THE SYMBOLISM OF COARSE CRYSTALLINE TEMPER: A FABRIC ANALYSIS OF EARLY POTTERY IN NEW YORK STATE

by

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DEDICATION

For Hayden. Thank you for letting Mommy steal away so many precious moments of our first years together. You are still my biggest surprise and greatest achievement.

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ABSTRACT

This research focuses on the problem of how early pottery in New York State is defined and analyzed. Many traditional models suggest early pottery developed from an earlier steatite stone bowl technology. Thus far, studies that examine early pottery in the Northeast, called the Vinette Type Series, focus on the potential functions, archaeological contexts, and surface appearance of these vessels and fail to account for the social practices and technological choices inherent within these artifacts. This dissertation reevaluates early pottery using a non-typological approach. In the place of descriptive analysis, this research uses petrography, experimental geo-archaeology, and technical choice and agency theories to identify the different types of temper present in early ceramic vessels. This study also looks at the patterns of different technical choices made by early potters. The redefinition of early ceramic technology using post-modern theories allows the author to better understand the social practices involved in the rise of ceramic technology. The ceramic technological patterns identified are then compared with steatite stone bowl technology. This study concludes that early ceramic technology is more closely related to the practices of earth oven convection cooking than it is to any other cooking artifact. A reclassification of early ceramic fabrics is presented and the traditional early ceramic Vinette type categories are rejected.

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INTRODUCTION

Since John Witthoft's discovery of steatite stone bowls throughout the Susquehanna River Valley in eastern Pennsylvania, archaeologists have associated stone pots with the highly mobile hunter and gatherer cultures of the ancient Eastern Woodlands (1949, 1953). These pots were often identified in archaeological sites alongside broad but extremely thin and well-crafted triangular projectile points, the so-called Susquehanna Broad points, in sites lacking pottery or any other evidence of sedentism. In the latter half of the twentieth century, William A. Ritchie connected these stone points and pots with what he believed was the end of the mobile, aceramic cultures (4,000-2,700 BP) and the start of ceramic production, agriculture, and sedentism in the Northeast and Middle Atlantic regions (Ritchie 1965; Ritchie and Funk 1973: 71). Problematically, many of the archaeological cultures designed by culture-historians were created before the development of radiocarbon dating and modern archaeological excavation techniques. In addition to this, archaeologists lacked a solid theoretical understanding of how social groups develop and interact, and how human behaviors effect and are affected by the material objects they produce. The archaeological cultures designated in the early twentieth century and before, were created for specific purposes by a select few individuals; rather than question the foundation of these groups, archaeologists adopted them ad hoc because they provided an easy way to discuss similarities and variances in material culture (Hart and Brumbach 2003: 746-749).

Recently, many archaeologists have questioned and unlocked the connections made between the appearance of specific types of artifacts, such a stone bowls and pottery, and stages of cultural development (Hart and Brumbach 2003, 2009; Saunders and Hays 2004; Schulenberg 2002a, 2002b; Sassaman 1993). Archaeologists have begun to understand that the visual characteristics of artifacts are not strictly a matter of that object's function in a society, but also contain symbolic and social information key to understanding how individuals navigated complex structures through agency and practice (Dietler and Herbich 1989; 1993; Joyce and Lopiparo 2005: 369; Lemonnier 1983, 1992; Leroi-Gourhan 1993; Lopiparo 2005; Nelson 1991; Sellet 1993; van der Leeuw 1993). As anthropological theory has grown to encompass a less deterministic understanding of human behavior, archaeologists have turned their attention from superficial discussions of the physical aspects of objects and have begun focusing on identifying technological style.

Frustratingly, this process of growth has been stymied in the Eastern Woodlands by the continued reliance on culture-historical types and processually-derived theories (Truncer 2004, 2006). One prevalent concern is the initial appearance and use of steatite technology in relation to early ceramic technology. This debate has become a ‘chicken versus the egg’ discussion. While searching for the earliest dates on steatite and pottery, archaeologists continue to focus on what functions these objects played in past societies as well as how adequately adapted the items where for their users. While some have made great strides towards examining the social processes behind the adoption of steatite and ceramic vessels (Sassaman 1993, 1995, 2006), these discussions remain firmly grounded in processual theory. For many, the style of an object continues to be defined as a matter of the object’s physical appearance and surface decoration; social information, if examined at all, is considered secondary to any discussion of the object’s function (Conkey 1989). These discussions fail to see the full potential of information held within an artifact.

It isn’t enough to apply theories of symbolic and technological style to the current descriptions of ceramic and stone bowl technologies because the descriptions themselves are outdated; they were created with the same descriptive approach that sought to define artifacts in terms of their potential function/s. These early technologies must be reevaluated at their foundations, using a less biased and reproducible approach, before a new theory describing their uses in the northeast can be presented and tested.

The objective of this study is to use a non-typological approach to examine the technological style of early pottery, its origin, and diversity in the Northeast. In the place of descriptive techniques, this study uses geoarchaeology, petrography and optical mineralogy. The first pottery wares in the Northeast are part of the Vinette Series, which were defined more than 60 years ago by Ritchie and MacNeish (1949). The Vinette Series is believed to have developed from steatite stone bowl technology (Boyd 1962: 477; Kinsey 1972: 360; Ritchie 1965: 171-173; Ritchie and MacNeish 1949: 100). This dissertation uses the concepts of technological style/technological choice (through *chaîne opératoire*) to "see" culturally determined choices (agency, structuration and practice) that are visible in pottery. This research traces the repeated pattern of technical choices, specifically the selection of coarse crystalline metamorphic and igneous rock for temper, back to its likely origin in the Northeast, which are hot rock cooking practices.

I reach my goal of examining the relationship between steatite and ceramic technologies by first identifying which technological aspects of early pottery represent repeated patterns of cultural practice. Separating temper, which is described as being intentionally added by potters, from natural inclusions in clay bodies requires a strong foundation in geology, petrology, and petrography (Chapter 1). Chapter 1 focuses on the theories that shape our understanding of how sediments, minerals and rocks form. This chapter also provides a description of what types of resources were available to ancient potters and lays out the necessary definitions for understanding petrography and optical mineralogy.

Chapter 2 describes the soapstone versus pottery debate, the typological foundations of both technologies, and the current discussion on their chronologies. This chapter also gives an overview of what is currently known about the Vinette pottery series, including the culture-historical type traits, archaeological contexts, and potential functions. Next, I examine the traditional theoretical models that describe the origin, development, and use of early pottery in the Northeast in Chapter 3, and show how these models fail to accurately describe the variation in early pottery.

I outline my theoretical position towards symbolic and technological style in Chapter 4 and provide examples of how studies using *chaîne opératoire* and ceramic petrography can provide more information about past social practices. I also explain the history of the petrographic method and its utility in archaeological studies today in this chapter.

Chapter 5 describes my data set and explains the different methodologies I used to examine the technological style of early pottery in New York. This research represents the first ever large-scale petrographic examination of early pottery in the Northeast. Stoltman's (1989) method is traditionally used for petrographic analysis of archaeological pottery, however, this study needed to adapt Stoltman's method to accommodate unique challenges presented by ceramics formed from glacial resources. The amended methodology is also presented in this chapter. Fabric patterns were identified using high-resolution scans of thin sections, petrography and optical mineralogy, via the amended point-counting method.

With the background firmly laid out, Chapter 6 explains the need for identifying temper as a necessary first step in reconstructing cultural practices involved in ceramic production. This chapter describes the different lines of evidence used by the author to separate natural background noise in Northeastern ceramics from intentionally added tempering agents. A second key contribution of this study is the acceptance that ceramic technology was intentional and actively designed (as opposed to haphazard and opportunistic).

Chapter 7 presents the results of this study. This chapter includes a discussion of the ceramic fabric patterns identified by this study with Ritchie and MacNeish's (1949) trait definitions. Chapter 7 also compares these results with the recent AMS ^{14}C dates complied by Taché and Hart (2013) on ceramic vessels in the Northeast in order to provide a relative chronology of technological change in early pottery fabrics.

The final chapter in this manuscript discusses my observations and results and compares them with the older practices of hot rock cooking in the Northeast. Early pottery can best be understood as a portable variation of earth oven technology and not as an adaptation to mast forest resources or resource intensification. It is independent of steatite technology and is a symbolic link to the continued practice of convection cooking. The crushed coarse-crystalline metamorphic and igneous rock temper in early pottery links people back to their cultural landscape and is part of a long-enduring symbolic worldview involving transformation through fire. This is the 'technological essence' inherent in artifacts, as described by Lechtman (1984). I reiterate how traditional types and culture-historical models fail to fully explain the diversity and social complexity of early ceramic technology and how technological style allows for a more detailed analysis. Agency and practice theories can be used to expose the symbolism within early pottery and show how these vessels were inherently social. This enables me to better explain the rise of ceramic technology in the Northeast. Finally, my hope for the future direction of ceramic analysis in the Northeast is presented at the end of this document.

CHAPTER ONE:

The Geologic Backdrop of the Eastern Woodlands

"During the time that the Northeast landscape was being shaped, life was evolving. Our story begins at a time when the only life on Earth was microscopic…"

Raymo and Raymo (2007: 6).

Introduction

Anthropology as a discipline formed during the earliest studies in geology; the adoption of geologic techniques and geologic theory is common in Archaeology. When one examines the history of the development of Geology as a discipline, one sees broad analogies in Anthropology, although Anthropology as a discipline has frequently lagged behind the current trends in Geology. Problematically, as the field of Anthropology has diversified and grown as its own discipline, its geologic roots have become vague and, in many cases, "the use of correct [geologic] terminology, has not been of the highest standards" (Kempe 1983: xiii).

The renewal of traditional geologic techniques combined with anthropologic theory is witnessed in the rise of the field of Geoarchaeology. Geoarchaeology (also spelled geo-archaeology) focuses on archaeological research using the methods and concepts of the Earth Sciences (Hassan 1979: 267). The origin of geoarchaeology can be found in the writings of Charles Lyell (1870) and his quest to understand the "antiquity of man." Lyell "clearly established the role of Geology in archaeological inquiry" (Rapp 1987: 97). Geologists started to become more directly involved with archaeological investigations after the 1930s; during the development of salvage archaeology. During the peak of Processual archaeology, archaeologists became more aware of how archaeological sites formed and how an understanding of site formation processes was necessary in order to fully understand archaeological deposits. During this time, many geologists were employed to help archaeologists reconstruct site contexts (Rapp 1987: 98). Beginning in the 1970s, Geoarchaeology became a true sub-discipline of both Geology and Anthropology (Kempe 1983). The field of Geoarchaeology is very diverse and includes all aspects of the traditional discipline of Geology (Rap 1987: 97). The rising popularity of Geoarchaeology is visible as more publications, journals, conferences, grants, and scholarships focus on geoarchaeological techniques.

The geologic concepts presented in this chapter form the basis for all of the experimental tests and methodologies conducted by this study. The terms presented in this chapter are necessary for understanding the identification and classification of Native American ceramic fabrics since petrology and optical mineralogy are the main techniques used to identify temper. The unique optical properties and appearance of minerals allows a petrographer to accurately identify different types of rocks and to suggest, with some accuracy, the origin of those rocks. In order to understand why specific types of rocks occur and where, a summary of the development of North America and the shaping of the modern Northeastern landscape is also presented. Finally, this chapter contains important information regarding the techno-functional properties of the different rock types found in the project area, how these rocks were formed and how they can be broken down. Only once all of the above is understood, what kinds of rock resources are available, where, and in what quantities, can we begin to understand the significance of the cultural choices made by ancient potters.

The Development of the Modern Geologic Timescale

The concept of an "old" Earth is relatively modern. Geologists today believe that the world is at least 4.6 billion years old; however, this was not always the case. The development of the geologic timescale occurred during the Scientific Revolution, before the creation of Geology as a discipline (Bjornerud 2005: 174). Prior to the Scientific Revolution, the Christian Church in Europe maintained that the Earth was only 6,000 years old. Using a little creative math and a very literal interpretation of *Genesis*, Archbishop James Ussher (1581-1656) calculated that the Earth was created on Sunday, October 23, 4004 BC (Park 2013: 40). The Earth's formations and landscapes were also described in terms of biblical accounts. Many Westerners accepted Georges Cuvier's (1769-1832) theory that the Earth had been shaped by a series of cataclysms as written in the Bible (Bjornerud 2005: 174; Park 2013). As a French naturalist and zoologist, Cuvier helped expand Linnaean taxonomy through his life's observations with plants and animals. Cuvier is better known today for his theory on extinction. Cuvier proposed that plants and animals went extinct because of horrific events. Those events could be seen in the remnant fossils of the Earth's formations. Today, scientists call this mode of thinking, *catastrophism*. The main premise behind catastrophism is the concept that all of Earth's rock features and landscapes where formed by violent events, such as volcanoes, epic floods, and earthquakes. "The roughness of the Earth's landscape was an expression of, and punishment for, human iniquitousness;" the resources of the earth, including plant, animal, and inorganic were not seen as resources and there was no systematic exploration and exploitation (Bjornerud 2005: 175). There was no desire to classify materials.

By the end of the 17th century, some individuals began rejecting the concept of catastrophism in favor of a more gradual or *uniformitarian* view of Earth's development. English

Theologian, Reverend Thomas Burnet author of the *Sacred Theory of the Earth* (1684) realized that there was not enough water on Earth to account for Noah's flood. Although he still accepted the idea of a pre- and post-flood Earth, Burnet's work opened the door for the rebuttal of catastrophism through uniformitarianism (Park 2013: 43). Uniformitarianism was strongly toted by individuals such as James Hutton (1726-1797) and Charles Lyell (1797-1875), men whose work heavily influenced the later writings of Charles Darwin (Park 2013). The principle rests on the understanding that "the present is key to the past" (Bjornerud 2005: 26). The past could be understood through the examination of modern, everyday processes because these were the same processes of the past. Uniformitarians rejected the idea of rapid transformation presented by followers of catastrophism.

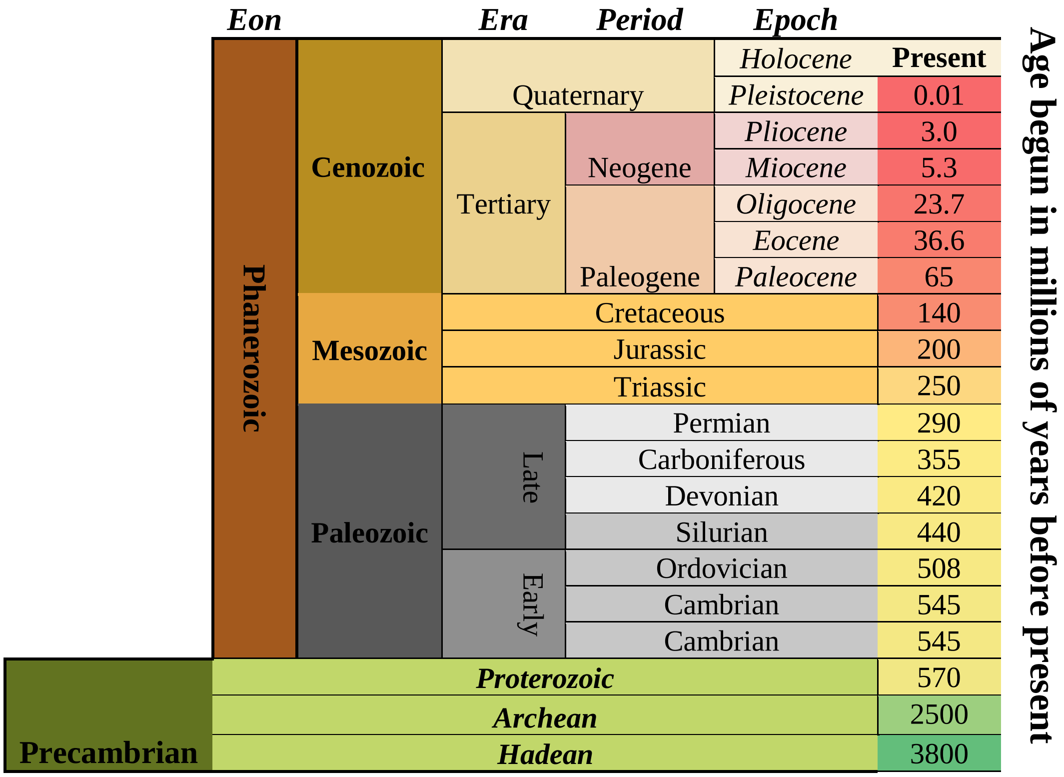
The Scottish farmer and physician, James Hutton enjoyed nature and closely observed all aspects of his large farming estate. In his publication, *The Theory of the Earth*, Hutton noted that through the everyday processes of erosion and weathering, the Earth continually consumed and created soils and rocks. Hutton realized that the rock building and destroying process was lengthy, much longer than the currently accepted age of the Earth proposed by the Church (Park 2013: 43). Hutton's work created an understanding of the "deep time" of the Earth, well beyond the memory of mankind (Bjornerud 2005: 178). In many ways, Hutton is the father of modern sciences, including Geology and Anthropology. Charles Lyell, friend and mentor to Charles Darwin, used Hutton's work to create two principles, which became the core of the discipline of Geology until the late-20th century. Firstly, the processes operating on nature have been constant across the ages. Secondly, these same processes also operate on geologic structures and have been ongoing at the same intensity and rate since the Earth began (Bjornerud 2005: 28). It was under the influence of Uniformitarianism that Philosopher John Locke wrote, the "Earth is a divine gift" but lacks value without human labor; Locke proposed that it was the job of mankind to "cultivate, subdue, and domesticate" the earth (Bjornerud 2005: 175).

The rise of Geology as a discipline occurred during the 18th and 19th centuries, driven by individuals heavily influenced by Unitarianism and the philosophies of John Locke. It was under these ideals that Carolus Linnaeus sought to organize the organisms of the Earth, providing a name and place for all beings (Bjornerud 2005: 177). Linnaeus' desire to classify can be seen throughout all of the sciences. It was the main task of scholars in the 18th and 19th centuries to identify, classify and create long chronologies for Earth's resources. "This epoch of scientific elucidation coincided with (and was used to justify) European colonization and settlement of the Americas, Africa, and the southern Pacific" (Bjornerud 2005: 179). The Earth was seen for the first time as a series of interconnected systems. It was during this period of European colonization that the Modern Geologic Timescale appeared.

Thomas Robert Malthus (1798) was the first scientist to warn that Earth's systems were fragile and needed to be protected. In addition to Unitarianism and the philosophes of Hutton, Charles Darwin adopted Malthus' concept of system collapse in his theory of *Evolution by Natural Selection.* The machines, factories, and rail road industries created during the Industrial Revolution caused wide-spread pollution and environmental destruction, however it wasn't until the middle of the 20th century that the idea of resource failure and system collapse was seen as probable and given wide-spread acceptance by the scientific community (Bjornerud 2005: 182). Earth's raw materials, water systems, and populations were seen as resources to be protected and managed. The world was no longer controlled by an all-powerful God who left resources behind for humans to use. Instead the humans became stewards of the Earth. This concept of preservation holds true today. The field of Cultural Resource Management was designed by the American Federal

Government to identify, manage, and protect past and present Native American cultures and their sites.

The geologic periods designated in the nineteenth century remain in use today, Paleozoic (old life), Mesozoic (middle life), and Cenozoic (recent life) (Raymo and Raymo 2007: 35). Figure 1.1 provides a summary of the major divisions in the geologic timescale with notable events listed on the right and major divisions and subdivisions on the left (summarized from Bjornerud 2005; Van Diver 1985). Geologists combined sequences of rock formations to create the geologic chronicles of the Earth. Problematically, nowhere on the planet is there a single complete sequence of rocks (Roberts 1996: 37). Erosion processes cause *unconformities* in the geologic record. An unconformity is a gap in the rock record. Gaps may represent only a few hundred years or many millions of years. Many unconformities are caused by the erosion and metamorphoses of sedimentary rocks; there are very few sedimentary rocks older than 600 million years because of these processes (Raymo and Raymo 2007: 35).



