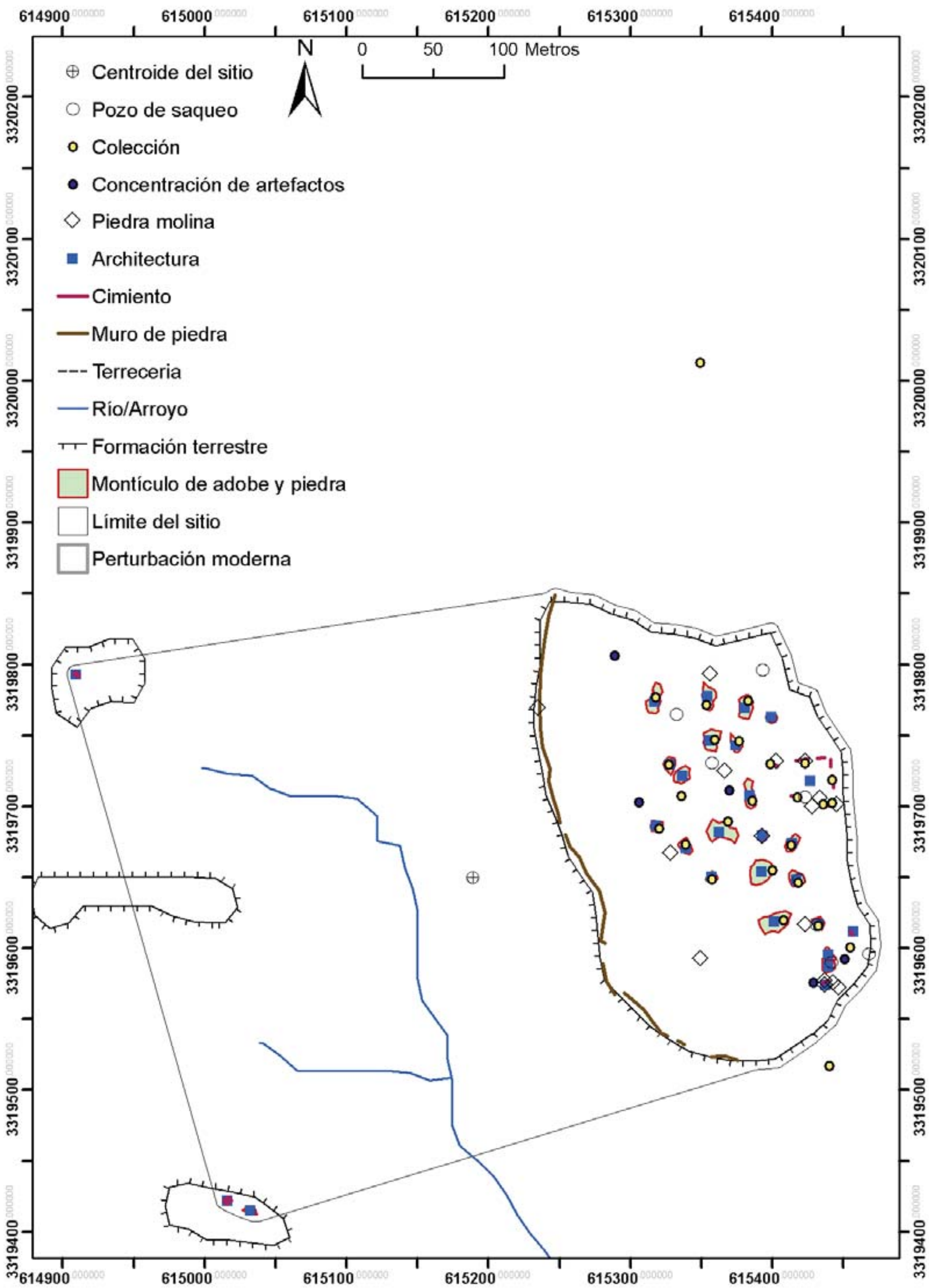
Progne subis	Purple martin	b
Pyrocephalus rubinus	Vermilion flycatcher	w & b
Quiscalus mexicanus	Great-tailed grackle	w & b
Rallus limicola	Virginia rail	w
Regulus calendula	Ruby-crowned kinglet	w & b
Salpinctes obsoletus	Rock wren	w & b
Sayornis nigricans	Black phoebe	w & b
Sayornis saya	Say's phoebe	w & b
Sialia currucoides	Mountain bluebird	w
Sialia mexicana	Western bluebird	w & b
Sitta carolinensis	White-breasted nuthatch	w & b
Sitta pygmaea	Pygmy nuthatch	w & b
Sphyrapicus nuchalis	Red-naped sapsucker	w
Spizella atrogularis	Black-chinned sparrow	w
Spizella brewart	Brewer's sparrow	w
Spizella pallida	Clay-colored sparrow	w
Spizella passerina	Chipping sparrow	w
Stelgidopteryx srripennis	Northern rough-winged swallow	b
Sturnella magna	Eastern meadowlark	w
Tachybaotys dominicus	Least grebe	w
Tachycineta bicolor	Tree swallow	w
Tachycineta thalassina	Violer-green swallow	b
Toxostoma bendirei	Bendire's thrasher	w & b
Toxostoma crissale	Crissal thrasher	w & b
Toxostoma curvirostre	Curve-billed thrasher	w & b
Tringa melanoleuca	Greater yellowlegs	w
Trogodytes aedon	House wren	w
Turdis migratorius	American robin	w & b
Tyrannus crassirostris	Thick-billed kingbird	b
Tyrannus melancholicus	Tropical kingbird	b
Vireo cassinii	Cassin's vireo	w
Xanthocephalus xanthocephalus	Yellow-headed blackbird	w
Zenaida asiatica	White-winged dove	w & b
Zenaida macroura	Mourning dove	w & b
Zonotrichia leucophrys	White-crowned sparrow	w

w= winter
b = breeding

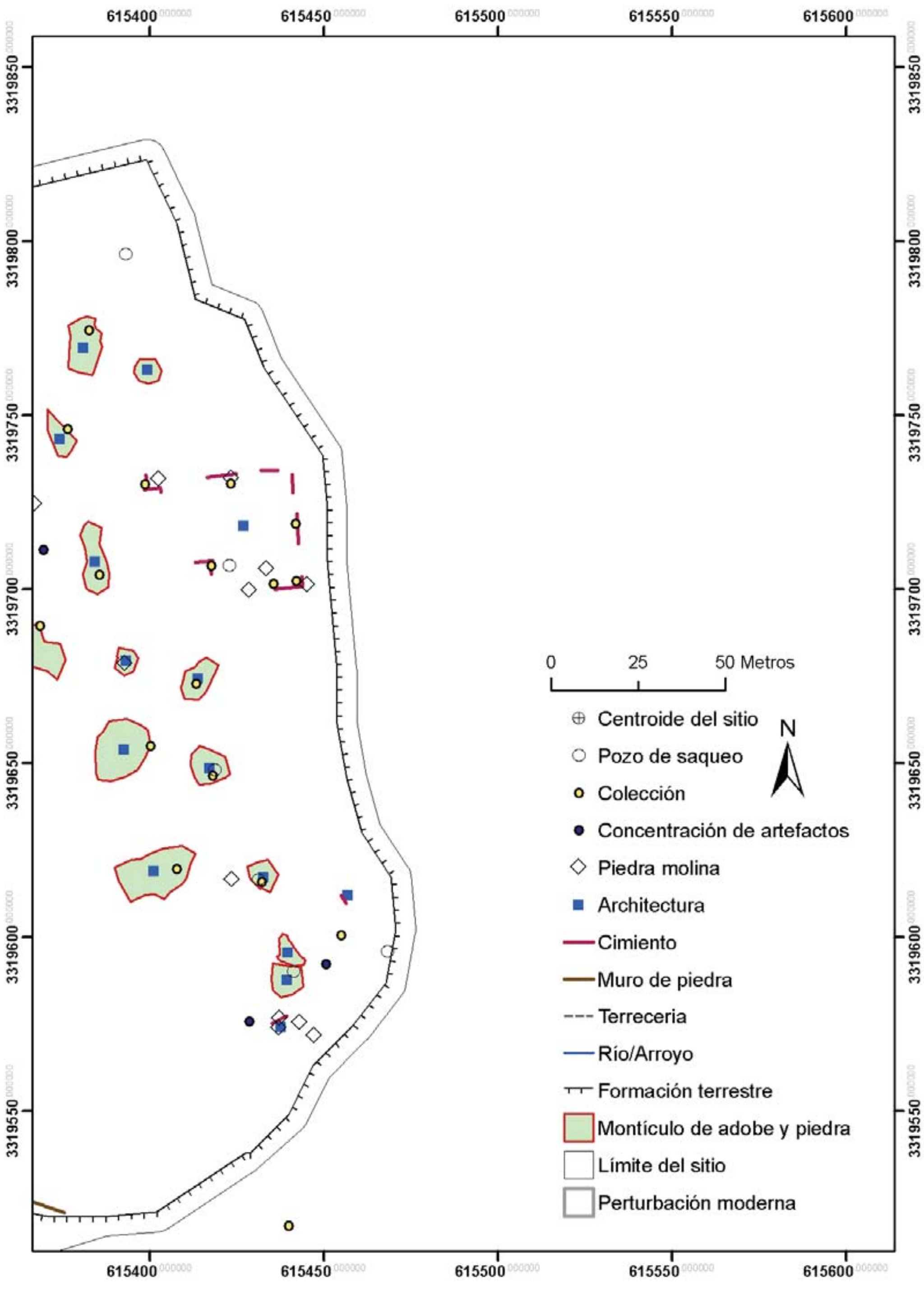
Sub-appendix D
Basic Site Data

Site number	Name	Type	Secondary Type	Era	X coordinate	Y coordinate
Son H:13:2	Las Clavellinas	habitation		prehispanic	615189	3319650
Son L:1:6	La Cuchilla	habitation		prehispanic	617669	3316055
Son L:1:7	La Galera	habitation		historic	619819	3315124
Son L:1:8	Mesa de la Galera	habitation		prehispanic	619517	3315063
Son L:1:9	La Cañada de la Cueva	rock art		prehispanic?/historic	619351	3317631
Son L:1:11	El Borbollón	habitation		prehispanic	615022	3308205
Son L:1:15	Tesotal	habitation		prehispanic/historic?	620701	3310231
Son L:1:16	Badehuachi	habitation		prehispanic/historic?	618311	3309705
Son L:1:17	Jamaica vieja	habitation		prehispanic/historic	620389	3314359
Son L:1:18	Dos casas	habitation		historic	620089	3314756
Son L:1:19	Fierros	habitation		prehispanic	619996	3314915
Son L:1:20	Las Peñitas	habitation		prehispanic	618383	3315551
Son L:1:21	Las Vacas	habitation		prehispanic	616820	3316796
Son L:1:22	La Boca	habitation		prehispanic	616267	3317465
Son L:1:23	Teonadepa	habitation		prehispanic	615669	3318977
Son L:1:24	El Salto	habitation		prehispanic/historic	619732	3315934
Son L:1:25	La Colonia	habitation		prehispanic	619208	3316372
Son L:1:26	Los Alamos	habitation		prehispanic?/historic	615327	3307831
Son L:2:1	El Nogal	habitation	rock art	prehispanic	628291	3296288
Son L:2:6	San Patricio	habitation		prehispanic	627198	3296437
Son L:2:13	Cajón de los Deargüelles	rock art		prehispanic	620862	3315325
Son L:2:16	Mesa abaja	habitation		prehispanic	628499	3294920
Son L:2:17	El Corral	special use	rock art	prehispanic?	628332	3295718
Son L:2:18	Tebisco	habitation		prehispanic	622342	3303301
Son L:2:19	Las Abejas	habitation		prehispanic	626427	3296801
Son L:2:20	Nicora chica	habitation		prehispanic	627482	3294246
Son L:2:21	Comachi	habitation	seasonal?	prehispanic	622943	3300964
Son L:2:22	Los Mineros	habitation		prehispanic/historic	622817	3302457
Son L:2:23	Tío Lugo	habitation		prehispanic	622592	3303103
Son L:2:24	Las Geodas	habitation		prehispanic	621259	3310755
Son L:2:25	El Leon	habitation		prehispanic/historic?	621259	3309304
Son L:2:26	La Pitahaya	habitation		prehispanic	620950	3309027
Son L:2:27	El Charco	habitation		prehispanic	621708	3310867
Son L:2:28	La Cruz	special use		prehispanic	621852	3311096
Son L:2:29	Jecori	habitation		prehispanic	621563	3311364
Son L:2:30	Pingüino	habitation		prehispanic	621538	3311966
Son L:2:31	El Campo	habitation		prehispanic	620856	3313494
Son L:2:32	La Platería	habitation	special use	historic	620690	3313828
Son L:2:33	Los Argüelles	habitation		prehispanic/historic	620666	3314757
Son L:2:34	La Calera	habitation	special use	prehispanic	622064	3308697
Son L:2:35	Parababi	rock art		prehispanic	621977	3307766
Son L:2:36	La Junta	seasonal		prehispanic	621128	3305261
Son L:2:37	Las Bagotas	seasonal		prehispanic	626085	3313592
Son L:2:38	La Cañada de los gatos	rock art		prehispanic/historic	621388	3311721
Son L:2:39	La Volanta	habitation	rock art	prehispanic	628815	3293777
Son L:2:40	Puente a Moctezuma	habitation		prehispanic	626865	3296509
Son L:2:41	Nicora	habitation		prehispanic/historic?	627564	3294761
Son L:2:42	La Presa	rock art		prehispanic?	626183	3296963

Sub-appendix E
Survey Site Maps



Las Clavellinas (Son H:13:2)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Pozo de saqueo
Colección
Concentración de artefactos
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Architectura
Cimiento
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Terreceria
Río/Arroyo
Formación terrestre
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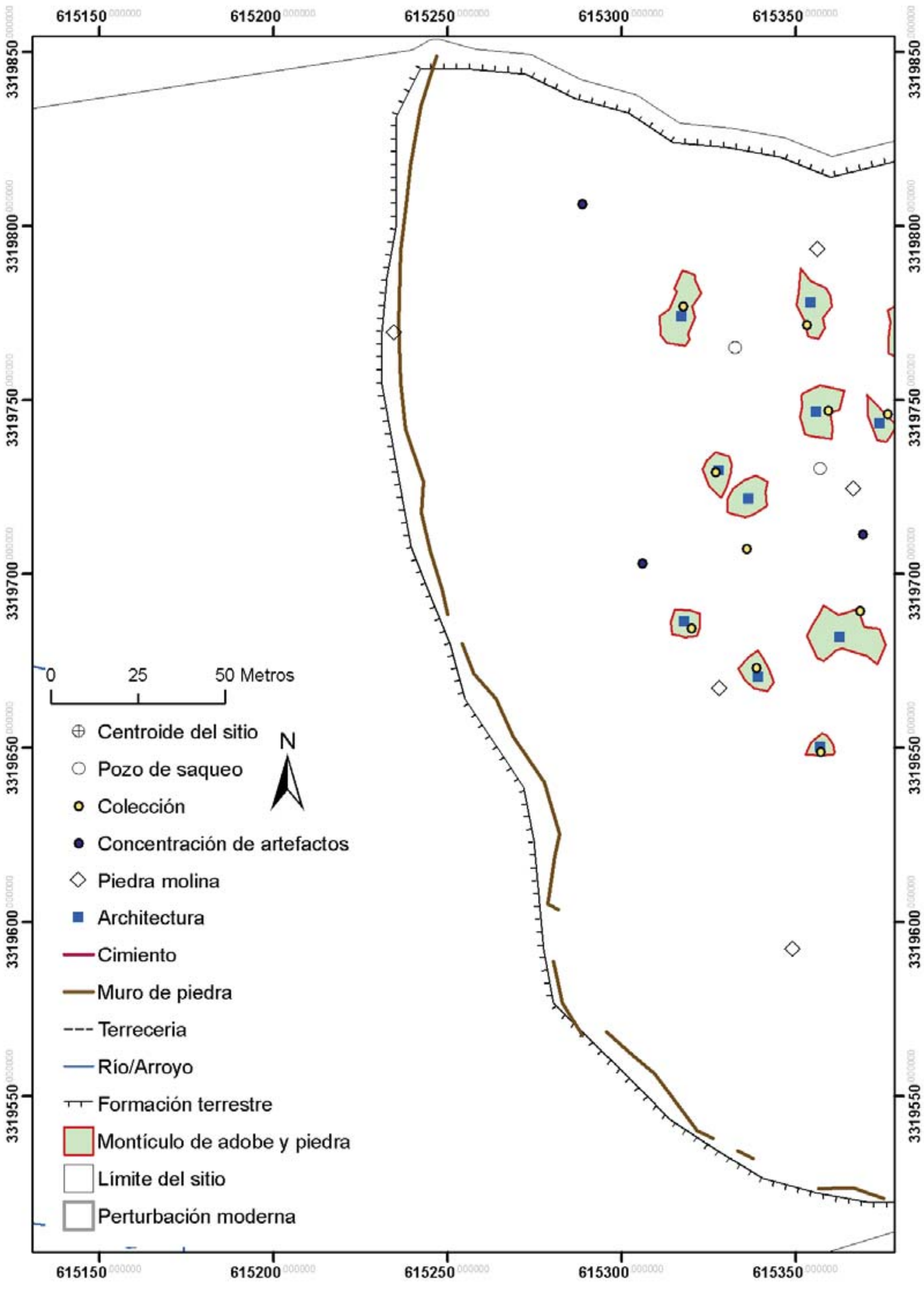
Límite del sitio
Perturbación moderna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Colección
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Architectura
Cimiento
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Terreceria
Río/Arroyo
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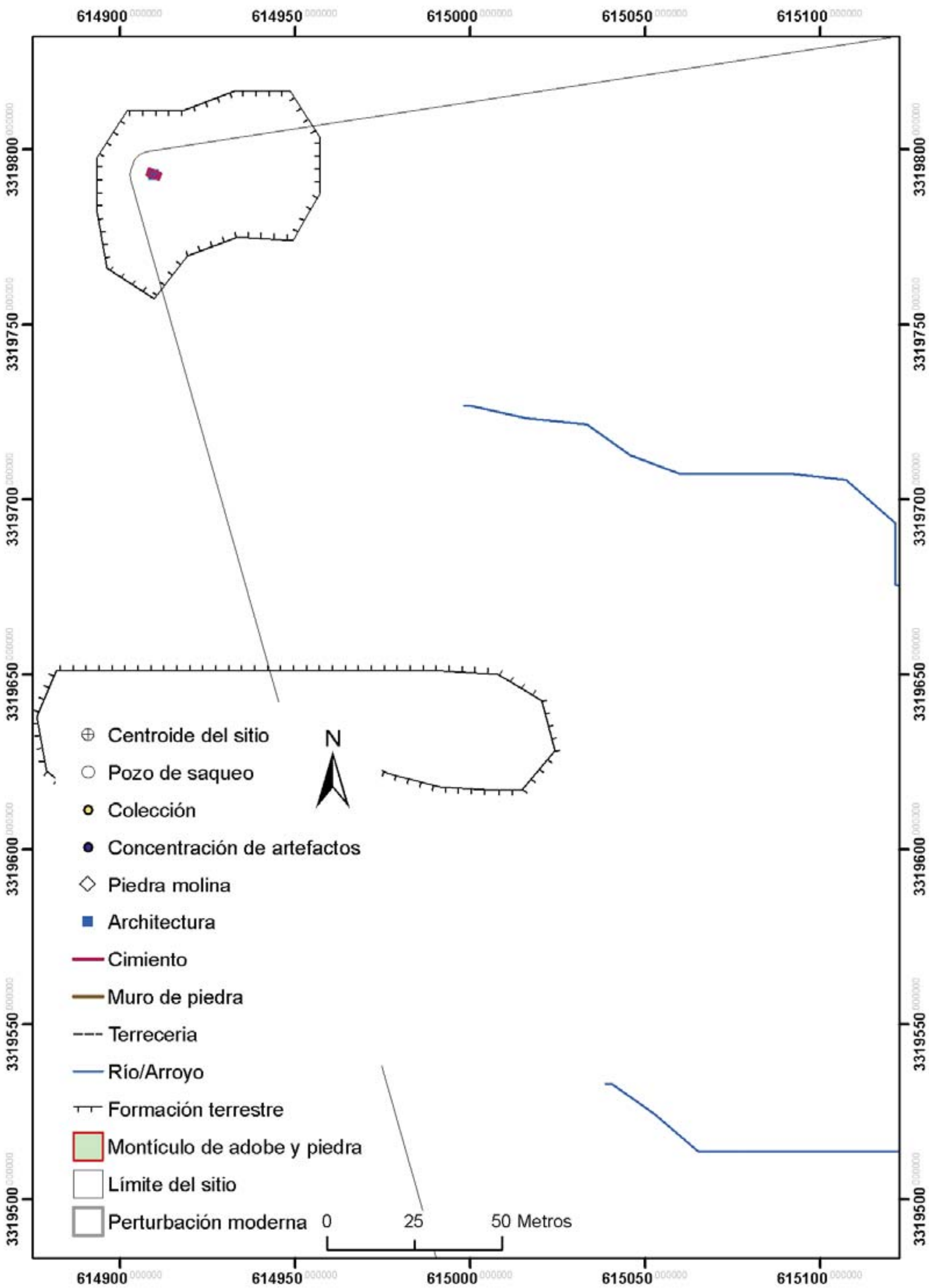
Montículo de adobe y piedra
Límite del sitio
Perturbación moderna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Colección
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Piedra molina
Architectura
Cimiento
Muro de piedra
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Río/Arroyo
Formación terrestre
Montículo de adobe y piedra
Límite del sitio
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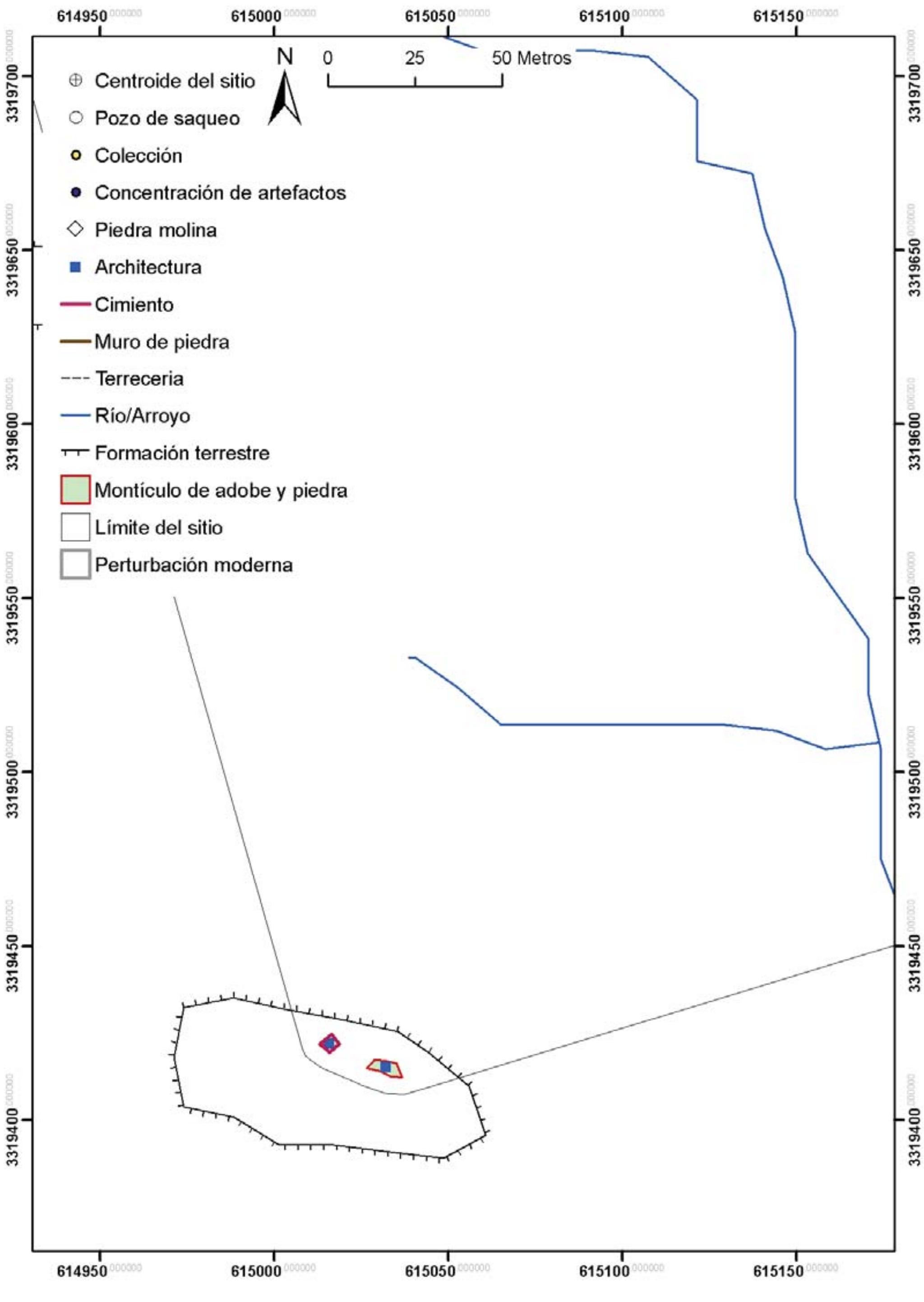

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Límite del sitio
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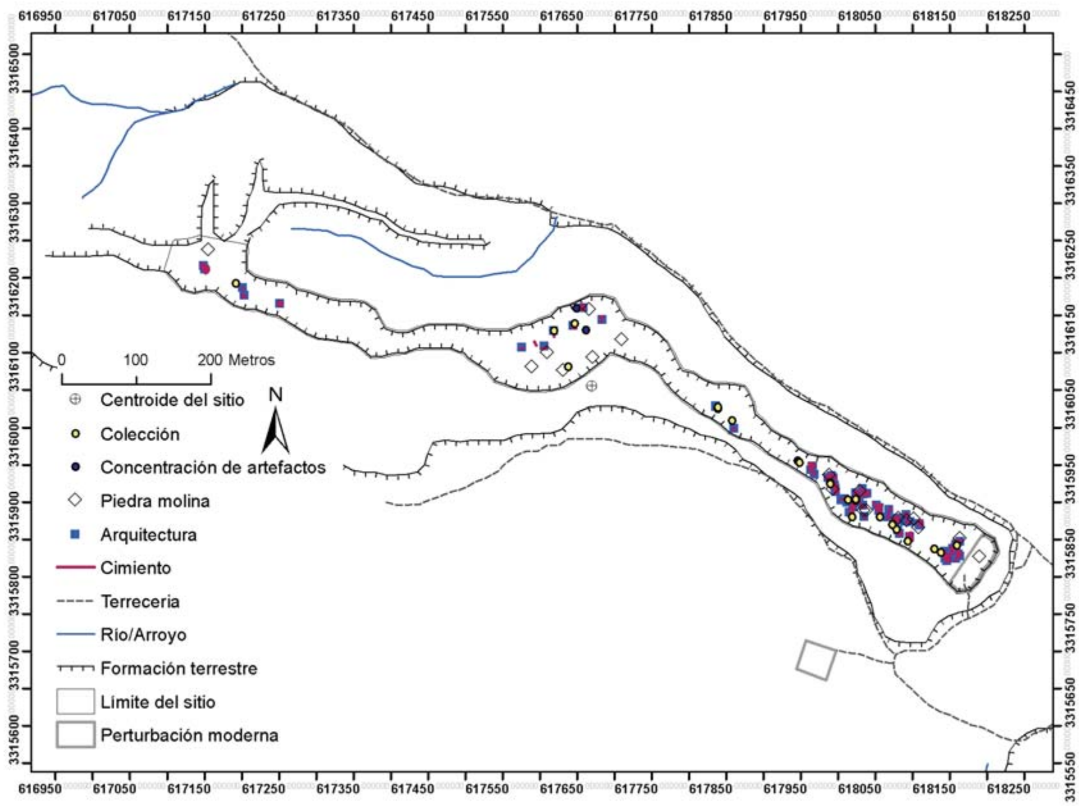
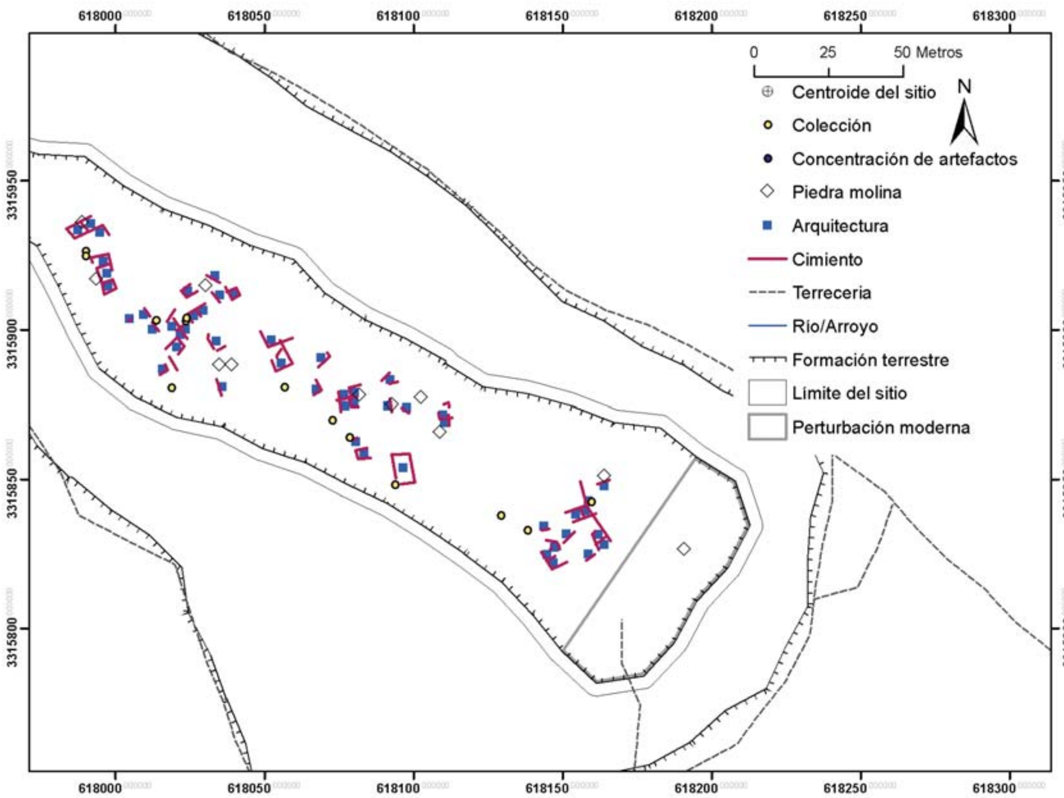


La Cuchilla (Son L:1:6)



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Formación terrestre
Límite del sitio
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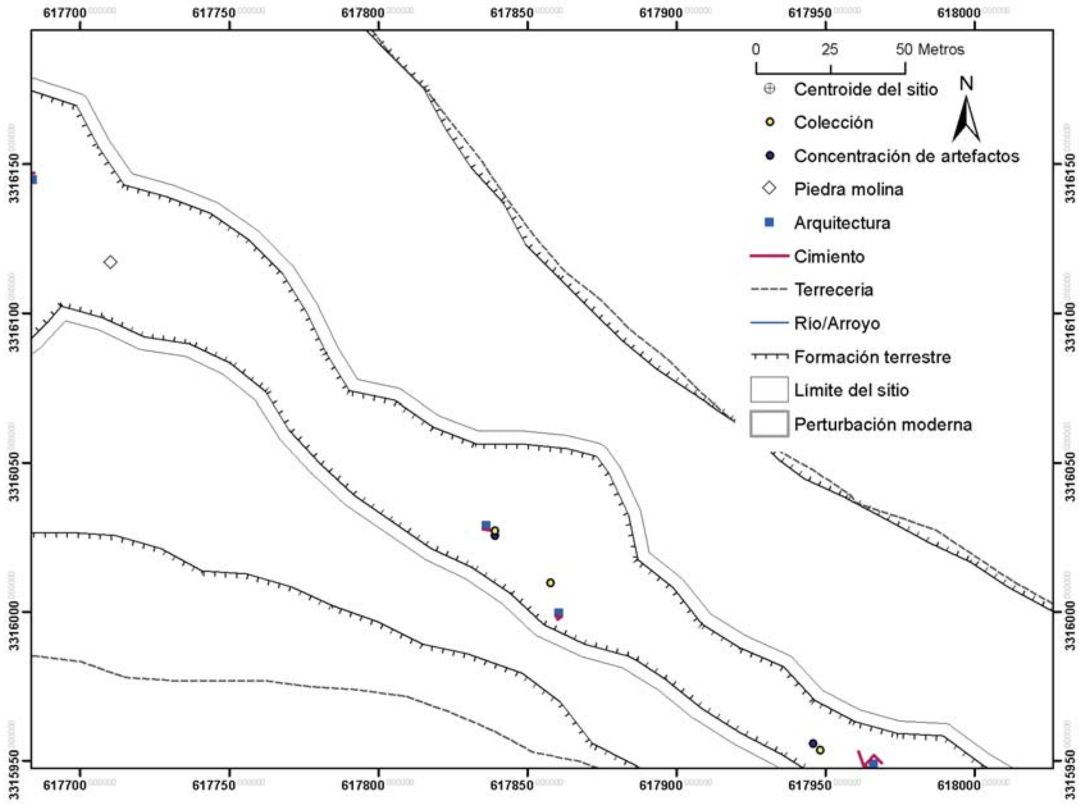

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Formación terrestre
Límite del sitio
Perturbación moderna
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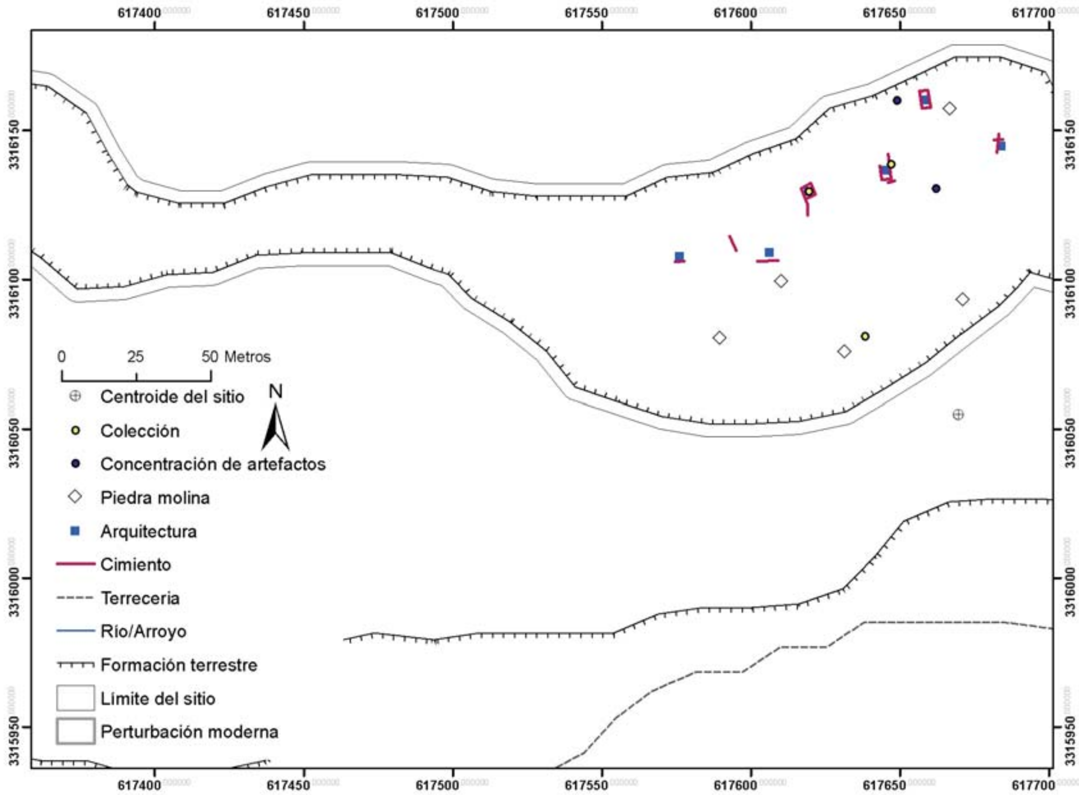
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Límite del sitio
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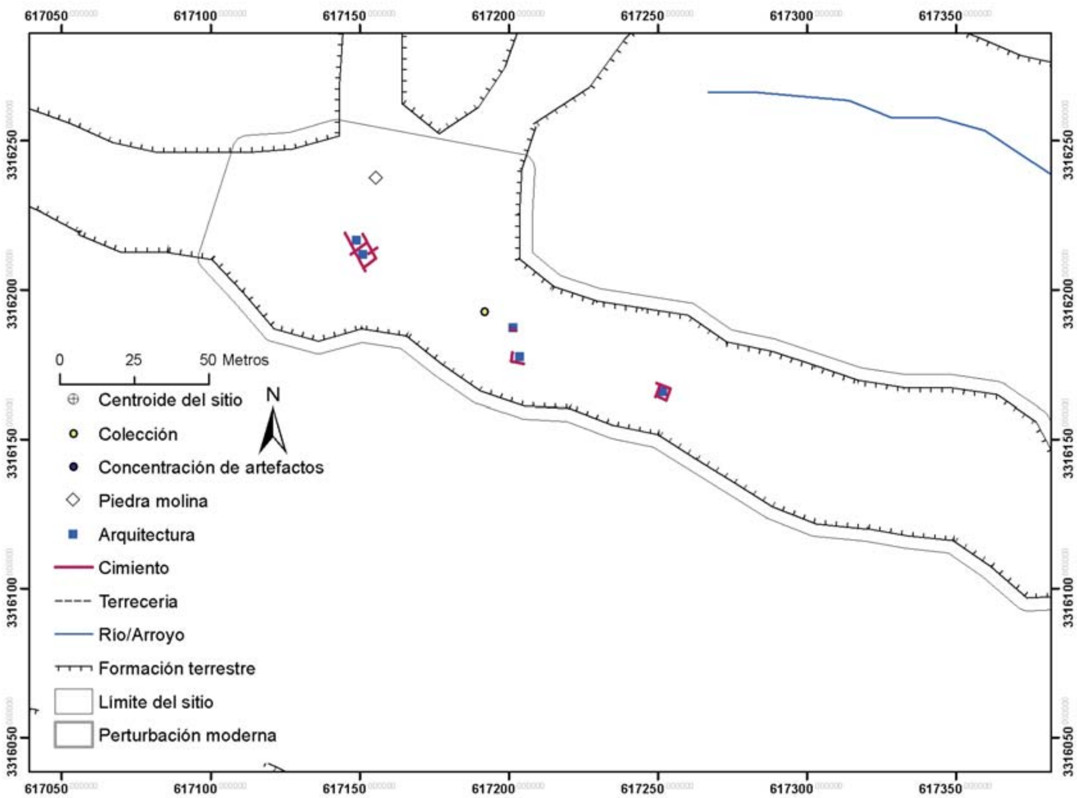

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Colección
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Cimiento
Terreceria
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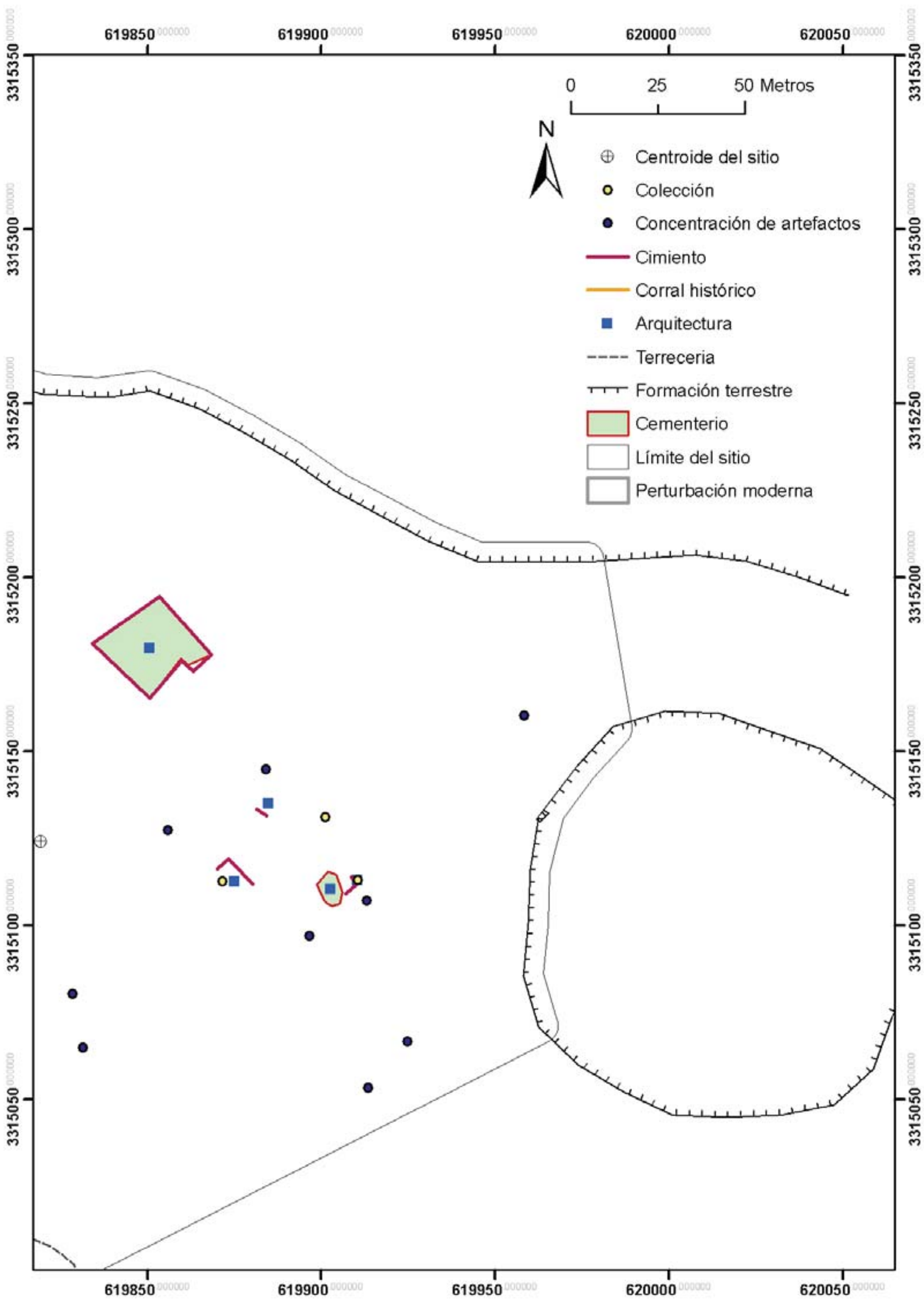
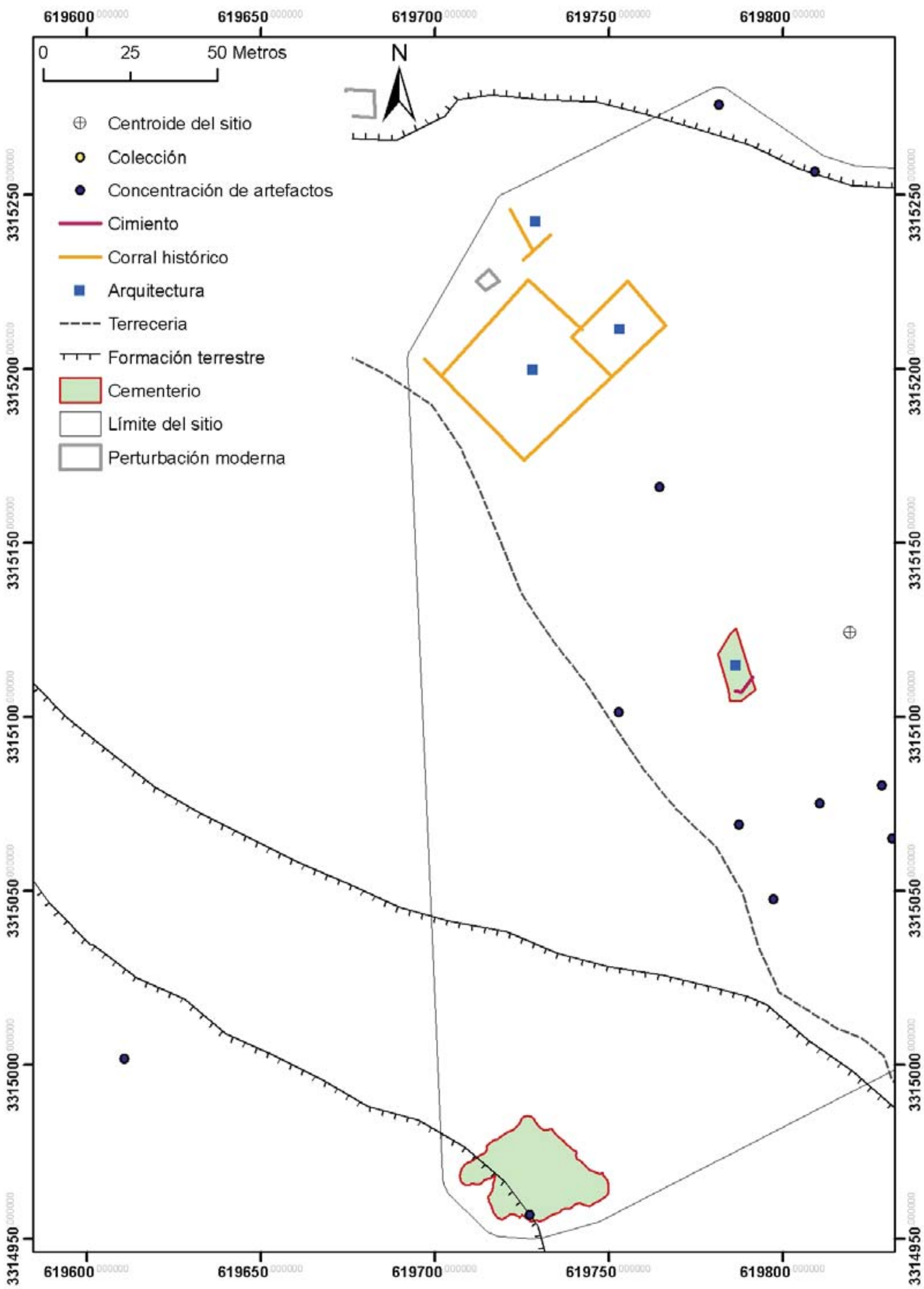
Formación terrestre
Límite del sitio
Perturbación moderna



La Galera (Son L:1:7)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Arquitectura
Terreceria
Formación terrestre
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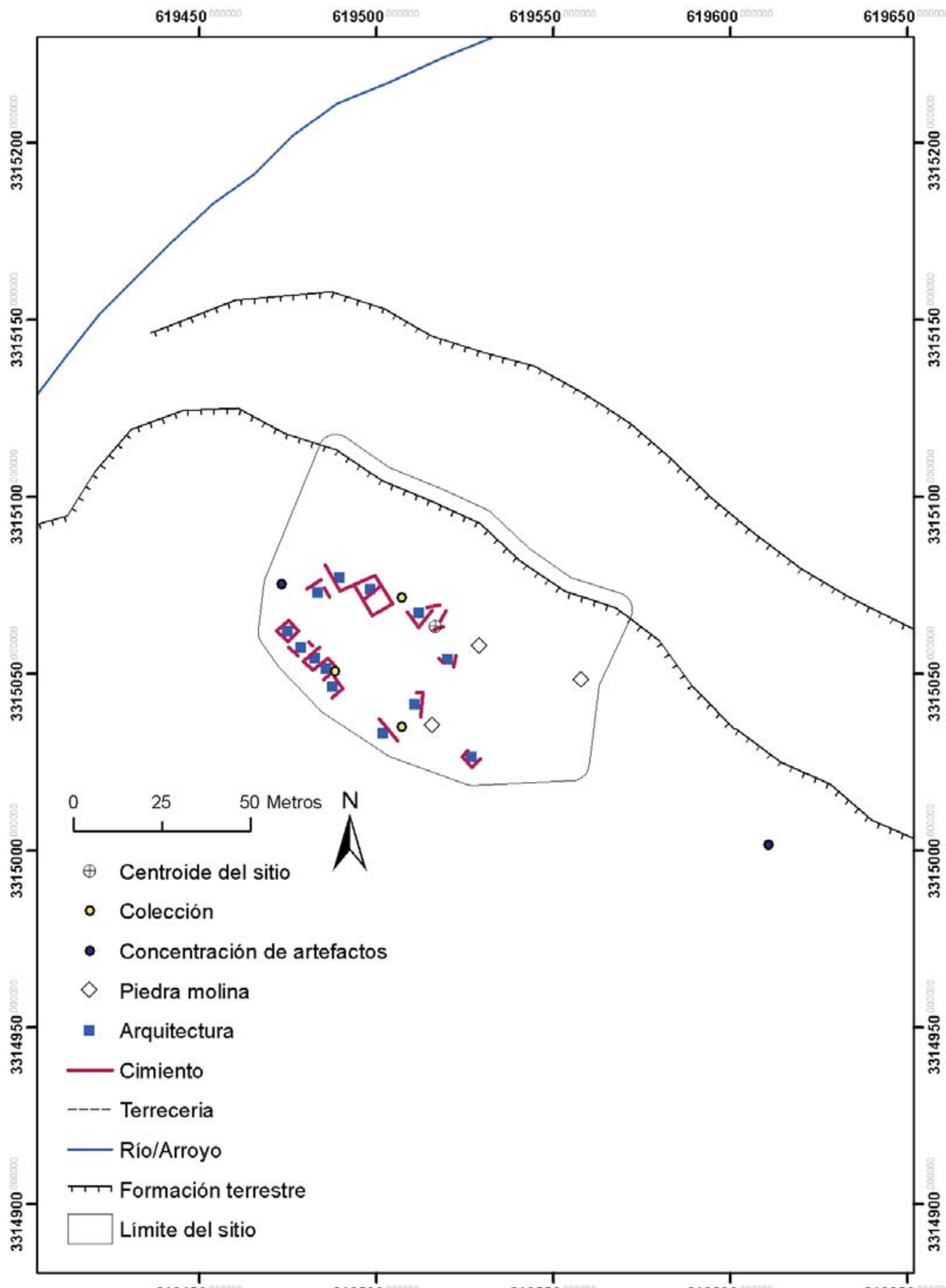
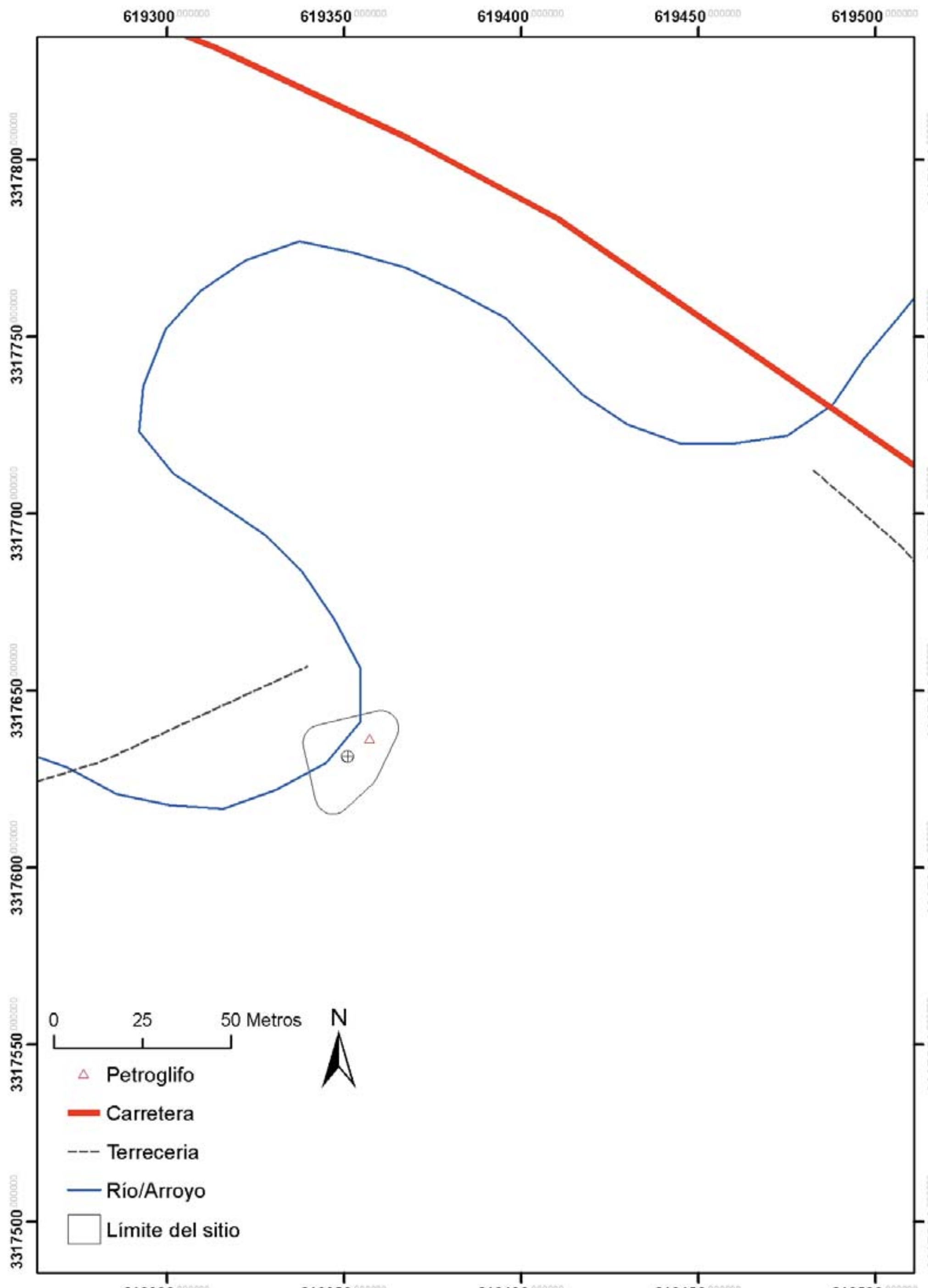
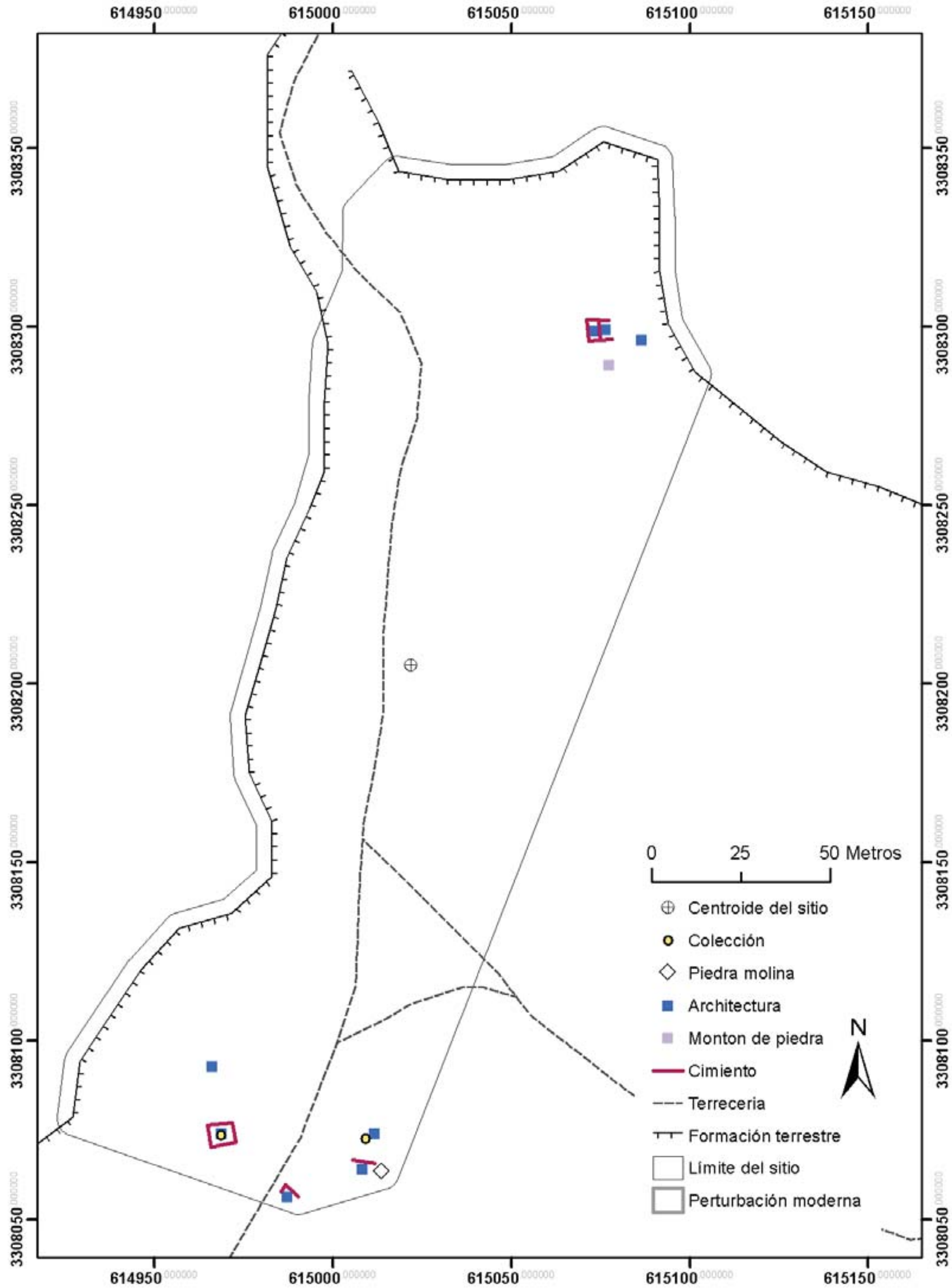


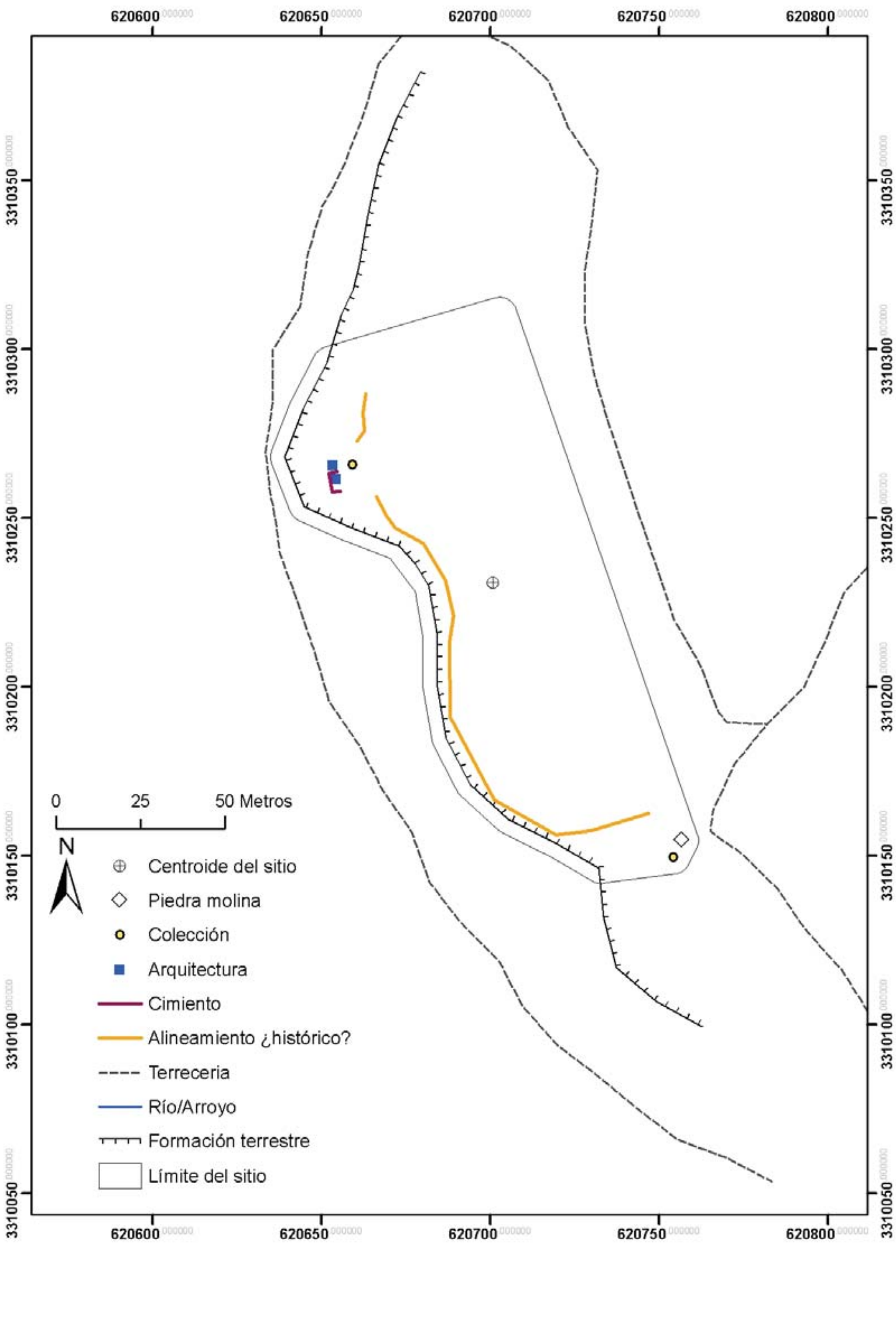
Mesa de La Galera (Son L:1:8)



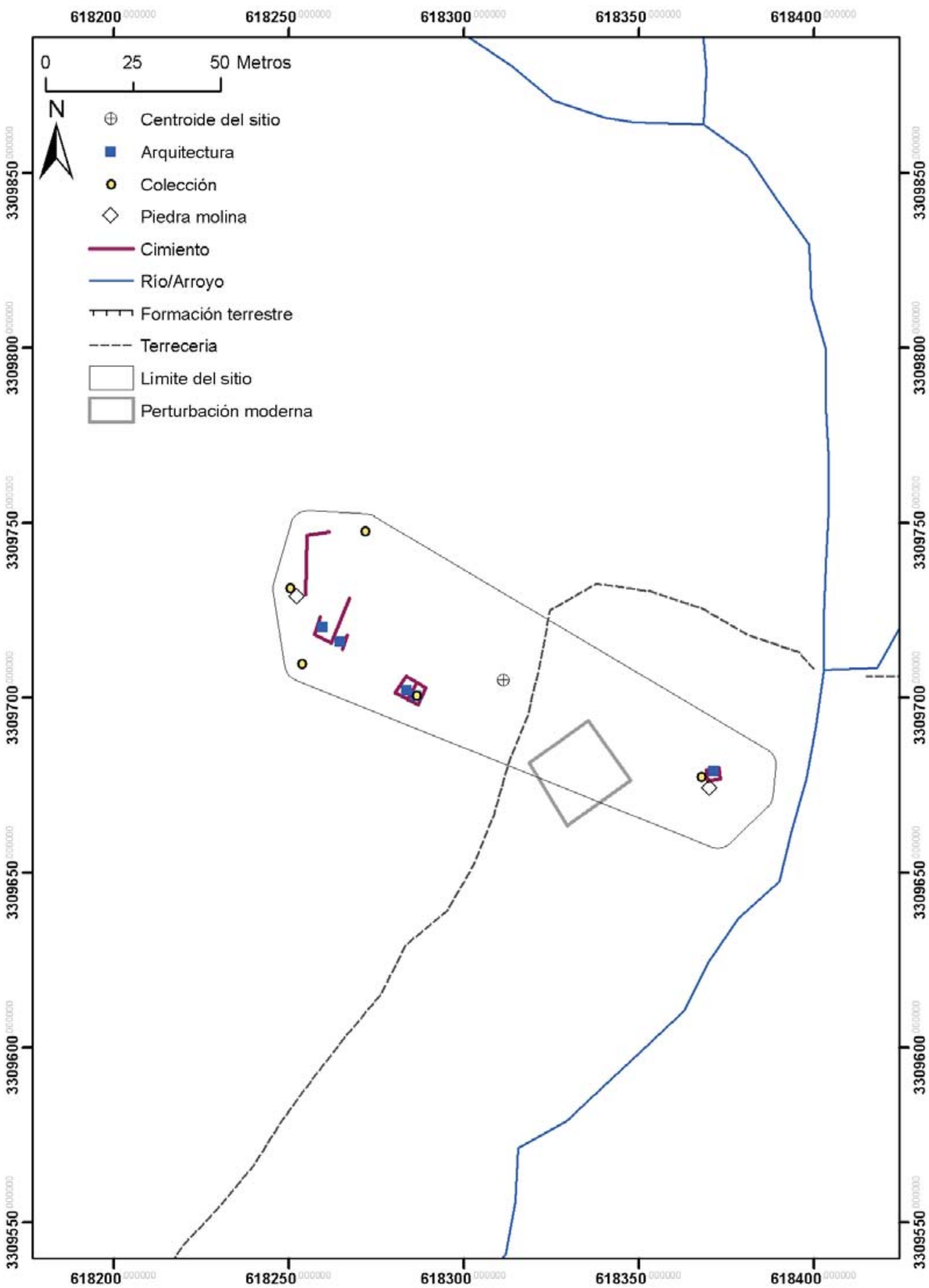
La Cañada de La Cueva (Son L:1:9)



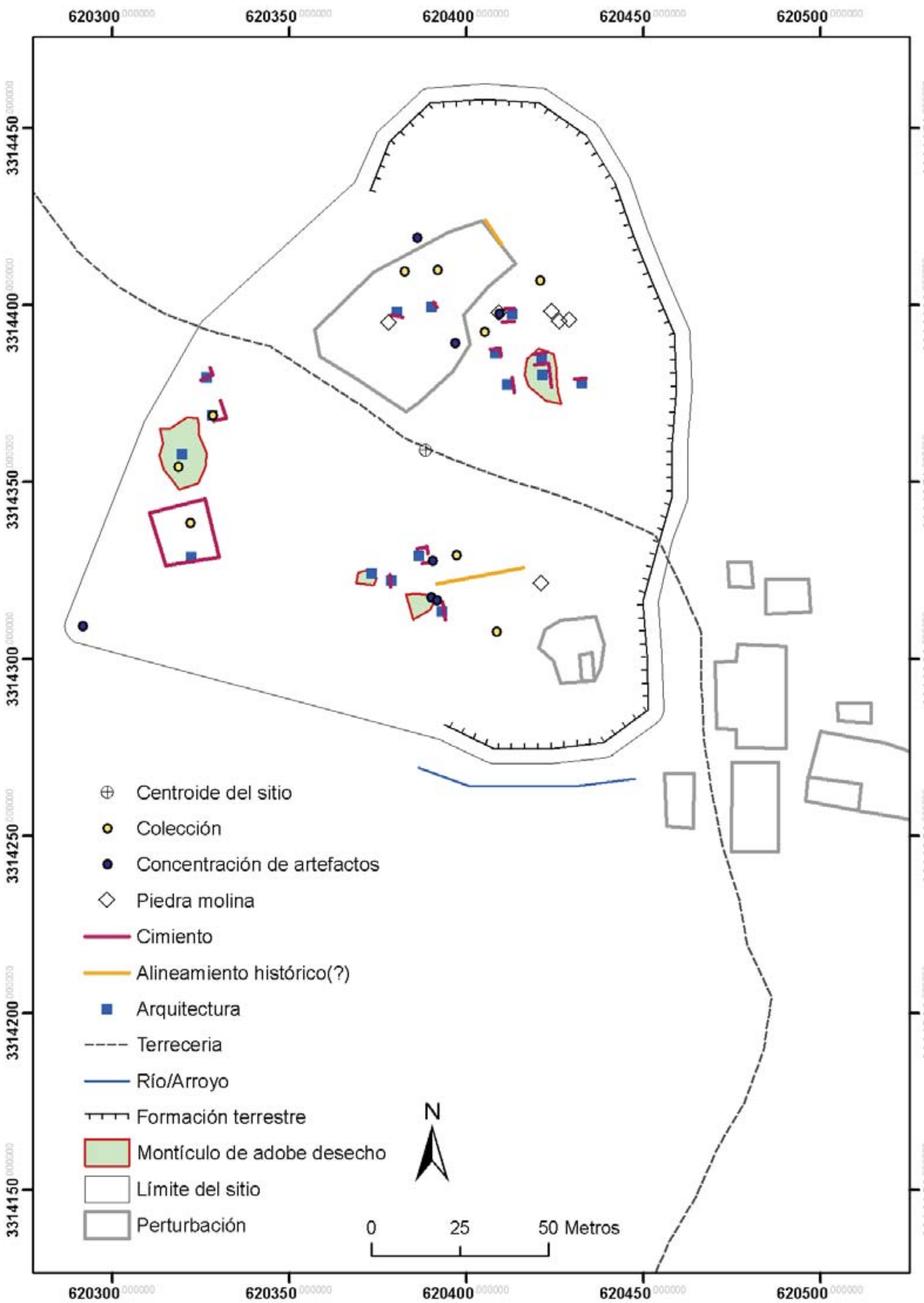
El Borbollón (Son L:1:11)



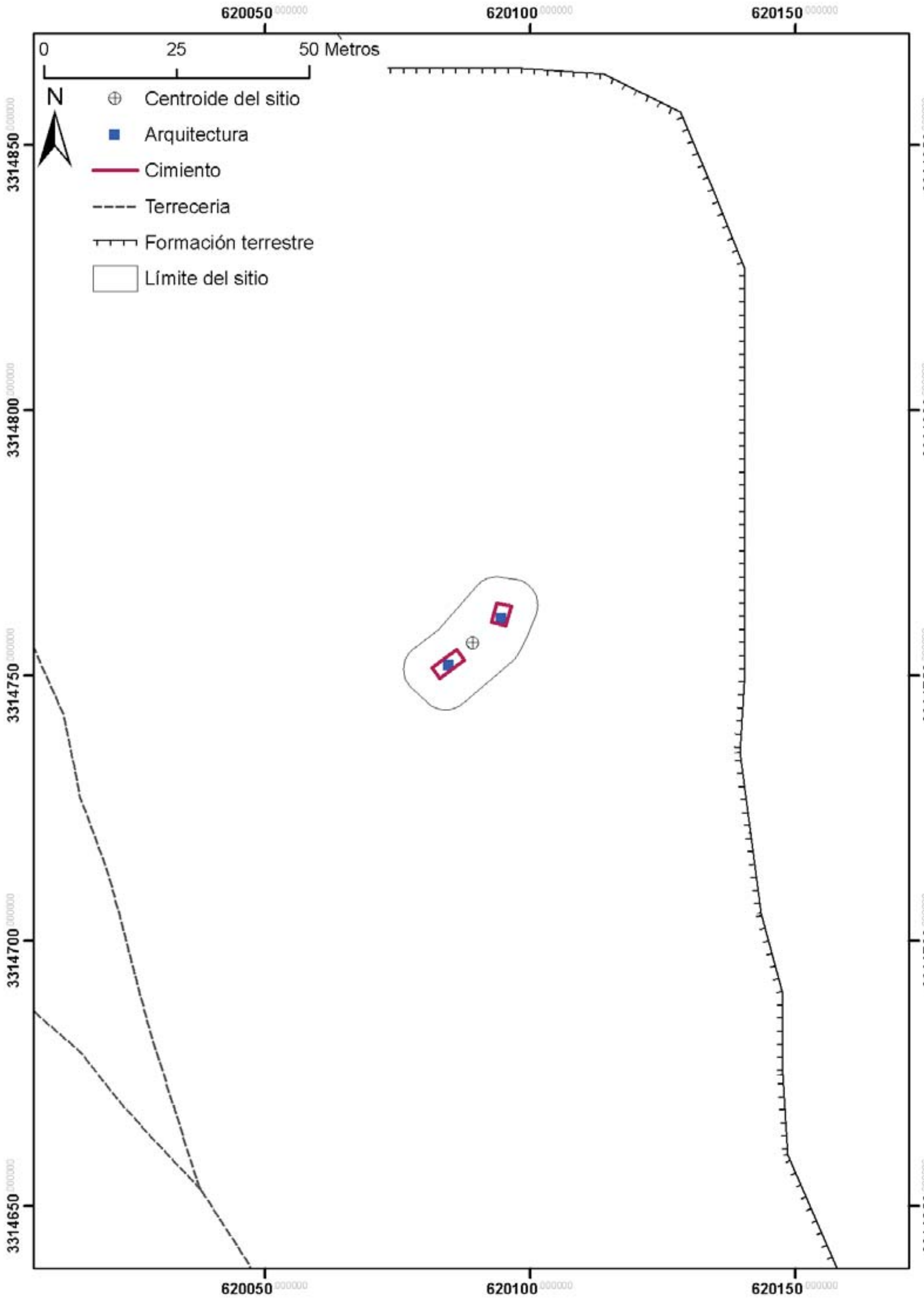
Tesotal (Son L:1:15)



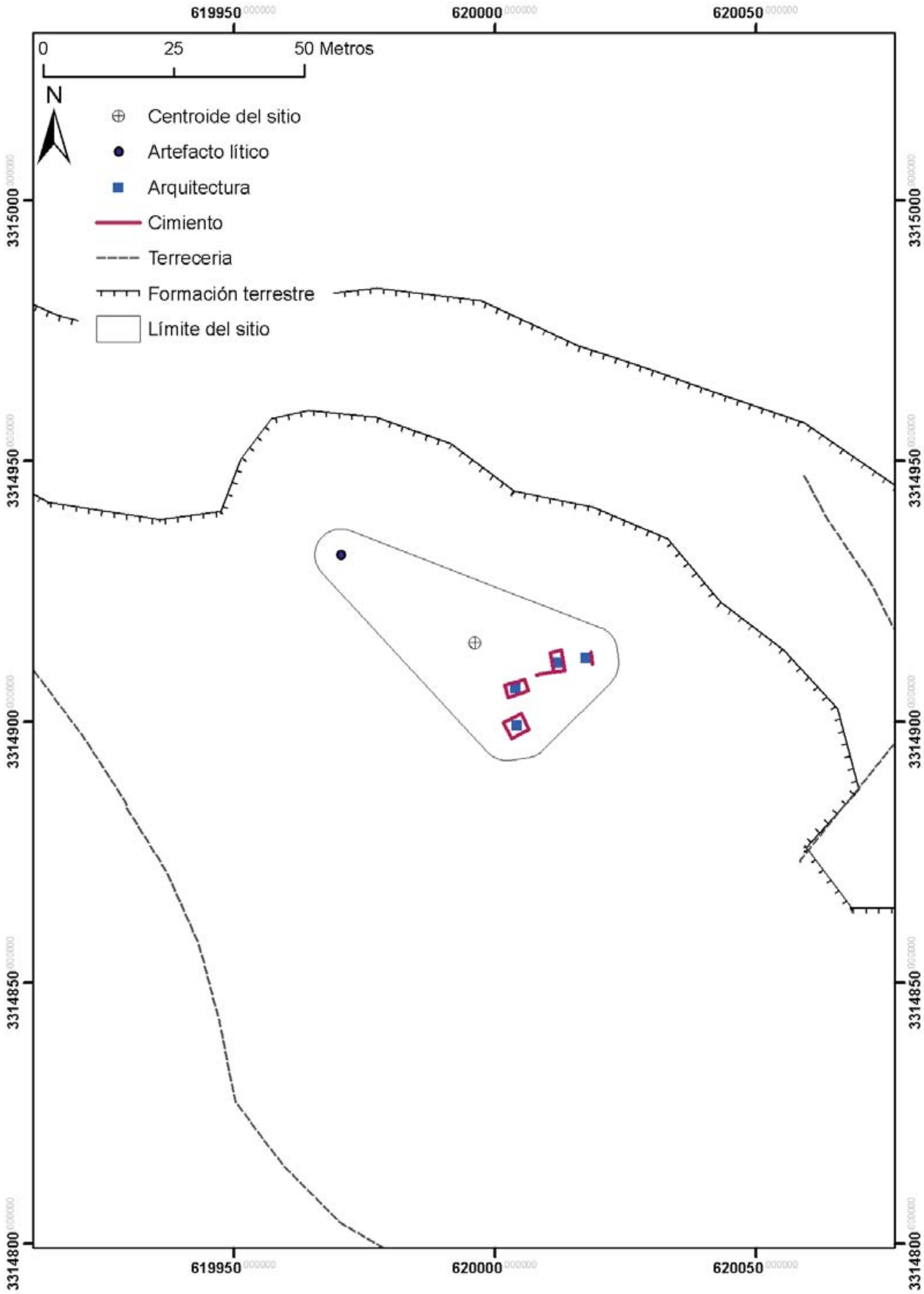
Badehuachi (Son L:1:16)



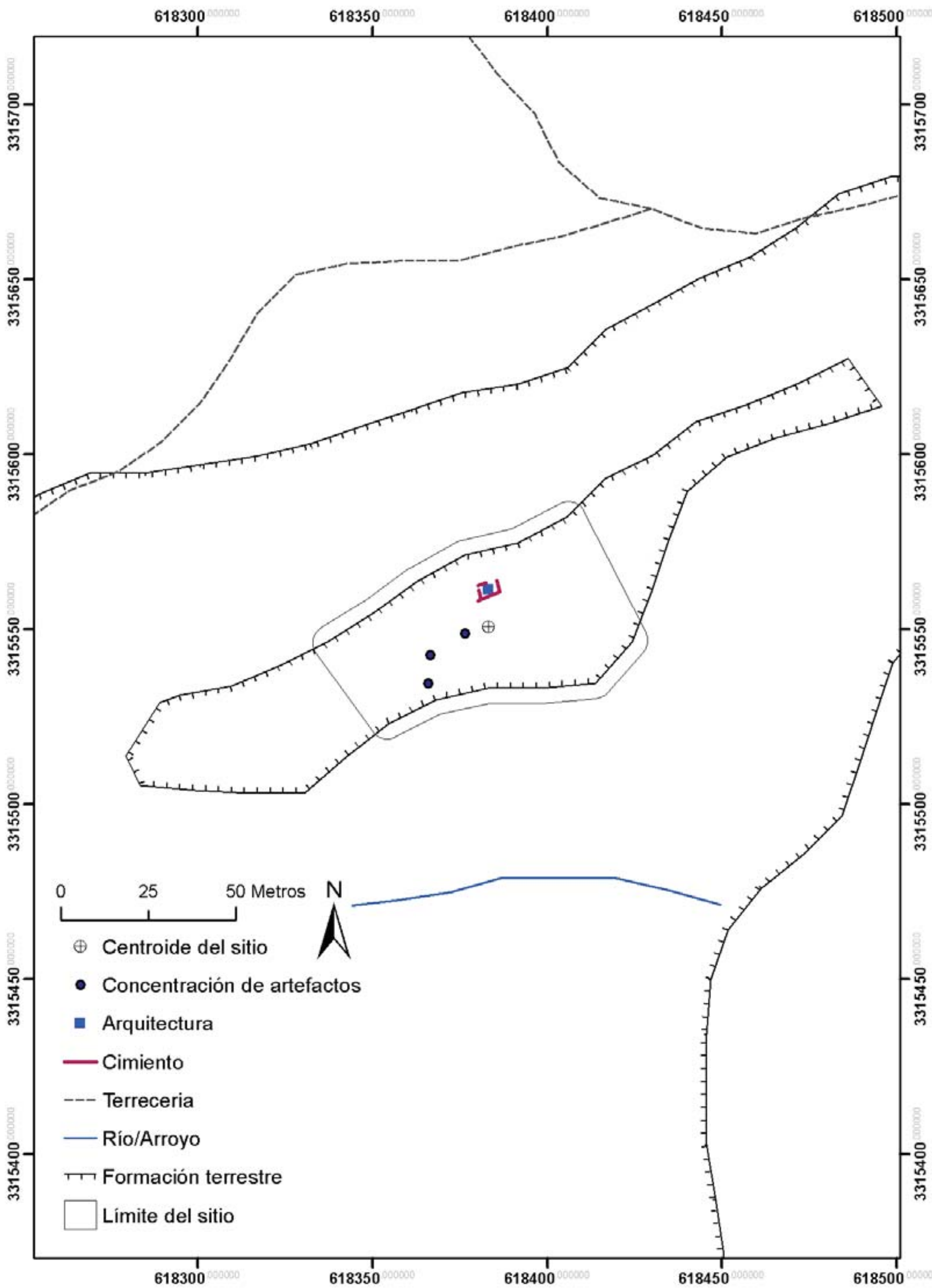
Jamaica Vieja (Son L:1:17)



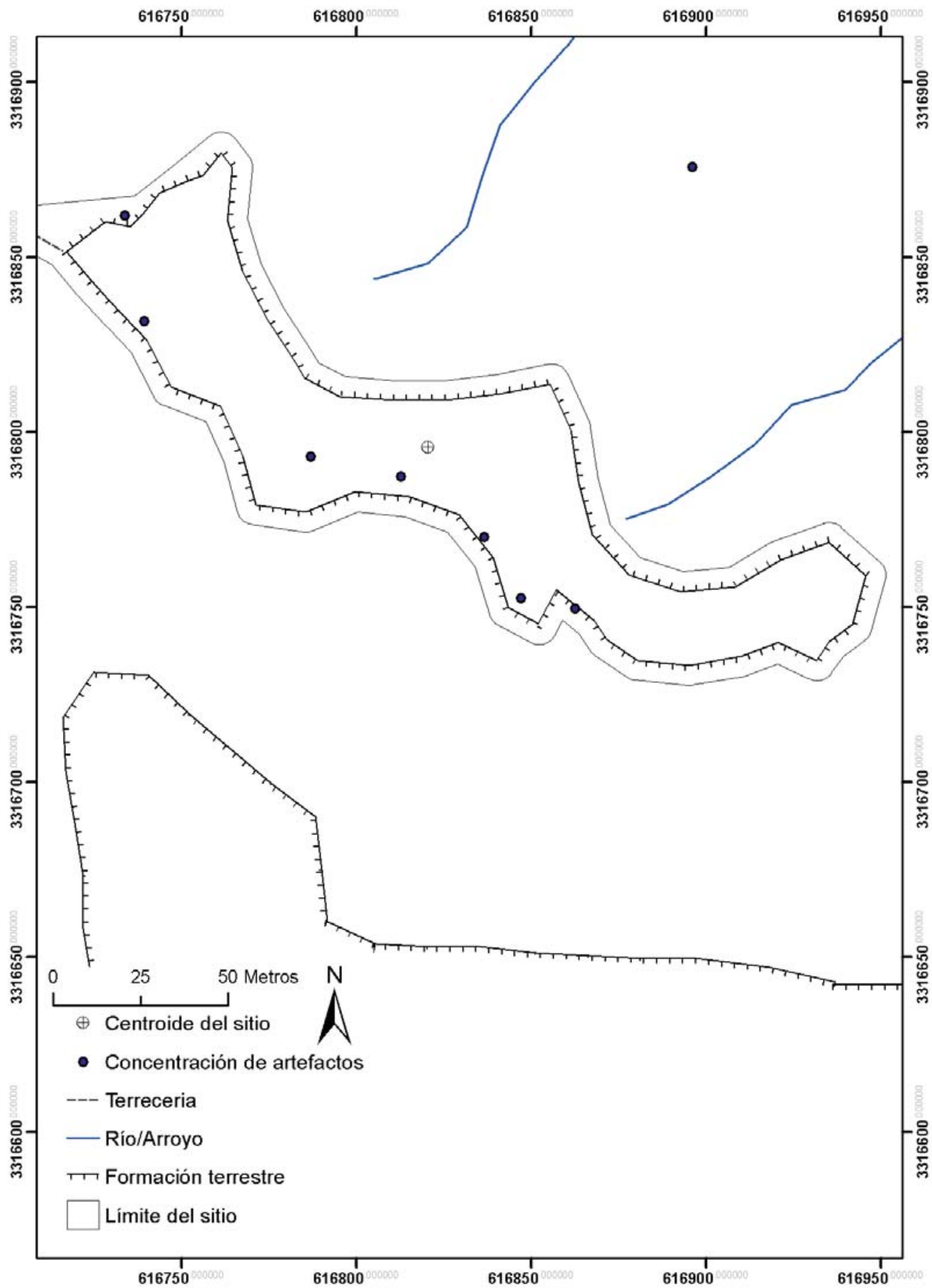
Dos Casas (Son L:1:18)