Eon	Era	Period		Epoch	Age begun in millions of years before present
Phanerozoic	Cenozoic	Quaternary		*Holocene*	**Present**
				Pleistocene	0.01
		Tertiary	Neogene	*Pliocene*	3.0
				Miocene	5.3
			Paleogene	*Oligocene*	23.7
				Eocene	36.6
				Paleocene	65
	Mesozoic	Cretaceous			140
		Jurassic			200
		Triassic			250
	Paleozoic	Late	Permian		290
			Carboniferous		355
			Devonian		420
			Silurian		440
		Early	Ordovician		508
			Cambrian		545
			Cambrian		545
Precambrian	***Proterozoic***				570
	Archean				2500
	Hadean				3800

Figure 1.1. The Modern Geologic Timescale (summarized from Bjornerud 2005; Van Diver 1985).

Mineral Classifications

In 1768, Carolus Linnaeus was the first to suggest that minerals should be classified in ways similar to living organisms. Linnaeus is known as the founder of Crystallography because of this (Perkins 1998: 38). Linnaeus classified minerals based on their external physical characteristics; this system of organization is still in place today. Mineralogy is integral to geology because rocks are classified by their mineral or chemical composition. This is why it is important to understand how minerals form, behave, undergo alteration, and breakdown; the physical properties of the mineral will affect the physical properties of the rock. Mineralogy can be utilized to determine the environment in which a rock formed (sedimentary, igneous, or metamorphic). It can also be used to identify alteration and weathering of rocks over time.

Minerals are classified as being either isotropic, having the same properties in all directions, or anisotropic, having different properties in different directions. All minerals are crystalline, whether or not they have "flat, crystal faces and a gemmy appearance" (Perkins 1998: 26). Any solid compound having an "ordered, repetitive, atomic structure" is defined as a crystal or having crystalline properties (Ibid). Not all rocks have crystalline properties, for example, obsidian is classified as a non-crystalline because it is glass, which has a random atomic structure.

Minerals form in one of three environments: igneous, precipitated from aqueous solutions, and metamorphism (Perkins 1998: 32-34). Minerals which form from molten material have interlocking textures and excellent crystalline formations. Common igneous minerals include olivine, pyroxenes, feldspars, amphiboles, and micas. Minerals will also form from mineral-rich water under the right conditions. Chemical solutions that will form minerals include the condensation of low-temperature inland lake and sea waters and the mixture of high-temperature heat flows into solutions at significantly lower temperatures, for example, a meteoric or magmatic event. Minerals that form from low-temperature chemical precipitates often have poorly-developed crystal faces. Low-temperature chemical precipitates include quartz, calcite, magnesite, halite, sylvite, gypsum, anhydrite, and sulfur; these minerals frequently form rocks with fine-grained textures, such as limestone.

Minerals may also form during metamorphic processes. Depending on the type of metamorphism, minerals may undergo recrystallization; becoming coarser, without alteration or new minerals may form from the recombination of the preexisting minerals (Perkins 1998: 34). For example, calcite and quartz can mix and combine together to form a third mineral, wollastonite. The types of minerals that can appear in metamorphic rocks are extremely diverse and include all minerals that form in igneous conditions and most sedimentary minerals. Minerals that are rare in igneous and sedimentary rocks but are common in metamorphic rocks include: cordierite, tremolite, wollastonite, andalusite, kyanite, sillimanite, staurolite, chloritoid, garnet, and zoisite.

The Optical Properties of Minerals

The optical properties of minerals are unique and provide aid in mineral identification. Almost all minerals will transmit light with a polarizing light microscope when sliced thin enough. In order for optical properties to be visible, minerals must be reduced to at least 0.03 mm in thickness (Perkins 1998: 61). The optical properties of thin sectioned minerals are not the same as hand sample minerals. A mineral may appear brightly colored in hand sample but will look completely different in thin section under plain and crossed polarized light, and vica versa. Below is a list of common optical properties of thin sectioned minerals useful for identification.

The term *relief* refers to how well you can see cleavage and borders of the individual mineral grains after it has been mounted on a test slide. Relief is described as negative (alkali feldspars and feldspathoids), low (quartz), moderate (mafic minerals and apaite), and high (ziron, calcite, and garnet). The more a mineral stands out on the slide, the higher the relief is (Perkins 2004: 28).

Mineral fracture refers to how minerals break into preferred directions, this is known as cleavage. Cleavage is described as perfect, good, fair, and poor. Using a microscope, cleavage appears as fine cracks within individual mineral grains. A mineral is said to have good cleavage based on how easy it is cleaves in different directions. Minerals with high relief show better cleavage than minerals with low relief. It may be difficult to see cleavage in minerals with fair or poor cleavage. Most importantly, “the number of different cleavages and the angles between them aid in mineral identification” (Perkins 2004: 28). Conchoidal fracture occurs in minerals with poor cleavage. To break along a concoidal fracture means to break along curved, rather than straight, lines. This is common in quartz minerals and chert rocks.

The color of a mineral is not an inherent property and is often the least accurate way to identify a mineral. Color is ambiguous because it is a formation of the interaction between observable light and the mineral structure. Even very small impurities within the atomic structure can alter the color of a mineral (Perkins 1998: 46). Pleochroism occurs when light is absorbed dissimilarly by the same mineral when rotated in different crystallographic directions. This phenomenon causes the same mineral to appear in different shades as it is rotated on the microscope plate (Perkins 1998: 68). For example, plagioclase feldspar will remain colorless in all directions but hornblende often appears pleochroic in a variety of olive greens. Interference colors occur when two different waves of light collide and interfere with each other. Light interference alters the color one observes only when the microscope polars are crossed. This is what is meant by crossed polar (in relation to plain polarized) light. In a petrographic microscope, crossing the polars causes two waves of light to travel in the same direction simultaneously and thus interfere with each other. Interference colors are unique and are key to identifying most minerals (Perkins 1998: 63-64). A mineral is said to be in extinction when it no longer reflects visible light. A mineral is in extinction when it appears dark under crossed polars (Perkins 1998: 80) The angle that a mineral appears extinguished is useful for identifying minerals. The angle of extinction is dependent upon the individual orientation of the mineral's grains. A mineral is said to have complete extinction when it always appears dark in crossed polars light; this is known an isotropic mineral. A mineral has straight extinction when it appears dark parallel to the elongation of the crystal or cleavage plane. Minerals that have extinction that is not parallel to the elongation of the cleavage plane has inclined extinction, or a specific angle of extinction. Minerals that have been deformed or formed with varying chemical zones often show undulose extinction; when different parts of a mineral grain go extinct at different rates. Undulating extinction is a common trait of quartz. Bird's eye extinction gives the mineral a pebbly or mottled appearance and is typical of mica (Perkins 2004: 29-30). Twinkling is a term used to describe the rapid strengthening and weakening of light within a mineral grain as it is rotated in plain polarized light.

There is no such thing as a mineral or crystal formation that is perfect; all minerals contain impurities. An impurity in a mineral occurs when there is a change in the mineral's atomic structure caused by a foreign atom. Different types of atomic errors will cause different types of crystal deformation. Many impurities have specific optical properties that are identifiable with a petrographic microscope (Perkins 1998: 28-29). Below is a list of common optical properties of mineral impurities. These unique properties assist the analyst in identifying different types of minerals. Compositional zoning occurs in minerals that have two or more zones of slightly different compositions that developed during crystallization. These subtle chemical irregularities may cause a color change in the mineral that varies from extremely subtle to distinct (Perkins 1998: 30). Twinning is common and occurs in minerals that have two or more zones within the mineral with different crystal orientations. This causes portions of the mineral to go extinct or brighten unequally under crossed nicols light (Perkins 2004: 28). Twins occur in simple and complex formations (Perkins 1998: 31). Common twins are lamellar (stripes), tartan (hatched), and Carlsbad (half and half).

The Physical Alteration and Weathering of Minerals

Minerals undergo alteration for numerous reasons, including but not limited to weathering (air plus water), hydrothermal fluids (mineral-rich water), and metamorphism (heat and pressure) (Perkins 2004: 29). Weathering is a destructive process that affects the minerals of rocks. Weathering can be mechanical or chemical (aqueous solution). Types of mechanical weathering include: water, wind, gravity, and frost. In hand-sample, weathering causes jagged fractures to appear in the crystalline structure of the rock. Additionally, minerals appear drab and their boundaries are obscured, making identification without a microscope extremely difficult. Weathered rocks often obtain a cortext along the exterior surface of the rock that is exposed to the elements (Perkins 1998: 121). The surfaces of rocks and minerals will become coated with red, brown, and gray materials as they weather.

Minerals that undergo alteration are known as secondary minerals, meaning they were not present during the original formation of the rock. Secondary minerals can be the result of the partial or total alternation of a mineral. In some situations, primarily minerals are replaced by new minerals; this process leaves pseudomorphs (the outline of the primary mineral) behind as testimony to the alteration process. In some cases, mineral alteration is only partial and a remnant of the primary mineral is visible inside or extending around the secondary mineral. When the alteration is incomplete, inclusions within the primary or secondary mineral can be used for identification. For example, the secondary mineral garnet contains remnants of quartz and cordierite contains sillimanite needles (Perkins 2004: 30). Minerals can have zones of compositionally mixed mineral grains. This is a process known as zoning. Minerals with zoning often have different optical properties. Zoning may be the result of the environment in which the mineral formed or by alteration.

The weathering and alteration of minerals is dependent upon the environment in which the mineral formed. Minerals that formed in high-temperature environments are generally less stable than low-temperature mineral formations (Perkins 1998: 121). Minerals that are poor in silicon (Si) and oxygen (O) are high in iron (Fe) and magnesium (Mg). These minerals are the first to form from high-temperature solutions and include olivine, pyroxenes, and calcic feldspar. These minerals weather and alter the easiest. Minerals with higher contents of Si and O, and therefore lower contents of Fe and Mg, are much less susceptible to weathering and alteration. These more resistant minerals include quartz and feldspars except for calcic feldspar (Perkins 1998: 121).

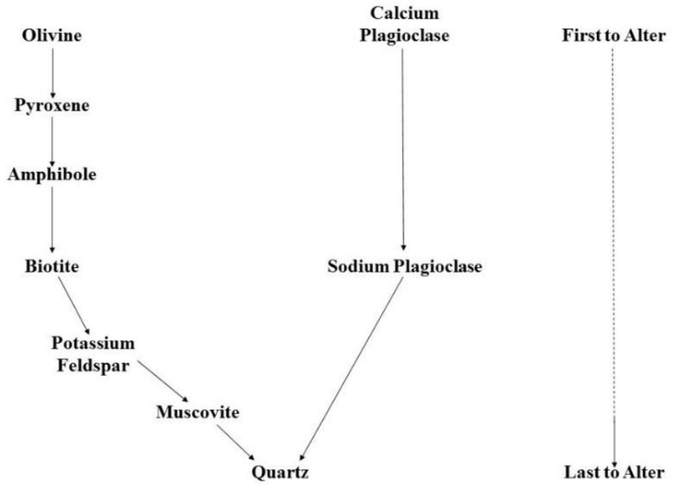


Figure 1.2. A summary of Goldich's 1939 weathering series, which describes the order in which minerals breakdown due to physical and mechanical weathering. The minerals closest to the top of the series (olivine and calcium plagioclase) weather significantly easier than those at the bottom (quartz) because they are the first minerals to form and are therefore, the least stable. Quartz is the mineral most resistant to weathering. The solid arrows represent continuous reactions to weathering and the dotted arrow, discontinuous reactions (after Perkins 1998: 122, Figure 6.4).

The most resistant minerals on Earth are quartz and zircon. Many minerals in sedimentary rocks are unstable and cannot survive for long periods of time, which is why there are no sedimentary rocks older than 600 million years (Raymo and Raymo 2007: 35). For example, olivine is altered by oxygen, carbon dioxide and water into serpentine, iron oxides, and magnesite (Perkins 1998: 36). Other forms of mineral weathering and alteration include oxidation (addition of oxygen), hydration and dehydration (addition or removal of water), kaolinization (alkali feldspars break down into the clay mineral kaolinite), epidotization (plagioclase feldspars transform into epidote), chloritization (amhiboles alter into chlorite), serpentinization (olivine changes into serpentine), dolomitization (calcite alters into magnesium), and pyritization (addition of iron to sulfur to form pyrite).

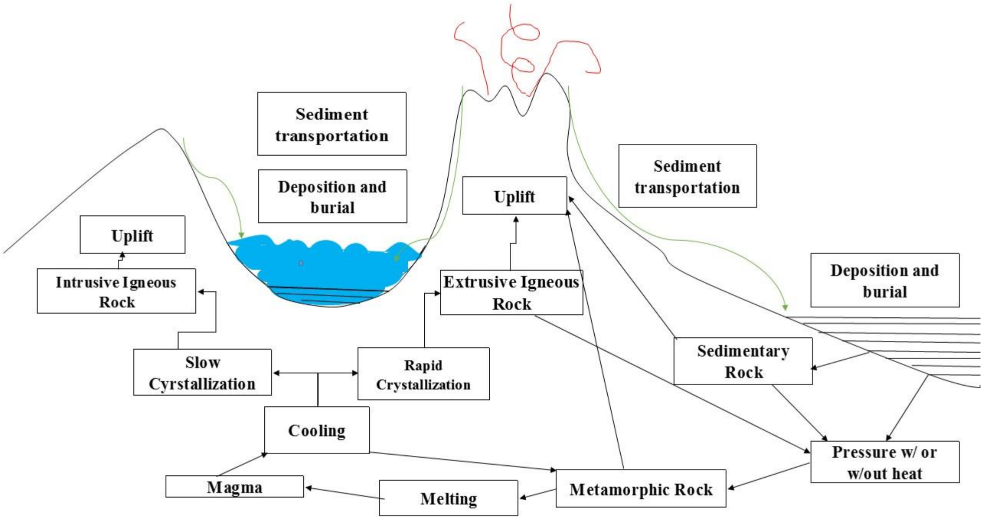


Figure 1.3 Schematic representation of the Rock Cycle.

The Rock Cycle

The Rock Cycle summarizes the processes that form, breakdown, and alter rocks through time. These processes include: heat, pressure, uplift, exposure, weathering, transportation, deposition, and lithification (Figure 2.2). The Earth has been creating and recycling rocks for billions of years. Geologists date rocks from the time at which they solidified. Sedimentary rocks are dated from their time of deposition, igneous rocks from the point when they are no longer molten, and metamorphic rocks from their point of recrystallization (Raymo and Raymo 2007: 41). The oldest-known rock-forming minerals on the planet are zircon crystals; these minerals were identified in Australia and date to 4.4 billion years ago (Bjornerud 2005: 37). The Rock Cycle divides rocks based on their form of origin; there are three general groups of rocks: igneous, sedimentary, and metamorphic.

Igneous rocks are created deep within the Earth’s crust by cooling of superheated and pressurized magmas (Raymo and Raymo 2007: 26). The chemical composition of the liquid magma and the depth, rate and temperature at which it cools, determines the final rock composition, color, and texture (Pidwirny 2013a). An igneous rock tells the tale of the often violent and “long-term chemical evolution of the Earth and its deeply buried processes” (Bjornerud 2005: 33). Igneous rocks are created by the same processes that build mountains up and rip continents asunder. An igneous rock is identified in thin section by its characteristic pattern of interlocking mineral grains (Perkins and Henke 2004). An igneous rock looks like a colorful mosaic of minerals in thin section.

Sedimentary rocks are created by the destruction of older rocks that were lifted from the warm interior of the Earth and become exposed to atmospheric conditions including oxygen, wind, and water. Chemical and physical weathering causes older (igneous, metamorphic, and sedimentary) rocks to break down into their mineral components. Minerals and very small rock fragments are then transported by wind and water to be deposited in terrestrial or marine environments. Over millions of years, these deeply stratified deposits become lithified through increasing heat and pressure and the result is metamorphosed rock. The type of depositional environment determines the type of sedimentary rock that will be produced. In thin section, each individual mineral grain is visible in a sedimentary rock. These grains are cemented together by a matrix of partially dissolved and chemically altered minerals (Perkins and Henke 2004). Individual mineral grains in sedimentary rocks are frequently coated in “rings” (partially dissolved and altered minerals). For example, quartz frequently appears surrounded by a reddish-colored ring, which is dissolved hematite, in sedimentary rocks.

“Metamorphic minerals and metamorphic rocks form when preexisiting rocks undergo changes in chemistry, texture, or composition *without* melting” (Perkins 1998:136, emphasis added).

Metamorphic rocks can form from any type of older rock (igneous, sedimentary, or metamorphic) when those rocks are submitted to high temperatures and/or pressure without returning to a liquid state. Metamorphism can rearrange a rock's texture and mineral composition but it cannot alter the rock's bulk chemical components (Raymo and Raymo 2007: 29). Metamorphic rocks move through the Earth's crust; they are created in one location and transformed in another environment (Bjornerud 2005: 33). In thin section, metamorphic rocks are indicated by the occurrence of altered minerals, specifically by the presence of minerals bearing other mineral inclusions (Perkins and Henke 2004).

Rock Classifications and the Physical Characteristics of Rocks

Igneous, sedimentary and metamorphic rocks are further subdivided into groups within each formation by the types and percentages of minerals present within the rock. Rock-forming minerals are described as *essential* or *primary* when they dominate the overall mineral assemblage. For example, calcite and dolomite are the main ingredients of calcitic and dolomitic limestones. A mineral is titled *accessory* or *secondary* when present in rocks as a minor ingredient. The presence of accessory minerals usually does not affect the properties of the rock (Perkins 1998: 36). The primary minerals found in igneous rocks include: olivine, diopside, augite, orthopyroxene, hornblende, biotite, muscovite, orthoclase, microcline, sanidine, plagioclase, leucite, nepheline, sodalite, and quartz (Perkins 1998: 36).

Igneous Rocks form from magmas and lavas and are characterized by their chemical composition and texture. There are four different types of igneous rocks: felsic, intermediate, mafic, and ultramafic; each of these rock types can said to be either intrusive or extrusive (Pidwirny 2013). *Intrusive igneous* are rocks that crystallize before they reach the surface of the earth. These rocks are also known as *plutonic* (Perkins 1998: 90). *Extrusive igneous* rocks crystallize very near (or on top of) the surface of the earth, and are also known as a *volcanic* rocks (Perkins 1998: 90).

The chemical composition of the magma, and the rate and the pressure (depth below surface) at which a magma cools directly affects the composition, grain size and texture of igneous rocks. The slower a rock cools, the larger the crystals (*phenocrysts*) grow. The more rapid the cooling, the smaller the mineral crystals and the glassier a rock surface becomes, e.g. obsidian. If phenocrysts are visible in the rock's groundmass (matrix), then the rock is said to be *porphyritic*. An *anphanitic* rock is a volcanic rock whose matrix is too fine for individual crystals to be identified without the aid of a microscope.

Magmas that begin to cool at relatively low temperatures are rich in silicon, potassium, and aluminum minerals. These minerals form silica-rich rocks, which are known as felsic rocks. Felsic rocks are light-colored because their matrix consists of mostly quartz and feldspars (Pidwirny 2013a). *Felsic* intrusive rocks have smaller amounts (less than 20%) of dark, iron-rich minerals, such as amphibole and biotite mica (Perkins 1998: 91). Common felsic rocks include granite, granodiorite, dacite, and rhyolite. *Mafic* rocks form at higher temperatures and pressures and therefore are rich in calcium, iron, and magnesium; minerals that are all poor in silica. Mafic rocks appear darker because they have high percentages of iron-rich minerals, such as pyroxene, amphibole, and olivine (Pidwirny 2013a). Common mafic rocks include basalt and gabbro.

Intermediate rocks have compositions that are half mafic and half felsic (Perkins 1998: 91). Most intermediate rocks form from continental crusts, including andesite and diorite. Intermediate rocks are primarily composed of plagioclase feldspars, amphiboles and pyroxenes (Pidwirny 2013a).

Sedimentary rocks are created by the weathering processes that destroy mountains (Raymo and Raymo 2007: 28); they "tell the tale of Earth's surface conditions" through time (Bjornerud 2005: 33). While it is true that some rock formations are more durable than others, all rocks exposed to wind, rain, freezing and thawing will begin to erode into smaller mineral and rock fragments. These smaller fragments are then carried by wind and water to be deposited into low-lying areas of the Earth's surface. The depositional environment of the stratified sediment determines the type of sedimentary rock that will form. During erosion and transportation, sediments become better sorted, rounded, and smaller as they get further from their origin (Paleontological Research Institute 2002: 32). This is how Geologists can infer "ancient climates, [past] biological activity, and the distribution of [now extinct] water bodies" from the Earth's deep past. Sedimentary rocks form "a thin blanket on top of the igneous and metamorphic basement rocks" (Perkins 1998: 119). Minerals commonly found in sedimentary rocks include carbonates, sulfates, halides, clay, quartz and feldspars (Perkins 1998: 124).

There are two main groups of sedimentary rocks: *detrital* and *chemical* rocks. A detrital (clastic) rock is formed from the compression and cementation of broken mineral and rock fragments (Perkins 1998: 119). Most sedimentary rocks are clastic rocks. The difference between a conglomerate, sandstone and shale (mudstone, siltstone, claystone) is individual particle size. Conglomerates are large, rounded lithic and mineral fragments (>2 mm in diameter). Conglomerates are poorly sorted with lithic and mineral fragments mixed in a fine-grained silt-sized matrix (Perkins 1998: 119). Sandstone contains layered, sand-sized particles (0.062-2 mm in diameter) of quartz or feldspar minerals (Schumann 1993: 272). The particles within a siltstone are much smaller (<0.062 mm in diameter) and include layers of quartz, feldspars, and micas (Perkins 1998: 119; Schumann 1993: 276).

Detrital rocks are based on their individual grain size because their chemical composition can vary greatly. Detrital rocks are subdivided between rocks formed from chemical precipitation and crystallization and rocks formed from lithified organic matter (Pidwirny 2012b). A chemical sedimentary rock requires alteration by water (Bjornerud 2005: 34). Chemical sedimentary rocks include limestone, dolomite, and chert. Geologists divide the chemical sedimentary rocks by their unique chemical signatures because of their unique formation processes "that tend to isolate certain elements" such as sodium or potassium in great abundance (Perkins 1998: 119). Limestone, for example, is composed of up to 95% calcite. The color and quality of limestone is based on its minor constituents and the environment in which it developed, meaning terrestrial, lacustrine, etc (Schumann 1993: 280). Chert is a fine-grained "microcrystalline" form of quartz (Perkins 1998: 128). Chert occurs in many different colors, textures and qualities. Geologists argue about how different cherts form exactly but the process seems to be related to the relative silica amount and deposition over time into temperate water (Perkins 1998: 128; Schumann 1993: 292).

Metamorphic rocks form from older igneous, sedimentary, or metamorphic rocks under pressure and high temperatures. "The term metamorphism describes a change in a rock's mineralogy, texture, or composition without melting" (Perkins 1998: 136, bolded removed from original). Metamorphism can involve either structural alterations to rock minerals or chemical changes within the rock (Pidwirny 2012b). There are numerous ways a rock can undergo these changes. The most relevant types of metamorphism are regional and contact metamorphism. Regional metamorphism refers to rocks that are either compressed (mountain building) or faulted (buried deep within the earth). Contact metamorphism occurs near a *pluton* or deeply buried igneous rock intrusion. The pluton causes pressure and increased temperatures on the surrounding rock and can alter rocks adjacent to the intrusion. The type of metamorphism, contact or regional determines the type of metamorphic rock formed. Foliation refers to the arrangement of minerals into parallel layers (Pidwirny 2012b).

Most geologists arrange metamorphic rocks into three broad categories: 1) aluminous clastic or mudrocks, 2) calcareous rocks, and 3) metamorphosed mafic or intermediate volcanic or pyroclastic rocks (Blatt and Tracy 1996: 364). Mudrocks, also commonly called metapelites are metamorphosed clay particles. The lower grade metapelites include mudrocks, slate, and phyllite; these rocks are extremely fine-to fine-grained and most have excellent cleavage. Slate is a very fine-grained rock that formed from shale or mudstone (Pidwirny 2012b). Slate forms from very low metamorphic processes and its key minerals include chlorite, quartz, and iron oxides (Blatt and Tracy 1996: Table 18-1). Phyllite is very similar to slate except that it has a shiny, metallic sheen to its surface. Phyllite forms from low metamorphic pressures and its key minerals are the same as slate with the addition of micas (Blatt and Tracy 1996: Table 18-1).

Higher-grade metapelites include schist and gneiss. Schists and gneisses are differentiated from aluminous clastic rocks because of their igneous composition. Mafic and ultramafic igneous rocks derive from mid-ocean ridge magma flows that become metamorphosed during continental building. The most common of the mafic and ultramafic metamorphic rocks are greenschists and amphibolite. Both of these rocks are found in the Canadian Shield. Greenschists contain hydrous ferromagnesian minerals, which turn the rock into its characteristic green color and amphibolite contains hornblendes and plagioclase (Blatt and Tracy 1996: 367). All types of igneous rocks (rhyolite, granite, etc) can undergo metamorphism. The texture of igneous rocks will change with higher grades of metamorphism but the composition will not.

The Theory of Plate Tectonics

Plate Tectonics is a modern concept derived from Continental Drift Theory, which was first proposed by German Geophysicist Alfred Wegener (Van Diver 1985: 15). In 1838, geologists began to suspect that a supercontinent, named Pangaea, once existed based on how the edges of continental shelves seem to fit together, like the pieces of a puzzle. However, geologists at the time lacked the understanding of how continents could be ripped apart. Pangaea remained a mystery until Wegener's publication in 1912 in which he suggested that the lithosphere was malleable (Roberts 1996: 47). The lithosphere is the thin, hard, cold exterior layer of the earth. The continents are broken pieces of the lithosphere that are constantly in motion. They move horizontally and vertically past each other, and crash and rip apart violently (Bjornerud 2005). Based on the similar age of rocks separated by the Atlantic Ocean and by the presence of contemporary fossils in both South America and Africa, Wegener suggested Pangaea began to break up during the Triassic Period (Roberts: 1996: 48). Wegener noted two important facts regarding Triassic and post-Triassic fossils. Firstly, fossils younger than the Triassic Period appeared different between the continents. Wegener argued for genetic isolation and independent evolution. Secondly, several Triassic fossils were found on both sides of the Atlantic. Wegener argued that it was much less likely these creatures swam across the Atlantic than it was that the continents were once a single, massive plate. Finally, Wegener noted that large glacial striations on bedrock were visible on multiple continents; these striations only line up when the plates are merged into Pangaea. Wegener's theory was not taken seriously by the geologic community and was considered unscientific until the 1950s (Roberts: 1996: 47-48)

Submarine expeditions during and post-World War II provided direct evidence for continental drift and the modern theory of Plate Tectonics was born (Roberts 1996: 49).

Researchers sent by military organizations mapped the ocean floor throughout the mid-19th century. During mapping, massive networks of volcanic ridges and trenches were discovered. Volcanic ridges are places where continents are colliding and trenches are areas of continental rift (Roberts 1996: 49). They also discovered that the ocean floor moves at about 0.75-1.75 in (1.0-4.5 cm) per year and the Earth creates about as much crust as it destroys annually (Roberts 1996: 50; Van Diver 1985: 28).

There are twelve plates recognized today (Van Diver 1985: 15). The continental and oceanic plates float on top of the denser asthenosphere. The asthenosphere is solid rock but it is under great pressure and heat because it is deeply buried within the Earth. The pressure and heat in combination with the steady decay of radioactive aluminum and magnesium isotopes and water causes radioactive convection (Bjornerud 2005: 120; Van Diver 1985: 16). Convective currents are circular, moving warmer materials upwards and colder (denser) downwards. As the colder material is heated, it begins to rise again. As it rises, heated material wells up into the lithosphere in the form of new continental and oceanic crust. This pushes plates away from each other. Plates collide where colder, denser crust is subducted and plunged back into the asthenosphere (Van Diver 1985: 16). Geological convection currents take 10-100 million years to cycle (Bjornerud 2005: 118-120).

The Earth has been slowly cooling off since its inception; Plate tectonics has been ongoing on the Earth for about half of its lifespan, c. 2.5 billion years (Van Diver 1985: 18), only after reaching its "thermal maturity" (Bjornerud 2005: 120). Prior to 2.5 billion years ago, the Earth lacked enough water, because it was too hot, to have convection ongoing in the asthenosphere. This means that some of the oldest rocks on earth, which date to the Archean Era (3.8 billion years ago) and include the rocks that form the Canadian Shield, predate Plate Tectonics. This explains the unique chemical structure of the oldest rocks on earth. The majority of the rocks in North America are significantly younger, forming less than 2.5 billion years ago (Raymo and Raymo 2007: 35).

The Earth before Pangaea (6 bya-570 mya)

"The key to understanding the history of the Earth [is in the] events of mountain-making, with folding, faulting, intrusion, and metamorphism…." (Roberts 1996: 46). Rocks have been dated in the Canadian Shield using radioactive isotope decay to older than 2.5 billion years (Van Diver 1985: 18). These rocks predate the existence of the supercontinent Pangaea and predate Plate Tectonics (Bjornerud 2005: 120). The period of time is known as the Precambrian Era. The Precambrian Canadian Shield forms the "basement" of North America and is the "core" of our continent, with younger rocks radiating out from all sides as well as covering portions of it (Van Diver 1985: 18-19). The Precambrian rocks of North America are very difficult to read because they are either buried beneath meters of younger rock and sediment and/or the rocks have been deformed nearly past recognition. Due to processes of erosion and the age of the rocks, the Canadian Shield has very few preserved fossils that can be used to date and analyze its orogeny (Roberts 1996: 60). The Canadian Shield includes nearly all of central and eastern Canada east to Labrador, south to the Adirondacks of New York State and southwest into small portions of northern Minnesota, Wisconsin, and Michigan (Roberts 1996: 57).

The Canadian Shield was not formed form a single geologic event. Rather it was formed during a continuous series of mountain building and continental rifting events that folded ocean floor and continental deposits into complicated layers. The Canadian Shield is "a patchwork of igneous and metamorphic rock" (Roberts 1996: 60). The basement rocks of the Northeast are battered and broken, "no other areas in the continent have had such as violent history" of formation

(Raymo and Raymo 2007: 43). The youngest rocks within the Canadian Shield are part of the Grenville Province; a 1,300-mile belt stretching from the eastern Great Lakes to Labrador (Van Diver 1985: 19). The Adirondacks of upstate New York, the Berkshires of Massachusetts, and the Green Mountains of Vermont are included in the Grenville Province. The Grenville Province was added to the Canadian Shield approximately 1,300-1,100 million years ago (Van Diver 1985: 19).

Rocks in the Grenville Province are layered sand, lime mud, and clay that were deposited east of the Canadian Shield as older igneous deposits laid down during the Archean period eroded into the shallow, warm sea. Over time and with increasing pressure, these deposits lithified into sedimentary rocks (Van Diver 1985: 21). Around 1,300 million years ago the ancestral North American continent collided with another early supercontinent, the shallow ocean was consumed and the layers of sedimentary rocks were metamorphosed, partially melted, and uplifted, creating a massive mountain chain stretching from Mexico to Sweden (Roberts 1996: 60). This newly developed chain formed the ancestral Adirondacks and when they were first built, they stood more than 1.5 miles in height (Van Diver 1985: 21). Rocks of the Grenville province included metamorphosed marble, quartzite, migmatite, granulite, gneiss, granitic gneiss, metagabbro, and anthrosite (Roberts 1996: 101). The fully formed Canadian Shield remained stable until 650 million years ago. By the time the continents began to rift apart again, the tall ancestral Adirondacks had been eroded to short nubs and more than a mile of sediment layered the ocean floor. The erosion created the subcontinent Avalonia and large volcanic island chains inside the shallow, warm ocean (Roberts 1996: 62). The development of Avalonia set the stage for the next great Geologic stage, the Paleozoic.

The Development of Pangaea (570-250 mya)

The supercontinent Pangaea was formed during the Paleozoic Era, 570-250 million years ago. The description of its development can be broken into three mountain building (orogenies) events: the Taconian, Acadian, and Alleghanian orogenies (Van Diver 1985: 27). Each successive orogeny was interrupted by the collision of exotic terranes, including the Dunnage, Gander, and Avalonia terranes (Raymo and Raymo 2007: 69-74). A terrane, a term short for tectonostratigraphic terrane, is a section of "continental or oceanic crust with significantly different characteristics from those of the crust immediately adjacent to it" (Raymo and Raymo 2007: 69). Nearly all of today's continental crust was part of Pangaea by the Permian period, about 260 million years ago (Caldwell 1998: 11). "The Taconic, Acadian, and Alleghenian orogenies were caused by pieces of the Earth's crust slowly crashing against the core of the North American continent from east, southeast, and south, one after the other, during the Paleozoic Era" (Roberts 1996: 53). During each collision, sections of continental and oceanic crusts were left behind, pasted on the side of developing North America as crumbled ridges and metamorphosed blocks of stone.

The supercontinents created by the breakup of Grenville include Laurentia (ancestral North America), Gondawana (ancestral Africa), and Baltica (ancestral Europe and Asia), Antartica, Australia, Siberia and the microcontinent, Avalonia (part of ancestral Europe). The shape of Pangaea included West Africa adjacent to New England, Nova Scotia attached to parts of Europe and Florida, a merged Africa and South America, and India, Antarctica, and Australia aligned on the eastern edge of the African plate (Caldwell 1998: 1). The entire supercontinent was positioned near the equator of the earth. At each continental suture, massive mountain ranges rose, merging former plates together with new molten material.

The Iapetus Ocean (Proto-Atlantic)-The eastern edge of ancestral North America (Grenville supercontinent) at 600 million years ago aligned with modern day cities of Québec and Albany. A massive ocean lay where New England is now located (Caldwell 1998: 1). Sometime between 650-600 million years ago, the Grenville continent, including pieces of the Canadian Shield, began to break into smaller plates. The destruction of the ancestral North American plate created the first (proto) Atlantic Ocean, called the Iapetus Ocean (Caldwell 1998: 2; Van Diver 1985: 21). Volcanic eruptions during the continental rifting caused lava to flow into the Grenville basement rocks in massive basaltic dikes (Caldwell 1998: 2). The dikes forced the Canadian Shield to split apart and a newly developed, shallow Iapetus Ocean intruded. The Iapetus Ocean grew large enough to genetically isolate organisms and cause independent evolutionary tracts between the continents. Fossils of Laurentia, Gondawana, and Baltica are very different from each other during this time period (Caldwell 1998: 2-3).

Avalonian Orogeny-The subcontinent Avalonia or possibly series of small, volcanic islands formed about 750 million years ago between the two supercontinents, Laurentia and Gondwana (Roberts 1996: 225). Avalonia remains a mystery because the entire continent was destroyed during the development of Pangaea. Terranes, believed to have once been part of Avalonia, have been identified in New England, the Canadian Maritime Provinces, Southern Ireland, England, and Wales (Raymo and Raymo 2007: 73). The Avalonia terranes are difficult to identify because where they survive, the rock has been intruded by volcanic material, overlain by sedimentary deposits, and metamorphosed numerous times throughout the Paleozoic.

Sometime around 575-400 million years ago, Laurentia collided with Avalonia and caused deformation and metamorphism throughout the Hudson Highlands of New York (Roberts 1996: 225; Van Diver 1985: 22-23). When the supercontinent collided with the smaller, Avalonia, the denser balastic ocean floor of the Iapetus Ocean was subducted beneath Laurentia. A chain of volcanic eruptions was created at the subduction zone, and increased in size as the Iapetus Ocean continued to close (Caldwell 1998: 4). The sedimentary rocks forming the floor of the Iapetus Ocean and the later-formed rocks of the volcanic arc were slammed against Laurentia and formed sections of northern New England, including the central slate belt in Maine. The collision of Laurentia with Avalonia caused the eastern edge of North America to depress and northeastern New England was submerged beneath the proto-Atlantic (Caldwell 1998: 8).

The Appalachian Foldbelt-the Appalachian Mountains can be divided into three separate orogenies, all of which occurred during the Paleozoic period (500-250 million years ago) (Roberts 1996: 53). These three mountain-building events, the Taconic, the Acadian, and the Alleghanian, formed the supercontinent Pangaea by 250 million years ago. The Appalachian Province stretches across the entire eastern edge of North America, from southwest Texas to Newfoundland and represents “multi-million year cycles of collision and rifting” between the continents (Roberts 1996: 220). Long, shallow oceans were formed between each orogeny as the continents rifted apart and these same oceans were filled in by sedimentation as the mountain belts wore away. The sediments of the eroded mountains were later folded, heated, and smashed together as the continents reversed direction and collided once again. Collide, build, erode, separate, and repeat. Most of the rocks within the Appalachian foldbelt are sedimentary in origin, formed from both continental and oceanic infilling but they have been highly metamorphosed by each successive orogeny (Roberts 1996: 221).

Taconic Orogeny-The Taconic mounting-building event occurred 480-430 million years ago, during the Middle Ordovician Period and represents the first collision of the ancestral North American plate with the ancestral European plate (Caldwell 1998: 7). This event enlarged

Laurentia by adding the volcanic mountain chain created during the earlier Avalonian collision (Roberts 1996: 225). During the Taconic orogeny, the proto-Atlantic Ocean began to close as the ocean floor sunk beneath the Laurentian continent (Caldwell 1998: 5). As the volcanic islands crashed into Laurentia, the volcanic rocks underwent extreme pressure and began to uplift (Van Diver 1985: 23). Sedimentary rocks that had once been part of the proto-Atlantic's ocean floor, pushed deep into the earth and recrystallized into granite (Caldwell 1998: 1). The faulting caused deformation as far west as the Alleghany Plateau in New York State (Van Diver 1985: 24). Geologists estimate the Taconic Mountains were once the height of the modern Himalayas (Van Diver 1985: 11).

Acadian Orogeny-After the Taconic orogeny, during the Silurian time, the Taconic Mountains weathered and shed sediment towards the eastern edge of Laurentia (Caldwell 1998: 8). The weight of the deposited Taconic sediments eventually pressed the land down, which allowed a shallow, warm sea to intrude. Marine organisms that once lived and died in that shallow water were added to the stratified Taconic sediments and formed thick layers of limestones, cherts, and dolomites across the Northeast (Raymo and Raymo 2007: 56). The tattered remnants of the Taconic Mountains can be seen today in the Berkshires of Massachusetts (Van Diver 1985: 11). As sediment continued to erode, and fan westward, it filled and eventually displaced the shallow, inland sea (located in today's Ontario Lowlands) and created the Queenston Delta. This sediment was uplifted by later orogenies and subjected to intense erosion by the start of the Silurian period (Van Diver 1985: 24-25).

The Acadian mountain-building event occurred between 400-335 million years ago, during the Devonian. Prior to the Acadian orogeny, Laurentia was separated from the already joined supercontinent of Gondwana and Baltica (Roberts 1996: 226). It was during this period that the

Gander Terrane was added to Laurentia, c. 416-359 million years ago (Raymo and Raymo 2007: 71). Gander was likely a fragment of Gondwana, which had earlier broken away from the main continent, and crashed into Laurentia to create most of New England, before Laurentia combined with the Africa and South American supercontinent. During the collision with Gander, massive volumes of molten material were forced into the older sedimentary and metamorphic rock of the Laurentian coast. The impact of the Gander Terrane formed with massive granite plutons in Maine, New Hampshire, Vermont, and Massachusetts (Caldwell 1998: 9; Raymo and Raymo 2007: 74).