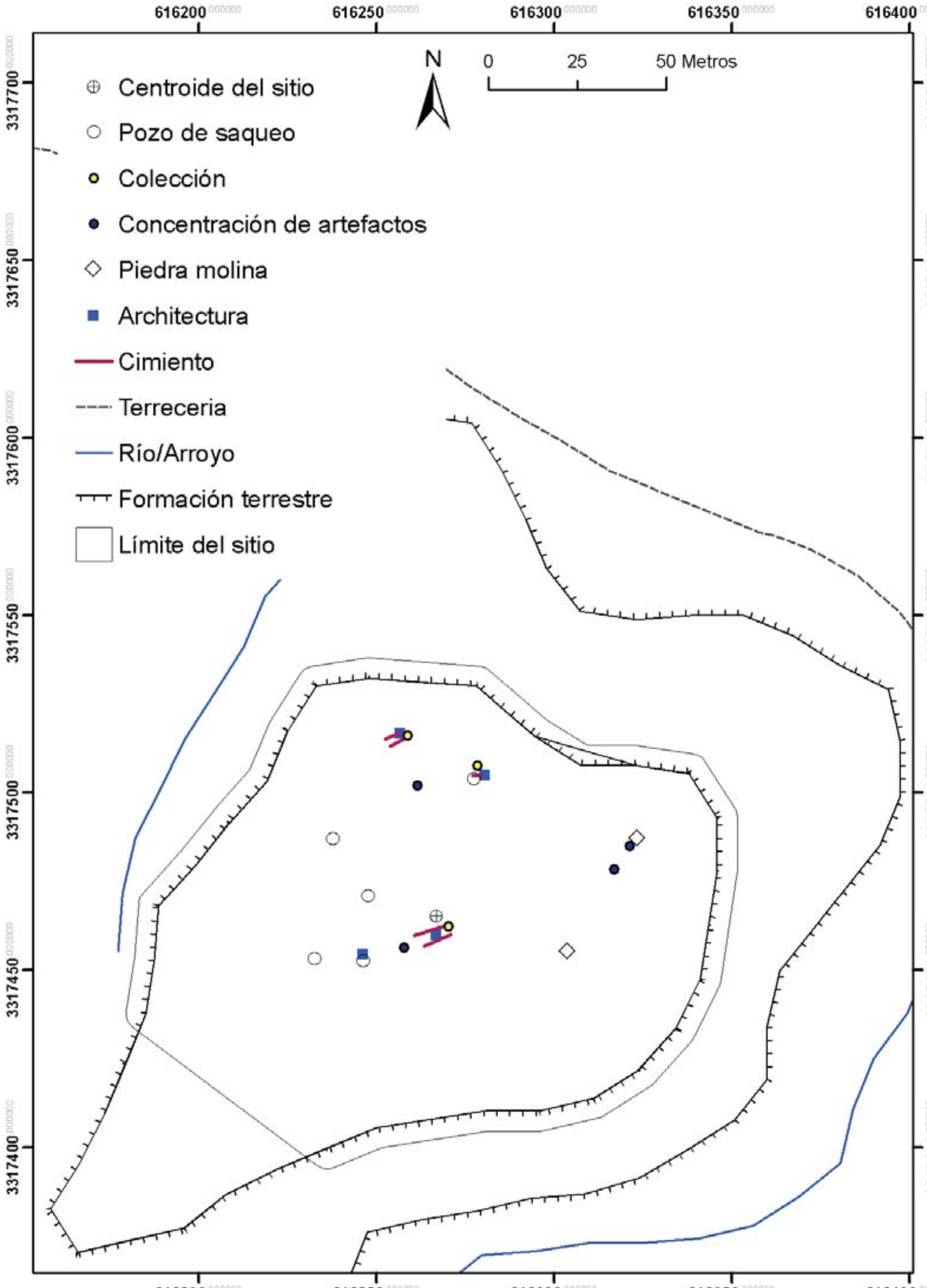
Fierros (Son L:1:19)



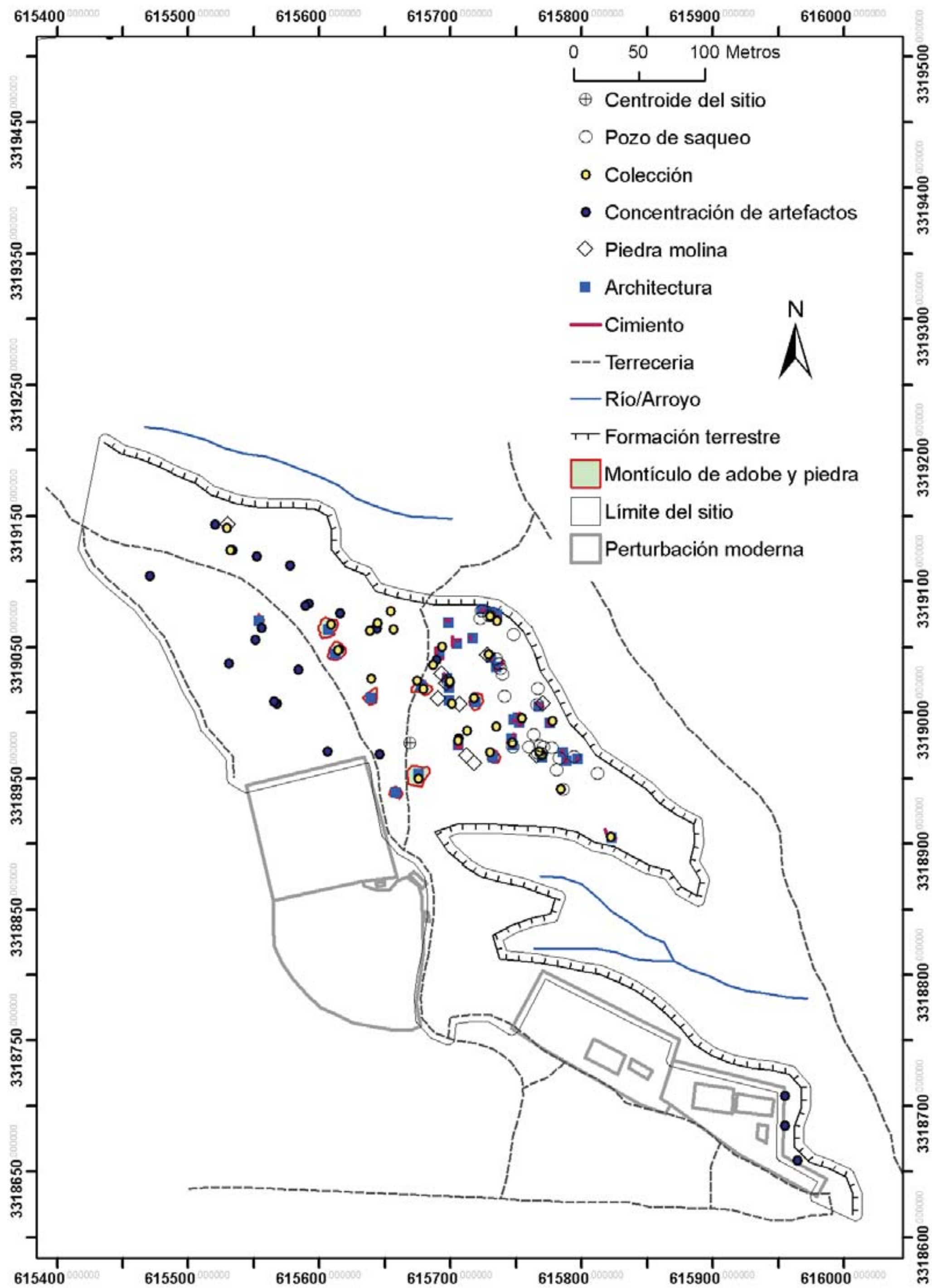
Las Peñitas (Son L:1:20)



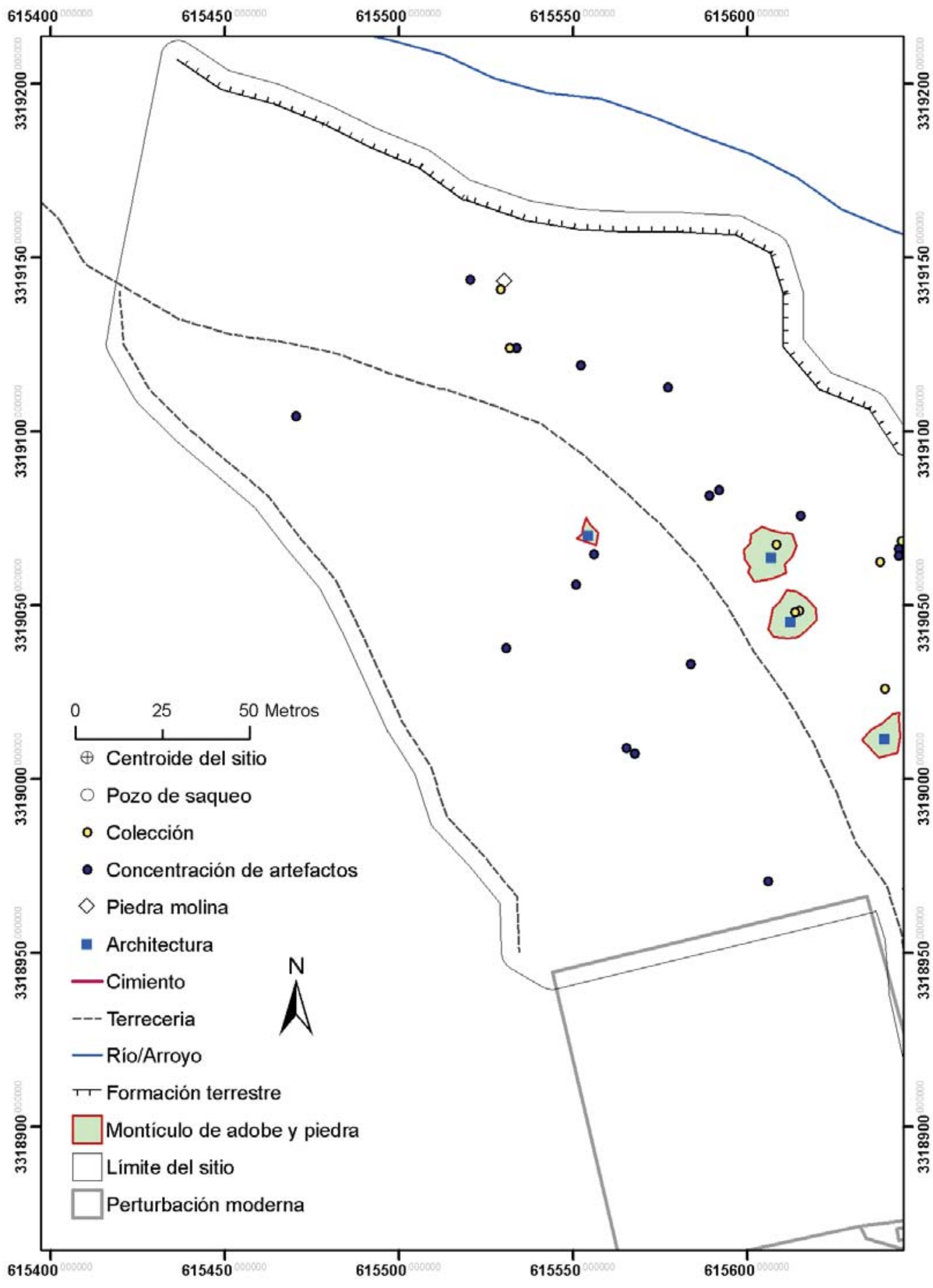
Las Vacas (Son L:1:21)



La Boca (Son L:1:22)



Teonadepa (Son L:1:23)



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Pozo de saqueo
Colección
Concentración de artefactos
Piedra molina
Architectura
Cimiento
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Río/Arroyo
Formación terrestre
Montículo de adobe y piedra
Límite del sitio
Perturbación moderna
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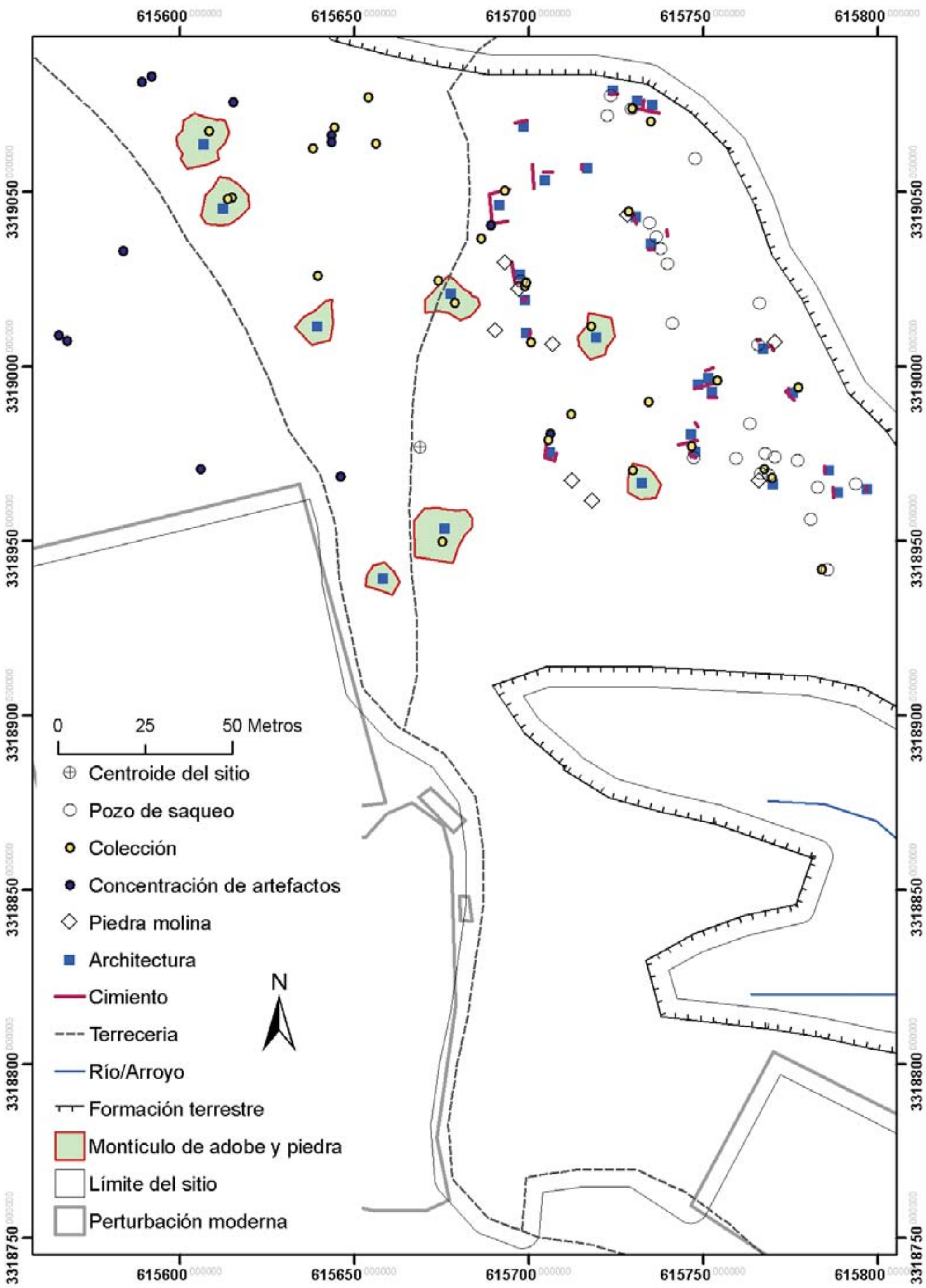
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Pozo de saqueo
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Piedra molina
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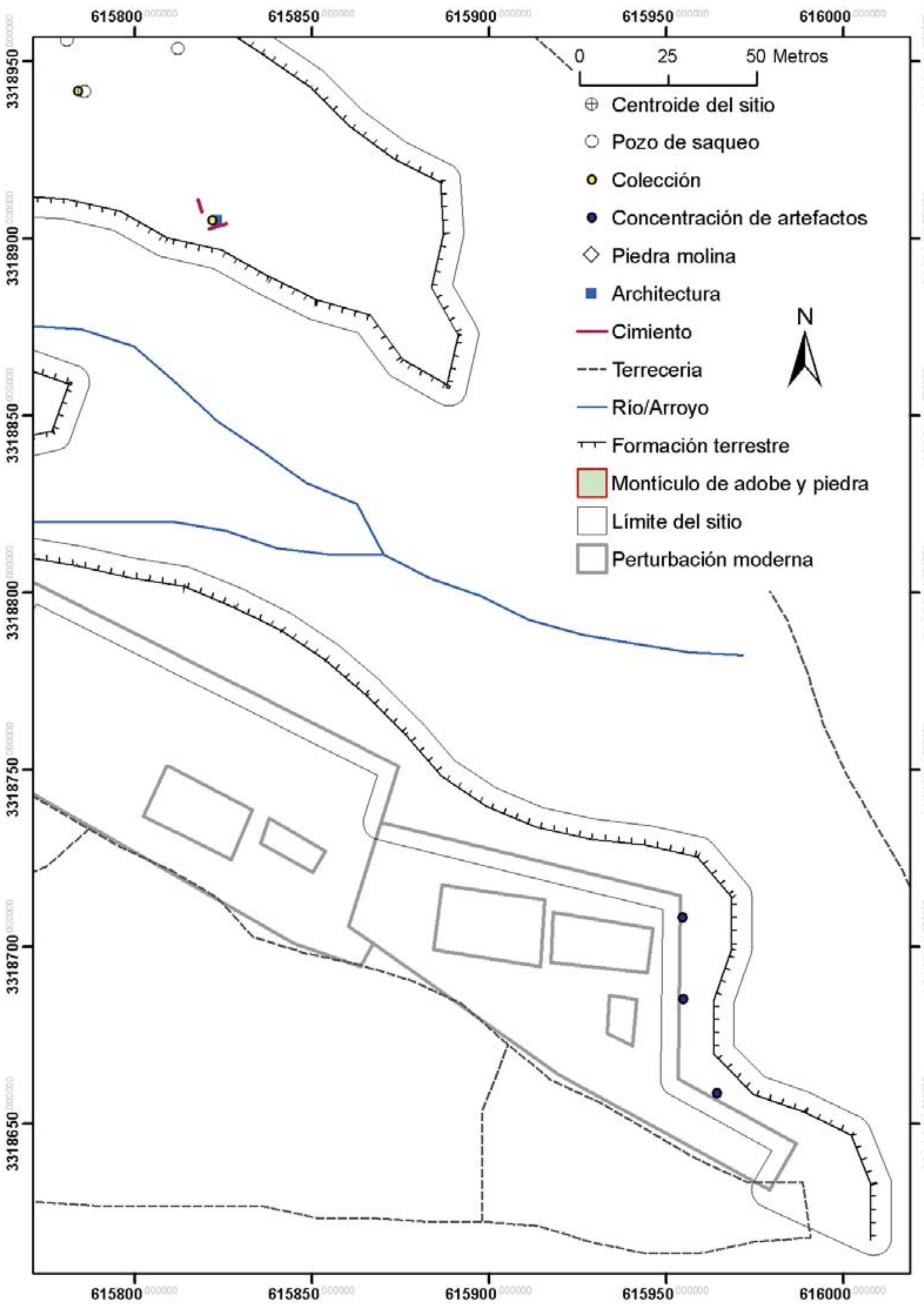

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Architectura
Cimiento
Terreceria
Río/Arroyo
Formación terrestre
Montículo de adobe y piedra
Límite del sitio
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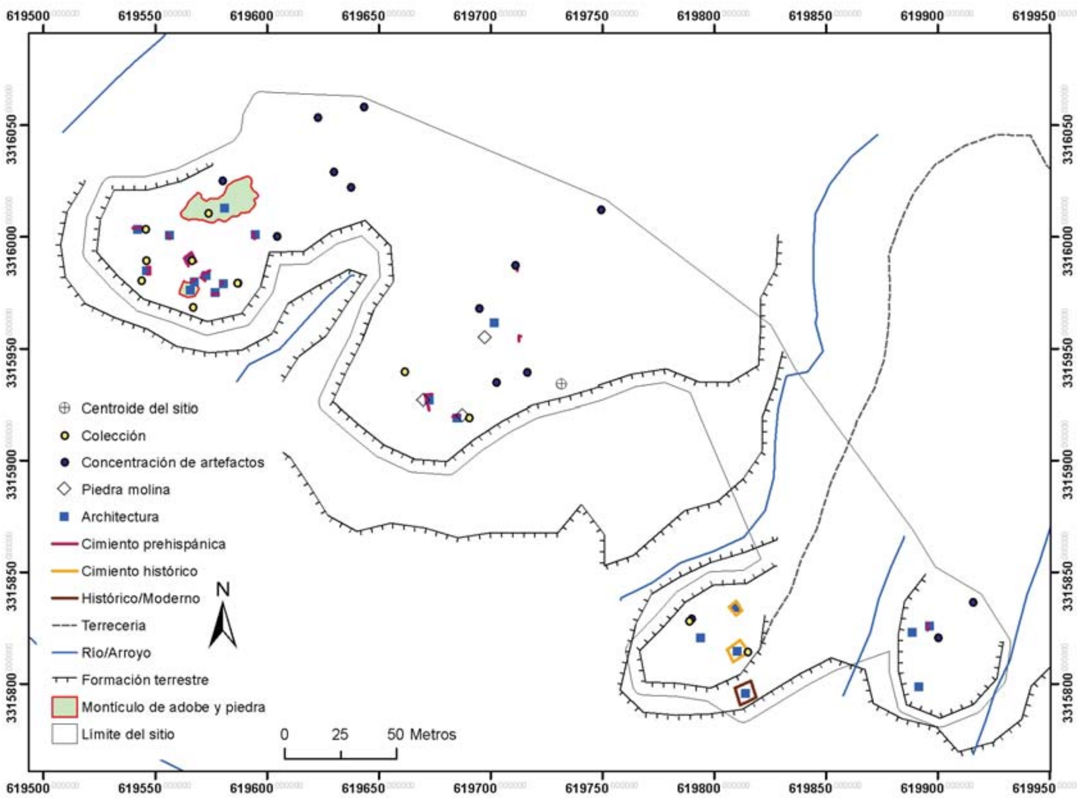

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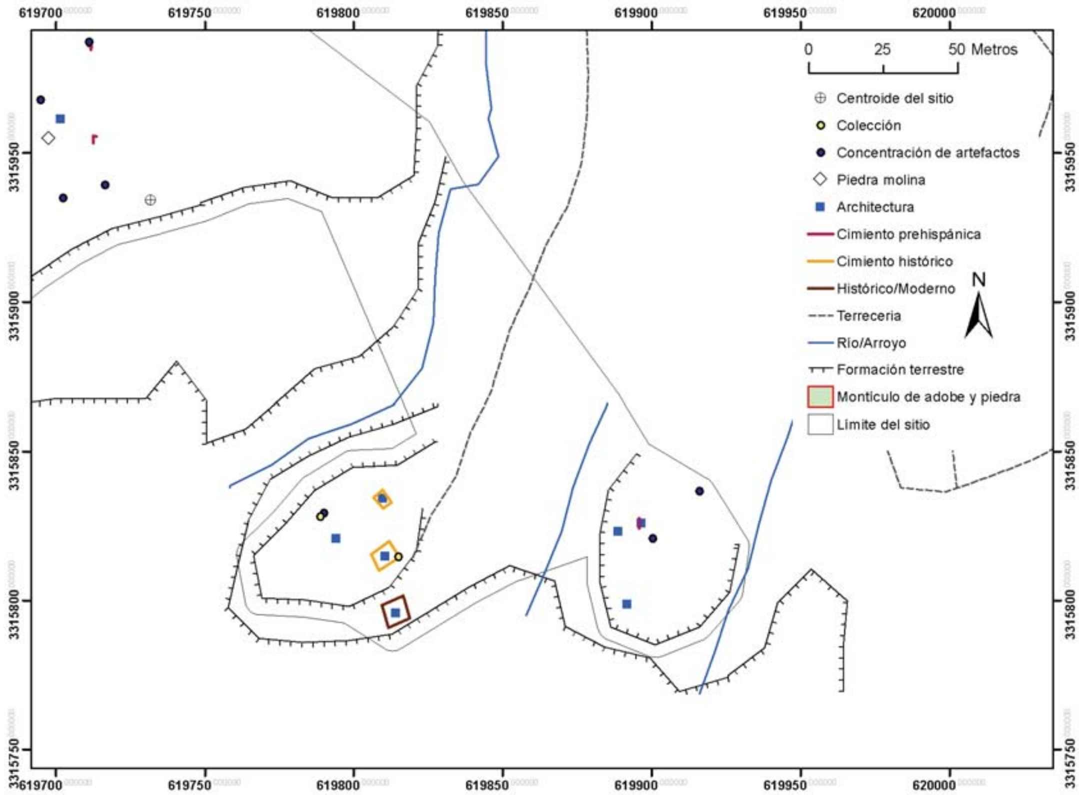
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Río/Arroyo
Formación terrestre
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Límite del sitio
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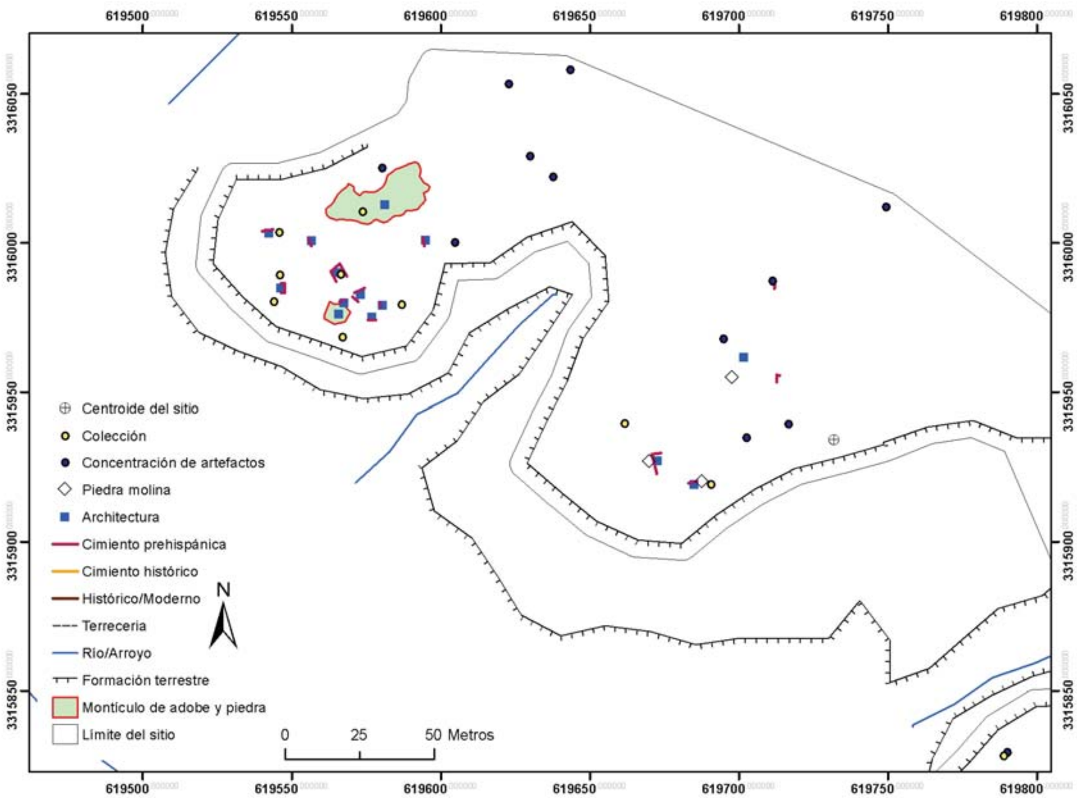

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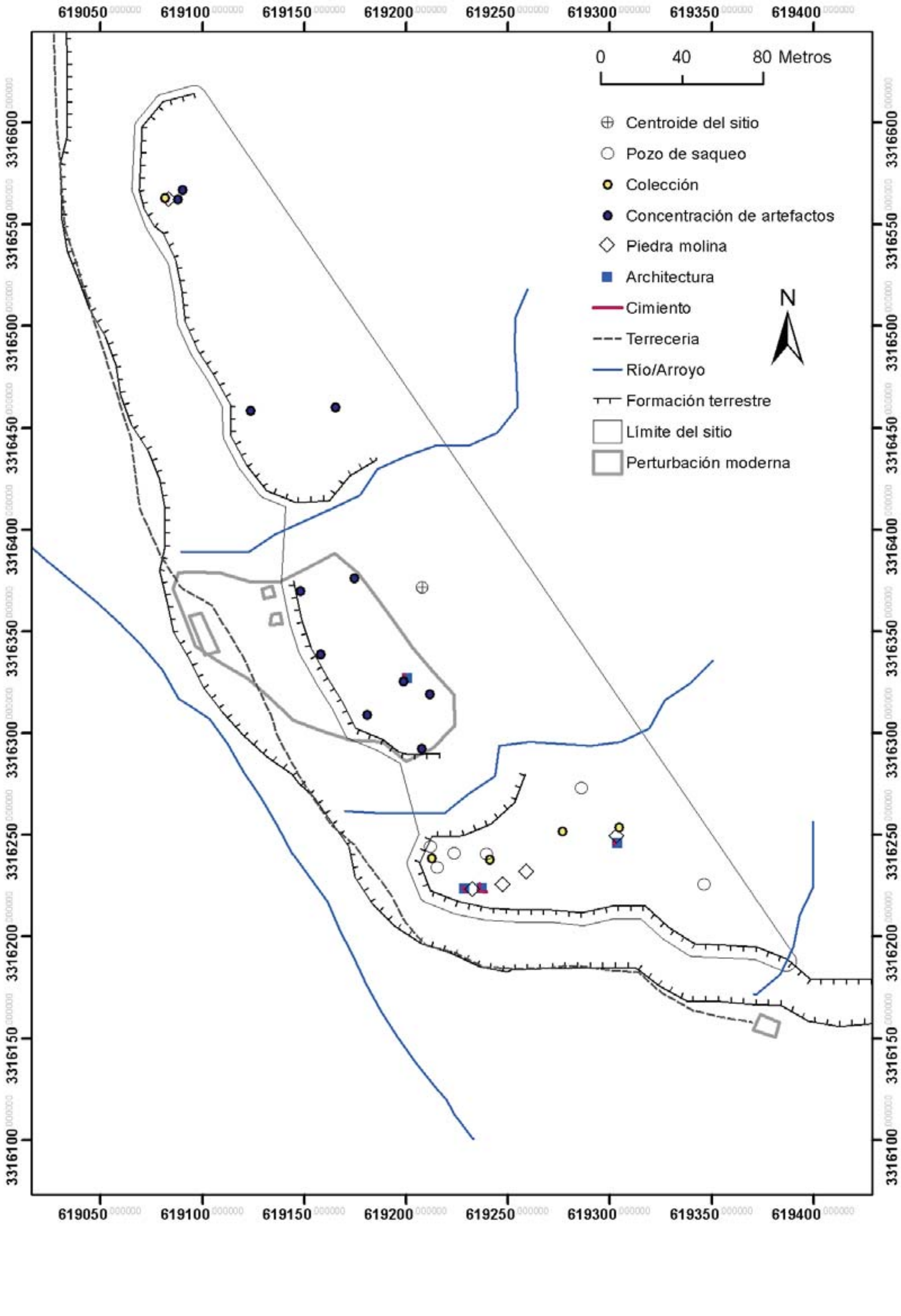

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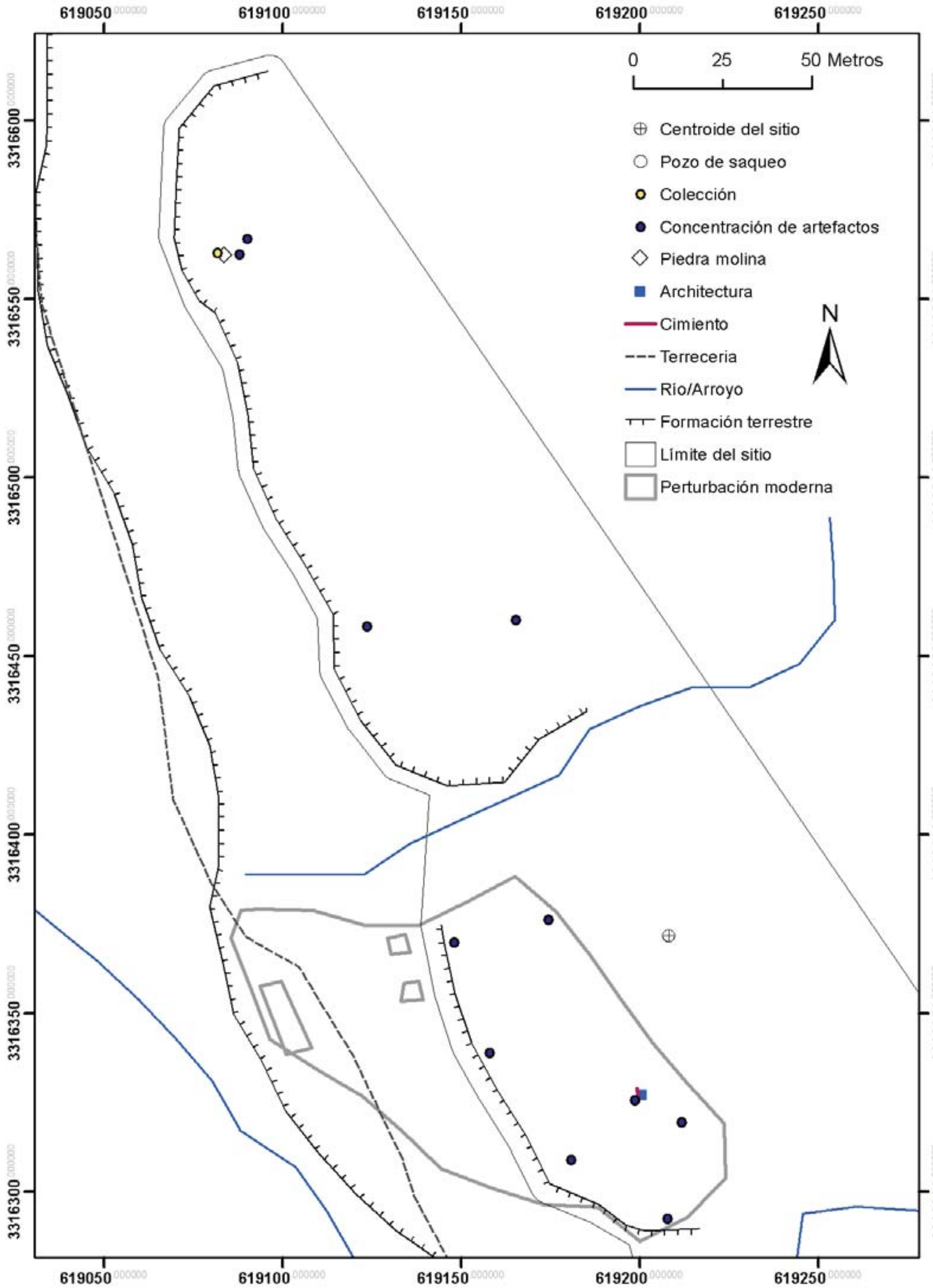
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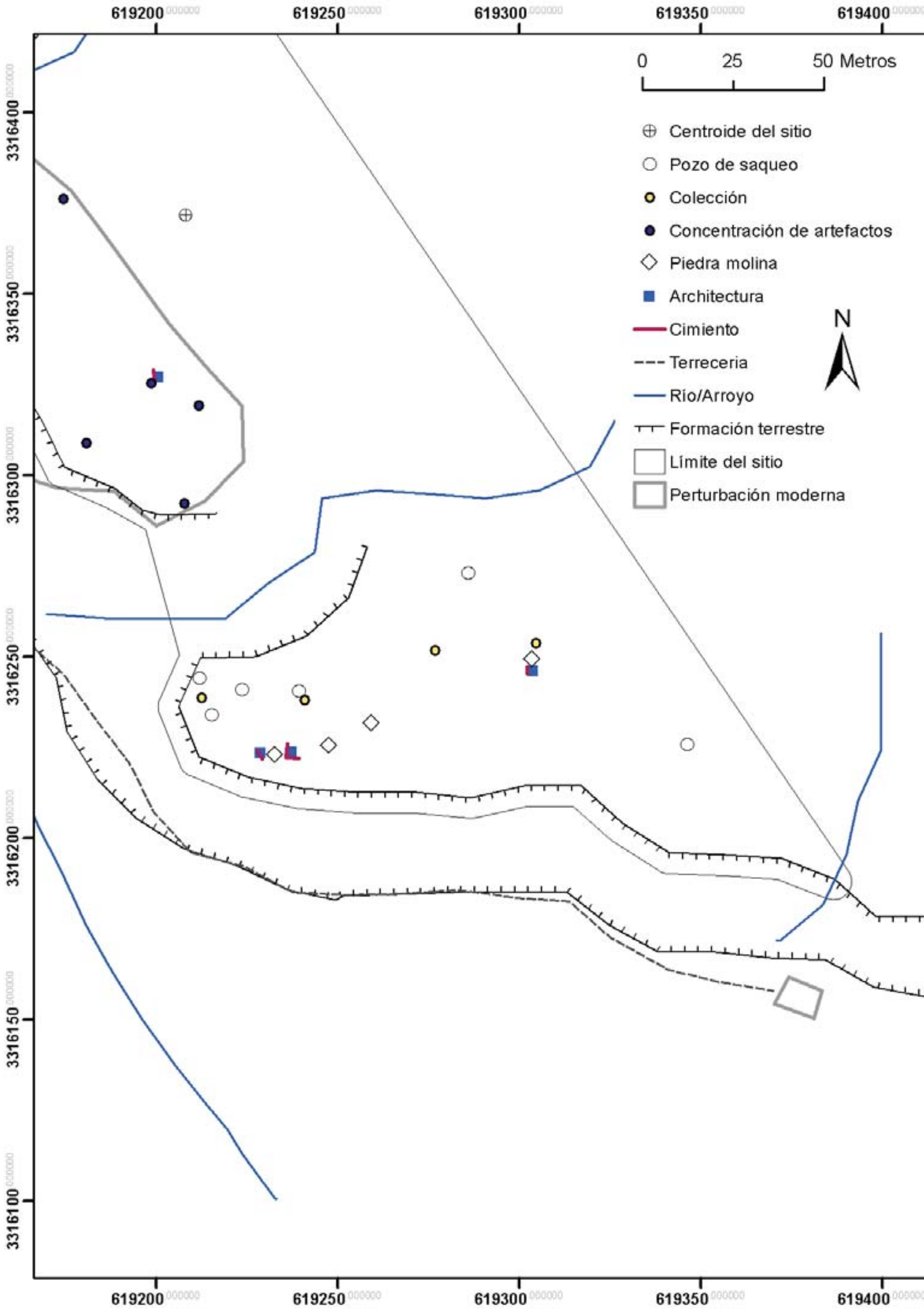
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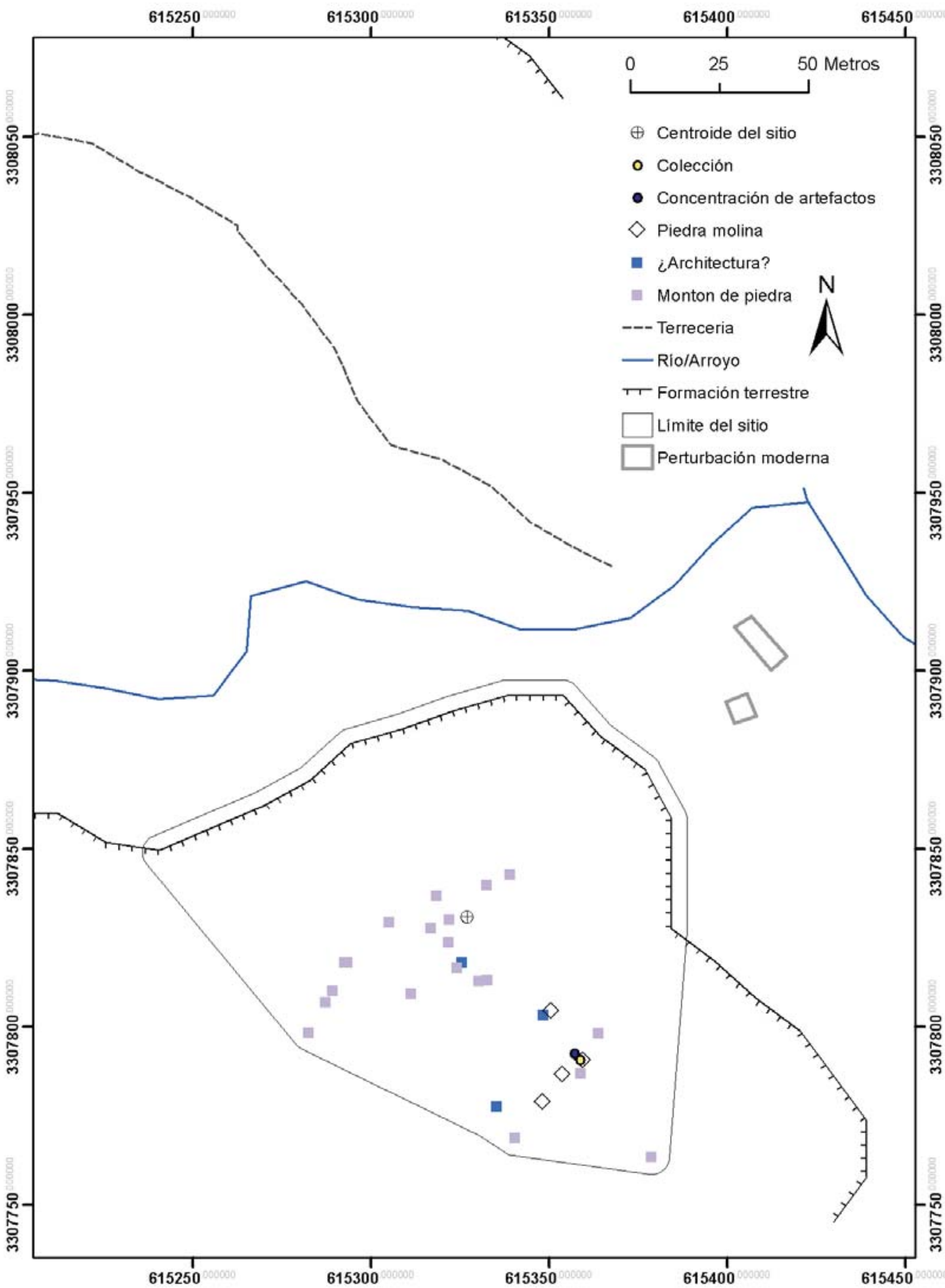
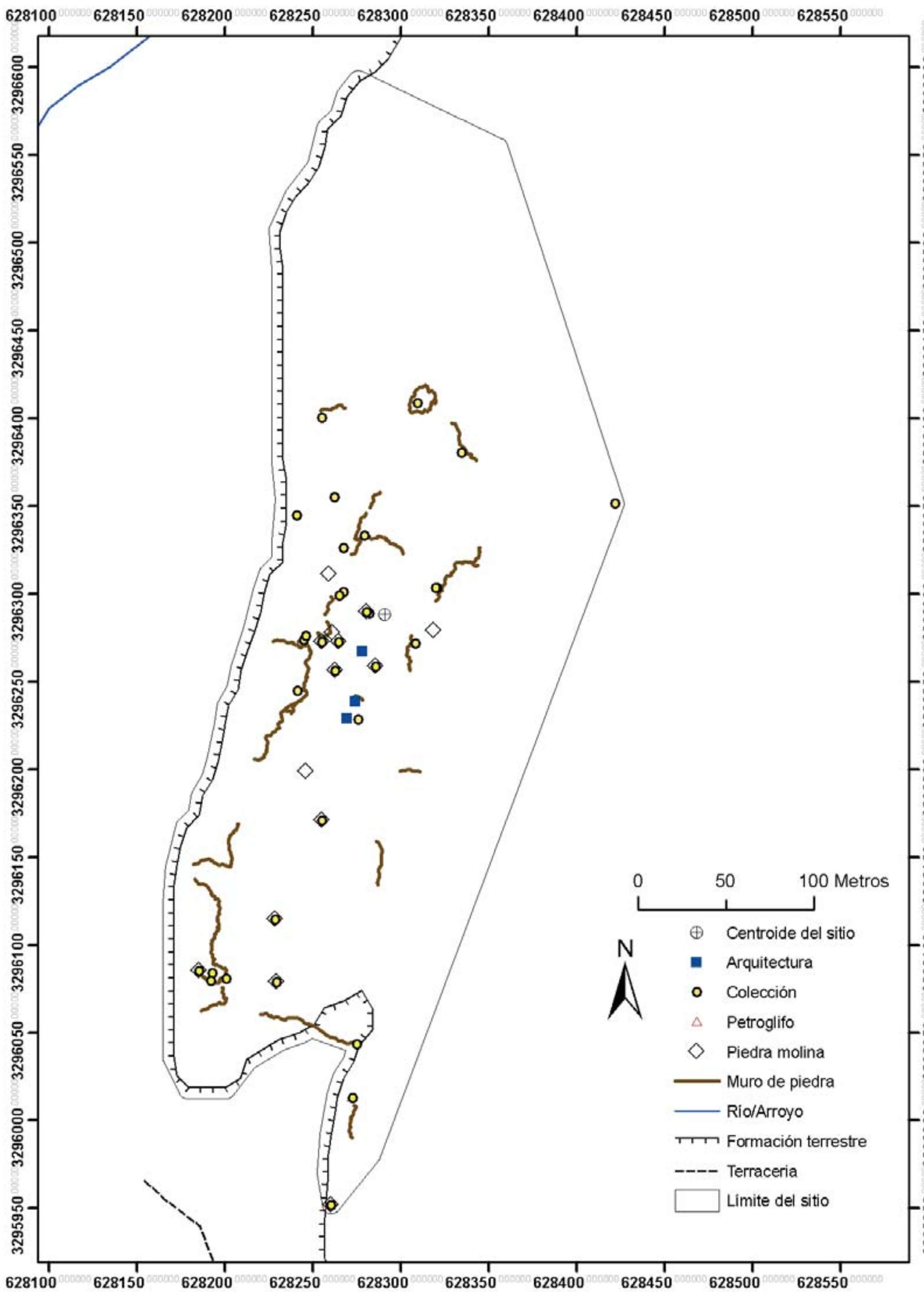
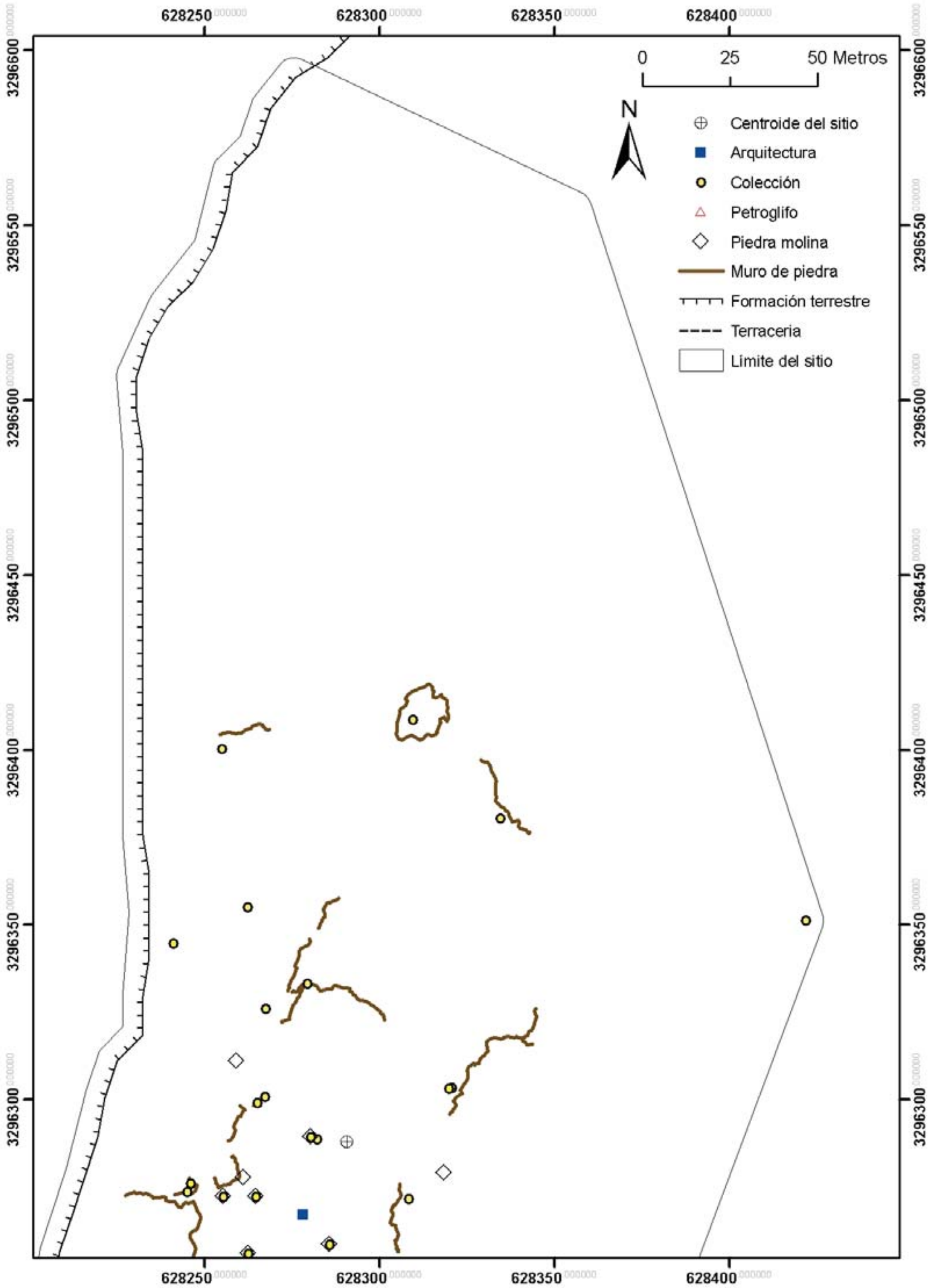


Los Alamos (Son L:1:26)



El Nogal (Son L:2:1)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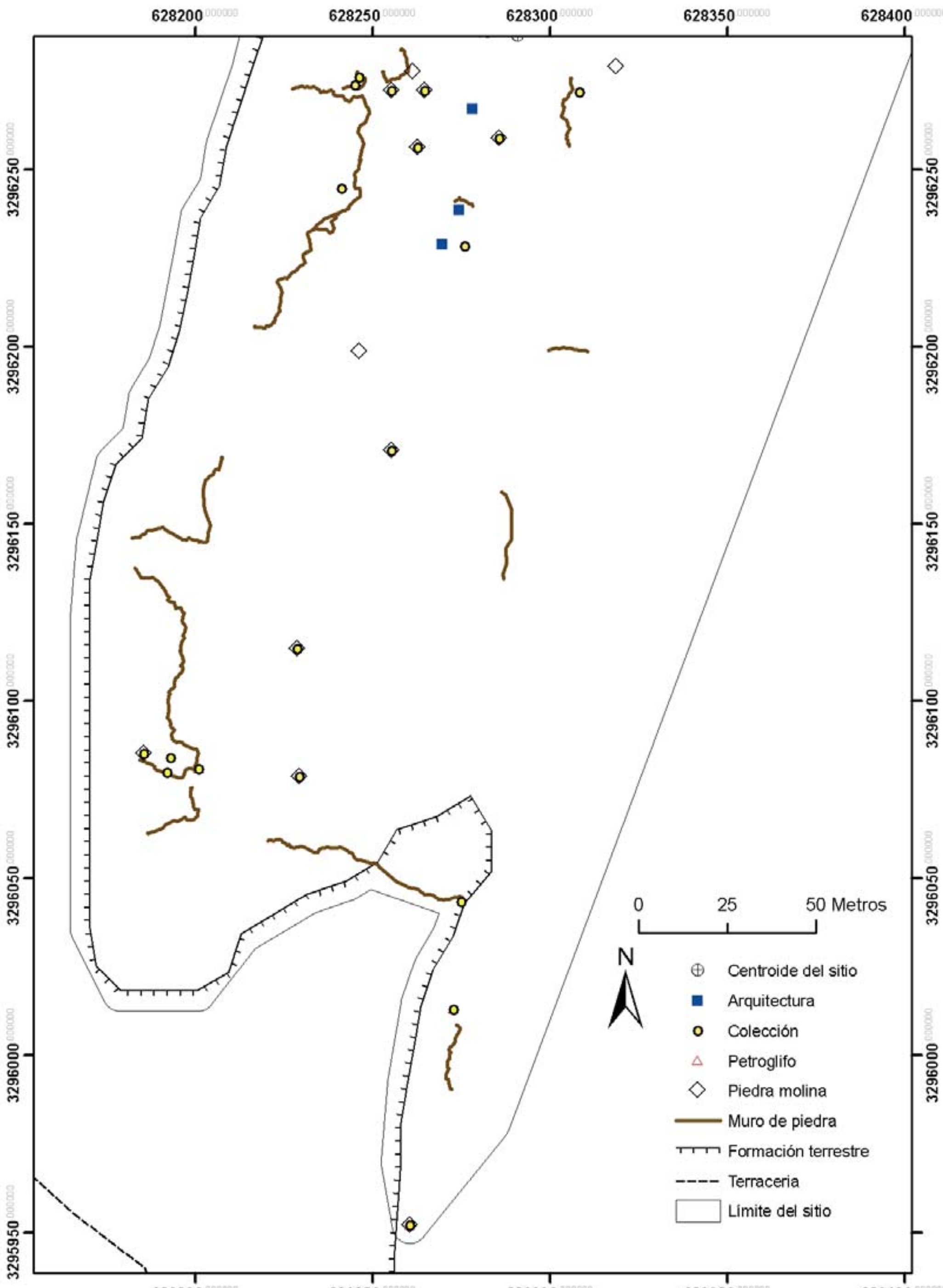
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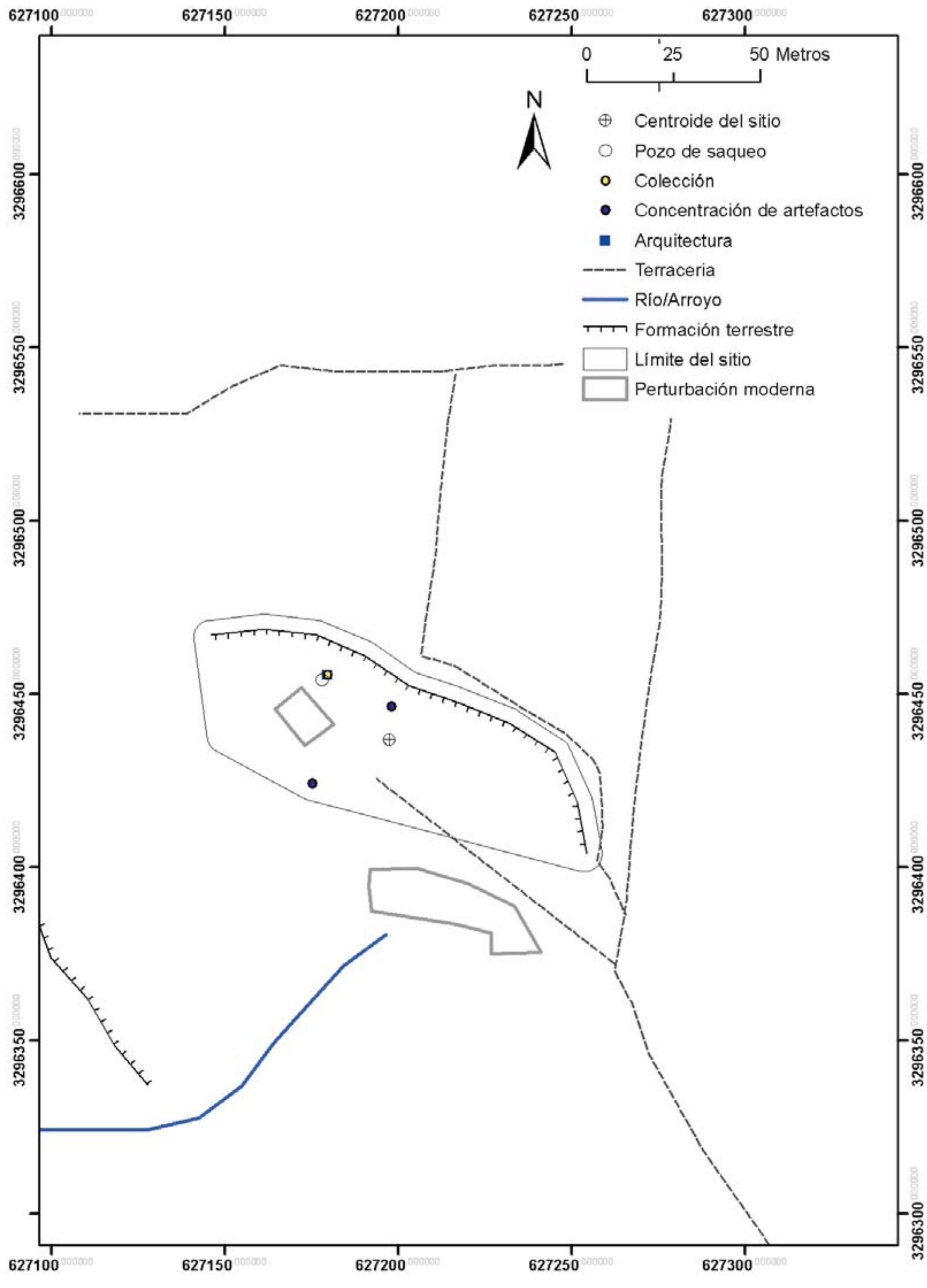
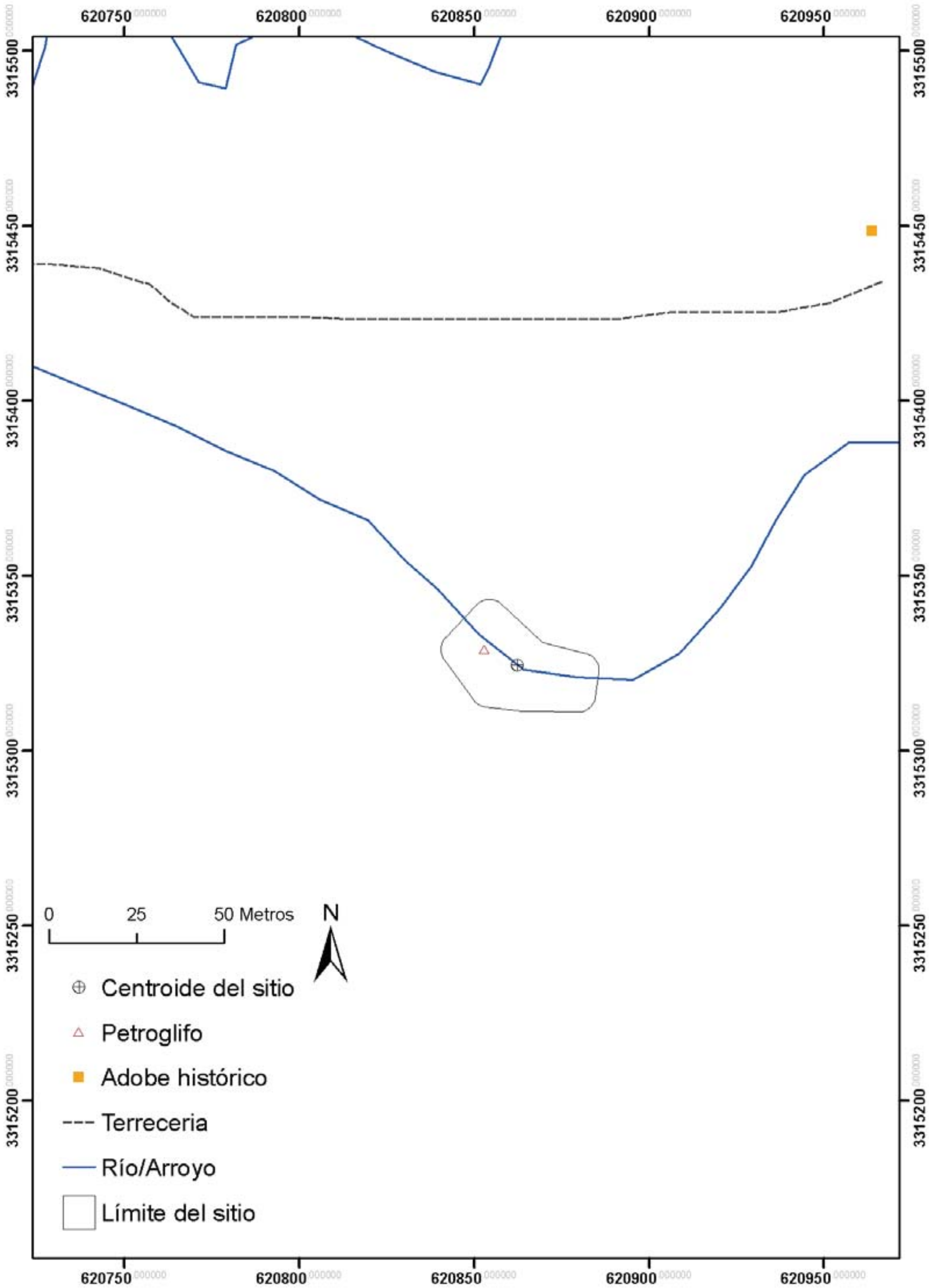
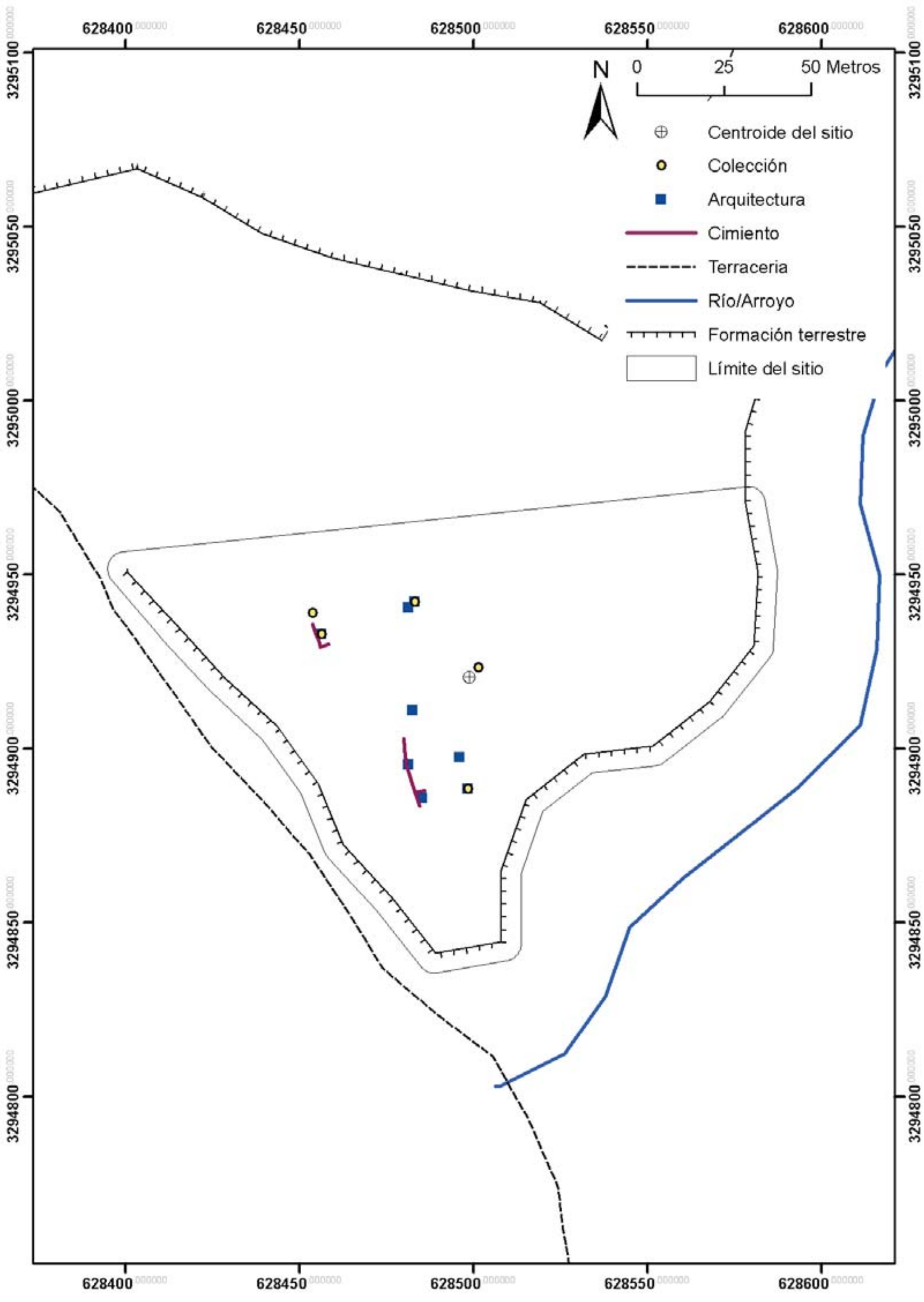


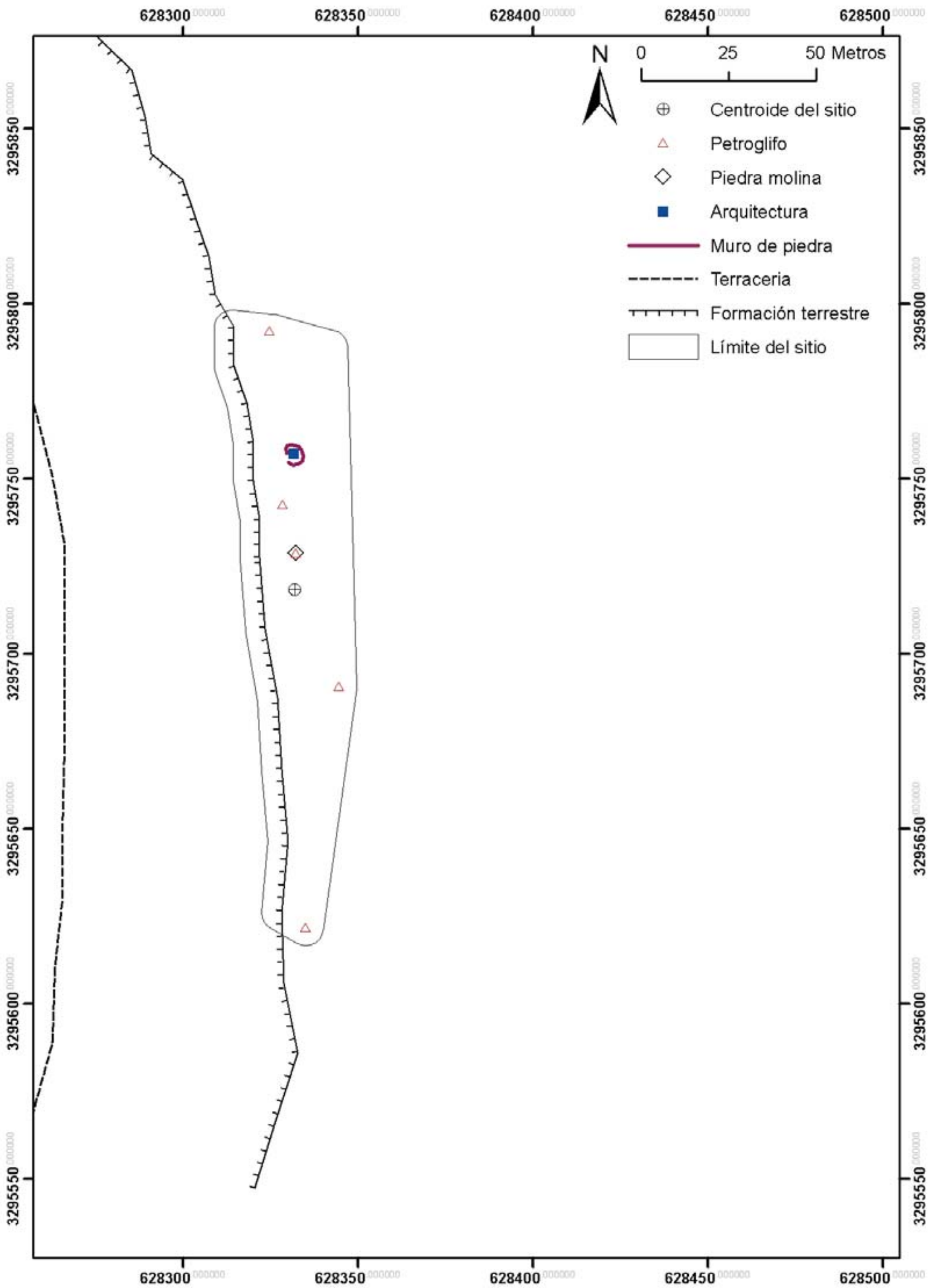
San Patricio (Son L:2:6)



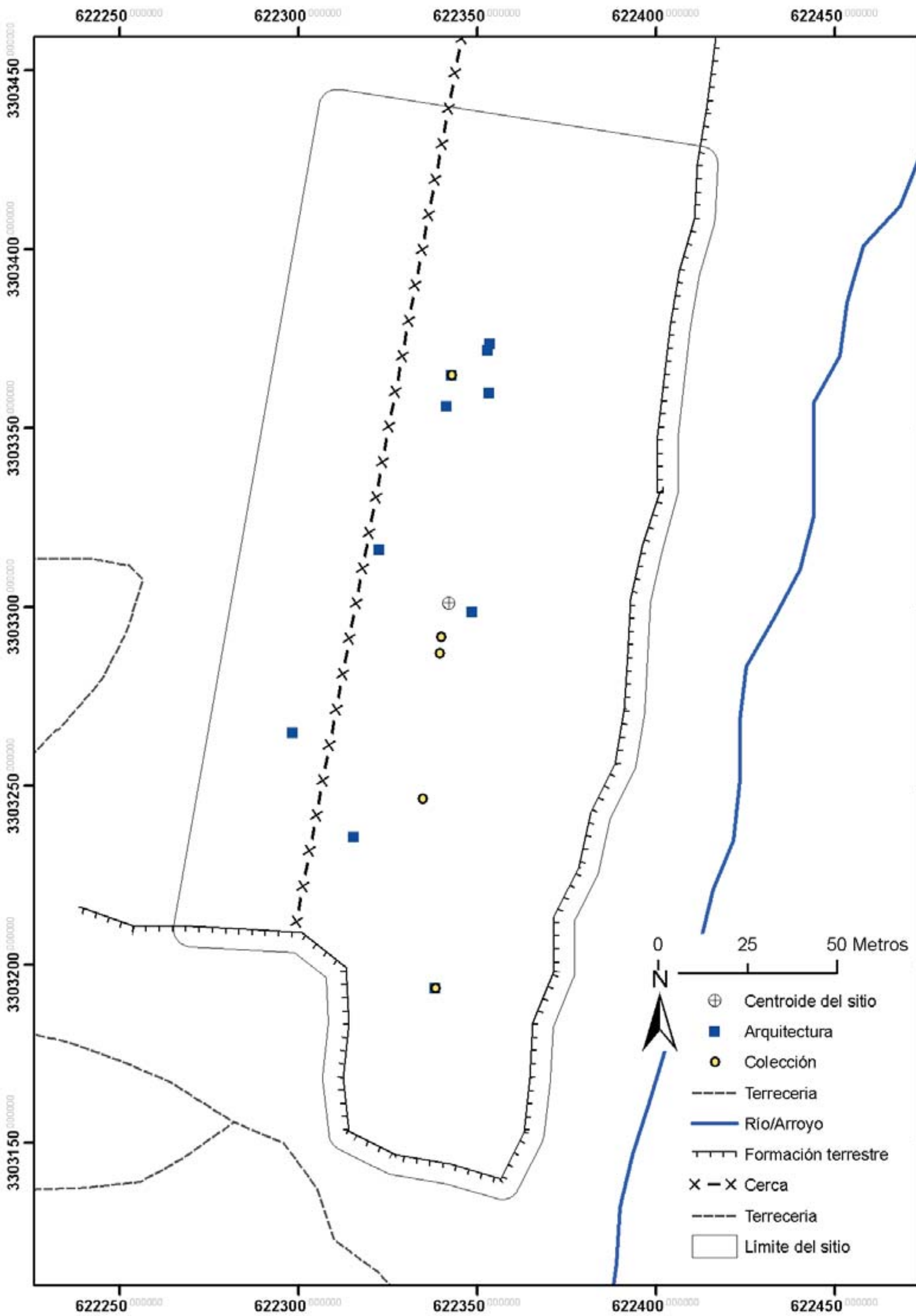
Cajón de los Deargüelles (Son L:2:13)



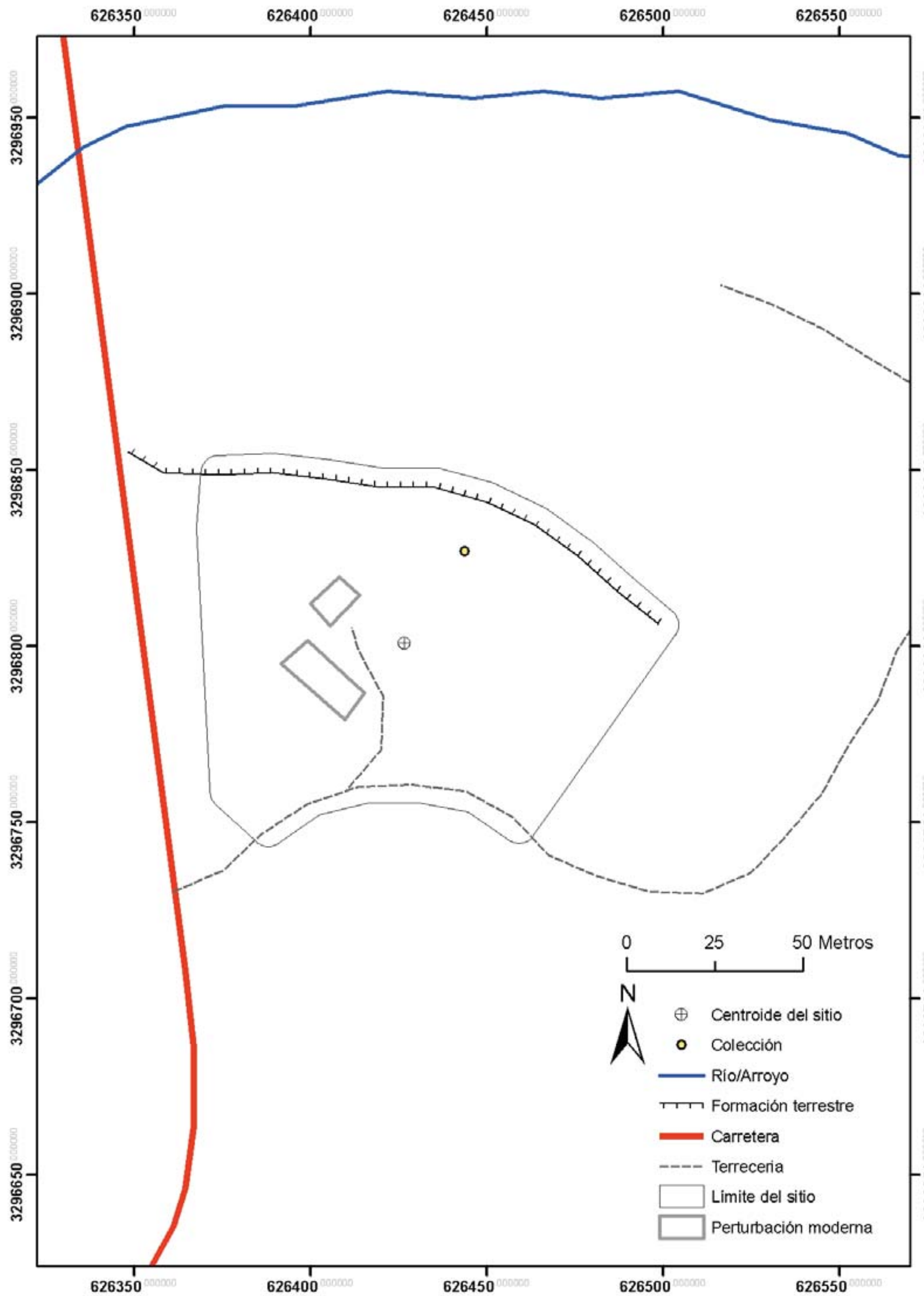
Mesa Abaja (Son L:2:16)



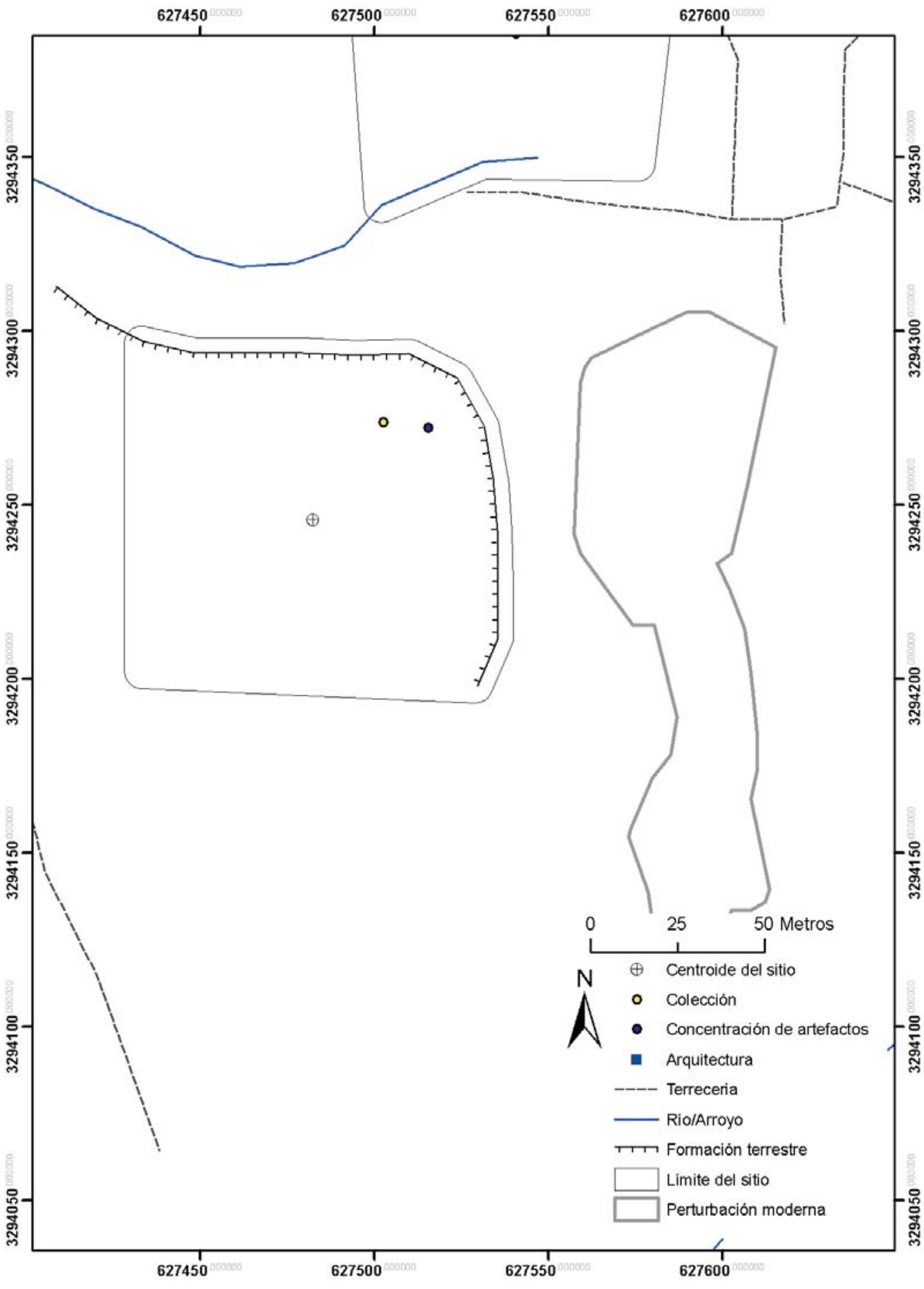
El Corral (Son L:2:17)



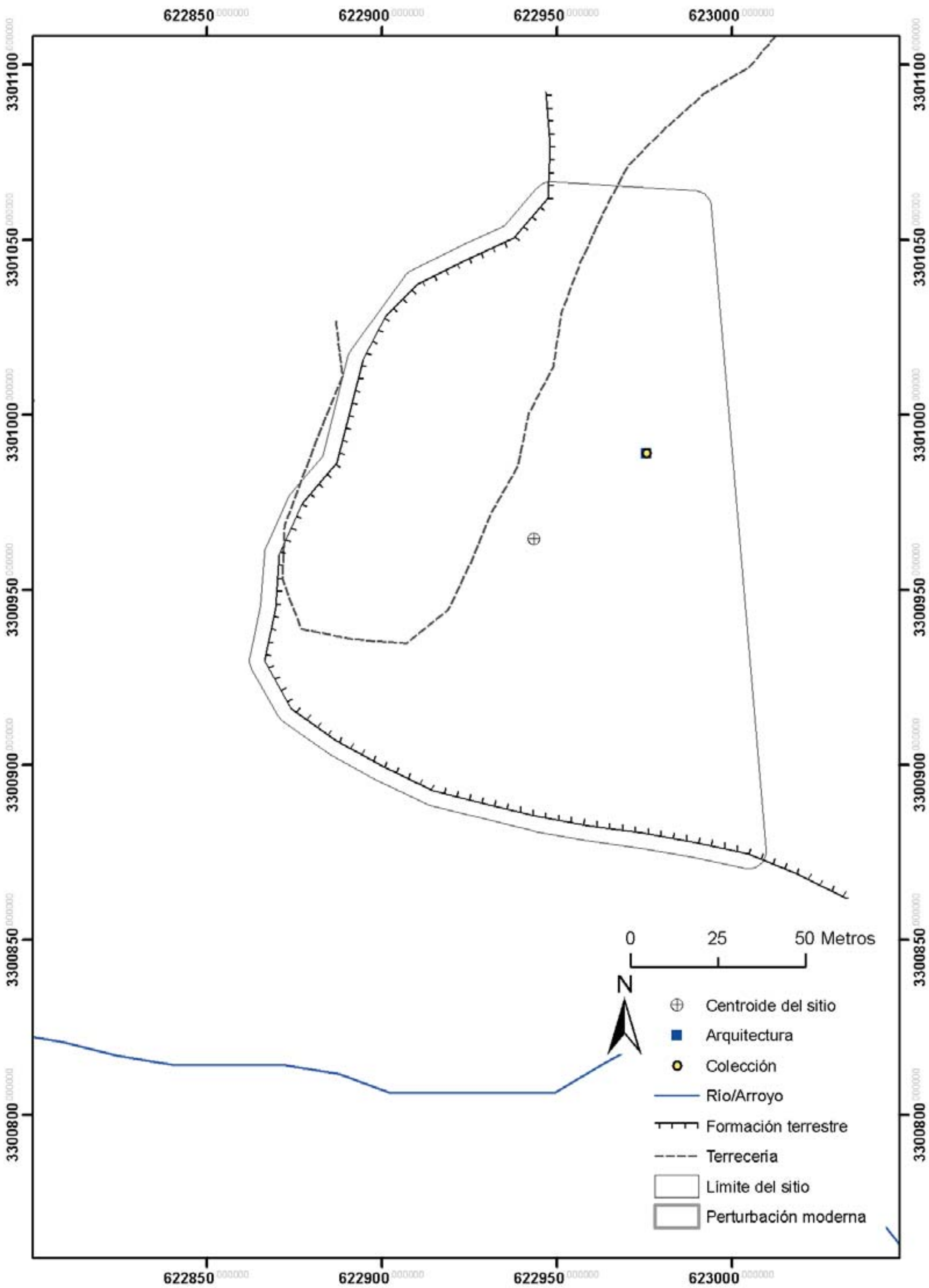
Tebisco (Son L:2:18)



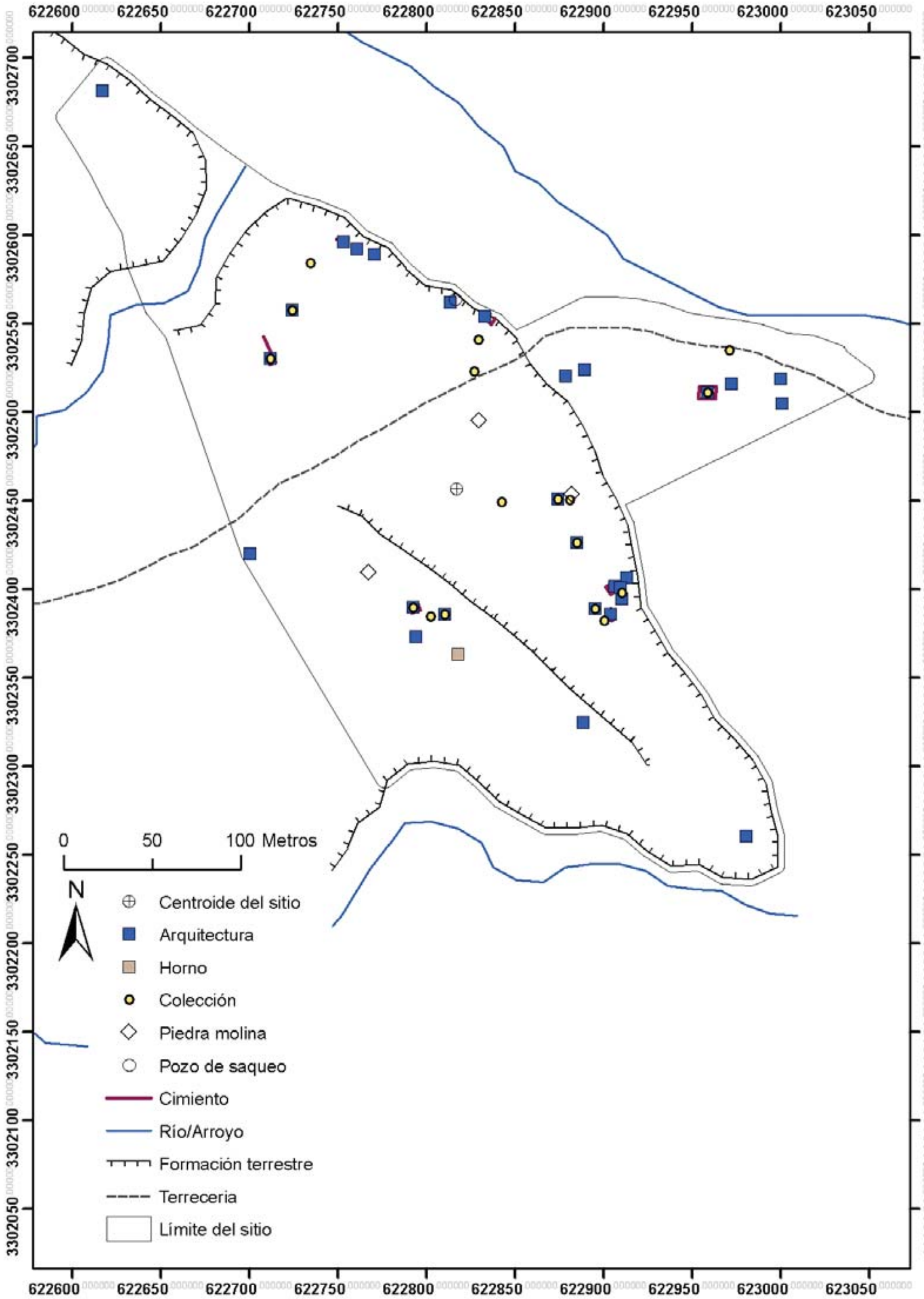
Las Abejas (Son L:2:19)