As Laurentia finished crashing into Gondwana and Baltica around 395 million years ago, the Appalachian Mountains were created along the suture, crushed the Avalonia and Gander Terranes, and closed the proto-Atlantic for the final time (Raymo and Raymo 2007: 74). The collision against the old, weathered Taconic Mountains caused deformation across Laurentia, as far west as the Adirondack region of the Canadian Shield (Van Diver 1985: 26). The last traces of the Iapetus Ocean floor submerged beneath Laurentia during the Acadian orogeny. The impact also caused the westward tilting and folding of the sedimentary rocks that had formed over the eroded Queenston Delta during the Silurian and early Devonian periods. This new combined supercontinent was called, the ‘Old Red Sandstone’ continent; the Acadian Mountains lay at its center, along the suture lines (Raymo and Raymo 2007: 77).

Today’s granite mountains of the Eastern Woodlands are the roots of the Acadian Mountains. Since their creation, the Acadian Mountains have slowly been eroding away to form the Catskill Delta (Van Diver 1985: 26). The surfaces of today’s mountains were once miles beneath the surface of the Earth (Raymo and Raymo 2007: 75). The erosion of this mountain chain covered the remnants of the Taconic Mountains and displaced a warm, shallow inland sea within the Stable Interior. The remains of the Catskill Delta today form the middle and late Devonian sequences of the Allegheny Plateau (Van Diver 1985: 26). The Queenston and Catskill Deltas combined, consisting of mostly red sandstones and mudstones, are more than 4,000 feet thick (Raymo and Raymo 2007: 75).

Alleghanian Orogeny (creation of Pangaea)-The Alleghanian mountain-building event completed the Appalachian foldbelt and marks the merging of all continental land masses into the supercontinent Pangaea. During this event, the eastern edge of Laurentia slammed into northwestern Africa. The final collision caused additional uplift in the Appalachian Province of North America (Roberts 1996: 122). The continental crust of Laurentia was crushed “like an accordion” and sections of rock were moved 200 or miles west away from their origin (Raymo and Raymo 2007: 90). With the creation of Pangaea, all of the world’s continental crust was combined into one massive supercontinent surrounded by a single, encompassing ocean.

The End of the Paleozoic Era and Summary of Mesozoic Events (250-140 mya)

Little is understood about the Late Paleozoic Era (251 million years ago) in the Northeast because of a massive unconformity (Raymo and Raymo 2007: 92). Pangaea slowly broke up beginning 200 million years ago; North America was completed separated by 146 million years ago, during the Triassic period of the Mesozoic Era (Caldwell 1998: 12; Raymo and Raymo 2007: 110; Roberts 1996: 227; Van Diver 1985: 27). As Pangaea split apart, it did not rift at the same sutures that it formed at; it created new rifts. After 200 million years ago, the continents and oceans began to take on modern form, each with small bits of older, remnant continents within them (Roberts 1996: 228). The youngest rocks in North America are found along the continental margins where North America separated from Europe. Pressure from the fracturing crust forced magma upwards to the surface of the Earth in the form of violent volcanoes (Raymo and Raymo 2007:

99). The rocks formed from the volcanoes are commonly basalts with fewer gabbro, syenite, and diorite inclusions between New York, Maine and Montreal, Canada. As the continental crusts continued to separate, new volcanoes formed, creating a “hot spot” arc. The hot spot created in New England during the breakup of Pangaea is the White Mountains chain, which stretches from Montreal into New Hampshire and southern Mane, and eastwards to the active undersea volcanic ridges in the Atlantic Ocean (Caldwell 1998: 32-33). The only visible continental evidence left of the separation of North America from Pangaea can be found in the New England Triassic Basins: The Newark Basin, which stretches from north-central New Jersey to Pennsylvania and the Connecticut Valley lowlands, found from New Haven to the New Hampshire border (Raymo and Raymo 2007: 100). The actual suture line of North America lies about 100 miles east of the present day coastline, in the Atlantic Ocean.

The Northeast has been tectonically uneventful since the Triassic period (Raymo and Raymo 2007: 120). Erosion and Plate Tectonics have been ongoing in North America since the Acadian orogeny. The Atlantic Ocean has grown 1,000 miles since the end of the Triassic and the Alleghanian Mountain chain has been worn down considerably. Prior to the Ice Age, weathering wore the face of the continent to a “featureless peneplain” (Raymo and Raymo 2007: 128). With the exception of the roots of the Alleghanian Mountains, the White Mountains of New Hampshire, and the Blue Mountains of Maine, the hills of the Northeast are of equal height. The mountains have resisted erosion because the durable materials that they are formed from. The hilltops of the Northeast are the remaining fragments of the once even peneplain. The remaining landscape has been cut by rivers and eroded by glaciers, unevenly exposing millions of years of sedimentary rocks across the Northeast (Raymo and Raymo 2007: 128-129).

The Quaternary Period: The Age of Ice (2 mya-10,000 years ago)

The theory that glaciers once covered the entire Northern Hemisphere was proposed in the mid-19th century by Jean de Charpentier and Louis Agazzis. Expeditions into Greenland during the 19th century provided the authors with the data to develop a Theory of Continental Glaciation. This theory replaced Catastrophism as an explanation for the development of the modern landscape (Caldwell 1998: 12-13). A glacier is a snow and ice formation that remains year-round because snow accumulates faster than climatic conditions allow it to melt. Continued accumulation and the increasing weight of the snow causes it to turn to ice. The authors noticed many similarities between landforms in Greenland and in Europe. Charpentier and Agazzis suggested that Europe's alpine glaciers once extended across the continent to the sea; just as the glaciers in Greenland do today. As the glaciers advanced, they acted like bulldozers, pushing soils and eroded rock in front of them. The glaciers rounded the old, heavily eroded mountain tops and exposed fresh bedrock. The combined destructive and constructive powers of the glaciers reshaped the topography of the Northern Hemispheres (Kendall 1987: 21-22).

Beginning about 1.8-2 million years ago, glaciers began to build in the Hudson Bay area of Canada. Once the ice reached one-mile-thick, it began to radiate outwards from its center across the entire northern hemisphere (The Paleontological Research Institution 2002: 59). The characteristic landscape of the Northeast, the numerous lakes, ponds and bogs, the loose, stony soil, rounded mountains and gently sloping U-shaped valleys, are a direct result of a series of successive of glacial advances and retreats over millions of years. There have been at least four major ice ages in North America. Each new advance of the ice erased the evidence of earlier advances so that only the most recent advance, known as the Wisconsin Glaciation, is visible in the Northeast (Van Diver 1985: 31). The Wisconsin Glaciation began about 65,000 years ago, reached its climax roughly 20,000 years ago, and began to retreat 18,000 years ago. The ice sheets were more than a mile thick during the deepest freeze of the Wisconsin (The Paleontological Research Institution 2002: 60-64). In the Northeast, only the tops of Mount Washington (New Hampshire) and Mount Katahdin (Maine), remained free of ice (Raymo and Raymo 2007: 137). The last of the ice retreated from New England between 12,000 and 10,000 years ago, marking the last 10,000 years as a rare warming period in the Earth's climate (Raymo and Raymo 2007: 136). This interglacial period is known as the Holocene.

Glacial processes are both destructive and constructive. As glaciers advance forward, they scrape away all vegetation, fertile soil, and loose sediment (Raymo and Raymo 2007: 145). Warmer conditions allow the ice to melt faster than it accumulates, which causes the sediment and soils to be dropped. Retreating glaciers produce new landforms. Glacial ice plucked loose rock and sediment as it expanded, the rock acted like "very coarse sandpaper," which scoured the ground surface down to bare bedrock (Kendall 1987: 23). All but the tallest mountains in the Northeast have been greatly reduced and rounded by glacial ice (The Paleontological Research Institution 2002: 61). The landscape of the Northeast is still predominately shaped by glacial processes though erosion by wind and water is still ongoing. Water always seeks the lowest possibly elevation, therefore rivers and streams continuously cut downwards. Erosion by water cuts V-shaped profiles into the landscape while ice cuts U-shaped profiles. Erosion by ice also tends to cut straighter, more gently rolling profiles than rushing water does (Kendall 1987: 27). Glacial ice expanded, rounded, and dammed older river valleys. This altered the flow of water across the landscape and created new outlets for meltwater. The Finger Lakes in New York are an example of river valleys that have been cut into deep troughs by glacial ice (Van Diver 1985: 31).

The rocks and sediments collected by the glacier were rapidly crushed into rock flour (a very fine mix of crushed sediments) by the weight of the ice. The rock flour mixed with meltwater and was later released by the retreating glacier. Rocks more resistant to erosion, such as igneous and metamorphic rocks, were polished and scratched as they rolled in the sandpaper-like ice. Cobble-sized and larger rocks indicate rapidly-moving, turbulent meltwater streams and stratified sands, silts and clays indicate quieter, gentler-moving water (Kendall 1987: 29). Generally speaking, the larger the rock, the shorter the distance it was carried by the meltwater. Using the debris scraped from the land, the glacier built new topographic formations, altered the direction of water drainage, and spread a thick coating of crushed rock and rock flour across in the Northeast.

Glacial till is an "unsorted mixture of boulders, gravel, sand, silt, and clay" that was gathered and deposited during the movement of glaciers (The Paleontological Research Institution 2002: 61). Glacial till appears similar to gravel, however it is compact and has both rounded and angular fragments of many different types of rocks within it. Till also tends to contain rock fragments greater than 64 mm (2.51 in) in size (Roberts 1996: 41). Most of the Northeast is covered with a thick layer of glacial till. This rocky soil is slowly being converted into soil, however the soil layers in the Northeast are still relatively thin and shallow (Kendall 1987: 21). An exception to this is a small area of Allegany State Park in western New York and Pennsylvania, which remained ice-free throughout the last glacial period (Van Diver 1985: 31). Piles of till that collect at the edge of a glacier are called moraines. A moraine indicates the point of furthest ice advance. Moraines vary greatly in size and extent and form at perpendicular angles to the ice. Elongated, rounded hills of glacial till are called drumlins and were shaped by melting ice beneath the glacier. Drumlins form in the direction of ice flow and represent old streams beneath the glacier that became clogged with debris (The Paleontological Research Institution 2002: 61).

Glacial outwash refers to areas where water streamed off from, or beneath, the melting glacier. Unlike till, glacial outwash is well-sorted layers of sediment of all sizes. An esker refers to meltwater streams that flowed beneath the ice. Eskers are marked as low-relief hills and mounds consisting of alternating bands of sand and gravel. Other outwash features include kettles, kames, and erratics. Rounded piles of sorted and stratified sediments make up a kame. Kettles form when large chunks of ice break off from the main section of the glacier. The broken ice becomes covered by sediment from the retreating glacier. As the ice melts, the land sinks into a rounded basin, and water remains trapped in the basin by the fine clays and silts deposited by the glacier. An erratic is any rock plucked and transported by the glacier. Erratics don't match the surrounding bedrock and are considered exotic (The Paleontological Research Institution 2002: 62).

The Retreat of the Ice (12,900-10,000 BP)

During the final stage of the Pleistocene, a period known as the Wisconsin glaciation (100,000-10,000 years ago), environmental conditions across North America constantly fluctuated and the landscape of North America was vastly different from today (Neusius and Gross 2014: 47). Two large glacial sheets covered North America, the Cordilleran and Laurentian ice sheet (2014: 48). The Cordilleran ice sheet covered most of southern Alaska, southwestern Canada, and the northern Rocky Mountains. The Laurentian ice sheet first formed in the Hudson Bay region in Canada before spreading in all directions across the northern hemisphere of North America. The Laurentian ice sheet covered all of New York to Long Island, with the exception of a small corner in the Alleghany Plateau of southwestern New York (Lothrop and Bradley 2012: 10). During the last ice age, a huge amount of the earth's water was locked in ice at the polar caps. This caused a global reduction in sea level, exposing large tracts land for human and animal occupation. The great weight of the one- to two-mile thick glaciers drove the earth's crust downwards, and the remaining ocean waters rushed inland across eastern New England to meet the edge of the glacier (Snow 1980: 105). As the glaciers retreated, melt water that rushed off from, beneath, and gathered behind the remaining ice, created massive glacial lakes and altered drainage patterns in New York (Lothrop and Bradley 2012: 11).

Plant and tree vegetation returned slowly to New York, beginning about 14,700 cal BP, as the earth entered a short warming period (Lothrop and Bradley 2012: 13). A mixed boreal and temperate forest spread across most of New York State. A short cooling period, known as the Younger Dryas (12,900-11,600 cal BP) followed the warmer Bolling-AllerØd, and temperatures throughout the region once again became much cooler. The Younger Dryas terminated around 11,600 cal BP, and the region became much warmer, encouraging the spread of pine and oak based forests (Ibid: 13-14). The variety of plant and animal resources available to human groups in New York was much different during the end of the Pleistocene than for other periods of occupation. A short list of these animals includes mastodon and Columbian mammoth, caribou, stage-moose, muskox, giant beaver, and flat-headed peccary. There was also a variety of waterfowl and fish species (Ibid: 14).

As the glaciers retreated from eastern North America between 12,000-10,000 years ago, human behavioral patterns are believed to have rapidly adapted to the changing environments and new subsistence patterns and lifestyles arose. The earliest inhabitants of New York were Paleo-Indian hunter-gatherers that moved into the region after the retreat of the Wisconsin glacier sometime between 10 and 12,000 years ago. The Paleo-Indians were highly mobile, foragers and big game hunter-gatherers, and are known in the archaeological record by their characteristic fluted spear points (Lothrop and Bradley 2012: 14; Neusius and Gross 2014: 98). It appears that Paleo-Indians were highly mobile populations that lived in small groups and therefore infrequently left features behind to mark their presence, or more likely, their features have not survived to be found by archaeologists.

CHAPTER TWO:

The Great Debate: Steatite Versus Ceramic Pots

> *"Diversity is a characteristic of northeastern Archaic groups, but a basic unity is provided on broad cultural-temporal levels by readily identified, recurrent trait-complexes"*
>
> (Ritchie and Funk 1973: 49).

A major debate in Eastern Woodland archaeology concerns the initial appearance and subsequent widespread use of steatite technology. The debate centers on whether steatite vessels appear early, prior to the development of ceramic technology (Boyd 1962; Ritchie 1965; Ritchie and Funk 1973; Truncer 2004; Witthoft 1953) or after the initial appearance of pottery (Hoffman 1998; Sassaman 1993; 2006). There are also disagreements on what function steatite containers played in ancient societies and what the relation of these vessels was to ceramic container technology (Ritchie and Funk 1973; Sassaman 1993, 1995, Sassaman and Rudolphi 2001; Truncer 2004, 2006). Steatite products, also known as soapstone or talc, have been found on sites dating to the Terminal Archaic period from Georgia to Massachusetts, and inland to the Mississippian heartland (Neusius and Gross 2014: 386-387). In the New York and Southern New England, early pottery forms and soapstone bowls are commonly associated with Transitional (Terminal) Archaic cultures (Ritchie and Funk 1973: 345; Mason 1981: 206-209).

The Geologic Classification and Occurrence of Steatite

Steatite, also known as soapstone, is a massive (meaning a rock that has a homogenous texture) rock that contains a variation of the mineral talc as a primary mineral. Talc is the softest mineral on earth and is easily identified by its greasy feel, perfect cleavage, flexible fracture, resinous luster, and silky or translucent white to gray color. Talc has a hardness of one on the Mohs scale of mineral hardness (Perkins 1998: 318-319) and can be easily scratched by rock, antlers, bone tools, or a fingernail. Talc is the primary mineral in many low-grade metamorphic mafic and ultramafic igneous rocks (Blatt and Tracy 1996: 474, Table 24-1; Frey and Robinson 1999: 110, 147). Talc occasionally also occurs as a secondary mineral in mafic igneous rocks (Perkins 1998: 319). Talc forms through the low-grade metamorphism, and is found in the upper greenschist and lower amphibolite facies. The facies refers to the depth at which the sediments and volcanic rocks are buried. Deeper buried materials undergo greater pressure and heat, and therefore, greater degrees of metamorphism. Greenschist facies is the lowest level of metamorphism (closest to the surface of the earth) that marks the start of mineral recrystallization and granulite is the highest level. When minerals completely recrystallize, the rock develops a massive structure (Blatt and Tracey 1996: 434).

Low-to-medium-grade metamorphism develops through the deep burial of sediment and volcanic rock at convergent continental boundaries or in basins. This includes the Mesozoic rift basin located along the eastern edge of North America (Blatt and Tracey 1996: 431). Talc can also form as an alteration mineral when calcareous sedimentary rock, such as marble, undergoes metamorphism. Bedrock sources of steatite are found on the eastern side of the Appalachian Mountains, from Alabama to Vermont (Truncer 2004: 488). The two types of steatite vary in quality and appearance due to their formation processes.

Since steatite is a metamorphic rock predominately composed of talc, it is therefore an easy medium for carving. Steatite also has a soapy feel to the touch, hence its secondary name ‘soapstone.’ Despite its softness, steatite has excellent thermal conductivity and low susceptibility to breakage from thermal shock, which makes it an ideal cooking element (Sassaman 1993: 118;

Truncer 2004: 507; Truncer et. al. 1998). Even today, steatite is commonly added during the manufacture of ceramic materials in order to reduce shrinkage during firing (Rice 1987: 105-106).

Pre-Contact Archaeological Contexts for Steatite

Although steatite outcrops are limited to the eastern edge of the Appalachian Mountains, artifacts produced from steatite have been found throughout the entirety of the Eastern Woodlands. William Ritchie was the first to identify steatite containers throughout the coastal region of New York State with other pre-ceramic artifacts he associated with the Frost Island, Orient, and Susquehanna cultures (Ritchie 1969: 150; Ritchie and Funk 1973: 71; Mason 1981: 206-209; Witthoft 1953: 7-12). Steatite artifacts occur in the form of bowls, pots, thick slabs, perforated stones, or as temper in early ceramic vessels. Steatite technology, including steatite-tempered pottery and carved stone bowls appear to have been highly prized throughout the Eastern Woodlands for their excellent thermal conductivity and low susceptibility to breakage from thermal shock (Sassaman 1993: 118; Truncer 2004: 507; Truncer et. al. 1998) as well as for various ceremonial associations (Klein 1997; Sassaman 2006).

Typological Foundations, Variability and Potential Functions of Vinette 1 Pottery

The Vinette pottery types are part of the Point Peninsula Series defined by Ritchie and MacNeish (1949); this series includes the types Vinette 1, Vinette Dentate, and Vinette Complex Dentate. These pottery types correspond to the Early and early Middle Woodland periods, 3000-2100 BP (1000-100 BC) in New York State and are believed to be the earliest known pottery in the Northeastern Woodlands. Vinette 1 was first identified at the Vinette site in Bewerton, New York. Vinette 1 is known to have an extensive geographic range, with similar forms and variants found along the Atlantic Coast from New England to Maryland, Pennsylvania, and north towards southern Ontario (Ritchie and MacNeish 1949:100). The authors define Vinette 1 pottery as: an exterior and interior cord-wrapped-paddle-marked with moderately thick, very porous walls and coarse-medium to coarse pieces of quartz or pulverized crystalline rock over 3 mm in diameter in large quantities (Photo 2.1). These vessels frequently range in color from gray-buff-black with dark cores due to uneven firing. Vinette 1 vessels are unornamented, with straight-sided necks, elongated bodies, and conodial bases. Vessels were usually coil-formed and coil breaks are frequently found. Vessel rims are usually straight and occasionally flared outwards in form, thinning of wall towards lip. The lip itself is often rounded and sometimes almost pointed.

Photo 2.1. A sample of Vinette 1 pottery sherds from the Saint Bonaventure site.

The Vinette Dentate type appears around the same time as Vinette 1 but continues through the Early Woodland and into the Middle Woodland period (Ritchie and MacNeish 1949: 100). Like Vinette 1, Vinette Dentate occurs as elongated bodied vessels with conodial bases, and outflaring rims. Contracted forms also occasionally occur. Rim lips are often pointed. Surface treatment of Vinette Dentate vessels varies significantly from Vinette 1. Interior surfaces are often channeled and the exterior is smoothed, sometimes with evidence of wiping. Similar to the other types in the Vinette series, Vinette Dentate has a dark interior firing core that contrasts with the much lighter colored exterior surface. The texture is laminated, flaky and crumbly due to the large amounts of crystalline rock temper (1-3 mm in size). Unlike Vinette 1, Vinette Dentate is often decorated with vertical or oblique dentations. These dentations can occur on the rim, or neck, or in combinations. Herringbones, horizontal plats, and horizontal bands are decorative themes that occur (Ritchie and MacNeish 1949: 100).

The final category of the Vinette Type Series is the Vinette 2 ware, described by Ritchie and Funk in 1973. Vinette 2 consists of "a distinctive group of significant modes in form, paste, and decoration, which derived, more or less independently, from cultural sources of diverse origin, temporal position, and geographic location" (1973: 117). Unlike earlier versions of Vinette pottery, Vinette 2 ceramics have decorative techniques, mainly dentate-stamping, rocker-stamping, and corded-stick ornamentation. According to the authors, Vinette 2 pottery marks the start of the Middle Woodland period (Ibid).

Taché (2005) conducted a detailed analysis of Ritchie and MacNeish's definition of Vinette 1 pottery as part of her doctoral research on the Meadowood Interaction Sphere. Taché's primary area of interest was the Batiscan site in Quebec. She examined 87 rim and 855 body sherds of Vinette 1 pottery recovered from Batiscan, then compared the data with sites across sites in eastern Canada, New York, and New England in order to examine the variability of Vinette 1. Taché examined temper along the edges of fractures sherds using both macroscopic and low-powered (10-60x) microscope. She found that at the Batiscan site, temper was composed of isolated quartz (77%), feldspar (44%), and mica (23%) mineral fragments. The author noted that hornblende and pyroxene are also occasionally found in the matrix. Taché hypothesized that sherds from Batiscan were likely tempered with locally collected and crushed gneiss, granite and syenite rock. Comparisons of temper in Vinette 1 sherds from other sites in the Northeast indicated to Taché that isolated quartz, feldspar, and mica mineral temper is a “recurring and very homogenous trait” of Vinette 1 (2005: 185). The author found two exceptions to this, the first at Chickadee Rockshelter in Maryland, and the second at Heck Shelter, in Pennsylvania. At the Chickadee rock shelter, the Vinette 1 sherds were tempered with limestone rock and isolated quartz fragments. At the rock shelter in Pennsylvania, she found the sherds were tempered with crushed chert, rhyolite, and isolated quartz minerals (2005: 185).

The overall results of her work indicates that “Vinette 1 ware exhibits some internal variability, it typically conforms to a single general form, i.e., a small to medium-sized, conoidal-based and open-mouthed bowl, with straight, converging and thick walls and no constriction at the neck” (Taché et. al. 2008: 63). Taché found variation exists in the overall size of Vinette 1. She states that the capacity of the vessels ranges “between 2 and 26 liters” (Taché et. al. 2008: 64). She attributes the probable reasons behind the variability of Vinette 1 as being caused by: 1) experimentation of a new technology, where the potters are striving towards increased “general technological efficiency,” 2) environmental constraints, “the nature of these [quartz, feldspar, and mica] inclusions suggests that local igneous rocks were crushed before being added to the clay used to manufacture pottery,” 3) increasing mastering of technical ability on the part of the potters, 4) differences in the use of the vessel (meaning ritual or utilitarian), and 5) whether or not the vessel was locally produced or imported on to a site (Taché 2005: 193-195).

According to Ritchie and MacNeish (1949), Vinette 1 ware is undecorated (100); however, Taché recorded that decorated wares do exist but occur towards the later end of the Vinette 1 spectrum. Decorative techniques include pseudo-scallop and dentate impressions and rough chevron-shaped incising along the lip, rim and upper body. Vessels that have one or more decorated surfaces lack the typical fabric-impressions, suggesting they were either smoothed over prior to the decoration being added, or they were never there (Taché 2005: 180). It is likely that these decorated Vinette vessels correspond to Ritchie and Funk's (1973) definition of Vinette 2 (Photo 2.2).

Photo 2.2. An example of decorated Vinette 1 from the Broken Clock Site (Vessel 3).

Taché concludes that Vinette 1 wares were produced at the household level and were likely manufactured by only a few individuals per site (2005: 198). The Vinette 1 type occurs "in very low frequencies at any one site, indicating a limited use of this new technology. Indeed, aside from a handful of components where more abundant sherds are thought to represent 10 to 40 vessels, most Early Woodland sites contain no more than one to five containers" (Taché et al. 2008: 63; Taché 2005).

It appears that Vinette 1 wares were likely traded and moved around the landscape, either for the vessel itself or for other items circulated through the Meadowood Interaction Sphere. Clermont et al. (1999) sampled eight Vinette 1 sherds from the Batiscan, Bilodeau, Gasser, and Saint-Nicolas sites with neutron activation analysis. The eight sherds from each site were compared with samples from 11 different clay sources surrounding the site of Pointe-du-Buisson in Montreal. The results of the analysis indicated that none of the archaeological samples matched the clay sources, suggesting to the authors that the vessels were not locally produced (Taché 2005: 199).

Excavations at the Dorothy Scott 1 site, located in the uplands of western New York, in the Town of Concord, revealed fragments of pottery in the feature fill of a hearth (Feature #1) and nearby artifact concentration (Feature #16) (Hartner et al. 2008: 21). The pottery from Dorothy Scott #1, includes 11 small sherds with a combined weight of 2.4 grams. All of the pottery fragments measure about 1 cm (0.4 in) or less in diameter. The pottery fragments were found during heavy fraction analysis after soils from Features 1 and 16 were wet sieved. The presence of pottery at Dorothy Scott #1 is surprising since there are no water sources in the nearby vicinity and the site was expected to be a short-term occupation, seasonal-camp (Hartner 2008: 21). The two above examples suggest the concept that early ceramic vessels may have been trade items needs to be further investigated.

The Steatite-Pottery Date Debate

Steatite-tempered pottery appears throughout the Middle Atlantic and Southeastern regions of the East Coast. These pottery types include Selden Island Steatite Tempered ware, Koens-Crispin ware, and Marcey Creek Plain (Dragoo 1976: 16; Manson 1948; Mason 1981:209; Ritchie 1965:151; Ritchie and Funk 1973:96-98). Steatite temper may have been retrieved from river cobbles, gathered from the outcrop itself, or it may have been obtained by crushing fragments of older steatite vessels. Ceramic vessels formed with steatite temper, such as Marcey Creek Plain, often mimic the appearance of soapstone pots, including shallow sides, flat bottoms, and lug handles (Dragoo 1976: 16; Manson 1948). Early pottery in the north, from the Hudson river valley to the Ohio river valley and into the Great Lakes region includes the following types: Fayette Thick, Half-Moon, Marion Thick, Baumer, and Vinette I (Dragoo 1963: 275). Steatite tempered wares often found in stratigraphic contexts beneath quartz-tempered pottery, leading archaeologists to believe that these forms are earlier and that pottery evolved from carved stone bowl technology (Boyd 1962: 477; Kinsey 1972: 360; Ritchie 1965: 171-173; Ritchie and MacNeish 1949: 100, against this see Dragoo 1976: 16). Photo 2.3-2.5 show body sherds of steatite-tempered pottery from the Ninemile Road site, the thick section view of the sherd's matrix, and a zoomed in image taken through the microscope's camera at 100x.

In the Northeast, steatite artifacts are generally associated with Ritchie's Transitional Archaic period (4,000-2,700 BP) and the final aceramic cultural sequences that existed prior to the appearance of ceramic technology (Boyd 1962; Ritchie 1965; Ritchie and Funk 1973; Truncer 2004, 2006; Witthoft 1953). Starting with Curtiss Hoffman's work in 1998, archaeologists have begun to question the reliability of early dates obtained on Vinette 1 and steatite vessels (Hoffman 1998; Sassaman 2006; Truncer 2004, 2006; Taché 2005; Taché and Hart 2013). Using a moderately liberal approach, Hoffman collected 84 combined radiocarbon dates from features associated with either steatite and/or Vinette 1 pottery. From this he concluded that Vinette 1 pottery comes into use significantly earlier than steatite vessels. Truncer (2004) used the same approach as Hoffman but drew from a larger database, examining 105 radiocarbon dates collected from contexts containing steatite vessels and vessel fragments. Truncer concluded that steatite vessel technology is significantly older than early pottery forms, appearing by 4910 ± 75 B.P.

According to Sassaman, perforated cooking slabs cut from steatite appear 1,000 years earlier in the Southeast, c. 5,000 B.P. (2001: 415) and vessels carved from soapstone may appear in sites as early as 3,500 B.P. (Sassaman 1995: 228-229) while the earliest pottery in the Southeast makes its first appearance by 4,500 B.P. (Sassaman 1993, 2006). Sassaman maintains that the thick-walled, fiber-tempered, basin-shaped vessels of the Southeast predate steatite vessels technology by 600-900 years (Sassaman 2006: 152).

Photo 2.3. Steatite-tempered body sherds recovered from the Ninemile Road site (Vessel 1).

Photo 1.4. Steatite-tempered body sherd from Ninemile Road (V1B1) that has been sectioned for petrographic analysis. Image was taken with a Dinolite microscope at 10x.

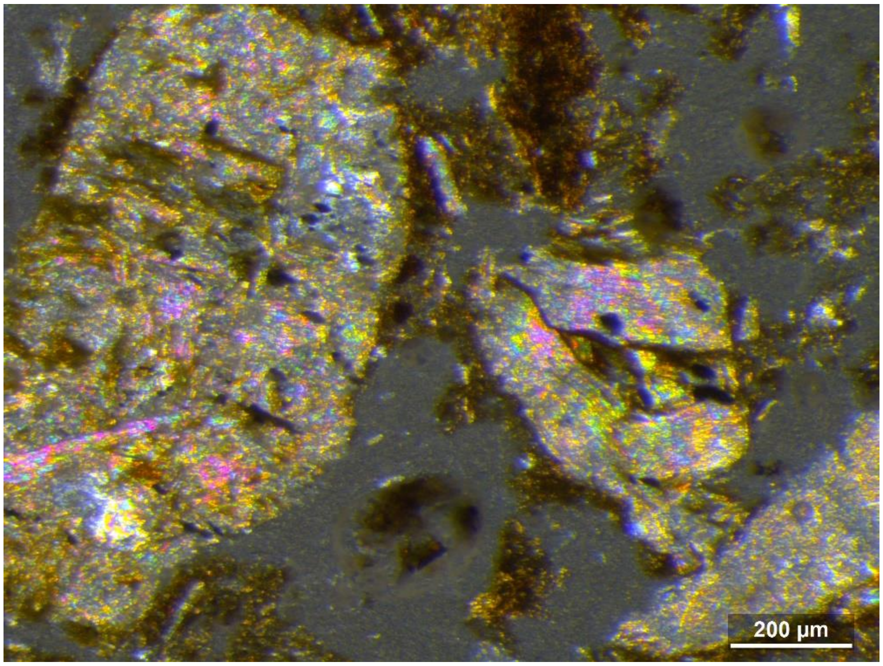


Photo 2.5. View of steatite rock temper in the Ninemile Road sample, V1B1, under crossed polarized light. Image taken at 100x.

The most recent work conducted in the steatite-pottery debate was completed by Taché and Hart (2013). The authors took an extremely conservative approach to dating vessels which included examining 192 chronometric hygiene assays on Vinette 1 pottery and 46 assays on steatite. Of the above samples, the authors tossed out 162 assays on the Vinette 1 pottery (n=84%) and 38 assays on the steatite vessels (n=83%) because of the date's large standard deviations and questionable association. The authors correctly point out that in the earlier days of radiocarbon dating, dates were frequently collected from associated contexts, such as charcoal recovered from feature soil, rather than directly from the residues adhering to an object's surface, presumably from its final use (Taché and Hart 2013: 359). Today's dating techniques are much more refined with smaller margins of error, even at the 95% level of confidence. The authors conclude that the earliest accepted date on Vinette 1 pottery is from the Batiscan site in Quebec (3110 ± 20 B.P.) and the latest date, also from Quebec, at the Pointe-du-Buisson site, (2285 ± 20 B.P.). The earliest acceptable date on steatite was recovered from the Hunter's Home site in New York (3530 ± 30 B.P.), and the latest from Broome Tech, New York (2400 ± 60 B.P.) (Taché and Hart 2013: 366). According to Taché and Hart, Vinette 1 pottery first appears in the archaeological record between 1495-1313 BC and is gone sometime around 395-261 B.C. Steatite begins 2574-1772 B.C. and extends throughout the entire Vinette 1 period, ending between 751 B.C. to A.D. 164 (2013: 366). These results show that steatite does in fact appear to have begun significantly earlier than Vinette 1 pottery (between 338 and 1202 years) and it persists for a longer period of time than the first ceramic technology, and it overlaps significantly with Vinette 1 technology for more than 1,000 years (Ibid).

The Significance of the Steatite-Pottery Debate

Prior to the 1980s, archaeologists believed that understanding past Native American cultures required a full understanding of how environmental stresses, such as raw material resources, limited and shaped the behaviors of cultures. The earliest definitions of Archaic cultures viewed social groups as simple, mobile foragers whose rudimentary lifestyle forced them into constant search for food (Ritchie 1969: 32). More recent interpretations of the Archaic tend to view cultures of this time as highly dynamic rather than static, and exceptionally adapted to the mid-Holocene environmental challenges, even to the point of surplus food production, social complexity, seasonally sedentary, and having widespread, long-distance intergroup communication (Bender 1985; Campbell et. al. 2004; Cordell 2004; Gibson and Melancon 2004; Hays and Weinstein 2004; Sassaman 1993; 2004).

Key to the argument that a unilineal shift from the Archaic to Woodland periods included a behavioral shift in both mobility and subsistence patterns, is the pre-20th century assumption that agriculture is advantageous to foraging, and mobility is undesirable for all human groups. The appearance of stone bowl technology is heralded as a "container revolution" associated with new food preparation techniques, resource intensification, and cultural complexity (Neusius and Gross 2014: 387). For many archaeologists, such as Ritchie, agriculture and sedentism are on the concluding end of a one-way spectrum, a place where all cultures are eventually destined to reach (Eder 1984: 839). Archaeologists did not begin to break these assumptions apart until after the start of the decline of Processual archaeology (Bender 1975: 5-13; Dragoo 1976: 16; Kelly 1992: 51-52; Scarre 2005: 186).

Although he currently appears to be incorrect regarding the order in which steatite and pottery appeared, Sassaman's (2006) conclusions regarding the debate over the appearance of soapstone and ceramic containers has several key points that challenge the currently accepted models of ceramic development, settlement, sedentism, and resource intensification in the Eastern Woodlands. Traditional theoretical models that adopt sweeping cultural syntheses pushed archaeologists into believing that ceramic technology is a product of settled, agricultural communities and stone bowl technology is a product of mobile, hunter-gatherers (Sassaman 2006: 153). According to the Sassaman, evolutionary models downplay or ignore critical social, political, and ideological factors involved in the appearance and widespread use of stone bowls and ceramic vessels:

> The archaeologists who conducted these early studies were among the best of their era, but they were also subject to the biases of the day, which, in an extension of unilineal evolutionary theory and the Old World Three-Age system, assumed a priori that stone vessels preceded pottery because pottery was among the "advances" of more settled, food-producing societies [Sassaman, 2006: 153].

Contribution of this Study to the Debate

The steatite-ceramic date debate threatens the culture-historical models of cultural development and their associated artifact types in the Eastern Woodlands. The type system developed during the 20th century encourages archaeologists to assume that stone bowl and ceramic vessel technologies are inevitably related processes when this has not actually been demonstrated. The steps of ceramic manufacture must be studied in detail within each region using scientific techniques before any determinations of the origin of those technologies can be made.

Ritchie and MacNeish believed that Vinette pottery series shared many exterior physical characteristics, such as shape, surface treatment, and decoration; the authors used external characteristics as the foundation for their classification system. This descriptive method is ineffective for describing pottery because there is far more variation in the exterior features of Vinette types than recognized by Ritchie and MacNeish (Taché 2005; this study). This has led archaeologists to create lists of regionalized Vinette and Vinette-like variants. The lack of consistent measurable attributes makes communication about the development of pottery between archaeological regions difficult. The discussion thus far has been firmly lodged in culture-historical and processual theories. For example, the Vinette and Vinette-like vessels have been identified across New England to Maryland, Pennsylvania, and northwestwards to New York and southern Ontario (Ritchie and MacNeish 1949: 100). The differing shapes of Vinette 1, from flat-bottomed to conical, are described as being the result of Vinette 1 being physically introduced into New York by the Frost Island (New York Susquehanna) culture and the idea being later incompletely adopted by the Meadowood culture (Mason 1981: 209). In New York and southern Ontario, early Vinette forms are thought to have developed into regional forms of Vinette Dentate and Vinette Complex Dentate (Jackson 1986: 396). These regional variants are suggested to be a gradual refining of technology through the process of trial and error (Spence and

Fox 1986: 4; Taché 2005: 193-194, 201). Variations of Vinette 1 include smoother walls, finer temper, thinner and more pointed lips, and incised or punctate design on the exterior.

Problematically, early pottery is often poorly preserved and extremely variable in external appearance, leaving this type of classification open to subjective interpretation and misidentification. Ritchie and MacNeish did not identify reliable diagnostic indicators for categorizing early pottery. The authors also failed to provide an objective, reproducible method for analysis. While variation in surface treatment and decoration may be important aspects of surface style, these features only occur in the upper portions of early ceramic vessels, including the lip, rim, neck, and occasionally the collar. Problematically, these areas represent a very small proportion of the complete vessel and are therefore less likely to be preserved over the more durable body and base sherds. In short, these descriptive methods limit our ability to understand ancient societies because they focus on functional and evolutionary explanations for change and ignore important social processes. Early pottery in the Northeast needs to be reevaluated and the description-based Vinette Type series needs to be examined for its usefulness. In order to achieve this goal, the remainder of this manuscript will:

1. Build a new database of attributes that form the foundation of the technological style of early vessels, using a reproducible and less biased methodology than that used by Ritchie and MacNeish,
2. Outline the chain of production for early ceramic vessels by looking specifically at the different types of temper and how they were intentionally selected and produced by potters,
3. Using the new database and the chain of production, this dissertation will challenge the foundation of Ritchie and MacNeish’s earliest ceramic types, and illustrate how early pottery in the Northeast is closer in technological style to earth oven technology than it is to steatite stone bowls.

4. Lastly, an examination of the symbolism embodied in early pottery will be presented.

As a note for the reader, this manuscript will continue to use Ritchie and MacNeish's categories in order to compare and contrast the different aspects of early pottery with the traditional types, but the author does not agree that the early vessels lumped together as the Vinette Series are in fact all part of the same technology. This study will show how the term 'Vinette' is outdated and no longer useful for archaeologists.

This project makes several contributions to Northeastern archaeology, including the demonstrated effectiveness of a practical, reproducible method for fabric analysis based on Native American symbolism and standardized fabric attributes. The redefinition of early ceramic technology proposed by the author reflects the importance of the natural landscape to early Native American cultures and demonstrates methods by which new information can be gleaned from existing and newly acquired ceramic collections. This project illustrates how the potential amount of information obtainable through the proposed method and typology outweighs the time and cost it requires to build the new database.

CHAPTER THREE:

Technological Studies in Northeastern Archaeology

"We choose not to call these wares by their historical type names, because those names convey the appearance of cultural relationships where none may exist…All too often, type names substituted as proof of those relationships—proof by typology instead of empirical demonstration"

Gibson and Melancon (2004: 172).