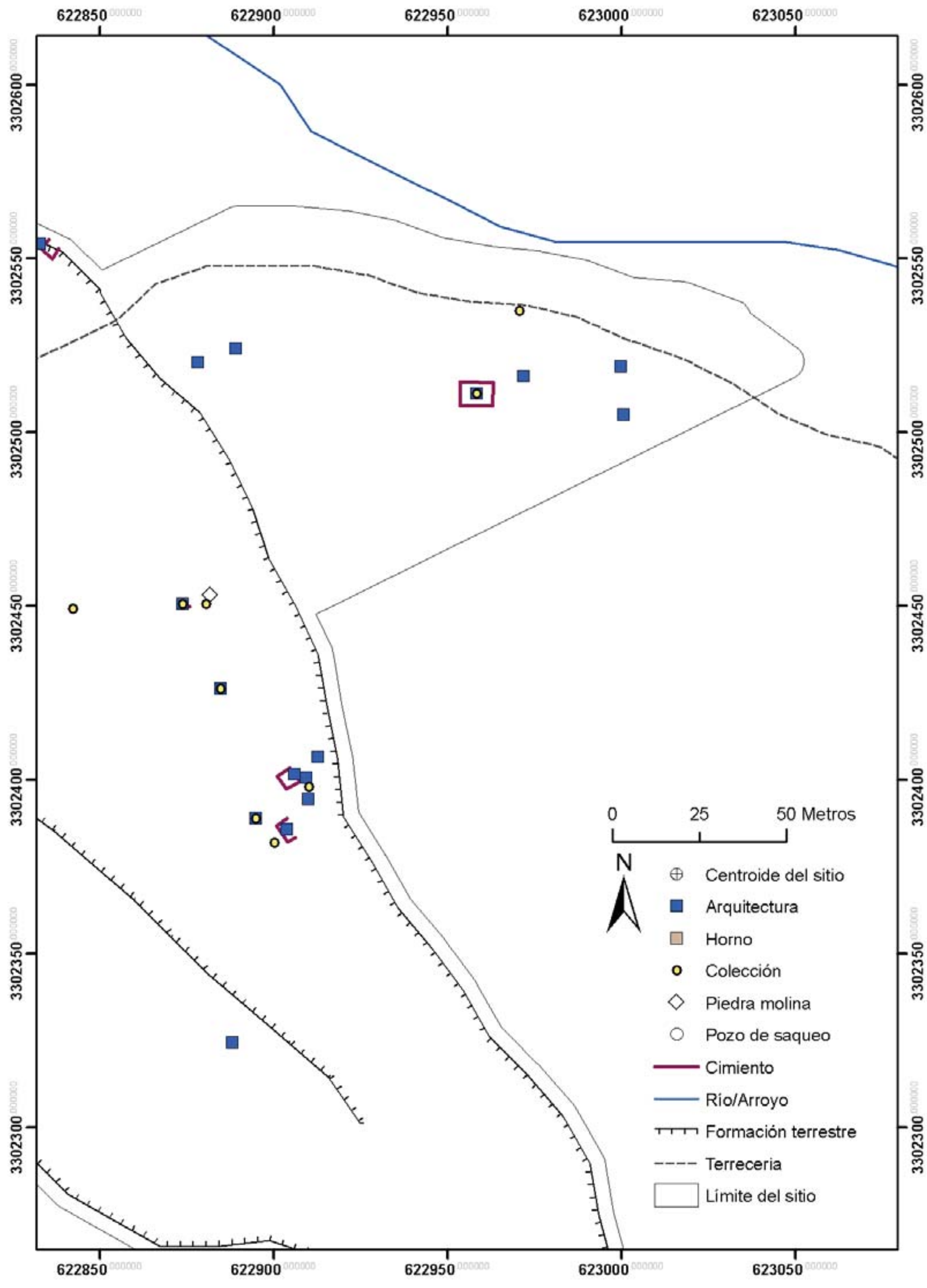
Nicora Chica (Son L:2:20)



Comachi (Son L:2:21)



Los Mineros (Son L:2:22)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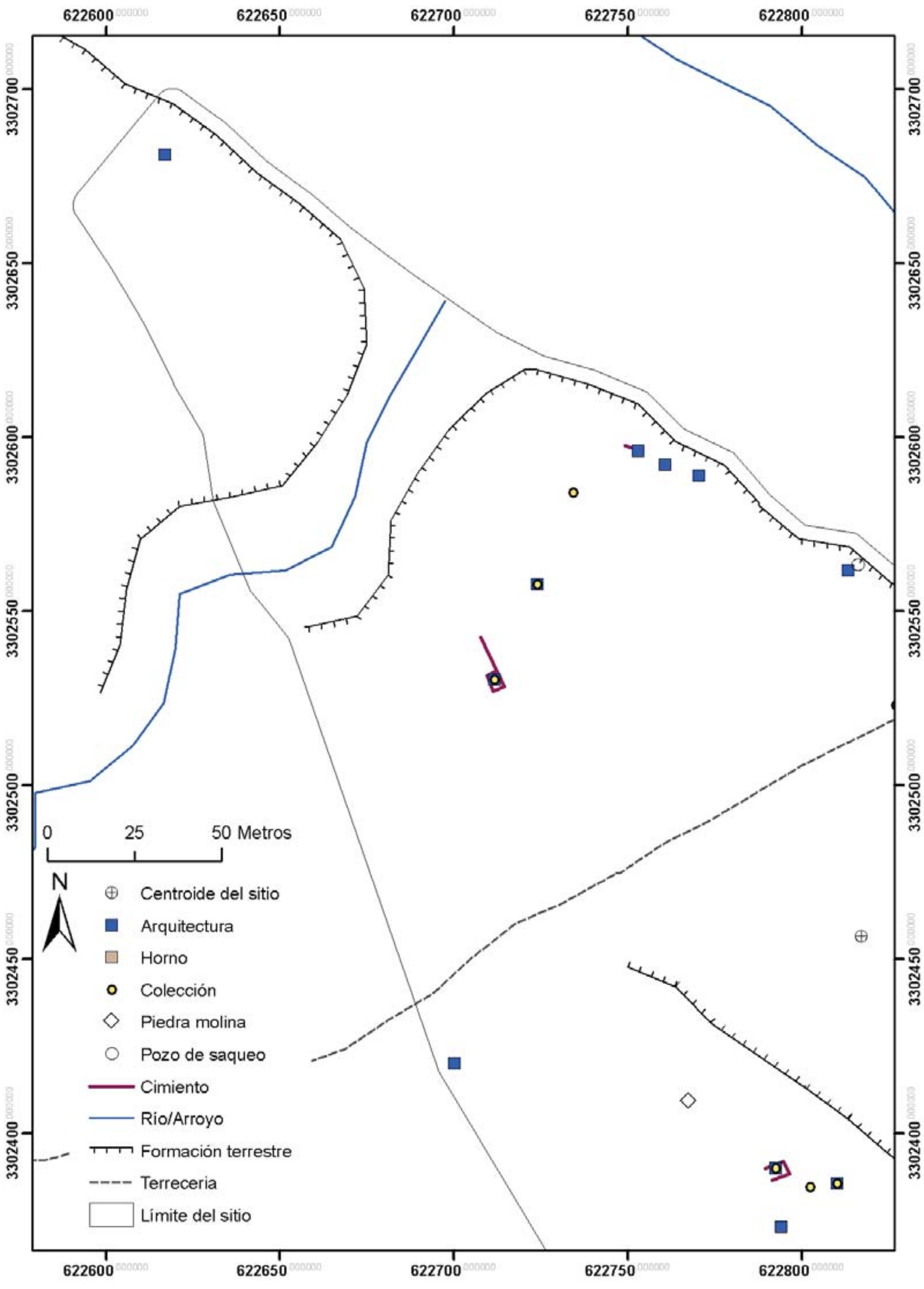
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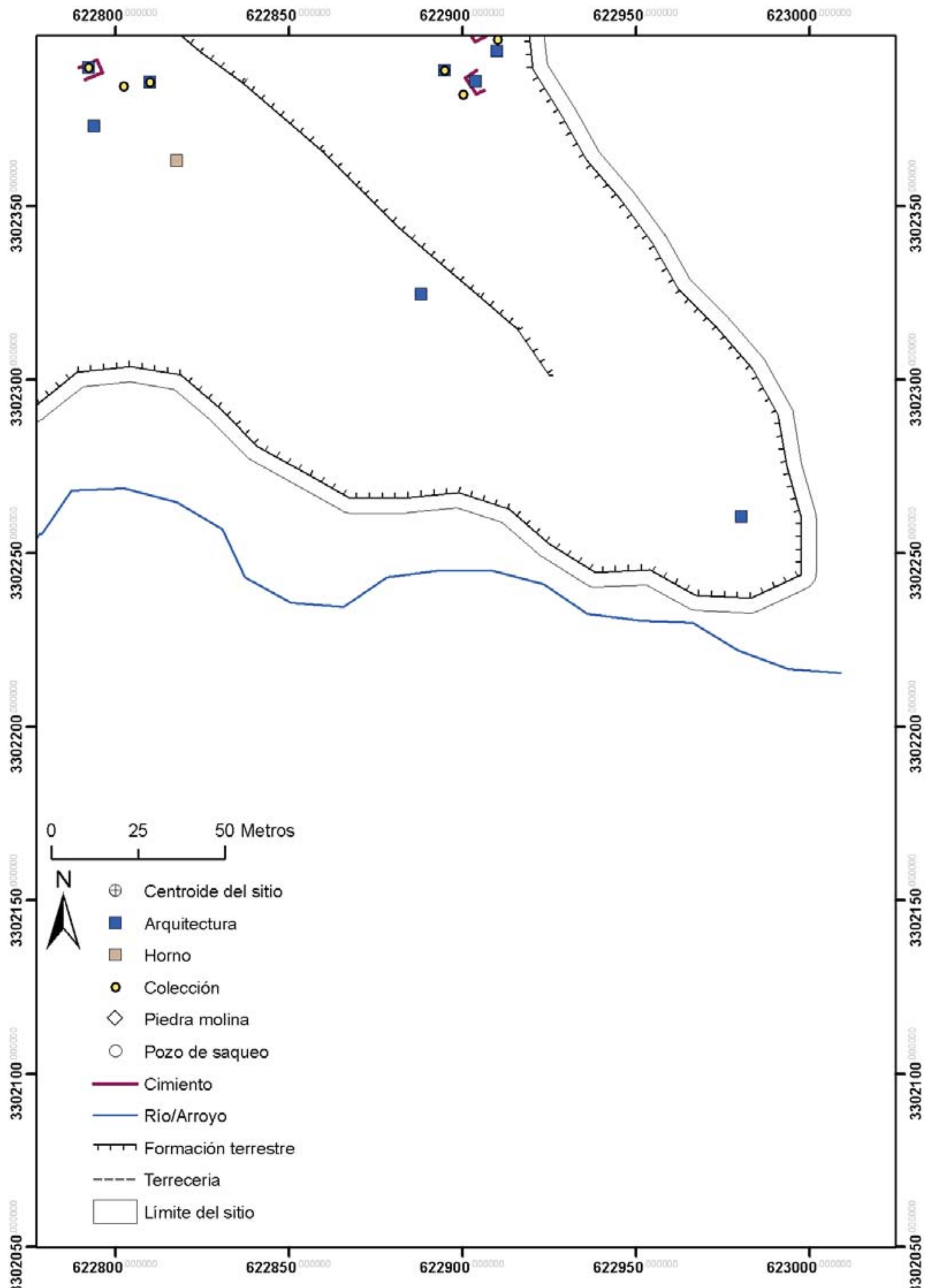

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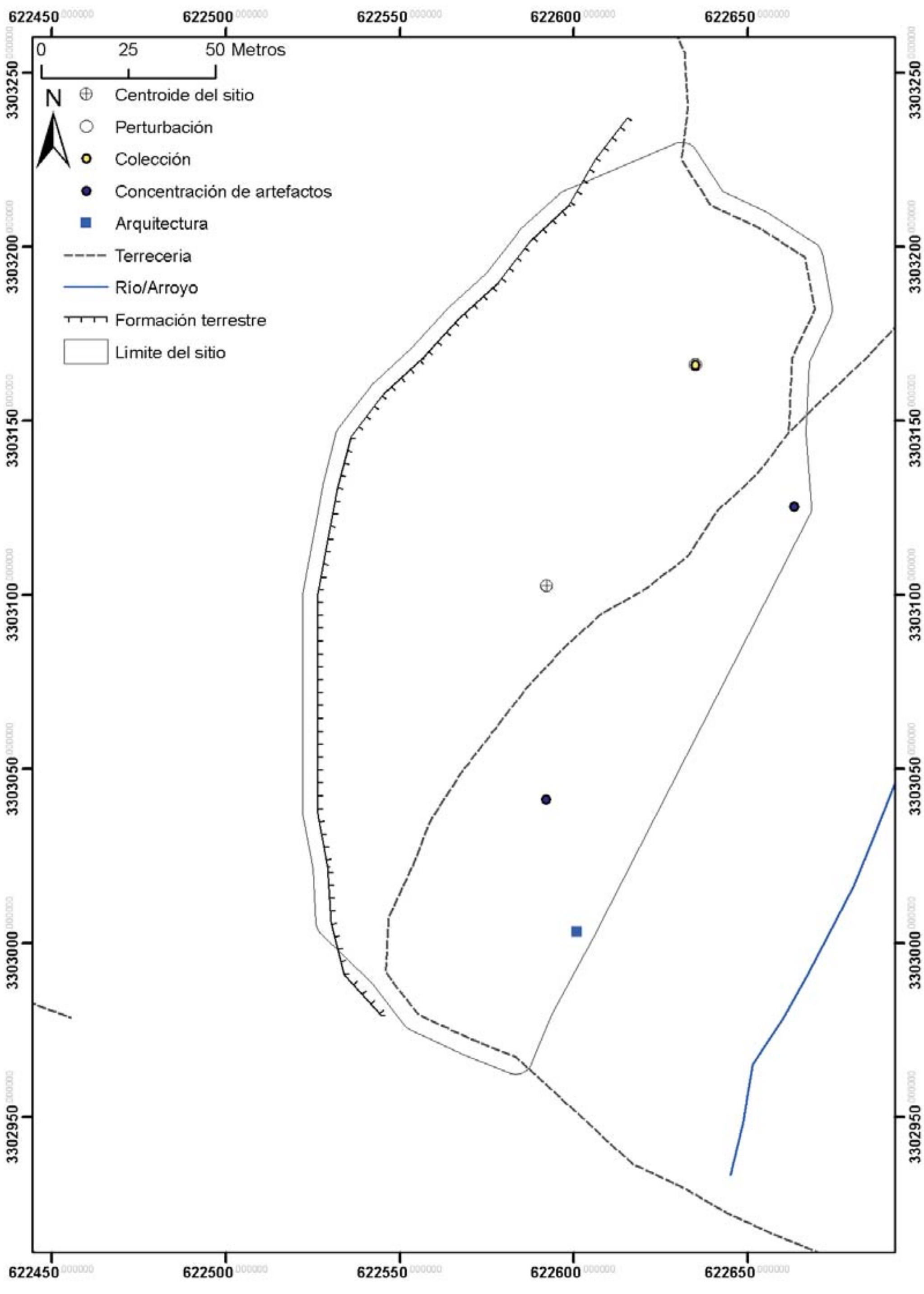
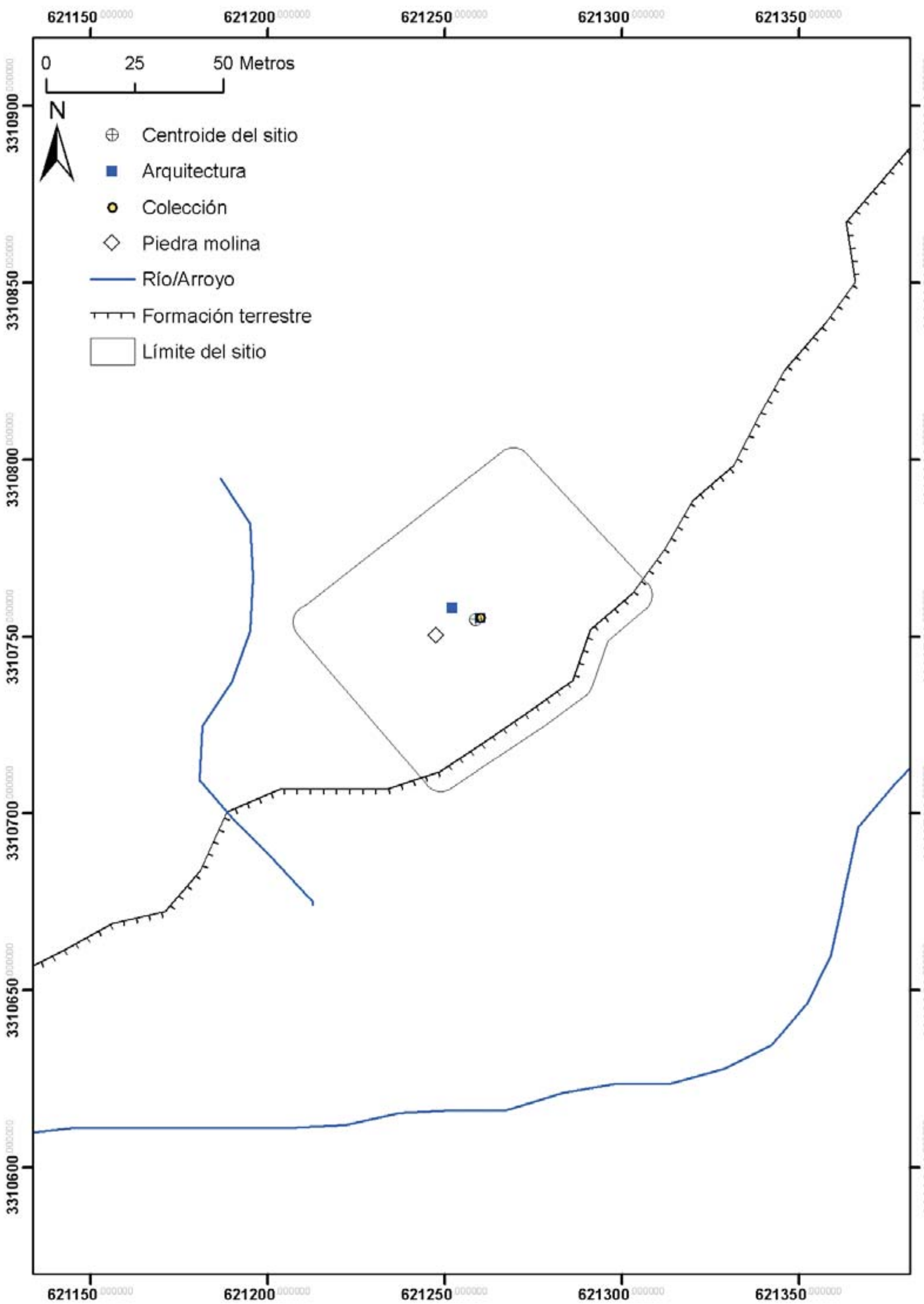
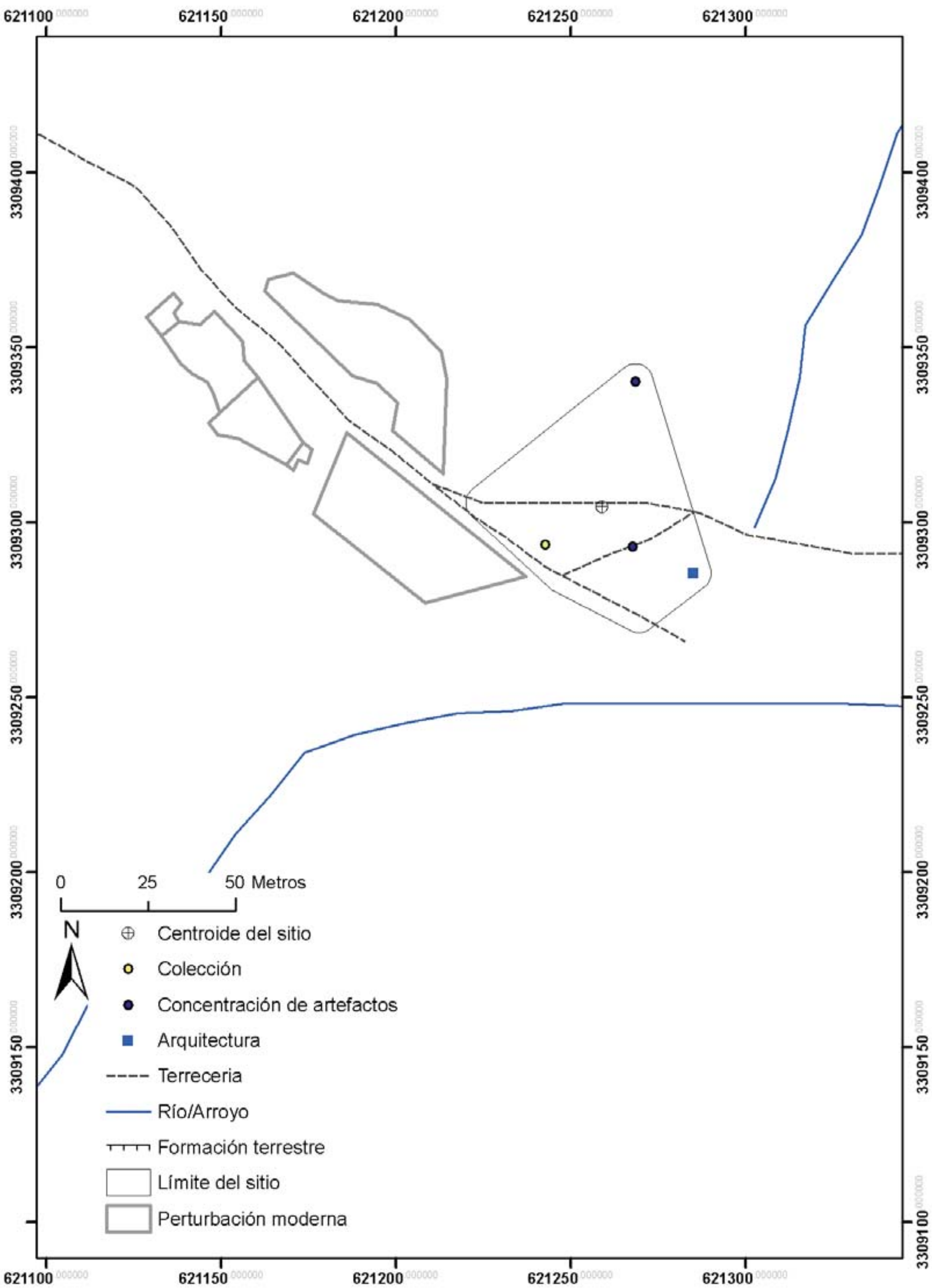


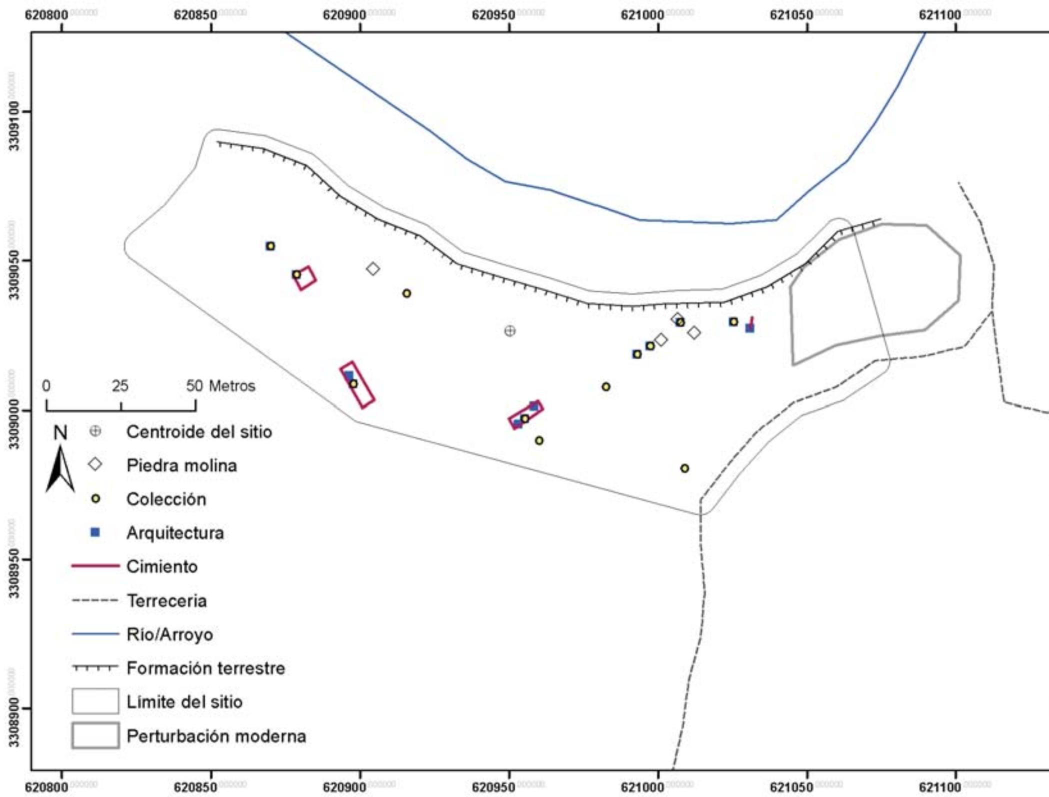
Tío Lugo (Son L:2:23)



Las Geodas (Son L:2:24)



El Leon (Son L:2:25)



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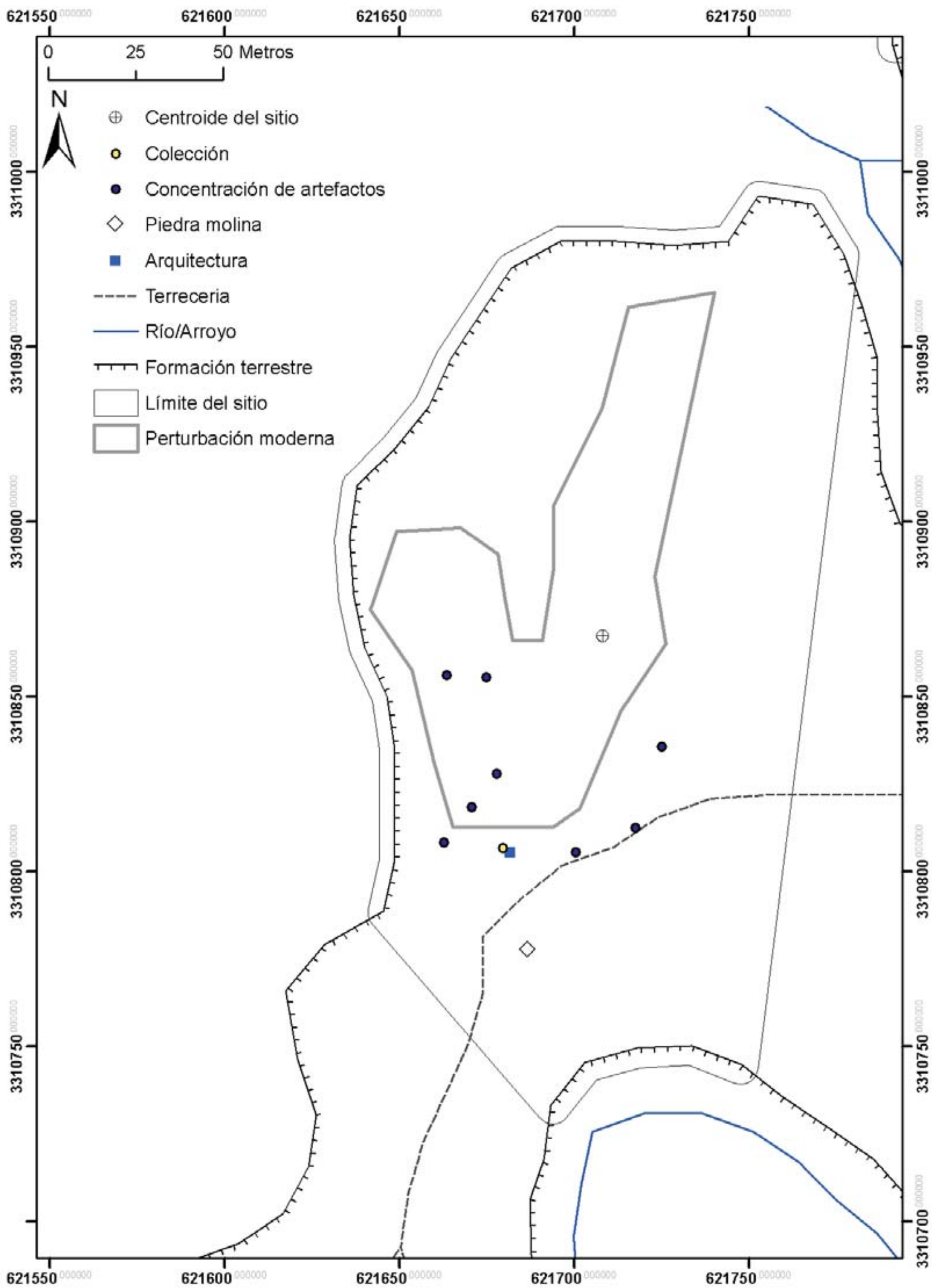
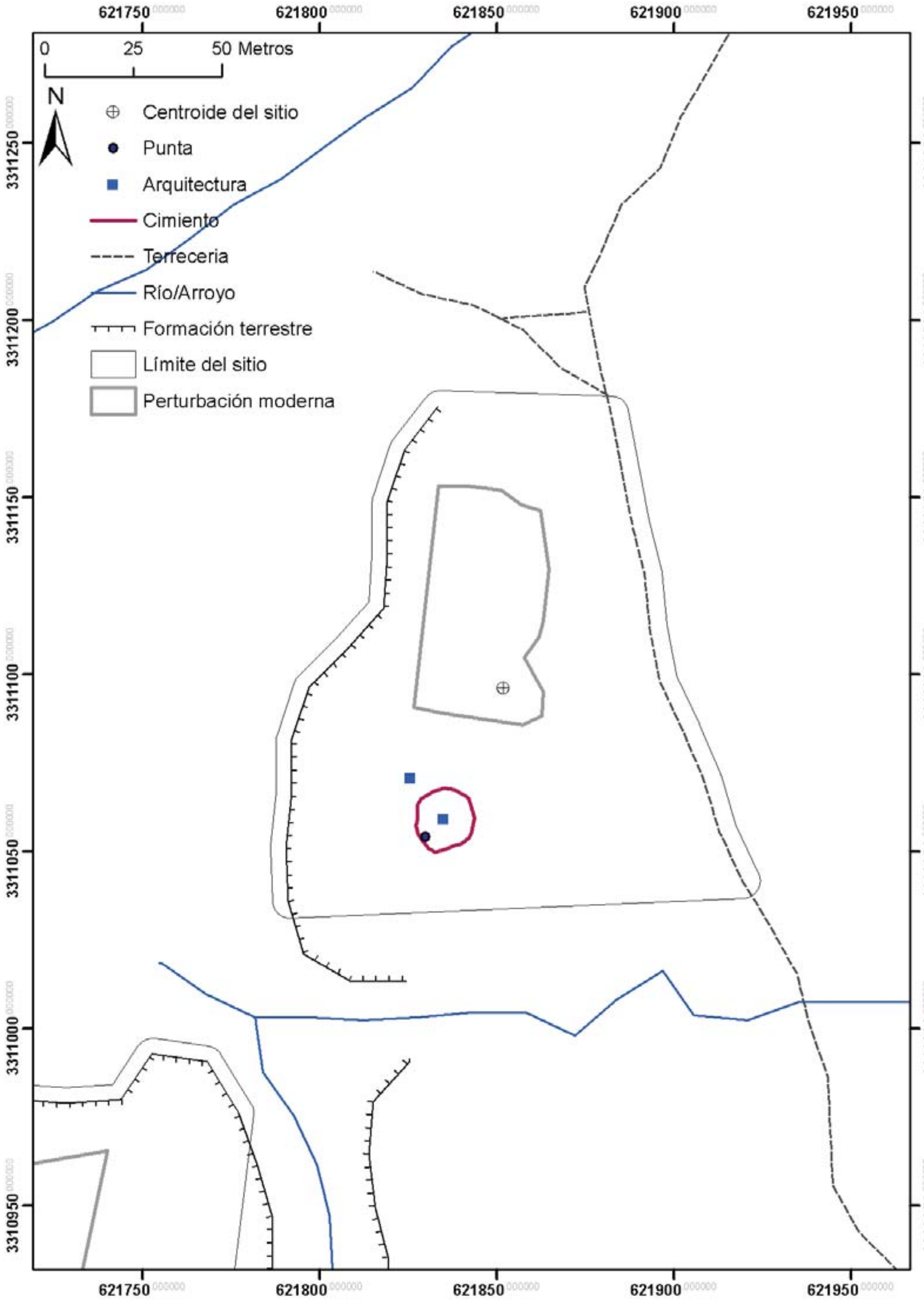


El Charco (Son L:2:27)



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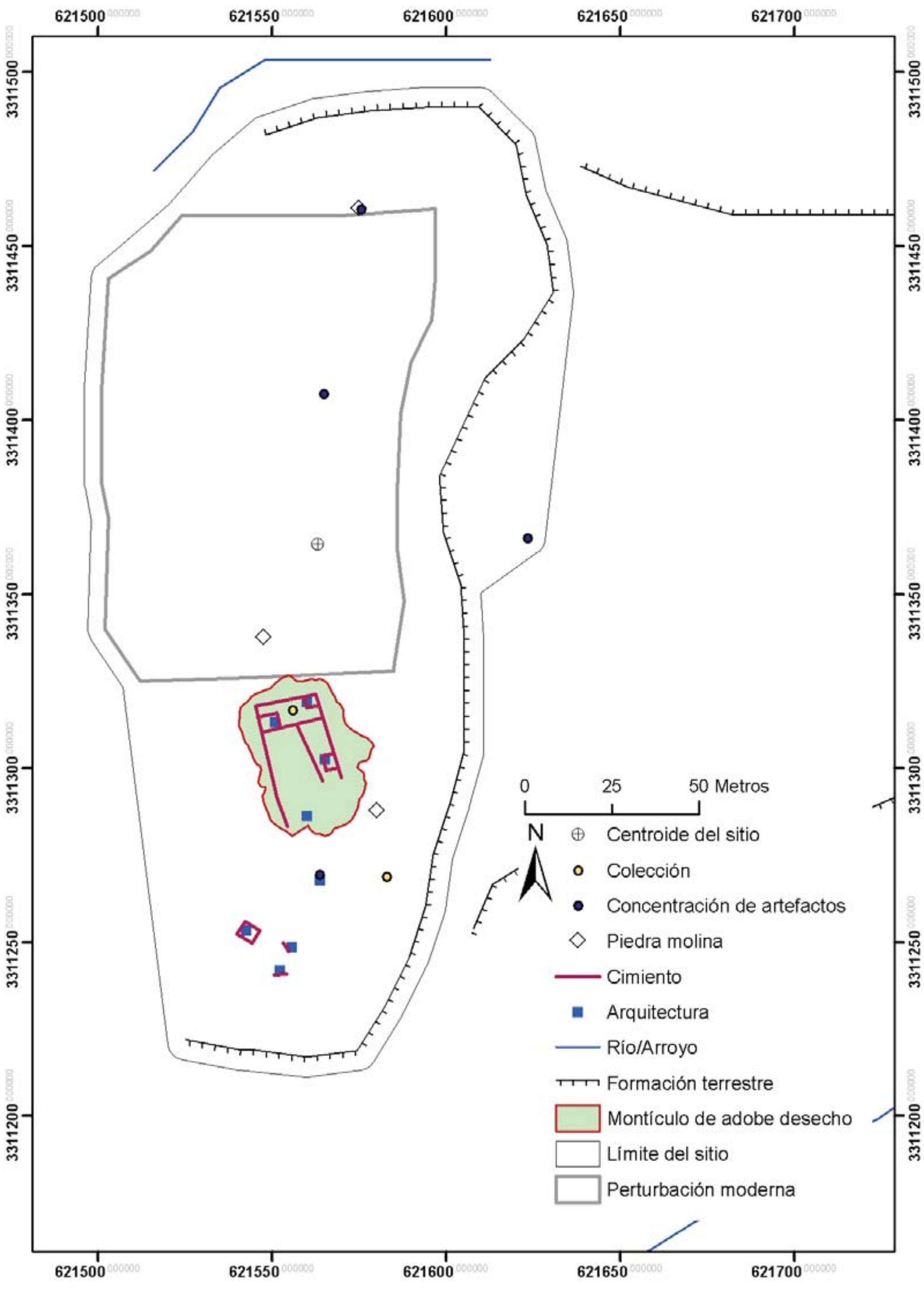

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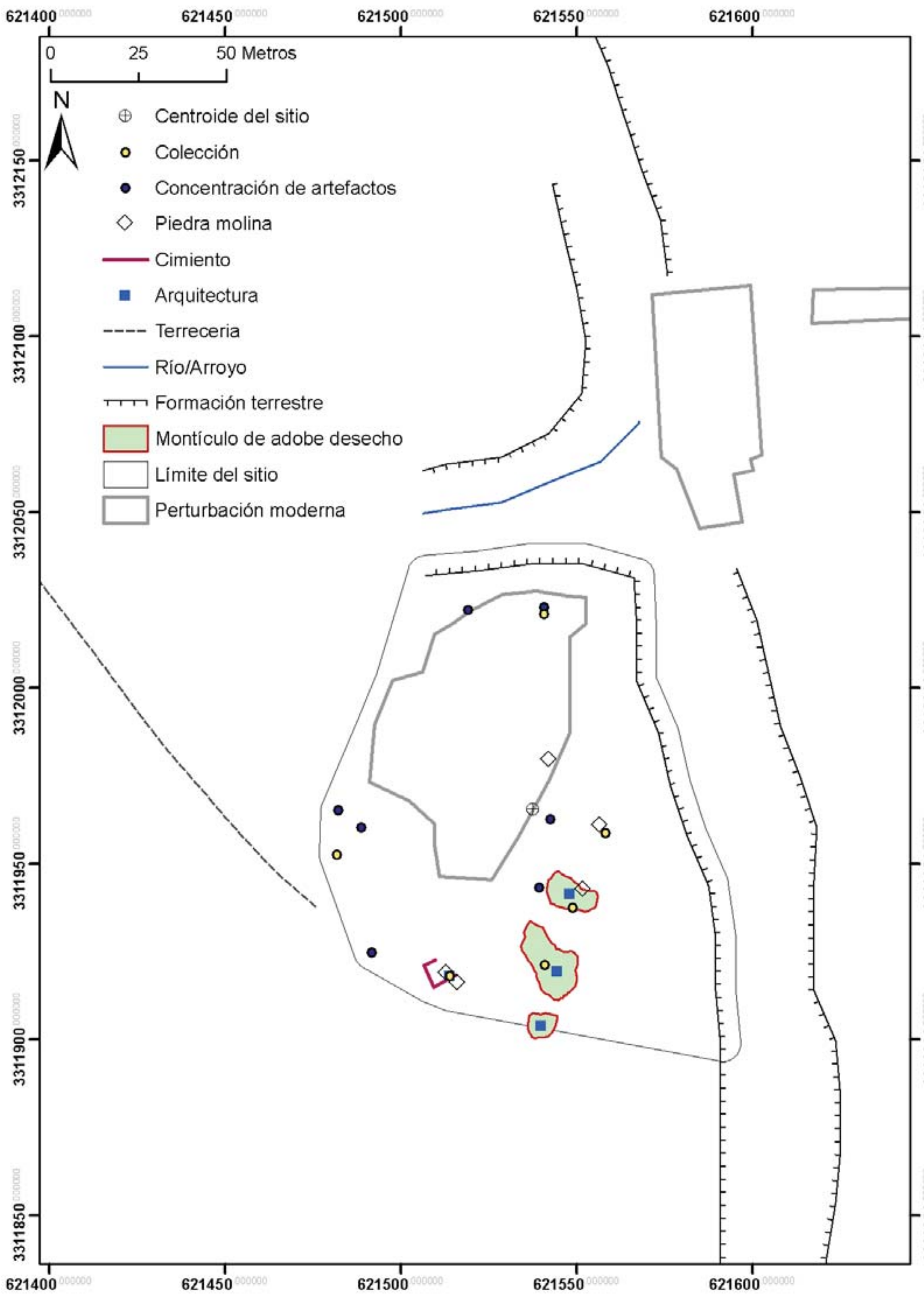

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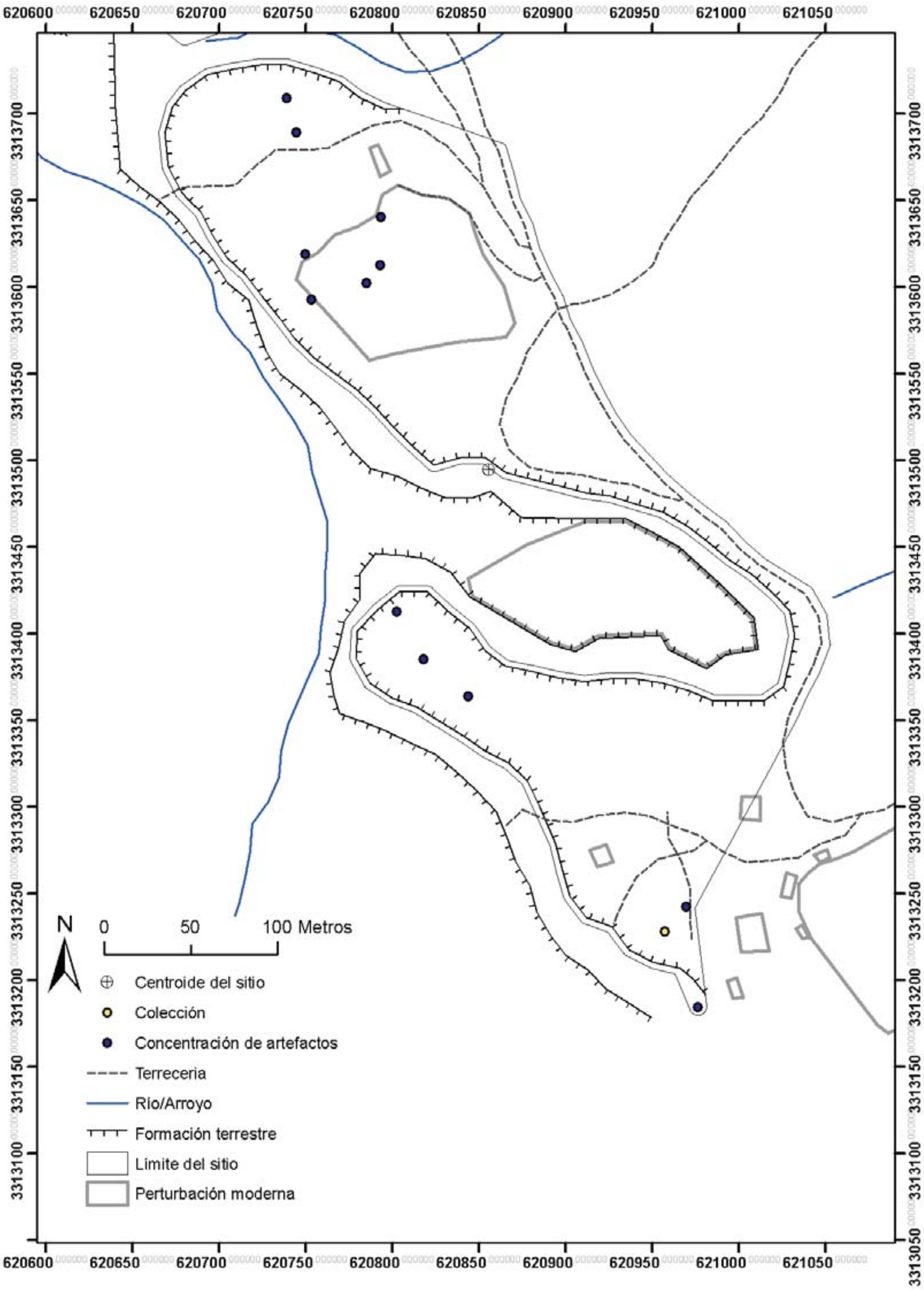

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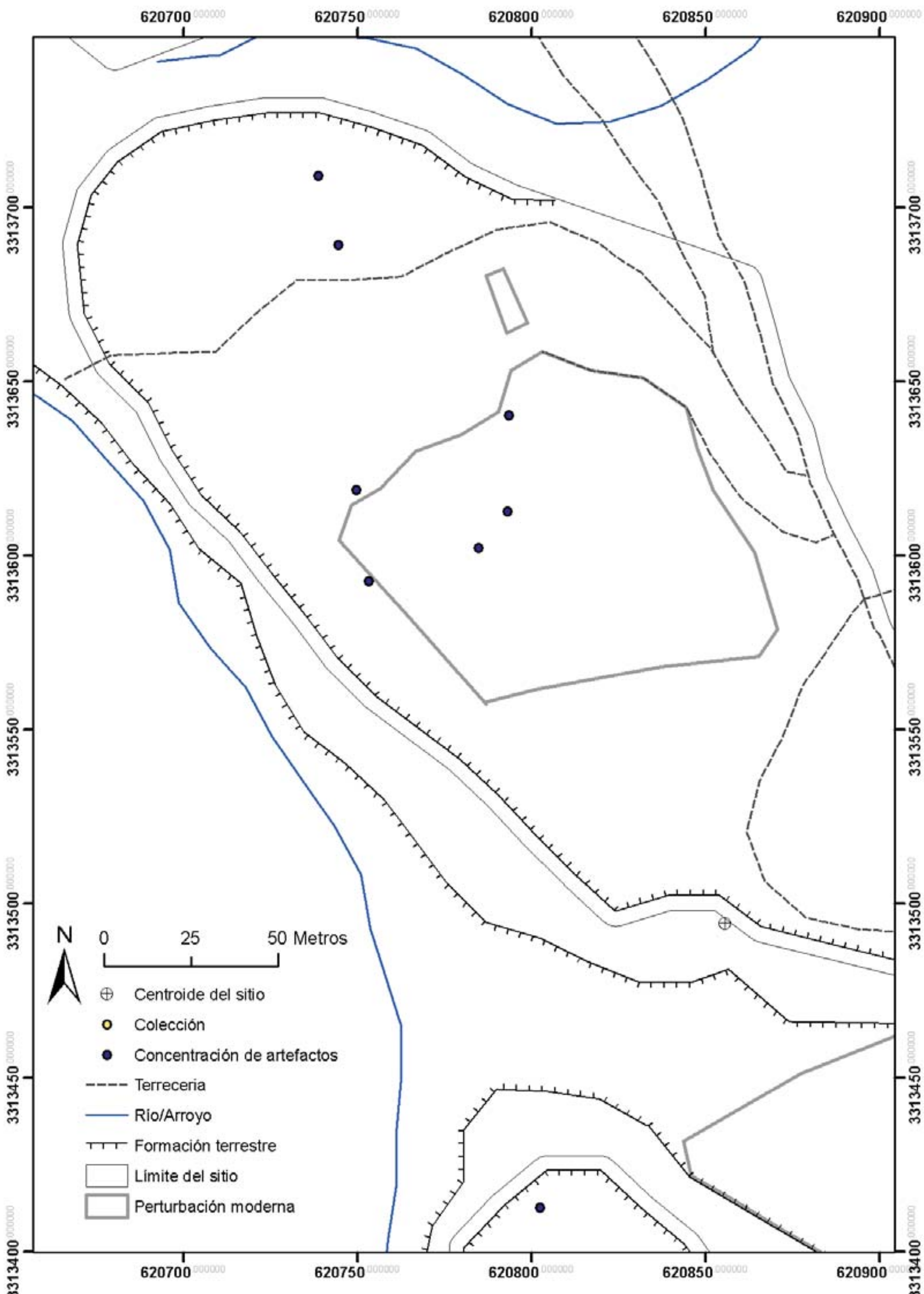

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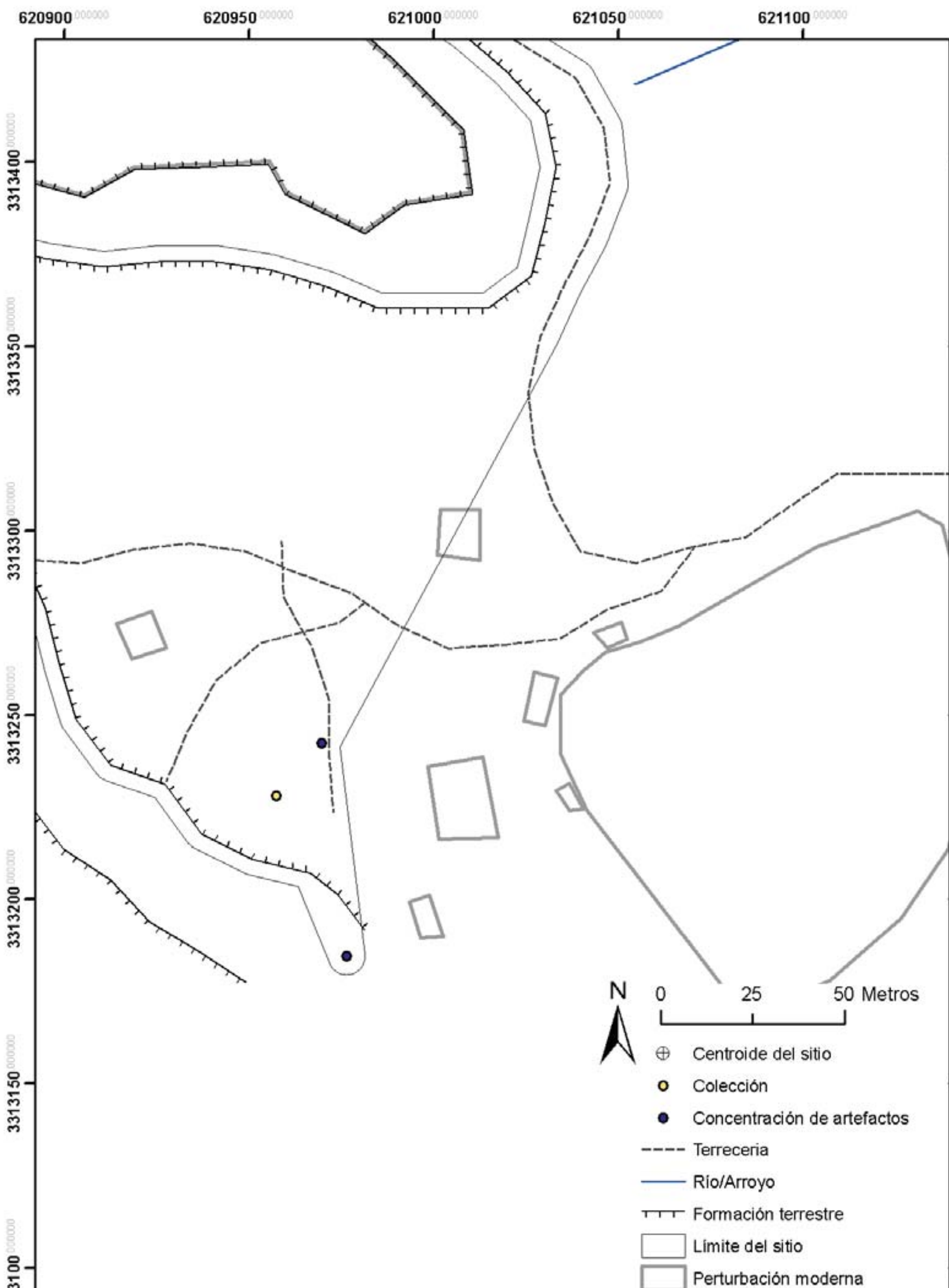

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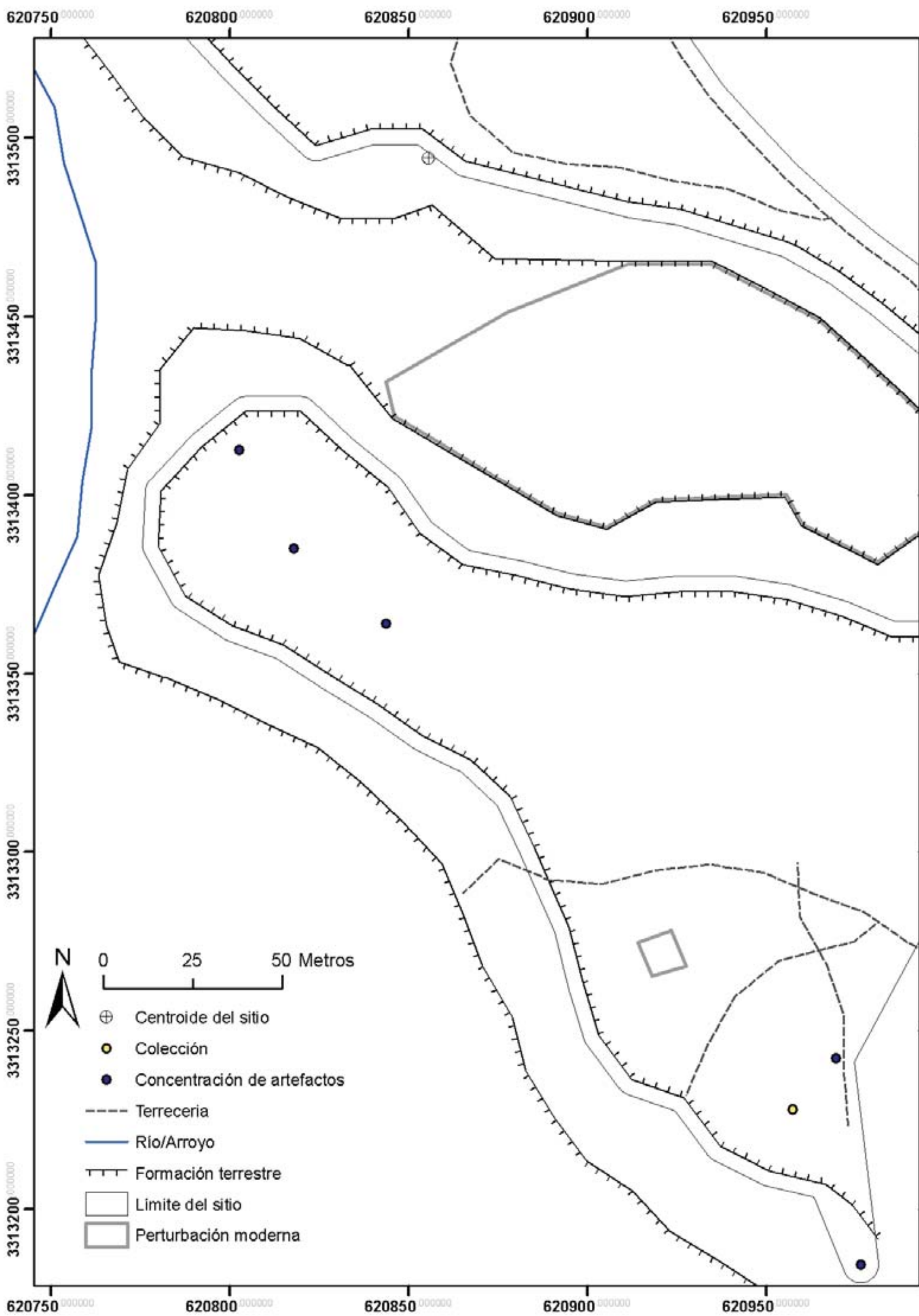
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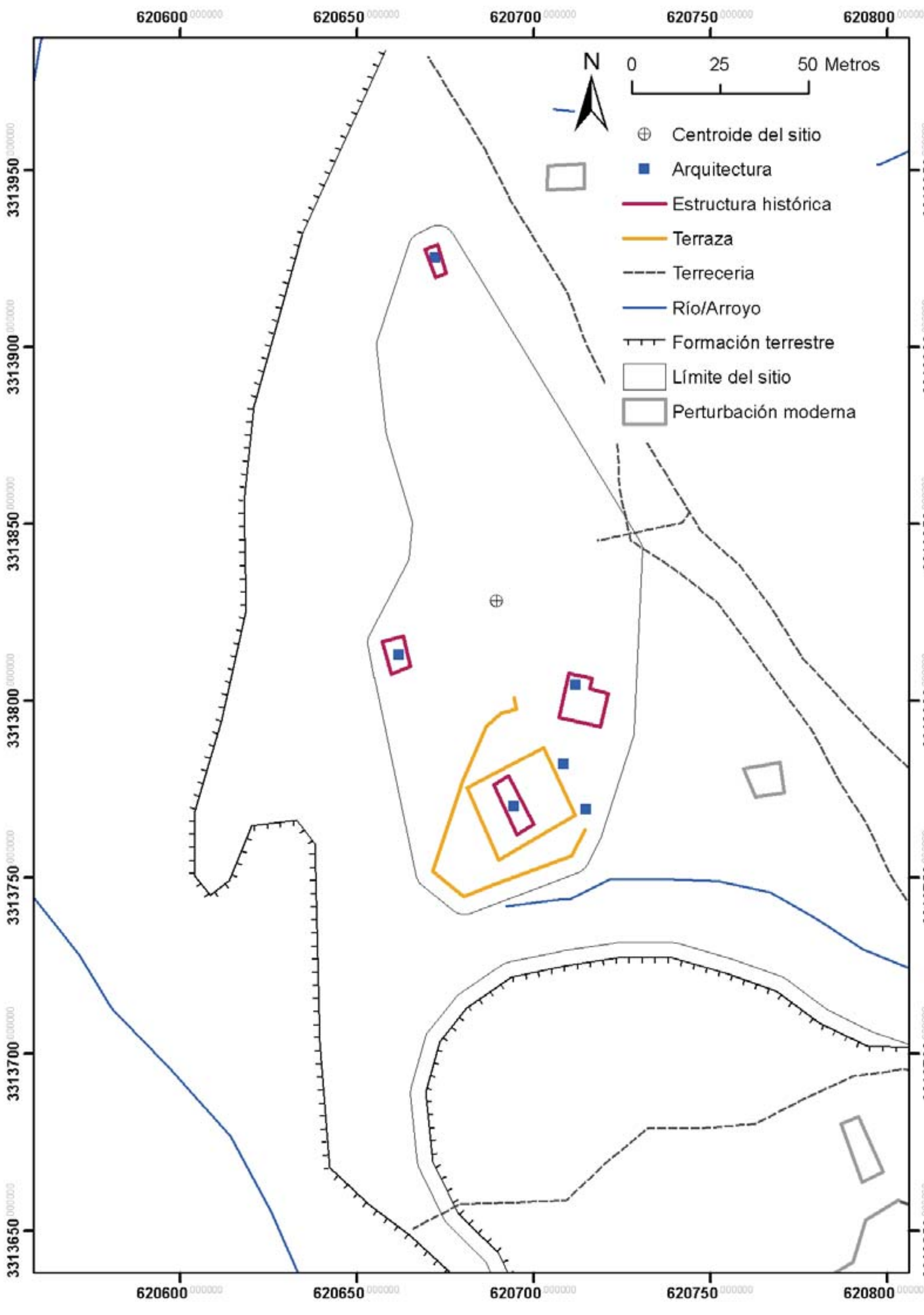

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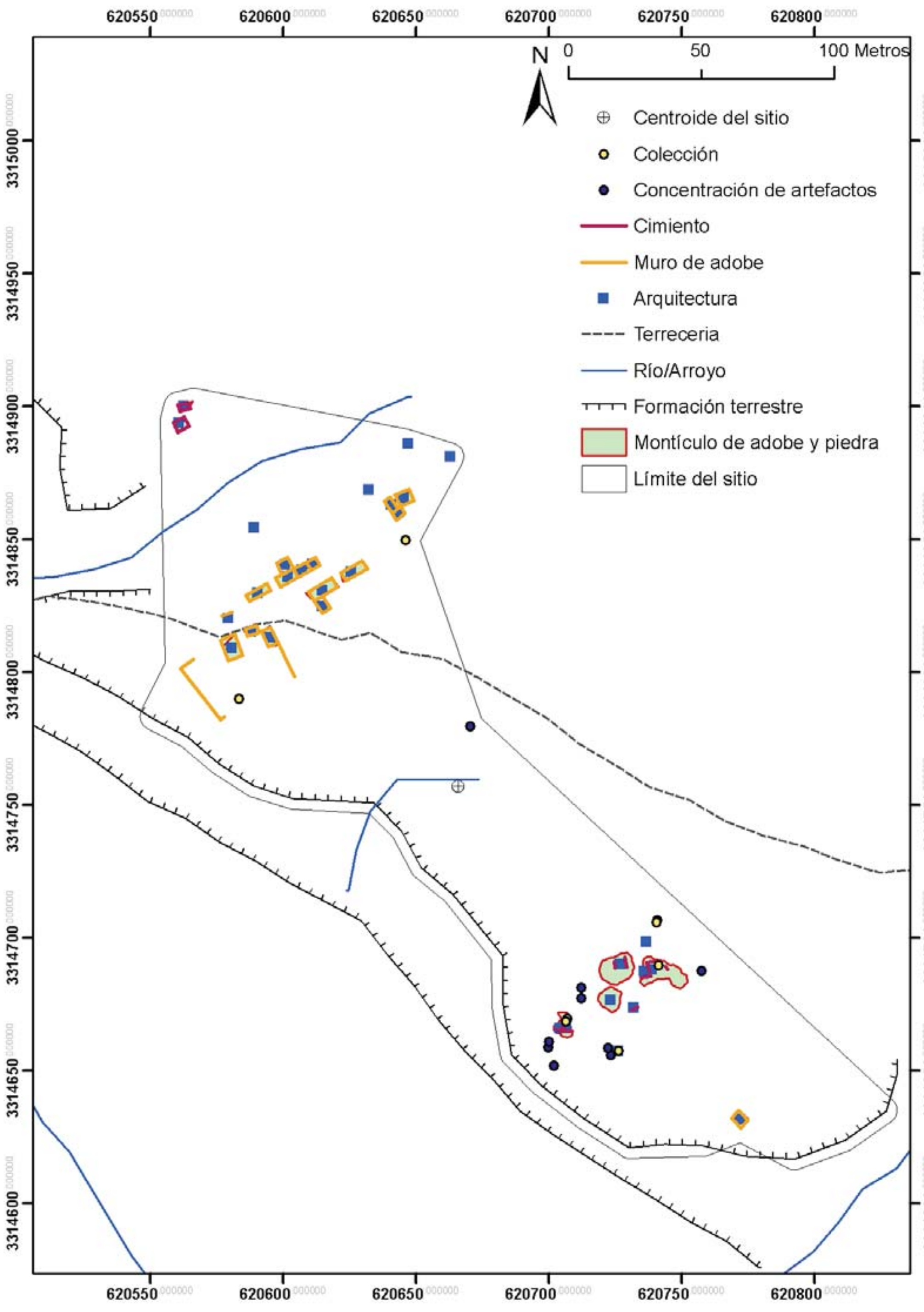

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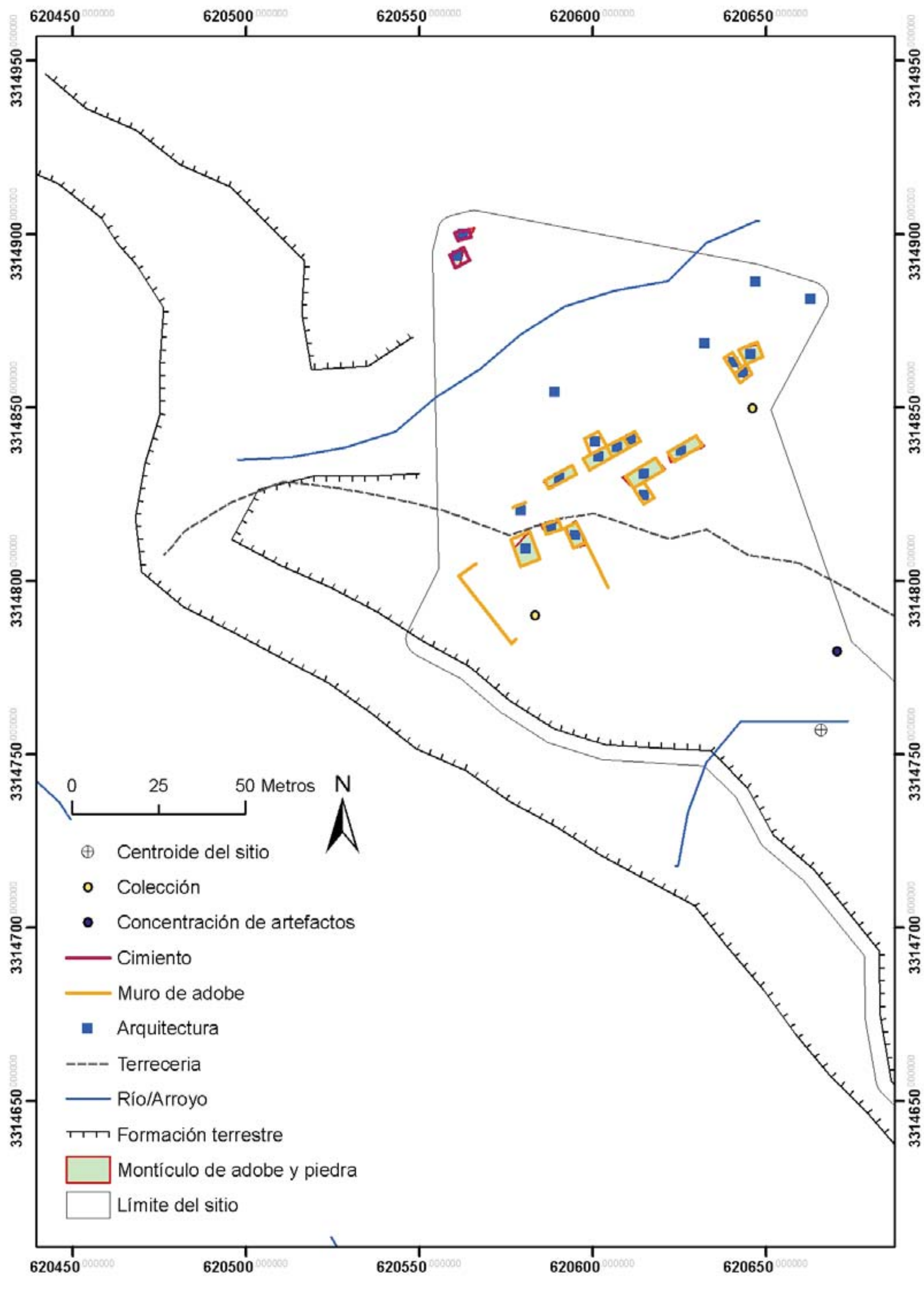
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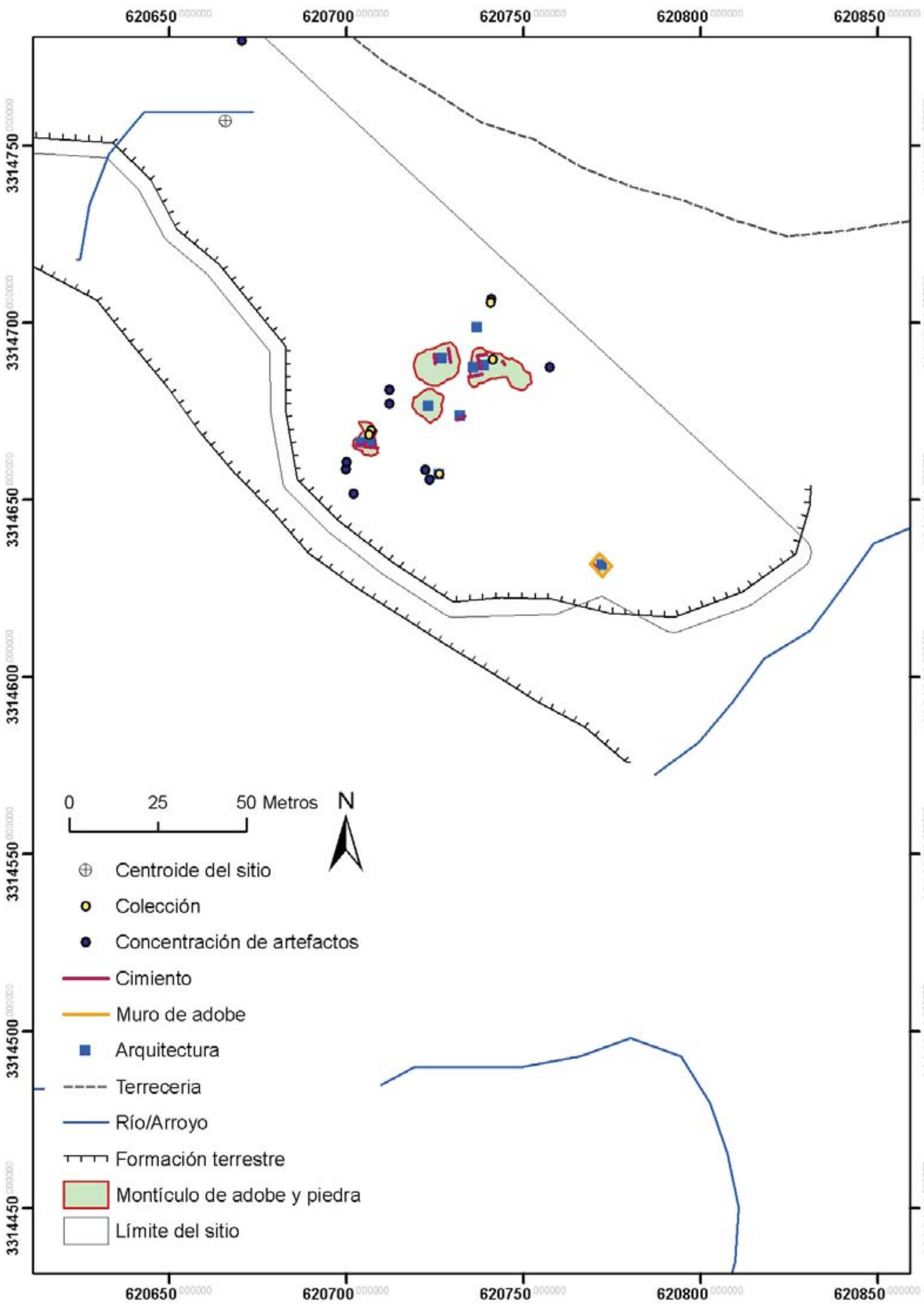

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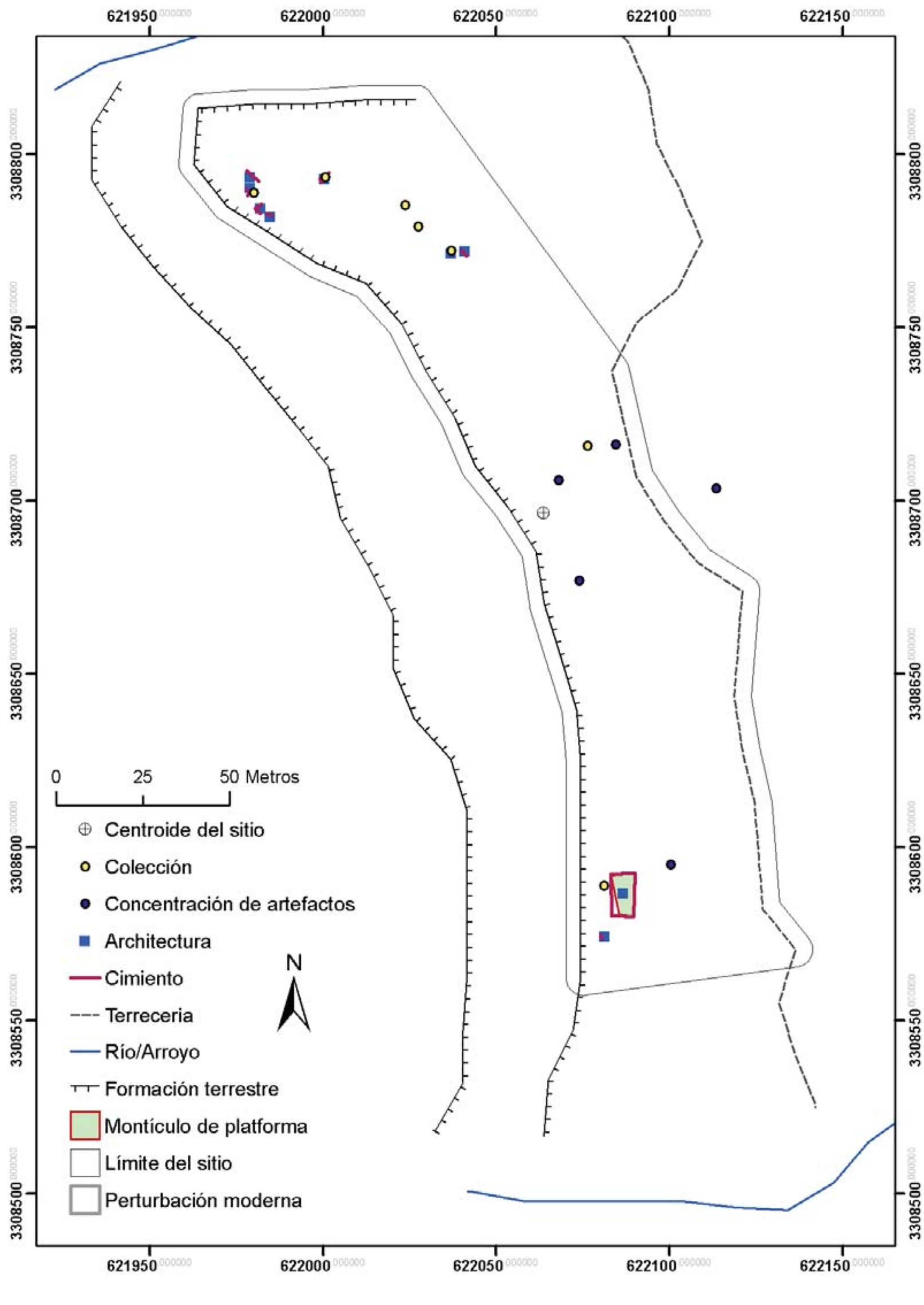

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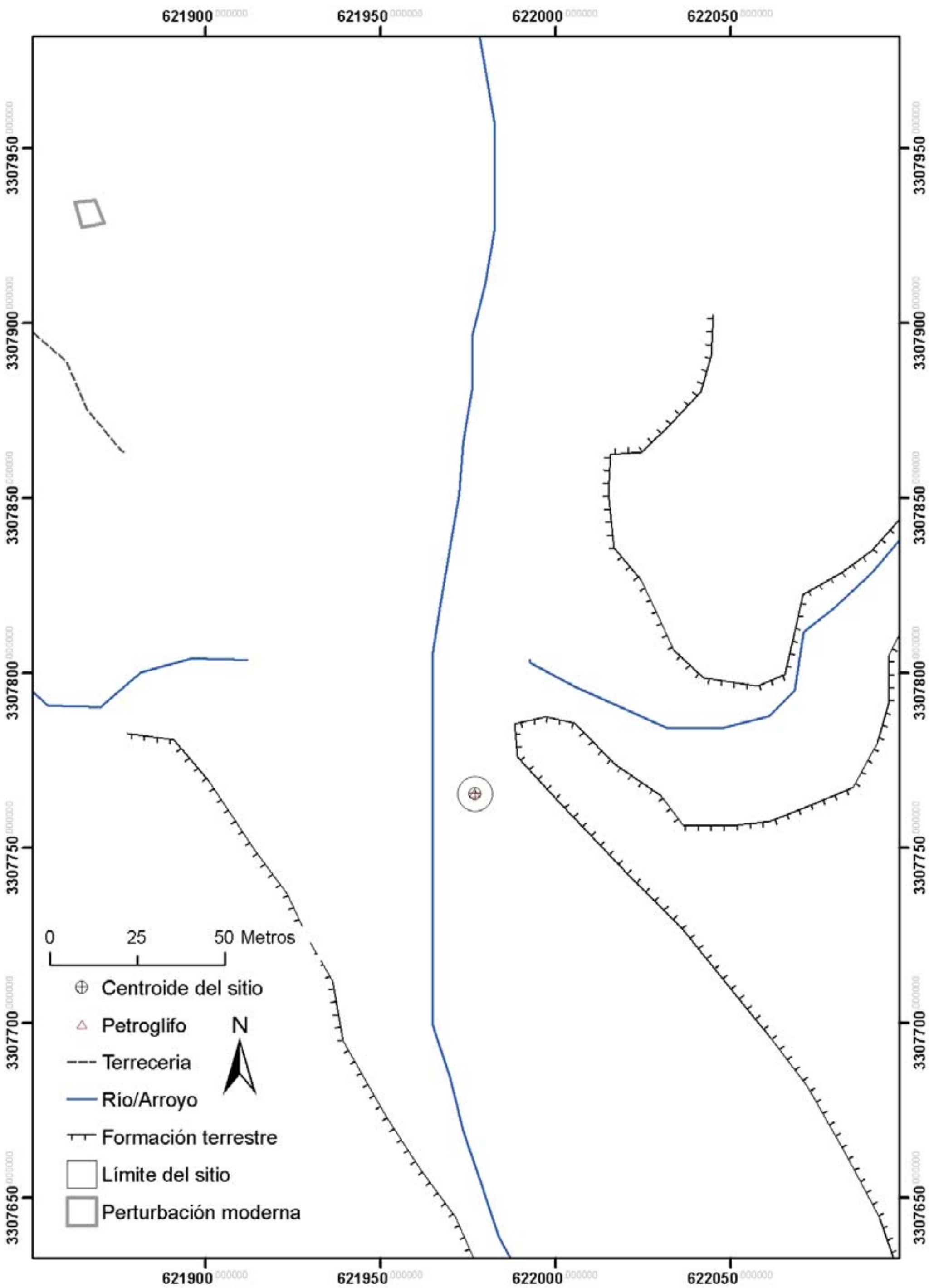

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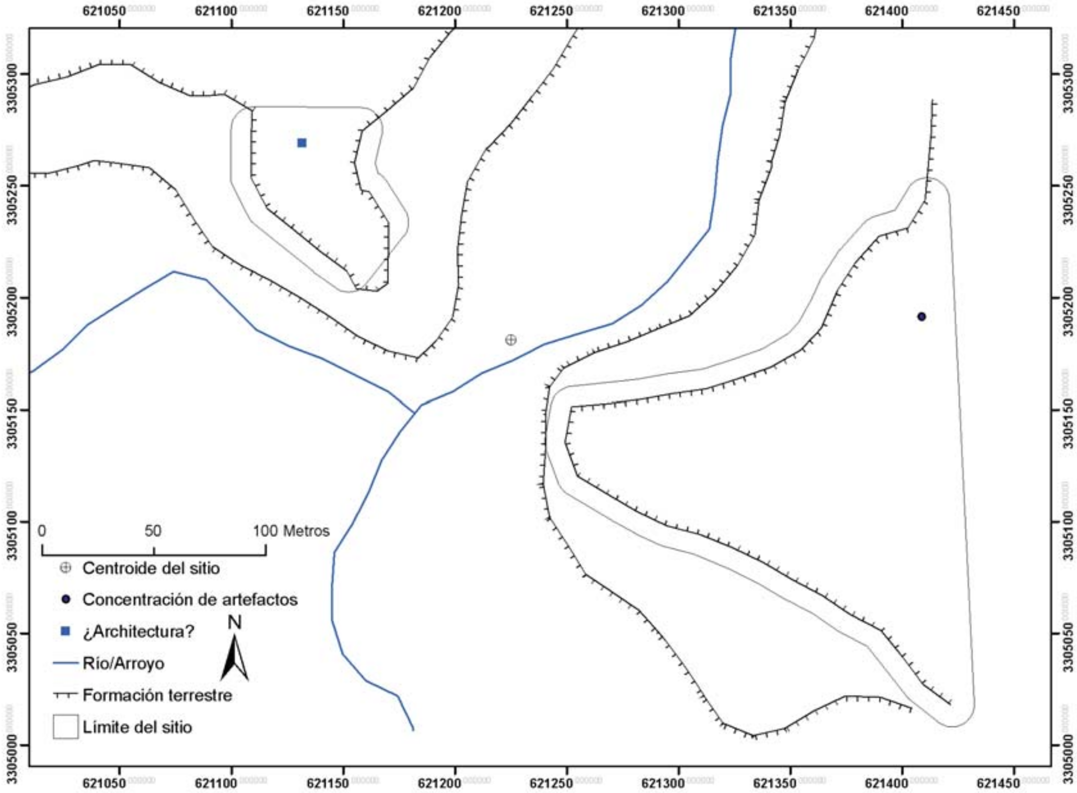