The History of Ceramic Technological Theory

The earliest technological studies began on ceramics in the late 18th century in Europe as part of a growing negative reaction to the Industrial Revolution (Rye 1981: 2; Trigger 1989: 148). It was during the late 18th and early 19th centuries that massive amounts of artifacts were being salvaged from the rapidly increasing development of factories, roads, railways, and water structures. Archaeologists sought to describe and categorize thousands of artifacts as they flooded into their museums and research institutions. The intent of the archaeologists at this time was to establish ethnic categories for objects that would provide European nations with historic information about their origins (Trigger 1989: 149). The work of Josiah Wedgewood and his students paved the way for the foundation of an organized discipline of ceramic technology (Rye 1981:2). Wedgewood and his contemporaries focused on the artistic value of ceramic objects, rather than on any cultural or social meaning behind them. Their work created "a body of knowledge of stylistic and decorative attributes…...that allowed for the identification of the place of origin and the time of manufacture" (Rye 1981:2). Later archaeologists adopted this body of ceramic knowledge in order to create detailed regional lists of cultural-historical traits.

As archaeologists struggled to control, describe, and organize archaeological data throughout the 19th century the concept of 'archaeological cultures' slowly developed from the lists of culture-historical traits. The major theoretical paradigm of the later 19th century was Diffusion. Diffusion theory "maintained that people are not inherently inventive," change is dangerous and against human; therefore, cultures "mostly stay static unless acted upon" by an external force (Trigger 1987:150). The descriptive archaeologies of the 19th century provided a quantitative comparison of cultural traits that were grouped together and used to define past cultural groups. Pottery classifications played a major role in the establishment of the relative chronologies (McKern 1939; Ritchie and MacNeish 1949). Though it should be noted that at the time, with the exception of a few archaeologists such as Anna O. Shepard and Frederick Matson, the goal was not to describe the individual ceramic technologies, it was to create regional chronologies of archaeological cultures (Rye 1981:2). The ceramic chronologies of the 19th century did not consider social aspects of cultural change; instead archaeologists viewed technical change as a unilineal development and credited changes in material culture to the processes of diffusion and immigration (Trigger 1987: 191).

McKern's Midwestern Taxonomic System organizes ceramic attribute data from finite to infinite, in order to create local ceramic types, regional type clusters, and large-scale ceramic systems. A 'type' is a small group of diagnostic traits; these traits are assumed to have been intentionally created by the potter and appears to be unique to one cultural manifestation (archaeological culture) (McKern 1939: 305-306). Ceramic vessel traits frequently examined by culture-historians include macro-attributes, meaning they can be seen without magnification, such as decorative surface design, surface treatment, rim shape, and overall vessel design (Rice 1987: 275-277; Sinopoli 1991: 52-53; Rye 1981). Individual ceramic types and variations of those types are often grouped together into broader type clusters. Type clusters represent "regional manifestations of similar ceramics" (Sinopoli 1991: 52). A ceramic system is the broadest, most general ceramic classification. These general ceramic systems covered large regions of space and were generally assumed to be statistically comparable through linked (shared) traits (McKern 1939: 305). Ceramic systems were conceived as "the product of shared ideas or normative concepts concerning ceramic form, decoration, and production techniques" and resulted from a "high intensity of interaction between potters" (Sinopoli 1991: 52). The purpose for creating ceramic types is so that they can be compared through space and time (Duff 1996; Gifford 1960: 341).

There are two major flaws of culture-historical approaches to studies of technology, the attributes chosen for analysis and the explanation of variation and change in technology. Firstly, culture-historical approaches assume that the macro-attributes chosen for analysis "reflect aesthetic and utilitarian standards of value which operated as cultural compulsives….and, therefore they possess some genuine measure of intrinsic validity" (Ritchie and MacNeish 1949: 98). The macro-attributes selected are often subjective and therefore difficult to reproduce, which reduces the accuracy of the method. There is far more variation in the exterior features of ceramic types than recognized by most culture-historians. This has led archaeologists to create lists of regionalized variants. The lack of consistent measurable attributes makes communication about the development of pottery between archaeological regions difficult. "No attention was paid to the fact that artifacts that were stylistically highly variable, such as pottery, often were divided into more types than other artifact classes" (Trigger 1989: 191).

Secondly, culture-historians relied on diffusion and migration theories to explain variation in ceramic types. Diffusionist theories focus on the idea that human groups lack continual creativity. Concepts and artifacts are created only once and then are spread to adjacent groups through cultural contact (Trigger 1989: 151). Migration theories focus on the movement of people, rather than thoughts and ideas. According to culture-historians, artifacts are products of shared ideas. This is an “over-simplified and over-generalized” view of the past (Johnson 1999: 17-20). Ceramic variables which fail to fit the neatly made type clusters are often considered to be inconsistencies created by a lack of data or they are seen as imports, rather than an error in methodology (Ritchie and MacNeish 1949:121). Diffusionist theories are also unilineal; cultures are seen as progressing in a series of inevitable stages (Trigger 1989: 191).

After the 1930s, archaeologists adopted McKern’s Midwestern Taxonomic System to define material culture across time and space in relation to subsistence strategies, ceramic and stone technologies, settlement structure, and land-use practices (Johnson 1999: 15-22; McKern 1939; Ritchie 1965; Ritchie and Funk 1973). Two main patterns or evolutionary stages were devised in the Eastern Woodlands, ‘Archaic’ and ‘Woodland’ (Trigger 1989: 190). Each of these manifestations were seen being reflective of unique adaptations to environmental stresses. “The ceramic types became more than associated attributes of craft production and decoration, they were treated as cultural and ethnic markers” (Hart and Brumbach 2003: 748).

The term ‘Archaic’ was first coined by the New York State Archaeologist, William A. Ritchie, during his attempts to expand on Parker’s four divisions of Algonkin cultures in New England (Ritchie 1932: 407; 1936; 1945). Ritchie used the Archaic category to differentiate the oldest, stone-using cultures from the later ceramic-producing, agricultural-based Iroquoian groups. Ritchie’s definition of the Archaic was widely adopted by North American archaeologists and is still heavily utilized today. Definitions of Archaic cultures have evolved considerably since its first introduction. The earliest definitions of the Archaic viewed social groups as simple, mobile foragers whose rudimentary lifestyle forced them into constant search for food (Ritchie 1969: 32). More recent interpretations of the Archaic tend to view cultures of this time as highly dynamic, rather than static, and exceptionally well-adapted to the mid-Holocene environment, even to the point of surplus food production, social complexity, seasonal sedentation, and widespread, long-distance, intergroup communication (Bender 1985; Campbell et. al 2004; Cordell 2004; Gibson and Melancon 2004; Hays and Weinstein 2004; Sassaman 1993; 2004; Yesner 1980).

The term ‘Woodland’ was created by McKern during his development of the Midwestern Taxonomic System. Like Ritchie, McKern was interested in defining cultures by a series of unique traits. Generally, the start of the Woodland phase is defined by the definite widespread use of ceramic technology, increasing social stratification, and a strong continuing movement towards longer periods of sedentism (Ritchie 1969: 179-180).

Archaeologists today recognize that the terms ‘Archaic’ and ‘Woodland’ are too meaning-laden, over-generalized, and simplified to provide useful information about social groups. “Individual aspects of human behavior and their associated artifacts have separate histories and that those histories are reticulate” (Hart and Brumbach 2003: 747-748). More critically, these terms “convey the appearance of cultural relationships where none may exist. Even if they do [exist], naming leave us with no earthly idea as to how those relationships were established…..All too often, type names substituted as proof of those relationships—proof by typology instead of empirical demonstration” (Gibson and Melancon 2004: 172). John P. Hart and Hetty J. Brumbach (2003) and Janet Schulenberg (2002), were some of the first archaeologists in the Northeast to question the validity of the Woodland pattern and its cultural package by examining three cultural traits associated with the Middle Woodland Point Peninsula and Late Woodland Owasco ceramic types: maize-bean-squash agriculture, nucleated villages, and “longhouses with inferred matrilocal residence” (738-739).

Ritchie's Archaic Period: A Summary of Life in the Northeast Before the Appearance of Ceramic Technology (10,000-2,700 BP)

The Archaic in the Northeast is divided into four chronologic periods: Early, Middle, Late, and Transitional. These periods are based on changes in material culture, settlement location, and subsistence practices within each region of northern North America. The changes in material culture between regions and over time are defined as unique adaptations to individual geographic niches and environmental changes within in the Northeast. Examples of these localized adaptions include the Shield Archaic (Canada), Old Copper Culture (western Great Lakes), Laurentian (eastern Great Lakes), and Maritime (coastal New England) cultures. The Archaic cultures, specifically the Late and Terminal periods, created patterns of settlement and subsistence practices and set a standard of lithic crafting seen in nearly all of the following periods.

The Early and Middle Archaic Periods (10,000-6,000 BP)

Little substantial information is known about the Early and Middle Archaic societies in New York. There has been considerable debate over whether or not this period represents a general hiatus in population after the disappearance of the early Paleoindian culture or whether the earliest Archaic sites are now submerged by rising water levels and isostatic rebound (Bourque 2001: 38-43; Curtin 1998: 37; Mason 1981: 132-133; Ritchie and Funk 1973: 37; Ritchie 1969: 32-34). It seems unlikely that the Northeast was depopulated for so long a period of time; therefore, Early Archaic cultures probably lived near coastal resources, which are now destroyed. Certainly by the Middle Archaic period, c. 8000-6000 BP, small, mobile groups had moved into the interior of the east coast in order to utilize terrestrial resources (Bourque 2001: 43).

The Archaic period began after the disappearance of Paleoindian adaptation (c. 10,000 BP). The Holocene period was already underway before the start of the Archaic period; however, paleobotanical evidence suggests the environment was still fluctuating (Neusius and Gross 2014: 380). A major climatic shift occurs during the Early Archaic period. This shift, known as the Hypsithermal, was a warm and dry period that extended from about 9,000-2,500 years before present. During this time, the flora and fauna populations in western New York continued to change as warmer climates prevailed throughout the region. The vegetation became almost entirely dominated by hardwood and pine species. Many new plant, animal, bird, and fish species replaced the extinct megafauna and became available as food resources including: black bear, beaver, white-tailed deer, moose, elk, wolverine, red fox, lynx, martens and turkey (Funk 1977: 32). The plethora and diversity of the lithic assemblages during this period suggest a hunting-based subsistence economy (Funk 1977: 25). Human populations through the Middle Archaic period remained small and fully nomadic (Ritchie and Funk 1973: 37).

According to Ritchie (1980), projectile points associated with Early and Middle Archaic cultures in the western half of New York include Lamoka and three variations of Laurentian points (Ibid: Figure 1). Note that the Lamoka culture has since been accepted as a Late Archaic adaptation (Curtin 2015; Snow 1980: 226) and will therefore be described later. The Laurentian Tradition is also known as the Lake Forest Archaic Tradition. The Laurentian tradition includes a broad list of traits, which loosely define cultural groups from southeastern Ontario, southern Quebec, northern New England, and northern New York (Ritchie 1980: 79). Laurentian cultures relied on hunting and fishing for sustenance and their basic toolkit included woodworking tools, ground slate tools, and barbed bone points (Ibid: 79-80). Laurentian cultures underwent localized environmental (niche) adaptation and slight differences in stone tool assemblages are visible across the region. In the western half of New York, the three phases of the Laurentian tradition include the Lamoka, Frontenac, and Brewerton cultures. Projectile point styles notably missing from New York, which are commonly found throughout the rest of the Northeastern Woodlands, are all forms of Kirk points (c. 9,000 BP), Hardaway Dalton points (c. 9,000 BP), bifurcate-base points (c. 9,000-8,000 BP), and Stark/Neville points (8,000-6,000 BP) (Snow 1980: 161-176). Ritchie's explanation for the missing styles is that Kirk and Hardaway Dalton points are associated with the Mast Forest Tradition, which was centered in southeastern New England and throughout the Southeastern Woodlands and the Stark/Neville complex is a coastal New England adaptation (Ibid).

The Late Archaic Period (6,000-4,000 BP)

The Late Archaic adaptations in the Northeast mark a substantial break from earlier periods. The Late Archaic period appears as a florescence of cultural variation. Widespread archaeological cultures identified throughout New York and portions of the Northeast during this time include the Brewerton, Frontenac, Glacial Kame, Lamoka, Laurentian, Snook Kill, and Vosburg. The Brewerton phase of the Laurentian tradition continues and becomes more widespread during this period (Ritchie and Funk 1973). Hunting, gathering, and fishing still make up the dominant subsistence strategy but cultigens appear for the first time. Early cultigens include squash (*Cucurbita pepo)*, sunflower *(Helianthus annuus* var. *macrocarpus),* and sumpweed *(Iva annua* var. *macrocarpa)* (Fritz 1995: 7; Hart and Scarry 1999; Hart and Sidell 1997). Four different types of settlements are recognizable in the archaeological record as well as organized cemeteries with elaborate mortuary practices. Extensive exchange networks were also in operation, with goods moving hundreds of miles between groups (Curtin 1998: 39; Hart and Sidell 1997: 530; Mason 1981: 136-137; Stewart 1994). Materials from the Northeast have been found as far south as Poverty Point in Louisiana (Truncer 2004). Outside the Northeast, Archaic fiber-tempered pottery has been identified (Campbell et. al. 2004; Cordell 2004; Gibson and Melancon 2004;

Sassaman 1993; 2004) and monumental mound building begins at the site of Poverty Point (Gibson 2006).

According to Ritchie and Funk (1973), the four basic settlement types visible in the archaeological record include 1) small campsites, 2) large campsites, 3) quarry/workshop sites, and 4) rockshelters and caves (1973: 337-338). Small campsites frequently occur inland on small water sources such as streams, springs, or marshes. These sites are occupied for short durations by small bands or extended family units and appear to be special-purpose resource procurement sites (including hunting and fishing stations). Large campsites are found frequently located near large bodies of water. Unlike their smaller counterparts, these campsites appear to be repeatedly occupied for extended periods of time. Procurement, processing, and maintenance of (stone) tools occurred at large campsites. Housing structures are often found in large campsites. The appearance of "living floors," which are hard-packed areas containing artifact concentrations, features, and/or postmolds provide evidence of the house structures (Ibid 1973: 338).

The third type of Late Archaic settlement identified by Ritchie and Funk is quarry-workshop sites. Quarry or lithic procurement sites frequently occur nearby outcrops of stone needed for tool production, such as chert. Archaeologists rarely find features containing organic material at these sites and lithic artifacts dominate the artifact assemblage, including flakes, cores, bifaces, preforms, and finished projectile points (Ritchie and Funk 1973: 338).

The final site type identified by Ritchie and Funk is rockshelters and cave sites (1973: 338). Unfortunately, because soil accumulation is often very low in caves, there is a consistent problem with understanding stratigraphic sequences. Cultural layers in caves often lay imposed one over the other on the same living floor with little to no soil accumulation. Even so, new evidence suggests that rockshelters and caves may provide the best evidence for early cultigens use in North

America due to their often-excellent preservation (Gremillion 2004). They also provide the earliest known cave art in the Eastern Woodlands (Simek et. al. 2001).

The diversity of cultures during the Late Archaic periods makes it impossible to discuss them all in this format. This section will focus on the cultures that are currently known to be relevant to the development of later Woodland cultures: the Lamoka and Brewerton phases of the Laurentian tradition. The Laurentian tradition begins in the Middle Archaic and its general characteristics are described above. The Brewerton phase is a key aspect of the Laurentian tradition (Ritchie and Funk 1973:44; Ritchie 1980: 89) and does not appear to be related to the Lamoka culture. The Lamoka people may have been an intrusive culture derived from the southeastern Woodlands (Curtin 2015).

The type-site of the Brewerton phase is the Brewerton site, located in Onondaga County at the confluence of the Oneida River and Lake. Ritchie was the first to excavate at the site and to name the assemblage as a cultural phase (Ritchie 1980: 89). Characteristic material used to identify the Brewerton culture include the characteristic broad-bladed Brewerton points, stone plummets, grinding tools, bifacially chipped knives, retouched flakes, including thumbnail scrapers, traiangular biface blade, the ulu, chopper, six different chipped stone drills, and unpitted and pitted hammerstones (Ritchie 1980: 89-99). Projectile points include eared-notched, eared-triangle, and side-notched varieties. Grinding and woodworking tools are also common in Brewerton assemblages. The grinding tools were most likely used for processing mast forest resources, such as acorns, and include mullers, mortars, and cylindrical and conical pestle. Woodworking implements included the gouge, and the plano-convex adz. The Brewerton culture marks the start of the long-distance exchange systems that burgeoned during the later Woodland periods. These trade networks extended in all directions from central New York, including the Upper Great lakes and New England (Ritchie 1980:103). Common trade and travel routes for humans and animals throughout the pre-Contact period include the Erie-Ontario, Hudson-Mohawk, and St. Lawrence-Champlain lowlands (Lothrop and Bradley 2012: 10). At both the Robinson and Oberlander No. 1 sites, located in central New York, Vinette pottery fragments were recovered from the upper cultural levels (Ritchie 1980: 89). Ritchie believes the Brewerton phase may have evolved into the Early Woodland Point Peninsula and possibly Meadowood cultures, which would explain the association of their pottery types with Brewerton materials. Like the Meadowood, the Brewerton people practiced seasonal sedentism, moving from small campsites to large central-base camps during the spring and summer. Ritchie suggests the Brewerton may have also had small groups of people who were fully sedentary and remained at the central-base camps year-round (Ritchie 1980: 99).

This new semi-sedentary lifestyle eventually defined the Lamoka culture at the Lamoka Lake site. Arthur Parker identified the Lamoka Lake site in the early 20th century. Parker sent Ritchie, then a student of his, to investigate the site in 1925 (Ritchie 1980: 36). Unlike phases of the Laurentian Tradition, the Lamoka culture seemed to have a strong preference for site locations along ridges above confluences of large bodies of water. The Lamoka toolkit is exemplified by a complex set of bone fishing gear, particularly the barbed harpoon, and a narrow-bladed projectile point technology (Funk 1977: 48; Ritchie 1980: 36). Other common tools at Lamoka sites include woodworking materials, specifically the beveled adze and celt, unpitted and bipitted hammerstones, anvilstones, pitted stones, mullers, and flint drills. In additional to fishing, the Lamoka maintained a diverse hunting strategy and a wide variety of lithic tools (Funk 1977: 50). Along with this new diverse hunting strategy came additions to the stone, leather and bone craft industries. The Lamoka were adept pressure flakers, as evidenced in the detailed craftsmanship of their lithic tools and the presence of antler and copper billets at their cultural assemblages (Funk 1977: 67).

Lamoka sites other than the Lamoka Lake site are temporary, small campsites (Ritchie 1980: 69). Lamoka Lake is one of the largest Archaic period sites in New York State and may represent evidence of increased sedentism. Ritchie recorded the site at more than 700x300 ft (213x91 m) in size. Stratified cultural deposits varied from about a foot to nearly five feet in thickness (Ibid: 71). The house floors identified by Ritchie contained 20-30 bands of alternating dark cultural soils divided by layers of clean sand and numerous, overlapping post molds were identified. The post molds ranged in size from 2 ¼ to 3 ¾ inches (5.7-9.5 cm) in diameter. The house structures were rectangular, were oriented parallel to the stream, and were located at the widest part of the site, which was approximately 100 ft (30 m) from the stream (Ritchie 1980:74-75). The Lamoka Lake inhabitants were likely sedentary for most of the year, leaving their base camp to procure nearby resources as needed. A nearby cemetery, large storage pits filled with acorn refuse, and multiple features attest to the sedentary nature of this site (Mason 1981: 158-159). Ritchie assumed that the size and concentration of artifacts and organic material at the Lamoka Lake site was a fluke, due to an optimal environment. He and many other archaeologists continue to define the Lamoka culture as small, mobile, hunter-gatherers (Ritchie 1981: 155; Ritchie and Funk 1973: 41; Ritchie 1969: 42).

Ritchie believed the Lamoka culture was an *in situ* development in New York that preceded and was not related to the other phases of the Laurentian tradition (Ritchie 1980; Ritchie and Funk 1973). Funk concurred that the Lamoka culture does not seem at all related to surrounding cultures in New York State. He proposed that the Lamoka was a short-lived adaptation that occurred after the Laurentian tradition and before the Brewerton phase (Ritchie and Funk 1973: 45). Curtin sees the Lamoka as an isolated, foreign population with cultural ties to the Archaic shell midden groups of Kentucky (Ibid 2015a; 2015b). Curtin argues that Lamoka Lake provides an unusual case of "continuity and permanence during the Archaic" (Ibid 2015a). As invaders, the Lamoka group remained clustered at Lamoka Lake and may have experienced trouble accessing key resources in the area, hence the need for subsurface storage pits "underground resource concealment" and their frequent use of glacial cobbles, rather than cores from quarry sources (Curtin 2015b). The Lamoka culture eventually was replaced by later phases of the Laurentian Tradition in a process of slow acculturation, rather than violent warfare, as Ritchie (1980) suggested (Ibid).

The Terminal (Transitional) Archaic Period (c. 4,000-2,700 BP)

The transition between the Late Archaic and the proceeding Woodland period is blurry and difficult to define archaeologically. Archaeologists must take care in defining this transition with a stark line, as several of the key traits of the Transitional Archaic are now understood to overlap with both earlier and later periods. Settlement patterns across New York continued unchanged during this period. Elaborate mortuary cults and evidence of complex religious systems appear throughout the region at this time. In all, archaeologists have proposed over 300 traits that define the Terminal Archaic from earlier phases. This phase is most commonly associated with the adoption of stone bowl technology, which was then closely followed by or contemporary with ceramic vessel technology. Ceremonial complexity and the widespread utilization of cultigens for subsistence are also common markers of the Terminal Archaic period (Stothers and Abel 2008: 79). Transitional cultures are not found in all regions of the Eastern Woodlands; many archaeological assemblages lack the characteristic soapstone artifacts defined as typical of this period. For example, in the western Great Lakes, the Transitional Archaic (also called Proto-Woodland) is marked by the appearance of the Red Ocher and Leimbach cultures, neither of which used soapstone (Mason 1981: 203). In the New York and Southern New England, early pottery forms and soapstone bowls are commonly associated with the Frost Island and Susquehanna cultures (Ritchie and Funk 1973: 345; Mason 1981: 206-209).

The Susquehanna culture is a broad point tradition that might possibly represent a large migration of people from the Southeastern Woodlands that moved first into the Middle Atlantic, and then into the Northeastern Woodlands (Neusius and Gross 2014: 387). Asides from steatite, key elements that define the Susquehanna toolkit include drills and broad stemmed projectile points (Ritchie and Funk 1973: 71). Ritchie suggests that the earliest phases of the Susquehanna culture, at least in New York, lack steatite and pottery technology. Steatite artifacts first occurred beneath pottery-bearing levels and above older stone tools in the North, leaving Ritchie to suggest these vessels represented a transitional phase of occupation between Archaic and Woodland cultures. The use of steatite containers continued well into Ritchie's Early Woodland period, where steatite was commonly found with early pottery types including Vinette 1, Selden Island Steatite Tempered ware, and Marcey Creek Plain (Ritchie 1980: 151).

The Development and Spread of Ceramic Technology in the Eastern Woodlands According to Culture-Historians (2,700 BP-Contact)

The start of the Woodland period is defined by the definite widespread use of ceramic technology, increasing social stratification, and a strong continuing movement towards longer periods of sedentism (Ritchie, 1969: 179-180). In Maine and the Maritime Provinces, this time frame is known as the Ceramic Period. Archaeologists believed that sedentism was tied to the gradual adoption of horticulture and ceramic technology. The term "Woodland" was first coined by McKern (1939) in his development of the Midwestern Taxonomic System. Like Ritchie, McKern sought to define cultures based on unique traits. He claimed that the Woodland phase cultures were characterized by:

> Flexed inhumation and/or secondary interments; a pottery ware characteristically grit-tempered, granular in structure, with intaglio surface ornamentation effected on the soft unfired paste by means of cords and/or other indenting tools, prevailingly subconoidal in shape with simple shape variety; stemmed or notched chipped-stone projectile points and cutting implements; primary chipping superimportant over secondary, to reduce thick flakes to a desired size and shape; grooved axes; semi-sedentary territorial adjustment [McKern 1939: 309-310].

Woodland cultures were based on fishing, hunting, and moderate plant-based subsistence. In many ways, after 1950 BP (AD 0), the cultures of the Northeastern Woodlands mimic the developments in the Adena and Hopewell cultures of the Eastern Woodlands interior, though to a lesser degree of intensity (Neusius and Gross 2014: 391). Although it was not understood at the time of Ritchie, Funk, and McKern, archaeologists now know that several cultigens were used throughout the Archaic period and horticulture during the Woodland period was not maize-based, until much later. Maize does make its first appearance in the Eastern Woodlands at this time, but does not become a significant aspect of Woodland subsistence until after 1,000 BP (Crawford et al. 1997: 115). New cultigens which appear during this period include tobacco (most likely *Nicotiana rustics*) and additional forms of squash and chenopod (Fritz 1995: 7).

Settlement types are similar to their Archaic counterparts but appear on a greater scale. These include 1) small, multiple use seasonal camps, 2) large, multiple use semi-permanent camps,

3) small, briefly occupied camps, 4) organized cemeteries, and 5) quarry/workshop sites (Ritchie and Funk, 1973: 349). Individual households vary from round to rectangular shaped and small to large in size (Ibid: 349-358). In the later Woodland period, c. A.D. 1000, settlements were defined by fully sedentary, long house structures, palisaded villages, and maize-beans-squash agriculture (Hart and Brumbach 2003). During the Woodland period there were clear mortuary spaces shared over longer distances, and thus there is evidence of sacred places shared by several communities (Stothers and Abel 1993: 108-9). The mortuary practices of the Woodland culture changed from the simple inhumation burials of the Archaic period to large burial grounds were several individuals from long distances were cremated. Beginning with the Meadowood, special mortuary blades became part of the complex ritual system, and thus garnered a symbolic importance (Ritchie 1980: 180-182). Large-scale lithic production areas occur within specific sites at this time as well, suggesting raw material was brought or traded from a source and then reshaped in specific, activity-based areas within the site. Most projectile points at this time continued to be fashioned from Onondaga chert and the lithic assemblage became more complex in its style of pressure flaking.

The Early Woodland Period (c. 3,000-2,200 B.P.)

Early Woodland groups are believed to have had riverine-oriented subsistence economies. Northeastern Early Woodland archaeological cultures include the Meadowood and Middlesex. The Meadowood culture (Point Peninsula I) is found throughout much of the eastern Great Lakes region, including New York, Ontario, and Quebec. This archaeological culture is defined by several diagnostic materials including Vinette 1 pottery, Meadowood cache-blades, side-notched points, endscrapers, T-base drills, tubular clay and stone pipes, and slate birdstones and boatstones (Spence and Fox, 1986: 4). According to Fritz (1995), there are no new cultigens that appear during this period, however there is an increasing appearance of an increasing reliance on seedy plants that occurs sometime after 2250 BP (7). Early Woodland cultures exploited fish and seasonal mast-forest resources like deer and nuts. Archaeologists believe that the Meadowood adoption of ceramic technology allowed the otherwise Archaic culture to become more seasonally sedentary, because the ceramic technology allowed for the difficult-to-access food resources, like acorns, to be accessed, stored, and utilized throughout lean seasons (Ritchie and Funk 1973: 96).

The Early Woodland Middlesex Complex is known exclusively as a mortuary cult. This culture has a greater geographic spread then the Meadowood culture, ranging from the Great Lakes into lower Canada and most of New England (Spence et al. 1990: 138). Asides from their use of Vinette 1 pottery, the Middlesex culture is essentially Adena (2450-2150 BP) in nature. Middlesex sites are noted for the high occurrence of exotic mortuary artifacts and mound burials. The most diagnostic Middlesex artifact is the blocked-end tube pipe, usually made of clays or ground and polished Ohio “firestone” (Ibid: 138). Bifacial tools are also commonly constructed from imported Indiana, Illinois, or Ohio cherts, including leaf-shaped blades, long stemmed blades, broad, thin, ovate blades, broad corner-notched bifaces, and large spade-shaped bifaces (Ibid). Unlike the Meadowood culture, ceramic vessels are occasionally found in Middlesex burials as grave goods. These vessels frequently have incised decoration over roughened cord-marked or fabric-marked exteriors. Virtually nothing is known about the subsistence or settlement patterns of this culture.

The Early Woodland Meadowood period in western New York is denoted by the widespread appearance of ceramic technology in an otherwise ‘Archaic’ settlement and subsistence pattern that consists of seasonally based hunting, gathering, and fishing (Ritchie 1980; Ritchie and Funk 1973, Granger 1978). The Meadowood periods dates to approximately 3,000-2,400 BP. The Meadowood culture is identified in the archaeological record by the presence of the following traits: lithic tools formed from Onondaga chert, including so-called ‘Meadowood’ projectile points and cache blades, side-notched points, endscrapers, and T-base drills; other stone artifacts such as pipes, slate birdstones, and boatstones are also common (Ritchie 1965:190-196). Ceramic materials include Vinette 1 and tubular clay pipes made of the same clay matrix as the Vinette 1 vessels (Spence and Fox 1986:4). The Meadowood are the earliest known consumers of pottery in western New York. This early pottery enabled the Meadowood people to become seasonally sedentary because these vessels allowed for difficult-to-access, high-calorie resources, to be processed, stored, and used during lean periods (Ritchie 1980:181). Meadowood period pottery is rarely found in mortuary contexts (Ritchie and Funk 1973:96).

Later interpretations expanded Ritchie’s list of Meadowood cultural traits to include a discussion of the Meadowood as an adaptive environmental strategy designed to optimally utilize mast forest and fresh water resources (Granger 1978; Jackson 1986). Unlike earlier Archaic cultures, the Meadowood people maintained central base camps with nearby seasonal camps for extracting resources (Granger 1978:267; Ritchie and Funk 1973:348). The Meadowood people were most likely a two-level band society, including local and regional band levels (Mason 1981:210). Local bands consisted of immediate and extended family units that were largely self-sufficient. Their use of Vinette ceramics allowed the small, regularly mobile groups to become more seasonally sedentary because ceramics enabled difficult-to-access food resources, like acorns, to be processed, stored, and utilized throughout lean seasons. Several local bands may have joined into regional bands during specific times of the year for ritual practices and other social gatherings (Mason 1981:211).

The definition of the Meadowood culture has changed drastically in recent years. Meadowood items are now recognized in archaeological sites far outside New York State, from the western Great Lakes to Northern Quebec and as far south as the Delaware Valley (Taché

2011:42 Figure 1). These materials are interpreted as evidence for a Meadowood Interaction Sphere that encompassed multiple different cultural groups. Rather than viewing the Meadowood as a single cultural unit, Taché sees “several regional cultures that retain their distinctiveness at the level of subsistence technology and local crafts, but which share supra-local values, rituals, behaviors, styles, and raw materials” (2011:42). Taché’s definition of the Meadowood best explains the similarities and differences in Vinette and Vinette-like pottery and other the styles of other Meadowood items across the Northeast.

The Middle and Late Woodland Periods (c. 2,200 BP-Contact)

The later phases of the Woodland Period show a huge variety of cultural phases, artifactual components, and complex regional development that are too numerous to discuss adequately in this report. There is no evidence that the Sinking Ponds site was occupied beyond the first years of the Middle Woodland period. Therefore, only a brief outline of the complexity of the latter Pre-Contact periods will be discussed here. The authors recommend the following sources for interested readers (Engelbrecht 2003; Levine et al. 1999; Hart and Engelbrecht 2011; Hart and Reith 2003; Hart and Lovis 2013; Reith and Hart 2011; Stothers et al. 1994; Stothers and Abel 1993).

The start of the Middle Woodland Period outside the Northeast is marked by the appearance of the Hopewell Mound Culture of Ohio and Illinois (Mason 1981: 239). The Hopewell is defined as an agrarian subsistence system with hunting and gathering of riverine resources supplementing the use of domesticated crops. Monumental mound-building occurred throughout the Hopewell heartland. The mounds, ceremonial plazas, and large, densely population settlements have been used as evidence that the Hopewell were a chiefdom-level society. Mound building and elaborate burials indicate large-scale labor mobilization, long-distance trade for exotic goods, craft specialization, economic diversification, and social stratification (Ibid 1981: 243). Although the Hopewell themselves are not believed to have been present in the Northeastern Woodlands or Western Great Lakes, both regions are believed to have been part of the "Hopewell Interaction Sphere."

The Hopewell Interaction Sphere refers to aspects of the Hopewell culture which are found outside the Hopewell heartland, including mound building, floodplain agriculture, elaborate burials with grave goods, Hopewell pottery styles, and Hopewell artifacts made of copper, mica, meteoric iron, silver, gold, marine shell, animal bone and teeth, pearl, and high-quality flints (Mason 1981: 238-239). In New York and northwestern Pennsylvania, Hopewellian cultures are known as the Squawkie Hill phase, while the Saugeen phase represents the Hopewell in southern Ontario, the Laurel culture in the Northern Great Lakes, and finally the Nokomis and North Bay cultures in the western Great Lakes region. In their respective areas, these cultures built mounds and buried their dead with Hopewell artifacts. Point Peninsula is contemporaneous with the New York Hopewellian and is found throughout most of the Northeastern Woodlands. The Point Peninsula culture is best described as a local Northeastern widespread ceramic tradition that is not Adena-influenced.

Ritchie divides the Middle Woodland period into five major phases: Canoe Point, Squawkie Hill, Kipp Island, Hunter's Home, and Fox Creek. These cultures set the stage for the development of key traits used to define the Late Woodland Iroquoian development. These traits included specific ceramic types (described above), long-houses, matriolocality, nucleated villages, and maize-bean-squash agriculture (Hart and Brumbach 2003: 743). According to Ritchie and Funk, the Iroquois developed insitu from the Owasco culture (but See Hart and Brumbach 2003; Snow 1995; 1996). The Middle and Late phases of the Point Peninsula Culture developed *insitu* in New York State but were heavily influenced by a series of exterior cultural influences from the Hopewell (Rtichie 1980: 228). Ritchie describes the Point Peninsula Tradition as a cultural continuum that culminated at Kipp Island to produce the Hunter's Home phase. Hunter's Home is described as a transitionary phase from Late Point Peninsula to early Owasco (Ibid).

A Summary of Ceramic Traditions from Ritchie's Middle and early Late Woodland Periods (c. 2,200-600 BP)

Ritchie and Funk (1973) describe the start of the Middle Woodland period with the appearance of Vinette 2 ceramic technology, which the authors describe as part of the Point Peninsula Ceramic Tradition (117). Point Peninsula is contemporaneous with the New York Hopewellian and is found throughout most of the Northeastern Woodlands. The Point Peninsula culture is best described as a local Northeastern widespread ceramic tradition that is not Adena-influenced. This tradition consists of "a distinctive group of significant modes in form, paste, and decoration, which derived, more or less independently, from cultural sources of diverse origin, temporal position, and geographic location" (Ritchie and Funk 1973: 117). The authors argue that Point Peninsula ceramics have relationships with the Hopewell and Laurel ceramic traditions (Ritchie and MacNeish 1949: 119). Ritchie believed the Owasco culture developed from the Middle and Late phases of the Point Peninsula Culture, Kipp Island and Hunter's Home (Ritchie 1980: 228). He describes the Point Peninsula Tradition as a cultural continuum that culminated at Kipp Island to produce the Hunter's Home phase. Hunter's Home is described as a transitional phase from Late Point Peninsula to early Owasco. Following the continuum, Ritchie and Funk (1973) believed the Iroquois developed *insitu* from the last periods of the Owasco culture (but see Snow 1995; 1996).

Unlike earlier versions of Vinette pottery, Vinette 2 ceramics have decorative techniques, mainly dentate-stamping, rocker-stamping, and corded-stick ornamentation (Ritchie and Funk 1973: 117). Decorative techniques become more elaborate throughout the Middle Woodland with complex, incised decoration marking the start of the Late Woodland period. Vessels throughout the Middle Woodland and early Late Woodland period also become larger, with more complex collars and gradually develop castellations. A larger variety of ceramic types appear during this period and large pot bases become less conical over time, changing to a globular shape. Vessels are tempered with a variety of materials, including sand, finely-crushed grit, and shell (Ritchie and MacNeish 1949).

Ritchie and MacNeish created the divisions between the Point Peninsula and Owasco ceramic traditions based on following attributes: decorative design, construction technique, and temper (1949). According to their traditional typology, decorative techniques become more elaborate throughout the Middle Woodland and into the Late Woodland period. Rocker-stamping and crisscross decoration, which are characteristic of the Point Peninsula ceramic tradition, disappear before the Owasco period begins. Dentate-stamping and corded decoration begin during Point Peninsula times but overlap into the early Owasco period. These ornamental impressions occur on smoothed vessel surfaces in the earlier Point Peninsula period, and later, on corded surfaces. Checked-stamp and incised decoration are limited to the later Owasco period. Complex incised decoration appeared in the Owasco tradition by the start of the Late Woodland.

In addition to alterations in surface treatment and decoration, vessels also underwent morphological changes (Ritchie and MacNeish 1949). Point Peninsula ceramics are traditionally thought to have been built with a coiling technique and Owasco with the paddle-and-anvil modeling technique. The paddle-and-anvil technique allows the walls of Owasco ceramics to be thinner and the bases to be more globular than Point Peninsula vessels (Ritchie and Funk 1973: 165). Additionally, vessels became larger over time and rims developed with more complex collars. The vessel collars evolved elaborately and developed castellations by the early Iroquoian period. Although the authors note several outlier types in the Owasco series (Owasco Herringbone, Owasco Corded Horizontal, and Castle Creek Incised), Ritchie and MacNeish record that the general trend through time is a reduction in the overall temper size from the Point Peninsula to the end of the Owasco period. The unstated assumption is: as vessel wall thickness decreases, the overall size of the temper follows suit.

Critiques of the Archaic-Woodland Model for Ceramic Development in the Northeast

By the end of the 19th century, technological studies fell out of favor in American archaeology. “In place of the former, almost obsessive concentration on the minute description of techniques and artifacts and on the tendency to study artifacts without regard for their social and cultural context,” archaeologists moved on to the study of “language, art, ceremony, and social organization” (Pfaffenberger 1992: 491). Again with the exception of individuals such as Shepard, Matson, and Prudence Rice technological studies did not widely reappear in the archaeological literature until Binford’s New Archaeology (Nelson 1991: 58). When technological studies were reintroduced in this new paradigm, archaeologists had adopted what Pfaffenberger terms, “The Standard View of Technology” (1992: 493). A summary of this processual view of technology is provided in the excerpt below:

> Necessity is the mother of invention…[Man faces the challenges of survival by the] fabrication of tools and material artifacts……In this we see Man's thirst for Progress. Form follows function. To be sure, Man decorates his tools and artifacts, but artifacts are adopted

> to the extent that their form shows a clear and rational relationship to the artifacts' intended function-that is, its ability to satisfy the need that was the raison d'être of the artifact's creation. Thus, a society's material culture becomes a physical record of its characteristic survival adaptation; material culture is the primary means by which society effects its reproduction. The meaning of human artifacts is a surface matter of style, of surface burnish or minor symbolization…..By viewing the material record of Man's technological achievements, one can directly perceive the challenges Man faced in the past, and how he met these challenges. This record shows a unilinear progression over time, because technology is cumulative. Each new level of penetration into Nature's secrets builds on the previous one, producing ever more powerful inventions…..Overall, the movement is from very simple tools to very complex machines [Harris 1968, quoted in Pfaffenberger 1992: 494-495].