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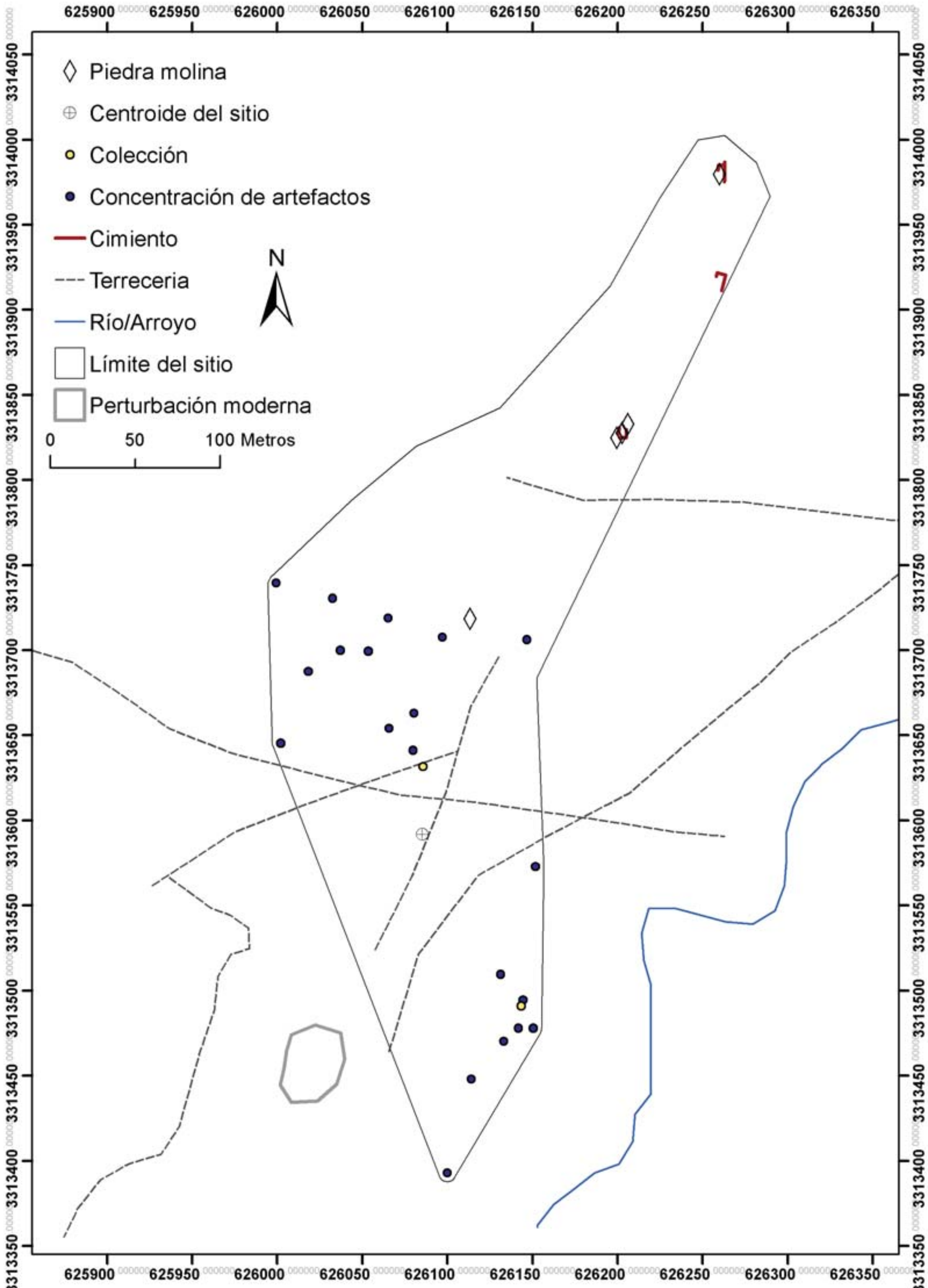
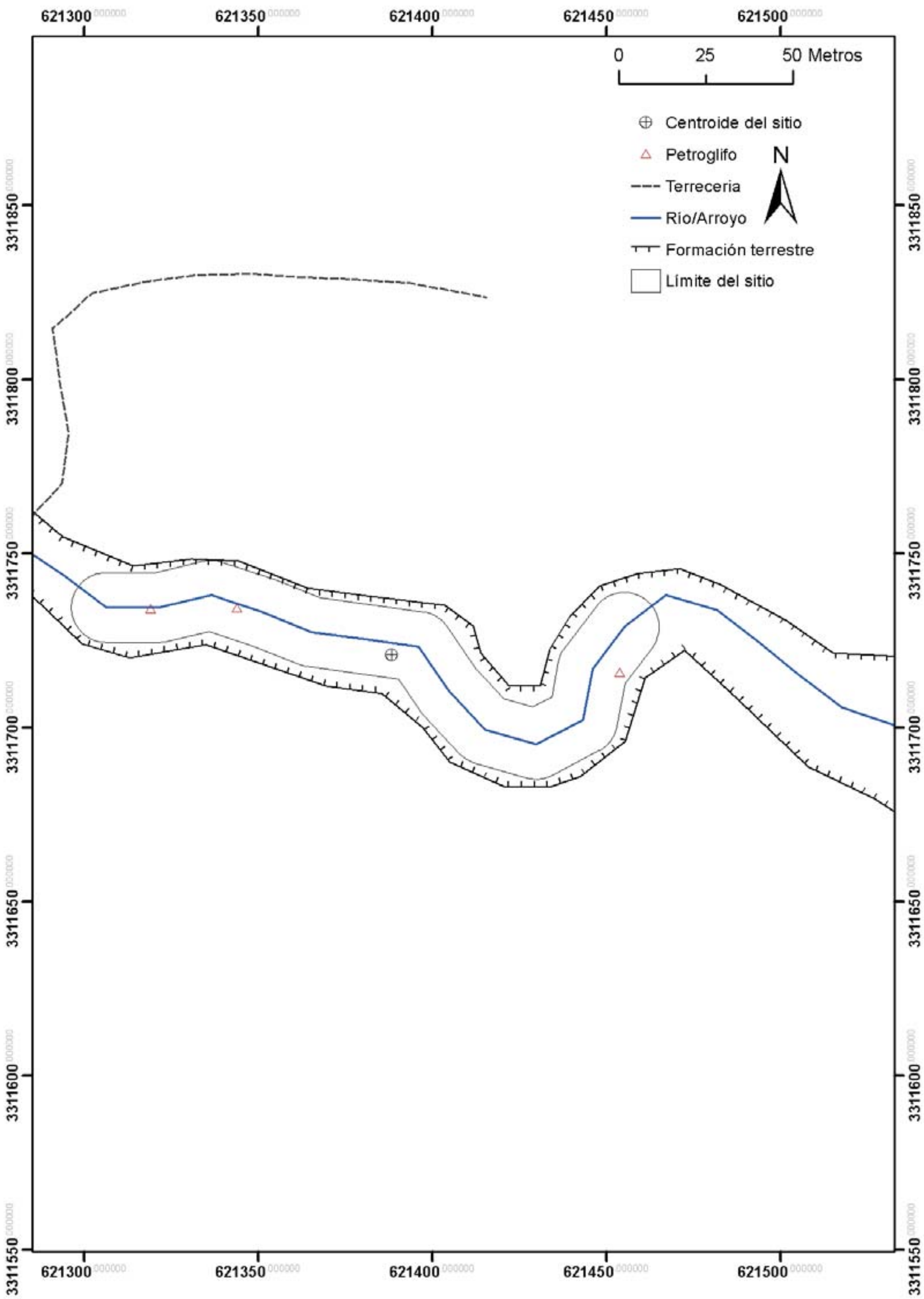
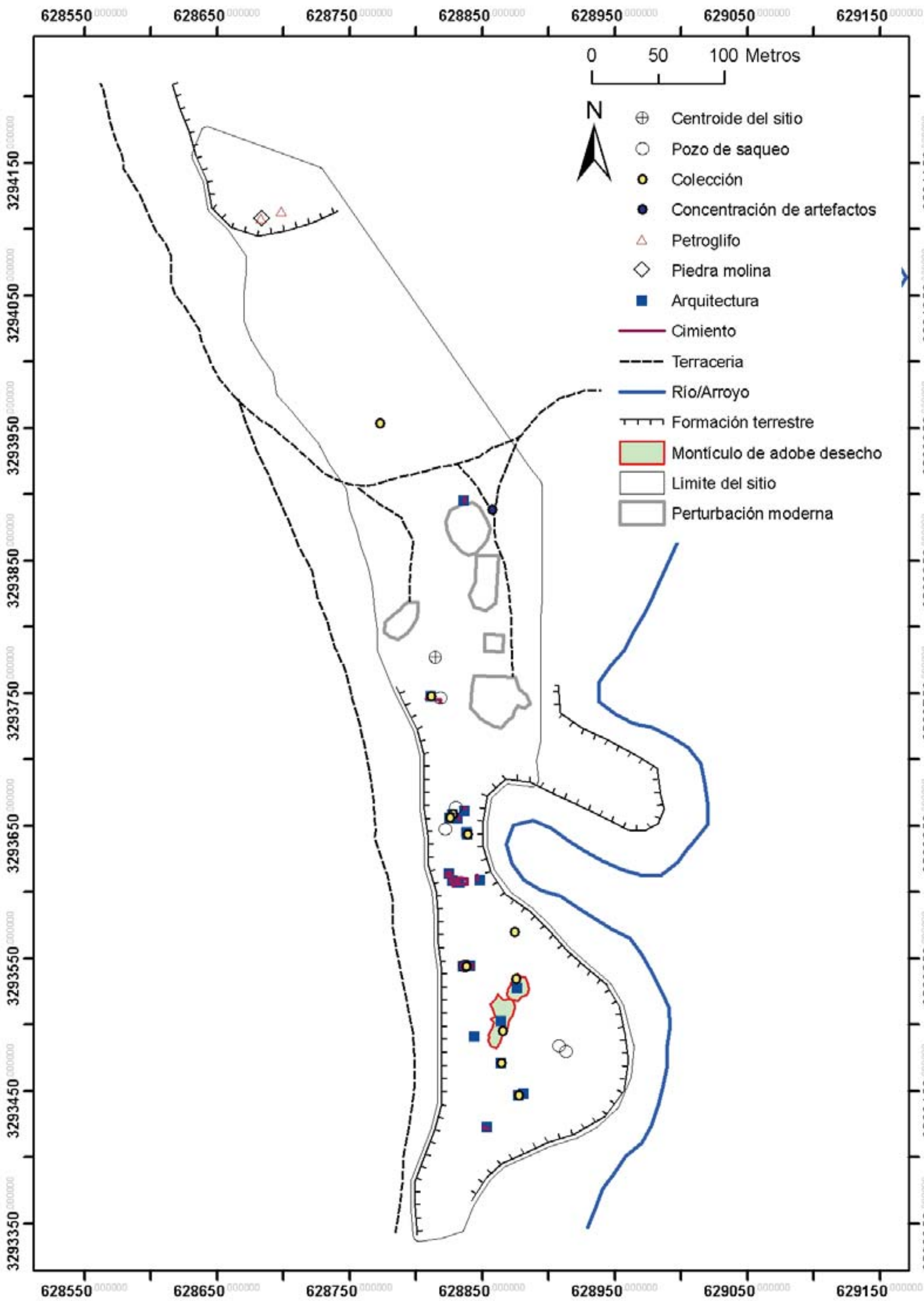


Las Bagotas (Son L:2:37)



La Cañada de Los Gatos (Son L:2:38)



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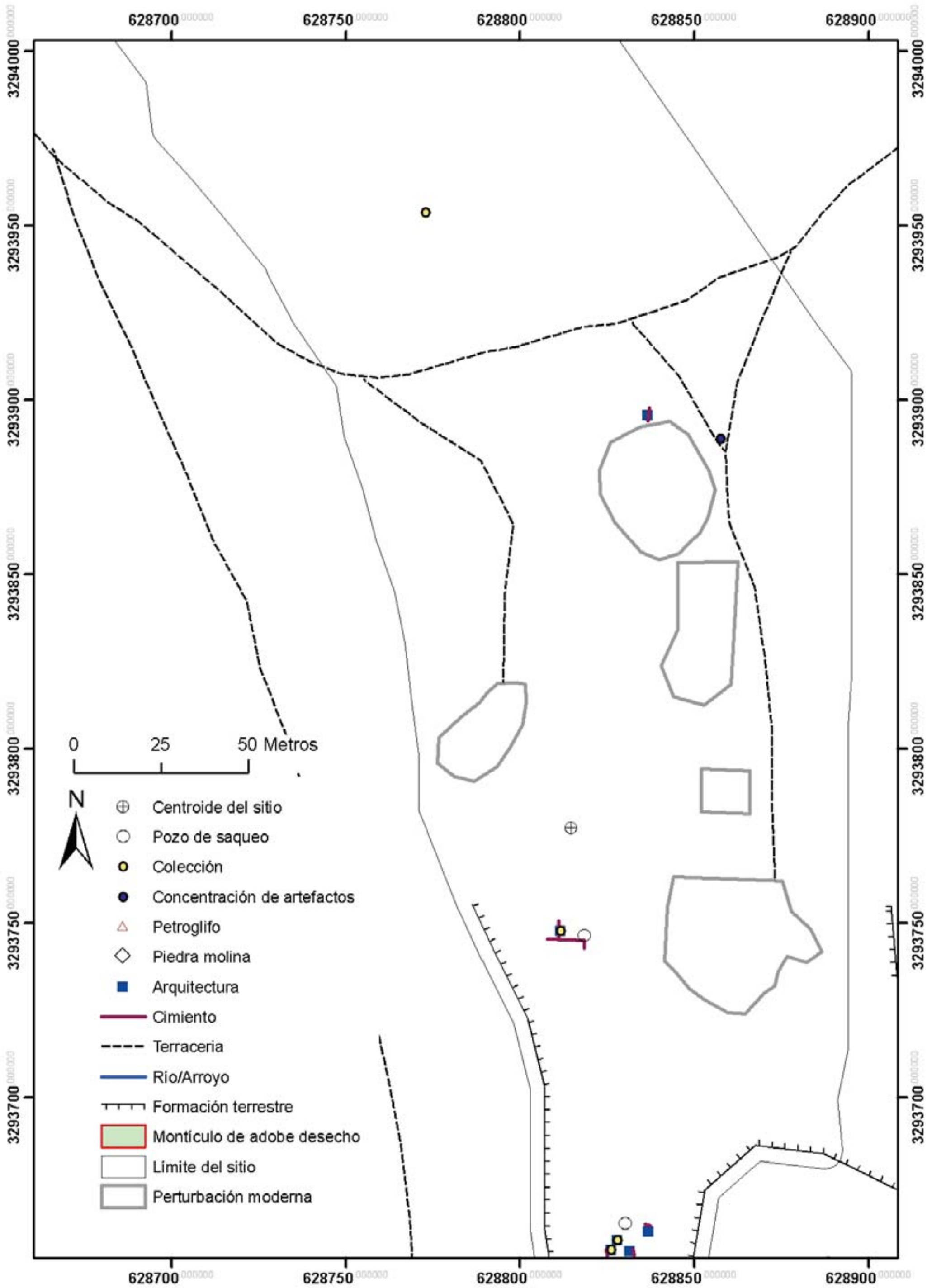

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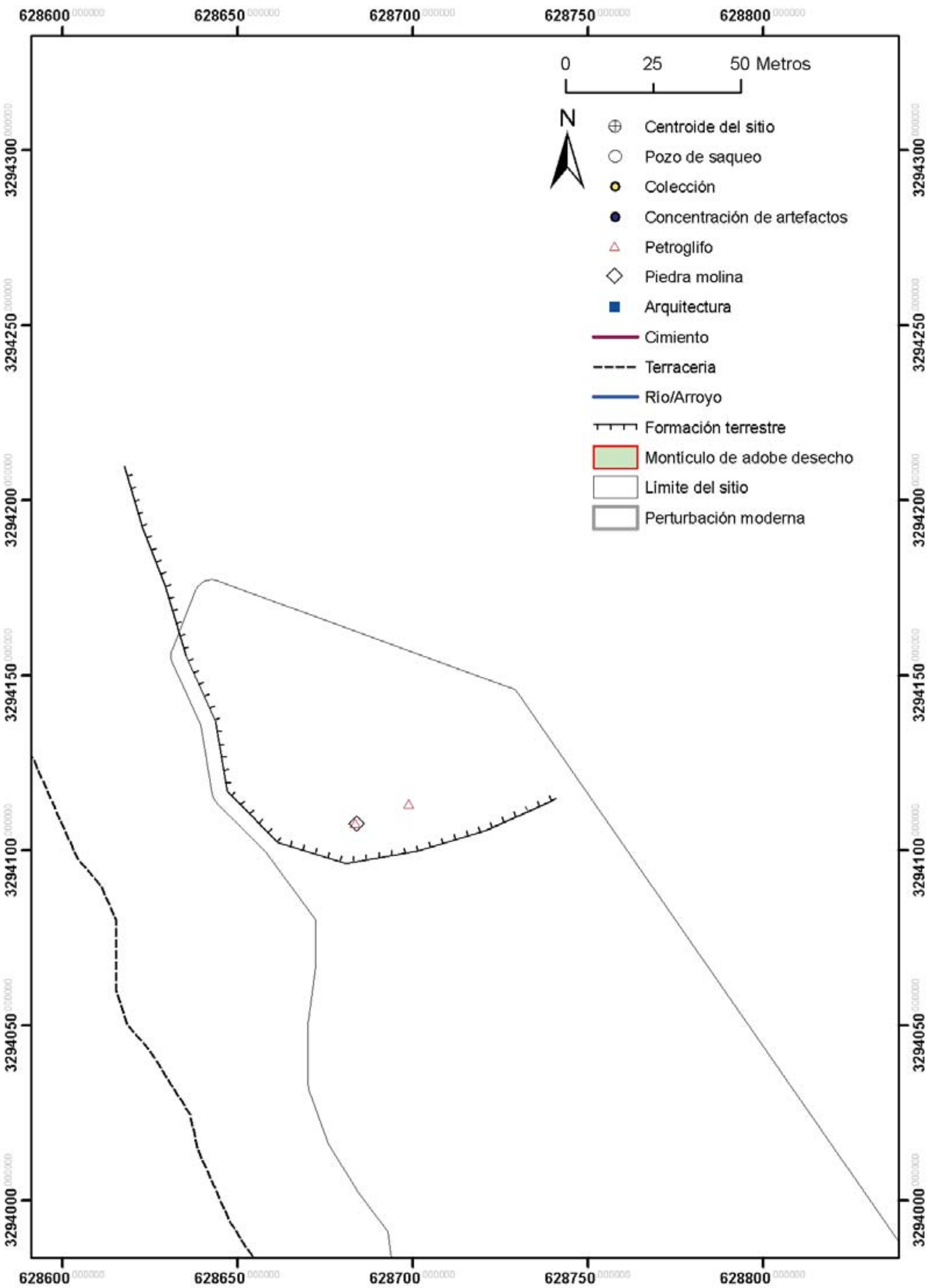

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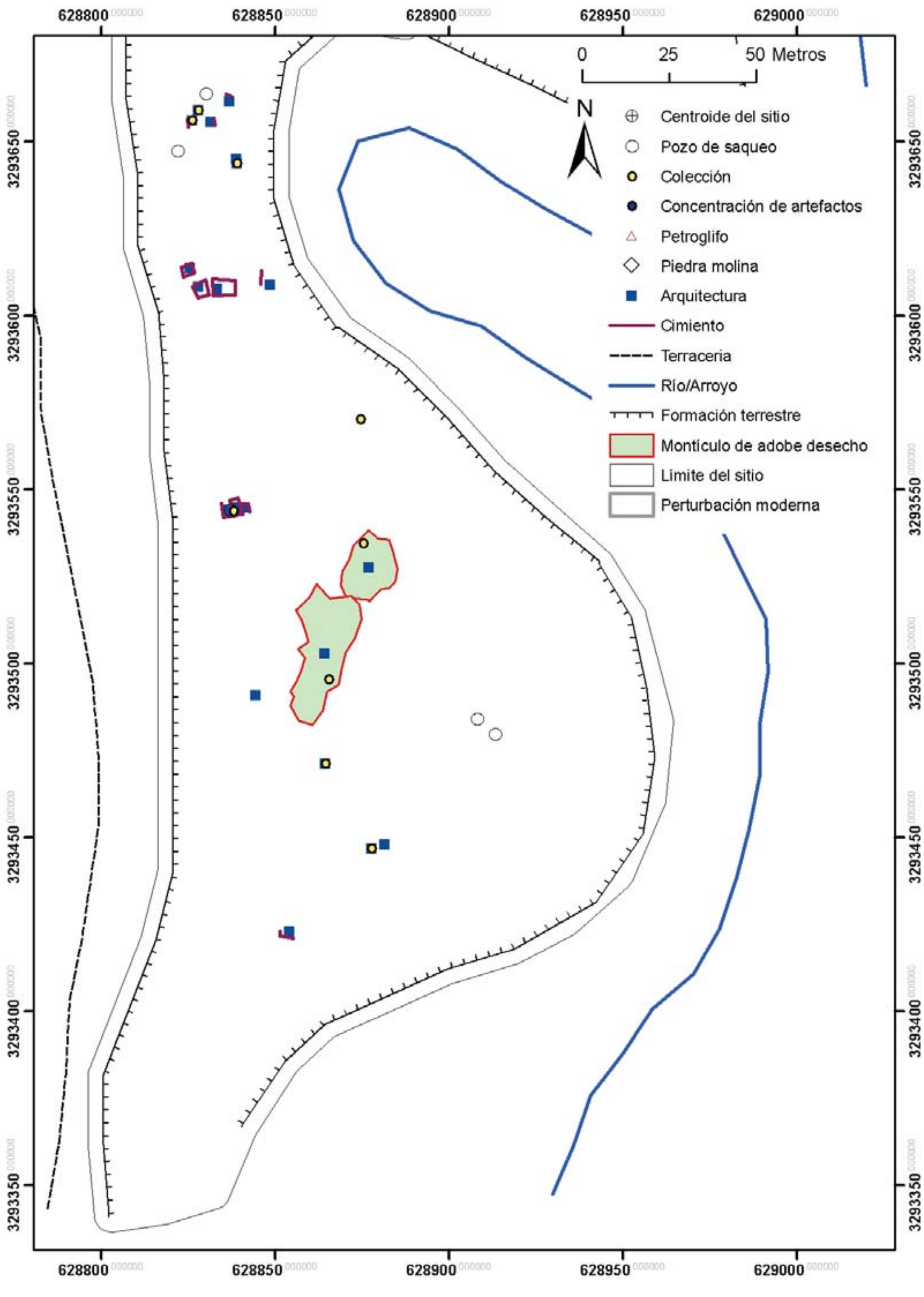
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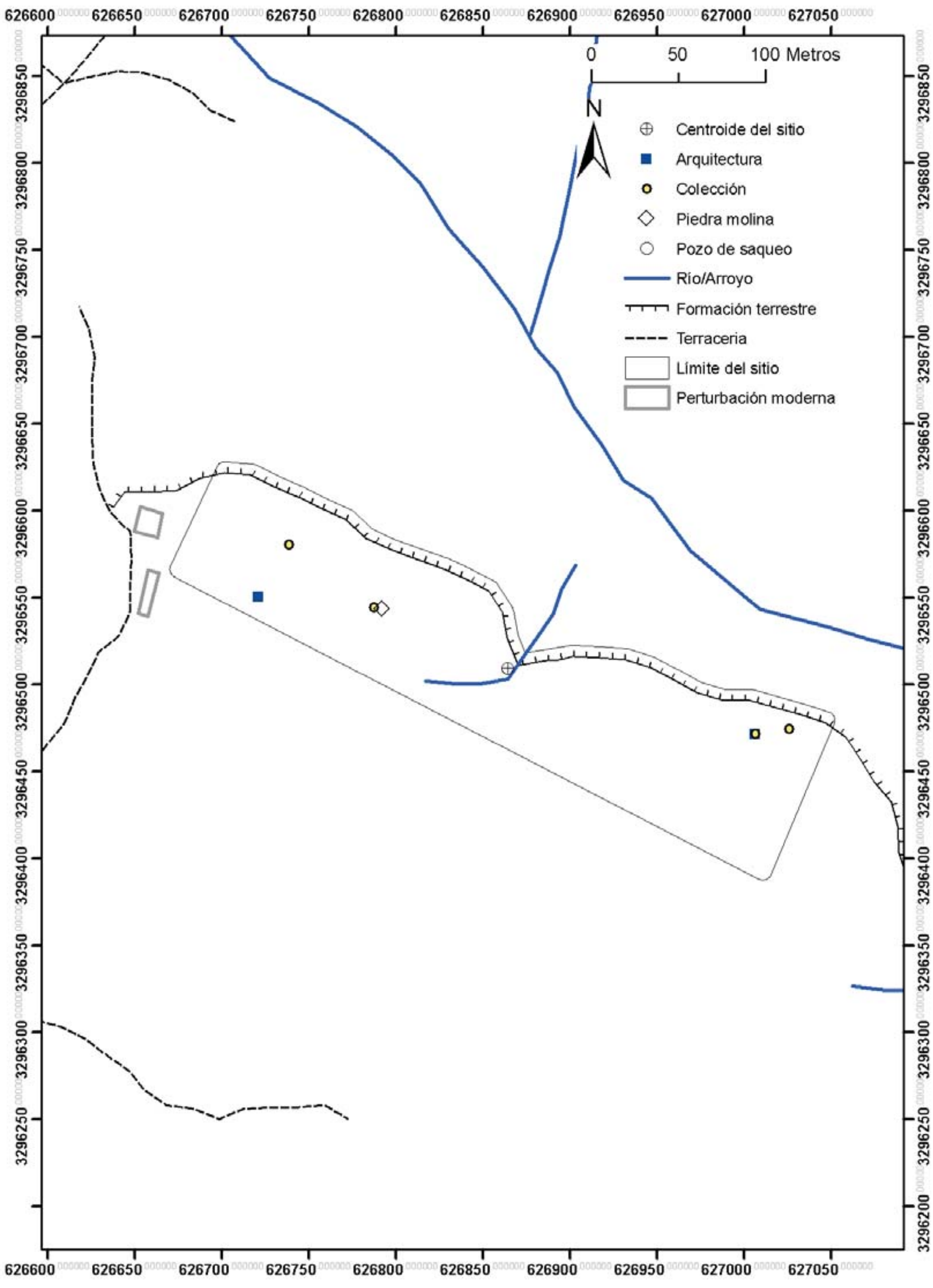

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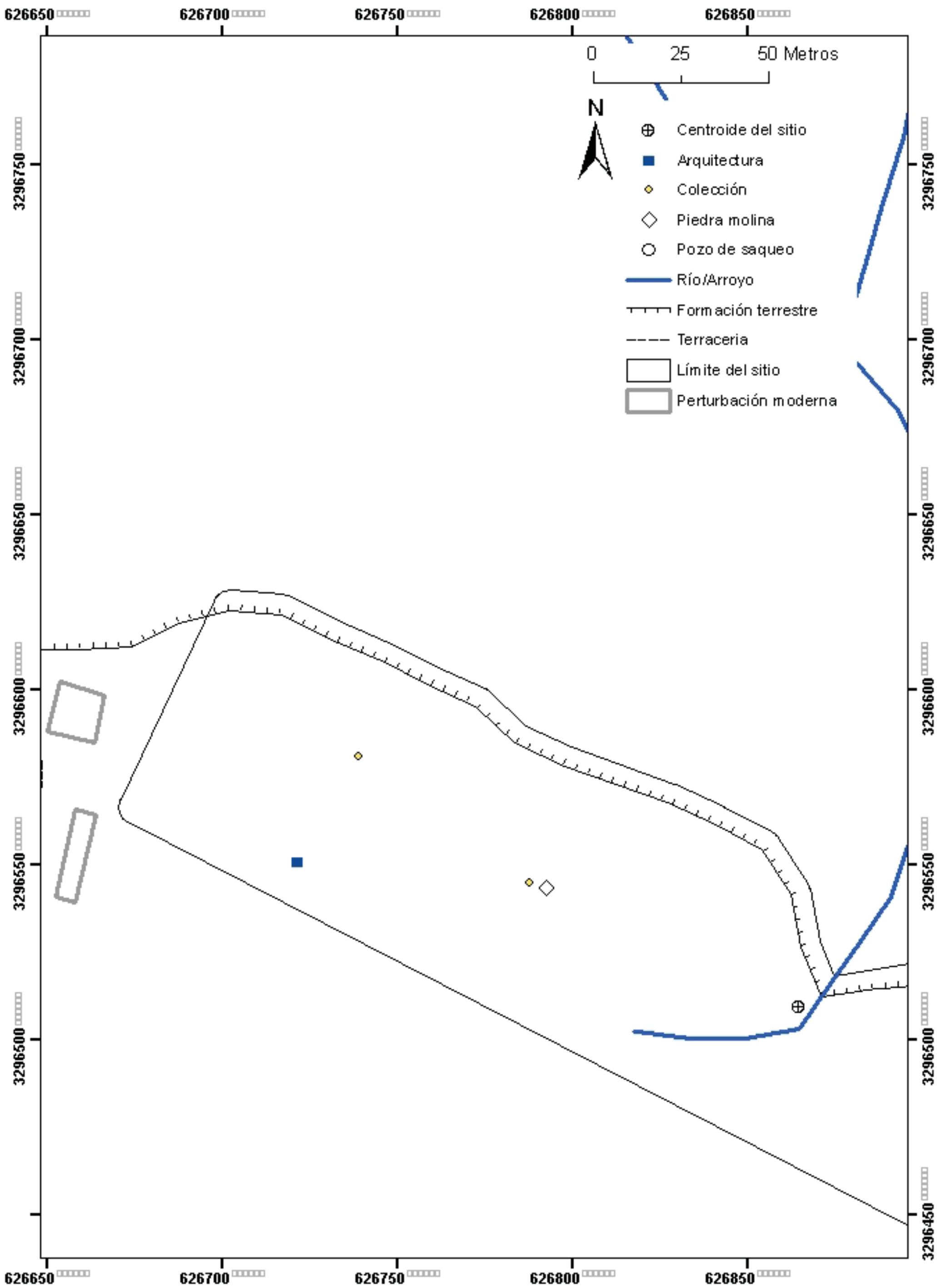

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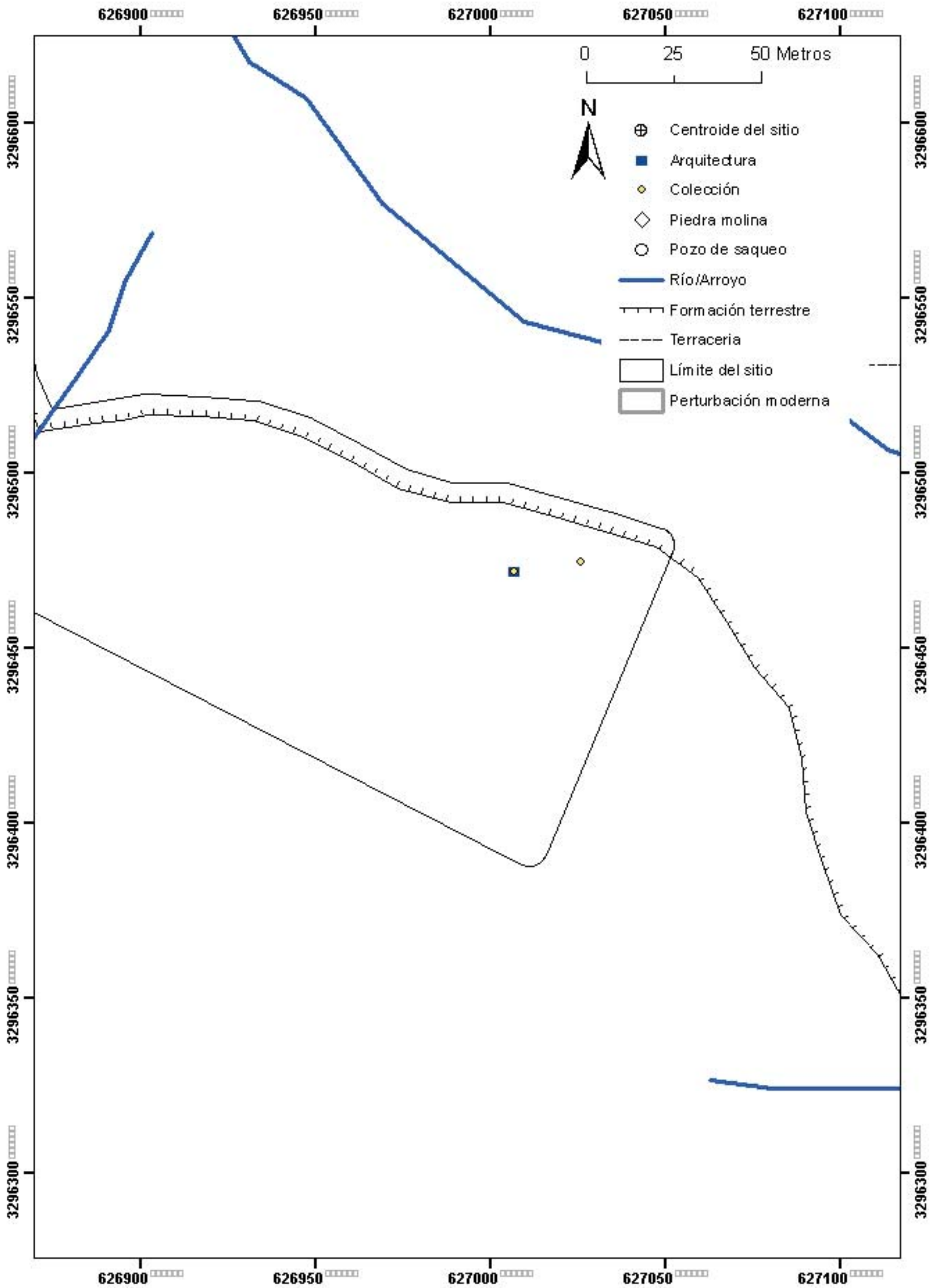

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Colección
Piedra molina
Pozo de saqueo
Río/Arroyo
Formación terrestre
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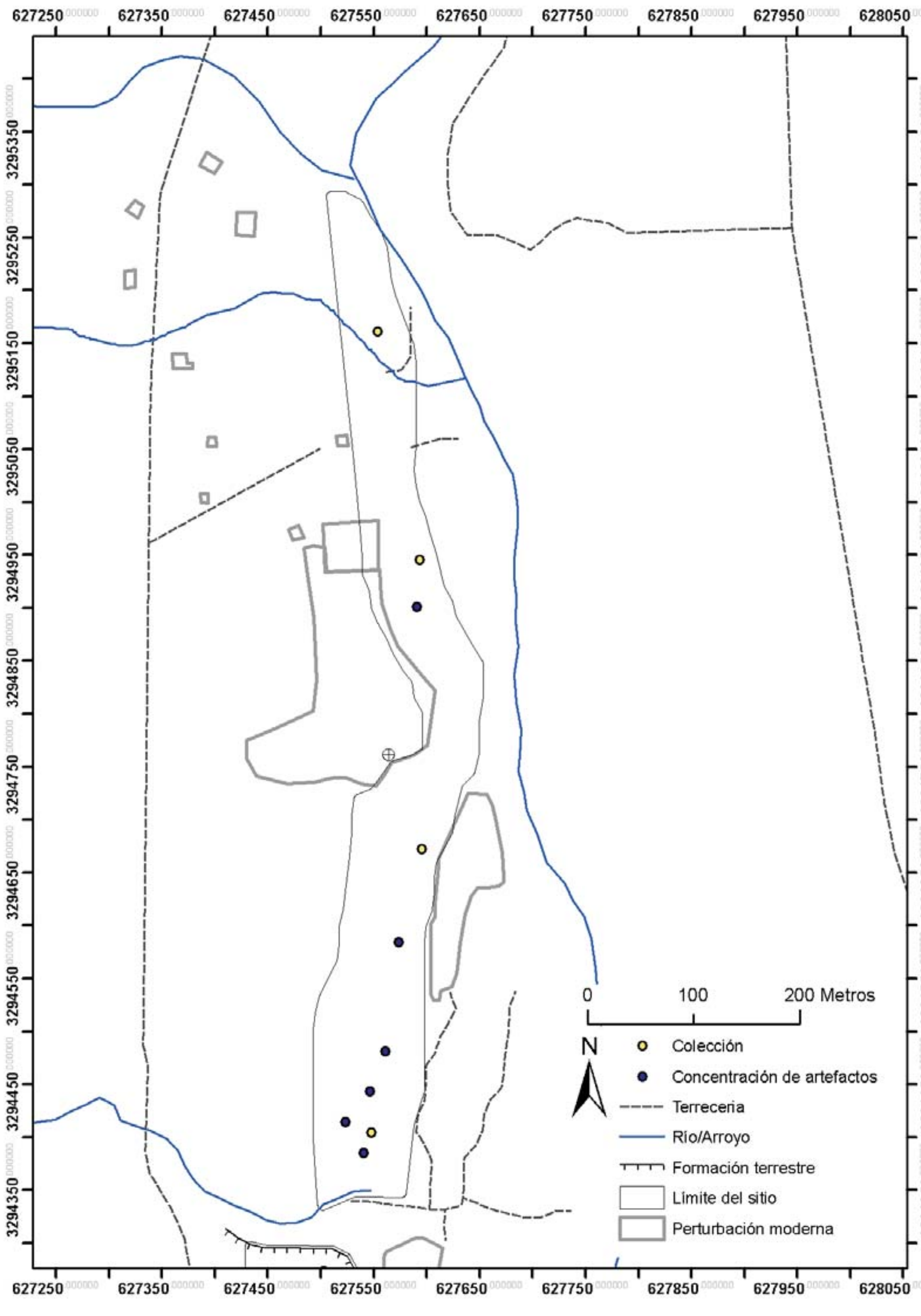

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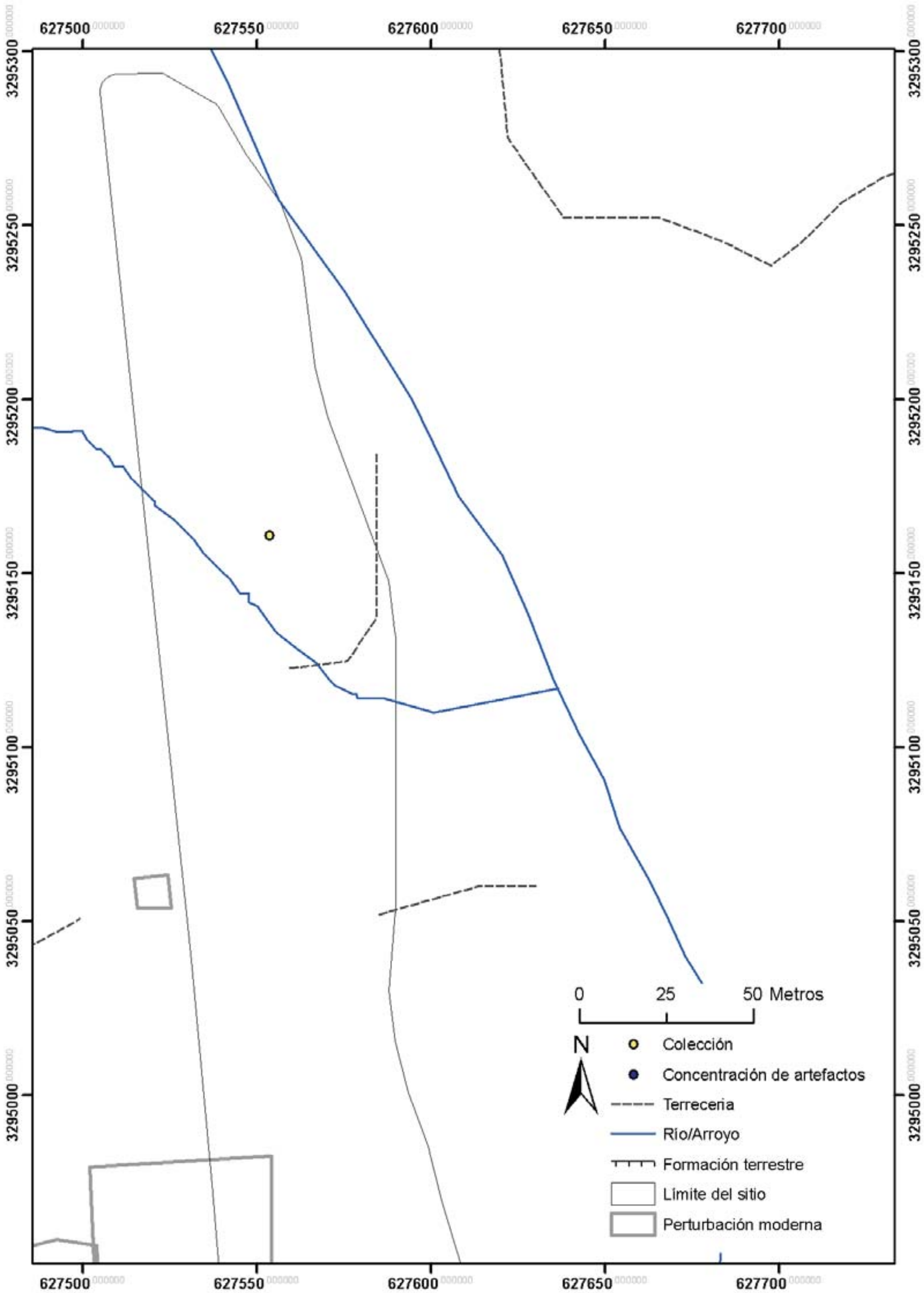
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Terreceria
Río/Arroyo
Formación terrestre
Límite del sitio
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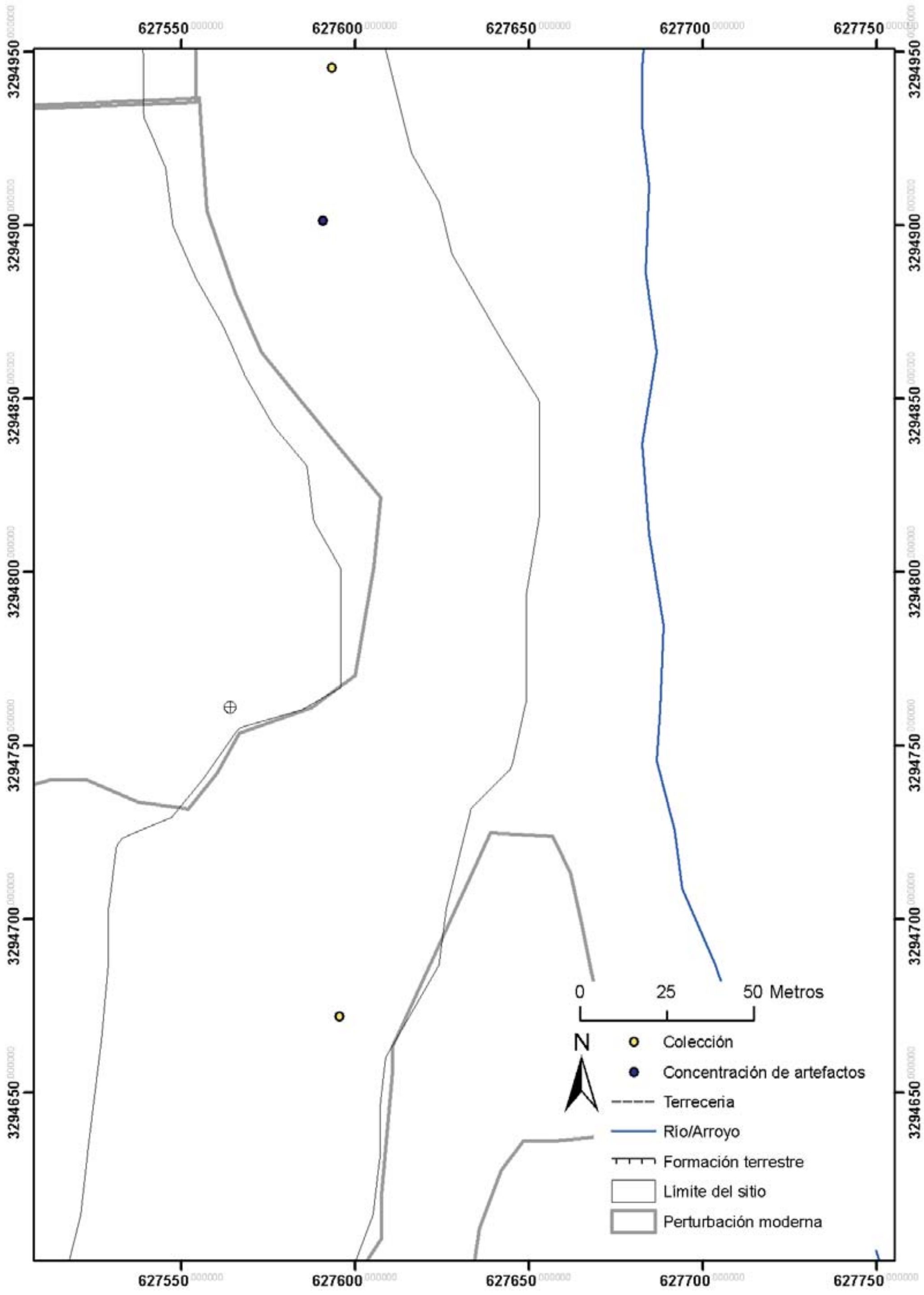
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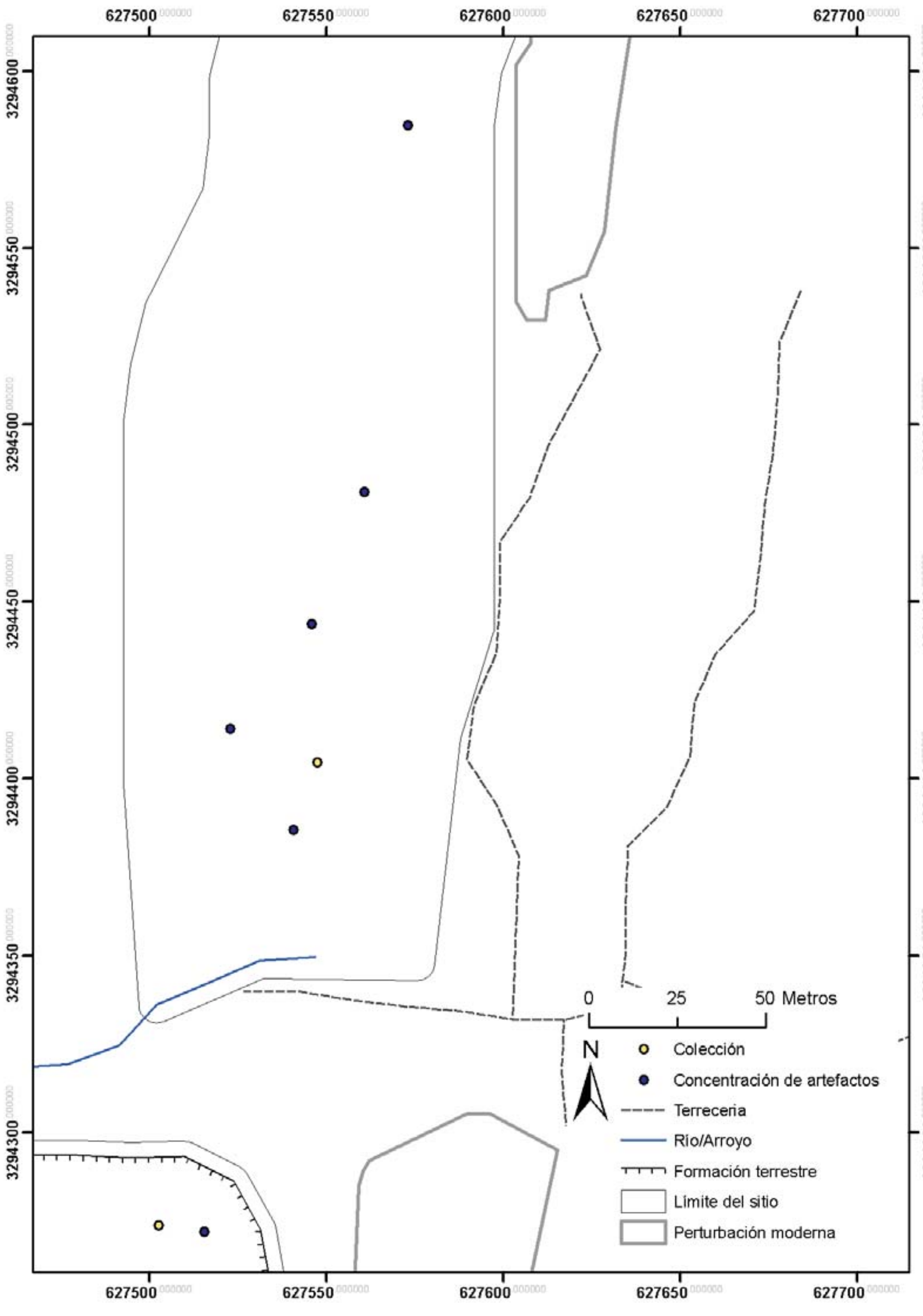
Terreceria
Río/Arroyo
Formación terrestre
Límite del sitio
Perturbación moderna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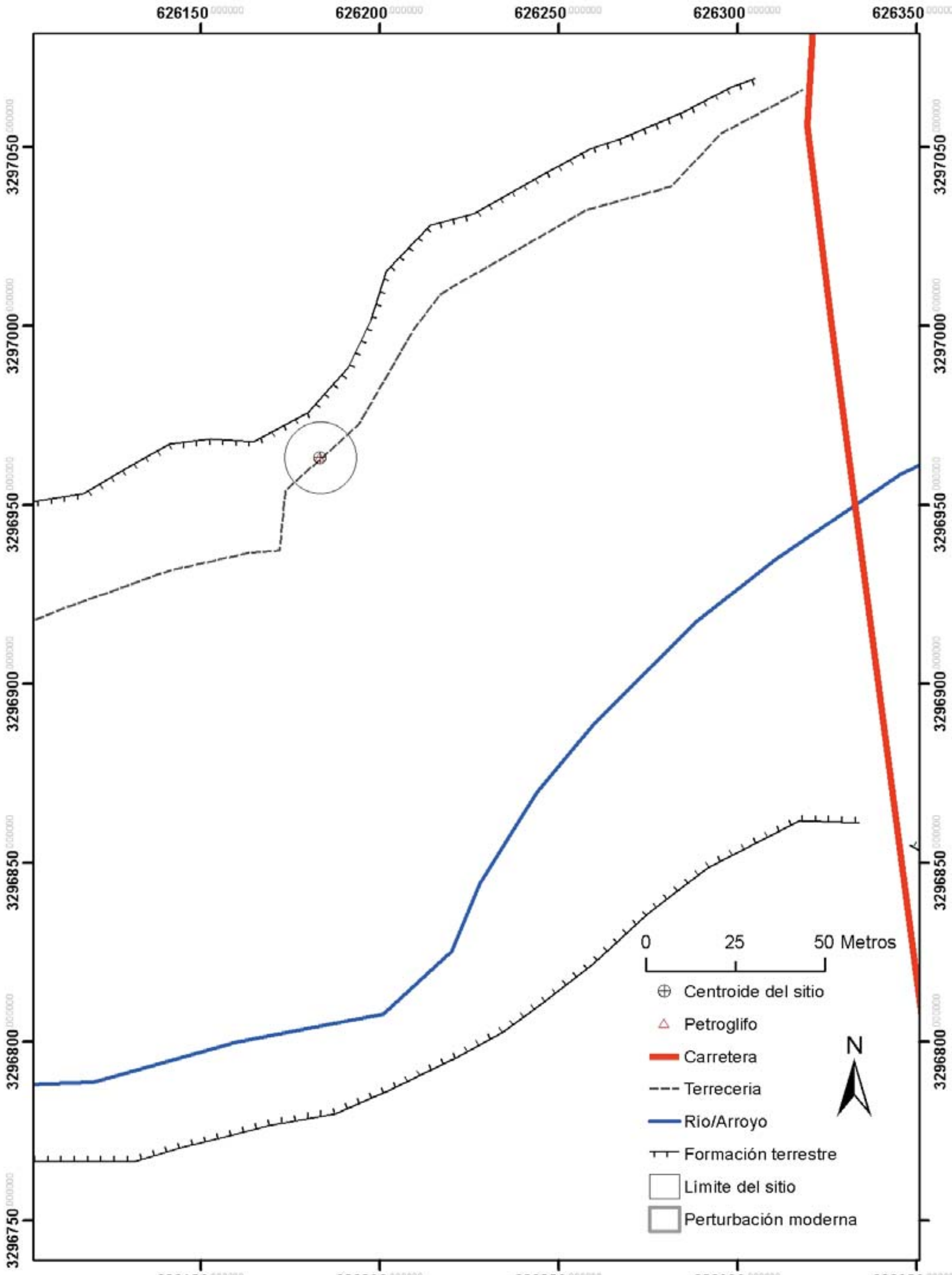
Río/Arroyo
Formación terrestre
Límite del sitio
Perturbación moderna



La Presa (Son L:2:42)

Sub-appendix F
Ceramic Data

Textured Brownware

Site	FN	Int / Ext	Size (cm)	Weight (g)	Execution Style	Textured Style Description	Element 1	Element 2	Element Relation	Note
Son L:1:23	1:18	ext	1.8	2	regular	incise parallel straight mult widths	incise parallel straight			
Son L:1:23	1:23	ext	3.2	4	regular	emboss bump	raised element			
Son L:1:23	7:12	ext	2.3	3	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:1:23	9:15	ext	2.2	3	obliterated	incise single linel / brush	incise indeterminate	brush	superimposed	
Son L:1:23	12:01	ext	2	2	deep	incise parallel straight	incise parallel straight			
Son L:1:23	12:27	ext	2.3	3	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:1:23	14:38	ext	3.5	5	regular	incise parallel wavy	incise parallel wavy			
Son L:1:23	20:15	ext	2.1	2	regular	incise parallel wavy	incise parallel wavy			
Son L:1:23	25:01	ext	2.2	2	obliterated	incise parallel straight	incise parallel straight			
Son L:1:23	26:04	ext	2.6	4	regular	incise angled design	incise angled design			
Son L:1:23	26:04	ext	2.6	4	regular	incise parallel straight	incise parallel straight			
Son L:1:23	31:14	ext	2.2	3	regular	tool punch triangle	tool punch			
Son L:1:23	31:18	ext	2.3	4	deep	pseudo corrugated	corrugation			
Son L:1:23	31:19	ext	3.1	5	fugitive	tool incise	tool incise			
Son L:1:23	31:20	ext	1.9	1	regular	incise parallel wavy	incise parallel wavy			
Son L:1:23	I0044	ext	2.3	2	regular	incise parallel wavy / red	incise parallel wavy		superimposed-red	
Son L:1:23	705	ext	2.4	3	regular	incise parallel straight / brush	incise / brush		zoned?	
Son L:1:23	705	ext	3.2	5	regular	incise parallel straight / brush	incise / brush		zoned	
Son L:1:23	724	ext	4.2	11	regular	incise angled design	incise angled design			rim

Son L:1:23	724	ext	2.8	7	fugitive	incise parallel straight / brush	incise / brush		superimposed	
Son L:1:23	724	ext	3.3	13	regular	rim embossed	raised element			rim
Son L:1:23	724	ext	3.5	11	fugitive	tool incise	tool incise			
Son L:1:23	731	ext	3	6	regular	incise parallel straight	incise parallel straight			
Son L:1:23	731	ext	3	petro-sampled	regular	tool punch lunate / incise angled design	tool punch	incise angled design	framer	
Son L:1:23	737	ext	2.8	5	fugitive	incise vertical	incise angled design			
Son L:1:23	740	ext	2.4	3	regular	incise parallel wavy	incise parallel wavy			
Son L:1:23	800	?	2	3	regular	finger nail	ad hoc design			
Son L:1:23	800	ext	3.2	8	fine	incise angled design	incise angled design			
Son L:1:23	800	ext	2.7	5	regular	incise parallel straight	incise parallel straight			
Son L:1:23	800	?	3	4	regular	incise parallel straight / brush	incise / brush		zoned?	
Son L:1:23	800	ext	1.7	3	regular	tool incise	tool incise			
Son L:1:23	800	ext	4.2	5	regular	tool punch lunate / brush	tool punch	brush	superimposed	sooted ext
Son L:1:23	800	ext	3.9	petro-sampled	regular	tool punch pin	tool punch			
Son L:1:23	800	ext	3.2	7	regular	tool punch pin / incise parallel straight	tool punch	incise parallel straight	framer	
Son L:1:23	802	ext	2.9	5	fine	incise parallel straight	incise parallel straight			
Son L:1:23	802	ext	2.5	4	regular	incise parallel straight / red	incise parallel straight		framer-red	in painted 802 bag
Son L:1:23	802	ext	2.7	5	fugitive	tool incise	tool incise			
Son L:1:23	802	ext	2.3	3	regular	tool punch circle / brushed	tool punch	brush	framer-brush-red	
Son L:1:23	802	ext	2.6	petro-sampled	regular	tool punch lunate	tool punch			
Son L:1:23	815	ext	2.5	3	regular	finger nail	ad hoc design		red int	

Son L:1:23	815	ext	2.2	2	fine	incise parallel straight	incise parallel straight			
Son L:1:23	815	ext	3.7	8	regular	tool punch circle	tool punch			
Son L:1:23	819	ext	2.3	3	regular	incise crosshatch	incise angled design			
Son L:1:23	819	ext	3.2	petro-sampled	fugitive	incise parallel wavy	incise parallel wavy			
Son L:1:23	819	ext	2.8	3	regular	incise single line / red	incise indeterminate		framer-red	
Son L:1:23	819	ext	2.2	2	regular	pin punch / incise curvilinear	tool punch		zoned?	
Son L:1:23	819	ext	2	2	wide	tool punch circle / incise parallel straight	tool punch	incise parallel straight	superimposed	
Son L:1:23	819	ext	2.1	2	regular	tool punch triangle	tool punch	incise other		sooted int
Son L:1:23	822	ext	3.1	6	regular	emboss ridge	raised element			rim
Son L:1:23	822	ext	2.1	1	regular	incise parallel straight	incise parallel straight			
Son L:1:23	827	ext	3	8	regular/obliterted	tool punch pin	tool punch			sooted int
Son L:1:23	832	ext	2.7	6	fine	incise parallel straight / brush	incise / brush		superimposed	
Son L:1:23	832	ext	3.3	13	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:1:23	832	ext	3.5	petro-sampled	regular	pseudo corrugated	corrugation			
Son L:1:23	832	ext	3.2	3	regular	shaped	other			
Son L:1:23	835	ext	2.1	2	regular	tool punch dimpled	tool punch		superimposed-red	rim, red both
Son L:1:23	835	ext	3.1	5	fugitive	tool incise	tool incise			
Son L:1:23	835	ext	7	47	regular	tool punch lunate-obliterated	tool punch	incise parallel straight		
Son L:1:23	835	ext	2.4	3	regular	tool punch pin	tool punch			
Son L:1:23	838	ext	1.9	2	regular	incise angled design	incise angled design		framer-red	red int
Son L:1:23	838	ext	3.9	8	fugitive	incise curvilinear	incise curvilinear			

Son L:1:23	838	ext	2.3	3	regular	incise parallel straight / brush	incise / brush			
Son L:1:23	838	ext	2.3	2	regular	incise parallel straight / brush	incise / brush			
Son L:1:23	838	ext	2.4	2	regular	tool punch circle	tool punch			
Son L:1:23	841	?	2.3	3	regular	emboss bump	raised element			
Son L:1:23	841	ext	3.5	6	deep	incise vertical	incise angled design			
Son L:1:23	844	ext	2.1	2	regular	emboss bump	raised element			rim
Son L:1:23	844	ext	2	1	regular	incise single line	incise indeterminate			
Son L:1:23	849	ext	3.2	8	regular/obliterted	incise parallel straight	incise parallel straight			
Son L:1:23	900	ext	3	4	regular	incise single line	incise indeterminate			sooted ext
Son L:1:23	906	ext	2.5	3	fugitive	tool incise	tool incise			
Son L:1:23	914	ext	2.6	4	fine	incise angled design	incise angled design			
Son L:1:23	914	ext	2	1	fine	incise parallel straight	incise parallel straight			
Son L:1:23	914	ext	2.4	3	regular	incise parallel straight / brush	incise / brush			
Son L:1:23	919	ext	2.7	9	regular	finger nail	ad hoc design			
Son L:1:23	919	both	2.7	3	regular	tool punch pin / incise parallel straight	tool punch	incise parallel straight	framer	rim
Son L:1:23	927	ext	2.8	7	regular	incise angled design	incise angled design			sooted ext
Son L:1:23	927	ext	1.7	1	regular	incise angled design	incise angled design			
Son L:1:23	927	ext	2	2	regular	incise parallel straight	incise parallel straight			
Son L:1:23	927	ext	2	3	regular	incise parallel straight / brush	incise / brush			
Son L:1:23	927	ext	2.3	3	regular	tool punch triangle	tool punch			
Son L:1:23	934	?	1.9	1	regular	incise single line	incise indeterminate			

Son L:1:23	1003	ext	sampled	petro-sampled	regular	finger pressed	ad hoc design		sooted?	
Son L:1:23	1233	ext	5	18	regular	tool incise	tool incise			TL
Son L:1:23	1234	int	3	5	regular	tool punch lunate	tool punch			
Son L:1:23	1235	ext	1.8	3	regular	incise angled design	incise angled design			
Son L:2:1	1:08	ext	3	6	regular	finger pressed rim	ad hoc design			rim
Son L:2:1	1:12	ext	2.1	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	1:13	ext	1.9	1	regular	incise parallel straight	incise parallel straight			
Son L:2:1	2:07	ext	2.5	6	regular	tool punch dash	tool punch			
Son L:2:1	2:11	ext	2.7	5	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	3:06	ext	1.9	2	regular	incise angled design	incise angled design			
Son L:2:1	3:06	ext	2.2	1	regular	incise single line	incise indeterminate			
Son L:2:1	3:41	ext	2.3	4	regular	incise angled design / incise crosshatch	incise angled design			
Son L:2:1	4:07	ext	4.2	8	regular	tool punch u/square	tool punch			
Son L:2:1	5:05	ext	2	2	fine	tool punch dash / tool incise	tool punch	tool incise	framer	
Son L:2:1	6:30	ext	2.9	8	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	6:31	ext	2.2	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	8:01	ext	1.8	2	regular	incise single line	incise indeterminate			
Son L:2:1	8:15	ext	2.6	4	regular	incise parallel straight / brush	incise / brush			sooted int
Son L:2:1	9:09	ext	2.2	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	9:25	ext	2.2	3	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	10:03	ext	2.6	5	deep	incise single line	incise indeterminate			

Son L:2:1	10:06	ext	3.3	11	regular	ribbed	raised element			handle
Son L:2:1	10:11	ext	1.8	1	regular	emboss bump	raised element			
Son L:2:1	12:03	ext	2	2	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	12:06	ext	3.9	7	regular	incise parallel straight	incise parallel straight			
Son L:2:1	14:01	ext	3.1	7	regular	incise crosshatch	incise angled design			
Son L:2:1	14:25	ext	1.9	3	regular	incise crosshatch	incise angled design			
Son L:2:1	14:52	ext	2.1	2	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	15:01	ext	2.1	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	15:02	ext	2	1	regular	finger nail / brushed	ad hoc design	brush	superimposed	
Son L:2:1	14:62	ext	3.2	8	regular	pseudo corrugated / incise parallel straight	corrugation	incise parallel straight	superimposed	
Son L:2:1	15:03	ext	2.4	4	regular	incise single line	incise indeterminate			
Son L:2:1	15:09	ext	3.3	7	regular	incise crosshatch	incise angled design			
Son L:2:1	17:02	ext	2.2	2	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	17:05	ext	2.4	2	regular	incise angled design	incise angled design			
Son L:2:1	18:02	ext	2.3	3	regular	tool punch pin / incise single line	tool punch	incise indeterminate		
Son L:2:1	18:06	ext	2.1	2	regular	incise single line	incise indeterminate			
Son L:2:1	19:06	ext	1.8	2	fugitive	incise parallel straight	incise parallel straight			
Son L:2:1	19:06	ext	2.5	4	regular	incise parallel straight / brush	incise / brush			
Son L:2:1	19:06	ext	2.1	1	regular	incise single line	incise indeterminate			
Son L:2:1	19:07	ext	2.4	4	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	19:07	ext	2	2	regular	tool incise	tool incise			

Son L:2:1	21:06	ext	2.1	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	21:10	ext	2.1	3	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	23:01	ext	3	7	regular	finger nail / incise single line	ad hoc design	incise indeterminate	framer	
Son L:2:1	23:11	ext	1.9	3	regular	incise parallel straight mult widths	incise parallel straight			
Son L:2:1	I0003	ext	6.5	21	deep	incise angled design / corrugated	corrugation	incise angled design	superimposed	
Son L:2:1	1	ext	2.4	2	regular	incise angled design	incise angled design			
Son L:2:1	1	ext	2.1	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	1	ext	3.1	8	obliterated	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	1	ext	4	9	regular	incise parallel straight / brush	incise / brush		framer	
Son L:2:1	1	ext	2.6	6	regular	tool punch lunate	tool punch			
Son L:2:1	4	ext	2.6	4	regular	tool punch circle	tool punch			
Son L:2:1	7	ext	2.6	4	regular	incise angled design	incise angled design			
Son L:2:1	7	ext	3.1	12	regular	incise parallel straight	incise parallel straight			
Son L:2:1	7	ext	2.9	4	deep	incise vertical / corrugated	corrugation	incise angled design	superimposed	
Son L:2:1	11	ext	3	4	regular	incise angled design	incise angled design			
Son L:2:1	11	ext	2.3	3	regular	incise angled design / incise single line	incise angled design	incise indeterminate	framer	
Son L:2:1	11	ext	2	2	deep	incise crosshatch	incise angled design			
Son L:2:1	11	ext	3	3	regular	incise parallel straight	incise parallel straight			rim
Son L:2:1	11	ext	1.7	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	11	ext	1.7	1	regular	incise parallel straight	incise parallel straight			
Son L:2:1	11	ext	1.8	1	regular	incise parallel straight	incise parallel straight			

Son L:2:1	11	ext	1.9	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	11	ext	2	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	11	ext	2	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	11	ext	2.2	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	11	ext	3.3	8	deep	incise parallel straight	incise parallel straight			
Son L:2:1	11	ext	1.7	2	regular	incise parallel straight / brush	incise / brush			
Son L:2:1	11	ext	2.6	5	regular	incise parallel straight / brush	incise / brush		framer	
Son L:2:1	11	ext	2.7	5	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	11	ext	1.7	2	regular	incise single line	incise indeterminate			
Son L:2:1	11	ext	3.5	11	fugitive	incise vertical	incise angled design			rim
Son L:2:1	11	ext	2.1	2	regular	pseudo corrugated	corrugation			
Son L:2:1	11	ext	3.5	petro-sampled	regular	pseudo corrugated	corrugation			
Son L:2:1	11	ext	2.7	4	regular	rim indent	other			unique paste
Son L:2:1	11	ext	3.1	6	regular	tool punch pin / incise parallel straight	tool punch	incise parallel straight	framer	
Son L:2:1	11	ext	3.3	7	regular	tool punch triangle / incise angled design	tool punch	incise angled design	framer	
Son L:2:1	11	ext	2.3	3	regular	tool punch u/square	tool punch		red int	
Son L:2:1	11	ext	2.7	4	regular	tool punch u/square	tool punch			
Son L:2:1	15	ext	4.1	19	regular	incise crosshatch	incise angled design			
Son L:2:1	15	ext	1.6	1	regular	incise parallel straight	incise parallel straight			
Son L:2:1	19	ext	3	4	obliterated	clapboard	corrugation			
Son L:2:1	19	ext	1.7	1	regular	emboss ridge	raised element			

Son L:2:1	19	ext	2.3	4	regular	emboss ridge	raised element	
Son L:2:1	19	ext	2.1	2	regular	incise angled design	incise angled design	
Son L:2:1	19	ext	2.3	4	regular	incise angled design	incise angled design	
Son L:2:1	19	ext	2.8	4	fine	incise angled design	incise angled design	
Son L:2:1	19	ext	2.9	5	regular	incise angled design	incise angled design	
Son L:2:1	19	ext	5.4	petro-sampled	regular	incise angled design	incise angled design	
Son L:2:1	19	ext	2.2	2	fugitive	incise crosshatch	incise angled design	
Son L:2:1	19	ext	1.7	2	regular	incise parallel straight	incise parallel straight	
Son L:2:1	19	ext	2	2	deep	incise parallel straight	incise parallel straight	
Son L:2:1	19	ext	2.1	1	regular	incise parallel straight	incise parallel straight	
Son L:2:1	19	int	2.2	2	regular	incise parallel straight	incise parallel straight	
Son L:2:1	19	?	2.7	4	fine	incise parallel straight	incise parallel straight	
Son L:2:1	19	?	2.9	3	regular	incise parallel straight	incise parallel straight	
Son L:2:1	19	ext	4.3	13	regular	incise parallel straight	incise parallel straight	
Son L:2:1	19	ext	4.6	10	regular	incise parallel straight	incise parallel straight	
Son L:2:1	19	ext	2.4	4	regular	incise parallel straight / brush	incise / brush	superimposed
Son L:2:1	19	ext	2.6	4	regular	incise parallel straight / brush	incise / brush	
Son L:2:1	19	ext	2.1	2	regular	incise single line	incise indeterminate	
Son L:2:1	19	ext	2.5	4	fugitive	incise single line	incise indeterminate	
Son L:2:1	19	ext	3.7	7	regular	incise single line	incise indeterminate	
Son L:2:1	19	ext	2.3	2	deep	pseudo corrugated	corrugation	

Son L:2:1	19	ext	2	1	fugitive	tool incise	tool incise			
Son L:2:1	19	?	2.9	8	deep	tool punch circle	tool punch		both sooted	
Son L:2:1	19	ext	2.1	3	regular	tool punch circle / incise parallel straight	tool punch	incise parallel straight	framer	
Son L:2:1	19	ext	2.5	3	deep	tool punch circle / incise parallel straight	tool punch	incise parallel straight	superimposed	
Son L:2:1	19	ext	2	3	regular	tool punch pin / incise angled design	tool punch	incise angled design		rim
Son L:2:1	19	ext	4.4	7	deep	tool punch pin / incise angled design	tool punch	incise angled design		
Son L:2:1	19	ext	2.4	3	regular	tool punch pin / tool incise / incise parallel straight	tool punch	incise parallel straight	integrated	
Son L:2:1	19	ext	2.3	4	regular	tool punch u/square	tool punch			
Son L:2:1	24	ext	1.7	1	regular	incise crosshatch	incise angled design			
Son L:2:1	24	ext	3.1	5	regular	incise crosshatch	incise angled design			
Son L:2:1	27	ext	2.3	5	regular	incise angled design	incise angled design			
Son L:2:1	27	ext	2.7	6	regular	incise parallel straight	incise parallel straight			
Son L:2:1	27	?	2.1	1	deep	incise single line	incise indeterminate			
Son L:2:1	27	ext	2.5	4	regular	pseudo corrugated	corrugation			
Son L:2:1	27	ext	2.5	2	regular	tool punch circle	tool punch			
Son L:2:1	29	ext	2.3	4	deep	clapboard / incise parallel wavy	corrugation	incise parallel wavy	superimposed	
Son L:2:1	29	ext	2.6	5	regular	incise angled design	incise angled design			
Son L:2:1	29	ext	2.8	3	regular	incise chevrons	tool punch			
Son L:2:1	29	ext	6.2	20	obliterated	incise crosshatch	incise angled design			
Son L:2:1	29	ext	1.8	3	fugitive	incise parallel straight	incise parallel straight			
Son L:2:1	29	ext	1.9	2	regular	incise parallel straight	incise parallel straight			

Son L:2:1	29	ext	2.1	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	29	ext	2.1	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	29	ext	2.1	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	29	int	2.4	3	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	29	ext	2.6	4	regular	incise parallel straight	incise parallel straight			
Son L:2:1	29	ext	3.1	4	regular	incise parallel straight	incise parallel straight			
Son L:2:1	29	ext	2.5	3	fine	incise parallel straight / brush	incise / brush			
Son L:2:1	29	ext	2.5	3	regular	incise parallel straight / brush	incise / brush			
Son L:2:1	29	ext	2.9	5	fine	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	29	ext	3	8	regular	incise parallel straight / brush	incise / brush			
Son L:2:1	29	ext	2.5	3	deep	incise parallel straight mult widths	incise parallel straight			
Son L:2:1	29	ext	2.2	2	deep	pseudo corrugated / incise single line	corrugation	incise indeterminate	superimposed	sooted int
Son L:2:1	29	ext	3.1	5	regular	tool punch dash	tool punch			
Son L:2:1	33	ext	3.6	12	regular	corrugated	corrugation			
Son L:2:1	33	ext	2	2	regular	incise angled design	incise angled design			
Son L:2:1	33	ext	2.3	4	regular	incise angled design	incise angled design			
Son L:2:1	33	ext	2.3	2	deep	incise angled design	incise angled design			
Son L:2:1	33	ext	4.1	11	regular	incise angled design	incise angled design			
Son L:2:1	33	ext	3.6	5	regular	incise angled design mult widths	incise angled design			
Son L:2:1	33	ext	1.9	3	fine	incise parallel straight	incise parallel straight			
Son L:2:1	33	ext	1.9	3	regular	incise parallel straight	incise parallel straight			

Son L:2:1	33	ext	3.1	5	regular	incise parallel straight	incise parallel straight		
Son L:2:1	33	ext	3.7	7	fine	incise parallel straight	incise parallel straight		
Son L:2:1	33	ext	1.8	1	regular	incise parallel straight / brush	incise / brush		
Son L:2:1	33	ext	2.1	4	regular	incise parallel straight / brush	incise / brush		
Son L:2:1	33	ext	3.7	7	regular	incise parallel straight / brush	incise / brush		superimposed
Son L:2:1	33	ext	3.7	11	regular	incise parallel straight / brush	incise / brush		superimposed?
Son L:2:1	33	ext	4.7	22	regular	incise parallel straight / brush	incise / brush		zoned
Son L:2:1	33	ext	4.6	10	deep	incise parallel wavy / embossed ridges	incise parallel wavy	raised element	superimposed
Son L:2:1	33	ext	2	3	regular	incise single line	incise indeterminate		
Son L:2:1	33	ext	3.1	7	fugitive	pseudo corrugated	corrugation		
Son L:2:1	33	ext	2.5	3	fine	pseudo corrugated / incise angled design	corrugation	incise angled design	superimposed
Son L:2:1	33	ext	2.5	3	fine	pseudo corrugated / incise parallel straight	corrugation	incise parallel straight	
Son L:2:1	33	int	2.9	3	regular	tool incise	tool incise		
Son L:2:1	33	ext	2.7	4	deep	tool punch lunate	tool punch		
Son L:2:1	33	ext	2.7	6	deep	tool punch pin / incise vertical	tool punch	incise angled design	framer
Son L:2:1	36	ext	1.9	2	deep	incise angled design	incise angled design		
Son L:2:1	36	ext	2	1	regular	incise angled design	incise angled design		
Son L:2:1	36	ext	2	3	regular	incise angled design	incise angled design		
Son L:2:1	36	ext	2	1	deep	incise angled design	incise angled design		
Son L:2:1	36	ext	2.2	2	regular	incise parallel straight	incise parallel straight		
Son L:2:1	36	ext	2.4	3	regular	incise parallel straight	incise parallel straight		

Son L:2:1	36	ext	3.1	3	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	36	ext	3.1	7	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	36	ext	1.8	3	regular	incise single line	incise indeterminate			
Son L:2:1	40	ext	2.5	4	regular	incise angled design	incise angled design			
Son L:2:1	40	ext	3.2	3	regular	incise angled design	incise angled design			
Son L:2:1	40	ext	1.9	3	fugitive	incise parallel straight	incise parallel straight			
Son L:2:1	40	ext	2.1	3	fine	incise parallel straight	incise parallel straight			
Son L:2:1	40	ext	3	5	deep	incise parallel straight	incise parallel straight			
Son L:2:1	40	ext	2.5	4	regular	incise parallel straight / brush	incise / brush			
Son L:2:1	40	ext	2.9	5	regular	pseudo corrugated	corrugation			
Son L:2:1	40	ext	2.2	2	regular	pseudo corrugated / tool incise	corrugation	tool incise	superimposed	
Son L:2:1	40	ext	3	6	regular	tool punch pin	tool punch			rim
Son L:2:1	40	ext	3.2	3	regular	tool punch pin / incise angled design	tool punch	incise angled design	framer	
Son L:2:1	42	ext	2.3	6	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	42	ext	1.7	2	regular	pseudo corrugated	corrugation			
Son L:2:1	42	ext	2.9	6	deep	tool punch lunate / incise single line	tool punch		framer?	
Son L:2:1	44	ext	3.3	6	deep	tool punch u/square	tool punch			
Son L:2:1	48	ext	2.7	6	fine	incise parallel straight	incise parallel straight			
Son L:2:1	57	ext	1.9	1	regular	finger pressed	ad hoc design			
Son L:2:1	57	ext	2.1	3	regular	incise angled design	incise angled design			
Son L:2:1	57	ext	2.8	5	deep	incise angled design	incise angled design			

Son L:2:1	57	ext	1.7	1	deep	incise parallel straight	incise parallel straight			
Son L:2:1	57	ext	2.2	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	57	ext	2.2	3	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	57	ext	2.5	4	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	57	ext	2.7	3	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	57	ext	2.2	2	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	57	ext	1.7	1	regular	incise single line	incise indeterminate			
Son L:2:1	57	ext	3.1	4	regular	tool punch pin / incise parallel straight	tool punch	incise parallel straight	alternating	
Son L:2:1	60	ext	4.2	8	deep	incise angled design two widths	incise angled design			TL 05
Son L:2:1	64	ext	2	2	deep	incise parallel straight	incise parallel straight			
Son L:2:1	67	ext	2.7	4	regular	tool punch dash	tool punch			
Son L:2:1	67	ext	2.4	4	regular	finger pressed	ad hoc design			rim
Son L:2:1	67	ext	4.4	11	regular	tool incise	tool incise			
Son L:2:1	69	ext	2.2	3	regular	emboss bump	raised element			
Son L:2:1	69	ext	2.3	5	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	69	ext	2.8	3	regular	incise single line	incise indeterminate			
Son L:2:1	69	ext	3.5	6	regular	tool punch triangle	tool punch			rim
Son L:2:1	69	ext	2.3	3	regular	tool punch u/square	tool punch			
Son L:2:1	69	ext	2.1	4	regular	tool punch u/square / brush	tool punch	brush	framer	
Son L:2:1	73	ext	3.1	4	fine	finger nail	ad hoc design			
Son L:2:1	73	ext	1.7	1	regular	incise angled design	incise angled design			

Son L:2:1	73	ext	1.7	1	fine	incise angled design / incise single line	incise angled design	incise indeterminate	framer	
Son L:2:1	73	ext	2	2	fine	incise crosshatch	incise angled design			
Son L:2:1	73	ext	3.2	5	regular	incise parallel straight	incise parallel straight			rim
Son L:2:1	73	ext	2.5	3	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	73	ext	2.6	3	deep	tool incise	tool incise			
Son L:2:1	73	ext	2.4	3	regular	tool punch circle	tool punch			rim
Son L:2:1	76	ext	2	2	obliterated	tool incise	tool incise			
Son L:2:1	76	ext	2.4	4	regular	tool punch pin	tool punch			
Son L:2:1	79	ext	2.7	5	regular	tool punch pin / brush	tool punch	brush	framer	
Son L:2:1	83	ext	2.9	8	regular	emboss bump	raised element			
Son L:2:1	83	ext	3.9	petro-sampled	regular	incise angled design	incise angled design			
Son L:2:1	83	ext	2.5	4	fine	incise angled design / incise single line	incise angled design	incise indeterminate	framer	
Son L:2:1	83	ext	2.3	4	fine	incise crosshatch	incise angled design			
Son L:2:1	83	ext	2.3	1	regular	incise crosshatch	incise angled design			
Son L:2:1	83	ext	2	3	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	83	ext	2.4	4	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	83	ext	2.7	6	regular	tool punch lunate	tool punch			
Son L:2:1	87	ext	3.2	5	regular	finger pressed	ad hoc design			
Son L:2:1	87	ext	2.7	3	regular	incise angled design	incise angled design			
Son L:2:1	87	ext	2.7	5	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	87	ext	3.9	12	fine	incise parallel straight	incise parallel straight			

Son L:2:1	89	ext	2.5	2	fine	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	89	ext	3.2	7	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	93	ext	3.7	9	regular	finger pressed	ad hoc design		rim	
Son L:2:1	93	ext	2.7	3	regular	incise single line	incise indeterminate			
Son L:2:1	93	ext	3.6	7	regular	tool incise	tool incise			
Son L:2:1	93	ext	2.6	3	regular	tool punch circle / brushed	tool punch	brush	framer	sooted int
Son L:2:1	93	ext	3.1	7	regular	tool punch triangle	tool punch			
Son L:2:1	95	ext	3.2	6	regular	incise angled design / incise single line	incise angled design	incise indeterminate	framer	
Son L:2:1	95	ext	3.3	7	regular	incise haphazzard pattern	incise other			
Son L:2:1	95	ext	2.7	2	fine	incise parallel straight	incise parallel straight			
Son L:2:1	95	ext	3.5	9	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	95	ext	2.6	4	regular	incise single line	incise indeterminate			
Son L:2:1	95	ext	2.1	2	regular	tool incise	tool incise			
Son L:2:1	95	ext	2.7	6	regular	tool punch u/square	tool punch			
Son L:2:1	100	ext	1.7	3	regular	emboss bump	raised element			
Son L:2:1	100	ext	3.6	7	regular	incise angled design	incise angled design			
Son L:2:1	100	ext	1.6	1	regular	incise parallel straight	incise parallel straight			
Son L:2:1	100	ext	1.7	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	100	ext	1.8	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	100	ext	2	1	regular	incise parallel straight	incise parallel straight			
Son L:2:1	100	ext	2	2	regular	incise parallel straight	incise parallel straight			

Son L:2:1	100	ext	2.2	4	obliterated	incise parallel straight	incise parallel straight		
Son L:2:1	100	ext	2.3	3	regular	incise parallel straight	incise parallel straight		
Son L:2:1	100	ext	2.7	6	obliterated	incise parallel straight	incise parallel straight		
Son L:2:1	100	ext	3.8	9	obliterated	incise parallel straight	incise parallel straight		
Son L:2:1	100	ext	1.8	2	fugitive	incise parallel straight / brush	incise / brush		
Son L:2:1	100	ext	2.9	5	regular	incise parallel straight / brush	incise / brush		
Son L:2:1	100	ext	3.2	6	fugitive	incise parallel straight / brush	incise / brush		
Son L:2:1	100	ext	2	1	regular	incise single line	incise indeterminate		
Son L:2:1	100	ext	2.3	3	regular	tool punch lunate / incise single line	tool punch	incise indeterminate	zoned?
Son L:2:1	100	ext	4.4	11	regular	tool punch oval / incise single line	tool punch	incise indeterminate	zoned?
Son L:2:1	100	ext	2.8	4	regular	tool punch u/square	tool punch		
Son L:2:1	100	ext	4	9	regular	tool punch u/square	tool punch		
Son L:2:1	103	ext	2.7	4	regular	incise angled design / incise single line	incise angled design	incise indeterminate	framer
Son L:2:1	103	ext	3.8	12	regular	incise angled design / incise single line	incise angled design	incise indeterminate	framer
Son L:2:1	103	ext	3.4	8	deep	incise parallel straight	incise parallel straight		
Son L:2:1	103	ext	2.1	3	deep	pseudo corrugated / incise parallel straight	corrugation	incise parallel straight	superimposed
Son L:2:1	103	ext	3.7	5	regular	tool punch circle / tool incise	tool punch	tool incise	superimposed
Son L:2:1	103	ext	3.7	11	regular	tool punch pin / incise parallel straight	tool punch	incise parallel straight	framer
Son L:2:1	103	ext	3.8	11	regular	tool punch pin / incise parallel straight	tool punch	incise parallel straight	framer
Son L:2:1	103	ext	5.1	11	regular	tool punch pin / incise parallel straight	tool punch	incise parallel straight	framer
Son L:2:1	103	ext	4.4	12	regular	tool punch u/square	tool punch		rim

Son L:2:1	107	ext	2	3	fine	incise parallel straight	incise parallel straight		
Son L:2:1	107	ext	2.3	3	deep	incise parallel straight	incise parallel straight		
Son L:2:1	107	ext	1.7	3	regular	incise parallel wavy	incise parallel wavy		
Son L:2:1	107	ext	3.4	9	regular	tool punch circle / brushed	tool punch	brush	framer	
Son L:2:1	111	ext	4.8	13	regular	incise parallel wavy / incise single line	incise parallel wavy		framer	TL no 101
Son L:2:1	112	ext	1.8	2	regular	emboss ridge	raised element			
Son L:2:1	112	ext	1.6	2	regular	incise angled design	incise angled design			
Son L:2:1	112	ext	2.2	3	fine	incise parallel straight	incise parallel straight			
Son L:2:1	112	ext	3.2	9	fine	incise parallel straight	incise parallel straight			
Son L:2:1	112	ext	1.8	1	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	112	ext	2.6	4	regular	tool punch circle / incise parallel straight	tool punch	incise parallel straight	zoned	
Son L:2:1	112	ext	2.3	3	regular	tool punch dash	tool punch			
Son L:2:1	114	ext	1.8	2	regular	tool punch dash / tool punch circle / incise parallel straight	tool punch	incise parallel straight		rim
Son L:2:1	114	ext	1.7	1	regular	incise angled design	incise angled design			
Son L:2:1	114	ext	2	3	regular	incise angled design	incise angled design			
Son L:2:1	114	ext	3.7	6	regular	incise angled design	incise angled design			
Son L:2:1	114	?	1.9	1	regular	incise parallel straight	incise parallel straight			
Son L:2:1	114	ext	2.2	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	114	ext	2.2	3	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	114	ext	2.5	6	regular	incise parallel straight	incise parallel straight			
Son L:2:1	114	ext	2.7	3	regular	incise parallel straight	incise parallel straight			

Son L:2:1	114	ext	4.3	14	regular	incise parallel straight	incise parallel straight			
Son L:2:1	114	ext	2.1	4	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	114	ext	2.4	4	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	114	ext	2.7	6	obliterated	incise parallel straight / brush	incise / brush		framer	
Son L:2:1	114	ext	2.1	4	regular	incise single line	incise indeterminate			
Son L:2:1	114	ext	2.5	3	obliterated	tool incise	tool incise			
Son L:2:1	114	ext	1.9	1	regular	tool punch circle	tool punch			
Son L:2:1	114	ext	1.8	2	regular	tool punch circle / incise parallel straight	tool punch	incise parallel straight		
Son L:2:1	114	ext	5.1	19	regular	tool punch circle / tool incise	tool punch	tool incise	superimposed	
Son L:2:1	114	ext	2.6	4	regular	tool punch indeterminate	tool punch			
Son L:2:1	114	ext	3.3	8	regular	tool punch pin	tool punch			
Son L:2:1	114	ext	3.6	6	regular	tool punch pin	tool punch			
Son L:2:1	114	ext	2.5	4	regular	tool punch u/square	tool punch			
Son L:2:1	119	ext	1.8	1	regular	emboss ridge	raised element			
Son L:2:1	119	ext	4.2	11	regular	incise angled design	incise angled design			
Son L:2:1	119	ext	2.4	3	regular	tool punch circle	tool punch			
Son L:2:1	121	ext	4.3	10	regular	incise curvilinear	incise curvilinear			TL 102
Son L:2:1	136	ext	3.5	10	fine	tool punch dash / incise parallel straight	tool punch	incise parallel straight	framer	sooted int
Son L:2:1	136	ext	2.2	3	regular	incise angled design	incise angled design			
Son L:2:1	136	ext	2	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	136	?	2	1	regular	incise parallel straight	incise parallel straight			

Son L:2:1	136	ext	2	2	fine	incise parallel straight	incise parallel straight			
Son L:2:1	136	ext	2.1	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	136	int	2.3	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	136	ext	2.4	3	fine	incise parallel straight	incise parallel straight			
Son L:2:1	136	ext	2.6	4	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	136	int	2.7	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	136	ext	3.2	7	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	136	ext	3	5	regular	incise parallel straight / brush	incise / brush		framer	
Son L:2:1	136	?	3.3	5	deep	incise parallel straight / corrugated	corrugation	incise parallel straight	superimposed	
Son L:2:1	136	ext	2.6	3	regular	incise single line	incise indeterminate			
Son L:2:1	136	ext	2	3	regular	incise vertical	incise angled design		framer-red	
Son L:2:1	136	?	3.4	5	high	incsie applique	raised element			
Son L:2:1	136	ext	2.2	4	regular	tool punch dash / brush	tool punch	brush	rim framer	
Son L:2:1	136	ext	3.1	sampled	regular	tool punch lunate	tool punch			
Son L:2:1	136	ext	2	1	regular	tool punch triangle	tool punch			rim
Son L:2:1	136	ext	2.3	3	regular	tool punch triangle	tool punch			
Son L:2:1	137	ext	1.8	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	137	ext	2.4	3	fugitive	incise parallel straight	incise parallel straight			
Son L:2:1	137	ext	4	sampled	regular	tool punch u/square	tool punch			
Son L:2:1	144	ext	2.9	4	fugitive	incise parallel wavy	incise parallel wavy			
Son L:2:1	144	ext	3.6	8	regular	tool punch indeterminate	tool punch			

Son L:2:1	148	ext	2.8	5	regular	tool punch dash	tool punch			
Son L:2:1	148	ext	3.1	7	regular	incise angled design	incise angled design			
Son L:2:1	148	ext	3.6	11	deep	incise angled design	incise angled design			
Son L:2:1	148	ext	1.7	2	regular	incise parallel straight	incise parallel straight			sooted ext
Son L:2:1	148	ext	1.9	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	148	ext	1.9	2	deep	incise parallel straight	incise parallel straight			
Son L:2:1	148	ext	2.7	5	regular	incise parallel straight	incise parallel straight			
Son L:2:1	148	ext	2.3	2	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	148	ext	2.5	3	regular	incise parallel straight / brush	incise / brush			
Son L:2:1	148	ext	2.6	5	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	148	ext	2.9	3	obliterated	incise parallel wavy	incise parallel wavy			
Son L:2:1	148	ext	2.9	3	regular	pressed design / incise parallel straight	tool punch	incise parallel straight	framer	
Son L:2:1	148	ext	2.7	5	regular	tool punch circle	tool punch			
Son L:2:1	148	ext	2.4	4	regular	tool punch triangle / dash line	tool punch			
Son L:2:1	154	ext	4	9	regular	clapboard	corrugation			
Son L:2:1	154	ext	2.5	2	regular	incise parallel straight	incise parallel straight			sooted ext
Son L:2:1	154	ext	2.6	5	deep	incise parallel straight / clapboard	corrugation	incise parallel straight	superimposed	
Son L:2:1	154	ext	4.7	8	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	154	ext	2.8	4	fine	pressed design / incise parallel straight	tool punch	incise parallel straight	framer	
Son L:2:1	157	ext	6.2	sampled	deep	tool punch triangle / grooved	tool punch	incise other		TL 104-submitted
Son L:2:1	159	ext	1.8	2	regular	incise parallel straight	incise parallel straight			

Son L:2:1	159	int	2	2	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	159	ext	2	2	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	159	ext	2.5	4	regular	incise single line	incise indeterminate			
Son L:2:1	159	ext	2.2	4	regular	tool punch pin / brush	tool punch	brush	framer	
Son L:2:1	159	ext	4	10	regular	tool punch u/square	tool punch			rim
Son L:2:1	161	ext	2.7	5	regular	emboss bump	raised element			
Son L:2:1	161	ext	2.6	6	regular	incise angled design	incise angled design			sooted ext
Son L:2:1	161	ext	2.9	6	fine	incise angled design	incise angled design			
Son L:2:1	161	ext	1.7	2	obliterated	incise parallel straight	incise parallel straight			
Son L:2:1	161	ext	3.2	4	regular	incise parallel straight	incise parallel straight			
Son L:2:1	161	ext	1.9	2	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	161	ext	2.5	5	obliterated	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	161	ext	2.6	4	fine	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	161	ext	2.7	4	fine	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	161	ext	3.5	9	fine	incise parallel straight / brush	incise / brush			
Son L:2:1	161	ext	5.4	16	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	161	ext	2.1	2	regular	incise single line	incise indeterminate			
Son L:2:1	161	ext	1.7	2	regular	tool incise	tool incise			
Son L:2:1	161	ext	5.2	36	regular	tool incise	tool incise			
Son L:2:1	161	ext	1.6	1	regular	tool punch circle / incise parallel straight	tool punch	incise parallel straight	combined	
Son L:2:1	161	ext	2.4	4	regular	tool punch circle / incise parallel straight	tool punch	incise parallel straight	framer	

Son L:2:1	161	ext	2.7	5	regular	tool punch lunate / incise parallesl straight	tool punch	incise parallel straight	zoned?	
Son L:2:1	161	ext	6.1	36	regular	tool punch u/square / brush	tool punch	brush	framer	
Son L:2:1	167	ext	5	17	regular	incise angled design	incise angled design			TL 06
Son L:2:1	172	rim	2.8	5	regular	rim notch	other			rim
Son L:2:1	172	ext	2.7	5	regular	tool punch u/square	tool punch			rim
Son L:2:1	174	ext	4.9	20	regular	incise angled design	incise angled design			TL 107
Son L:2:1	175	ext	1.7	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	175	ext	2.2	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	175	ext	2.4	3	regular	incise parallel straight	incise parallel straight			
Son L:2:1	175	ext	2.8	5	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	175	ext	2.3	3	obliterated	incise parallel wavy	incise parallel wavy			
Son L:2:1	177	ext	6.6	26	regular	incise angled design	incise angled design			rim
Son L:2:1	177	ext	3.7	7	regular	incise angled design	incise angled design			
Son L:2:1	177	ext	2.3	2	regular	incise curvilinear wavy	incise curvilinear			
Son L:2:1	177	ext	3.3	5	regular	incise single line	incise indeterminate			
Son L:2:1	177	ext	2.2	3	regular	tool incise	tool incise			
Son L:2:1	179	ext	6.4	24	regular	tool incise	tool incise			
Son L:2:1	179	ext	2.4	3	regular	tool punch pin	tool punch			
Son L:2:1	201	ext	3.7	10	regular	incise angled design	incise angled design			
Son L:2:1	201	ext	5.1	15	regular	incise angled design / emboss bump	incise angled design	raised element	zoned	
Son L:2:1	201	ext	3.1	4	obliterated	incise parallel straight	incise parallel straight			

Son L:2:1	201	ext	2.1	3	regular	tool incise	tool incise			
Son L:2:1	204	ext	2.7	3	regular	incise angled design / pseudo corrugated	corrugation	incise angled design		TL 02
Son L:2:1	206	ext	4.4	11	regular	incise angled design	incise angled design			TL 04
Son L:2:1	207	ext	4.6	sampled	deep	incise angled design	incise angled design			TL 09-submitted
Son L:2:1	209	ext	6.3	29	regular	incise angled design	incise angled design			TL 11
Son L:2:1	212	ext	6.4	28	regular	incise angled design	incise angled design			TL 20
Son L:2:1	222	ext	2.1	2	regular	tool punch u/square	tool punch			worked
Son L:2:1	231	ext	1.5	8	deep	incise parallel straight	incise parallel straight			
Son L:2:1	305	ext	2.9	4	regular	tool incise	tool incise			
Son L:2:1	305	ext	3.1	3	regular	tool punch lunate / incise single line	tool punch	incise indeterminate	framer	
Son L:2:1	305	ext	5.5	19	regular	tool punch triangle / brush	tool punch	brush	framer	
Son L:2:1	308	ext	3	6	regular	incise angled design	incise angled design			
Son L:2:1	308	ext	2	3	fine	incise parallel straight	incise parallel straight			
Son L:2:1	308	ext	3.2	5	regular	incise parallel wavy	incise parallel wavy			
Son L:2:1	308	ext	2.6	4	regular	tool incise	tool incise			
Son L:2:1	308	ext	3.5	7	regular	tool punch lunate / brush	tool punch	brush	framer	
Son L:2:1	308	ext	2.9	4	regular	tool punch pin / incise parallel straight	tool punch	incise parallel straight	framer	
Son L:2:1	308	ext	3.2	5	regular	tool punch u/square / incise single line	tool punch	incise indeterminate	framer	
Son L:2:1	313	ext	2.2	3	fugitive	incise parallel straight	incise parallel straight			
Son L:2:1	313	ext	2.6	3	deep	incise parallel straight	incise parallel straight			
Son L:2:1	313	ext	2.8	6	regular	incise parallel straight / brush	incise / brush		zoned	

Son L:2:1	313	ext	2.3	3	regular	tool incise	tool incise			
Son L:2:1	313	ext	2.5	4	regular	tool incise	tool incise			
Son L:2:1	315	ext	sampled	petro-sampled	?	?	?			
Son L:2:1	315	ext	3.1	6	regular	incise parallel straight	incise parallel straight			sooted int
Son L:2:1	325	ext	2.2	4	regular	incise angled design	incise angled design			
Son L:2:1	325	ext	1.6	2	regular	incise parallel straight	incise parallel straight			
Son L:2:1	325	ext	4.5	8	regular	incise parallel straight	incise parallel straight			
Son L:2:1	325	ext	1.9	1	regular	incise parallel straight / brush	incise / brush		superimposed	
Son L:2:1	325	ext	2.5	4	obliterated	incise parallel straight / brush	incise / brush			
Son L:2:1	325	ext	2.5	4	deep	incise parallel wavy	incise parallel wavy			
Son L:2:1	325	ext	3	5	deep	incise single line / brush	incise indeterminate	brush	superimposed	
Son L:2:1	325	ext	3.2	5	regular	tool punch triangle	tool punch			
Son L:2:1	325	ext	2.7	6	regular	tool punch u/square / brush	tool punch	brush	framer	
Son L:2:1	329	ext	2.5	5	regular	incise parallel straight / brush	incise / brush		zoned?	
Son L:2:1	329	ext	3.3	5	obliterated	incise parallel straight double line	incise parallel straight			
Son L:2:22	5:10	ext	3.7	12	fugitive	tool incise	tool incise			
Son L:2:22	9:08	ext	1.7	1	regular	incise angled design / red	incise angled design		zoned-red	
Son L:2:22	11:04	ext	3.1	3	fugitive	incise parallel wavy / red	incise parallel wavy		superimposed-red	
Son L:2:22	11:04	ext	1.7	1	fugitive	tool incise	tool incise			
Son L:2:22	38:07	ext	2.5	3	regular	tool punch pin	tool punch			
Son L:2:22	39:12	ext	3	petro-sampled	regular	tool punch pin	tool punch			

Son L:2:22	39:13	ext	2.6	4	regular	incise parallel wavy	incise parallel wavy			
Son L:2:22	40:06	int	1.9	3	regular	incise single line	incise indeterminate			
Son L:2:22	52:04	ext	5.3	petro-sampled	regular	incise parallel wavy	incise parallel wavy			
Son L:2:22	I0026	ext	3.7	8	regular	tool punch pin / incise angled design	tool punch	incise angled design	rim/sooted int	
Son L:2:22	I0027	ext	3.1	petro-sampled	deep	incise parallel straight	incise parallel straight			
Son L:2:22	413	ext	3.5	petro-sampled	fugitive	incise parallel straight	incise parallel straight			
Son L:2:22	449	ext	2.1	2	fine	incise curvilinear wavy	incise curvilinear			
Son L:2:22	500	ext	3.3	8	regular	emboss bump	raised element			sooted int
Son L:2:22	500	int	3	5	regular	incise parallel wavy	incise parallel wavy			
Son L:2:22	500	ext	2.7	petro-sampled	regular	tool punch pin / incise single line	tool punch	incise indeterminate	framer	
Son L:2:22	505	ext	2.4	2	regular	incise single line	incise indeterminate			
Son L:2:22	506	ext	2.2	3	regular	tool punch triangle / incise single line	tool punch	incise indeterminate	framer?	
Son L:2:22	554	ext	1.5	1	regular	incise parallel straight	incise parallel straight			
Son L:2:22	557	ext	4.8	petro-sampled	regular	tool punch oval / incise parallel straight	tool punch	incise indeterminate	framer	
Son L:2:22	631	ext	2.9	petro-sampled	obliterated	incise parallel straight	incise parallel straight			
Son L:2:22	?	ext	2.4	2	regular	incise angled design	incise angled design			

Painted

Site	FN	Size (cm)	Weight (g)	sub FN	Tradition	Type	Style / Variant	Slip	Description paint	Surface	Description paste
Son L:1:23	01:31	3.7	11	1	Sonora	Other Local	R/br		red on brown	interior	brown paste
Son L:1:23	02:18	1.6	1	1	Chihuahua	Other Chihuahua		chalky white	black on white chalky slip	interior/exterior	orange paste
Son L:1:23	02:18	1.6	1	2	Chihuahua	Other Chihuahua		chalky white	black and red on white chalky	interior/exterior	orange paste
Son L:1:23	03:05	1.6	2	1	Chihuahua	Other Chihuahua		chalky white	black on white chalky slip	interior	dark grey paste
Son L:1:23	08:01	1.4	1	1	Chihuahua	Other Chihuahua		chalky white	black on white chalky slip	interior/exterior	brown paste
Son L:1:23	17:18	1.8	2	1	Chihuahua	Other Chihuahua		chalky white	black on white chalky slip	exterior	orange paste
Son L:1:23	20:12	2.3	3	1	Chihuahua	Other Chihuahua		brillant white	black on white glossy slip	exterior	grey paste
Son L:1:23	25:05	2.9	7	1	Chihuahua	Other Chihuahua		chalky white	black on white chalky slip	interior/exterior	
Son L:1:23	I0030	2.3	2	1	Chihuahua	Santa Ana	1		black and red on orange paste	exterior	orange paste
Son L:1:23	I0032	3.7	9	1	Chihuahua	Jecori	1	white	black on white slip / black and red on white slip	interior/exterior	orange with light grey core
Son L:1:23	I0034	7.2	27	1	Sonora	Other Local	R/br		red on orange paste	exterior	orange with grey core
Son L:1:23	I0040	2.6	3	1	Sonora	Cumpas	1		black on red slip	interior/exterior	orange with grey core
Son L:1:23	I0043	4.6	12	1	Chihuahua	Other Chihuahua		white	black on white slip	interior/exterior	brown paste

Son L:1:23	705	4.6	12	1	Sonora	Serrana	P/br		purple on orange paste	exterior	orange paste
Son L:1:23	719	6.6	15	1	Sonora	Other Local	R/cream		red on cream chalky slip	exterior	orange with grey core
Son L:1:23	724	3.5	0	4	Chihuahua	Other Chihuahua		white	black on white slip	exterior	orange paste
Son L:1:23	724	3	4	2	Chihuahua	Other Chihuahua		white	black on white slip	interior	orange with light grey core
Son L:1:23	724	2.5	3	1	Chihuahua	Other Chihuahua		grey	black on grey slip	interior/exterior	brown / grey paste
Son L:1:23	724	3	4	3	Chihuahua	Other Chihuahua		white	black on grey slip	interior/exterior	orange with light grey core
Son L:1:23	800	1.8	1	1	Chihuahua	Other Chihuahua		white	two black paints on white slip	interior/exterior	brown paste
Son L:1:23	802	2.5	3	7	Chihuahua	Other Chihuahua		white	black on white slip / red on white slip	interior/exterior	orange with dark grey core
Son L:1:23	802	3.3	5	12	Chihuahua	Other Chihuahua		white	two black paints on white slip	interior/exterior	light grey paste
Son L:1:23	802	0	0	13	Sonora	Cumpas	1		black on orange paste	exterior	orange and brown paste
Son L:1:23	802	3.4	9	11	Chihuahua	Jecori	1	chalky white	black on chalky white / black and red on chalky white slip	interior/exterior	orange paste
Son L:1:23	802	3	5	1	Chihuahua	Jecori	2	white	black on white / black and red on white slip	interior/exterior	orange with light grey core
Son L:1:23	802	2.8	5	6	Chihuahua	Other Chihuahua		chalky white	black on white chalky slip	exterior	orange with dark grey core
Son L:1:23	802	1.8	2	4	Chihuahua	Other Chihuahua		chalky white	white slip	interior	orange with dark grey core

Son L:1:23	802	1.7	1	5	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	interior	orange with dark grey core
Son L:1:23	802	3.3	4	2	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	interior/exterior	orange paste
Son L:1:23	802	1.8	2	3	Chihuahua	Other Chihuahua		white	black on white slip / white slip	interior/exterior	orange paste
Son L:1:23	802	2.5	1	10	Chihuahua	Other Chihuahua		eroded	black on grey slip	interior/exterior	orange with dark grey core
Son L:1:23	802	3.5	7	9	Chihuahua	Teonadepa	2	white	black on chalky white / black and red on chalky white slip	interior/exterior	orange paste
Son L:1:23	809	3	4	5	Chihuahua	Jecori	1	grey	black and red on glossy grey slip / black on grey slip	interior/exterior	brown with grey core
Son L:1:23	809	2.1	2	2	Chihuahua	Jecori	3	white	black on white slip / red on white slip	interior/exterior	brown paste
Son L:1:23	809	3.6	7	6	Chihuahua	Jecori	3	white	black on white slip / red on white slip	interior/exterior	black core
Son L:1:23	809	3	7	3	Chihuahua	Jecori	4	grey	black on white slip / red on white slip	interior/exterior	black core
Son L:1:23	809	2.8	5	7	Chihuahua	Jecori	4	white	black on white slip / red on white slip	interior/exterior	brown paste
Son L:1:23	809	1.9	1	1	Chihuahua	Other Chihuahua		chalky white	chalky white slip	interior	brown paste
Son L:1:23	809	3	8	11	Chihuahua	Other Chihuahua		eroded	black on grey slip	interior	brown paste
Son L:1:23	809	3	3	8	Chihuahua	Other Chihuahua		white	black on grey slip / white slip	interior/exterior	brown paste
Son L:1:23	809	2.5	4	10	Chihuahua	Other Chihuahua		white	black on white slip	interior/exterior	light brown paste
Son L:1:23	813	0	0	1	Chihuahua	Jecori	1.1	chalky white	red and two blacks? on chalky white	interior/exterior	brown with light grey core
Son L:1:23	814	3.3	5	1	Chihuahua	Jecori		grey	red and black on grey slip / black on grey slip	interior/exterior	brown / grey paste

Son L:1:23	815	2.3	4	2	Chihuahua	Jecori	1	white	two black paints and red paint on good white paste	interior/exterior	grey paste
Son L:1:23	815	1.9	2	1	Chihuahua	Other Chihuahua		chalky white	white chalky slip	interior	orange paste with dark grey core
Son L:1:23	819	3.1	0	4	Sonora	Cumpas	2		black on orange paste	exterior	orange and brown paste
Son L:1:23	819	2.3	2	2	Sonora	Moctezuma			black on brown paste	exterior	brown paste
Son L:1:23	819	1.9	1	1	Chihuahua	Other Chihuahua		white	black on grey slip	exterior	brown paste
Son L:1:23	819	1.9	2	3	Sonora	Serrana	P/br		specular purple on orange paste	exterior	orange paste with black paste
Son L:1:23	822	4.4	15	1	Chihuahua	Teonadepa	1	white	black and red on white slip	exterior	orange paste
Son L:1:23	827	2.3	3	3	Sonora	Cumpas	1		black on red	exterior	brown paste
Son L:1:23	827	2.6	4	4	Chihuahua	Jecori	1	brillant white	black on glossy white slip / black and red on grey slip	interior/exterior	orange paste
Son L:1:23	827	1.5	1	2	Chihuahua	Jecori	3	white	black on salmon slip / red on salmon slip	interior/exterior	dark grey paste
Son L:1:23	827	2	3	1	Chihuahua	Other Chihuahua		white	black on white slip	interior/exterior	orange with dark grey core
Son L:1:23	832	2.4	4	5	Chihuahua	Jecori	1	salmon	black on salmon slip	interior/exterior	grey paste
Son L:1:23	832	1.9	2	1	Sonora	Cumpas	2		black on orange paste	interior	orange with light grey core
Son L:1:23	832	2.6	2	2	Chihuahua	Other Chihuahua		white	black on glossy white slip	interior	brown paste
Son L:1:23	832	2.5	2	3	Chihuahua	Other Chihuahua		chalky white	black on salmon slip	interior/exterior	brown paste eggshell thickness
Son L:1:23	832	2.5	3	4	Chihuahua	Other Chihuahua		white	black on salmon slip	interior/exterior	orange paste

Son L:1:23	832	4.6	0	6	Chihuahua	Teonadepa	1	white	black on white slip / black and red on white slip	interior/exterior	brown with grey core
Son L:1:23	835	2.3	2	1	Chihuahua	Other Chihuahua		white	black on cream slip	interior	orange paste
Son L:1:23	835	3.3	6	4	Chihuahua	Other Chihuahua		brillant white	glossy black on white slip / black on grey slip	interior/exterior	grey paste
Son L:1:23	835	2.3	2	2	Sonora	Other Local		grey	black on grey slip / black on brown paste	interior/exterior	brown with black core
Son L:1:23	835	3.8	13	3	Sonora	Serrana	R/br		red on brown paste	interior	brown paste
Son L:1:23	838	2.1	1	1	Chihuahua	Other Chihuahua		white	black on grey slip	exterior	grey paste
Son L:1:23	838	1.9	1	2	Chihuahua	Other Chihuahua		brillant white	gloss black on white gloss slip	interior	orange paste
Son L:1:23	844	3.4	4	1	Chihuahua	Teonadepa	3	grey	black and red on white slip	interior/exterior	orange paste
Son L:1:23	849	2.7	2	1	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	interior/exterior	orange with light grey core
Son L:1:23	910	1.7	1	1	Chihuahua	Other Chihuahua		chalky white	white chalky slip	interior/exterior	dark grey paste
Son L:1:23	913	3.1	0	1	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	interior/exterior	orange with light grey core
Son L:1:23	919	2.6	4	1	Sonora	Moctezuma			black on brown paste	exterior	brown paste
Son L:1:23	919	3	4	2	Sonora	Moctezuma			black on brown paste	exterior	brown paste
Son L:1:23	921	2	2	1	Chihuahua	Other Chihuahua		white	black on white slip / white slip	interior/exterior	grey paste
Son L:1:23	921	2.5	1	2	Sonora	Serrana	R/br		red on brown paste	exterior	grey paste

Son L:1:23	927	1.9	1	5	Chihuahua	Other Chihuahua		grey	black on grey slip	exterior	orange paste
Son L:1:23	927	3.7	5	3	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	interior	orange with dark grey core
Son L:1:23	927	1.9	1	4	Chihuahua	Other Chihuahua		white	black on white slip	interior	brown with grey core
Son L:1:23	927	2.3	2	2	Chihuahua	Other Chihuahua		chalky white	black on white slip	interior/exterior	orange with grey core
Son L:1:23	927	1.8	1	1	Sonora	Serrana	P/br		purple on brown paste	exterior	brown paste
Son L:1:23	927	2.6	3	6	Unique		R/buff		red on buff slip	exterior	orange paste
Son L:1:23	930	2.2	2	5	Chihuahua	Other Chihuahua			gloss black on white gloss slip	exterior	orange with brown core
Son L:1:23	930	3.2	0	6	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	interior	dark grey paste
Son L:1:23	930	2.8	3	1	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	interior/exterior	orange with dark grey paste
Son L:1:23	930	3.5	7	2	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	interior/exterior	orange with dark grey paste
Son L:1:23	930	2.4	2	3	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	interior/exterior	orange with dark grey paste
Son L:1:23	930	2	1	4	Sonora	Serrana	R/br		red on brown paste	exterior	brown paste
Son L:1:23	938	5.7	0	1	Chihuahua	Other Chihuahua		salmon	black on salmon slip	interior/exterior	black core
Son L:1:23	1003	5.3	18	1	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	exterior	orange paste

Son L:1:23	1231	2.7	4	1	Chihuahua	Other Chihuahua		brillant white	black on white glossy slip	interior/exterior	black core
Son L:1:23	1232	2.5	3	1	Chihuahua	Other Chihuahua		white	black on white slip	interior/exterior	brown paste
Son L:1:23	1234	2.1	3	1	Sonora	Serrana	P/br		purple on red slip	interior	brown with grey core
Son L:1:23	1235	3.5	9	6	Chihuahua	Jecori	1	white	black on grey slip / black and red on grey slip	interior/exterior	black core
Son L:1:23	1235	3.9	7	2	Chihuahua	Other Chihuahua		grey	grey slip	exterior	black core
Son L:1:23	1235	1.9	1	4	Chihuahua	Other Chihuahua		white	black on white slip	exterior	brown with grey core
Son L:1:23	1235	3.1	7	5	Chihuahua	Other Chihuahua		white	two black paints on white slip	exterior	orange with brown core
Son L:1:23	1235	3.2	8	8	Chihuahua	Other Chihuahua		white	glossy black on white slip	exterior	orange with dark grey core
Son L:1:23	1235	2.2	3	3	Chihuahua	Other Chihuahua		chalky white	chalky white slip	interior	orange with brown core
Son L:1:23	1235	3.6	7	7	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip / red on chalky white slip	interior/exterior	orange paste
Son L:1:23	1235	2.7	6	1	Chihuahua	Teonadepa	1	white	black and red on white slip	exterior	brown with grey core
Son L:2:1	05:09	1.7	1	1	Sonora	Volanta	1		black stripes on white slip	exterior	brown paste
Son L:2:1	06:18	1.8	2	1	unknown				salmon slip	interior	orange brown paste
Son L:2:1	14:23	1.6	2	1	Sonora	Serrana	Bl/br		black on brown paste	interior	orange brown paste
Son L:2:1	14:48	1.9	2	1	Sonora	Cumpas	2		black paint	exterior	grey paste
Son L:2:1	19:06	1.4	1	1	Chihuahua	Santa Ana	2		black and red on cream paste	exterior	cream paste
Son L:2:1	I0001	2.9	3	1	Chihuahua	Santa Ana			black and red on buff paste	exterior	buff with light grey core

Son L:2:1	I0005	3	8	1	Sonora	Serrana	Bl/br		black on buff paste	exterior	buff with dark grey core
Son L:2:1	I0006	3.6	8	1	Sonora	Serrana	P/or		purple on orange paste	exterior	orange with brown core
Son L:2:1	1	3.1	5	2	Sonora	Moctezuma	1		black on brown paste	interior	brown paste
Son L:2:1	1	2.9	3	1	Chihuahua	Other Chihuahua		chalky white	black on chalky white slip	exterior	orange with grey core
Son L:2:1	1	2.3	3	3	Sonora	Other Local			black on orange paste	-	orange paste
Son L:2:1	1	2.8	2	4	Sonora	Serrana	Br/br		brown on brown paste	exterior	orange and brown paste
Son L:2:1	4	4	0	1	Sonora	Serrana	1		black and red on brown paste	exterior	brown paste
Son L:2:1	7	2.1	1	1	Sonora	Serrana	P/br		purple on brown paste (fishnet)	exterior	orange with grey core
Son L:2:1	9	2.8	3	1	Unique		R/buff		red on buff paste	exterior	brown with grey core
Son L:2:1	11	2.1	2	2	Sonora	Other Local	R/br		red on brown paste	exterior	brown paste
Son L:2:1	11	3	3	6	Sonora	Other Local	R/br		red on brown paste	exterior	brown with grey core
Son L:2:1	11	3.2	3	1	Sonora	Serrana	P/br		purple on brown paste	exterior	brown paste with black core
Son L:2:1	11	1.9	1	5	Sonora	Serrana	P/br		purple on brown paste	exterior	orange paste
Son L:2:1	11	2.8	4	4	Sonora	Volanta	1		black and red on grey paste	exterior	orange paste
Son L:2:1	19	2.3	2	4	Chihuahua	Santa Ana	3		black and red on brown paste	exterior	brown with grey core
Son L:2:1	19	2.1	2	7	Chihuahua	Other Chihuahua		chalky white	white slip	interior	orange paste
Son L:2:1	19	1.8	1	1	Sonora	Other Local	R/cream		red on white paste	exterior	brown paste
Son L:2:1	19	3.4	5	2	Sonora	Other Local	R/cream		red paint? on white paste	exterior	white paste
Son L:2:1	19	1.8	1	3	Sonora	Other Local	R/cream		red on white paste	exterior	white paste
Son L:2:1	19	2.5	2	5	Sonora	Other Local	R/cream		red on white paste	exterior	white paste

Son L:2:1	24	2	0	2	Chihuahua	Santa Ana	3		black and red on buff paste	exterior	brown with black core
Son L:2:1	24	2	1	1	Sonora	Other Local	R/cream		red on white paste	exterior	brown paste
Son L:2:1	27	3	3	1	Chihuahua	Santa Ana	2		black and red on brown paste	exterior	brown paste
Son L:2:1	29	2.1	2	1	Chihuahua	Santa Ana			black and red on brown paste	exterior	brown paste with grey core
Son L:2:1	33	2.6	3	4	Sonora	Moctezuma	2		black on brown paste	exterior	brown paste
Son L:2:1	33	2.2	2	6	Sonora	Serrana	P/or		purple on orange paste	exterior	orange with brown core
Son L:2:1	33	2.8	4	3	Sonora	Serrana	R/br		red on brown paste	exterior	brown paste
Son L:2:1	33	3.4	7	2	Sonora	Serrana	R/br		red on brown paste	interior	orange with brown core
Son L:2:1	33	2.2	1	5	Unique		R/buff		red on buff slip	interior/exterior	light grey paste
Son L:2:1	36	3	3	3	Chihuahua	Santa Ana	1		black and red on buff paste	exterior	buff paste with grey core
Son L:2:1	36	2.1	1	5	Chihuahua	Santa Ana	1		black and red on buff paste	exterior	brown paste
Son L:2:1	36	3.4	5	7	Chihuahua	Santa Ana	1		black and red on buff paste	exterior	buff paste with grey core
Son L:2:1	36	2.8	3	9	Chihuahua	Santa Ana	1		black and red on buff paste	exterior	buff paste with grey core
Son L:2:1	36	2.1	1	4	Chihuahua	Santa Ana	2		black and red on buff paste	exterior	buff paste with grey core
Son L:2:1	40	2.7	6	1	Sonora	Volanta	1		red on white slip	exterior	orange paste
Son L:2:1	57	2.6	3	1	Sonora	Other Local	R/cream		red on cream paste	interior	light grey paste
Son L:2:1	93	2.7	3	1	Sonora	Serrana	P/br		purple on brown paste	exterior	orange paste
Son L:2:1	100	3.6	8	1	Chihuahua	Other Chihuahua		chalky white	white chalky slip	exterior	orange paste
Son L:2:1	103	2.2	2	1	Sonora	Serrana	sP/br		specular purple on orange paste	interior	orange and brown paste
Son L:2:1	161	4.2	8	1	Sonora	Volanta	1		red on grey slip	exterior	brown paste
Son L:2:1	161	3	6	2	Sonora	Volanta	1		red on grey slip	exterior	brown paste
Son L:2:1	161	7.7	42	3	Sonora	Volanta	1		red and black on white slip	exterior	brown paste
Son L:2:1	161	7.1	37	4	Sonora	Volanta	1		red and black on white slip	exterior	brown paste
Son L:2:1	161	7.4	40	5	Sonora	Volanta	1		red and black on white slip	exterior	brown paste
Son L:2:1	161	6.3	32	6	Sonora	Volanta	1		black on white slip	exterior	brown paste

Son L:2:1	161	5	15	7	Sonora	Volanta	1		black on white slip	exterior	brown paste
Son L:2:1	161	4.4	14	8	Sonora	Volanta	1		black on white slip	exterior	brown paste
Son L:2:1	161	6.5	22	9	Sonora	Volanta	1		black on white slip	exterior	brown paste
Son L:2:1	161	6.1	23	10	Sonora	Volanta	1		black on brown paste	exterior	brown paste
Son L:2:1	161	5.4	16	11	Sonora	Volanta	1		black on brown paste	exterior	brown paste
Son L:2:1	161	4.9	14	12	Sonora	Volanta	1		red and black on white slip	exterior	brown paste
Son L:2:1	165	7.8	0	1	Sonora	Volanta	1		red and black on chalky white	exterior	brown
Son L:2:1	179	4	0	1	Chihuahua	Santa Ana	1		black and red on tan paste	exterior	light brown paste
Son L:2:1	201	2	2	1	Chihuahua	Other Chihuahua		chalky white	black on white chalky slip	interior	brown paste
Son L:2:1	301	5.3	8	1	Chihuahua	Jecori	1	grey	black and red on grey paste / grey slip	exterior	interior
Son L:2:1	313	3.6	9	1	Sonora	Serrana	P/br		purple on brown paste	exterior	brown and orange paste
Son L:2:1	325	3.7	9	2	Chihuahua	Santa Ana	1		black and red on orange paste	exterior	orange paste
Son L:2:1	325	2.5	0	1	unknown				cream slip	exterior	orange paste
Son L:2:22	205	5.6	0	1	Sonora	Serrana	1		purple and red on brown	exterior	red-brown
Son L:2:22	400	6.6	29	1	Sonora	Moctezuma	1		black on brown paste	interior/exterior	brown with dark grey core
Son L:2:22	400	4.1	10	2	Sonora	Moctezuma	1		black on brown paste	interior/exterior	brown with dark grey core
Son L:2:22	411	2.8	3	1	unknown				orange on buff paste	interior	buff paste
Son L:2:22	446	7.3	0	1	Sonora	Moctezuma	1		black on brown paste	exterior	brown paste
Son L:2:22	500	2.7	3	1	Sonora	Serrana	sP/br		specular black on smudge	interior	smudge over brown
Son L:2:22	505	5.1	18	1	Sonora	Other Local	R/br		red on brown paste	exterior	brown paste
Son L:2:22	506	5.8	32	1	Sonora	Volanta	1		red on brown paste	interior	brown with grey core
Son L:2:22	609	4.1	0	1	Sonora	Moctezuma	2		fugitive black on brown paste	exterior	brown paste
Son L:2:22	?	2	1	1	unknown				buff slip	exterior	dark grey paste
Son L:2:22	?	2.8	3	2	unknown				buff slip	exterior	dark grey paste

Sub-appendix G
Microprobe Data

								Weight%								
ID	Na	Al	Si	K	S	Fe	Mg	Pb	Ti	Ca	P	Zn	Cu	Mn	O	Total
838-3xt-1-1	0.13	3.54	15.33	0.49	0.10	2.67	0.27	25.88	0.53	0.87	0.05	1.87	3.38	10.93	29.11	95.15
838-ext-1-2	0.09	3.92	18.55	0.62	0.14	0.34	0.16	37.43	0.28	1.24	0.06	0.50	1.11	3.49	30.27	98.21
838-ext-1-3	0.25	3.00	19.06	0.63	0.13	0.94	0.18	29.82	0.32	1.17	0.10	0.59	1.66	5.11	30.34	93.28
838-ext-1-4	0.15	3.59	12.43	0.32	0.04	2.64	0.35	23.77	0.62	0.68	0.04	2.33	5.80	18.37	28.47	99.60
838-ext-1-5	0.09	3.86	17.56	0.56	0.07	0.42	0.20	38.98	0.24	1.10	0.05	0.44	1.32	3.44	29.06	97.39
838-ext-2-1	0.09	4.17	16.74	0.73	0.03	0.69	0.31	33.46	0.56	0.98	0.11	0.60	2.14	6.49	29.48	96.57
838-ext-2-2	0.08	3.58	18.18	0.72	0.05	1.24	0.29	31.58	0.50	0.67	0.03	0.98	3.90	8.19	31.40	101.40
838-ext-2-3	0.13	5.57	12.04	0.34	0.04	2.68	0.46	25.93	0.74	0.79	0.08	2.64	4.82	12.91	28.46	97.64
821-int-1-2	0.08	1.75	8.89	0.38	0.09	0.50	0.14	52.76	0.13	0.67	0.06	0.14	0.80	5.95	18.64	90.99
821-int-1-3	0.13	3.47	11.71	0.36	0.07	0.49	0.31	52.40	0.13	0.76	0.07	0.15	0.99	5.48	23.41	99.94
821-int-1-4	0.10	3.37	11.70	0.38	0.09	0.43	0.30	51.65	0.12	0.93	0.11	0.13	0.89	5.79	23.42	99.41
821-int-1-5	0.03	1.07	1.93	0.14	0.02	0.77	0.11	35.34	0.30	0.54	0.02	0.07	0.30	10.31	9.78	60.71
821-int-2-1	0.08	3.29	10.52	0.36	0.33	0.31	0.29	54.33	0.10	0.38	0.03	0.08	0.71	6.76	22.41	99.98
821-int-2-2	0.09	3.21	10.58	0.38	0.11	0.36	0.30	52.50	0.11	0.42	0.04	0.13	0.86	7.55	22.27	98.90
815-ext-4-1	0.09	2.81	10.64	0.47	0.34	0.51	0.60	58.94	0.12	0.84	0.12	0.36	0.61	2.18	21.80	100.43
815-int-1-1	0.08	9.83	16.63	2.16	0.28	0.82	0.34	34.68	0.15	0.85	0.02	0.12	0.20	0.60	32.44	99.20
815-int-1-2	0.08	9.80	15.59	2.07	0.24	0.89	0.30	37.25	0.17	0.73	0.02	0.14	0.14	0.67	31.32	99.42
815-int-3-1	0.10	7.81	17.45	2.51	0.05	0.75	0.31	34.50	0.10	0.95	0.01	0.15	0.38	1.03	31.42	97.50
815-int-2-1	0.18	2.74	11.15	0.47	0.32	0.54	0.59	55.95	0.10	0.97	0.02	0.35	1.15	3.23	22.44	100.20
815-int-2-2	0.11	2.46	12.41	0.51	0.32	0.47	0.59	54.34	0.14	0.91	0.03	0.41	0.86	3.14	23.39	100.08

930-ext-1-2	0.12	5.32	16.03	0.68	0.03	1.34	0.52	29.04	0.20	0.72	0.04	0.19	3.11	9.08	30.13	96.53
930-ext-1-3	0.06	4.97	17.46	0.57	0.09	0.24	0.50	34.89	0.12	0.81	0.04	0.10	1.38	4.87	29.93	96.03
930-ext-2-1	0.11	4.47	16.62	0.40	0.04	0.43	0.52	39.34	0.25	1.11	0.05	0.09	2.25	4.34	29.11	99.12
930-ext-2-2	0.23	5.87	17.26	1.30	0.04	0.60	0.32	31.46	0.20	0.94	0.04	0.16	2.32	6.82	31.28	98.84
930-ext-3-1	0.15	4.42	29.66	0.83	0.04	0.21	0.26	10.08	0.27	0.88	0.05	0.07	0.05	0.01	39.66	86.65
800-ext-1-1	0.45	11.14	18.04	3.74	0.00	1.17	0.15	28.21	0.10	0.34	0.02	0.46	0.26	0.32	34.51	98.93
800-ext-1-2	0.10	3.02	15.25	0.28	0.00	1.13	0.35	49.22	0.49	0.51	0.04	0.61	1.69	0.67	25.87	99.23
800-ext-1-3	0.12	3.15	15.48	0.38	0.04	0.63	0.32	47.75	0.53	0.65	0.18	1.05	0.74	1.80	26.50	99.32
205-slip	1.25	14.19	20.04	9.42	0.36	2.55	0.69	0.01	0.13	2.95	0.23	0.02	0.00	0.11	41.13	93.08
813-1-1	0.15	2.79	9.55	0.58	0.22	1.23	0.26	57.20	0.19	1.47	0.05	0.20	0.05	3.87	20.77	98.58
813-1-2	0.18	2.88	10.68	0.54	0.09	1.41	0.34	55.44	0.23	1.89	0.09	0.27	0.08	2.87	21.90	98.88
813-2-1	0.26	7.43	14.46	2.50	0.91	1.01	0.16	37.36	0.47	1.29	0.11	0.22	0.12	1.50	29.81	97.60
813-2-2	0.30	7.70	13.90	3.07	0.37	0.77	0.09	32.70	0.23	2.71	1.79	0.05	0.01	0.65	30.53	94.86
813-2-3	0.16	1.79	9.15	0.15	0.87	1.20	0.35	57.33	0.58	0.13	0.09	0.33	0.45	2.42	19.87	94.88
813-3-1	0.33	9.37	18.31	2.91	0.09	0.91	0.23	30.80	0.19	0.34	0.03	0.13	0.07	0.31	33.27	97.29
813-3-2	0.38	9.64	17.69	3.03	0.04	0.69	0.19	31.76	0.08	0.22	0.04	0.15	0.03	0.21	32.61	96.76
938-1-1	0.19	1.62	14.01	0.17	0.87	0.72	0.21	45.79	0.05	0.08	0.02	2.28	4.63	3.43	25.50	99.57
938-1-2	0.24	2.40	14.62	0.24	0.58	0.58	0.23	46.19	0.12	0.07	0.02	2.00	3.25	2.66	25.89	99.09
938-1-3	0.22	2.47	14.85	0.37	0.54	0.57	0.17	45.35	0.11	0.13	0.02	1.58	3.44	2.77	26.08	98.68
938-1-4	0.26	2.69	10.12	0.49	1.22	1.12	0.64	45.24	0.14	0.14	0.03	2.71	6.30	3.38	23.61	98.11
913-1-1	0.22	8.90	18.61	4.27	0.06	0.59	0.34	30.84	0.05	0.37	0.06	0.09	0.31	0.49	33.43	98.63
913-1-2	0.11	8.70	15.95	3.10	0.09	0.33	0.17	37.55	0.07	0.36	0.04	0.09	0.41	0.90	30.46	98.33
913-1-3	0.07	0.32	0.98	0.25	0.14	0.13	0.05	48.84	0.02	11.02	8.35	0.08	0.18	0.10	20.83	91.36
913-1-4	0.18	8.69	16.04	2.85	0.42	0.60	0.29	30.92	0.08	0.76	0.02	0.11	0.41	1.28	30.92	93.57
913-2-1	0.07	2.61	12.56	0.31	0.27	0.25	0.28	55.08	0.08	0.49	0.02	0.06	1.31	2.19	22.89	98.48
913-2-2	0.06	2.93	8.06	0.19	0.28	1.00	0.61	40.26	0.11	0.22	0.04	0.15	5.11	15.44	22.09	96.53
913-3-1	0.27	8.76	15.81	2.41	0.08	0.56	0.22	37.00	0.03	0.25	0.02	0.00	0.36	0.56	30.07	96.39

ID	Na2O	Al2O3	SiO2	K2O	SO3	FeO	MgO	Oxide PbO	TiO2	CaO	P2O5	ZnO	CuO	MnO	Total
838-3xt-1-1	0.18	6.69	32.80	0.59	0.24	3.44	0.45	27.88	0.89	1.22	0.10	2.33	4.23	14.11	95.15
838-ext-1-2	0.12	7.41	39.69	0.75	0.35	0.44	0.27	40.32	0.47	1.73	0.14	0.62	1.38	4.51	98.21
838-ext-1-3	0.34	5.67	40.77	0.76	0.32	1.21	0.29	32.12	0.53	1.63	0.22	0.73	2.08	6.59	93.28
838-ext-1-4	0.20	6.78	26.58	0.39	0.10	3.40	0.58	25.61	1.04	0.95	0.10	2.90	7.25	23.71	99.60
838-ext-1-5	0.12	7.29	37.56	0.67	0.17	0.54	0.34	41.99	0.40	1.54	0.12	0.54	1.65	4.45	97.39
838-ext-2-1	0.13	7.89	35.81	0.88	0.09	0.88	0.52	36.05	0.93	1.37	0.24	0.74	2.67	8.38	96.57
838-ext-2-2	0.11	6.77	38.90	0.86	0.14	1.60	0.47	34.02	0.84	0.94	0.08	1.22	4.89	10.57	101.40
838-ext-2-3	0.18	10.53	25.76	0.41	0.09	3.44	0.77	27.94	1.24	1.10	0.19	3.28	6.03	16.67	97.64
821-int-1-2	0.11	3.31	19.02	0.46	0.21	0.64	0.23	56.83	0.21	0.93	0.15	0.18	1.00	7.69	90.99
821-int-1-3	0.17	6.56	25.06	0.43	0.18	0.63	0.52	56.45	0.21	1.06	0.16	0.19	1.24	7.08	99.94
821-int-1-4	0.14	6.38	25.03	0.46	0.22	0.55	0.50	55.63	0.20	1.30	0.25	0.17	1.11	7.48	99.41
821-int-1-5	0.04	2.02	4.12	0.16	0.06	0.99	0.18	38.06	0.50	0.76	0.05	0.08	0.37	13.31	60.71
821-int-2-1	0.10	6.22	22.50	0.43	0.83	0.39	0.49	58.52	0.18	0.53	0.06	0.10	0.89	8.72	99.98
821-int-2-2	0.12	6.06	22.64	0.45	0.28	0.46	0.50	56.56	0.18	0.59	0.08	0.16	1.08	9.74	98.90
815-ext-4-1	0.12	5.31	22.77	0.56	0.84	0.65	0.99	63.49	0.21	1.17	0.27	0.45	0.76	2.82	100.43
815-int-1-1	0.11	18.58	35.58	2.61	0.69	1.06	0.56	37.36	0.25	1.19	0.05	0.15	0.25	0.78	99.20
815-int-1-2	0.11	18.52	33.36	2.49	0.59	1.15	0.50	40.13	0.29	1.02	0.05	0.18	0.17	0.86	99.42
815-int-3-1	0.14	14.76	37.33	3.02	0.12	0.96	0.51	37.16	0.16	1.33	0.02	0.19	0.48	1.33	97.50
815-int-2-1	0.24	5.18	23.85	0.57	0.80	0.69	0.98	60.27	0.16	1.36	0.06	0.44	1.44	4.17	100.20
815-int-2-2	0.15	4.65	26.55	0.61	0.79	0.61	0.97	58.54	0.23	1.27	0.07	0.51	1.07	4.06	100.08

930-ext-1-2	0.16	10.06	34.29	0.82	0.07	1.72	0.86	31.28	0.33	1.01	0.09	0.23	3.89	11.72	96.53
930-ext-1-3	0.08	9.39	37.35	0.69	0.24	0.31	0.82	37.59	0.21	1.14	0.10	0.13	1.73	6.28	96.03
930-ext-2-1	0.15	8.44	35.56	0.48	0.09	0.55	0.86	42.38	0.41	1.55	0.11	0.12	2.82	5.61	99.12
930-ext-2-2	0.31	11.09	36.93	1.57	0.10	0.77	0.54	33.89	0.33	1.32	0.09	0.20	2.90	8.80	98.84
930-ext-3-1	0.20	8.34	63.46	0.99	0.11	0.27	0.44	10.85	0.45	1.23	0.12	0.09	0.06	0.02	86.65
800-ext-1-1	0.61	21.06	38.60	4.50	0.01	1.51	0.25	30.39	0.17	0.47	0.05	0.57	0.33	0.41	98.93
800-ext-1-2	0.14	5.71	32.62	0.34	0.01	1.46	0.57	53.02	0.82	0.72	0.09	0.76	2.11	0.86	99.23
800-ext-1-3	0.17	5.95	33.11	0.46	0.10	0.81	0.54	51.44	0.88	0.91	0.40	1.31	0.93	2.32	99.32
205-slip	1.69	26.82	42.87	11.35	0.90	3.28	1.14	0.01	0.22	4.12	0.52	0.03	0.00	0.14	93.08
813-1-1	0.20	5.28	20.43	0.70	0.55	1.59	0.44	61.61	0.31	2.05	0.11	0.25	0.06	4.99	98.58
813-1-2	0.25	5.45	22.85	0.65	0.24	1.82	0.56	59.72	0.38	2.64	0.21	0.33	0.10	3.71	98.88
813-2-1	0.35	14.03	30.94	3.02	2.27	1.30	0.26	40.24	0.78	1.81	0.25	0.27	0.15	1.93	97.60
813-2-2	0.40	14.55	29.73	3.70	0.91	0.99	0.15	35.22	0.39	3.80	4.11	0.06	0.02	0.83	94.86
813-2-3	0.22	3.39	19.58	0.18	2.16	1.54	0.58	61.76	0.97	0.19	0.20	0.41	0.56	3.12	94.88
813-3-1	0.44	17.71	39.16	3.50	0.23	1.17	0.38	33.18	0.32	0.47	0.06	0.16	0.09	0.40	97.29
813-3-2	0.51	18.21	37.84	3.65	0.11	0.88	0.32	34.22	0.14	0.31	0.09	0.18	0.04	0.27	96.76
938-1-1	0.26	3.06	29.97	0.21	2.16	0.93	0.35	49.32	0.09	0.11	0.05	2.84	5.79	4.44	99.57
938-1-2	0.33	4.54	31.29	0.29	1.45	0.75	0.38	49.76	0.19	0.09	0.04	2.48	4.07	3.43	99.09
938-1-3	0.30	4.67	31.78	0.45	1.35	0.74	0.29	48.85	0.18	0.18	0.05	1.97	4.31	3.58	98.68
938-1-4	0.36	5.08	21.65	0.59	3.05	1.44	1.07	48.73	0.24	0.20	0.07	3.38	7.89	4.36	98.11
913-1-1	0.30	16.81	39.80	5.14	0.16	0.76	0.57	33.22	0.08	0.52	0.13	0.11	0.39	0.64	98.63
913-1-2	0.15	16.43	34.13	3.74	0.22	0.42	0.28	40.45	0.11	0.50	0.10	0.11	0.52	1.16	98.33
913-1-3	0.10	0.60	2.11	0.30	0.35	0.17	0.08	52.61	0.04	15.42	19.14	0.10	0.22	0.13	91.36
913-1-4	0.24	16.43	34.32	3.43	1.04	0.77	0.49	33.31	0.13	1.06	0.04	0.14	0.52	1.65	93.57
913-2-1	0.10	4.93	26.87	0.37	0.67	0.32	0.46	59.34	0.13	0.68	0.06	0.08	1.64	2.83	98.48
913-2-2	0.08	5.53	17.24	0.22	0.69	1.29	1.00	43.37	0.19	0.31	0.10	0.19	6.40	19.93	96.53
913-3-1	0.36	16.56	33.82	2.90	0.19	0.72	0.36	39.86	0.05	0.35	0.04	0.00	0.45	0.72	96.39

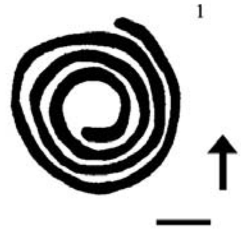
Sub-appendix H
Lithic Projectile Point Data

Site	FN	Material	Color	Opacity	Basic Forming	Edge Shaping	Base Shape	Base Forming	Base Width/ Max Width	Length	Broken (missing)	Base Notch Depth	Side / Corner Notch Depth (one side)	Thickness	edge shape	Notes
Son L:1:23	02:08	obsidian	black	translucent	bifacial	bifacial	base notch	bifacial	0.9	1.3	complete			0.2	straight	
Son L:1:23	02:15	obsidian	black	translucent	unifacial	bifacial edges	unknown	unknown	1.3	1.6	tip only			0.4	straight	
Son L:1:23	03:19	chert	pink	translucent	unifacial	bifacial edges	triangular	bifacial	1.1	1.8	complete			0.2	straight	
Son L:1:23	04:09	chert	pink	opaque	unifacial	bifacial edges	triangular	bifacial	1.2	1.2	tip			0.3	straight	
Son L:1:23	05:14	chert	red	opaque	unifacial	bifacial edges	triangular	bifacial	1.2	1.5	complete			0.3	straight	
Son L:1:23	13:20	chert	brown	opaque	bifacial	bifacial	stem	bifacial	2.3	4.8	complete		0.4	0.9	straight	
Son L:1:23	31:04	chert	red	translucent	unifacial	unknown	stem	unifacial	0.9	1.5	lateral break		0.3	0.3	concave	eccentric, point?
Son L:1:23	716	chert	tan	translucent	bifacial	bifacial	triangular	bifacial	1.4	2	complete			0.4	eccentric	
Son L:1:23	734	obsidian	black	translucent	unifacial	unifacial	base notch	bifacial	0.9	1.3	complete	0.2		0.2	straight	
Son L:1:23	912	chert	white	opaque	unifacial	right edge bifacial	triangular	unifacial	1.3	2.1	base corner			0.4	straight	
Son L:1:23	912	obsidian	black	translucent	unifacial	unifacial	unknown	unknown	1.4	1.4	tip only			0.2	straight	
Son L:1:23	925	obsidian	black	translucent	unifacial	right edge bifacial	base notch	bifacial	1.1	1.5	complete	0.2		0.2	straight	
Son L:1:23	1105	chert	white	translucent	bifacial	bifacial	triangular	unifacial	1.3	2	complete			0.4	straight	
Son L:1:23	1105	obsidian	black	translucent	bifacial	bifacial edges	triangular	bifacial	0.9	1.5	complete			0.2	straight	
Son L:1:23	1105	volcanic	purple	opaque	unifacial	left edge bifacial	concave	unifacial	1.3	1.9	complete	0.1		0.3	straight	

Son L:1:23	1105	chert	pink	translucent	unifacial	unifacial	convex	unifacial	1.2	2.7	complete			0.6	straight	abandon in production
Son L:1:23	1210	chert	pink/white	opaque	unifacial	unifacial	convex	unifacial	1.2	2.5	complete			0.4	straight	
Son L:1:23	1211	chert	light pink	translucent	bifacial	bifacial	base notch	bifacial	1.4	2	base corner	0.3		0.4	straight	
Son L:1:23	1212	chert	pink	opaque	unifacial	bifacial edges	concave	bifacial	1.2	2.1	complete	0.1		0.2	straight	
Son L:1:23	1216	chert	pink	translucent	unifacial	bifacial edges	eared	bifacial	1.7	2.1	tip and left ear	0.2		0.6	concave	eccentric, crude, maybe not a point
Son L:1:23	1216	obsidian	black	translucent	unifacial	right edge bifacial	concave	bifacial	1	0.9	base only	0.1		0.2	straight	
Son L:1:23	1220	chert	orange	translucent	unifacial	left edge bifacial	triangular	unifacial	1.4	1.2	tip			0.4	straight	
Son L:1:23	1228	chalcedony	white	translucent	unifacial	right edge bifacial	concave	bifacial	1.1	2.2	complete	0.2		0.4	straight	
Son L:1:23	I0033	chert	white	opaque	bifacial	bifacial	unknown	unknown	1.5	1.7	tip only			0.4	straight	
Son L:1:23	I0042	chert	red	opaque	bifacial	bifacial	concave	bifacial	1.1	1.7	complete			0.3	straight	
Son L:2:1	09:20	chert	white	opaque	bifacial	bifacial	corner notched	bifacial	1.6	1.8	ear	0.1	0.4	0.6	straight	Los Mineros
Son L:2:1	46	chert	brown	translucent	bifacial	bifacial	stem	unifacial	1.3	1.8	complete		0.4	0.3	straight	Los Mineros
Son L:2:1	106	chert	mottled red	opaque	bifacial	bifacial	convex	bifacial	1	1.8	complete			0.4	serrated	
Son L:2:1	116	chert	red/white patina	opaque	bifacial	bifacial	side notched	bifacial	1.4	2.6	base tip	0.1	0.15	0.4	straight	
Son L:2:1	147	obsidian	black	translucent	bifacial	bifacial	stem	bifacial	0.7	1.5	complete		0.2	0.3	straight	
Son L:2:1	234	obsidian	black	translucent	bifacial	bifacial	corner notched	bifacial	0.8	1.4	complete		0.1	0.3	concave	
Son L:2:1	I0201	volcanic	red	opaque	bifacial	bifacial	unknown	unknown	2.8	5	base			0.6	straight	
Son	03:04	chert	pink	translucent	bifacial	bifacial	unknown	unknown	0.8	1.9	tip only			0.5	straight	

L:2:22															
Son L:2:22	535	chert	white	translucent	bifacial	bifacial	unknown	unknown	1.5	2.3	tip only		0.5	straight	
Son L:2:22	504	obsidian	black	translucent	bifacial	bifacial	stem	bifacial	1.9	2.5	ear	0.5	0.5	serrated	Los Mineros
Son L:2:22	654	chert	tan	translucent	unifacial	bifacial edges	triangular	unifacial	2.1	2.8	very end tip		0.5	straight	crude, maybe not a point
Son L:2:22	I0020	obsidian	black	translucent	unifacial	right edge bifacial	triangular	unifacial	1.2	1.8	complete		0.4	straight	abandon in production?
Son L:2:22	I0030	obsidian	black	opaque	bifacial	bifacial	leaf w/ ear	bifacial	1.7	2.1	ear		0.3	serrated	

Sub-appendix I
Petroglyphs

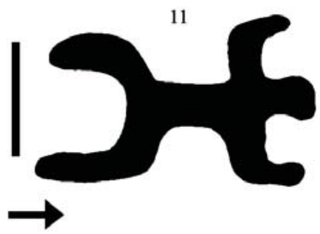


Son L:2:1 (1)

Son L:2:1 (3-8)

Son L:2:1 (2)

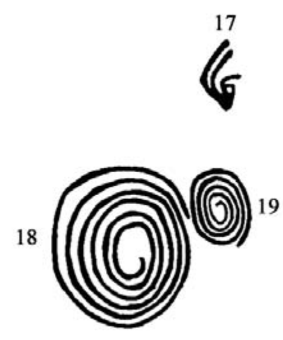
Son L:2:1 (9-10)



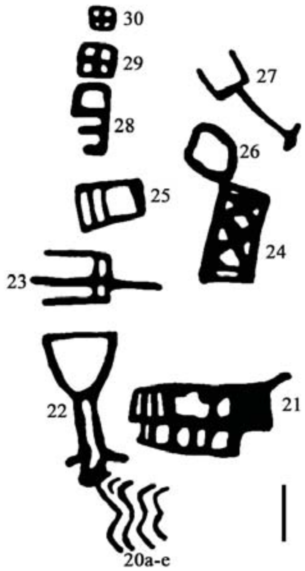
Son L:2:1 (11)

Son L:2:1 (14-16)

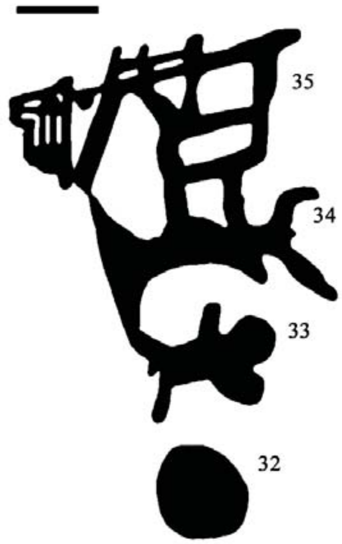
Son L:2:1 (12-13)



Son L:2:1 (17-19)

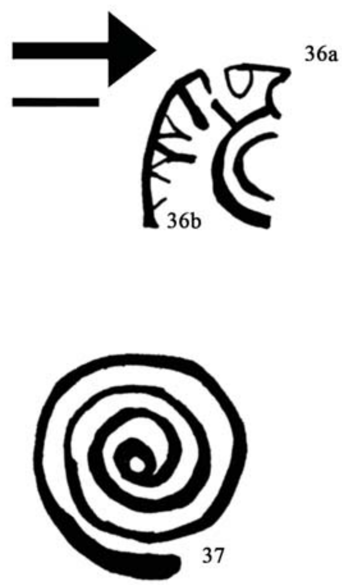


Son L:2:1 (20-30)

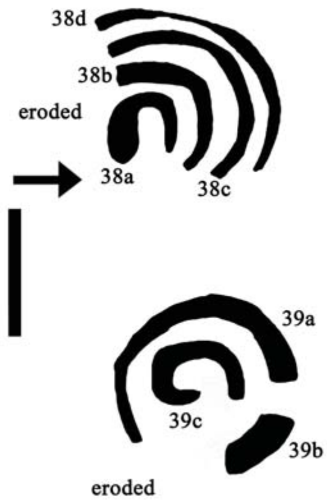


Son L:2:1 (32-35)

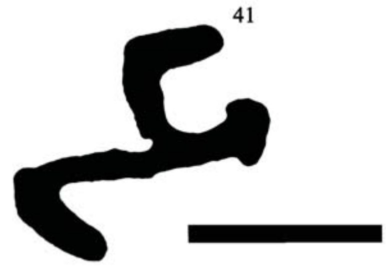
Son L:2:1 (31) angled aspect



Son L:2:1 (36-37)



Son L:2:1 (38-39)

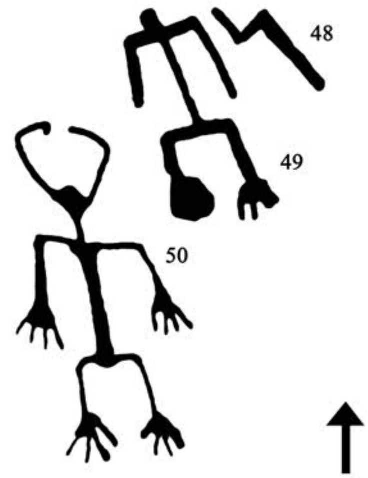


Son L:2:1 (41)

Son L:2:1 (40)

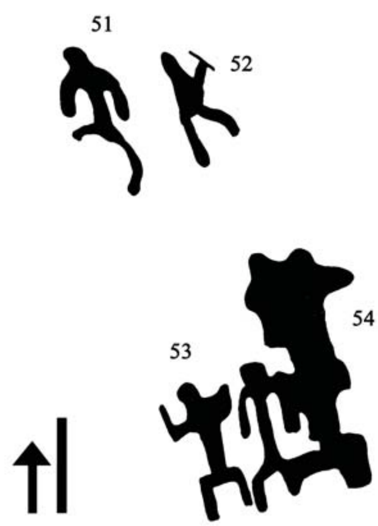
Son L:2:1 (42)

Son L:2:1 (43-44) angled aspect

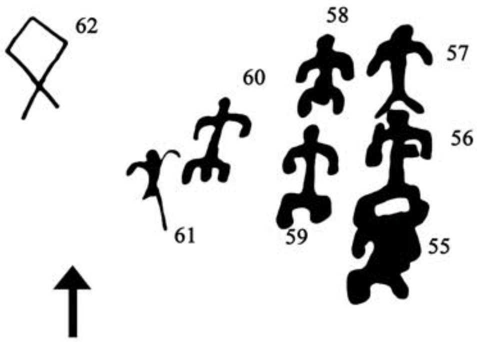


Son L:2:1 (48-50) angled aspect

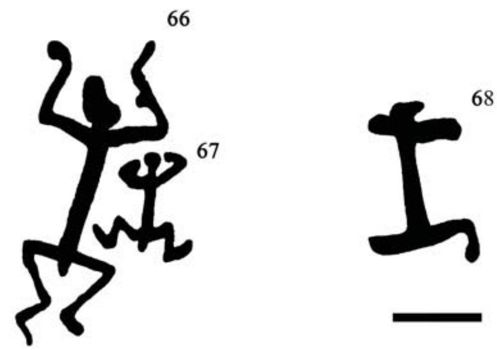
Son L:2:1 (45-47) angled aspect



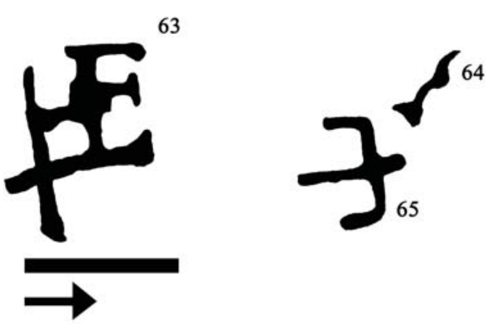
Son L:2:1 (51-54)



Son L:2:1 (55-62)

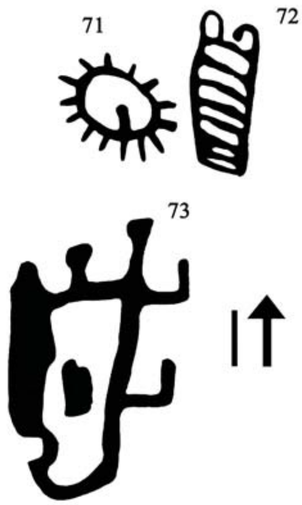


Son L:2:1 (66-68)

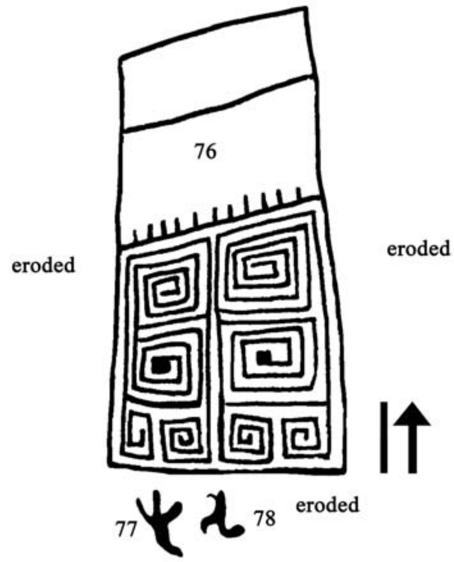


Son L:2:1 (63-65)

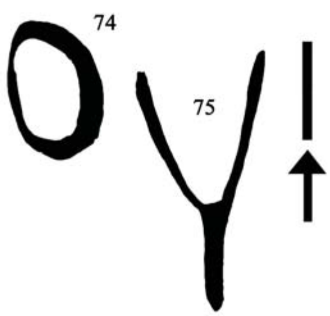
Son L:2:1 (69-70)



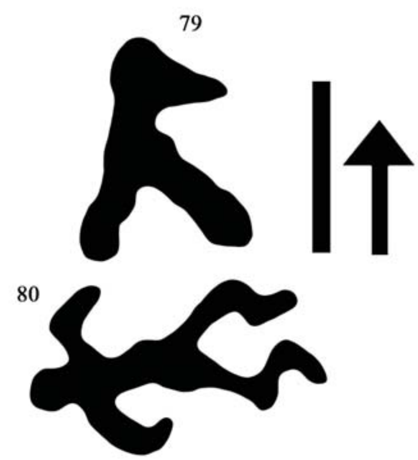
Son L:2:1 (71-73)



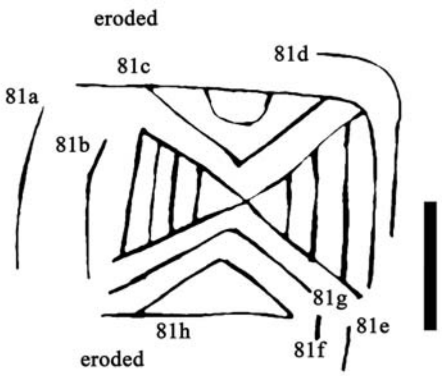
Son L:2:1 (76-78)



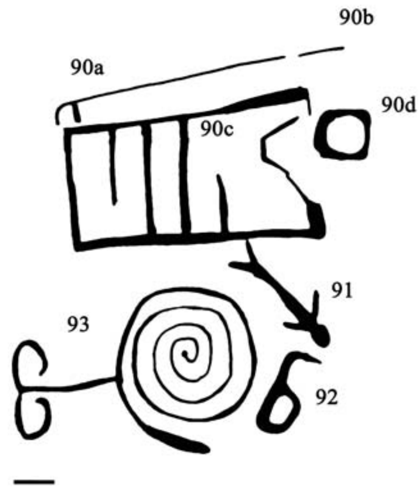
Son L:2:1 (74-75)



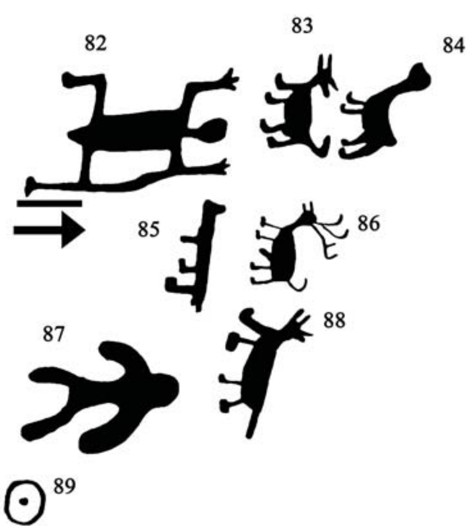
Son L:2:1 (79-80)



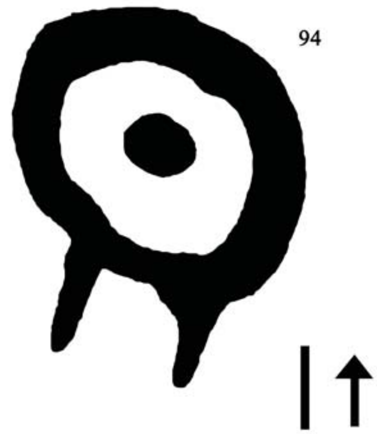
Son L:2:1 (81)



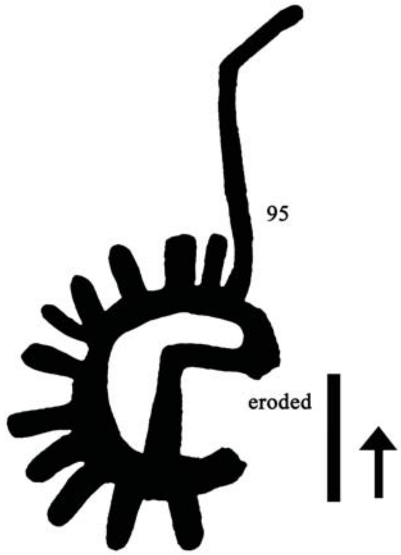
Son L:2:1 (90-93)



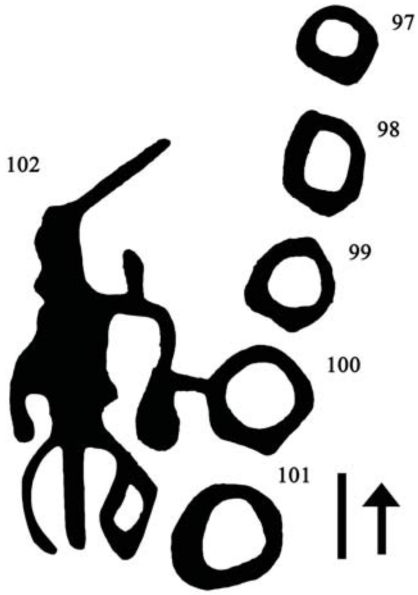
Son L:2:1 (82-89)



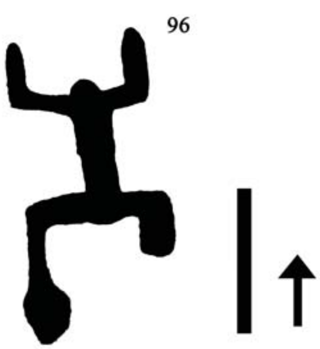
Son L:2:1 (94)



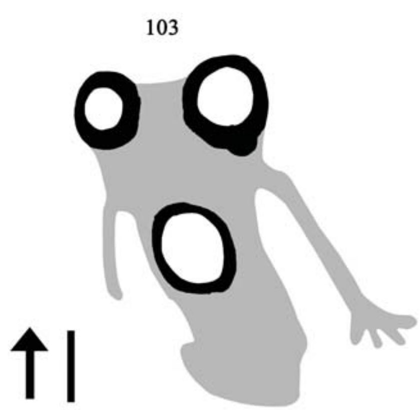
Son L:2:1 (95)



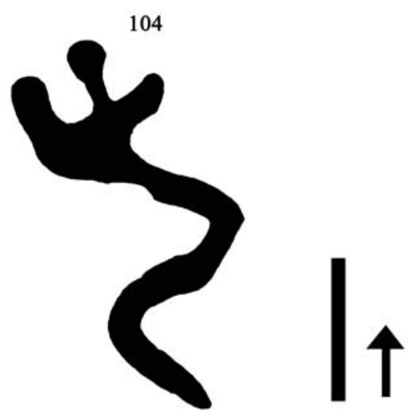
Son L:2:1 (97-102)



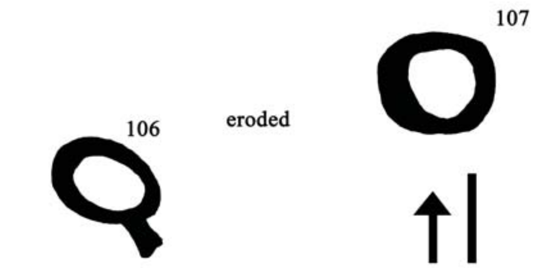
Son L:2:1 (96)



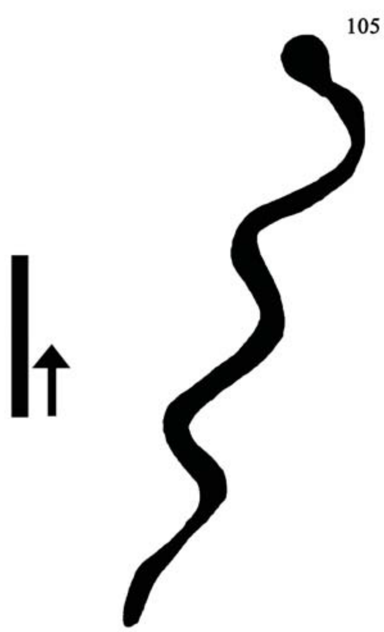
Son L:2:1 (103) grey area lightly pecked



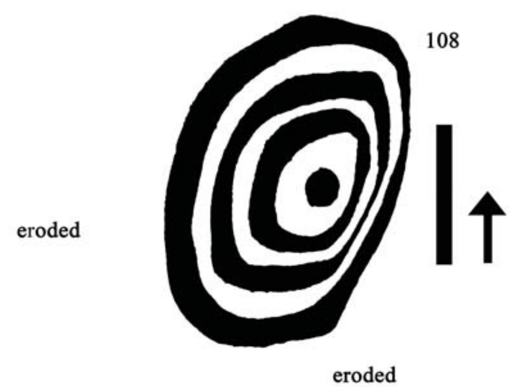
Son L:2:1 (104)



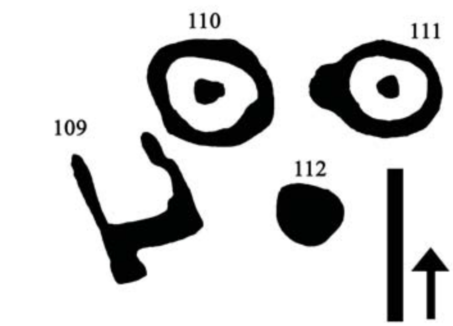
Son L:2:1 (106-107)



Son L:2:1 (105)

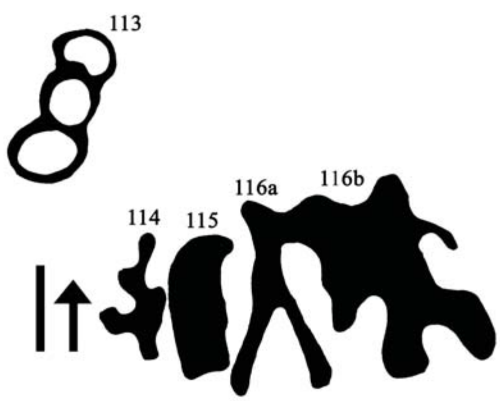


Son L:2:1 (108) executed on multi-angled surface

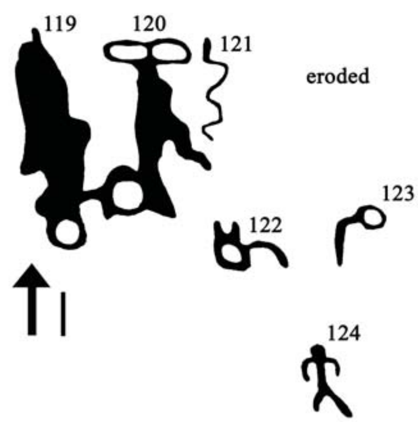


Son L:2:1 (109-112)

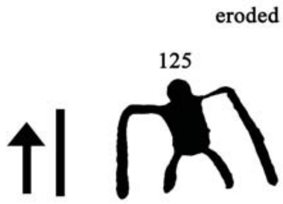
Son L:2:1 (117-118)



Son L:2:1 (113-116)



Son L:2:1 (119-124)



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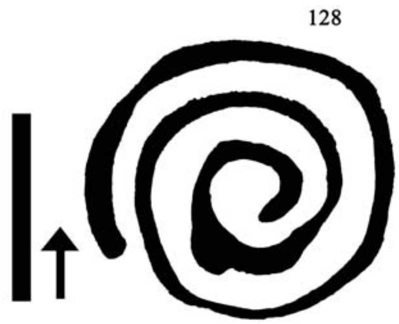
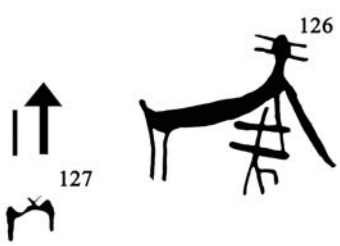
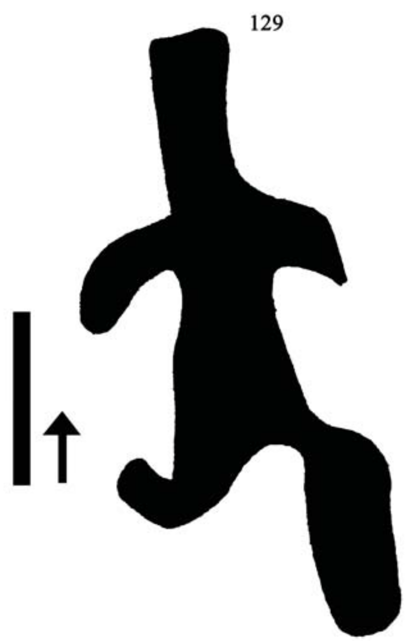


Son L:2:1 (128)



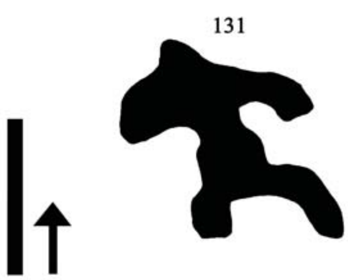
Son L:2:1 (126-127)



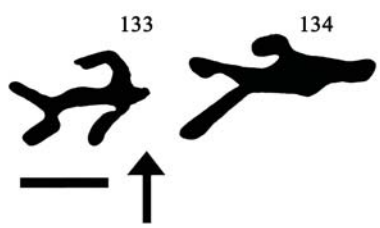
Son L:2:1 (129)

Son L:2:1 (130)

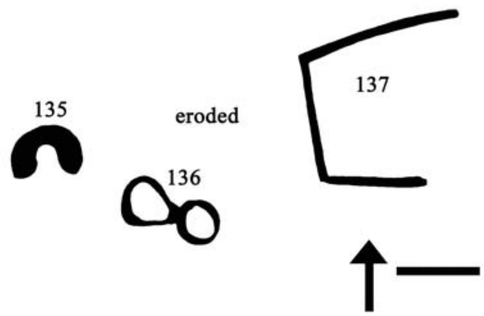
Son L:2:1 (132)



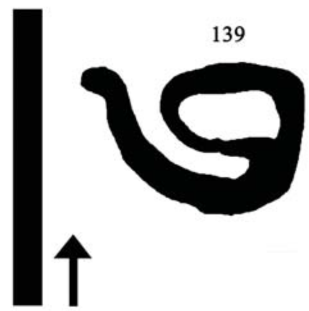
Son L:2:1 (131)



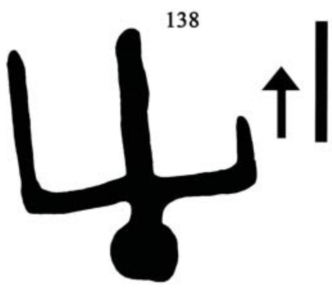
Son L:2:1 (133-134)



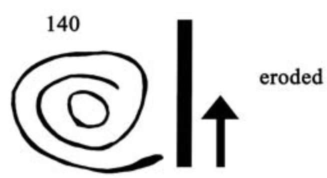
Son L:2:1 (135-137)



Son L:2:1 (139)

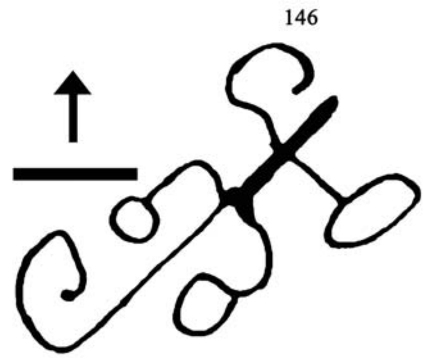


Son L:2:1 (138)

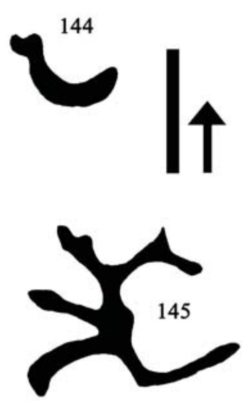


Son L:2:1 (140)

Son L:2:1 (141-143) angled aspect

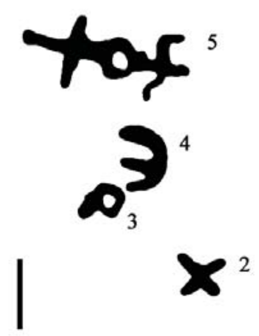


Son L:2:1 (146)

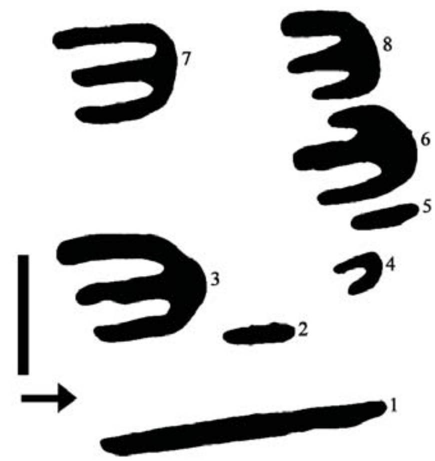


Son L:2:1 (144-145)

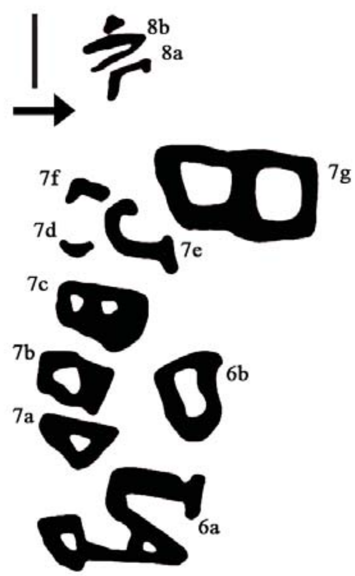
Son L:1:9 (1)



Son L:1:9 (2-5)

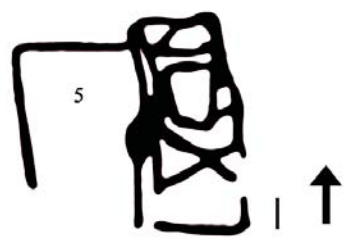


Son L:1:9 (9-15)

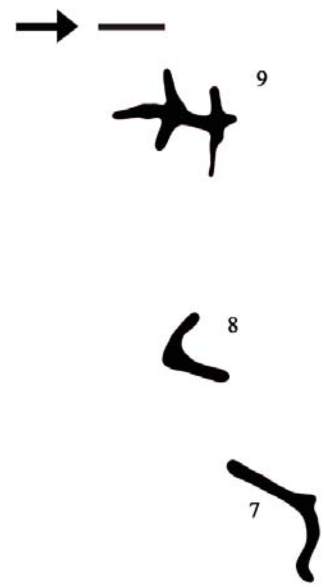


Son L:1:9 (6-8)

Son L:2:13 (1-4)

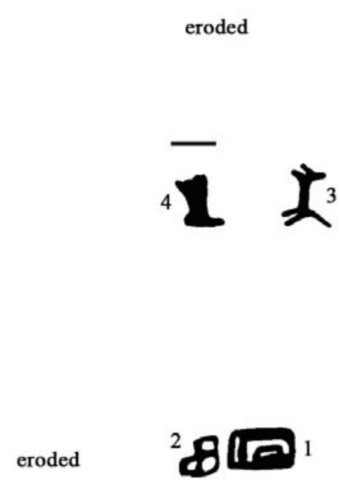


Son L:2:13 (5) angled aspect



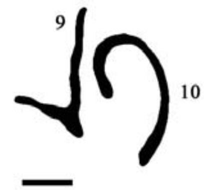
Son L:2:13 (7-9)

Son L:2:13 (6)

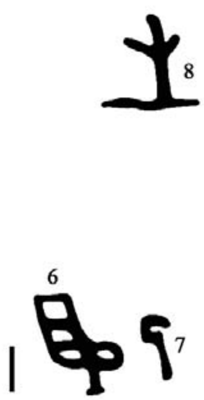


Son L:2:17 (1-4)

Son L:2:17 (5)

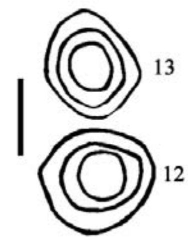


Son L:2:17 (9-10)



Son L:2:17 (6-8)

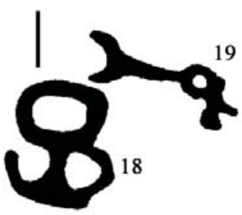
Son L:2:17 (11)



Son L:2:17 (12-13)

Son L:2:17 (17)

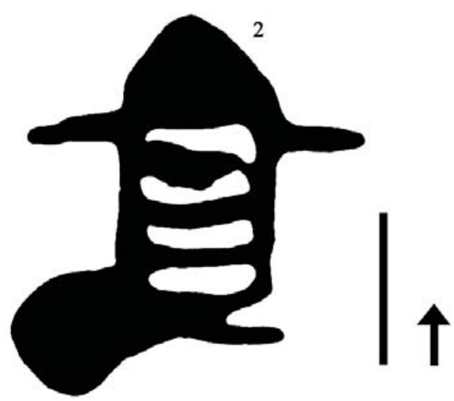
Son L:2:17 (14-16)



Son L:2:17 (18-19)

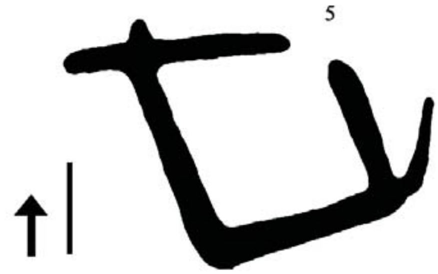
Son L:2:38 (1)

Son L:2:35 (1-8)



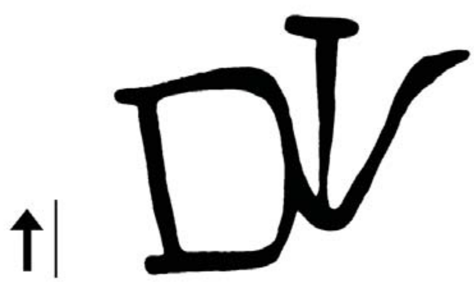
Son L:2:38 (2)

Son L:2:38 (3)



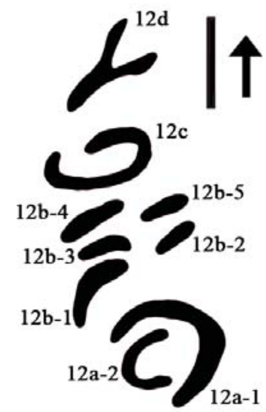
Son L:2:38 (5)

Son L:2:38 (4)

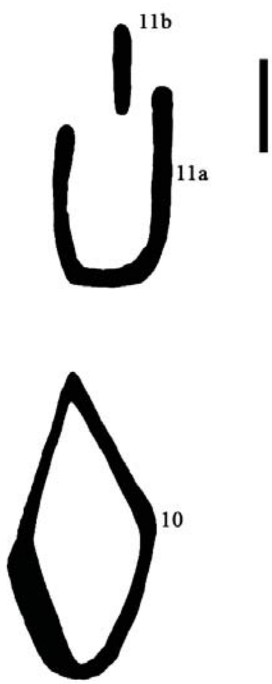


Son L:2:38 (6)

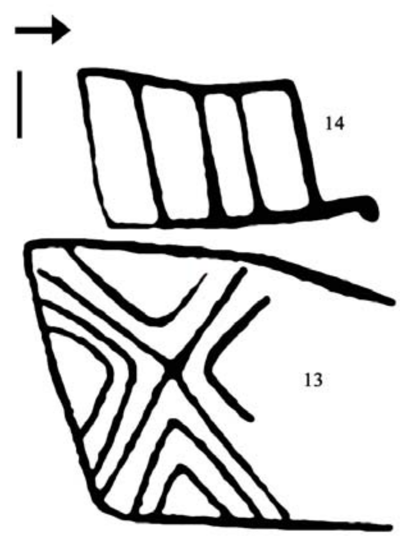
Son L:2:38 (7-9) angled aspect



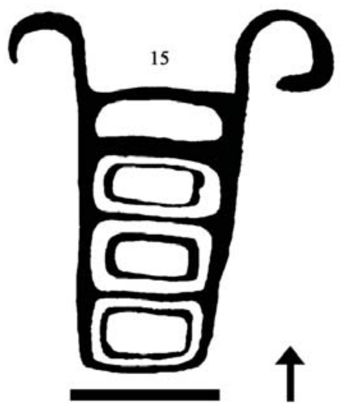
Son L:2:38 (12)



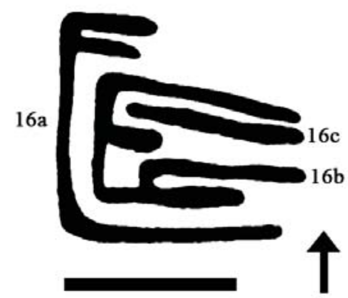
Son L:2:38 (10-11)



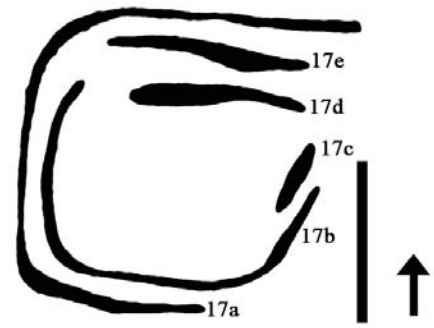
Son L:2:38 (13-14) angled aspect



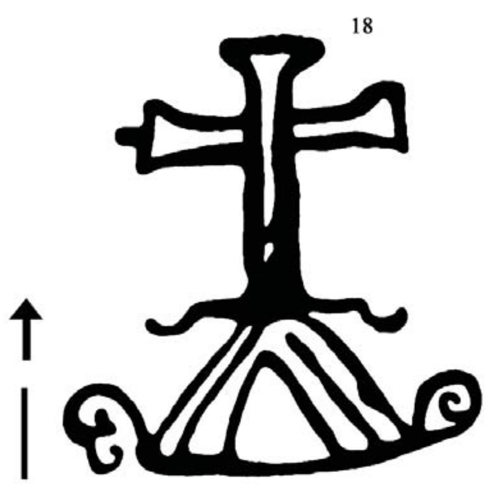
Son L:2:38 (15)



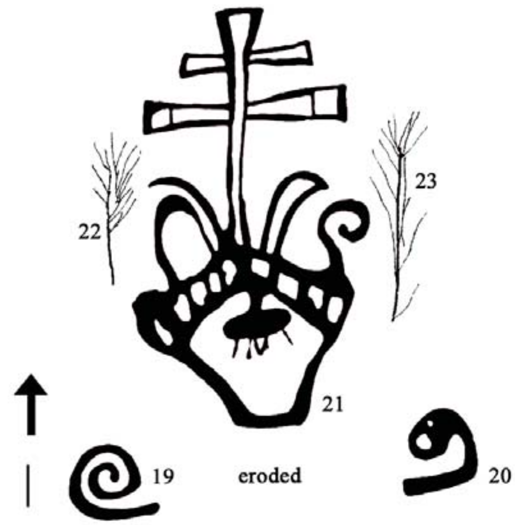
Son L:2:38 (16)



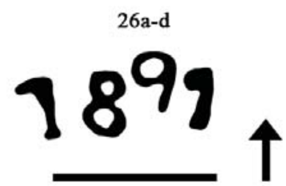
Son L:2:38 (17)



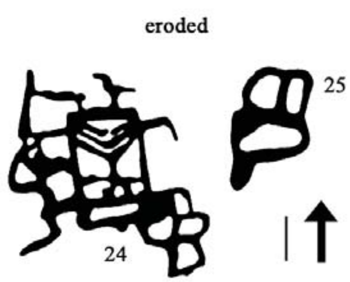
Son L:2:38 (18)



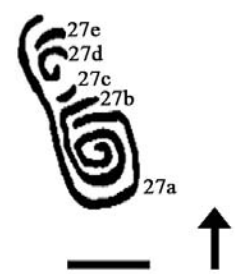
Son L:2:38 (19-23)



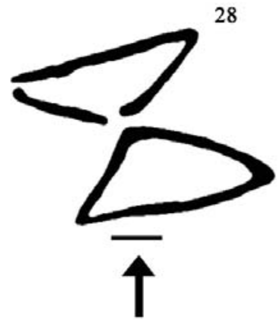
Son L:2:38 (26)



Son L:2:38 (24-25)

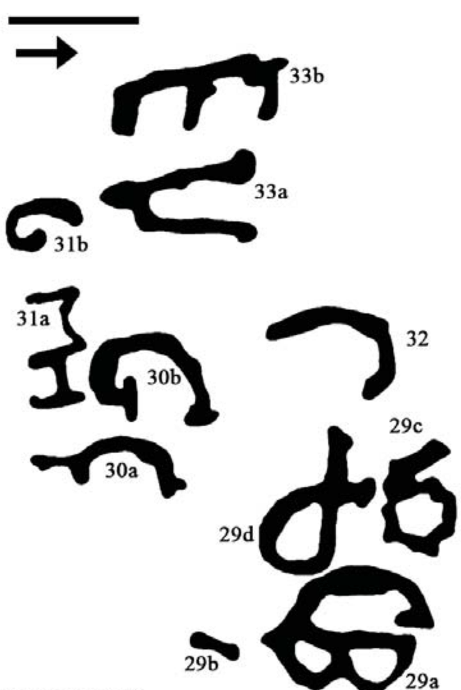


Son L:2:38 (27) angled aspect

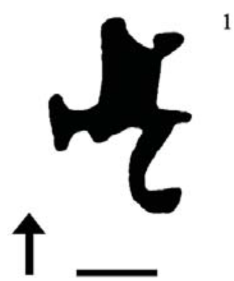


Son L:2:38 (28) angled aspect

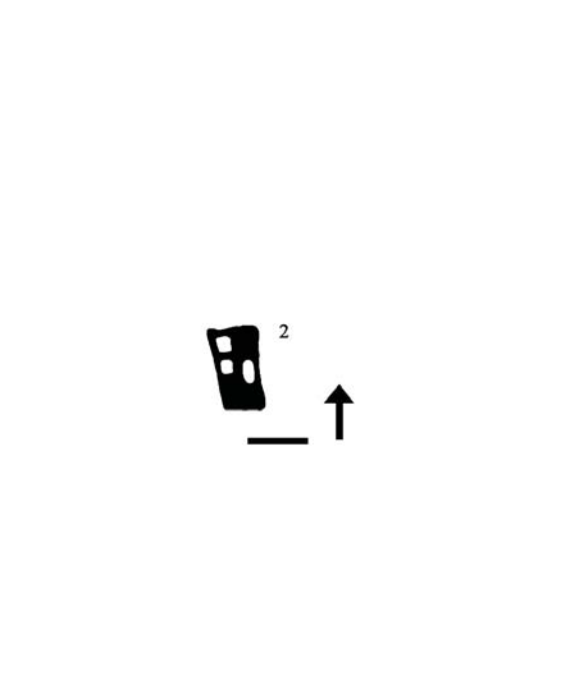
Son L:2:38 (34)



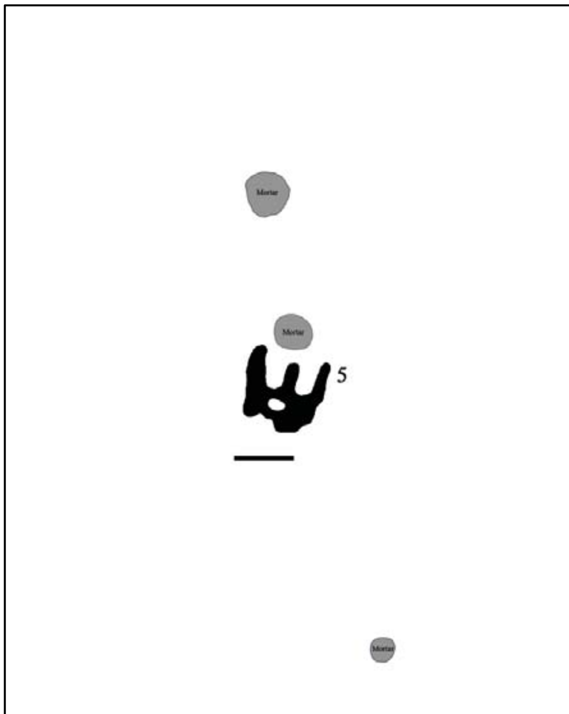
Son L:2:38 (29-33)



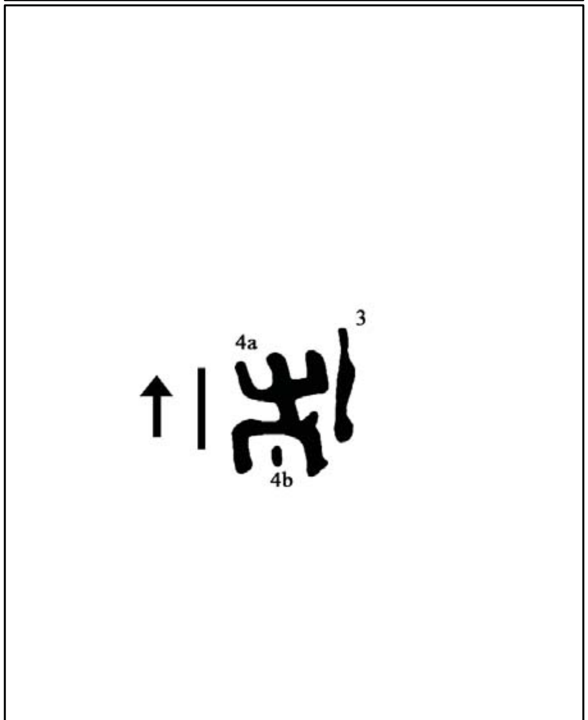
Son L:2:39 (1)



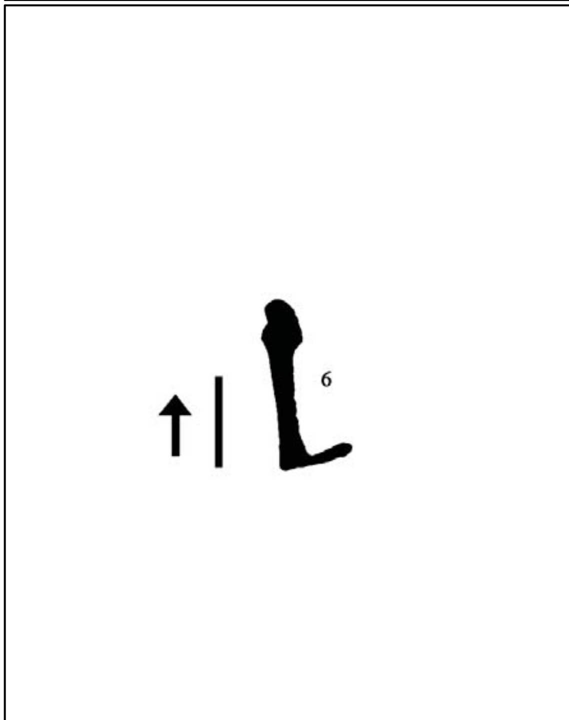
Son L:2:39 (2)



Son L:2:39 (5)

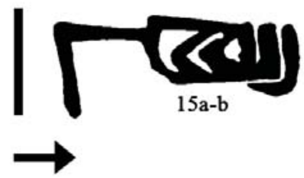


Son L:2:39 (3-4)

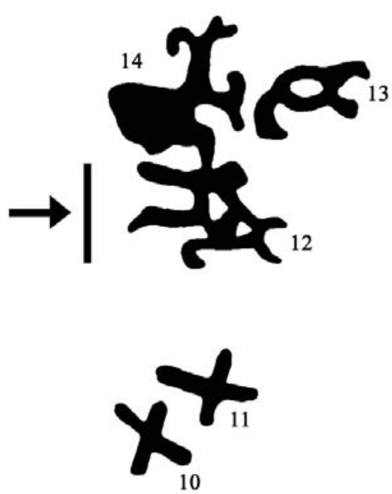


Son L:2:39 (6)

Son L:2:39 (7-9) angled aspect

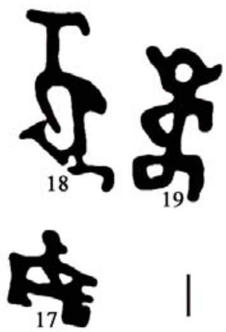


Son L:2:39 (15)



Son L:2:39 (10-14)

Son L:2:39 (16)



Son L:2:39 (17-19)

Son L:2:42 (1)

Son L:2:39 (20)

Sub-appendix J
Luminescence Dating Report

by
James K. Feathers

LUMINESCENCE ANALYSIS OF CERAMICS FROM SONORA

29 January 2014

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This report presents the results of luminescence analysis on 18 ceramic samples from three sites in Sonora, Mexico. The samples were submitted by Matthew Pailes of University of Arizona. Table 1 lists the samples, provenience information and burial depth. Laboratory procedures are given in the appendix.

Table 1. Samples

UW Lab #	Reference TL #	FN	site	Unit/feature	Burial depth (cm)	type
UW2820	1011	813	Son L:1:23	80/31	35	Painted CG
UW2821	922	938	Son L:1:23	81/32	41	Painted CG
UW2822	105	165	Son L:2:1	19/2	13	Painted local
UW2823	940	913	Son L:1:23	77/21	5	Painted CG
UW2824	03	205	Son L:2:1	7/1	21	Plain South
UW2825	300	604	Son L:2:22	52/15	8	Plain with fileted rim
UW2826	104	157	Son L:2:1	15/2	17	textured
UW2827	09	207	Son L:2:1	14/3	38	textured
UW2828	920	848	Son L:1:23	81/32	37	brushed
UW2829	407	na	Son L:2:22	40/11	5	brushed
UW2830	406	561	Son L:2:22	47/17	13	plain
UW2831	1002	739	Son L:1:23	72/21	10	brushed
UW2832	206	453	Son L:2:22	60/10	14	Plain with fileted rim
UW2833	10	208	Son L:2:1	14/3	18	brushed
UW2834	308	634	Son L:2:22	54/18	40	plain
UW2835	931	861	Son L:1:23	90/33	31	Red with flaring rim
UW2836	22	na	Son L:2:1	20/3	20	adobe
UW2837	202	429	Son L:2:22	36/10	15	adobe

Dose rate

The dose rate was measured on each ceramic and on an associated sediment. Dose rates on the ceramics were mainly determined using alpha counting and flame photometry. The beta dose rate calculated from these measurements on the ceramics was compared with the beta dose rate measured directly by beta counting. For the sediments, concentrations of the parents ^{238}U and ^{232}Th, plus %K were measured by ICP-MS by ALS Minerals, Reno, NV. For the decay chains, this assumes secular equilibrium. Moisture content was estimated as 50 ± 30 % of saturated value for the ceramic sherds, and 6 ± 3 percent for the sediments, reflecting the arid environment. Table 2 gives the radioactivity data and comparison of the beta dose rate calculated in the two ways mentioned. On only two samples, UW2834 and UW2835, marked in bold in Table 2, did these differ at one-sigma. As a more direct measure, the beta counting results were used in age calculation for these two samples. Some samples had quite high concentrations of U and Th. The pairs technique used for separating U and Th concentrations in alpha counting, is less accurate for high activities, but this should not greatly affect the overall dose rates. Table 3 gives all dose rates for each sample

Table 2. Radionuclide concentrations

Sample	^{238}U *(ppm)*	^{233}Th *(ppm)*	*K (%)*	*Beta dose rate (Gy/ka)*	
				ß-counting	α-counting/flame photometry
UW2820	3.64±0.27	11.84±1.48	2.78±0.17	2.96±.26	3.14±0.15
Sediment	3.5±0.35	14.7±1.47	3.09±0.31		
UW2821	3.58±0.25	10.65±1.40	2.19±0.14	2.73±0.25	2.62±0.12
Sediment	6.4±0.64	20.2±2.02	3.48±0.35		
UW2822	5.57±0.49	34.28±2.90	2.52±0.07	3.86±0.40	3.76±0.12
Sediment	2.5±0.25	13.7±1.37	1.94±0.19		
UW2823	11.62±0.61	6.67±1.54	2.62±0.12	No meas.	4.02±0.14
Sediment	3.6±0.36	15.3±1.53	3.08±0.31		
UW2824	4.67±0.30	11.19±1.36	2.65±0.09	3.26±0.29	3.17±0.09
sediment	2.8±0.28	14.7±1.47	2.55±0.26		
UW2825	4.00±0.31	17.11±1.69	3.10±0.14	3.69±0.32	3.54±0.13
Sediment	4.4±0.44	17.9±1.79	2.72±0.27		
UW2826	4.71±0.31	12.87±1.46	2.49±0.08	3.39±0.36	3.03±0.09
Sediment	3.6±0.36	19.0±1.90	1.92±0.19		
UW2827	7.47±0.55	30.70±2.77	3.11±0.14	3.96±0.32	4.42±0.16
Sediment	3.3±0.33	16.8±1.68	3.15±0.32		
UW2828	3.78±0.25	8.53±1.25	3.34±0.10	3.52±0.10	3.43±0.30
Sediment	3.9±0.39	15.3±1.53	3.28±0.33		
UW2829	14.32±0.99	53.20±4.28	2.87±0.10	5.91±0.20	6.06±0.61
Sediment	4.3±0.43	17.7±1.77	2.97±0.30		
UW2830	4.74±0.33	13.78±1.66	2.64±0.08	3.19±0.29	3.19±0.09
Sediment	5.1±0.51	20.2±2.02	3.04±0.30		
UW2831	4.09±0.26	7.24±1.16	2.74±0.08	3.21±0.27	2.99±0.08
Sediment	3.7±0.37	15.9±1.59	3.25±0.32		
UW2832	5.42±0.40	20.62±2.07	3.02±0.09	3.74±0.35	3.78±0.11
Sediment	5.0±0.50	27.4±2.74	2.99±0.30		
UW2833	10.22±0.66	28.77±2.64	2.62±0.07	4.40±0.37	4.38±0.13
Sediment	3.7±0.37	16.1±.161	2.98±0.30		
UW2834	2.55±0.19	8.49±1.20	3.03±0.12	**3.58±0.31**	**3.10±0.11**
Sediment	4.6±0.46	21.3±2.13	2.83±0.28		
UW2835	2.80±0.19	6.68±0.89	2.71±0.11	**3.30±0.28**	**2.82±0.10**
Sediment	3.5±0.35	14.9±1.49	3.19±0.32		
UW2836	2.78±0.25	14.93±1.66	3.12±0.10	3.06±0.26	3.32±0.10
Sediment	2.8±0.28	14.3±1.43	2.96±0.30		
UW2837	3.15±0.23	9.25±1.28	3.16±0.07	3.56±0.31	3.31±0.08

Sediment	4.3±0.43	18.3±183	3.26±0.33		

Table 3. Dose rates (Gy/ka)*

Sample	*alpha*	*beta*	*gamma*	*cosmic*	*total*
UW2820	0.87±0.06	2.86±0.18	1.77±0.11	0.25±0.05	5.75±0.23
UW2821	1.03±0.10	2.39±0.15	2.35±0.15	0.24±0.05	6.02±0.24
UW2822	1.78±0.21	3.51±0.18	1.40±0.10	0.28±0.06	6.97±0.30
UW2823	1.78±0.17	3.62±0.23	1.49±0.29	0.30±0.06	7.19±0.41
UW2824	1.20±0.11	2.82±0.17	1.54±0.10	0.26±0.05	5.83±0.23
UW2825	0.89±0.14	3.29±0.19	1.68±0.18	0.29±0.06	6.15±0.30
UW2826	1.71±0.17	2.83±0.14	1.65±0.11	0.27±0.05	6.46±0.25
UW2827	1.99±0.13	4.10±0.23	1.98±0.12	0.24±0.05	8.32±0.30
UW2828	0.56±0.09	3.20±0.17	1.87±0.12	0.25±0.05	5.88±0.23
UW2829	6.72±0.42	5.49±0.28	1.84±0.32	0.29±0.06	14.34±0.60
UW2830	0.66±0.12	2.97±0.15	2.00±0.15	0.28±0.06	5.90±0.25
UW2831	0.65±0.04	2.77±0.14	1.65±0.15	0.29±0.06	6.90±0.86
UW2832	0.87±0.08	3.43±0.21	2.33±0.83	0.28±0.06	6.90±0.86
UW2833	2.07±0.13	4.05±0.22	1.89±0.12	0.27±0.05	8.27±0.29
UW2834	0.46±0.05	3.35±0.31	2.09±0.14	0.24±0.05	6.14±0.35
UW2835	0.59±0.22	3.07±0.30	1.77±0.11	0.25±0.05	5.68±0.39
UW2836	0.68±0.25	3.00±0.20	1.61±0.29	0.26±0.05	5.55±0.44
UW2837	0.48±0.05	2.93±0.18	1.80±0.11	0.27±0.06	5.48±0.23

* Dose rates for ceramics are calculated for OSL. They will be higher for TL and IRSL due to higher b-values. Also the beta dose rate is lower than that given in Table 2 due to moisture correction.

Equivalent Dose

Equivalent dose was measured for TL, OSL and IRSL as described in the appendix. TL plateaus (Table 4), ranged from 40 to 180°C in breadth, with nine of them more than 100°C. Most samples showed a sensitivity change with heating. TL anomalous fading was evident in all but UW2831. Anomalous fading rates, or g-values, were high ranging up to 16% per decade, with 8 of them higher than 10. But none were so high that the correction could not be performed. The high g-values imply that the fading rate may be over-estimated for many of these samples because it has changed through time, reducing the reliability of the correction. Correction for fading followed Huntley and Lamothe (2001).

Table 4. TL parameters

Sample	*Plateau (°C)*	*1st/2nd ratio**	*fit*	*Fading g-value***
UW2820	260-380	1.0	linear	8.3±1.3
UW2821	250-360	1.76±0.18	quadratic	10.4±4.0
UW2822	250-350	2.85±0.19	linear	13.4±5.0
UW2823	250-430	0.41±0.09	linear	7.9±4.0
UW2824	250-290	1.0	linear	11.0±2.9
UW2825	250-360	3.28±0.40	linear	4.6±1.5
UW2826	250-420	1.70±0.28	linear	12.0±5.0
UW2827	270-430	1.75±0.11	linear	15.5±2.8
UW2828	260-350	1.42±0.08	quadratic	6.0±3.5
UW2829	250-330	1.88±0.13	linear	15.3±8.4
UW2830	260-320	2.48±0.16	linear	7.1±2.5
UW2831	250-420	1.0	linear	None evident
UW2832	250-390	1.57±0.12	linear	10.9±2.4
UW2833	280-330	1.62±0.18	linear	12.7±1.7
UW2834	250-330	3.14±0.43	linear	9.0±3.4
UW2835	270-310	1.0	linear	13.7±2.8
UW2836	260-310	NA	linear	11.6±6.6
UW2837	250-330	NA	linear	26.1±13

*Refers to slope ratio between the first and second glow growth curves. A glow refers to luminescence as a function of temperature; a second glow comes after heating to 450°C.
** A g-value is a rate of anomalous fading, measured as percent of signal loss per decade, where a decade is a power of 10.

OSL/IRSL was measured on 5-6 aliquots per sample (Table 5). Scatter was high (more than 10% over-dispersion) on only 5 samples. An IRSL signal could be measured on most samples, but it was relatively weak, 2 to 40 times weaker in magnitude than the OSL signal, between 2 and 12 for all but two samples. Weaker IRSL signal is not uncommon for ceramics. IRSL stems from feldspars, which are prone to anomalous fading. A relatively large IRSL signal may suggest the OSL signal partly stems from feldspars and therefore may fade, so a weak IRSL suggests the OSL is dominated by quartz. The average OSL b-value, which is a measure of alpha luminescence efficiency, is 0.80 ± 0.27, which is a little higher than is typical of quartz (usually 0.5-0.6). The OSL b-value was not measured on UW2835, so this average was used. The somewhat higher OSL b-value makes it likely that feldspars contribute some to the OSL signal, but fading of the OSL signal may not be too significant. As a test of the SAR procedures, a dose recovery test was performed. The recovered dose was within one-sigma of the given dose for all samples, except three for which it was within two-sigma. Equivalent dose and b-values are given in Table 6.

Table 5. OSL/IRSL data

Sample	# aliquots*		OSL Over-dispersion (%)	Dose Recovery (OSL)	
	OSL	IRSL		Given Dose (sß)	Recovered Dose (sß)
UW2820	6	6	7.9±2.9	34	35.1±1.3
UW2821	6	6	0	70	74.8±3.1
UW2822	6	6	0	40	35.0±4.2
UW2823	6	5	10.2±3.4	34	35.1±1.6
UW2824	6	5	10.0±4.5	40	38.2±3.8
UW2825	6	0	0	40	37.5±5.7
UW2826	6	5	0	40	42.4±4.7
UW2827	6	6	4.4±2.5	60	60.5±3.1
UW2828	6	6	0	40	38.4±6.6
UW2829	6	6	3.1±3.5	60	59.9±3.1
UW2830	5	6	0**	40	43.8±6.4
UW2831	6	3	15.9±5.0	14	15.3±0.8
UW2832	5	5	0	60	59.1±2.6
UW2833	6	6	3.0±2.5	80	80.2±3.3
UW2834	5	0	14.0±5.1	14	14.6±0.7
UW2835	6	0	0**	30	32.5±4.7
UW2836	2	3	3.3±11.7	40	36.0±5.3
UW2837	5	**2**	7.3±2.9	20	21.8±1.1

* Denotes number of aliquots with measurable signals.
** Over-dispersion after outliers removed.

Table 6. Equivalent dose and b-value – fine grains

Sample	*Equivalent Dose (Gy)*			*b-value (Gy µm²)*		
	TL	*IRSL*	*OSL*	*TL*	*IRSL*	*OSL**
UW2820	3.49±0.12	3.71±0.55	3.37±0.12	2.20±0.15	1.40±0.28	0.80±0.03
UW2821	3.77±0.65	3.13±0.21	3.84±0.08	2.00±0.12	1.00±0.05	0.99±0.07
UW2822	3.85±0.38	2.67±0.06	5.21±0.17	1.87±0.08	1.09±0.03	0.74±0.07
UW2823	7.62±1.93	4.16±0.67	3.60±0.16	3.50±0.72	1.53±0.15	0.85±0.05
UW2824	3.99±0.14	4.99±0.70	4.02±0.20	1.59±0.08	1.48±0.08	1.00±0.06
UW2825	3.35±0.40		5.16±0.23	1.45±0.16		0.64±0.09
UW2826	3.43±0.59	3.63±0.22	6.02±0.19	0.92±0.12	1.15±0.04	1.30±0.10
UW2827	5.63±0.38	4.31±0.13	6.36±0.16	1.88±0.13	1.07±0.03	0.78±0.03
UW2828	4.26±0.38	4.69±0.26	5.40±0.19	1.38±0.07	0.82±0.05	0.57±0.08
UW2829	7.65±0.49	4.41±0.22	7.68±0.19	1.85±0.11	1.21±0.04	1.44±0.06
UW2830	3.60±0.23	3.57±0.28	3.84±0.19	1.26±0.07	0.68±0.06	0.48±0.08
UW2831	9.46±1.46	13.78±1.86	9.80±0.66	1.38±0.76	0.86±0.05	0.67±0.02
UW2832	5.79±0.40	4.26±0.33	6.08±0.12	1.26±0.07	0.91±0.09	0.50±0.03
UW2833	8.74±1.03	4.79±0.14	8.74±0.18	1.48±0.08	0.93±0.03	0.72±0.02
UW2834	1.34±0.28		3.17±0.21	1.32±0.17		0.59±0.05
UW2835	7.31±0.45		12.18±1.15	3.54±0.60		*0.80±0.28*
UW2836	4.65±0.72**	9.22±2.48	5.16±0.22	1.17±0.22		0.64±0.08
UW2837	0.52±0.09**	5.59±0.65	3.83±0.14	1.73±0.41	2.18±0.65	0.55±0.03

* OSL value for UW2835 is an average of all other OSL b-values. The b-value was not measured for UW2835 due to machine issues.
**Equivalent dose based on additive dose intercept.

Ages

Table 7 gives the derived ages for each sample. They will be discussed in the following groups:

1) *Agreement between OSL and the fading-corrected TL.* This perhaps is the most reliable group because there is internal consistency. Six samples fall in this group. The dates for UW2828 and UW2830 are particularly good because the OSL b-value is also typical of quartz so the OSL does not likely fade. UW2830 has the extra bonus of having the IRSL date also in agreement, suggesting any fading in this sample is minimal. The IRSL date also agrees with OSL and corrected TL for UW2823, although the OSL b-value is a little high for this sample. UW2822 has agreement between OSL and corrected TL, but the error on the fading correction is high and the OSL b-value is a little higher than typical. It is possible there is some OSL fading in this sample, but likely not significant. The OSL signal was nine times larger than the IRSL signal for this sample. UW2831 has agreement between OSL and TL, no TL fading was detected, the errors are not overly large, and the OSL b-value is in the range of quartz. This seems like a reliable date but the age is quite a bit older than other samples. The date for the final sample in this group, UW2826, is somewhat problematic. Although the OSL and corrected TL agree, the error on the TL correction is high, the OSL b-value is high (in the range of feldspar b-value), and the OSL signal is only twice as large as the IRSL signal. Because the OSL signal likely fades, the age may be somewhat under-

estimated, although not likely by more than 100 years. (Fading was not measured on OSL because of exorbitant machine time.)

2) *Agreement between OSL and uncorrected TL*. There are four samples in this category. For the ages to be correct, an argument must be made why the TL fading correction is not valid. For UW2824, there is also agreement with the IRSL age. This suggests that fading is minimal, and the high TL g-value of 11% is probably an overestimate. The TL g-values for UW2821 and UW2829 are also high, but the OSL b-value is also in the feldspar range, so some OSL fading is likely and therefore the ages are under-estimates, more so for UW2829 because the OSL signal is only three times the size of the IRSL signal, compared to 8 times for UW2829. The fading correction for UW2836 did not produce a significant difference in TL age, and the OSL b-value was in the range of quartz.

3) *TL age older than corrected OSL age*. Four samples fall into this category. On three of them, UW2827, UW2832 and UW2833, the TL g-value is high (more than 10.9%), so the fading correction is probably over-estimated. The OSL b-values on all three are also relatively low, so the OSL signal does not likely fade. All three should be reliable dates. On UW2820 the TL g-value is lower (8%) and the OSL b-value is a little higher than typical (0.8), but the OSL age agrees with that from IRSL and the OSL signal is 12 times larger than the IRSL signal. OSL fading is unlikely. This date should be reliable.

4) *TL age younger than OSL age*. There are three of these, UW2825, UW2834, and UW2837 but all have OSL b-values in the range of quartz. Neither UW2825 nor UW2834 had a measurable IRSL signal. Most likely, the g-valuefor these two was underestimated, making the TL age too young. Both ages should be reliable. UW2837 did have an IRSL signal and the age from it agreed with the age from OSL. This should be a reliable date. The TL data on this sample was highly scattered and ill-behaved.

5) *Only uncorrected TL age is reasonable*. This is the case for UW2835, the most unreliable date of the lot. The OSL date actually agrees with the corrected TL age, but this age is BC 150 ± 260 which is not a reasonable date for pottery in this region. Perhaps TL fading is over-estimated, because of a high g-value. The uncorrected TL age of AD 1060 ± 100 is more reasonable, but this does not explain the old OSL age. The OSL decay curves were rather gradual, which could mean they were dominated by a slower-bleaching component and therefore not fully bleached at the time of firing.

Table 7. Ages

Sample	Age (ka)	% error	Basis for age	Calendar date (years AD)
UW2820	0.58±0.03	5.8	OSL/IRSL	1430 ± 30
UW2821	0.62±0.03*	5.3	OSL/uncorrected TL	1390± 30
UW2822	0.75±0.05	6.2	OSL/Corrected TL	1260 ± 50
UW2823	0.50±0.04	7.1	OSL/IRSL/corrected TL	1510 ± 40
UW2824	0.65±0.03	4.5	OSL/IRSL/uncorrected TL	1370 ± 30
UW2825	0.84±0.06	7.3	OSL	1170 ± 60
UW2826	0.94±0.06*	5.9	OSL/corrected TL	1080 ± 60
UW2827	0.76±0.04	5.4	OSL	1250 ± 40
UW2828	0.91±0.05	5.9	OSL/corrected TL	1100 ± 50
UW2829	0.51±0.02*	4.8	OSL/uncorrected TL	1500 ± 30
UW2830	0.63±0.03	5.4	OSL/IRSL/corrected TL	1390 ± 30
UW2831	1.78±0.14	7.8	OSL/TL (no fading)	230 ± 140
UW2832	0.88±0.05	5.5	OSL	1130 ± 50
UW2833	1.06±0.05	5.1	OSL	960 ± 50
UW2834	0.52±0.05	9.1	OSL	1500 ± 50
UW2835	2.17±0.26	11.9	OSL/corrected TL	-150 ± 260 (BC)
	0.95±0.10	10.4	Uncorrected TL	1060 ± 100

UW2836	0.88±0.07	6.5	OSL/uncorrected TL	1130 ± 60
UW2837	0.71±0.04	5.9	OSL/IRSL	1300 ± 40

* May be underestimate
** May be overestimate

Figure 1 is a histogram of the derived dates. The majority fall between A1000-1600, with a broad peak between AD 1000-1400 and a tail of older ages. Figure 2 separates the ages by site in a box chart, with the horizontal line the median and the symbol the mean. Ends of the boxes are 25 and 75 percentiles. Figure 3 separates the ages by type in a box chart.

Figure 1

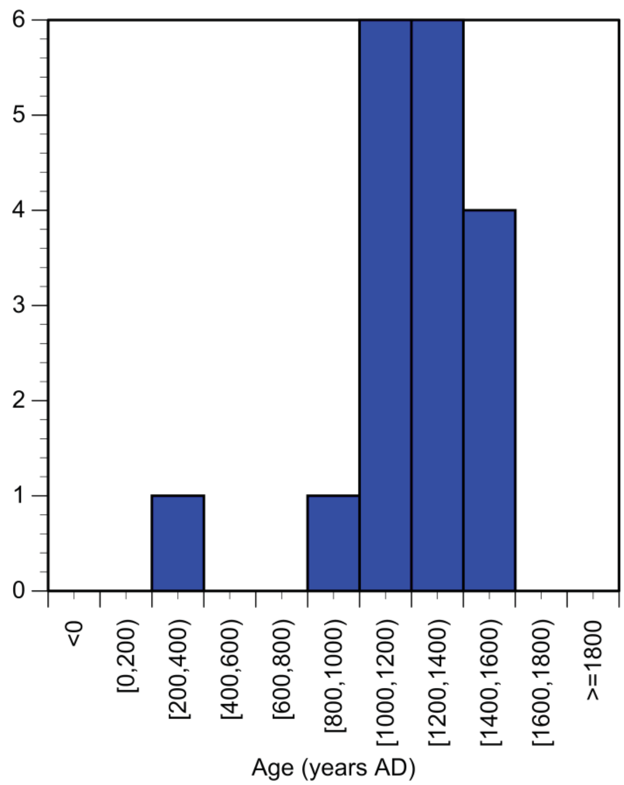


Figure 2

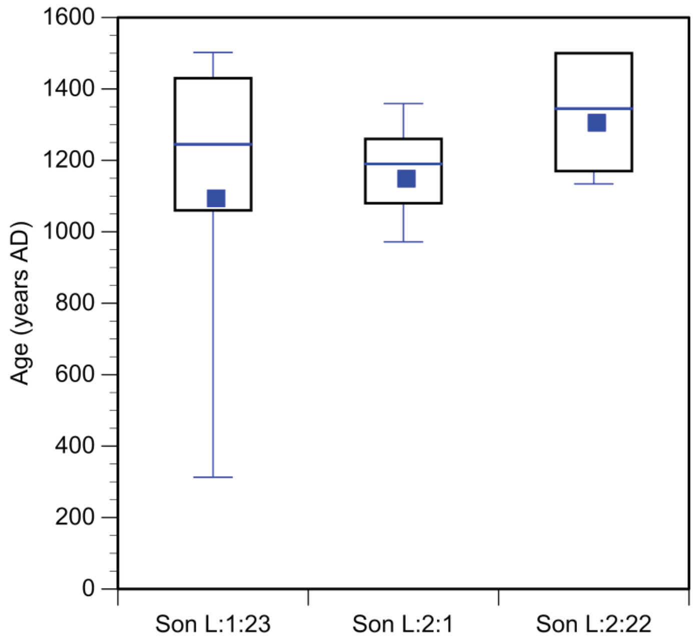
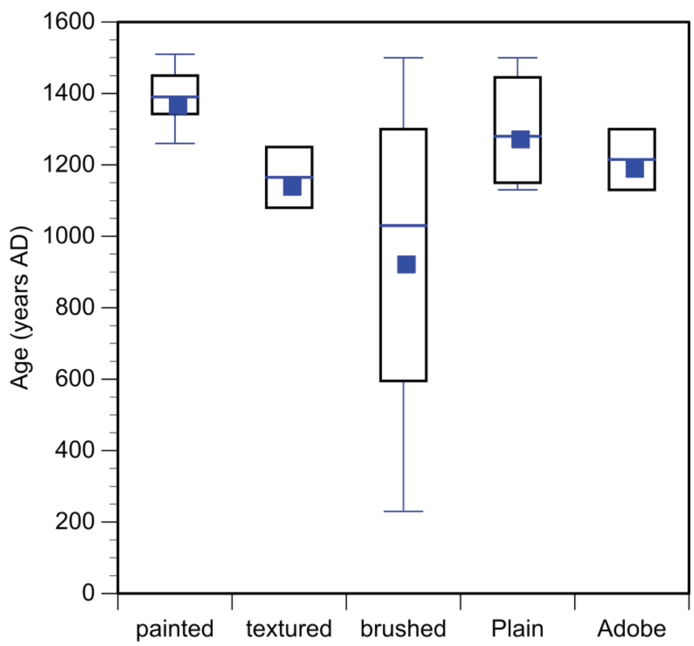


Figure 3



Appendix

Procedures for Thermoluminescence Analysis of Pottery

Sample preparation -- fine grain

The sherd is broken to expose a fresh profile. Material is drilled from the center of the cross-section, more than 2 mm from either surface, using a tungsten carbide drill tip. The material retrieved is ground gently by an agate mortar and pestle, treated with HCl, and then settled in acetone for 2 and 20 minutes to separate the 1-8 µm fraction. This is settled onto a maximum of 72 stainless steel discs.

Glow-outs

Thermoluminescence is measured by a Daybreak reader using a 9635Q photomultiplier with a Corning 7-59 blue filter, in N_2 atmosphere at 1°C/s to 450°C. A preheat of 240°C with no hold time precedes each measurement. Artificial irradiation is given with a ^{241}Am alpha source and a ^{90}Sr beta source, the latter calibrated against a ^{137}Cs gamma source. Discs are stored at room temperature for at least one week after irradiation before glow out. Data are processed by Daybreak TLApplic software.

Fading test

Several discs are used to test for anomalous fading. The natural luminescence is first measured by heating to 450°C. The discs are then given an equal alpha irradiation and stored at room temperature for varied times: 10 min, 2 hours, 1 day, 1 week and 8 weeks. The irradiations are staggered in time so that all of the second glows are performed on the same day. The second glows are normalized by the natural signal and then compared to determine any loss of signal with time (on a log scale). If the sample shows fading and the signal versus time values can be reasonably fit to a logarithmic function, an attempt is made to correct the age following procedures recommended by Huntley and Lamothe (2001). The fading rate is calculated as the g-value, which is given in percent per decade, where decade represents a power of 10.

Equivalent dose

The equivalent dose is determined by a combination additive dose and regeneration (Aitken 1985). Additive dose involves administering incremental doses to natural material. A growth curve plotting dose against luminescence can be extrapolated to the dose axis to estimate an equivalent dose, but for pottery this estimate is usually inaccurate because of errors in extrapolation due to nonlinearity. Regeneration involves zeroing natural material by heating to 450°C and then rebuilding a growth curve with incremental doses. The problem here is sensitivity change caused by the heating. By constructing both curves, the regeneration curve can be used to define the extrapolated area and can be corrected for sensitivity change by comparing it with the additive dose curve. This works where the shapes of the curves differ only in scale (i.e., the sensitivity change is independent of dose). The curves are combined using the "Australian slide" method in a program developed by David Huntley of Simon Fraser University (Prescott et al. 1993). The equivalent dose is taken as the horizontal distance between the two curves after a scale adjustment for sensitivity change. Where the growth curves are not linear, they are fit to quadratic functions. Dose increments (usually five) are determined so that the maximum additive dose results in a signal about three times that of the natural and the maximum regeneration dose about five times the natural.

A plateau region is determined by calculating the equivalent dose at temperature increments between 240° and 450°C and determining over which temperature range the values do not differ significantly. This plateau region is compared with a similar one constructed for the b-value (alpha efficiency), and the overlap defines the integrated range for final analysis.

Alpha effectiveness

Alpha efficiency is determined by comparing additive dose curves using alpha and beta irradiations. The slide program is also used in this regard, taking the scale factor (which is the ratio of the two slopes) as the b-value (Aitken 1985).

Radioactivity

Radioactivity is measured by alpha counting in conjunction with atomic emission for ^{40}K. Samples for alpha counting are crushed in a mill to flour consistency, packed into plexiglass containers with ZnS:Ag screens, and sealed for one month before counting. The pairs technique is used to separate the U and Th decay series. For atomic emission measurements, samples are dissolved in HF and other acids and analyzed by a Jenway flame photometer. K concentrations for each sample are determined by bracketing between standards of known concentration. Conversion to ^{40}K is by natural atomic abundance. Radioactivity is also measured, as a check, by beta counting, using a Risø low level beta GM multicounter system. About 0.5 g of crushed sample is placed on each of four plastic sample holders. All are counted for 24 hours. The average is converted to dose rate following Bøtter-Jensen and Mejdahl (1988) and compared with the beta dose rate calculated from the alpha counting and flame photometer results.

Both the sherd and an associated soil sample are measured for radioactivity. Additional soil samples are analyzed where the environment is complex, and gamma contributions determined by gradients (after Aitken 1985: appendix H). Cosmic radiation is determined after Prescott and Hutton (1988). Radioactivity concentrations are translated into dose rates following Adamiec and Aitken (1998).

Moisture Contents

Water absorption values for the sherds are determined by comparing the saturated and dried weights. For temperate climates, moisture in the pottery is taken to be 80 ± 20 percent of total absorption, unless otherwise indicated by the archaeologist. Again for temperate climates, soil moisture contents are taken from typical moisture retention quantities for different textured soils (Brady 1974: 196), unless otherwise measured. For drier climates, moisture values are determined in consultation with the archaeologist.

Procedures for Optically Stimulated or Infrared Stimulated Luminescence of Fine-grained pottery.

Optically stimulated luminescence (OSL) and infrared stimulated luminescence (IRSL) on fine-grain (1-8μm) pottery samples are carried out on single aliquots following procedures adapted from

Banerjee et al. (2001) and Roberts and Wintle (2001. Equivalent dose is determined by the single-aliquot regenerative dose (SAR) method (Murray and Wintle 2000).

The SAR method measures the natural signal and the signal from a series of regeneration doses on a single aliquot. The method uses a small test dose to monitor and correct for sensitivity changes brought about by preheating, irradiation or light stimulation. SAR consists of the following steps: 1) preheat, 2) measurement of natural signal (OSL or IRSL), L(1), 3) test dose, 4) cut heat, 5) measurement of test dose signal, T(1), 6) regeneration dose, 7) preheat, 8) measurement of signal from regeneration, L(2), 9) test dose, 10) cut heat, 11) measurement of test dose signal, T(2), 12) repeat of steps 6 through 11 for various regeneration doses. A growth curve is constructed from the L(i)/T(i) ratios and the equivalent dose is found by interpolation of L(1)/T(1). Usually a zero regeneration dose and a repeated regeneration dose are employed to insure the procedure is working properly. For fine-grained ceramics, a preheat of 240°C for 10s, a test dose of 3.1 Gy, and a cut heat of 200°C are currently being used, although these parameters may be modified from sample to sample.

The luminescence, L(i) and T(i), is measured on a Risø TL-DA-15 automated reader by a succession of two stimulations: first 100 s at 60°C of IRSL (880nm diodes), and then 100s at 125°C of OSL (470nm diodes). Detection is through 7.5mm of Hoya U340 (ultra-violet) filters. The two stimulations are used to construct IRSL and OSL growth curves, so that two estimations of equivalent dose are available. Anomalous fading usually involves feldspars and only feldspars are sensitive to IRSL stimulation. The rationale for the IRSL stimulation is to remove most of the feldspar signal, so that the subsequent OSL (post IR blue) signal is free from anomalous fading. However, feldspar is also sensitive to blue light (470nm), and it is possible that IRSL does not remove all the feldspar signal. Some preliminary tests in our laboratory have suggested that the OSL signal does not suffer from fading, but this may be sample specific. The procedure is still undergoing study.

A dose recovery test is performed by first zeroing the sample by exposure to light and then administering a known dose. The SAR protocol is then applied to see if the known dose can be obtained.

Alpha efficiency will surely differ among IRSL, OSL and TL on fine-grained materials. It does differ between coarse-grained feldspar and quartz (Aitken 1985). Research is currently underway in the laboratory to determine how much b-value varies according to stimulation method. Results from several samples from different geographic locations show that OSL b-value is less variable and centers around 0.5. IRSL b-value is more variable and is higher than that for OSL. TL b-value tends to fall between the OSL and IRSL values. We currently are measuring the b-value for IRSL and OSL by giving an alpha dose to aliquots whose luminescence have been drained by exposure to light. An equivalent dose is determined by SAR using beta irradiation, and the beta/alpha equivalent dose ratio is taken as the b-value. A high OSL b-value is indicative that feldspars might be contributing to the signal and thus subject to anomalous fading.

Age and error terms

The age and error for both OSL and TL are calculated by a laboratory constructed spreadsheet, based on Aitken (1985). All error terms are reported at 1-sigma. The reference for ka (thousand years before present) is 2010.

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.

Sub-appendix K
Point Count Data

Point Count Categories

lvf Ca porph	lithic, volcanic, felsic, calcium heavy, porphyritic
lvf Ca porph oxy alt	lithic, volcanic, felsic, calcium heavy, porphyritic, Mg Fe oxide alteration
lvf Ca apha	lithic, volcanic, felsic, calcium heavy, aphanitic
lvf Ca apha oxy alt	lithic, volcanic, felsic, calcium heavy, aphanitic, Mg Fe oxide alteration
lvf K porph	lithic, volcanic, felsic, potassium heavy, porphyritic
lvf K porph oxy alt	lithic, volcanic, felsic, potassium heavy, porphyritic, Mg Fe oxide alteration
lvf K apha	lithic, volcanic, felsic, potassium heavy, aphanitic
lvf K apha oxy alt	lithic, volcanic, felsic, potassium heavy, aphanitic Mg Fe oxide alteration
lvi Ca porph feld	lithic, volcanic, intermediate, calcium heavy, feldspar dominant porphyritic
lvi Ca porph feld oxy alt	lithic, volcanic, intermediate, calcium heavy, feldspar dominant porphyritic, Mg Fe oxide alteration
lvi Ca porph maf	lithic, volcanic, intermediate, calcium heavy, mafic mineral dominant porphyritic
lvi Ca porph maf oxy alt	lithic, volcanic, intermediate, calcium heavy, mafic mineral dominant porphyritic, Mg Fe oxide alteration
lvi Ca apha homo	lithic, volcanic, intermediate, calcium heavy, aphanitic, homogenous composition
lvi Ca apha hetero	lithic, volcanic, intermediate, calcium heavy, aphanitic, heterogeneous composition
lvi K porph feld	lithic, volcanic, intermediate, potassium heavy, feldspar dominant porphyritic
lvi K porph feld oxy alt	lithic, volcanic, intermediate, potassium heavy, feldspar dominant porphyritic, Mg Fe oxide alteration
lvi K porph maf	lithic, volcanic, intermediate, potassium heavy, mafic mineral dominant porphyritic
lvi K porph maf oxy alt	lithic, volcanic, intermediate, potassium heavy, mafic mineral dominant porphyritic, Mg Fe oxide alteration
lvi K apha homo	lithic, volcanic, intermediate, potassium heavy, aphanitic, homogenous composition
lvi K apha hetero	lithic, volcanic, intermediate, potassium heavy, aphanitic, heterogeneous composition
lvm basalt	lithic, mafic, basalt
lvm basalt oxy alt	lithic, mafic, basalt, Mg Fe oxide alteration
lvm other	lithic, mafic, other
lvv obs	lithic, volcanic, vitreous, obsidian
lvv tuft	lithic, volcanic, vitreous, tuft
lvh	lithic, volcanic, hypabyssal
lvh oxy alt	lithic, volcanic, hypabyssal, Mg Fe oxide alteration

2nd qtz	secondary Si
lvs	lithic, volcanic, sedimentary
lsch	lithic, sedimentary, chert
CaCo	calcium carbonate
other min	other mineral (specified)
unknown	unknown mineral
oxide	Mg Fe oxide alteration product
sericite	sericite mineral
iddingsite	iddingsite
other alt	other alteration product
sqtz	sutured quartz grain (plutonic)
skspar	sutured potassium feldspar grain (plutonic)
splag	sutured plagioclase grain (plutonic)
lmss	lithic, metamorphic, sandstone (quartzite)
qtz	quartz grain
kspar	potassium feldspar (not microcline)
micr	microcline (sutured and free)
plag	plagioclase mineral, no alteration
plagal	plagioclase mineral, low to moderate alteration
plaggn	plagioclase mineral, high alteration
musc	muscovite
biot	biotite
pyr	pyroxene
amph	amphibole
opaq	opaque mineral
epi cry	epidote phenocryst
epi apha	epidote aphanitic
paste	non-aplastic sherd
void	void in sherd paste

sample #	lvf Ca porph	lvf Ca porph oxy alt	lvf Ca apha	lvf Ca apha oxy alt	lvf K porph	lvf K porph oxy alt	lvf K apha	lvf K apha oxy alt	lvi Ca porph feld	lvi Ca porph feld oxy alt	lvi Ca porph maf	lvi Ca porph maf oxy alt	lvi Ca apha homo	lvi Ca apha hetero	lvi K porph feld	lvi K porph feld oxy alt
001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01.04.04	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0
01.11.05	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0
01.18.05	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
004	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
06.01.01	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
06.01.03	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0
06.01.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
011	0	0	0	0	1	0	2	0	0	0	0	0	0	0	1	1
16.05.05	0	0	0	0	1	0	3	1	0	0	0	0	2	0	6	1
16.13.03	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0
16.15.01	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1
019	0	0	0	0	1	0	6	1	0	0	0	0	1	2	0	0
21.01.04	0	0	2	1	1	0	3	0	0	0	0	0	0	0	0	0
21.05.02	0	0	1	0	1	0	2	1	0	0	0	0	0	14	0	0
21.07.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24.01.02	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0
24.01.05	0	0	0	0	4	1	10	1	2	0	1	0	5	1	3	0
24.03.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
26.01.0	0	0	1	0	1	0	4	0	3	0	0	0	0	2	12	1

5																
26.04.03	0	1	1	0	0	0	14	2	0	0	0	0	4	2	2	0
26.06.01	0	0	1	0	6	0	9	3	0	0	0	0	0	0	1	2
26.07.01	0	0	1	0	3	1	7	4	0	0	0	0	2	0	7	3
26.12.01	0	0	0	0	1	0	2	0	1	0	0	0	0	1	2	0
26.13.03	1	0	0	0	0	1	12	4	1	0	0	0	1	1	3	1
029	0	0	2	0	1	4	0	0	0	0	0	0	0	1	2	0
033	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
35.04.03	0	0	0	0	3	0	15	2	1	1	0	0	2	3	7	0
35.09.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35.10.03	0	0	2	0	5	2	6	3	2	0	0	1	0	1	9	1
39.12	0	0	3	0	0	0	1	0	1	0	20	20	0	38	0	0
040	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0
52.04	0	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0
083	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0
093.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
093.2	0	0	0	0	6	1	3	0	0	0	0	0	0	11	10	2
107	0	0	1	0	0	0	2	0	0	0	0	0	0	0	1	0
114.1	1	0	0	0	5	0	6	2	6	0	1	0	1	48	1	0
114.2	0	0	2	0	1	0	12	0	0	0	0	0	0	0	0	0
114.3	0	0	1	0	8	0	7	1	9	0	0	0	1	19	5	1
114.4	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0
114.5	0	0	1	1	0	0	2	1	0	0	0	0	0	0	1	1
136	0	0	1	0	1	0	3	0	0	0	0	0	0	0	0	0
137	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0
148.1	0	0	0	0	0	0	0	0	0	0	0	0	0	80	0	0
148.2	1	0	2	0	1	0	8	0	3	0	0	0	2	0	2	1
148.3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0
157	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
159	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0
177	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0

208	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
308	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0
315.1	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0
315.2	1	0	1	0	18	1	10	0	5	1	0	7	1	24	4	0
406	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
408.1	1	0	2	0	2	1	4	0	8	1	0	5	0	32	3	0
408.2	0	0	0	0	5	0	6	0	3	0	0	10	2	22	2	1
408.3	0	0	2	0	12	0	6	1	5	0	0	12	0	31	4	0
408.4	0	0	2	0	10	3	15	6	0	1	0	0	0	5	4	0
408.5	0	0	0	0	2	0	5	2	2	0	0	2	0	7	1	0
419.3	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0
446	1	0	1	3	6	0	11	0	0	0	1	2	1	1	4	2
449	5	0	2	1	0	3	3	1	1	0	0	6	0	13	3	0
453	0	0	0	0	0	0	3	1	0	0	0	0	0	0	1	0
458.1	0	0	0	0	0	0	0	0	1	0	0	2	0	1	0	1
458.2	3	0	8	0	4	1	7	1	3	0	0	3	1	21	4	1
458.3	0	2	1	0	0	0	0	0	2	0	0	7	1	15	0	1
458.4	2	0	5	1	0	1	4	5	2	1	0	7	1	34	0	2
458.5	0	0	0	0	0	1	1	1	0	1	0	5	0	18	0	1
461	0	0	3	0	7	1	10	0	0	0	0	0	0	0	4	1
500.1	0	0	3	0	1	0	2	0	0	0	0	1	5	1	3	0
500.2	1	0	1	0	3	6	8	4	0	0	0	1	0	0	1	1
505	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
538	1	1	1	2	4	8	18	5	0	1	0	0	1	8	4	0
557	0	0	0	0	4	0	7	0	0	0	0	0	0	0	10	0
561	1	0	1	0	3	2	4	1	1	0	2	14	3	10	0	1
604	12	10	1	0	0	8	3	0	0	0	0	0	0	16	3	0
609.1	1	0	1	0	4	1	7	8	0	0	0	0	6	2	2	2
609.2	2	2	8	0	1	2	4	0	0	0	0	3	22	1	2	0
627.1	0	1	2	0	1	0	5	1	0	0	0	0	0	1	2	4
627.2	2	0	1	0	1	0	7	0	0	0	0	0	1	0	5	1
631	0	0	0	0	0	3	0	1	1	0	1	0	0	0	0	3
635.1	0	0	3	1	8	1	15	3	1	0	0	0	1	3	0	0

635.2	0	0	0	0	0	1	1	1	3	0	0	2	0	24	0	11
635.3	0	0	0	0	0	0	1	2	1	0	0	8	3	20	0	0
635.4	0	0	0	0	1	0	12	2	0	0	0	0	0	0	0	1
700.1	0	0	2	0	1	1	20	7	0	0	0	0	0	0	1	0
724.1	0	1	2	2	3	2	3	0	0	0	1	0	1	2	4	2
724.2	0	0	0	0	4	3	13	4	0	1	0	0	0	0	3	0
731	1	0	2	0	4	4	8	6	0	0	0	0	0	3	6	3
737	1	0	1	0	4	2	19	4	1	0	0	0	1	8	3	0
800.1	3	2	3	0	5	0	18	2	0	0	0	0	1	4	3	0
800.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
802.1	0	1	2	0	1	0	1	0	6	7	0	0	9	6	0	0
802.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
809	2	1	4	1	5	1	6	1	3	2	0	4	2	1	1	0
819	2	1	4	0	4	2	4	1	2	4	1	0	2	5	7	1
827	0	0	0	0	4	0	20	2	0	0	0	0	2	4	10	0
832.1	0	1	0	0	1	0	0	0	3	0	6	3	1	19	3	2
832.2	2	5	2	10	4	1	8	2	0	1	0	1	6	6	3	2
838.1	3	0	5	1	2	3	37	6	1	1	0	0	5	3	4	0
838.2	0	0	1	0	2	2	16	2	2	1	0	0	3	2	3	0
838.3	0	0	0	0	1	1	12	6	2	0	0	1	2	3	4	0
841.1	0	0	0	1	2	1	11	3	2	0	0	1	2	4	1	0
841.2	1	0	1	0	9	1	17	6	0	2	0	2	0	9	9	1
844	0	3	1	1	0	2	1	1	2	1	0	0	3	4	0	2
858	2	0	0	0	4	2	5	2	12	1	0	8	18	10	0	1
900.1	0	0	3	0	1	2	3	2	0	0	0	0	3	0	2	0
900.2	3	0	0	0	1	0	2	2	1	0	0	2	10	8	1	4
903.1	2	0	1	0	1	0	4	5	0	0	0	0	13	1	0	0
903.2	0	0	1	0	3	1	7	1	0	1	0	2	3	1	3	0
903.3	1	0	1	0	6	1	6	6	0	0	0	1	2	4	5	4
903.4	1	0	2	0	3	0	2	2	1	0	0	2	5	9	9	2
903.5	1	0	0	0	2	0	1	2	0	0	0	0	8	4	0	0
906.1	1	0	0	0	3	1	3	2	2	2	0	1	1	1	3	1
906.2	0	0	3	0	3	2	3	5	0	0	0	0	9	7	1	2
910	1	2	7	2	1	4	6	7	0	1	0	2	1	10	3	0
919.1	1	0	0	0	1	1	3	1	1	0	0	0	5	2	3	2
919.2	0	0	0	0	0	0	0	1	0	0	0	3	4	23	0	0
930	1	1	8	0	2	0	8	4	2	0	0	0	2	7	1	0
934	1	0	1	0	0	0	6	0	0	0	0	0	9	2	1	0

1003.1	0	0	0	0	3	2	3	3	0	2	0	1	4	5	4	0
1003.2	0	0	1	0	1	0	0	0	1	1	0	0	5	9	0	3
1003.3	1	0	4	2	2	1	10	3	0	0	0	0	0	4	10	4
419.1.1	0	0	0	0	0	5	1	21	0	0	0	0	0	0	0	1
419.1.2	0	0	0	0	0	0	0	4	10	0	0	13	0	39	0	0
419.1.3	0	0	0	0	3	0	7	0	7	0	0	12	0	56	2	0
419.2.1	0	0	2	1	3	1	4	4	0	0	0	5	1	17	3	0
419.2.2	0	0	0	0	0	0	0	0	1	0	0	36	0	40	0	0
419.2.3	0	0	0	0	0	0	2	2	0	0	0	20	3	33	1	0
43.05.01	0	1	0	0	7	3	6	1	0	2	0	2	2	7	7	2
43.07.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43.08.05	3	0	8	0	4	0	7	2	0	1	0	1	4	4	8	1
43.14.03	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
43.15.01	2	1	2	0	0	2	2	4	1	4	0	2	5	11	1	2
43.20.03	1	0	0	0	4	0	4	1	0	0	0	1	1	1	10	2
I0027	1	1	1	0	2	1	0	3	0	0	0	0	0	5	1	2

sample #	lvi K porph maf	lvi K porph maf oxy alt	lvi K apha homo	lvi K apha hetero	lvm basalt	lvm basalt oxy alt	lvm other	lvv obs	lvv tuft	lvh	lvh oxy alt	2nd qtz	lvs	lsch	caco	other min
001	0	0	1	1	1	2	2	0	2	0	0	0	0	0	0	1
01.04.04	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
01.11.05	0	0	0	0	0	0	0	1	0	0	3	0	0	1	0	1
01.18.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06.01.01	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
06.01.03	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1
06.01.04	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0
011	0	0	2	0	0	0	1	55	0	2	0	0	0	0	0	0
16.05.05	0	1	5	42	0	0	0	0	1	0	4	0	0	0	0	0
16.13.03	0	0	0	0	0	0	0	0	0	1	3	0	0	1	0	0
16.15.01	0	13	2	40	0	0	0	0	0	0	0	0	0	0	0	0
019	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
21.01.04	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
21.05.02	0	3	12	16	0	0	0	0	14	0	1	0	0	0	0	0
21.07.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24.01.02	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
24.01.05	0	0	8	2	1	0	0	0	1	0	2	0	0	0	5	0
24.03.01	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
26.01.05	0	0	14	2	0	0	0	0	1	0	4	0	0	0	2	0
26.04.03	0	0	5	3	0	0	1	0	1	0	2	0	0	0	0	0
26.06.01	0	0	8	9	0	0	0	0	3	0	4	0	0	0	1	0
26.07.01	0	0	22	10	0	0	0	0	2	0	3	0	0	0	0	0
26.12.01	0	0	6	1	0	1	1	0	1	0	2	0	0	0	0	0
26.13.03	0	0	8	13	0	0	0	0	1	0	1	0	0	0	0	0
029	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
033	0	0	1	0	0	0	0	0	0	1	3	0	0	0	0	0
35.04.0	0	1	15	2	0	0	0	0	1	0	1	0	0	0	2	0

3																
35.09.02	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
35.10.03	0	1	6	2	0	0	0	0	0	0	0	0	0	0	2	0
39.12	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0
040	0	0	1	0	0	0	0	0	0	0	10	0	0	0	0	0
52.04	0	0	0	0	0	0	0	0	0	0	7	0	0	0	1	0
083	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
093.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
093.2	0	0	3	28	0	0	1	0	3	0	2	0	0	0	2	0
107	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
114.1	1	0	0	1	2	0	7	0	1	0	0	0	1	0	0	0
114.2	0	0	13	1	0	0	2	1	12	0	10	0	0	0	0	0
114.3	0	0	0	15	0	0	0	0	1	0	0	0	0	0	0	0
114.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
114.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
136	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
137	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
148.1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
148.2	0	0	0	5	3	2	1	0	2	0	3	0	0	0	0	0
148.3	0	0	4	0	0	0	0	0	1	0	3	0	0	0	0	1
157	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5	0
159	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1
177	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
208	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0
308	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0
315.1	0	0	0	1	0	0	0	0	4	0	0	0	0	0	1	0
315.2	0	2	0	4	0	0	1	0	2	0	1	0	0	0	1	0
406	0	0	1	0	0	0	0	0	2	0	0	0	0	0	1	0
408.1	0	1	1	8	0	0	0	0	1	0	0	2	0	0	0	0
408.2	0	0	1	8	0	0	3	0	3	0	1	0	0	0	0	0
408.3	0	0	6	10	0	0	2	0	0	0	12	1	0	0	0	0
408.4	1	1	9	3	0	0	0	1	4	0	4	0	0	0	3	0
408.5	1	7	7	5	0	0	1	0	3	0	4	0	1	0	0	0

419.3	0	0	2	0	0	0	0	0	4	0	3	0	0	0	0	0
446	0	1	10	4	0	0	0	0	0	0	0	0	0	0	2	0
449	0	2	13	6	0	0	1	0	3	0	1	0	0	0	0	0
453	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0
458.1	0	2	9	6	0	0	0	2	4	0	2	0	0	0	0	0
458.2	0	3	3	0	0	0	0	0	0	0	8	0	0	0	0	0
458.3	0	0	2	3	0	0	0	0	5	0	0	0	0	0	0	0
458.4	0	2	4	2	0	0	2	0	4	0	3	0	0	0	0	0
458.5	0	0	5	3	0	0	2	0	2	0	0	0	0	0	0	0
461	1	0	3	23	0	1	0	0	3	0	0	0	1	0	0	0
500.1	0	1	10	3	0	0	0	0	2	0	0	0	0	0	0	0
500.2	0	6	9	1	0	0	0	0	3	0	6	0	0	0	2	0
505	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0
538	0	0	11	12	0	0	0	1	2	0	2	0	0	0	0	0
557	0	0	5	39	0	0	0	1	5	0	2	0	1	0	0	0
561	6	0	1	17	0	0	0	0	0	0	0	0	0	0	0	0
604	2	1	2	49	0	0	0	0	0	0	1	0	0	0	0	0
609.1	1	1	9	4	0	0	0	1	1	0	6	0	0	0	0	0
609.2	0	0	22	7	0	0	0	0	1	0	5	0	0	0	0	0
627.1	0	0	14	5	0	0	0	0	3	0	2	0	0	0	0	0
627.2	0	0	4	0	0	0	0	0	0	0	3	0	0	0	0	0
631	3	2	2	11	0	0	0	0	1	0	1	0	0	0	0	0
635.1	0	0	3	1	0	0	0	0	0	0	14	0	0	0	0	0
635.2	0	4	0	5	0	0	0	0	0	0	1	0	0	0	0	0
635.3	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
635.4	0	0	7	1	0	0	0	0	2	0	1	0	0	0	0	0
700.1	0	0	5	0	0	0	0	0	1	0	4	1	0	0	0	0
724.1	0	0	19	9	0	0	0	1	10	0	1	0	1	0	0	0
724.2	0	6	6	3	0	0	0	0	2	0	2	1	0	0	2	0
731	0	2	7	9	0	0	0	0	1	0	1	0	0	0	0	0
737	0	0	3	3	0	0	0	3	2	0	6	0	0	0	0	0
800.1	0	0	6	1	0	0	0	1	2	0	6	1	0	0	0	0
800.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
802.1	1	0	2	0	0	0	2	0	6	0	3	0	0	0	0	0
802.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
809	0	3	9	5	0	0	0	0	5	0	1	0	0	0	1	0

819	1	0	7	3	0	0	0	0	0	0	1	0	0	0	1	0
827	1	0	6	10	0	0	0	0	11	0	7	2	0	0	4	0
832.1	1	0	2	1	0	0	0	0	0	0	1	0	0	0	0	0
832.2	0	2	8	4	0	0	0	0	2	0	5	0	0	0	2	0
838.1	0	1	9	3	0	0	0	0	0	0	7	0	0	0	2	0
838.2	0	0	14	5	0	0	0	1	2	0	4	0	0	0	0	0
838.3	0	0	9	6	0	0	0	0	2	0	3	0	0	0	2	0
841.1	0	1	1	3	0	0	0	0	1	0	6	0	0	0	1	0
841.2	0	1	11	3	0	0	0	0	2	0	6	0	0	0	0	0
844	0	0	20	5	0	0	0	1	5	0	9	0	0	0	0	0
858	0	0	2	2	0	0	0	0	2	0	6	0	0	0	2	0
900.1	0	0	11	2	2	1	0	0	5	0	0	0	0	0	0	0
900.2	0	1	10	4	0	0	1	0	5	0	2	0	0	0	1	0
903.1	0	0	1	1	0	0	1	0	2	0	3	0	0	0	2	0
903.2	0	2	10	2	1	0	0	0	4	0	5	0	0	0	2	0
903.3	0	4	2	1	0	0	1	0	2	0	3	0	0	0	6	0
903.4	1	0	21	4	0	0	0	1	5	0	4	0	0	0	0	0
903.5	2	0	6	1	0	0	0	0	0	0	5	0	0	0	0	0
906.1	0	0	15	2	0	0	0	1	2	0	6	1	0	0	1	0
906.2	0	3	7	10	0	0	0	0	1	0	2	0	0	0	2	0
910	0	7	4	10	0	0	0	0	6	0	2	2	0	0	0	0
919.1	1	0	16	3	0	0	0	1	2	0	3	1	0	0	1	0
919.2	0	1	2	7	0	0	0	1	2	0	5	0	0	0	0	0
930	0	0	12	3	0	0	0	0	1	0	1	0	0	0	1	0
934	0	0	1	1	0	0	0	0	1	0	3	0	0	0	1	0
1003.1	0	0	7	1	0	0	1	0	2	0	11	0	0	0	10	0
1003.2	0	0	14	6	2	0	0	1	7	0	5	1	0	0	6	0
1003.3	0	0	29	9	0	0	0	0	10	0	0	0	0	0	0	0
419.1.1	0	20	0	77	0	0	0	0	0	0	3	0	0	0	0	0
419.1.2	0	2	2	16	0	0	1	0	1	0	1	0	0	0	0	0
419.1.3	0	1	1	0	0	0	0	0	2	0	3	0	0	0	0	0
419.2.1	1	4	3	0	0	0	4	0	2	0	4	0	0	0	0	0
419.2.2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
419.2.3	0	0	1	0	0	0	3	0	6	0	0	0	0	0	0	0

43.05.01	2	2	11	1	0	0	0	0	5	0	4	0	0	0	1	0
43.07.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43.08.05	0	8	21	8	1	0	0	0	1	0	1	0	0	0	8	1
43.14.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43.15.01	0	1	15	8	0	0	0	1	4	0	3	0	0	0	0	0
43.20.03	0	3	17	3	0	0	0	0	2	0	8	0	0	0	0	0
I0027	0	0	2	38	0	0	0	0	0	0	1	0	0	0	0	0

sample #	un-known	oxide	sericite	idding-site	other alt	sqtz	skspar	splag	lmss	qtz	kspar	micr	plag	plagal	plaggn	musc
001	1	2	0	0	0	14	12	6	0	24	11	2	0	27	1	1
01.04.04	0	2	0	0	0	6	0	3	0	23	10	5	14	27	1	0
01.11.05	0	0	1	0	0	5	6	8	0	11	16	2	14	14	2	0
01.18.05	0	1	1	0	0	6	7	9	0	18	17	7	8	25	2	0
004	0	0	0	0	0	4	12	12	0	16	22	0	0	65	0	0
06.01.01	0	1	0	0	0	11	12	4	0	17	8	5	13	8	0	0
06.01.03	0	1	0	2	0	6	9	9	0	24	9	3	24	15	0	0
06.01.04	0	3	0	0	0	3	2	6	0	17	7	7	14	15	2	0
011	0	0	0	0	0	0	0	0	0	2	3	0	3	4	0	0
16.05.05	0	8	0	0	0	0	0	3	0	1	2	0	0	6	0	0
16.13.03	0	0	0	0	0	10	7	5	0	14	9	2	13	4	0	0
16.15.01	0	4	0	0	0	0	1	0	0	0	4	0	2	11	0	0

019	0	2	0	0	0	2	16	9	0	25	36	0	13	19	0	1
21.01.04	0	2	2	0	0	10	10	3	0	12	8	0	13	8	0	0
21.05.02	0	3	0	0	0	1	0	0	0	4	0	0	3	1	0	0
21.07.03	0	0	0	0	0	5	10	17	0	11	13	2	5	24	3	0
24.01.02	0	1	0	1	0	0	0	0	0	5	2	0	6	4	0	0
24.01.05	0	2	0	0	0	1	0	0	0	9	2	0	4	20	0	0
24.03.01	0	0	0	0	1	8	5	7	0	10	8	2	0	16	0	0
26.01.05	0	1	0	0	0	1	1	0	0	3	4	0	2	3	0	0
26.04.03	0	0	0	0	0	0	0	1	0	9	1	0	3	7	0	0
26.06.01	0	0	0	0	0	0	0	0	0	13	5	0	3	11	0	0
26.07.01	0	1	0	0	0	0	1	0	0	10	8	0	6	12	0	0
26.12.01	0	0	0	0	0	0	1	0	0	6	7	0	11	10	0	2
26.13.03	0	2	0	0	0	0	2	0	0	6	3	0	8	13	0	0
029	0	0	0	0	0	13	5	4	0	21	18	4	0	38	1	0
033	1	1	0	0	0	10	7	1	0	28	24	4	9	6	1	0
35.04.03	0	0	0	0	0	0	0	0	0	3	0	0	0	6	0	0
35.09.02	0	2	1	0	0	1	4	0	0	22	8	10	4	14	0	0
35.10.03	0	1	0	0	0	0	0	2	0	3	1	0	0	3	0	0
39.12	0	0	0	0	0	0	0	0	0	2	0	0	1	6	0	0
040	0	3	0	0	0	14	6	8	0	18	4	3	0	14	1	0
52.04	0	1	0	0	0	2	1	8	0	40	5	2	0	33	1	0
083	0	4	0	0	1	1	3	1	0	28	22	0	2	30	0	0
093.1	0	1	0	0	0	2	1	3	0	15	10	0	0	17	1	0
093.2	0	1	0	0	0	0	0	0	0	7	2	0	0	6	0	0
107	0	0	0	0	0	2	7	3	0	25	20	0	0	30	1	0
114.1	0	1	0	0	0	1	0	0	0	4	0	0	0	6	0	0

114.2	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0
114.3	0	3	0	0	0	0	0	0	0	7	1	0	0	6	0	0
114.4	1	0	0	0	0	1	6	5	0	21	4	0	4	15	1	0
114.5	0	1	0	0	0	2	5	12	0	26	20	0	0	9	1	0
136	0	0	0	0	0	1	0	3	0	25	18	0	0	5	3	0
137	0	0	0	0	0	2	5	3	0	35	20	0	19	7	0	0
148.1	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0
148.2	0	4	0	0	0	3	1	7	0	8	5	0	0	14	2	0
148.3	0	0	0	0	0	6	3	3	0	16	7	3	2	12	1	0
157	0	0	0	0	0	18	3	6	0	27	9	4	0	13	0	0
159	1	1	0	0	0	14	6	2	0	16	29	2	5	14	2	0
177	0	0	1	0	0	2	3	0	0	29	10	1	1	15	2	0
208	1	0	0	0	1	2	0	4	0	19	16	1	14	23	1	2
308	1	1	0	0	0	5	4	1	0	26	14	5	6	11	1	0
315.1	0	1	0	0	0	5	4	0	0	21	23	4	0	2	0	0
315.2	0	0	0	0	0	0	0	0	0	8	1	0	0	8	1	0
406	0	0	0	0	0	3	7	5	0	36	24	1	2	24	2	0
408.1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
408.2	0	1	0	0	0	0	0	0	0	2	0	0	0	11	0	0
408.3	0	2	0	0	0	1	0	0	0	4	2	0	0	15	0	0
408.4	0	8	0	0	0	1	0	1	0	15	0	0	0	3	1	0
408.5	0	9	0	0	0	0	0	0	0	1	0	0	1	2	0	0
419.3	1	2	1	0	2	6	6	8	0	20	22	0	8	30	0	0
446	0	6	0	0	0	0	0	0	0	9	3	0	2	10	0	0
449	0	2	0	0	0	0	0	0	0	3	0	0	0	9	1	0
453	0	0	0	0	0	3	10	3	0	38	22	0	2	22	0	1
458.1	0	11	0	0	0	0	0	0	0	4	1	0	1	6	0	0
458.2	0	4	0	0	0	0	0	0	0	1	0	0	0	3	0	0
458.3	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0
458.4	0	6	0	0	0	0	0	0	0	0	0	0	0	8	0	0
458.5	0	4	0	1	0	0	0	0	0	1	0	0	0	3	0	0
461	0	0	0	0	0	1	0	0	0	4	1	0	0	4	0	0
500.1	0	4	0	0	0	0	0	0	0	2	2	0	2	3	0	0
500.2	0	4	0	0	0	0	0	1	0	22	5	0	0	6	0	0

505	0	0	0	1	0	8	8	7	0	36	22	0	1	19	0	0
538	0	6	0	0	0	0	0	1	0	12	1	0	0	7	0	0
557	0	2	0	0	0	1	0	2	0	5	3	0	0	7	0	0
561	0	6	0	0	0	0	0	0	0	4	2	0	1	16	0	0
604	0	4	0	0	0	2	0	0	0	1	0	0	0	5	0	0
609.1	0	4	0	0	0	1	0	0	0	9	9	0	6	21	0	0
609.2	0	7	0	0	0	0	0	0	0	4	0	0	0	9	0	0
627.1	0	5	0	0	0	0	2	1	0	10	7	0	4	10	0	0
627.2	0	4	0	0	0	12	5	6	0	25	12	2	0	20	0	0
631	0	3	0	0	1	0	0	1	0	1	2	0	0	8	0	0
635.1	0	2	0	0	0	0	1	13	0	2	1	0	0	20	0	0
635.2	0	2	0	0	0	0	0	0	0	1	0	0	0	5	0	0
635.3	0	5	0	0	0	0	0	0	0	1	0	0	0	3	0	0
635.4	0	4	0	0	0	0	0	0	0	14	0	0	0	9	0	0
700.1	0	3	0	0	0	0	0	0	0	4	0	0	0	2	0	0
724.1	0	5	0	0	0	0	0	0	0	3	2	0	3	3	0	0
724.2	0	4	0	0	0	0	0	0	0	4	1	0	0	10	0	0
731	0	2	0	0	0	0	1	1	0	7	2	0	0	9	0	0
737	0	2	0	0	0	0	0	0	0	10	1	0	0	13	0	0
800.1	0	2	0	0	0	0	0	0	0	11	2	1	2	17	0	0
800.2	0	0	0	0	0	3	1	3	0	34	26	4	1	10	0	0
802.1	0	5	0	0	0	0	0	0	0	11	0	0	6	7	0	1
802.2	0	0	0	0	0	2	0	1	0	24	25	2	8	8	0	0
809	0	6	0	0	0	1	0	0	0	5	1	0	2	7	0	0
819	0	5	0	0	0	1	0	1	0	3	4	0	5	7	0	0
827	0	2	0	0	0	0	0	0	0	8	6	0	0	8	0	1
832.1	0	0	0	0	0	0	0	0	0	2	1	0	1	15	0	0
832.2	0	2	0	0	0	3	0	1	0	8	4	0	1	17	0	0
838.1	0	9	0	0	0	2	0	1	0	8	1	0	0	13	0	0
838.2	0	5	0	0	0	0	0	0	0	8	0	0	0	7	0	0
838.3	0	3	0	0	0	0	0	0	0	3	3	0	0	6	0	0
841.1	0	4	0	0	0	0	0	0	0	5	0	0	0	6	0	0
841.2	0	8	0	0	0	1	0	0	0	8	3	0	0	16	0	0
844	0	7	0	0	0	0	0	1	0	10	6	0	0	9	0	0
858	0	5	0	0	0	1	0	1	0	4	0	0	0	4	0	0
900.1	0	6	0	0	0	1	0	1	0	9	2	0	1	5	0	0
900.2	0	9	0	0	0	1	0	3	0	9	0	0	1	13	0	0

903.1	0	8	0	0	0	11	2	4	7	14	3	0	0	14	1	0
903.2	0	4	0	0	0	0	0	0	0	11	1	0	1	6	0	0
903.3	0	4	0	0	0	1	0	0	0	11	2	0	0	9	0	0
903.4	0	5	0	0	0	3	0	2	0	10	4	0	1	19	0	0
903.5	0	1	0	0	0	0	0	0	0	3	1	0	0	5	0	0
906.1	0	2	0	0	0	2	0	0	0	3	0	0	0	8	0	0
906.2	0	10	0	0	0	1	0	0	0	5	1	0	0	7	0	0
910	0	4	0	0	0	0	0	0	0	7	4	0	0	3	0	0
919.1	0	1	0	0	0	0	0	0	0	4	3	0	1	8	0	0
919.2	0	3	0	0	0	0	0	0	0	2	0	0	0	5	1	0
930	0	2	0	0	0	1	0	0	0	4	0	0	1	10	0	0
934	1	1	0	0	0	6	0	13	0	36	12	4	8	22	0	0
1003.1	0	7	0	0	0	0	0	2	0	8	3	0	1	14	0	0
1003.2	0	5	0	0	0	0	1	2	0	15	3	0	0	12	0	0
1003.3	0	1	0	0	0	1	0	0	0	5	2	0	0	12	0	0
419.1.1	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0
419.1.2	0	5	0	1	0	0	0	0	0	1	0	0	0	2	0	0
419.1.3	0	2	0	0	0	0	0	1	0	0	0	0	0	11	0	0
419.2.1	0	2	0	0	0	0	0	0	0	0	0	0	0	5	0	0
419.2.2	0	9	0	0	0	0	0	0	0	2	0	0	0	9	0	0
419.2.3	0	8	0	0	0	0	0	0	0	1	0	0	0	4	0	0
43.05.01	0	4	0	0	0	0	2	0	0	4	1	0	1	16	0	0
43.07.03	0	0	0	0	0	3	1	4	0	9	12	2	6	25	0	0
43.08.05	0	6	0	0	1	0	0	0	0	3	0	0	2	14	2	0
43.14.03	0	0	0	0	0	6	2	2	0	9	8	1	7	9	0	0
43.15.01	0	5	0	0	0	0	0	1	0	6	3	0	5	20	0	0
43.20.03	0	4	0	0	0	0	1	0	0	5	6	0	1	16	0	0
I0027	0	2	0	0	0	0	0	0	0	1	1	0	0	2	0	0

sample #	biot	pyr	amph	opaq	epi cry	epi apha	paste	void	lvi oxy alt & maf porph & hetero	lvi & lvf exlcu-oxy alt, hetero, & maf	total mineral	total geog	total non geo	total points counted
001	0	0	0	3	0	0	136	28	1	1	98	114	164	278
01.04.04	0	0	0	1	0	0	133	38	0	3	89	98	171	269
01.11.05	0	0	1	0	0	0	166	51	0	5	79	93	217	310
01.18.05	0	0	1	2	0	0	111	55	0	4	100	109	166	275
004	0	0	2	2	2	2	187	25	0	0	133	140	212	352
06.01.01	0	0	0	0	1	0	147	39	0	1	78	84	186	270
06.01.03	0	0	0	3	0	1	162	38	0	4	99	113	200	313
06.01.04	0	0	2	2	0	0	97	36	0	0	75	83	133	216
011	0	0	0	0	0	0	168	14	1	6	12	77	182	259
16.05.05	0	0	0	2	0	0	113	20	44	17	12	89	133	222
16.13.03	0	0	0	1	0	0	136	16	0	3	64	73	152	225
16.15.01	0	0	1	6	1	0	202	15	55	3	19	89	217	306
019	0	0	2	4	0	1	114	46	2	9	123	142	160	302
21.01.04	0	0	3	5	1	0	139	32	0	6	67	85	171	256
21.05.02	0	0	0	12	0	0	243	9	33	16	9	89	252	341
21.07.03	0	0	1	3	0	0	130	35	0	0	91	94	165	259
24.01.02	0	0	0	0	0	0	146	15	0	4	17	26	161	187
24.01.05	0	0	1	9	0	0	185	24	4	32	37	95	209	304
24.03.01	0	0	0	1	0	0	83	22	0	3	56	62	105	167
26.01.05	0	1	0	3	0	0	194	52	5	35	15	66	246	312
26.04.03	0		0	1	0	0	141	47	5	26	21	60	188	248
26.06.01	1	0	0	2	0	0	188	29	11	25	33	82	217	299
26.07.01	0	0	0	7	0	0	180	15	13	42	37	110	195	305
26.12.01	0	0	0	2	0	1	139	31	2	12	37	59	170	229
26.13.03	0	1	0	5	0	0	200	30	15	26	33	88	230	318
029	0	0	0	0	0	1	188	64	1	5	104	117	252	369
033	0	0	0	3	1	0	199	30	1	1	90	103	229	332
35.04.03	0	1	1	1	0	3	109	10	7	43	11	71	119	190
35.09.02	0	0	0	1	0	0	137	19	0	0	63	70	156	226
35.10.03	0	0	0	2	1	1	127	27	6	30	9	57	154	211

39.12	1	0	0	4	0	0	104	16	91	5	10	110	120	230
040	0	1	0	1	0	0	154	13	0	4	69	88	167	255
52.04	0	1	0	4	0	1	135	25	0	8	93	115	160	275
083	1	0	0	2	0	0	128	20	0	3	88	98	148	246
093.1	0	0	0	8	0	0	110	8	0	0	49	58	118	176
093.2	0	0	0	6	0	0	88	7	41	22	15	94	95	189
107	0	0	0	0	0	0	243	30	1	4	88	93	273	366
114.1	0	0	0	3	0	0	144	29	51	20	11	99	173	272
114.2	0	0	0	6	0	0	80	8	1	28	1	64	88	152
114.3	0	0	0	4	0	0	105	6	35	31	14	89	111	200
114.4	1	0	1	5	0	0	121	19	0	4	59	71	140	211
114.5	0	0	0	2	0	0	166	43	1	4	75	85	209	294
136	0	0	0	1	0	0	117	28	0	5	55	63	145	208
137	0	0	0	2	0	0	195	31	0	5	91	100	226	326
148.1	0	0	0	2	0	0	116	1	80	0	3	88	117	205
148.2	0	0	0	1	0	2	171	25	6	19	40	83	196	279
148.3	0	1	0	4	0	0	100	4	0	8	54	71	104	175
157	0	0	0	0	1	0	228	16	0	5	80	92	244	336
159	0	0	0	4	1	0	106	11	1	4	90	103	117	220
177	0	0	0	2	0	0	173	15	0	3	63	71	188	259
208	0	0	4	3	0	0	193	27	1	1	86	96	220	316
308	0	0	0	2	0	0	187	38	2	3	73	83	225	308
315.1	0	0	0	0	0	0	214	21	1	4	59	70	235	305
315.2	0	0	1	6	0	0	129	8	38	40	19	109	137	246
406	0	0	0	0	1	0	177	47	0	2	104	110	224	334
408.1	0	0	0	2	0	0	136	7	47	21	4	78	143	221
408.2	0	0	0	9	0	1	163	13	41	19	13	91	176	267
408.3	0	0	0	7	0	0	178	20	53	35	22	135	198	333
408.4	0	0	0	6	1	2	210	21	11	40	21	110	231	341
408.5	0	0	1	7	0	0	136	25	22	17	5	71	161	232
419.3	0	0	0	4	0	0	155	44	0	4	100	122	199	321
446	0	0	0	2	0	0	152	25	11	34	24	82	177	259
449	0	0	0	6	0	0	134	15	27	27	13	85	149	234
453	0	0	0	4	0	2	168	30	1	4	101	115	198	313

458.1	0	0	0	3	0	0	100	6	12	10	12	56	106	162
458.2	0	0	0	2	0	0	126	24	28	33	4	81	150	231
458.3	0	0	0	3	0	0	135	4	26	6	2	47	139	186
458.4	0	0	0	5	0	0	146	17	48	18	8	101	163	264
458.5	0	0	0	5	0	0	105	10	28	6	4	54	115	169
461	0	1	0	3	0	0	211	28	25	27	11	72	239	311
500.1	0	0	0	6	0	0	112	9	6	24	9	51	121	172
500.2	0	0	0	6	0	0	178	15	9	23	34	97	193	290
505	0	0	0	2	1	1	215	18	0	2	101	111	233	344
538	0	1	0	5	0	4	156	8	21	40	22	119	164	283
557	0	0	0	6	0	0	143	33	39	26	18	100	176	276
561	0	0	0	6	0	0	154	24	50	14	23	102	178	280
604	0	0	0	4	0	0	212	15	68	21	8	124	227	351
609.1	0	0	0	6	0	0	139	27	10	30	46	113	166	279
609.2	0	0	0	3	0	0	183	9	11	61	13	105	192	297
627.1	2	0	1	5	0	2	201	19	10	24	37	90	220	310
627.2	0	0	0	5	0	0	133	10	1	21	82	116	143	259
631	0	0	0	3	0	0	96	12	20	3	12	48	108	156
635.1	0	0	0	4	0	3	196	21	4	31	37	100	217	317
635.2	0	0	0	4	0	0	114	10	46	4	6	65	124	189
635.3	0	0	0	3	0	0	129	4	29	7	4	50	133	183
635.4	0	0	0	3	0	2	122	17	2	20	23	59	139	198
700.1	0	0	0	0	1	1	211	7	0	29	6	54	218	272
724.1	0	0	0	3	0	0	202	18	14	32	11	83	220	303
724.2	0	0	0	4	0	1	127	11	10	26	15	74	138	212
731	1	0	0	2	1	1	115	39	17	28	21	84	154	238
737	0	0	0	11	0	0	100	41	11	33	24	98	141	239
800.1	0	2	0	6	0	3	183	29	5	39	35	104	212	316
800.2	0	0	0	4	0	0	192	25	0	1	82	87	217	304
802.1	0	0	0	10	0	0	163	15	14	21	25	87	178	265
802.2	0	0	1	0	0	0	180	13	0	0	71	71	193	264
809	0	1	0	3	0	0	139	38	15	32	17	84	177	261
819	0	0	0	0	1	0	121	38	15	32	21	80	159	239
827	0	0	0	7	0	1	172	29	15	42	23	116	201	317
832.1	0	0	0	1	0	0	111	8	32	10	19	64	119	183
832.2	0	0	0	3	0	0	186	40	16	33	34	115	226	341
838.1	0	0	0	4	0	1	192	16	8	66	25	132	208	340
838.2	0	0	1	2	0	0	97	21	8	41	16	83	118	201

838.3	0	0	0	4	0	2	124	13	10	30	12	75	137	212
841.1	0	0	0	4	0	0	141	12	9	19	11	60	153	213
841.2	0	0	0	3	1	0	157	17	18	48	28	121	174	295
844	0	0	0	4	0	0	187	14	12	27	26	98	201	299
858	0	0	0	4	0	1	123	18	22	43	10	99	141	240
900.1	0	0	0	0	0	0	143	12	2	23	19	62	155	217
900.2	0	0	0	4	0	0	124	12	19	28	27	98	136	234
903.1	0	0	0	3	0	0	174	8	2	22	49	104	182	286
903.2	0	0	0	0	1	2	164	4	8	27	19	75	168	243
903.3	0	0	0	8	0	0	119	6	14	23	23	91	125	216
903.4	0	0	0	8	1	1	120	15	18	44	39	128	135	263
903.5	0	0	0	1	0	1	120	13	7	18	9	44	133	177
906.1	0	0	0	2	0	0	183	11	7	28	13	66	194	260
906.2	0	0	0	4	1	2	193	16	22	26	14	91	209	300
910	0	0	0	5	0	1	145	30	30	23	14	102	175	277
919.1	0	0	0	4	0	1	165	10	8	30	16	70	175	245
919.2	0	0	0	5	1	0	73	20	34	6	8	66	93	159
930	0	0	0	4	0	4	145	23	10	36	16	80	168	248
934	0	0	0	1	0	0	171	8	3	19	101	131	179	310
1003.1	0	0	0	3	2	0	177	19	9	21	28	99	196	295
1003.2	0	0	0	1	1	1	178	20	19	22	33	104	198	302
1003.3	0	0	0	3	1	1	157	40	17	56	20	115	197	312
419.1.1	0	0	0	3	0	0	133	15	98	1	1	134	148	282
419.1.2	1	0	0	1	0	0	130	10	70	12	4	100	140	240
419.1.3	0	0	0	1	0	0	102	6	69	20	12	109	108	217
419.2.1	0	0	1	4	0	0	164	25	27	16	6	71	189	260
419.2.2	0	0	0	7	0	0	174	20	76	1	11	106	194	300
419.2.3	0	1	0	3	0	0	155	17	53	7	6	88	172	260
43.05.01	0	0	0	5	1	3	129	46	18	33	24	103	175	278
43.07.03	0	0	0	0	0	0	73	48	0	0	62	62	121	183
43.08.05	0	0	0	0	1	2	154	29	23	55	21	123	183	306
43.14.03	0	0	0	1	0	1	99	28	0	2	44	48	127	175
43.15.01	1	0	0	5	1	0	160	52	28	28	36	118	212	330
43.20.03	0	0	0	5	0	1	179	11	10	37	29	97	190	287

I0027	0	0	0	1	0	0	145	19	45	7	4	65	164	229

sample #	primary character	secondary character	accessory rocks	accesory minerals	Site	type	sampling
001	granitic		basalt		Son L:2:1	plain	random
01.04.04	granitic				Son L:2:1	plain	qa
01.11.05	granitic				Son L:2:1	plain	qa
01.18.05	granitic				Son L:2:1	plain	qa
004	granitic				Son L:2:1	painted	random
06.01.01	granitic				Son L:2:6	plain	qa
06.01.03	granitic				Son L:2:6	plain	qa
06.01.04	granitic				Son L:2:6	plain	qa
011	**obsidian**				Son L:2:1	textured	random
16.05.05	heterogenous volcanic				Son L:2:22	plain	qa
16.13.03	granitic				Son L:2:22	plain	qa
16.15.01	heterogenous volcanic				Son L:2:22	plain	qa
019	granitic			amphibole / pyroxene	Son L:2:1	textured	random
21.01.04	granitic				Son L:2:26	plain	qa
21.05.02	heterogenous volcanic	vitreous		unique paste	Son L:2:26	plain	qa
21.07.03	granitic				Son L:2:26	plain	qa
24.01.02	granitic				Son L:2:29	plain	qa
24.01.05	mixed granitic/volcanic		basalt		Son L:2:29	plain	qa
24.03.01	granitic				Son L:2:29	plain	qa
26.01.05	mixed volcanic		basalt		Son L:1:17	brushed	qa
26.04.03	mixed volcanic				Son L:1:17	plain	qa

26.06.01	mixed granitic/volcanic				Son L:1:17	plain	qa
26.07.01	homogenous volcanic	heterogenous volcanic			Son L:1:17	plain	qa
26.12.01	granitic	mixed volcanics	basalt		Son L:1:17	plain	qa
26.13.03	mixed granitic/volcanic				Son L:1:17	plain	qa
029	granitic				Son L:2:1	plain	random
033	granitic			epidote	Son L:2:1	brushed	random
35.04.03	mixed volcanic				Son L:1:6	plain	qa
35.09.02	granitic				Son L:1:6	plain	qa
35.10.03	mixed volcanic				Son L:1:6	plain	qa
39.12	heterogenous volcanic			biotite	Son L:2:22	textured	random
040	granitic		moderate volcanics		Son L:2:1	plain	random
52.04	granitic	mixed volcanics			Son L:2:22	textured	random
083	granitic				Son L:2:1	textured	random
093.1	granitic				Son L:2:1	plain	qa
093.2	heterogenous volcanic		high porphyretic		Son L:2:1	plain	qa
107	granitic				Son L:2:1	brushed	random
114.1	heterogenous volcanic				Son L:2:1	plain	qa
114.2	homogenous volcanic				Son L:2:1	plain	qa
114.3	heterogenous volcanic				Son L:2:1	plain	qa
114.4	granitic			zircon	Son L:2:1	plain	qa
114.5	granitic				Son L:2:1	red	random
136	granitic		basalt		Son L:2:1	textured	qa
137	granitic	felsic volcanic			Son L:2:1	textured	random
148.1	heterogenous volcanic				Son L:2:1	plain	qa
148.2	mixed granitic/volcanic				Son L:2:1	plain	qa
148.3	granitic	mixed volcanics		zircon	Son L:2:1	plain	qa
157	granitic				Son L:2:1	textured	random
159	granitic			zircon	Son L:2:1	plain	random
177	granitic				Son L:2:1	red	random
208	**granitic (crushed)**			un-id minerals	Son L:2:1	brushed	random

308	granitic		zircon, arfvedsonite	Son L:2:1	plain-handle	random
315.1	granitic			Son L:2:1	textured	random
315.2	heterogenous volcanic	porphyretic		Son L:2:1	plain	qa
406	granitic		hornblende	Son L:2:22	smudged / plain	random
408.1	heterogenous volcanic		biotite	Son L:2:22	plain	qa
408.2	heterogenous volcanic			Son L:2:22	plain	qa
408.3	heterogenous volcanic			Son L:2:22	plain	qa
408.4	mixed volcanic			Son L:2:22	plain	qa
408.5	mixed volcanic			Son L:2:22	plain	qa
419.3	granitic		arfvedsonite, hornblende	Son L:2:22	plain	random
446	mixed volcanic			Son L:2:22	painted	random
449	mixed volcanic	Fe, Mg Oxides		Son L:2:22	plain	random
453	granitic		arfvedsonite	Son L:2:22	plain fillet rim	random
458.1	mixed volcanic			Son L:2:22	plain	qa
458.2	heterogenous volcanic	mixed volcanics		Son L:2:22	plain	qa
458.3	heterogenous volcanic			Son L:2:22	plain	qa
458.4	heterogenous volcanic			Son L:2:22	plain	qa
458.5	heterogenous volcanic			Son L:2:22	plain	qa
461	heterogenous volcanic			Son L:2:22	plain	random
500.1	mixed volcanic			Son L:2:22	textured	random
500.2	mixed volcanic			Son L:2:22	plain	random
505	granitic			Son L:2:22	brushed	random

538	mixed volcanic		tourmaline	Son L:2:22	plain	random
557	heterogenous volcanic			Son L:2:22	textured	random
561	heterogenous volcanic			Son L:2:22	plain	random
604	heterogenous volcanic			Son L:2:22	plain fillet rim	random
609.1	mixed volcanic	granitic		Son L:2:22	painted	random
609.2	homogenous volcanic	mixed volcanics		Son L:2:22	plain	random
627.1	mixed volcanic	granitic	tourmaline	Son L:2:22	plain	random
627.2	granitic	mixed volcanics		Son L:2:22	plain	random
631	heterogenous volcanic	mixed volcanics		Son L:2:22	textured	random
635.1	hypabyssal granitic	mixed volcanics		Son L:2:22	plain	qa
635.2	heterogenous volcanic	porphyretic		Son L:2:22	plain	qa
635.3	heterogenous volcanic	mixed volcanics		Son L:2:22	plain	qa
635.4	homogenous volcanic	porphyretic	epidote	Son L:2:22	plain	qa
700.1	homogenous volcanic		tourmaline	Son L:1:23	plain	random
724.1	homogenous volcanic	mixed volcanics		Son L:1:23	painted	random
724.2	mixed volcanic			Son L:1:23	plain	random
731	mixed volcanic			Son L:1:23	textured	random
737	mixed volcanic		biotite	Son L:1:23	plain	qa
800.1	mixed volcanic		pyroxenes	Son L:1:23	plain	random
800.2	granitic			Son L:1:23	textured	random
802.1	mixed volcanic	porphyretic		Son L:1:23	painted	random
802.2	granitic			Son L:1:23	textured	random

809	mixed volcanic				Son L:1:23	plain	random
819	mixed volcanic		**limestone**		Son L:1:23	textured	random
827	mixed volcanic	tuff	carbonate		Son L:1:23	red	random
832.1	heterogenous volcanic				Son L:1:23	textured	random
832.2	mixed volcanic				Son L:1:23	painted	random
838.1	homogenous volcanic			hornblende	Son L:1:23	plain	qa
838.2	homogenous volcanic				Son L:1:23	plain	qa
838.3	homogenous volcanic				Son L:1:23	plain	qa
841.1	mixed volcanic				Son L:1:23	plain	qa
841.2	mixed volcanic				Son L:1:23	plain	qa
844	mixed volcanic				Son L:1:23	plain	random
858	mixed volcanic				Son L:1:23	plain	qa
900.1	mixed volcanic		basalt		Son L:1:23	plain	qa
900.2	homogenous volcanic				Son L:1:23	plain	qa
903.1	mixed volcanic	**granitic / metamorphic**		muscovite, pyroxene	Son L:1:23	plain	qa
903.2	mixed volcanic		mafic		Son L:1:23	plain	qa
903.3	mixed volcanic		carbonate		Son L:1:23	plain	qa
903.4	mixed volcanic				Son L:1:23	plain	qa
903.5	mixed volcanic				Son L:1:23	plain	qa
906.1	mixed volcanic				Son L:1:23	plain	qa
906.2	mixed volcanic			calcite	Son L:1:23	plain	qa
910	mixed volcanic				Son L:1:23	brushed	random

919.1	homogenous volcanic			calcite	Son L:1:23	plain	qa
919.2	heterogenous volcanic				Son L:1:23	plain	qa
930	mixed volcanic				Son L:1:23	painted	random
934	granitic			hornblende	Son L:1:23	textured	random
1003.1	mixed volcanic				Son L:1:23	plain	qa
1003.2	mixed volcanic		basalt and obsidian	biotite	Son L:1:23	plain	qa
1003.3	mixed volcanic			tourmaline	Son L:1:23	smudged / plain	random
419.1.1	heterogenous volcanic	porphyretic			Son L:2:22	plain	qa
419.1.2	heterogenous volcanic	Fe, Mg Oxides			Son L:2:22	plain	qa
419.1.3	heterogenous volcanic				Son L:2:22	plain	qa
419.2.1	heterogenous volcanic	mixed volcanics			Son L:2:22	plain	qa
419.2.2	heterogenous volcanic	porphyretic		pyroxene / amphibole in some grains	Son L:2:22	plain	qa
419.2.3	heterogenous volcanic			pyroxene pigonite?	Son L:2:22	plain	qa
43.05.01	mixed volcanic			epidote	Son H:13:2	plain	qa
43.07.03	granitic				Son H:13:2	plain	qa
43.08.05	mixed volcanic		basalt	tourmaline	Son H:13:2	plain	qa
43.14.03	granitic				Son H:13:2	plain	qa
43.15.01	mixed volcanic				Son H:13:2	plain	qa
43.20.03	mixed volcanic				Son H:13:2	plain	qa
I0027	heterogenous volcanic				Son L:2:22	textured	random

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APPENDIX B

Río Sonora Polities: A Reconsideration of Scale and Organization

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Abstract. Eastern Sonora, Mexico plays an important role in macro-scale reconstructions of late period prehispanic political organization in the Greater Northwest/Southwest. Most reconstructions regarding this time period rely heavily on the interpretation of ethnohistoric, Spanish conquest accounts of the 1500s augmented by some archaeological data. Research efforts of the 1970s and 1980s concluded that polities in this region were organizationally complex, played a significant role in long distance trade networks, and exerted considerable political control over substantial territories. Recent research in the Moctezuma Valley refutes most of these interpretations. The research presented in this paper will focus on examining the scale of political organization, which appears very limited. Various lines of evidence support this interpretation including settlement pattern analysis, demographic reconstructions, the distribution of precocities, and stylistic differences in material culture. The conflation of different kinds of interaction spheres and ambiguity in ethnohistoric interpretations led to the original suggestion of large politically unified territories. Specifically, previous ethnohistoric based research took any evidence of peaceful interaction or even communication as indicators of political consolidation. This practice ultimately gave rise to the concept of Sonoran statelets.

Resumen. La zona Este de Sonora en México juega un rol importante dentro de las reconstrucciones a macro-escala sobre la organización política durante el Periodo Prehispánico en el Gran Noroeste/Suroeste. La mayoría de las reconstrucciones para este periodo se basan principalmente en interpretaciones sobre los relatos

etnohistóricos de la conquista Española durante el Siglo XVI, en conjunto con algunos datos arqueológicos. Los esfuerzos de investigación de los años 70s y 80s concluyeron que los sistemas de gobierno en esta región tuvieron una organización compleja, participaron de manera significativa en redes de intercambio a larga distancia y ejercieron control político considerable sobre abundante territorio. La investigación reciente en el Valle de Moctezuma refuta la mayoría de estás interpretaciones. El estudio presentado en este artículo se enfoca en examinar la escala de organización política, que al parecer es bastante limitada. Varias líneas de evidencia apoyan esta interpretación, incluyendo el análisis del patrón de asentamiento, las reconstrucciones demográficas, la distribución de bienes exóticos y las diferencias estilísticas en cultura material. La combinación de los diferentes tipos de esferas de interacción y la ambigüedad en las interpretaciones etnohistóricas condujeron a la sugerencia original sobre territorios abundantes unificados políticamente. En específico, las investigaciones etnohistóricas previas basaban su investigación en cualquier evidencia que indicara interacción pacífica o en la comunicación como indicadores de consolidación política. Estos enfoques terminaron por dar origen al concepto de los pequeños Estados Sonorenses.

This analysis is concerned with identifying the approximate scale of political integration, in the sense defined by Renfrew (1986:2) as the largest consistently functioning, autonomous sociopolitical unit. These units have previously been termed *“polities”,* but as will be shown “local settlement community” is probably a more apt moniker. For logical consistency the term *"polity"* will be maintained for the present. To properly discuss the methods of identifying the boundaries of such units it is necessary to consider the functions they served and how they might be reflected in the archaeological record, a topic of considerable theoretical breadth. Archaeologists utilizing neo-evolutionary models generally treated middle range political systems as integrated wholes, subsuming greater systemic roles as complexity increased (Earle 1987:298). By the time a moderate level of complexity was achieved, generally commensurate with a chiefdom in the classic definition (Service 1962), economic, kinship, and ideological power bases were assumed to be largely coterminous with political authority. Throughout the 1970s a variety of both functionalist and evolutionary models questioned the relative importance of such dimensions of interaction in different organizational schemas, giving rise to a litany of subtypes. Beginning in earnest by the 1980s researchers in turn began to question all typological approaches. Focus was instead shifted to *unpacking* and *deconstructing* the various components of social organization and complexity as a means to better understand both the emergence and maintenance of middle range political systems (Feinman and Neitzel 1984). McGuire (1983) explicitly raised the question of the interplay between various dimensions of interaction. Particular effort was also exerted to move away from simple metrics of stratification to include horizontal measures of differentiation (cf Drennan, et al. 2010; McGuire and Saitta 1996; Rautman 1998). Such studies invariably make note of the difficulty in discerning the situational importance of various hierarchies that exist in any given society. The realization that various dimensions of interaction may be partially or wholly independent of one another leads to the conclusion that the spatial extent of just one form of interaction is inadequate to delineate a political boundary without *a priori* theoretical justification. This is often an easy assumption to make in regards to dimensions that are closely associated with the rise of elite power and its maintenance, such as economic and ideological interactions. Archaeologists also obviously make use of data that are argued to directly correlate to political divisions, most notably demographic/settlement analyses.

Another theoretical point requiring clarification is the nature of *boundaries* as perceived by archaeologists. A number of categorizations have been put fourth that deconstruct the concept along multiples axes of variation (Green and Perlman 1985a; Lightfoot and Martinez 1995; Parker 2006). Boundaries that have a reified point of demarcation on the landscape are of particular concern to studies of political territorial control. However, political boundaries are rarely maintained through active perimeter defense and most coterminous social boundaries are neither reified nor distinct, but rather abstract and diffuse, leaving little direct evidence in the archaeological record. Thus to attempt to define the limit of some hypothetical political entity requires two stages of argument: 1) Some archaeologically discernable pattern has to be identified on the landscape with definable spatial limits. 2) The pattern must then be shown to correspond to some principle domain of interaction that is likely to be coterminous with a political unit of concern. In some cases it may only be possible to argue some pattern represents a maximum or a minimum of political boundary extent. However, such information can still be used to effectively bracket the likely size of political units.

This analysis is focused on eastern Sonora, Mexico, a region where interpretations of political structure and polity size were formulated in the 1970s (Riley 1979). As such it is not surprising that many interpretations do not conform to contemporary theoretical paradigms. A similar theoretical realignment of the scale of influence was effected in the neighboring Casas Grandes (Paquimé) region and serves as a partial analog for the goals of this paper. Paquimé, was once taken as a hegemonic primate center across the Greater Northwest/Southwest from A.D. 1200 to 1450 (DiPeso 1974).[i] Whalen and Minnis (1999, 2001a, 2001b, 2009) demonstrated that in actuality Paquimé exerted direct political control over only a relatively small region. They estimate a radius of 15 km of intensive political control and 30 km for a lesser influence (2001a:190-191). Regular economic relationships extended through the near periphery, ca. 75 km, with preciosities flowing to the hinterland and subsistence resources to the core area (2001a:193). Ideological influence of some degree, as indicated by the distribution of ceramic traditions that made use of a shared symbolic repertoire (VanPool and VanPool 2007) and to a lesser extent forms of public architecture (Whalen and Minnis 1996), had a distribution more in line with DiPeso's original formulation. Such clear cut categories of interaction are obviously simplified archetypes. And, in fact, present models of Paquimé's political machinations rely on an inter-digitation of power bases with a recursive relationship between elite control of both ideological content and the exchange in symbolically important goods distributed to hinterlands as a means to control subsistence resources. Nonetheless, conceptualizing interaction within the distinct spheres of politics, ideology, and economy serves to highlight useful patterns of influence as it relates to physical territory, the loyalties of the people who occupy those spaces, and the means and degree to which power could be exerted over them. The approach presented below will make use of diverse data sets to delineate political boundaries in eastern Sonora. Any one method by itself provides only a weak argument, but together the preponderance of the evidence strongly suggests that the largest consistently maintained political unit consisted of relatively small communities of cooperating settlements.

Prior Research

Carroll Riley offers the most comprehensive reconstruction of the sociopolitical landscape of eastern Sonora. Riley refers to his vision of eastern Sonora political units as *statelets,* which is intended to suggest a middle range level of organizational complexity (1999:196). Riley (2005:164) acknowledges the size and even location of many identified polities are very rough guesses, but provides several maps (1987:72) that are the bases for Figure 1. Riley also explicitly states that his boundaries are arbitrary but names each statelet after a primary village mentioned in ethnohistoric texts, thereby suggesting there should be only one political unit per named area. Riley's model predicts large towns, or *energetic polities,* surrounded by satellite villages (2005:152). The scale of the territory included in these polities is not explicitly stated. It is entirely possible the maps should be taken as indicating some polity should be located within the boundaries delineated rather than suggesting the polities are approximately the size of the shaded regions. Regardless of intent, the former is the likely interpretation drawn by most archaeologists (e.g. Phillips 1989).

Much of the ambiguity in Riley's interpretations is a direct result of incongruities in his source data. For instance, Oera is listed as subsuming 20 towns (Riley 2005:163 based on Obrégon 1928[1584]). The Moctezuma Valley is noted as having around 100 towns (1987:58 based on AGN 1593) and in the 1620s the region near modern Sahuaripa is cited as including 70 towns under the control of one cacique, Sisibotari (Riley 1987 based on Ribas 1999[1645]). Riley also (1987:55) cites Las Casas (1951[1552]) who mentions two large towns, Corazones and Agastán being 25 km apart. Other citations from the Ibarra expedition (1987:55 based on Obrégon 1928[1584]) indicate polity size by describing the *province* of Señora as equivalent to 5 by 8 km. Equally variable are references to the largest towns in various areas. Las Casas suggests 3000 houses for Señora (Riley 1987:74 based on Las Casas 1951[1552]); Obregón (1928[1584]) mentions 1000 in Oera and 500 and 600 at Cumupa and Guaraspi respectively. In short there are obviously diverse references from which to choose regarding the scale and integration of polities. Riley, to his credit, was distinctly aware of these limitations and was quite direct in stating that major revisions would be necessary when adequate archaeological data was available. Unfortunately, the sorts of settlement surveys required to improve the situation have not been forthcoming and Riley's outline of statelets has largely stood unmodified for 30 plus years.

Archaeological confirmation or refutation of the statelet concept is variable and overall slim. Contemporaries of Riley's ethnohistoric research described settlement patterns that appeared commensurate in many regards with his model. Doolittle (1984b, 1988) demonstrated that a distinct hierarchy was present in site sizes in the Sonora Valley. The two largest sites both had some form of public architecture and were described as having *nodal* positions in the valley. Doolittle argued the political power of these sites arose largely through the management of subsistence surplus. This was in contrast to other contemporary models, which saw trade as the driving force throughout the sequence (Pailes 1978, 1980). Limited survey and excavation in several reaches of the Bavispe Valley in the 1990s (Douglas 1997) failed to find such a clear pattern. The settlement hierarchy was less stark and public architecture was not associated with the largest sites and was generally of an equivocal nature.

Project Area and Data Collection

The state of archaeology in Sonora is such that even defining the limits of regions sharing a relatively homogenous material culture (a.k.a cultural areas) is difficult. Most contemporary scholars of what has typically been called the Río Sonora region (Amsden 1928) would draw the western limit at the San Miguel Valley and the eastern at the Bavispe Valley. The later transitions into the Casas Grandes region in a poorly understood manner (J. Martínez and Jaramillo 2014). The northern limit is *de facto* defined as the international border, but largely unverified through research. The southern limit is equally ill-defined; R. Pailes (1973) originally argued the region extended to near the Sonora Sinaloa border. Today most researchers led by Carpenter (J. Carpenter 2014; J. P. Carpenter and

Vicente 2009), now define this southern portion as a separate Serrana region, which transitions to the Río Sonora region somewhere north of the Onavas reach of the Yaqui Valley and south of the Sahuaripa Valley. Case study data presented in this report come from a recent project in the Moctezuma Valley, squarely in the middle of the more conservative estimate for the Río Sonora region, roughly between the modern towns of Moctezuma and Cumpas. An approximately 30 km reach of the river was surveyed by near systematic inspection of all landforms along both sides of the river. Settlements are undoubtedly present to both the north and south of these arbitrary project boundaries. A subsequent season excavated a sample of structures and extramural contexts at three sites. The excavation results from only the two largest sites, El Nogal (Son L:2:1) and Teonadepa (Son L:1:23), will be discussed in this paper. Approximately 8.3 m^3 were excavated at El Nogal and 6.3 m^3 at Teonadepa; both sites were also subjected to a systematic surface collection and detailed mapping (see supplementary material). Only a limited number of reliable dates were obtained but in conjunction with minimal diagnostic artifact evidence suggest general contemporaneity (supplementary material) and occupation from the A.D. 1200s to at least 1500s. The main occupation of El Nogal may have started about a century earlier, but this discrepancy in dates is likely a result of the chance sampling of a few younger contexts. Both sites appear to have been minimally used into the contact period based on the rare presence of flaked glass debitage at both sites.

Evidence for Political Boundaries

Settlement Patterns

Settlement pattern data is of obvious relevance to discerning social affiliations. How people are distributed on the landscape and how centers of population are connected sets fundamental limits on the sorts of interactions that are likely to occur between those groups. Of particular concern to potential political and economic structures are the distributions of sites within an area that is thought to represent a cohesive group. Given the nature of the Río Sonora data the most effective way to approach this issue is via the well used approach of rank-size correlation. There is a substantial literature on such approaches (e.g. Berry 1961; Cavanagh 2009; Crumley 1976; Drennan and Peterson 2004; I. R. Hodder 1979; Paynter 1982; Whalen and Minnis 2001a). The size and rank distribution of sites is evaluated relative to an ideal straight line with a negative slope when both axes are logarithmically transformed. A predictive equation of the value of a demographic variable (ideally population) at a given rank is thus given by $P_i = P_I / i$, when values are arranged from greatest to least, P = demographic variable, and P_I is the size of the larges site (Zipf 1949). The equation thus predicts that the second largest site would be .5 the size of the first, the third largest .33 the first, and so on.

The basic premise of the approach is that settlement systems will exist on a continuum of integration in both horizontal and vertical dimensions. Settlement systems that form a linear arrangement on the log-log plot are said to be log-normal, and suggest a system that is organizationally cohesive and interdependent (G. A. Johnson 1980); a scenario that strongly suggests a distinct sociopolitical unit. The ultimate causation for the relationship is complex but related to an increase in entropy in systems characterized by a higher volume and greater diversity of interactions (Berry 1961; Bettencourt, et al. 2010; I. R. Hodder 1979), circumstances created by many stochastic forces acting simultaneously and nonlinear emergent properties. Qualitatively stated, entropy is serving as a proxy for integration in that it is reflective of a higher volume of interaction between all subunits. Deviations that result in convex distributions above the log-normal plot are interpreted as suggesting weak hierarchical organization and likely the inclusion of multiple smaller scale, and largely independent systems, or conversely, a sample that failed to capture the highest echelon of population centers (Drennan and Peterson 2004; G. A. Johnson 1980:11; Peterson and Drennan 2005). Deviations below the line typically are thought to indicate a situation of primacy, in which one center overly dominates all interactions and thereby diminishes horizontal integration between centers of lesser size and importance (I. R. Hodder 1979; G. A. Johnson 1980; Whalen and Minnis 2001a). A summary statistic, of Rank Sum Convexity, known as the *A* statistic was proposed by Johnson (1980:239) and refined by Drennan and Peterson (2004). Values range from a maximum of one in cases where all sites are of equal size to zero for systems similar to the log-normal distribution and approach negative one for increasingly primate distributions.

For comparative purposes datasets from across the Northwest/Southwest were assembled in Figure 2 and Table 1 (also see supplementary material). The figures and statistics were calculated utilizing *rsboot* (Drennan 2012). Note the clear primacy reflected in the Casas Grandes and Trincheras data, which are neighbors of the Río Sonora region. Marana, an example drawn from the Hohokam region follows a roughly log-normal pattern except for the tail end of the distribution. Independent lines of data confirm economic interdependence in this settlement community (Fish, et al. 1992). The Sonora Valley data most closely follows a log-normal distribution. As noted there are currently two polities identified in this region, but it is possible that demographically and economically the valley was moving towards complete centralization. All other valleys have clearly convex distributions. In the case of the Bavispe data, the survey was noncontiguous so portions of non-integrated systems would be expected, but nonetheless highlight a lack of any obvious regional primate centers. Both the Moctezuma and Onavas Valley data suggest that multiple smaller scale units (or portions thereof) are subsumed in the survey area. Several important observations are suggested by this data set. The valleys that have overwhelmingly dominated the literature of Northwest Mexico, Casas Grandes, Magdalena (Trinchearas), and Sonora are likely unique cases. It is also clear that there is a fair degree of variation within the Río Sonora region as suggested by the unique nature of the Sonora Valley data compared to the Moctezuma, Bavispe, and Onavas Valleys.

The data thus suggest that there are multiple, or portions of multiple, communities captured within the 30 km reach of the Moctezuma Valley. This is visually perceptible in Figure 3 in which the settlement pattern is clearly bisected by a portion of narrow valley with the major sites of El Nogal in the south and Teonadepa in the north anchoring the two separate communities. Presumably, based on the principles described above, the level of economic and political integration would be greater within these communities than between them. This pattern, based on present data, appears to be the most common for settlement community scale in the Río Sonora region and indicates communities of significantly smaller scale than those suggested by ethnohistoric research.

Aspirant Leader (Elite) Exchange

Considerable attention has been paid to the role of prestige goods exchange economies as a means to support leadership offices (Earle 1982; Friedman and Rowlands 1977) Such exchanges bind the upper social echelons of disparate polities into networks of reciprocity and other forms of economic interaction. In most reconstructions the practical value of these rare goods is garnered in their parceling out to supporters as a means to curry favor with local populations (e.g. Griffith, et al. 1992; Neitzel 1992:215) or in direct exchange for materials needed to control local populations, such as subsistence resources (e.g. Whalen and Minnis 2001a). Conspicuous consumption of rare or special goods by aspirant leaders themselves as a means to legitimize power also cannot be ruled out as a potential role for certain materials (e.g. Bayman 2002; Nelson 1986). And of course none of the roles for rare goods are mutually exclusive (Bayman 1995). For the present analysis the exact nature of rare goods exchange and subsequent employments does not need to be reconstructed, so long as several assumptions can be made. Specifically, it is assumed that 1) rare materials, once acquired, were dispersed among at least some inhabitants of the largest settlements within the local polity and that 2) exclusion from a given exchange network likely implies simultaneous exclusion from the immediate political network. This last point is somewhat more tenuous; obviously not all individuals will receive the beneficence of their local aspirant leaders. There seems little doubt of this in the Moctezuma Valley, as almost no items that could be considered exotic were discovered at any small sites. However, it seems unlikely that major populations centers, demographic peer polities, would participate in different networks unless they were not members of the same polity. In short, the size of the aspirant leader exchange network should surpass or equal the limit of any political boundary, but not be smaller (Figure 4).

Data on exotic or rare goods from the Moctezuma Valley are limited almost entirely to obsidian. Obsidian is not locally available, with the closest known source at 70 km distance, and is often interpreted as a preciosity circulated in prestige goods economies (cf Bayman 1995; Darling 1998; Mills, et al. 2013; Mitchell and Shackley 1995). There is a clear difference between the largest sites of the Moctezuma Valley with only16 obsidian artifacts recovered at El Nogal, the primate center of the southern settlement community, compared to 123 at Teonadepa, the primate center of the northern settlement community. Every piece noted on the surface of El Nogal was collected whereas obsidian at Teonadepa was so ubiquitous only a sample was collected. Only one other site recorded on survey was noted to contain significant amounts of obsidian on the surface, La Cuchilla (Son L:1:6). This site, also located in the northern settlement community closely conforms to expectations of a contemporaneous near peer of Teonadepa that was intertwined in the same aspirant leader exchange/reciprocity network. The vast majority of pieces subjected to XRF sourcing analysis came from a single source, Selene, located in the Bavispe Valley. The data suggest that whatever economic processes that regularly delivered obsidian materials to Teonadepa and La Cuchilla did not include El Nogal. Given the relative size parity of these sites, this is taken as evidence that the same political unit did not subsume both sites. In fact, it may suggest that not only were these two sites not in the same local polity but in different macro-interaction spheres in which aspirant leaders did not engage in reciprocity or other exchange relationships.

Other potential prestige goods items are unfortunately too few for quantitative analysis to be useful, but some, qualitative suggestions, upholding the present model can be made. Specifically, shell items are extremely rare across the project area, with only 19 recovered specimens. This is in stark contrast to neighboring regions, Paquimé contained nearly 4 million pieces (DiPeso, et al. 1974), the Hohokam (Haury 1976), and Trincheras (Villalpando and McGuire 2009) regions are renowned for their ubiquitous use of shell, and even a mere 150 km to the south in the Onavas Valley shell artifacts are common (L. A. Martínez and Garcia 2011; Martinez 2012). These patterns clearly indicate that the Moctezuma Valley was socially isolated from these other regions and not significantly participating with any of them in regards to shell goods exchange. These observations offer some further support for the conclusion that rare goods economies did not operate on large scales or even include entire valleys.

Artifact Style Boundaries

Perhaps the most traditional of all methods for discerning boundaries of any sort in the archaeological record is the delineation of styles of material culture.

There are a litany of theories that underpin the ultimate source of variation in such patterns, specific to both material categories and particular ecological and historical contexts (Green and Perlman 1985b). This section will briefly review a few of the more salient differences evident between samples collected from El Nogal and Teonadepa. Stylistic boundaries are clearly not isomorphic with any form of cultural or social boundary. But as Hegmon (1992:528) points out, while the absence of boundaries cannot be interpreted as evidence of cultural homogeneity the presence of material culture boundaries can most often be interpreted as a reliable marker of some form of social distinctions. A somewhat more problematic issue is at what scale these distinctions are operative and if they are coterminous with political boundaries. In some cases a clear argument can be made that prehispanic individuals were distinctly aware that the use of one style as opposed to alternatives conveyed overt social meaning. That is, the style differences were intentionally manipulated to signify adherence to some socially salient concept that also connoted membership to a group. Whether the impetus to make use of such symbolic content was intentionally undertaken to demarcate exterior relationships or as a side effect of managing within group relationships (*sensu* I. Hodder 1985) is not critical to the present case. In both instances it can be assumed that the resulting borders would likely be coterminous with or greater than political boundaries. That is, the perceived boundary might include multiple political units that made use of identical or related symbolic repertories and multiple fonts of symbolism might be employed in any one polity but it seems unlikely political units would surpass the size of these of stylistic boundaries (Renfrew 1986:2).

Alternatively, some stylistic differences are arguably reflective of unconscious behaviors. Tasks were performed in certain ways because that is how they were encoded into social learning frameworks and remained mostly at the level of subconscious *habitus* (Dietler and Herbich 1998 after Bourdieu 1977). The limited data presented here are relevant to both modes of delineation 1) those that were manipulated with the intent of purposefully signaling ascription to specific concepts and by extension groups, 2) and those that were the result of following rote behavioral patterns but are nonetheless useful to archaeologists for discerning certain kinds of group membership. These alternative focuses have the potential to identify crosscutting memberships in different kinds of groups, but in the present case study the identified boundaries appear largely co-terminus.

Ceramics. Substantial differences are apparent in the basic composition of ceramic assemblages from El Nogal and Teonadepa (Figure 5 and supplemental material). The small painted sherd assemblages provides the clearest example of differences that were likely intentionally manipulated. There is a near mutual exclusion of painted types, with Teonadepa clearly adhering to a Chihuahuan tradition reminiscent of Casas Grandes and El Nogal participating in poorly defined traditions of southern and western Sonora. The one exception to this rule are ceramics typed as Babícora like, (possibly Santa Ana) which is a type undoubtedly related to Casas Grandes styles, but also nearly absent from Teonadepa. Researchers generally accept that painted ceramic styles of the Northwest/Southwest make use of many ideologically charged symbols (e.g. Crown 1994; Eckert 2008) that would not be emulated without some understanding of the implications. The norm is for such styles to far surpass the geographic reach of any political and most economic boundaries (Figure 6), as discussed for Paquimé above. The near geographical exclusiveness of painted traditions in the Moctezuma Valley is thus almost certainly a conscious choice and statement about adherence to certain concepts as well as an acknowledgement of participation in alternative exterior networks that reached far beyond the Moctezuma Valley but apparently not through it. The control of symbolic meaning is of course a fundamental means of legitimizing power in middle range societies (Cohen 1969; Feinman and Neitzel 1984; Pauketat 1992). As such, the exclusive traditions suggest local leaders might have trouble exercising simultaneous authority in both El Nogal and Teonadepa.

Other differentially represented types such as *brushed brownware* characterized by a surface treatment with low visual acuity potential, may be more apt to represent variations in manufacturing processes that were not of any symbolic interest to prehispanic individuals. Such manufacturing preferences still serve as a useful delineator of communities of practice that in this case appear to co-vary on a gross level with other manifest social distinctions.

Stone Implements. In middle range societies of the Northwest/Southwest lithic artifacts, both ground and chipped, are generally much less suitable than ceramics to use as correlates of ideological or social affiliation. A periodic exception is projectile points. Flaked stone point styles undoubtedly reflect a particular learning framework resulting from following a routinized sequence that aims to produce a previsioned form. Due to their use in warfare, a venue that demands the perception of a salient social distinction, projectile points are also eligible as a means of conveying group membership. They are of course also geographically variable even when not routinely utilized in warfare. With these simple observations in mind, it is noteworthy that again there is a strong typological distinction between the points recovered from El Nogal and Teonadepa (supplementary material), although the sample sizes are admittedly small.

Demographic Organization

One of the few topics to receive ample attention in the Río Sonora region is that of population estimates (Doolittle 1984a, 1988; Pailes 1997; Reff 1985; Riley 1987; Sauer 1935). The methods used to derive estimates are highly variable and rely on a mix of qualitative ethnohistoric references, historical population levels, and agricultural capacity. Estimates of the apogee of population levels, presumably sometime in the 1500s, range from 100k (Doolittle 1984a) to approximately 65k (Sauer 1935) with densities ranging from 1.5 to 2.65 persons per km^2 (see also Riley 1987:57). Crude figures based on these estimates broken down by watershed are provided in Table 2.[ii] As noted, only a few sites have been found in the extensive bajada zones. Sites are known from sierra settings (J. R. Martínez and Jaramillo 2013), especially cave sites, but in general populations from these areas appears much less dense than riparian zones. They are also often some distance from riparian zones, suggesting political independence. Assuming almost all of the population resided in river valleys, more refined estimates of particular areas can be generated from the relative amount of arable land. There are obviously many factors that complicate comparison of river valley segments, namely length of growing season and available water, but the approach serves for the very rough outline sought here. Google Earth imagery was the bases for measuring arable land as indicated by obvious evidence of current or recent cultivation or substantial flat land within a river valley corridor. The goal was to record all large parcels (>20 hectares) cultivatable by either irrigation or floodwater control. Assuming a distribution of population commensurate with this arable land estimate produces a population of 11k for the Central Sonora Valley. This is in close concordance with Doolittle's (1980) estimate of 10-15k. If Doolittle's interpretation, that there are two polities in this region is accepted then the populations would presumably be around 5.5k apiece. Assuming the same proportionality for the Moctezuma Valley, and that there are only two polities in this section, would produce respective estimates of 4.9 and 4.1k for Teonadepa and El Nogal settlement groups. It is, of course, possible and even likely, that the populations of the Moctezuma Valley and most other valleys were less dense than the Sonora Valley.

At this point it is worth reviewing how the evidence thus far presented can be fit to previously proposed models and how they might be revised. Riley identifies nine polities, seven of which would partially fall in the area discussed by Doolittle in his population estimates. For the Sonora Valley Son K:4:24, near Baviacora, is a good fit for Señora and Son K:4:16, near Banimichi, is a plausible fit for Guaraspi. However, the name Guaraspi implies, this center would more likely be located to the north near modern Arizpe. Similarly, in the Moctezuma Valley, El Nogal, near

Moctezuma could be Batuco, and Teonadepa could feasibly be part of Cumupa, which would be an obvious place name match to the nearby modern town of Cumpas. However, the substantial material culture differences between these areas might suggest groups that were differentiated by more than just political affiliation. The boundary identified between Ópata and O'odham groups may be placed too far to the south in Riley's tentative reconstruction. Beyond this, the correlation falls apart completely. Obviously if 100k is accepted for the region and a generous ~20k assigned between four of nine statelets that are located in the most agriculturally productive areas of the region it seems unlikely 80k people are residing in only three or four more undiscovered polities. Either population estimates for this region are far too high, or populations were more diffusely distributed in a manner that is not conducive to large scale political centralization. As implied by the divisions between El Nogal and Teonadepa and the overall character of the polities visible in the archaeological record it seems unlikely that polity boundaries ever stretched across substantial areas of minimal population. Working on this assumption the discrete nature of most river valley segments would likely give rise to many independent centers with only loose cultural, linguistic, and social affiliations. The map and data presented in Figures 7 and 8 displays this alternative scenario and distribution. Notably, in most cases there are only one or two modern population centers located in the resulting 34 Thiessen polygons.

If populations are indeed limited to at most 5000 in the largest polities and likely significantly less in most others, then several other curious aspects of the settlement pattern also may be explained. The Río Sonora area has always been an outlier relative to neighboring regions for its lack of communal architecture. A few large enclosures were identified in the Sonora Valley and argued to be possible ballcourts (cf Doelle 1989:168; Riley 2005), but examples were not found in either the Bavispe or Moctezuma drainages. Possible platform mounds were found in both of these valleys, but neither was associated with very large settlements and both were so small that their role as communal features is questionable. The Moctezuma example is only 11 by 6 by 1 m. Ethnohistoric documents make no mention of the ballgame. Castañada (Hammond and Rey 1940) states that leaders stood upon *terraces* to issue directions, but these may have simply been natural features. The only clearly religious venues mentioned were *very tall temples of stone and mud* that contained idols and the seated bodies of deceased rulers, and huts into which many arrows were shot during times of war. Las Casas (1951) describes the more impressive sounding temples, but as he never visited the area personally the reference is apocryphal. In general, it appears communal features or other physical manifestations that provided a focal point for large scale integration are absent. Minimally, it can be stated that an archaeologically visible, consistently replicated form of communal architecture is lacking in the region. If anything, the few large enclosures found in the Sonora Valley and the few possible very small mounds found in the Moctezuma and Bavispe Valleys suggest alternative options for integrative features. This is no trivial observation as a common method of delineating polities or communities is to identify the communal features, assume they are focal points and work outward to examine other components of the system. Most of the investigated Río Sonora polities appear to lack any substantial edifices to anchor anything more than a local group. In a comparison with other Northwest/Southwest region this may place the Río Sonora polities more on par with formative Hohokam groups in which most integrative mechanisms remained at the extended household level, as opposed to Pueblo great kiva or great house communities, Casas Grandes ballcourt communities, Trincheras terraced hills, or Hohokam platform mound or antecedent ballcourt communities.

It is also worth noting that in contrast to many surrounding regions the demand for coordination of subsistence production above the level of local settlement communities is less evident. Irrigation was and continues to be practiced on a relatively small scale throughout the region. However, the narrowness of the river valley and the steep mesas that flank it typically preclude expanding the practice onto the surrounding bajada. As a result, even today most canals are at most a few kilometers long and most no more than a few hundred meters (Doolittle 1988; Sheridan 1996). Laterals directly off of the main river are a common practice. These small systems would likely not require the large scale control postulated for neighboring desert groups such as those discussed above (Abbott 2003; DiPeso 1974).

Discussion

The previous analyses beg two obvious questions, why were the polities (settlement communities) of eastern Sonora ever thought to be large, and why were they actually quite small? The first issue undoubtedly lies in a somewhat selective reading of the ethnohistoric literature. The context in which these models were generated clearly impacted the course of interpretations. At the time, virtually nothing was known of Northwest Mexico aside from the polity of Casas Grandes with Paquimé at its center. DiPeso's monolithic reconstruction that identified Paquimé as a fallen trading center of Mesoamerican origin proposed complex societies were present in this portion of North America and intertwined with surrounding regions in World Systems style relationships (*sensu* Wallerstein 1974; see also Whitecotton and Pailes 1986). In this theoretical milieu it made logical sense to infill Sonora with chiefdom like units that could easily facilitate contact between the U.S. Southwest and Mesoamerica proper and likewise serve as lesser economic vassals of Paquimé. With this model as a starting point, and few data it is entirely understandable that any hint of interaction in the ethnohistoric documents was counted as evidence of undifferentiated political control regardless of the social domain in which the interaction took place. These observations should not be taken as criticism of the effort. Presumably theories of social organization have progressed in the last 40 years, as has the amount of relevant data for this region. As such, it would be inappropriate to criticize these theories as inadequate, they were actually remarkably insightful for their time and many elements of the resultant cultural historical reconstruction remain intact and have been verified by the recent research. The interpretation offered here would undoubtedly seem like less of a stark contrast to existing theories if published English language research in eastern Sonora had been more gradual and less punctuated. Hopefully, further revisions will not require such long hiatuses.

As to the more difficult question of why were the polities of eastern Sonora so small in scale, there are likely many intertwined factors. Much more research is required on this point for definitive answers. The nature of the landscape itself undoubtedly played the largest role. The segmentation of river valleys by steep sections of *barranca* precluded the possibility of controlling large contiguous areas of densely occupied arable land in all valleys except the Sonora. Perhaps, more critically though, at present, it appears there were few opportunities for aspirant leaders to pursue strategies that are central to most models of political ascendency. Researchers all seem to be in agreement that the region was well below carrying capacity. Surplus production is obviously a central point of many arguments regarding the emergence of inequality, but such theories are only applicable in contexts where surplus can be achieved by only a select segment of the population. As pointed out above, the nature of agricultural production in the region left few opportunities for large scale monopolization of productive capacity, such as in the control of irrigation infrastructure. At present there is also little evidence for substantial intensification, which is expected only after the least labor intensive options are utilized to their maximum potential (Netting 1993). The ethnohistoric mention of warfare primarily being driven by a desire to capture slaves also suggests labor limited, as opposed to resource limited production capacities. Few theorists of social organization would doubt the role of sufficient surplus population in the emergence of more complex hierarchical political systems. It seems quite possible this region of Sonora simply had not passed the demographic thresholds to permit the easy emergence of complex hierarchical systems (see Feinman and Neitzel 1984).

Evidence for other sources of aspirant leader power are equally lacking in the archaeological record of eastern Sonora. To be sure, this is at least partially the result of a lack of adequate investigation. However, at present the presence of communal architecture seems very limited, and unspectacular. Evidence of participation in the well known religious macro-traditions of the broader region also seems to be lacking. This curious scenario was noted to some degree by Riley (1987, 2005). These are no trivial observations, as ideological justification was undoubtedly a central component of any institutionalized leadership office. However, at present there is no archaeological evidence that the physical manifestations or symbolical content of ideological systems were ever monopolized by aspiring leaders. Warfare receives much attention as a source of political legitimacy in most reconstructions of the region (J. B. Johnson 1971; Riley 1987, 2005). However, there are ample ethnographic sources that demonstrate it is common among groups with otherwise low levels of social complexity organized on small scales (Strathern 1971). The last component of most reconstructions of the area is long distance trade. This is a subject deserving of its own article length review, which will be forthcoming. Suffice it so say for the present that there is no evidence for the significant consumption of preciosities in the region or participation in long distance economic forays. In short, the archaeological data provide no evidence of a convenient path to social ascendance and the physical and demographic landscape was such that small scale polities were the most stable and practical unit across most of the region.

Conclusion

The above analysis makes a case that the polities (settlement communities) of eastern Sonora Mexico present in the 1200 to 1500s were relatively small local affairs. This argument is based on multiple lines of evidence including, settlement pattern data, differences in artifact styles, the distribution of likely aspirant leader trade items, and an evaluation of demographic distributions. At present the sample of well investigated settlement communities is quite small at four, two previously delineated in the 1970 and 1980s and two more from recent research. The later were a particularly fortuitous set of examples since political boundaries appear to have coincided with other forms of identifiable social boundaries. This may correspond to Ópata/O'odham prehispanic equivalents or perhaps other groups, such as the Eudeve and Jova, who also inhabited this region. Such conveniently identifiable boundaries are unlikely to exist between most settlement communities of the region. Some lines of evidence, such as artifact style and rare goods exchange networks undoubtedly will often incorporate multiple settlement communities but still suggest a maximum size from which multiple political units can be delineated through other means. The overall, picture of eastern Sonora presented here is one of high cultural and political diversity, balkanized into small mostly independent settlement communities that only had low levels of interaction between each other. The extent of arable land along reaches of river valley appear to have placed an upper boundary on the size of settlement communities, and in some cases, such as the Sonora Valley, multiple groups were possibly present in a single large reach. The ultimate causal factors for the lack of larger scale integration include a lack of opportunity to monopolize resources, limited ideological cohesiveness, and low demographic pressure. This reconstruction, like the model it partially refutes, will certainly require significant changes as more work is accomplished in this little understood region.

Supplemental Text

Regarding Settlement Pattern Analysis

R. Pailes (1997:187) has suggested that the largest sites throughout the Río Sonora region may be concealed by modern towns. This might affect the shape of the log-log curves provided in the article and the *A*-statistics. This is an extremely difficult proposition to test and is more apt to be true for the Sonora Valley than for the Moctezuma Valley. Some minimal artifactual evidence can be found on the edges of modern day Moctezuma and Cumpas, but it is hard to discern if it is prehistoric or historic and its extent is unknowable. The locations of Moctezuma and Cumpas are on low first terraces, significantly different landforms from the high second and third terraces that are the locations of virtually all recorded sites. In the case of Cumpas, local folklore holds that the preexisting indigenous community lived at Son H:13:2, Las Clavelinas. In fact, all the largest sites located on survey were adjacent to these large modern centers. Based on first principles, it seems unlikely a lost primate center would be located very close by, since such settlements tend to greatly restrict the growth of their nearest neighbors. Conversely, missionaries, who determined the location of modern towns, likely located optimally near several large population centers in order to maximize access to human capital. Nevertheless, an attempt was made to model the potential for another level in the site hierarchy by estimating the approximate size of the oldest parts of both towns located on fairly level ground for both the Moctezuma and Sonora Valley. This led to the inclusion of two more large sites in both samples It should be emphasized these are highly conjectural estimates. In both cases the alternate estimates only slightly reduce the convexity of distributions (denoted in Table S 1 as *altered*).

Figures

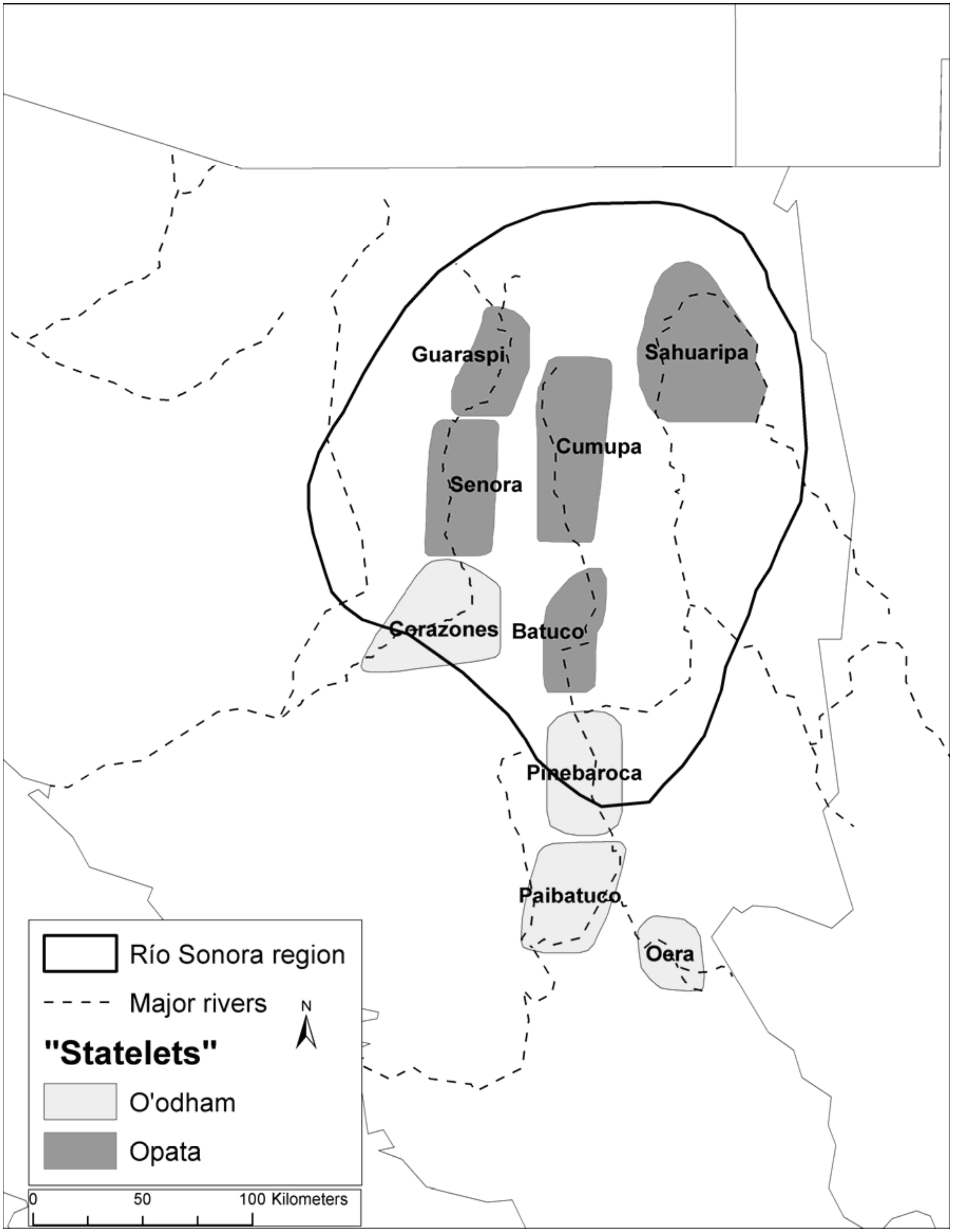


Figure 1. The "statelet" polities envisioned by Riley, black line denotes area defined by Doolittle as Río Sonora region.

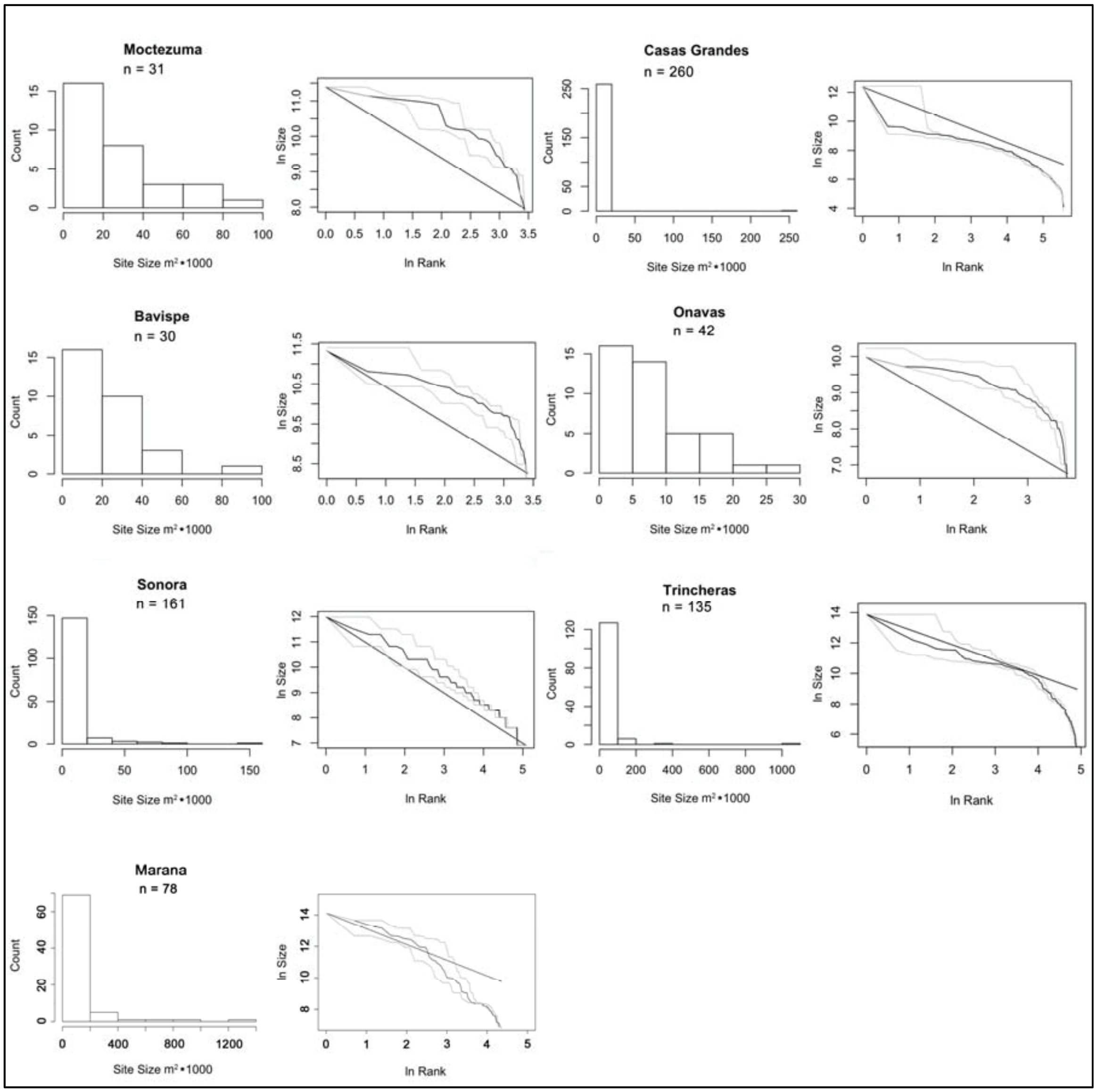


Figure 2. Log-log plots of rank size distributions from across Northwest Mexico. All values based on site size except Casas Grandes, which is based on mound size.

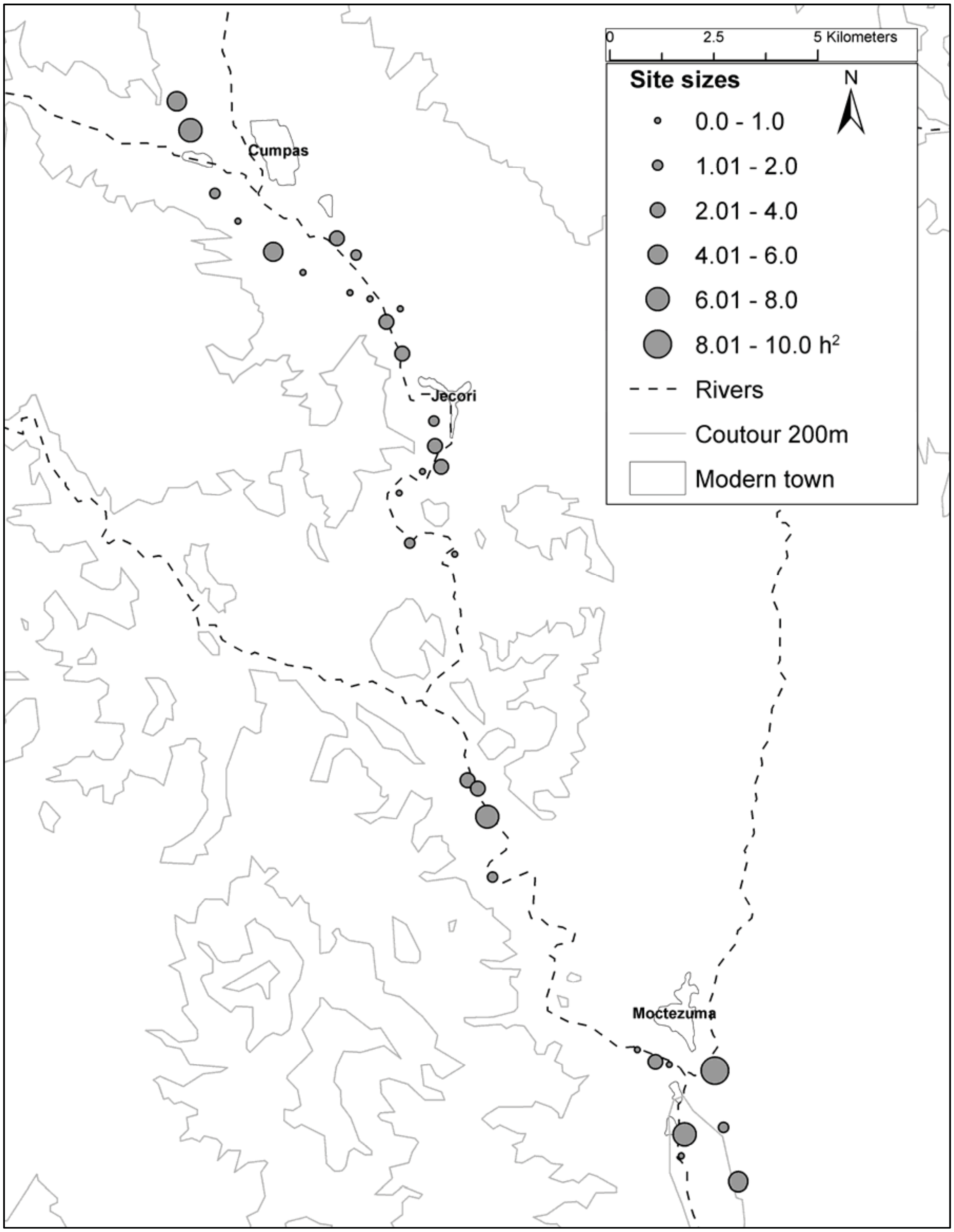


Figure 3. The settlement distribution in the Moctezuma Valley.

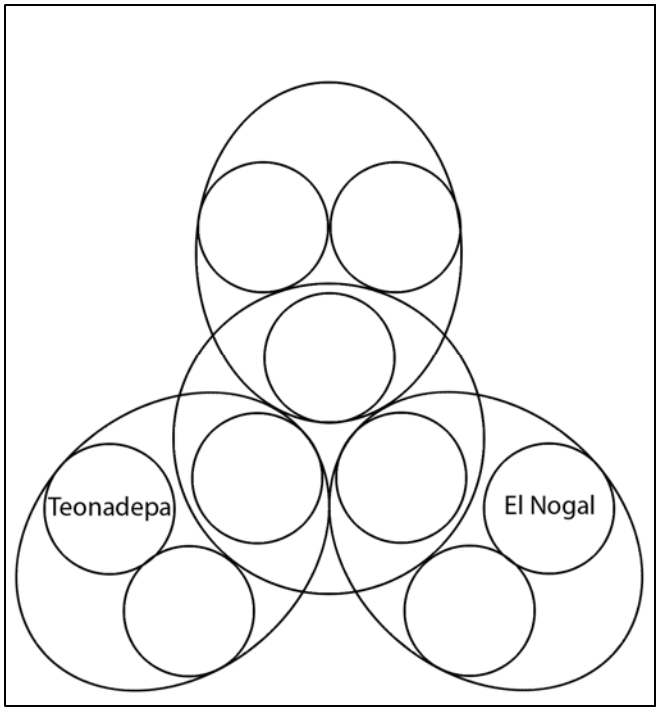
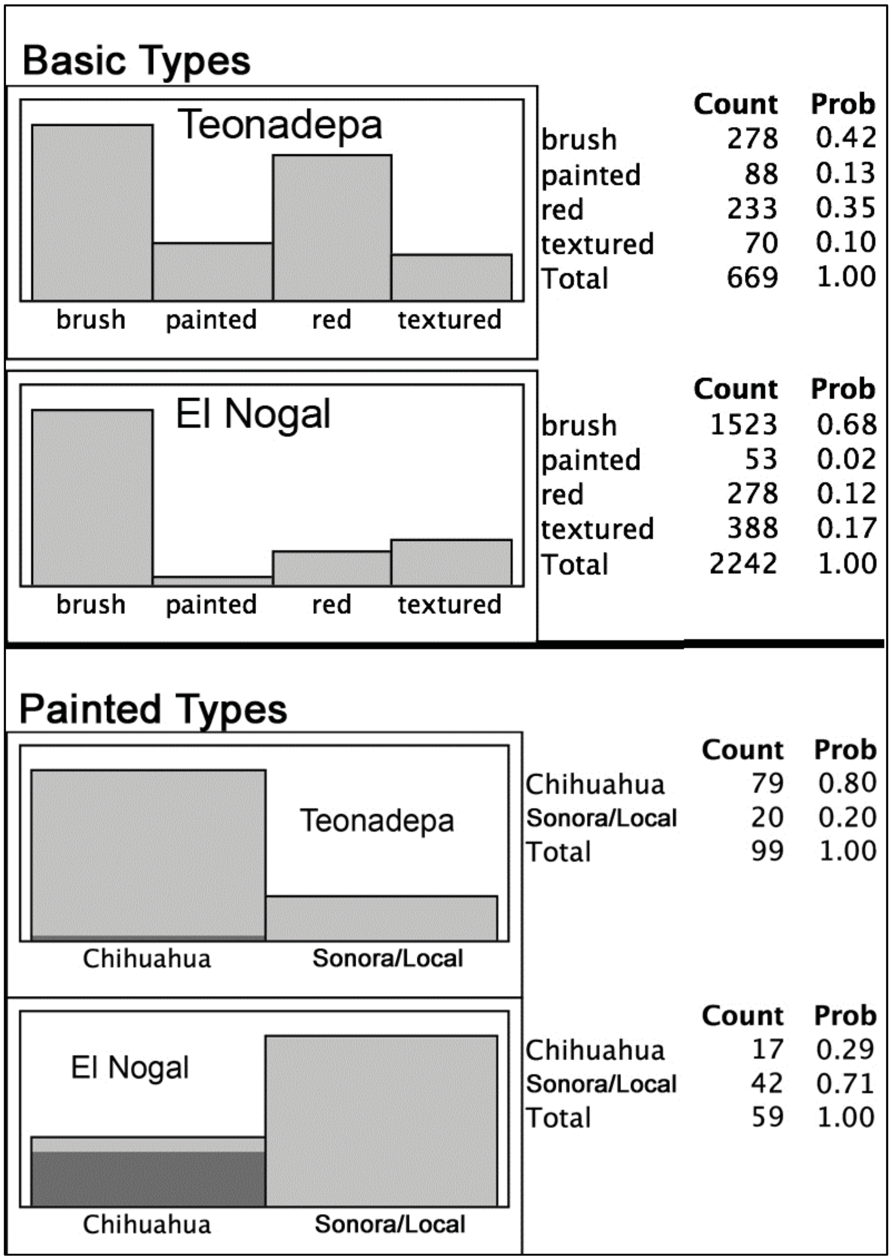


Figure 4. Venn diagram of likely relationship between elite exchange networks and polity boundaries. Teonadepa and El Nogal are apparently in different exchange networks with minimal access to the same sources of preciosities.



Basic Types

Teonadepa

	Count	Prob
brush	278	0.42
painted	88	0.13
red	233	0.35
textured	70	0.10
Total	669	1.00

El Nogal

	Count	Prob
brush	1523	0.68
painted	53	0.02
red	278	0.12
textured	388	0.17
Total	2242	1.00

Painted Types

Teonadepa

	Count	Prob
Chihuahua	79	0.80
Sonora/Local	20	0.20
Total	99	1.00

El Nogal

	Count	Prob
Chihuahua	17	0.29
Sonora/Local	42	0.71
Total	59	1.00

Figure 5. Ceramic data from El Nogal and Teonadepa showing basic type differences and a comparison of painted ceramic types, shaded area represents Babícora-like proportion of Chihuahua style ceramics.

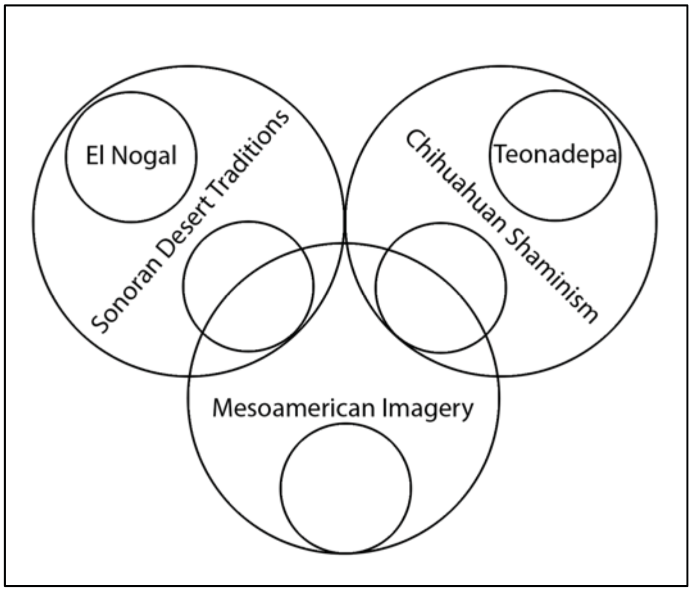


Figure 6. Venn diagram of one possible relationship between styles relevant to ideological interaction spheres and polity boundaries. Other iterations are possible, but the critical point remains that it is unlikely for two groups that share very few symbols in common to be components of the same polity.

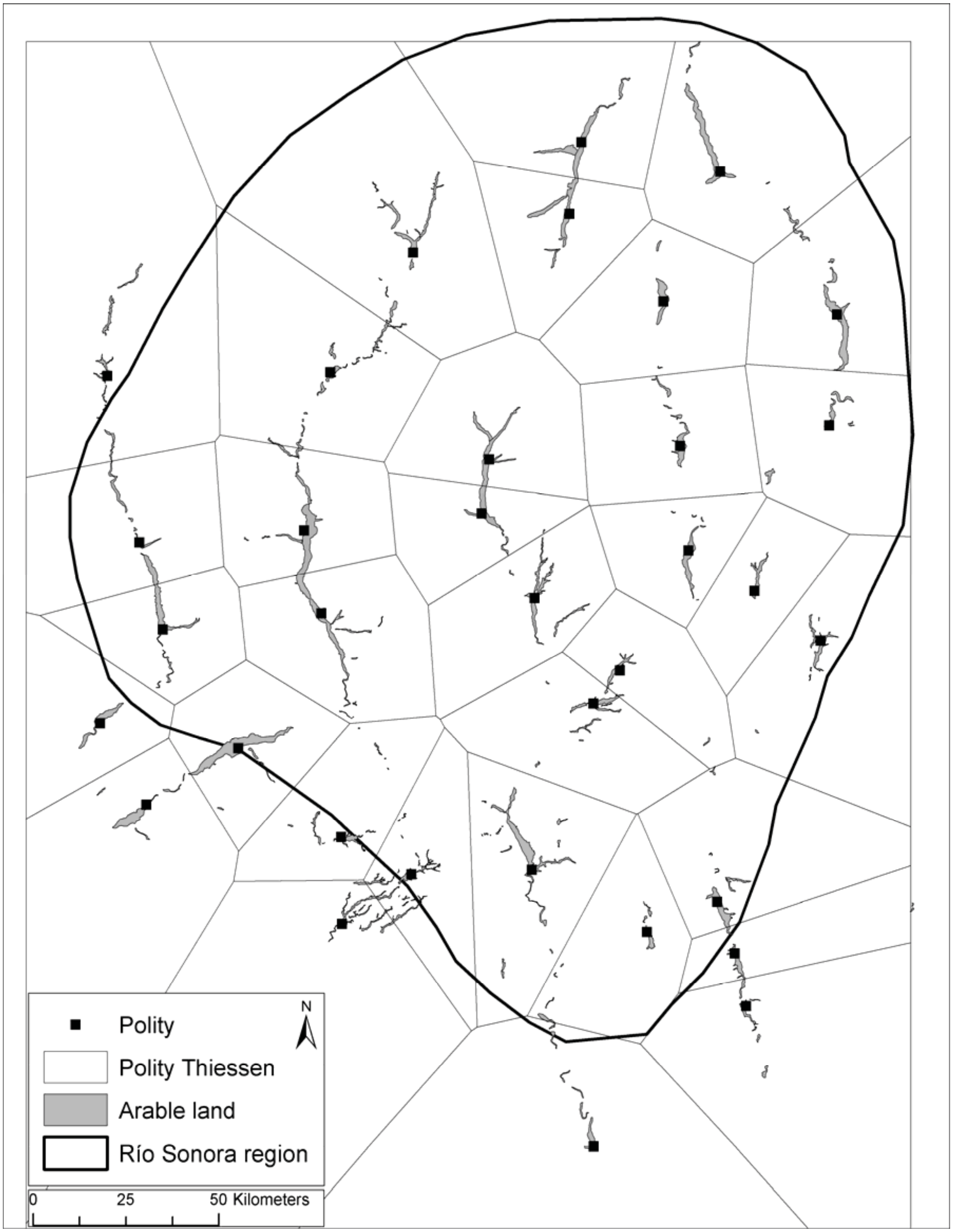


Figure 7. Alternative hypothesis for the political landscape of Río Sonora region ca. A.D. 1200-1550.

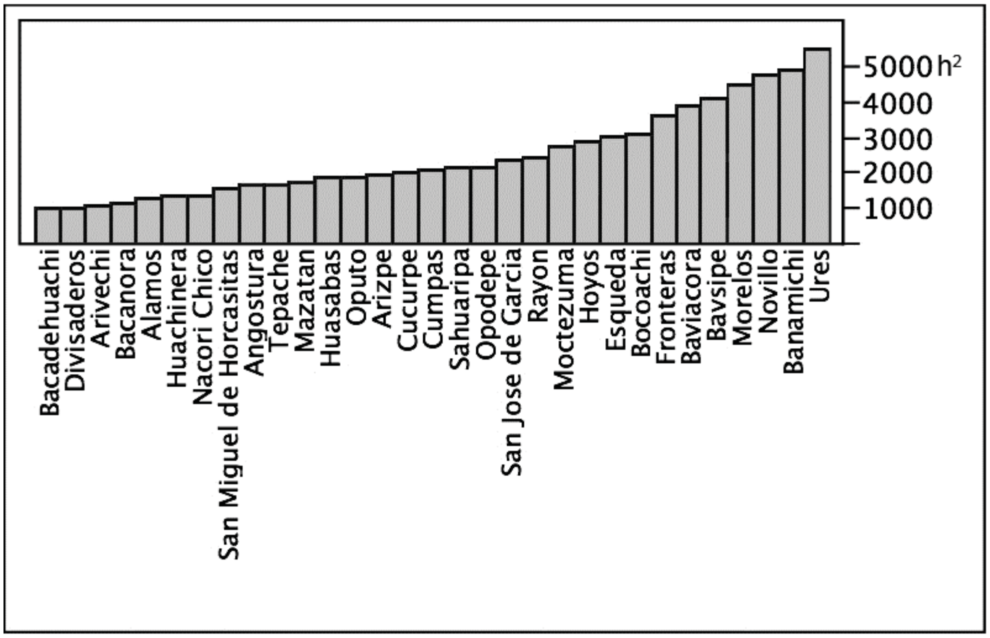


Figure 8. Distribution of arable land among polities based on Thiessen polygons of Figure 7.[iv]

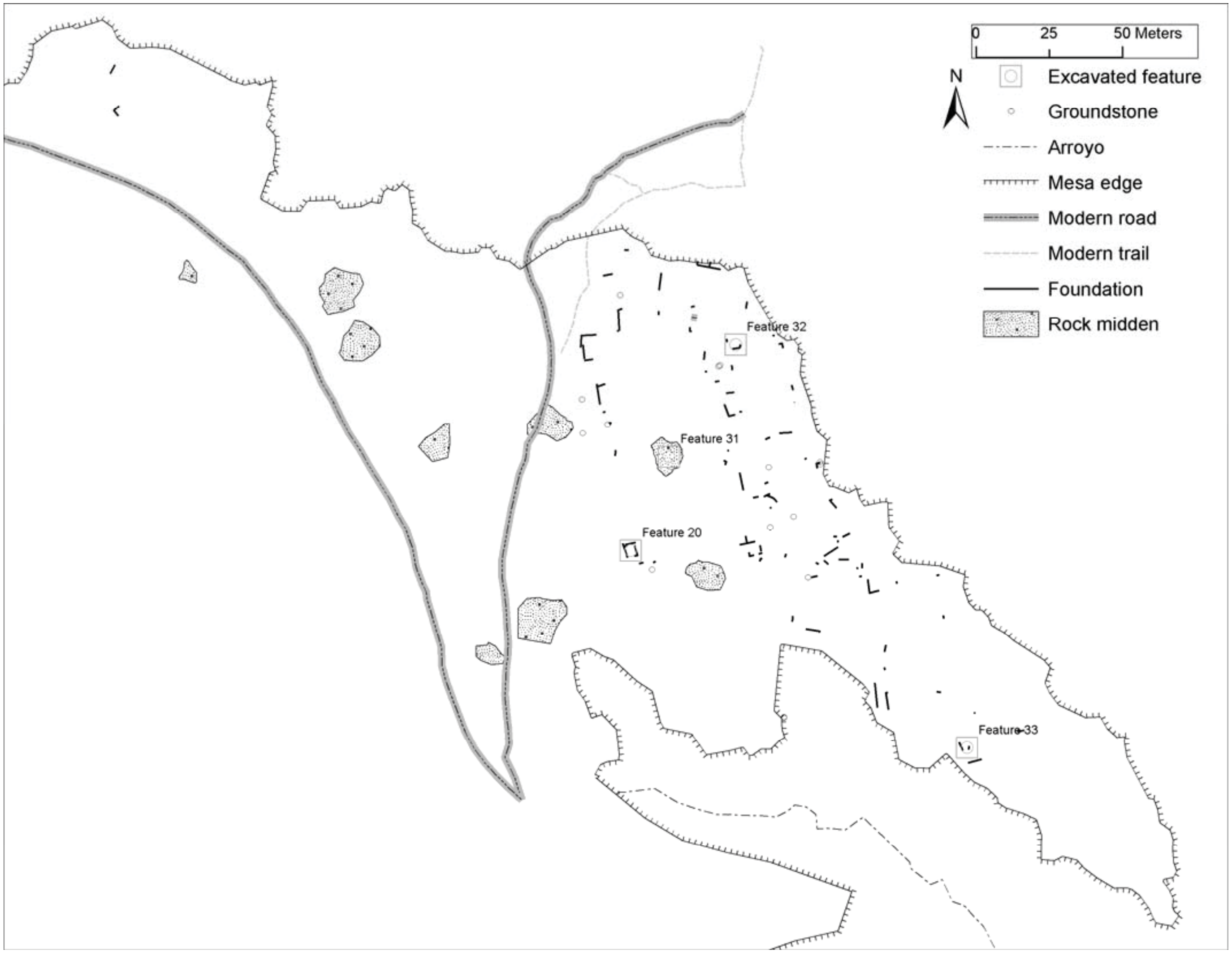


Figure S 1. Site map of Teonadepa.

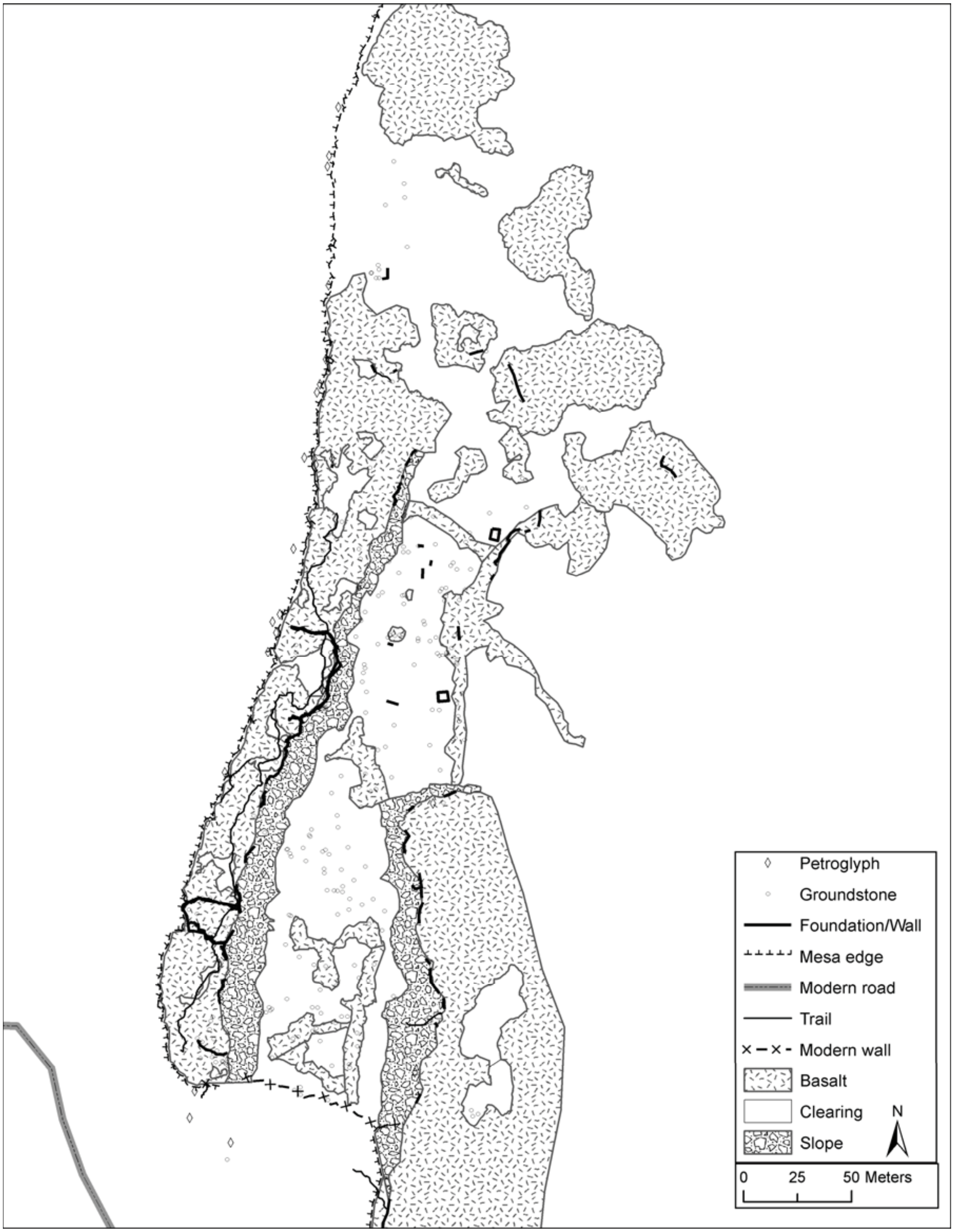
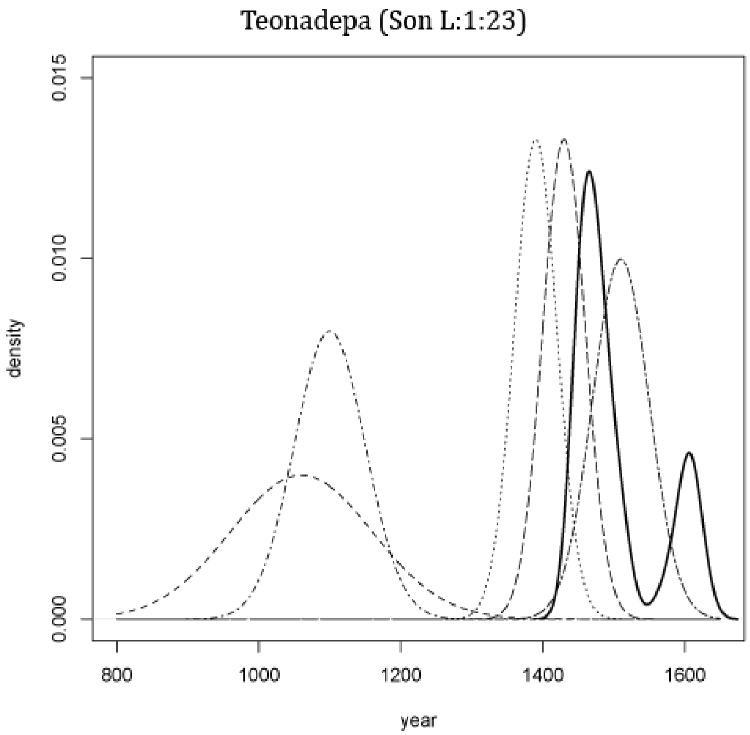


Figure S 2. Site map of El Nogal.



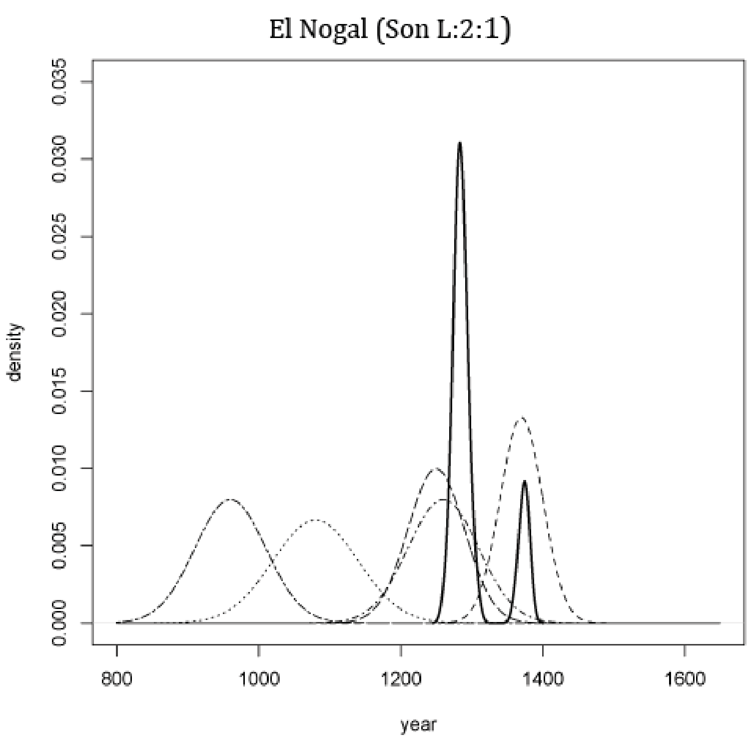


Figure S 3. Dates from Teonadepa and El Nogal, solid line is ^{14}C all others are luminescence. Note density axes are not the same in both graphs.

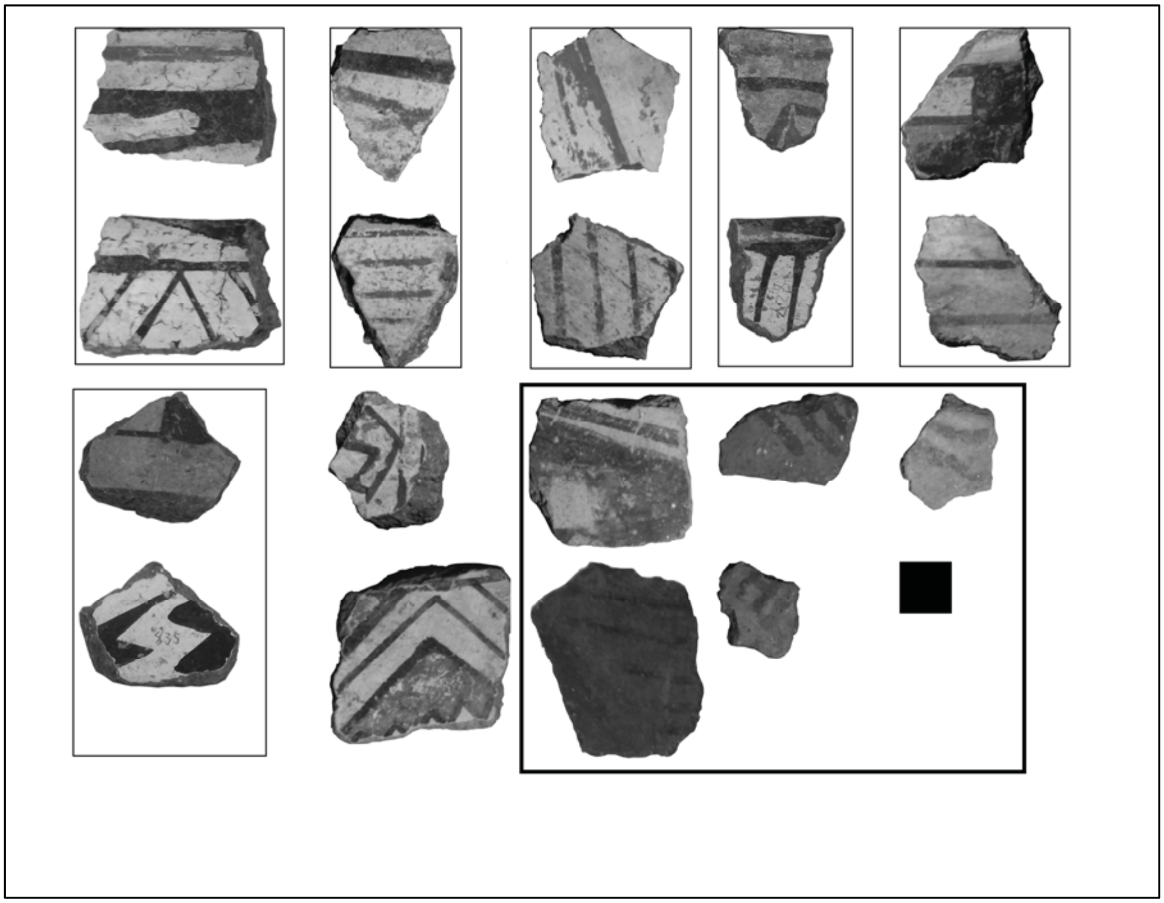


Figure S 4. Examples of painted sherds from the Moctezuma Valley; thin line boxes denote opposed sides of same sherd among Chihuahuan styles from Teonadepa, thick line denotes the sample from El Nogal. Scale is one cm.

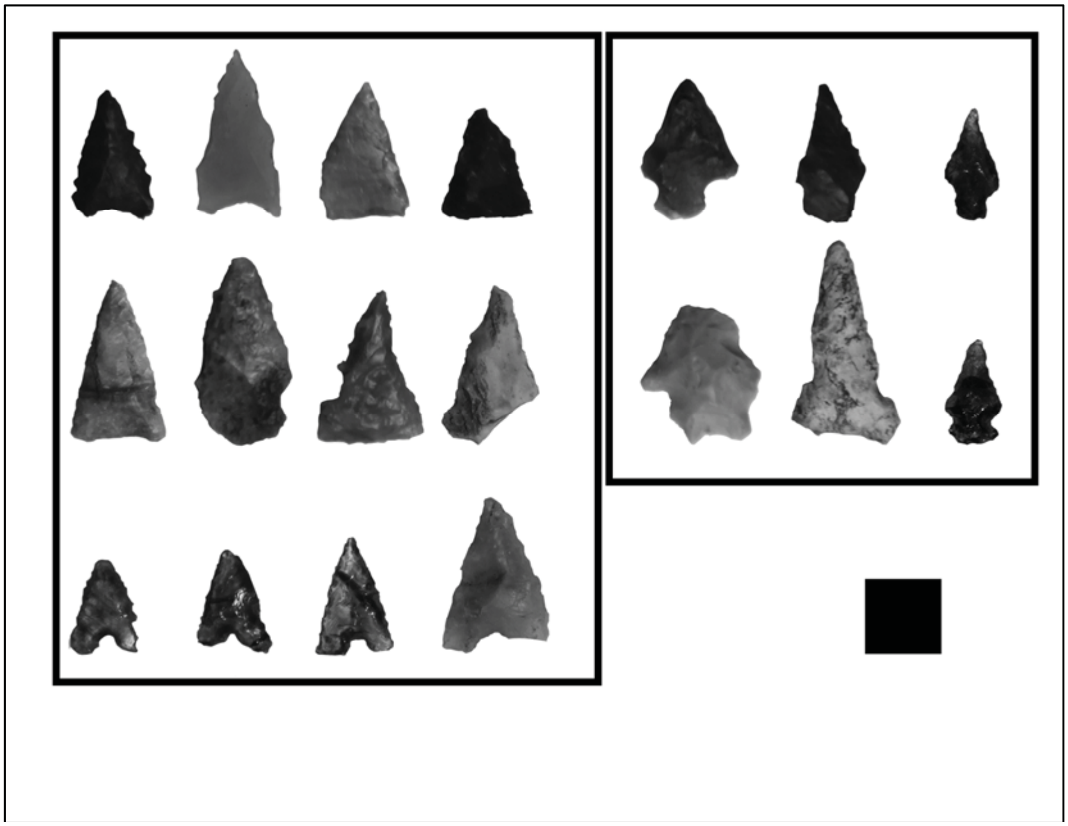


Figure S 5. Projectile point styles recovered in the Moctezuma Valley. The left box of triangular and triangular base notched points are from Teonadepa; the right side of stemmed and side notched points are from El Nogal. Scale is one cm.

Tables

Table 1. *A* statistic of investigated valleys/regions of Northwest Mexico.

Valley	A statistic	95% upper	95% lower	Data Source
Bavispe	.40	.17	.63	Douglas and Quijada 1997
Marana	-.22	-.51	.09	Fish et al. 1992
Moctezuma	.49	.31	.64	
Onavas	0.56	0.43	0.7	Gallga 2006
Paquimé	-0.42	-0.83	0.26	provided by M. Whalen[ii]
Sonora	0.18	0.03	0.37	Doolittle 1979
Trincheras	-0.23	-0.56	0.26	Fish and Fish 2004

Table 2. Population estimates by watershed using three different density estimates.

Name	Hectares	Sauer	Riley	Doolittle
Bavispe/Yaqui	1860323	27905	37206	49509
Moctezuma	680700	10211	13614	18115
San Miguel	329042	4936	6581	8757
Sonora	887513	13313	17750	23619
Total area	3757582	56364	75152	100000

Table S 1. A-statistics with altered values included.

Valley	A statistic	95% upper	95% lower	Data Source
Bavispe	.40	.17	.63	Douglas and Quijada 1997
Marana	-.22	-.51	.09	Fish et al. 1992a
Moctezuma	.49	.31	.64	Pailes 2015
Moctezuma altered	0.44	0.26	0.62	
Onavas	0.56	0.43	0.7	Gallga 2006
Paquimé	-0.42	-0.83	0.26	provided by M. Whalen
Sonora	0.18	0.03	0.37	Doolittle 1979
Sonora altered	0.13	-0.03	0.31	
Trincheras	-0.23	-0.56	0.26	Fish and Fish 2004

Table S 2. X^2 of ceramic categories at Teonadepa and El Nogal.

		Teonadepa	El Nogal	Count Totals
Brushed	Count	278	1523	1801
	Expected	413.9	1387.1	
	Deviation	-135.9	135.9	
	Cell X^2	44.6	13.3	
Painted	Count	88	53	141
	Expected	32.4	108.6	
	Deviation	55.6	-55.6	
	Cell X^2	95.4	28.5	
Red	Count	233	278	511
	Expected	117.4	393.6	
	Deviation	115.6	-115.6	
	Cell X^2	113.8	33.9	
Textured	Count	70	388	458
	Expected	105.3	352.7	
	Deviation	-35.3	35.3	
	Cell X^2	11.8	3.5	
Count Totals		669	2242	2911

$X^2 = 344.8$ $df = 3$ $p < .01$

Table S 3 X^2 of painted ceramic categories at Teonadepa and El Nogal.

		Teonadepa	El Nogal	
Chihuahua	Count	79	17	96
	Expected	60.2	35.8	
	Deviation	18.8	-18.8	
	Cell X^2	5.9	9.9	
Sonora/Local	Count	20	42	62
	Expected	38.8	23.2	
	Deviation	-18.8	18.8	
	Cell X^2	9.1	15.3	
	Count	99	59	158

$X^2 = 40.3$ $df = 1$ $p < .01$

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Notes

[1] DiPeso's original argument would actually place this period 150 years earlier, here the revised and widely accepted chronology is employed (Ravesloot, et al. 1995).
[1] These estimates are based on density calculations for the area identified by Doolittle, hence the reason the totals do not match the population estimates of Riley and Sauer who define the region slightly differently.

Appendix C

Exchange Economies of Protohispanic Eastern Sonora, Mexico: A Reevaluation Based on Provenance Data Analyses

Submitted to Journal of Field Archaeology

Abstract. Provenance data on mundane and rare artifact classes from eastern Sonora are examined in order to revise interpretations of the political economy of Northwest Mexico. Previous research argued long-distance exchange was a predominantly *elite* activity utilized to generate economic wealth as a means to political ascendance. Data presented in this analysis contradict these previous models and indicate that all segments of society employed exchange to forge relationships for diverse reasons. Commoner households used the exchange of mundane artifacts to bank social capital with groups unlikely to undergo simultaneous social depredations. Aspirant leaders rarely utilized unequal access to regionally acquired exchange-goods to attract local supporters. There is no evidence that foreign objects and symbolism imported from Mesoamerica were a component of aspirant leader strategies. Overall, eastern Sonora would have been a very poor conduit for long-distance exchange.

Scholars of the Northwest/Southwest (Figure 1) have often enlisted exchange as an agent of change in political trajectories (DiPeso 1974; Pailes 1980). These reconstructions relied on broad theories to propose mechanisms of transference with little reference to the feasibility of moving goods through specific social landscapes. As they relate to eastern Sonora, many of these models now seem dated as they assume a class of elites as the primary brokers for the movements of goods and a preference for economic over symbolic value. Current and recent prior research has failed of find evidence of pronounced social hierarchy in eastern Sonora (Douglas and Quijada 2004). Most data suggest small-scales of political-social integration in which aspirant leaders at most achieved a degree of control over local settlement-communities and rare exotic goods played a relatively minor role in the political economy. There is no evidence for attached (Costin 1991) or elite-produced (Inomata 2001) specialization and only minimal evidence that aspirant leaders disproportionately participated in the circulation of certain goods. Prestige-goods (Friedman and Rowlands 1977) and other elite centric models now seem to be inappropriate as neither the presence of elites nor significant production or transference of precocities has been demonstrated. Even in neighboring regions, where such goods do exist, they are no longer seen as resulting from regular, long-distance, exclusive, elite mediation of exchange networks (Whalen and Minnis 2003).

This is not to say that rare goods had no role in the nascent political economy of eastern Sonora. Based on archaeological research conducted in other regions in the last twenty years it now seems much more likely that many of the *prestige goods* and economic valuables hypothesized for eastern Sonora are better understood as *social valuables* (Spielmann 2002). Inherent properties of rareness or associations through either indexical or direct provenance relationships often charge these goods with ideological significance that is the true nature of their value (Helms 1993). Such items are desired and accessible by more than just aspirant leaders. They may serve to materialize ideologies that are both supportive of and undermining of aggrandizement (DeMarrais, et al. 1996; Wells 2006). The ubiquity, distribution within settlement-communities and sites, and time invested in the production/acquisition of social valuables all reflect the degree to which aspirant leaders successfully controlled both the physical distribution of these resources and the crafting of their associated ideologies. Understanding how such social valuables as well as more mundane goods moved around the landscape of eastern Sonora is critical to evaluating this region’s potential as a participant in far reaching social networks and the character of its internal organization. This paper will present the results of provenance analyses on a variety of materials in order to realign interpretations of eastern Sonora with present data and theory.

Previous Macro-regional Models

Most reconstructions of exchange that include eastern Sonora are based on elite managerial models embedded in a larger theater of core-periphery relationships with the northern frontier of Mesoamerica and Paquimé, located in Chihuahua. These theories were born out of three impetuses: an inordinate amount of rare and exotic items discovered in Paquimé, Chihuahua (DiPeso, Rinaldo and Fenner 1974), references to Native exchange habits in Spanish exploration era documents, and similarities in material culture and ideational content in the U.S. Southwest and Mesoamerica that suggested at least sporadic contact (Gladwin, et al. 1937; Haury 1945; Pepper and Nelson 1927). Mentions of trading activity in contact era accounts (Adorno and Pautz 1999; Hallenbeck 1949; Hammond and Rey 1940; Obrégon 1928) do suggest salt, slaves, feathers, alum, cotton and other commodities circulated in eastern Sonora. Few details or further specifics are given; no clear mention of markets or other distributional mechanisms are made.

R. Pailes and Whitecotton, (Pailes 1990; Pailes and Whitecotton 1979, 1995; Whitecotton and Pailes 1986) explained the incorporation of eastern Sonora into broader Mesoamerican economies through a World-Systems approach (*sensu* Wallerstein 1974). In this model polities of eastern Sonora were seen as the result of local elites emulating their more advanced Mesoamerican neighbors. This *elite* class exercised local control through special access to rare items of Mesoamerican paraphernalia and associated ritual knowledge. In turn, raw materials, such as cotton and turquoise, attracted the beneficence of Mesoamerican patrons.

J. Charles Kelley was a strong proponent for the presence of actual Mesoamerican traders in hinterland regions. He viewed these itinerants as *vanguard merchants* (J. C. Kelley 1986, 1992, 1995, 2000), seeking out new markets and opportunities, and carrying with them the seeds of many Northwest/Southwest political strategies. Kelley argued such entrepreneurial exchange would progressively establish contacts in hinterlands (including eastern Sonora) through an ever-expanding network. The prestigious association of these brokerage agents with foreign persons and concomitant access to prestige goods would overtime lead to the emergence of a local managerial class fully invested in the maintenance of the mercantile system. Bulk goods and raw materials would be the primary products extracted from these regions and possibly moved through the system by contracted arrangements (J. C. Kelley 1992:141).

Carroll Riley (1987, 1999, 2005) argued ethnohistoric texts reflected considerable complexity in the region, much of it underpinned by frequent mercantile activity. Riley, as well as the other researchers discussed above, argued the trade in rare-wealth objects spurred a more generalized exchange economy across the region in which essential staples also circulated. Most researchers saw Culiacan and Guasave as entrepôts to the wider system with Paquimé as an archetype endpoint (R. J. Bradley 1996; Carpenter and Vicente 2009; DiPeso 1974; Foster 1999; Pailes 1994; Riley 2005). More recent research in the Paquimé area has turned away from models of long-distance exchange or other mechanisms of exterior influence (Whalen and Minnis 2003). Current Paquimé research places primacy on ideological justifications of inequality (VanPool and VanPool 2007; Whalen and Minnis 2012). Social valuables played a role in supporting, justifying, and reifying this system and were possibly intertwined with staple goods production in both near core and hinterland regions (Minnis, et al. 2006; Whalen and Minnis 2001, 2009).

Eastern Sonora

Despite being its hypothesized role in pan-regional processes eastern Sonora has been the target of little archaeological research. Various political-territorial entities have been proposed for the area based on exploration era accounts. These units have variously been called *statelets, chiefdoms,* or *polities* (Doolittle 1984, 1988, 2008; Reff 1985; Riley 1987, 1999, 2005), but these labels may overstate the case for complexity (Lekson 2009:215). The presence of densely occupied, highly productive, irrigation dependent, communities in all sufficiently wide river valleys is not in question. Considerable variance was likely present in the demographic and political organization across this large area. Archaeological survey of the Sonora Valley led to a model of fairly small, but hierarchically structured settlement groups with centers located equidistantly from each other and the arable limits of the valley (Doolittle 1984, 1988, 2008). Possible public—if not monumental—architecture at these centers confirms their primacy in the settlement system. This research will simply reference these units as *settlement-communities,* in the sense utilized in the neighboring U.S. Southwest to indicate multi-site, political entities that likely orchestrated at least some aspects of production and were the largest regularly cooperating social unit (Doyel and Fish 2000; S. K. Fish 1996; see also Renfrew 1986).

Unequivocal public architecture has not been found in surveys of other river valleys and less size (population) variance between settlements in a community may be the norm (Douglas and Quijada 2004; Quijada and Douglas 2003). Survey and excavation in the Moctezuma Valley, which generated the present data, also suggests relatively small settlement communities that apparently lacked large-scale public architecture. The map in Figure 2 estimates the distribution of settlement-communities utilizing the scale identified in the Sonora and Moctezuma valleys as a model and extrapolates based on the distribution of arable land. Except for the few Sonora Valley examples the region is quite notable for its lack of public architecture or any other clear means of community integration. The ethnohistoric texts indicate warfare was a persistent preoccupation (Johnson 1971), and was the principle mechanism of social mobility. War-leaders and councils of elders are essentially the only identifiable positions of authority in any ethnohistoric text. In total, most evidence suggests small, weakly integrated settlement-communities were the largest consistently maintained social groups. The presence of at least some social ranking seems clear, but how much is debatable (J. H. Kelley and Villalpando 1996; McGuire and Villalpando 1989). The closest clear archaeological evidence of participation in anything other than a local political economy is located in northern Sinaloa/southern Sonora to the south (Carpenter 1996; Carpenter and Sanchez de Carpenter 2007:27; Carpenter and Sánchez 2008; Carpenter and Vicente 2009) and Paquimé to the north.

Analysis and Results

The range of materials subjected to analysis includes goods that are both mundane and varying degrees of exotic. They thus offer a cross-section of the methods of exchange/acquisition and attendant relationships likely employed in the region. This section will focus on descriptive analyses of the distance and scale at which items were procured and subsequently distributed. The agents of procurement, transport, and consumption will be identified to the extent possible. The motivations for these practices will be addressed in the discussion section. Due to a lack of suitable previous research provenance data sets from this region will be compared to both patterns recorded in neighboring regions and ideal patterns to highlight certain qualities. References will be made to "*down-the-line*" (Renfrew 1975, 1977) exchange, a term borrowed from distributional analysis. This technique has well-established problems of equifinality (Hodder 1982). It is used here in only a limited scope to denote patterns that suggest a very high attenuation in the frequency of acquisition relative to distance or the number of times an item changes hands before entering the archaeological record. The data sets result from a settlement survey of 30 km of the Moctezuma Valley and test excavations at three of the largest sites: Teonadepa (Son L:1:23), El Nogal (Son L:2:1), and Los Mineros (Son L:2:22) (Supplementary Materials 1).

Teonadepa and El Nogal are the primate centers of separate settlement communities occupied minimally from the thirteenth to fifteenth centuries. Several lines of data support this assertion. The small painted ceramic assemblages from El Nogal and Teonadepa are categorically different. The frequency of ceramics with textured designs is also starkly different at both sites. Non-ceramic data including, projectile point styles, lithic raw material preference, faunal assemblage data, and limited adornment/jewelry assemblages also suggest a social boundary between the northern and southern end of the project area. Settlement pattern data likewise suggest El Nogal and Teonadepa were roughly equally sized primate villages anchoring separate communities.

Obsidian

Obsidian sourcing data is one of the most frequently used methods of reconstructing exchange networks (e.g. Bayman 1995; Darling 1998; Shackley 1995). Obsidian is not available in the study area. Its importation would require interaction with exterior settlement-communities across significant demographic voids. The distribution of obsidian in the study area was extremely unequal. During the initial survey only five habitation sites (16 percent) produced any obsidian artifacts. At three of these sites only one or two obsidian artifacts were recorded, while at La Cuchilla (Son L:1:6) and Teonadepa they were so ubiquitous that complete collection was impractical. Excavation and a systematic surface collection produced two more small assemblages from El Nogal (*n*=16) and Los Mineros (*n*=12) and significantly augmented the sample from Teonadeopa (*n*=123). While La Cuchilla and Teonadepa are large sites, the total number of individuals living in non-obsidian bearing sites is undoubtedly much higher. Simple proportionality of populations would not account for obsidian distributions within settlement-communities and certainly cannot explain the disparity between El Nogal and Teonadepa. At Teonadepa and La Cuchilla obsidian was dispersed fairly evenly across all contexts. These patterns suggest a limited number of exchange conduits reaching this settlement-community, wide dispersal within select settlements, and very little employment of obsidian in social networks larger than settlement boundaries. I interpret this as suggestive of a select group of individuals acquiring obsidian and then dispersing it to spatially proximate allies. Teonadeopa and La Cuchilla are located only 3.5 km apart and potentially received obsidian directly from the same exterior connections or were engaged in a relationship that linked their inhabitants in the locally exclusive distribution of the material. El Nogal, located ~30 km from Teonadepa, is of a comparable size, is also the largest site in a local settlement-community, and likely had a larger or longer occupation. The substantial differences in obsidian density must thus be attributed to differential access to exterior connections not shared by individuals at El Nogal and Teonadepa/La Cuchilla.

To further explore the relationship of obsidian access a total of 42 samples were submitted[i] for quantification of trace elements through X-ray fluorescence to identify geologic source. Many of the sources in Northwest Mexico remain unidentified (Shackley 1995), but a rough sketch of connections can still be made. The first rounds of sampling choose specimens at random (*n* = 33). Eighty-five percent of this sample had an identical provenance, known as the Selene source, located 70 km to the east-northeast of Tenoadepa. Nine more samples were subsequently submitted that had macorscopic qualities suggestive of alternative provenances. Four of these sourced to two unknown locations. In total five additional sources other than Selene are present in the total sample, four are unknown and the last is from Los Sitios del Agua in far western Sonora (Figure 3). Keeping in mind the nature of the sampling strategy the distribution of provenance identifications indicates the Moctezuma Valley was on the very margins of the trade networks in which the four unknown and Los Sitios del Agua sources circulated. Only in regards to the relatively nearby Selene source does the frequency of importation suggest regular exchange.

Referring to Figure 2, the settlement-community of Teonadepa would likely have direct access to the overseers of the Selene source without needing to pass through territory controlled by an intervening settlement-community. In other words, no other major population centers likely lie between the two valleys that would necessitate a middleman role. The near absence of obsidian at El Nogal suggests the need to pass through even one other such settlement-community exponentially decreases the frequency of acquisition. Distributions significantly dominated by the closest available sources such as these data indicate a down-the-line system of exchange operative at the level of settlement-communities. That is select individuals at the primate centers of some settlement-communities had the where-with-all and resources to forge some sort of exchange connections outside of their immediate region. Due to either physical distance or social barriers these sorts of connections were clearly not available to all individuals and items were rarely passed on in a second step of exchange to other settlement-communities.

Ceramics

The painted ceramic assemblage reinforces the observations made regarding obsidian exchange. The overall low frequency of all painted ceramics suggests they are mostly imports and not the result of an endemic industry, routine exchange, or large volume acquisitions. Survey collections identified only four other sites besides, El Nogal and Teonadepa, with any painted ceramics. The same observations made above regarding primate centers and population distributions and artifact assemblage size in relation to obsidian also hold for this material class. The northern and southern reaches of the survey area clearly had access to near mutually exclusive suppliers, as indicated by very different painted ceramic traditions (Figure 4). The assemblage compositions also suggest that once acquired painted ceramics were traded further in only very low frequencies. The painted ceramic assemblage is also likely the result of down-the-line systems operative at the settlement-community scale. This is supported both by the diversity of unique types and the extremely lopsided distributions of painted types at spatially proximate settlement-communities.

Ceramics are also a particularly useful means for exploring local and some regional exchange relationships in the Moctezuma Valley due to the ubiquity of production potential. Excavations at all three tested sites yielded potting tools, as did surface collections at other sites identified on survey. There is no suggestion that the availability of raw materials was sufficiently spatially heterogeneous to produce significant inequities in production potential. The quest for subsistence sufficiency was also likely unproblematic, indicating the adoption of craft production was likely not related to marginal household productive potential. Given this set of conditions an easy null model is provided by assuming mundane (brown-ware) ceramics circulated according to simple need based economic motives. Since production was minimally carried out at all three excavated sites, it is expected the "*supply zone*" (Renfrew 1975, 1977) of a particular production location should not extend far beyond most sites and certainly not beyond most settlement-communities since there is a demographic blank space that separates these units.

The ceramics in this region are amenable to the identification of production zones through the examination of aplastics included in ceramic pastes. These aplastics were either natural or more likely added tempers collected from local stream sands. In accordance with ethnographic data it is expected that ubiquitously available material, i.e. sand, would be gathered from the nearest possible source (Arnold 1988), which in the study is always under two km. As a result, the lithological and mineralogical signature of sands serve as a reliable fingerprint for where a vessel was made on the landscape. This geologic variance was classified utilizing a petrofacies model (Miksa and Heidke 2001) based on 34 sand samples drawn from secondary and tertiary tributaries of the Río Moctezuma (Supplementary Materials 2) and 137 thin-sectioned ceramics to test the reliability of macroscopic categorizations of temper classification. All sherds collected on survey as well as all excavated sherds recovered from floor levels or possessing some form of decorative treatment were inspected with a binocular microscope and typed as to either granitic or extrusive volcanic temper. A blind comparison with the point count results indicates a high accuracy rate when only one principal lithic origin was present (granitic or volcanic), as long as the paste of the sherd was not blackened.

Only the extreme southern portion of the survey area is characterized by granitic tempers Figure 5. The presence of granitic temper is thus argued to mostly denote production in the southern portion of the survey zone. The remaining portion of the study area falls into the mixed volcanic category. The combined thin-section point counting data and binocular qualitative data are sufficient to discern several very clear patterns in the circulation of ceramic vessels in the project area. A higher than expected movement of plain and textured brown wares is evident in the project area. The relative percent of the assemblage assignable to the granitic provenance diminishes in a linear manner ($r^2 = .61$, $F = 36.5$, $df = 24$, $p < .01$) from south to north as depicted in Figure 6. This data considers both surface collections samples, which are generally small n<50 and much larger excavation samples. The lineal drop-off in granitic temper is anomalous in that it crosses the otherwise distinct cultural boundary, indicating these two settlement-communities were intertwined through regular face-to-face economic interaction across the 30 km of the project zone. The fact that brown-ware vessels were traded at these frequencies is surprising based on first principles of economic theory. Specifically, ubiquitously available commodities should rarely travel far beyond their immediate production zones except through rare down-the-line exchange, which produces much steeper fall-offs, or in more complex systems that are also unlikely to produce the linear pattern observed.

Petrographic data are less informative of regional or long-distance exchange. The general ubiquities of the rock types utilized in the petrofacies model make them inadequate for identifying more far ranging connections. It is entirely likely that non-local granite or extrusive volcanics would not be discriminated from local varieties through binocular inspection. Four of the 137 sherds subjected to thin section analysis do conclusively indicate rare and likely more distant connections. There was one example each of a sherd with fossiliferous limestone, a metamorphic component, a near pure obsidian temper, and a painted sherd with crushed granite. The fact that all four sherds are distinctly different and singular examples indicates they are certainly not indicative of regular trade conduits and are more likely the result of goods circulating in networks that very rarely reached the region.

Marine shell

The study of long-distance trade requires investigation of items that are only available at a significant distance. Among the recovered materials marine shell is the only suitable example. The shell assemblage is most notable for its sparseness. Only 19 specimens were collected. The assemblage includes five identifiable genera. All of the shell specimens were likely items of adornment (Figure 7). The re-use of one *Glycymeris* bracelet fragment as a pendant suggests that shell material was rare enough that it retained value even in recycled form. In contrast to virtually every rare material retrieved the site of El Nogal had a greater prevalence than Teonadepa with respective ratios of m^3 of excavation/*n*-of-recovery of .32 and .96. It should be stressed though, that these numbers reference overall very low total excavated specimens.

Six of the shell specimens were analyzed via mass spectrometry with the same method described by Grimstead and others (2013) to measure $\delta^{18}O$ and $\delta^{13}C$ isotope ratios. These signatures vary predictably with temperature (minimum values) and fresh-water pulses. Together they can identify archaeomollusks to one of three provinces in the Sea of Cortez: near the Colorado River debouch, between the Colorado River debouch and Isla Tiburon, and south of Isla Tiburon. All samples clearly have a provenance in the north of Isla Tiburon province. These results are quite notable, since previously it had been hypothesized that shell in this region traveled up major river valleys from near modern day Guaymas with a major endpoint consumer at Paquimé (DiPeso, Rinaldo and Fenn 1974:401). These results suggest that shell came from the nearest possible coast at approximately the same latitude, and again that the Moctezuma Valley was likely on the tail end of a down-the-line system.

The relative parity in the distribution of shells genera is notable. The SD/*n* of the Moctezuma Valley assemblage counts is .11. By comparison at Paquimé (DiPeso, Rinaldo and Fenn 1974) the SD/*n* is .17 and at Pueblo Grande (Gross and Stone 1994), a large Classic Hohokam site in southern Arizona, it is .19. The relatively higher SD is indicative of a situation in which consumers demand a specific, popular form and exchange/acquisition systems respond by delivering a preponderance of only a few species while the magnitude of the system inevitably increases the number of genera included. The Hohokam pattern offers a particularly clear example of a well-understood directed system (select middlemen, and direct procurement) (see Marmaduke 1993). The respective sherd/shell ratios are as follows: Paquimé=.20, Pueblo Grande≈65, and Moctezuma=2082.[ii] Vagaries of collection strategy aside, it is clear massive deliveries of shell were made to Paquimé that are not characteristic of any other region. Again such low overall numbers in the Moctezuma assemblage and an apparent demand for any genera that happened to make its way to the region is much more indicative of the tail end of a down-the-line system. Notably, regions with known greater shell consumption, such as the Onavas area (Martínez and Garcia 2011), are spatially more proximate to El Nogal than Teonadepa, again suggesting arrival through a general filtering through down-the-line trade.

Turquoise

As a last point of comparison the general paucity of other rare items suitable for long-distance trade is itself informative. Only three specimens of turquoise were recovered during the project, a piece of raw mineral on survey from La Cuchilla and two beads, one each from El Nogal and Teonadepa. The raw mineral fragment was analyzed in the development of a mass spectrometry strontium (Sr) and lead (Pb) isotope based method for the determination of turquoise provenance (Thibodeau 2012; Thibodeau, et al. 2012). Lead (Pb) and strontium (Sr) occur as trace elements in turquoise that vary predictably based on host geology composition, age, and tectonic history. $^{87}Sr/^{86}Sr$ ratios alone can identify a sample to one of three broad geographic regions identified in the Greater Southwest and a few specific locations. Further geographical refinement is provided by comparison of various ratios of lead isotopes within Sr defined groups, most importantly $^{208}Pb/^{204}Pb$ versus $^{207}Pb/^{204}Pb$. The tested sample does not correspond to any region characterized to date. The sample can thus be excluded from essentially any provenance on the U.S. side of the international border and the porphyry deposits near Cananea, Sonora. No other Northwest Mexican sources have been tested as of yet. The nearby modern day copper sources of Nacozari or Cumobabi would seem like the most probable candidates. As a singular specimen no profound statements can be made about the circulation of turquoise or precious stones in prehispanic Northwest Mexico. Minimally it can be stated that this sample fails to provide any support for the long-distance movement of turquoise from the U.S. Southwest through Northwest Mexico to Mesoamerica as hypothesized in previous research (Weigand 1994; Weigand and Harbottle 1993). The data is consistent with a down-the-line model in which small quantities of rare materials enter local systems in an inversely proportional manner to distance of production/acquisition.

Discussion

Ritual Economy

Ritual economy is concerned with the management of the materialization of socially constructed values and beliefs in the actions of production/acquisition and consumption (Wells 2006:284). It is obviously inextricably linked with all aspects of the political economy (Watanabe 2007). Much research on ritual economy focuses on how aspirant or established leaders try to bend ideologies to their favor (Blitz 2010; Vaughn 2006; Wells 2006). They often do this by monopolizing or setting the terms of production/acquisition or consumption of social valuables. Both competitors and the general populace may resist their attempts through the construction of alternative materialized ideologies or undermining established monopolies (Mills 2004; Spielmann 2002; Wells 2006). It is obviously quite difficult to read these strategies from the archaeological record, especially among groups with low levels of complexity that do not have well developed specialist craft industries. However, many examples suggest overlooking such machinations risks misinterpreting both the how and the why of political ascendance strategies and their contestation (papers in Wells and McAnany 2008).

Social valuables recovered in the Moctezuma Valley easily linked to specific roles in ritual economies are few. Such items are often valuable by benefit of either natural rarity or significant time investment in manufacture, and therefore susceptible to monopolization. They must also be possessed of qualities amenable to serving as indexical markers of specific ideological content. Shell is one such material but research in neighboring regions indicates it was generally employed as a marker of communal identity (Bayman 1996; Marmaduke and Martynec 1993; Vargas 2004). Such social valuables often gain their associated ideologies through use in communal ritual only to be extracted into wider use as a generalized marker of affiliation (Spielmann 2002:198). The very low amounts of shell and other items of adornment, such as turquoise, in the Moctezuma Valley relative to these neighboring regions is likely indicative of less emphasis placed on the materialization of these ideologies.

The apparent lack of public architecture in the Moctezuma Valley, a paramount theater of communal ritual, could suggest a low demand for social valuables serving such roles. The lack of communal features also raises the question of whether other aspects of communal rituals associated with the materialization of specific ideologies namely feasting, served a less predominant role in this region. References in ethnohistoric texts to 600 deer hearts given to Cabeza de Vaca (Adorno and Pautz 1999:235) may suggest such events did take place. If so they must have had a starkly different material character relative to better known archaeological examples in either Mesoamerica (LeCount 2001) or the U.S. Southwest (Mills 2007) given the lack of signaling media discovered to date. Cotton products may have fulfilled any or all of these roles, and its widespread manufacture is hinted at by the recovery of numerous spindle whorls (Pailes 1990). At present, however, this is mere conjecture. We are thus left with largely negative evidence of the materialization of either aggrandizing strategies or countervailing ideologies expressed through widely shared and accessible social valuables.

One explanation is that the ethnohistoric description of warfare as the principle means of social ascendance is accurate. The general instability of such positions (Earle 1997:109) and their close link to measurable and manifest success or failure potentially placed less emphasis on the manipulation and materialization of ideologies through public ritual. Conversely, if the landscape was sufficiently hostile the regular acquisition of rare goods may have simply been impractical regardless of motives or methods. In no way am I arguing ideology was any less of an underpinning of aspirant leader's machinations, only that the manipulation of exotic goods was not a major component of their strategies, which lessened the incentive to resist their motives through alternative materialized ideologies also reliant on exotic goods. Moving forward on the assumption that social valuables appear to have been both rare in the region and perhaps of little efficacy will guide the following discussion of political economy.

Long-Distance Exchange in the Political Economy

The sum of the available evidence suggests down-the-line trade was the dominant character for the movement of goods that could potentially be called social valuables. It should be stressed that this down-the-line behavior was operative at the level of settlement-communities not individual settlements. The *tail end* character of all shell, turquoise, several ceramic types, and all obsidian from provenances other than the Selene source indicate forays to distant localities were not a regular acquisition strategy and social networks of exchange did not have an amenable topology to regularly facilitate the transference of such items. I interpret the limited geographic range of the vast majority of all exchange relationships to indicate that the procurers of exotic objects rarely reached beyond neighboring settlement-communities and may have avoided some near neighbors. The regular movement of obsidian from the Selene area to the Teonadepa area, and only after significant attenuation further down river to the El Nogal area is particularly telling; as is the participation pf Teonadepa and El Nogal in different painted ceramic networks.

There is no evidence at present to suggest these neighboring communities were hostile towards one another. Since neither El Nogal nor Teonadepa were the producers of archaeologically visible social valuables circulating in wider networks and decay rates for down-the-line exchange are significant, it is difficult to discern the nature of interaction between aspirant leaders in these two settlement-communities. Their proximity may have allowed material exchanges to be based on the movement of bulkier goods, such as food staples. Alternatively, the contrasting material cultural and exterior connections of these two areas is commensurate with a competitive political relationship (Goldstein 2000).

Assuming ethnohistoric accounts of frequent warfare are relatively accurate it seems likely these relationships say something about the topology of local alliances. Namely, they involved some neighbors and not others. They also suggest the failure to reach to more far-flung contacts was due to either the structure of alliances that made connections with more distant contacts unstable or they were effectively cut off because of intervening hostile groups. Douglas (1995) introduced the concept of transaction costs to models of exchange among settlement communities in Northwest Mexico. Some of the variables he cites, such as a moderate rate of settlement movement, are not applicable to this region. Alternative forces suggested here including, minimal control of non-riverine zones, unstable leadership positions, frequent internecine warfare, and a high spatial area to settlement-community ratio would likewise reduce the allure of investment in reciprocal exchanges with far flung contacts and focus such efforts on near neighbors.

Applying these observations at the macro-level provides insight into the probability of successfully transmitting goods across eastern Sonora via down-the-line exchange. Taking Figure 2 as a heuristic model and imagining goods starting in the most southern settlement-community the ratio of goods arriving in *n* steps at any of the three northernmost predicted settlement-communities can be estimated. This is calculated as the proportion of all potential walks at each step that terminate in these settlement-communities. This ratio is then multiplied by the probability of transmission to this point, assuming a per step consumption probability of .25, a conservative figure. The exponential relationship of the iteration makes calculating anything past 10 steps superfluous. The summation of steps one through ten equates to a proportion of only .0017. Obviously, down-the-line mechanisms are an ineffective means of transmission across this fractured landscape. It should also be noted that the starting point of this exercise is a good deal north of Culiacan, and would not actually be constrained to either the east or west, indicating actual probabilities are significantly lower. To put these figures into perspective if the entire annual transmission of the Silk Road (Rausing 1988) was placed in this situation only five camel loads would reach the other side.

These observations also significantly undermine the argument that local Sonoran aspirant leaders were reliant on an influx of Mesoamerican paraphernalia as a significant source of legitimization for their roles. It is notable that none of the social valuables, thus far recovered, actually has a Mesoamerican provenance or ideational association. In fact, with the exception of shell and perhaps rare exotic ceramics, none of the discussed items would necessarily even denote a specific distant place through distinctive markers of its provenance. That is they carried no intrinsic value clearly tied to a specific conception of foreignness (*sensu* R. Bradley 2000). They were apparently social valuables only by benefit of rarity, and perhaps in the case of obsidian and turquoise striking physical properties that may, or may not, have denoted specific connotations of origins. Additionally, although not a focus of this paper, there are no artistic examples of rock art or ceramic design that reference Mesoamerican or other distant ideologies recorded in the study area. Even the exotic ceramics were imitations of Paquimé styles that borrowed only color palettes and line work norms, leaving out all of the Mesoamerican charged symbolism. In short, if long-distance exchange networks stretched across this region, local leaders were apparently unable to siphon off any appreciable amount of resources or even symbolism to their own benefit.

This argument does not extend beyond eastern Sonora to polities such as Paquimé, which were obviously receiving goods through directed exchange and present numerous examples of Mesoamerican symbolism. Though, most of the precocities at Paquimé were also obtained on a regional level. Aspects of ritual economy, such as pilgrimages, are a likely mechanisms for moving much of this material (P. R. Fish and Fish 1999; Wells and Nelson 2007). Travelers with ritual motivations might not have been levied for contributions in the regions they passed through. As such, a failure to discover similar objects to those at Paquimé in eastern Sonora may not unequivocally demonstrate non-participation. It is also worth noting that perishable items, such as feathers that are light in weight and potentially high in value (Reyman 1995), could have circulated in a manner more akin to prior reconstructions.

Regional Political Economy

Obsidian and the small painted ceramic assemblage are the only objects that provide evidence that material goods were potentially a component of aspirant leader strategies. Within settlement-communities these rare and foreign items were very rarely partitioned out beyond the limits of primate settlements. I interpret the limited distribution of these goods within settlement-communities to suggest a limited number of individuals orchestrated their procurement and facilitated their distribution to close social contacts. Most evidence suggests this region was labor limited, as opposed to land/resource limited. These conditions would lead to competition over labor and encourage household heads to offer incentives to secure the affiliation of extended family and unrelated individuals. Aspects of the political economy that are largely invisible with present archaeological data, namely land tenure rights and marriage alliances, were probably the predominant means of securing such relationships. The distribution of the few rare goods discussed here is commensurate with a strategy of supporting alliances with co-resident compatriots and immediate neighbors that coordinated production efforts while eschewing independent producers at more distant satellite sites. It is hardly surprising that the most effective manipulators of such strategies would be located at the largest sites, adjacent to the largest parcels of arable land, and would be among the select class of individuals capable of procuring rare resources possibly as an embedded component of orchestrating warfare alliances.

To summarize, aspirant leaders of eastern Sonora likely did utilize regional exchange in rare goods to manipulate their position in society. However, it is equally clear that these individuals did not sponsor markets, engage in far-flung redistributional exchanges, regularly reach beyond near neighbors, or engage in any other behavior that suggests they were particularly effective or interested in manipulating social relations and/or wealth generation through access to exclusive networks (*sensu* Earle 1994, 1997). The apparent focus on naturally rare items, namely obsidian, also suggests aspirant leaders never developed systems of specialist patronage, which reflect more institutionalized positions of authority (Brumfiel and Earle 1987; see also Schortman and Urban 2004).

Local Political Economy

How can these interpretations be rectified with a supply zone of brown-ware ceramics that clearly stretched from a production zone near El Nogal to Teonadepa and across boundaries not penetrated by obsidian and rare ceramic networks? The intensity of transactions indicates regular face-to-face interactions. This combined area is larger than what would be expected for a supply zone driven by purely economic or functional factors, especially since it seems obvious that brown-ware ceramics were produced in all areas. Assuming internecine warfare was indeed a frequent issue in this region it would not be surprising if households forged as many exterior relationships as possible as a buffering mechanism. In this case, it appears brown-ware ceramic consumers, which likely subsumes most of the population, might have intentionally crossed a political/social boundary to forge ties with groups that would be subject to non-synchronous social upheavals. This reconstruction assumes exchanges orchestrated between aspirant leaders correlated with likely military alliances. Present data indicate this would subject Teonadepa and El Nogal to potentially non-synchronous social circumstances. Similar strategies are utilized to avoid subsistence risk in many contexts (Hegmon 1989; R. L. Kelley 2007:169). These brown-ware exchange relationships would likely be reified and reinforced by much more than the plain and textured vessels that provide archaeological evidence of the linkage. The use of exchange as a means to bank social capital is a standard practice world wide (Mauss 1924), and there appears to be little other reason to trade such a ubiquitously available item at such distances. Lastly, the lack of integrative communal architecture features, or associated integrative mechanisms operative at the settlement-community or larger levels may indicate that no higher order social buffering mechanisms were available. That is, the social contract between aspirant leaders and commoners may have been weak or included few responsibilities to care for dispossessed households as a result of social upheaval. This would increase the motivation for lower level units, such as households, to develop effective buffering strategies.

Conclusion

This analysis provided a review and major revision of prehistoric exchange practices in eastern Sonora based on newly acquired data. In general, it appears aspirant leaders, to the extent they can be identified, participated in exchange relationships mostly through down-the-line mechanisms with their near, but perhaps not closest, neighbors. This pattern is discernable at the scale of settlement-communities. Once acquired from distant locations social valuables were most often enlisted in the maintenance of immediately local relationships and rarely traveled outside primate centers. This may reflect particular strategies of attracting and maintaining the support of followers and potential labor contributors or warrior allies. The general paucity of social valuables suggests they served a relatively small role in such machinations. Conversely, most households apparently choose to regularly cross the nearest neighbor boundary in their exchange behaviors. Tentatively, I suggest this was due to a desire to make social connections with households that were unlikely to experience synchronous social upheaval.

This is likely a result of the internecine warfare that was reported as constant in this region by early explorers. Social valuables that do not appear to be clearly linked to any kind of social ascendance strategy, such as shell, are decidedly rare in the region. I argue this reflects an overall low effort put into strategies that materialized ideologies through public performance aimed at either group cohesion or manipulations of the social order by aspirant leaders. Accordingly at present there are few clear indications of feasting activities or other venues in which such social and political dramas are enacted. This may certainly be a result of inadequate study. The role of archaeologically invisible perishable materials that might contradict these suggestions should not be ignored in future work.

While this analysis has contributed substantially to the understanding of exchange in this area it certainly could benefit from significant elaboration in the geographical distribution, sample size, and diversity of provenance determination methods and associated material classes. While it is demonstrated that in the studied region that down-the-line trade predominated as the means of distribution, huge hoards, i.e. four million pieces of shell, at Paquimé suggest some long-distance movements of social valuables did occur. It should also be stressed that this analysis was based on the reconstruction of one river valley, substantial variation is likely present in this broader region and the conditions identified here may not hold for all of eastern Sonora.

Acknowledgements

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Figures

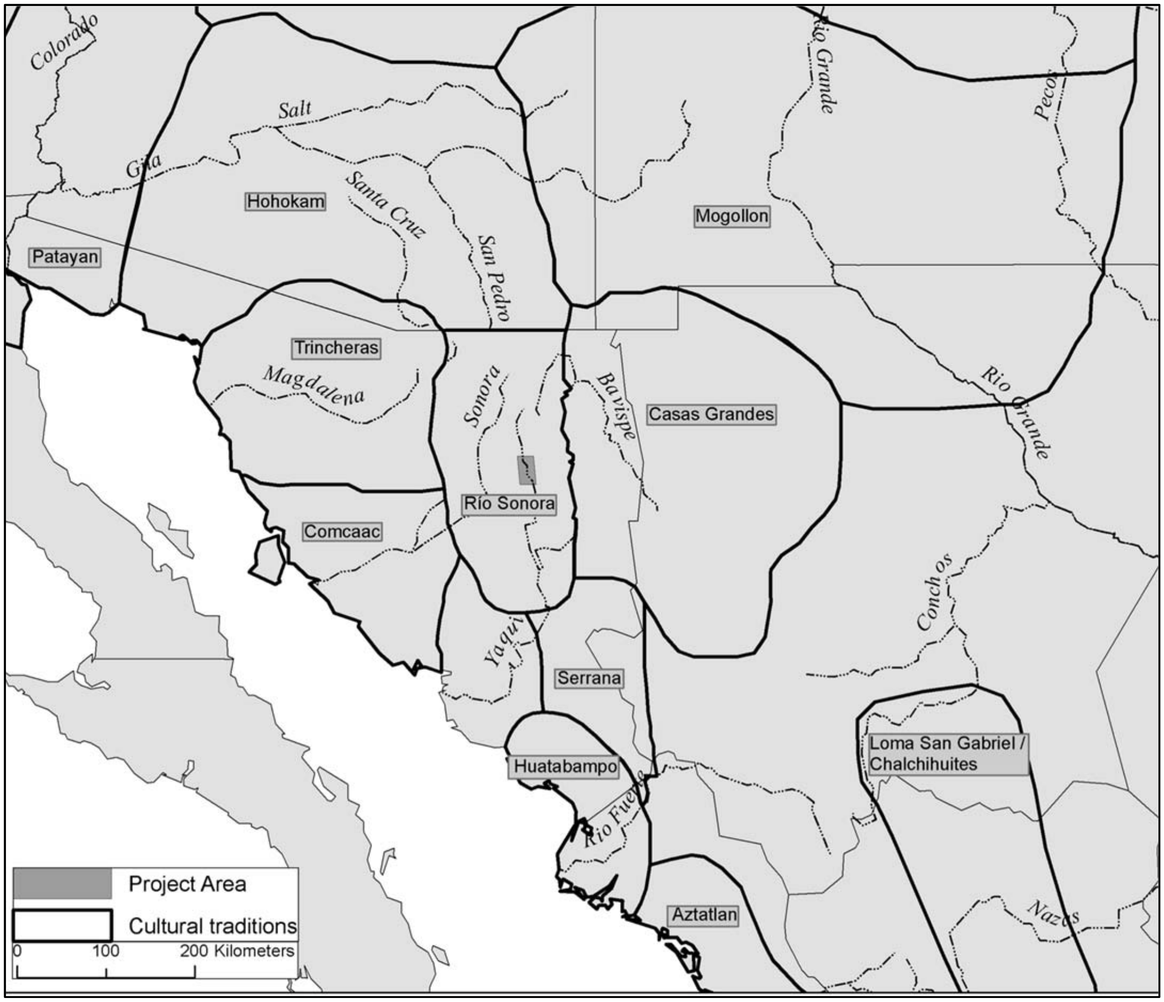


Figure 1. The Northwest/Southwest and project area.

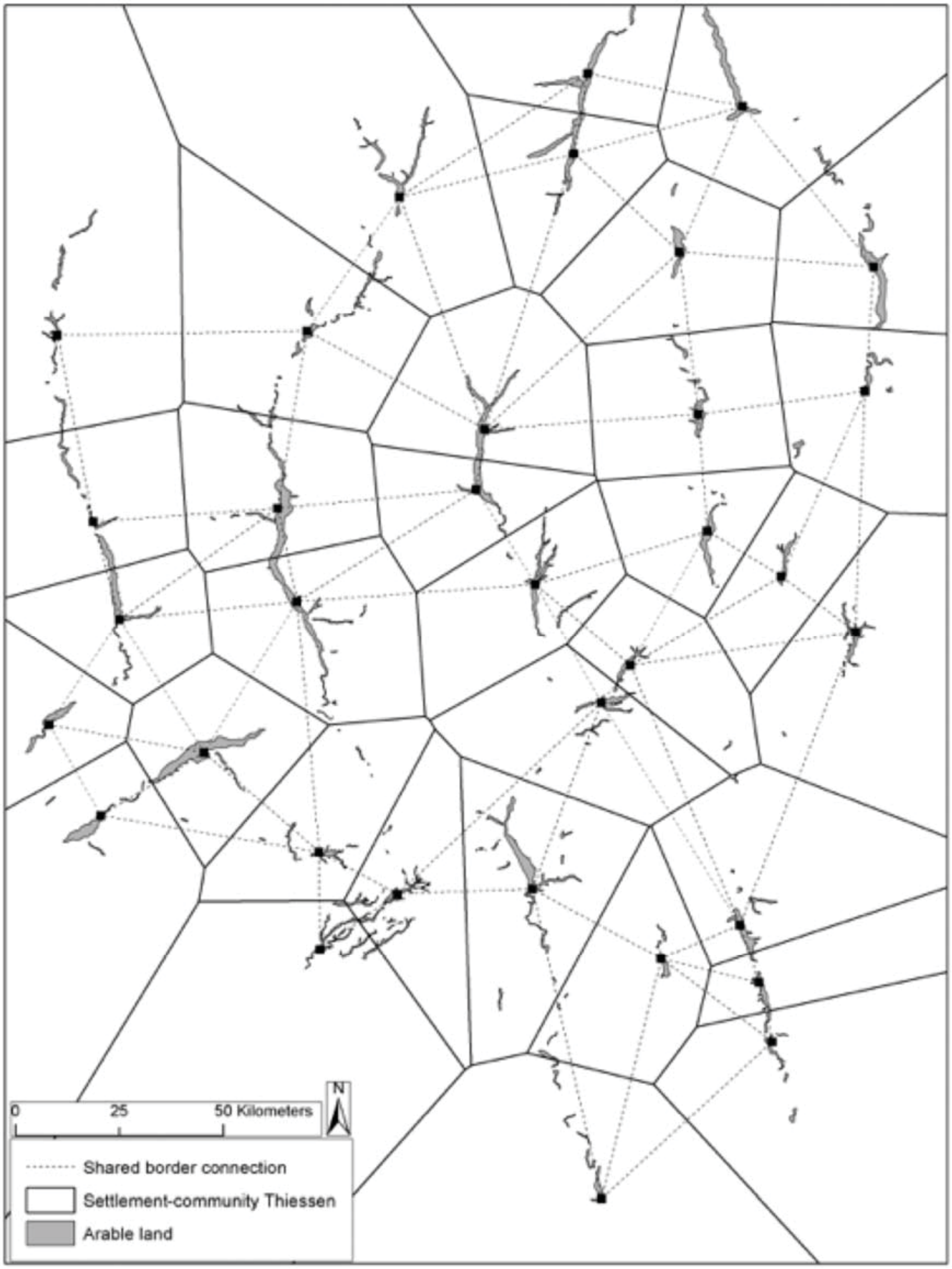


Figure 2. Predicted distribution of settlement-communities with ties based on shared borders indicated.

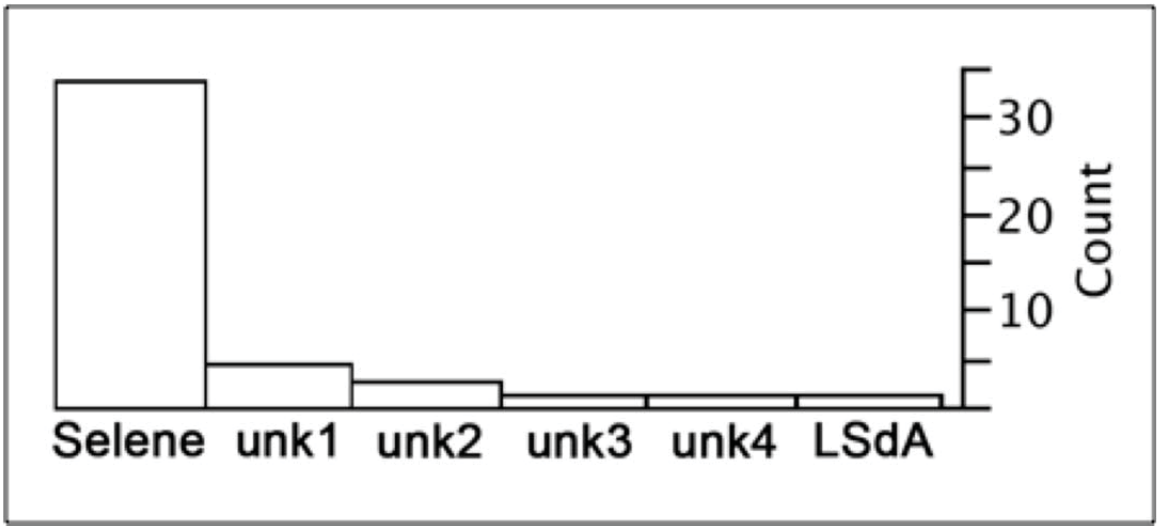


Figure 3. The distribution of obsidian sources.

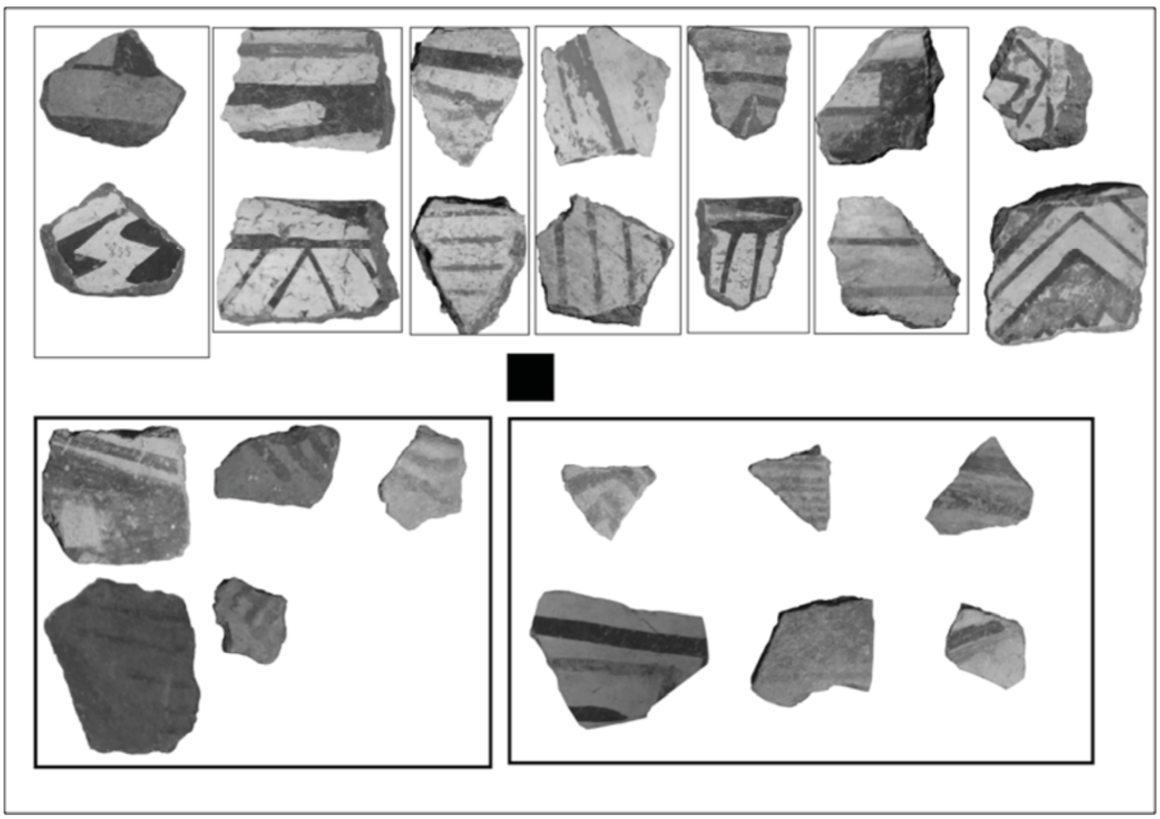


Figure 4. Examples of painted sherds collected from Teonadepa (top) and El Nogal (bottom) showing categorical differences; scale is one cm.

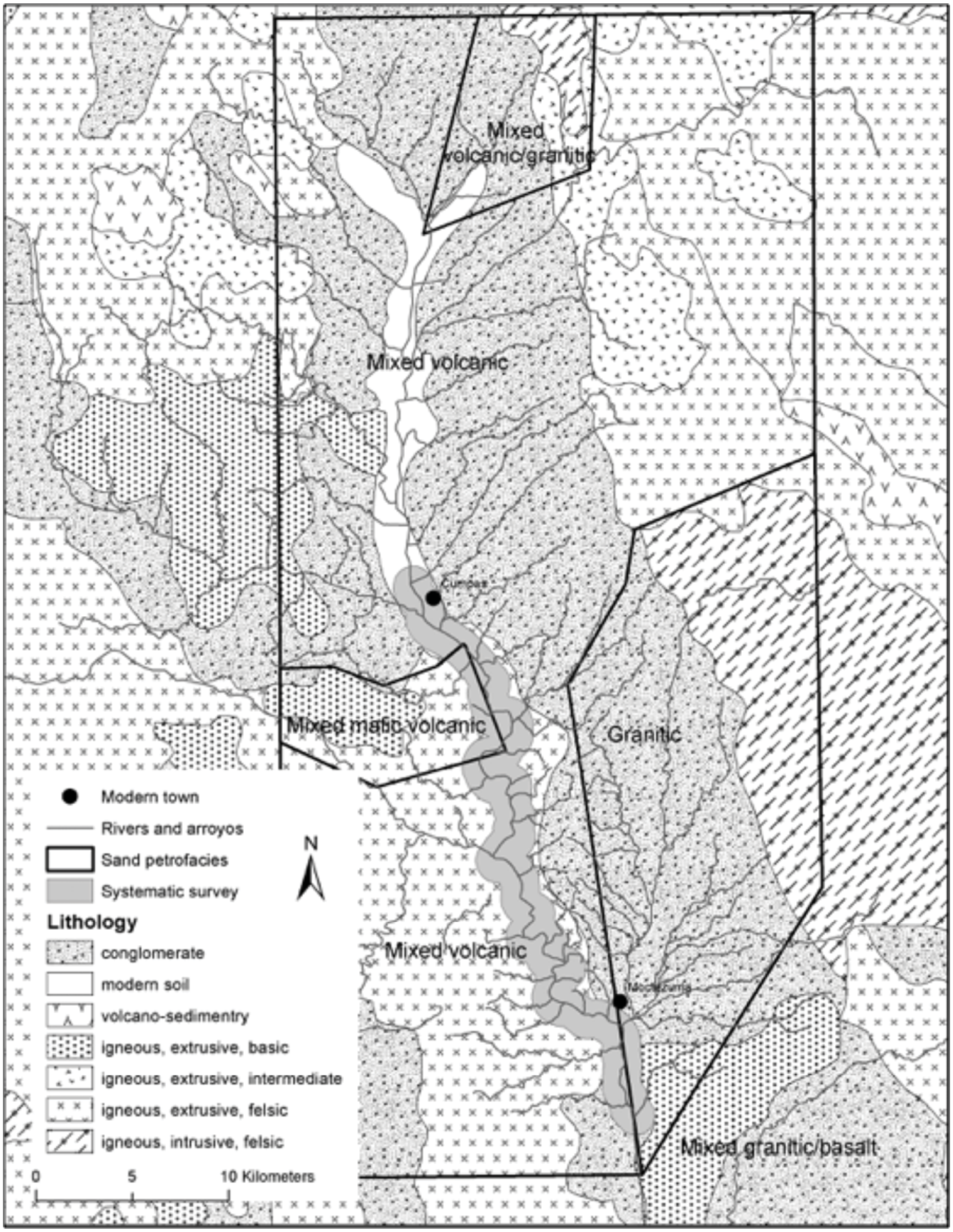


Figure 5. Petrofacies identified in the project area vicinity.

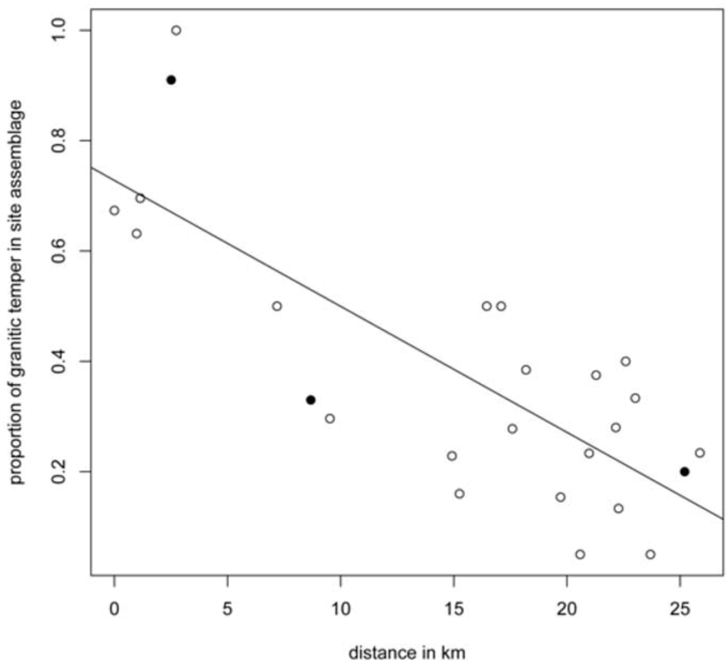


Figure 6. Linear fall off in granitic-aplastic sherds with distance from source, hollow dots are surface collections with small n<100 and solid dots are much larger excavation samples.

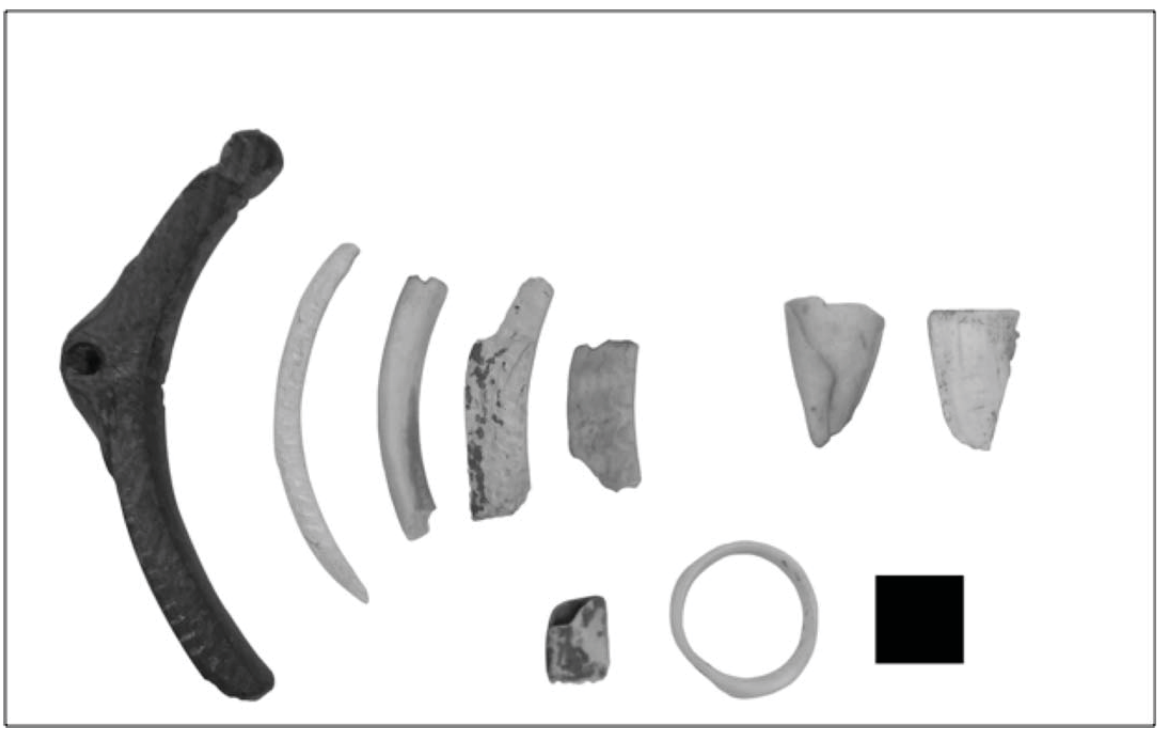


Figure 7. Items of shell adornment recovered in the project area, scale is one cm.

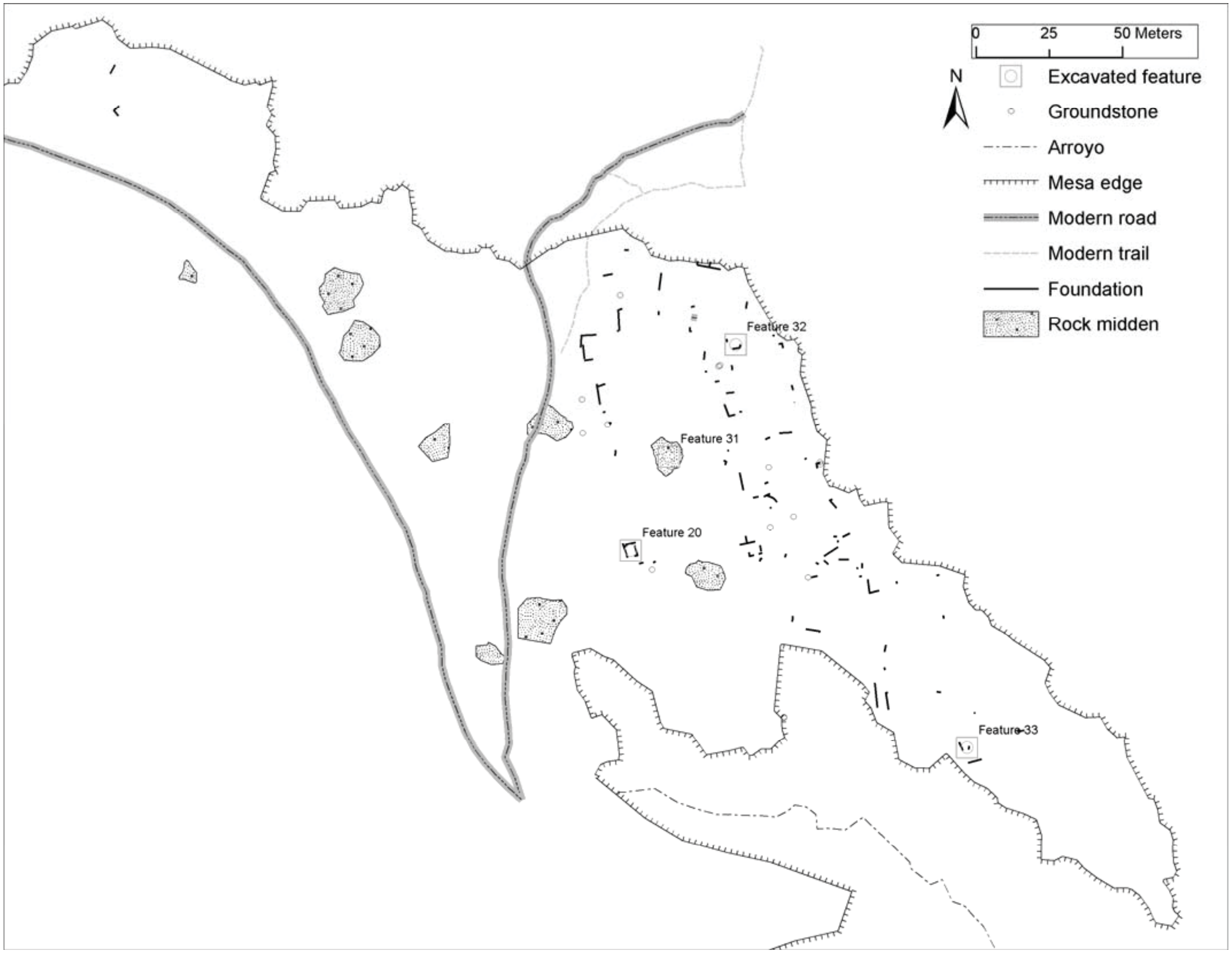
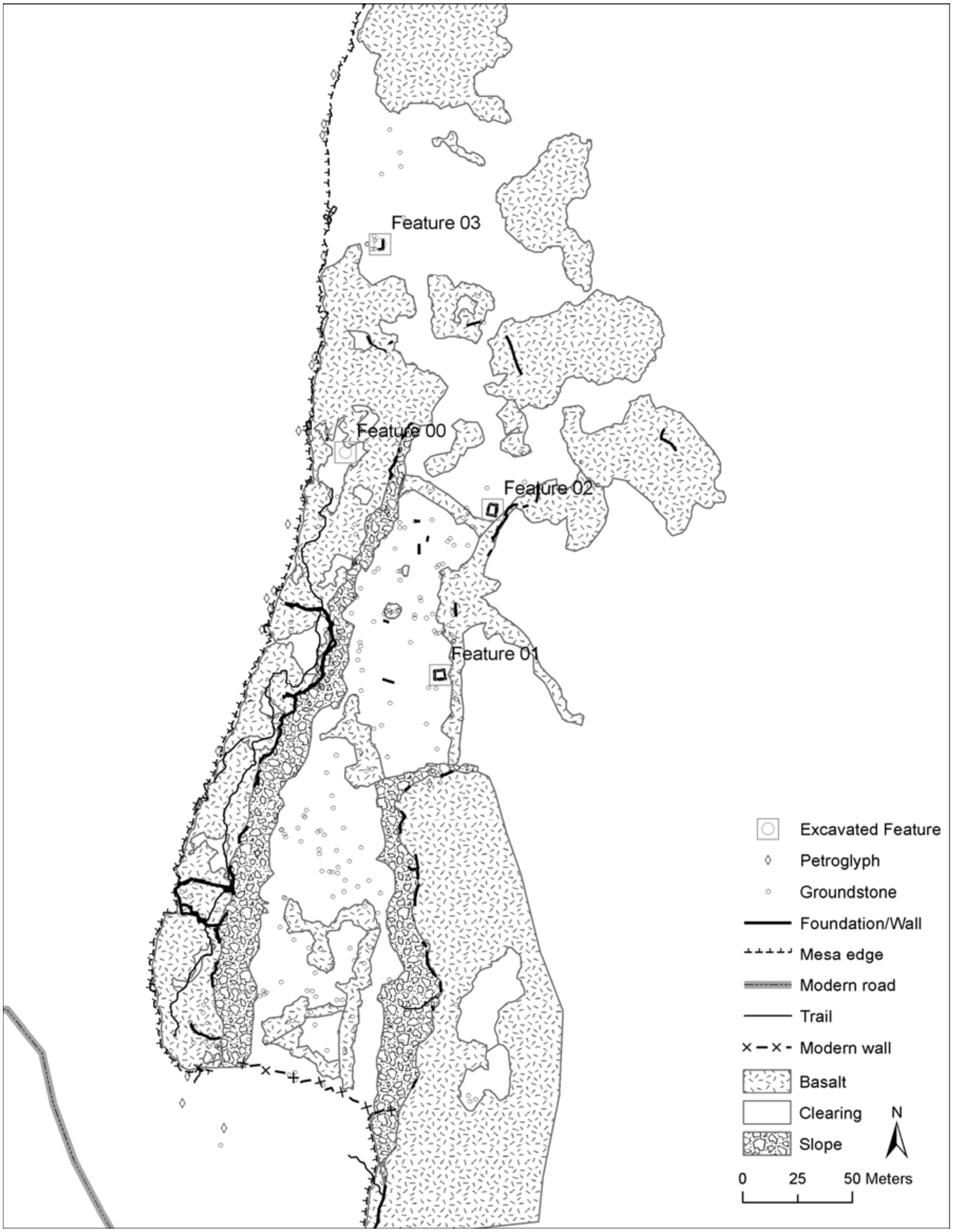
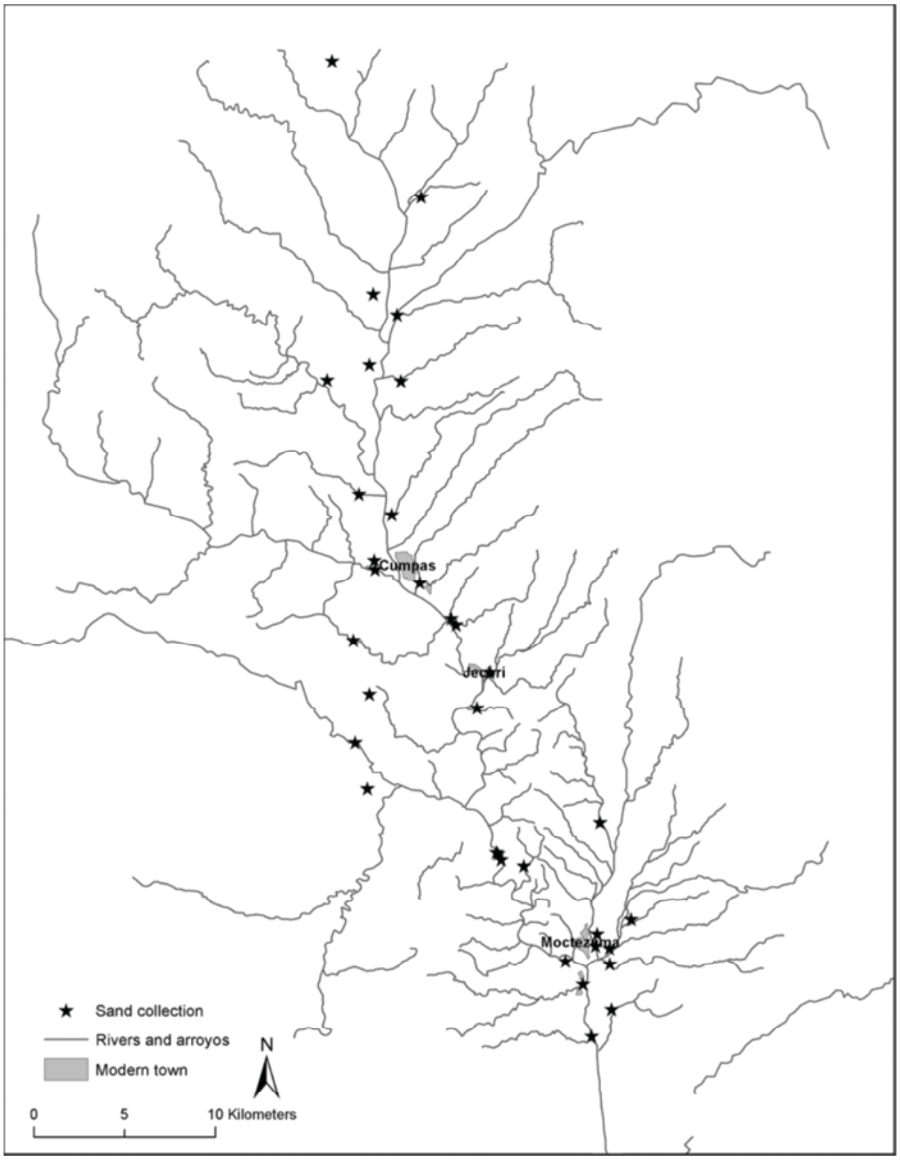


Figure S 1.1. Site map of Teonadepa.



S 1.2. Site map of El Nogal.



S 2. Sand sample locations.

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Notes

[1] 10 samples were submitted to the Gila River Indian Community XRF lab and 33 to the Archaeological X-ray Fluorescence Spectrometry Laboratory in Albuquerque. One sample was submitted to both labs.
[1] Shell counts based on NISP, not NSP.