Pfaffenberger (1992) points out five assumptions inherent in this processual approach to technological analysis: 1) the statement is gendered and is focused towards males, 2) that necessity is required for invention, 3) the form of the object follows the perceived function, 4) that the "meaning" or the *why* behind artifacts is a matter of surface 'style,' and 5) technological development is unilinear, always progressing from simple to complex. In addition to this, the wide-spread, large-scale types, were still assumed to be produced through diffusion and migration processes as well as being evidence of regional cultural environmental adaptation (Arnold 1985: 13-14; Dunnell 1978: 192; Funk 1993: 27-29).

Another example of the confusion caused by the Standard View of Technology is the traditional view of shift from the Archaic to Woodland periods. Cultural groups moved away from mobile lifestyles, becoming more sedentary in the Woodland period; they also shifted from being predominately hunters and gatherers to being fully agricultural. Key to the argument that a unilineal shift from the Archaic to Woodland (aceramic to ceramic) periods included a behavioral shift in both mobility and subsistence patterns is the pre-20th century assumptions that agriculture is advantageous to foraging and mobility is undesirable for all human groups. Archaeologists did not begin to break these assumptions apart until after the start of the decline of Processual archaeology (Bender 1975: 5-13; Kelly 1992: 51-52; Scarre 2005: 186). For many archaeologists, such as Ritchie, agriculture and sedentism are on the concluding end of a one-way spectrum, a place where all cultures are eventually destined to reach (Eder 1984: 839). The need to produce a food surplus forces groups to adopt agriculture. "*Necessity is the mother of invention.*" This is why many archaeologists view sedentism and therefore technologies associated with sedentism and food storage, such as pottery, as "an important social and behavioral threshold" (Kelly 1992: 50). In truth, behaviors and cultural processes are not ubiquitous, "even when sedentary settlement systems develop, they do not necessarily involve all of a region's people," only particular groups of individuals will choose to participate (Ibid).

Dragoo (1976) was the first to begin to question the Archaic-Early Woodland Transition as envisioned by Ritchie and others of his time. More recently, archaeologists have conducted detailed examinations on New York's Point Peninsula to Owasco transition using Ritchie and MacNeish's key attributes as defining divisions between the two ceramic traditions (Gates St. Pierre 2001; Schulenberg 2002a, 2002b; Hart and Brumbach 2009). Gates St. Pierre conducted stylistic and technological attribute analysis on 400 vessels (n=462 rim sherds) from the Kipp Island site and 388 vessels (n=424 rim sherds) from Hunter's Home. The author found that all but five vessels in the sample contained mineral (as opposed to organic) inclusions. These aplastic inclusions varied considerably in type and content; no attempt was made to classify the different minerals. Gates St. Pierre also found that Point Peninsula vessels have evidence of coil manufacture about 40% of the time and Owasco vessels 20-25%. The interior of both Point Peninsula and Owasco vessels are always smoothed but there are differences in the decorative designs. In general, Point Peninsula vessels have a greater variety of surface treatments and designs while the Owasco vessels are more limited in their design types. He concludes that there is no obvious discontinuity between the two groups. "Despite the rather rapid disappearance of such attributes as dentate stamping or rocker stamping during the passage from Point Peninsula to Owasco ceramics, there seems to be a clear continuity in ceramic technology and style…" (Gates St. Pierre 2001: 49).

Though her primary goal was to directly AMS date encrusted material from ceramic vessels in order to examine subsistence changes between the two cultures; Schulenberg's research included analyzing the decorative and the construction techniques of 70 sherds from the Kipp Island site (n=70 sherds), 70 sherds from Hunter's Home, and 59 sherds from the Levanna site (2002a, 2002b). Schulenberg found that Point Peninsula ceramics show evidence of primary production by coiling 60% of the time and Owasco vessels 30%. Point Peninsula ceramics were also on average thicker (10.3 mm) than Owasco ceramics (9.3 mm). Using X-ray analysis Schulenberg found that the aplastic inclusions in Owasco vessels are actually larger than in Point Peninsula vessels (Ibid 2002: 86-87). Schulenberg concluded that the technological distinctions between the Point Peninsula and Owasco ceramics are blurry and significant overlap occurs between the different decorative techniques (2002: 88).

Hart and Brumbach (2009) examined more than 3,800 ceramic sherds from 18 different sites in the Finger Lake region in order to examine the insitu versus migration debate for the origin of the Iroquois. The authors used the theory that "pots are tools" and therefore reflect social learning and the structure of group populations (Ibid 2009: 367-368). The authors examined sherds for evidence of forming techniques (coil breaks), wall thickness, and surface decoration. They found that the change over from coiling to the paddle-and-anvil technique occurred very slowly, until coiling was eventually completely replaced. They also found a general trend towards wall width reduction, beginning around AD 1 and continuing through AD1600 (also see Hart 2001). The authors found that Point Peninsula and Owasco decorative styles have significant periods of overlap, however; ceramics began to appear more stylistically similar starting around AD 200 and continuing through AD 1600. The authors concluded:

> earlier in time the greater similarity in design and manufacturing techniques reflected the fact that there was little in the way of decoration on the pots—most being simply cord-marked on the interior and exterior surfaces, with much of the design variation reflecting the shape of the lips. This may reflect smaller populations, numbers of subpopulations, and or fewer occupations of the sites through time. The trend toward greater similarity of design and forming technique after ca. AD 500 reflects increasing sedentism, aggregation, and concomitant decreases in the relative number of potters/teachers [Hart and Brumbach 2009: 377].

According to Ritchie and Funk (1973), the Owasco culture (AD 900-1300) was heralded by the appearance of the so-called Owasco type ceramics (359). “Clearly the Owasco culture was the product of a rather numerous agricultural people, having a well-developed ceramic complex in which Woodland pipes and pottery attained their apogee” (Ritchie 1944: 52 qtd in Hart and Brumbach 2003: 740). The Owasco types were generally large, globular vessels with smoothed interiors with corded or fabric-impressed decorated exteriors that cover the upper portion of the vessel from the shoulder to the flaring rim (Ritchie and MacNeish 1949: 107). Small variations in the Owasco series include semi-to fully-globular vessel bases and the occasional appearance of punctate, corded, and checked-stamped decoration. Decorative elements included simple punctates, linear and oblique cord-wrapped-stick indentations, indented corded herringbone designs. Incised decoration appears at the end of the sequence, during the Castle Creek phase, and mimics all the earlier phase decorative patterns (Ibid: 107-116).

By obtaining AMS radiocarbon dates from soot attached to Owasco type vessels, the authors discovered that many Owasco vessels are actually older than Ritchie believed, dating well into the Middle Woodland period (AD 600-900) (Hart and Brumbach 2003: 744; Schulenberg 2002: 163). When tested, the other three Owasco traits (matrilocal long-house patterns, nucleated villages, and maize-bean-squash agriculture) also provided to be false. Evidence suggests that these three traits did not occur together until the *middle* of the Late Woodland period, no earlier than AD 1200 (Hart and Brumbach 2003: 746; Hart 2008).

CHAPTER FOUR:

The Concepts of Symbolic and Technological Style in Archaeology

"What kind of cultural meaning is embodied in technological artifacts?"

Bryan Pfaffenberger (1992: 492).

An important distinction needs to be drawn between the concept of technology and the approaches used by archaeologists to study variability in technological artifacts. The term technology refers to the variables related to raw materials, production, distribution, use, reuse, and discard of an artifact (Rice 1987: 310; Rye 1981: 2; Sinopoli 1991: 56). Technological approaches are not limited to ceramics; any object can undergo a technical analysis. The selection and description of the individual attributes is dependent on the project's parameters, the object under study, and the overall research design. Technological analyses focus on the elements of an artifact which archaeologists believe can provide information about an object's lifecycle; they are descriptive accounts of specific technological traits. A description of an object's technology explains *how* the artifact was constructed; it does not explain *why*.

Studies that utilize technical data provide one kind of approach to understanding past human behaviors (Rye 1981: 2-3). Like any approach in archaeology, technological studies are influenced and biased by larger theoretical paradigms in which they are situated. The theoretical paradigm in which the technological study takes place provides the explanation of the behavior behind *why* an artifact was constructed the way it was. The way artifacts are rationalized, the examined data, and the assumptions and biases of any project are also determined by its theoretical underpinnings (Hegmon 2000; Trigger 1987).

A basic premise behind all studies of technology is the idea that artifact variability encodes behavioral information regarding the object's production process. Which variables are examined and what each technological variant means is the subject of high-range theory (Raab and Goodyear 1984).

The Concepts of Social and Technological Style, and Technological Studies Today

Technological studies today have shifted away from processual theories and instead focus on identifying patterns of ceramic recipes, sometimes referred to as "technological style," or "technological choice," often through the use of "*chaîne opératoire*" (Dietler and Gosselain 1992, 2000; Gosselain and Smith 1995; Herbich 1989; 1993; Joyce and Lopiparo 2005: 369; Killick 2004; Lemonnier 1983, 1992; Leroi-Gourhan 1993; Lopiparo 2005; Nelson 1991; Sellet 1993; van der Leeuw 1993). Modern technological approaches assume that the construction technique, form, and function of every object is based on active decisions by potters as individuals are influenced by the environmental and social forces surrounding them (Dunnell 1978; Hegmon et al. 2000; Mills 1989; Sackett 1990; Schiffer and Skibo 1987). Technologies include the applied knowledge to build finished artifacts, the means of production and the finished product. Networks include the social, political, and environmental context in which those knowledge, tools, and artifacts developed. Similarities in technical styles suggests continuity in knowledge within the *chaîne opératoire* production.

Chaîne opératoire theory, translated as the "chain of technical operations" (Dobres and Hoffman 1994: 229), was created by Leroi-Gourhan (1964; 1965). *Chaîne opératoire* stresses the importance of understanding the individual steps leading up to the manufacture of artifacts because each step taken both shapes and is shaped by the social worldview of the creator. "Analysis of technology using *chaîne opératoire* is the best documented strategy to lay out such sequences of actions, carried out by knowledgeable agents acting within a received structure and through their actions restructuring it" (Joyce and Lipiparo 2005: 369). The *chaîne opératoire* theory maintains that human behaviors are "deeply embedded operational sequences. These sequences comprise the foundation of a society's technology and are reflected in all manner of material culture…" (Stark 1998: 5-6). Cultural or group practices provide the basis for the preferred methods of manufacture. Otherwise stated, that "socially acquired dispositions [exist] which limit in subtle fashion the perception of possibilities in decorative, formal, and technical choices" at every stage of the vessel manufacturing process (Dietler and Herbich 1993: 465).

To be clear, *technological style* is not the same as the concept of *style* as it is traditionally used in American archaeology prior to the 1980s. Over the decades, the term 'style' has had many connotations (for a detailed history on the use of the term style, see Conkey 1989). Studies of style are concerned with finding patterns between artifacts. The key difference between different interpretations of style is where the focus of investigation lies and the assumptions connected to the method of analysis. Prior to the New Archaeology, the archaeological record was filled with the descriptions of how specific groups of how "anthropormorphized" artifacts appeared similar or different from each other. The chief concern at the time, was to provide a chronological framework for these differences; but archaeologists were not interested in understanding why or how artifacts came to be (Conkey 1989: 8). Artifacts were viewed in isolation from all other aspects of human groups; there was no concern with peopling the past.

With the appearance of the New Archaeology, the concepts of style and formal variation were firmly enmeshed. When applied to Systems Theory, artifacts became byproducts of behavior systems; mere adaptive strategies used by humans to maximize their access to resources in the land. In this way, artifacts "functioned" as "codes" to be read by archaeologists (Conkey 1989: 9-10). Style became "inherent within the object" and worked a means of communicating an object's function to archaeologists (Conkey 1989: 10). Any potential symbolic or social information within the object was cast aside as being secondary in importance or created by happenstance and of little value to archaeologists because it couldn't be empirically proven. The processual studies which focused solely on the individual exterior vessel decoration or vessel morphology imagine style as a "means of communicating cultural identity" (Dietler and Herbich 1993: 461) and failed to see the full potential of information within a ceramic vessel.

The ethnographic work of Dietler and Herbich (1989, 1993) on Luo Kenyan pottery illustrates that it is the way that a vessel is created, not the surface decoration that conveys division between social groups. Style is an intentionally chosen, distinct form; "*style involves a choice* among various alternatives" (Hegmon 1992: 517-518, emphasis in original). In this way, style is a part of shared technology or learned behavior; a practice passed between generations in a learning network (Dietler and Herbich 1989: 156-157). Technology has "social significance," meaning that some technologies are "symbolically charged" and contain social identities (Lechtman 1977). Unlike Sackett (1982), Lechtman feels that technological style is active, rather than a product of subconscious practices (Lechtman 1977, 1979, 1993). "Technological styles are not merely tradition-bound choices arbitrarily selected from the range of all possible technical choices," active participation is involved (Dobres and Hoffman 1994: 218).

This study uses Dietler and Herbich's (1989, 1993) definition of ceramic *style* and Joyce and Lopiparo's (2005) definition of *scale*. Deitler and Herbich view style as a series of technical choices made during the *chaîne opératoire* production. This theory acknowledges that "socially acquired dispositions [exist] which limit in subtle fashion the perception of possibilities in decorative, formal, and technical choices" at every stage of the vessel manufacturing process (Dietler and Herbich 1993: 465). Similarly, Joyce and Lopiparo see "technical production, with reconstructable traces of individual action and statistically definable large-scale tendencies" as required to identify large-scale social structures and technological patterns from a linked series of individual or small-scale actions (2005: 369). Social information regarding *why* an object was created in a particular way is "embedded" within the vessel and can be identified using techniques that examine the technology that created the vessel, such as petrography (Braun 2012: 1).

Technological approaches assume that the construction technique, form, and function of every ceramic vessel is based on the active decisions by potters as individuals are influenced by the environmental and social forces surrounding them (Mills 1989; Dunnell 1978; Hegmon et al. 2000; Sackett 1990). Technologies include the applied knowledge to build finished artifacts, the means of production and the finished product. Networks include the social, political, and environmental context in which those knowledge, tools, and artifacts developed. The assumption behind technological studies is that measurable technofunctional attributes, including the type, frequency, and color of ceramic temper allows for a more detailed understanding of past peoples. In terms of ceramic vessel production, this includes the specific steps available to each potter and the range of perceived freedom of expression each potter has to creatively alter their specific style (Joyce and

Lopiparo 2005: 368). This knowledge is the ‘recipe’ for building a pot, the distinct fabric-signature that is passed between social groups and through generations; based on well-established social networks. Social practice and agency can be identified through the variation of finished artifacts (Pauketat 2001; 2004; 2009) and intention is seen in the act of temper selection. The choice of a particular rock or other tempering material over any number of available materials is an active decision. This choice may have techno-functional, symbolic, and/or aesthetic foundations; regardless, the act shows intention. The individual potter does not act in isolation or ignorance of concurrent technological learning networks that exist around them. The awareness and subsequent choice not to participate in other technologies creates and maintains variation. This means that individual potters in the Northeast were aware that there were other ways to temper their vessels besides crushing coarse-grained metamorphic and igneous rock, yet they chose to do so because of long-held social practices and symbolic beliefs.

Geo-Archaeological Methods and the Application of Technological Style

This study seeks to examine the theoretical methodologies of the current condition of ceramic analysis in New York State in order to show that there is a need for ceramic material to be re-examined and re-defined using modern social technological theory and methods. Method and theory are inexorably intertwined therefore; one cannot simply slap a new theory on old data. The ways in which data are collected is biased by archaeology’s “theoretically informed methodology” (Dobres and Robb 2005: 160). Detailed empirical and scientific analysis is necessary for archaeologists to identify specific aspects of agency and structuration in objects. Cultural materials are evidence of “continuity” and “repeated replication” of both individual and group-scale worldviews; they are “deep histories of repeated practices” and represent the “expression of the intentional actions of past agents working within the structures they inhabited” (Joyce and Lopiparo 2005: 368). *Chaîne opératoire* is a “notable middle range interpretive methodology” that can form an “interpretative bridge” between the high range agency and practice theories and the otherwise meaningless empirical data (Dobres and Robb 2005: 163; Raab and Goodyear 1984; Johnson 1999: 12-15).

This interdisciplinary study combines petrographic analysis of ceramic fabrics with a series of experimental geo-archaeology tests to categorize the technological patterns of early ceramic recipes. Identification of early ceramic recipes using *chaîne opératoire*, though necessary as a starting point for redefining early ceramic technology in New York State, isn’t the sole purpose of this manuscript. The ultimate goal of this dissertation is to seek to understand the social processes that helped shape early ceramic technology. “It is only through detailed empirical identification of technical attributes, sequences, and *chaîne opératoires* that a more comprehensive and anthropological understanding of prehistoric technology can emerge” (Dobres and Hoffman 1994: 214). In this study, the experimental geo-archaeology tests are microscalar middle range theory used to bridge the gap between the petrographic data obtained from the archaeological ceramics and agency theory (Dobres and Hoffman 1994: 213; Raab and Goodyear 1984; Joyce and Lopiparo 2005: 369).

Social practices and cultural meaning can be seen in technology (Dobres and Robb 2005; Dobres and Hoffman 1994; Hegmon 2003; Lechtman 1984; Trigger 1998). Lechtman’s (1977, 1993; and Letchtman and Steinberg 1979) concept of ‘technological style’ and ‘technology of essences’ allows for a more detailed understanding of past peoples than the limiting descriptive approaches of the early twentieth century. This study illustrates how the act of temper selection in early New York State vessels is a) intentional,

b) drawn from a number of known possible choices with nearly equal technofunctional properties, c) a continuation of a much older practice of thermally altered rock cooking, and d) contains symbolic information.

From the standpoint of available data, the geo-archaeological methods used by this study require only small-sized (about the size of an American quarter) pottery sherds to conduct a complete petrographic analysis. For the purposes of descriptive analysis, these small sherd fragments are considered to have limited usefulness. Traditional descriptive ceramic methodology requires relatively large rim, base, and body sherds for the purpose of recording the appearance of a vessel's surface treatment, morphology, and decoration. When key traits are missing from a ceramic vessel, either because the vessel remained undecorated or the sherds did not survive, pottery sherds cannot be placed into Ritchie and MacNeish's (1949) typology and a more detailed social analysis cannot proceed. This is problematic with early pottery because these sherds are relatively rare, friable and poorly preserved. Also, many vessels lack decorative treatments below the rim or entirely. Preservation in the Northeastern Woodlands favors thick (and frequently undecorated) body sherds, not fragile rims. This form of methodology leads to incomplete, biased, unsystematic, and difficult to obtain data. Descriptive analysis is beneficial for describing the morphology and exterior appearance of vessels but it should not be used to provide chronological placement or cultural identity to either sites or even individual pots. The data obtainable from what is inside the pot, e.g a vessel's technological style and essence, is far more valuable for understanding social processes. Petrography is required to identify temper, delineate a sherd into fabric subcategories, and to discuss a vessel's technological attributes.

Ceramic Petrography

Ceramic petrography is “the study and classification of pottery using the characteristics of the clay body from which the pottery is made” and provides information about the vessel manufacturing process (Orton and Hughes 2013: 71). Petrography is a technique adopted from petrology and mineralogy; it provides basic technological information and creates a starting point for artifact analysis. Information gained by the petrographic method is designed to be built upon (Kempe and Harvey 1983: 30). In the field of mineralogy, the technique provided better “identification of minerals, the analysis and interpretation of rock texture, the estimation of mineral abundances of minerals within rocks, and the determination of the order of crystallization of minerals” (Young 2003: 143). The adoption of the thin-section technique in archaeology allowed for the better identification and classification of the different types of artifact technologies, the establishment of relative chronologies, the examination of the origin of materials (based on the ability to identify and analyze rock textures within the ceramic matrix), and the indication of exchange mechanisms (Bishop and Lange 1991: 3; Shepard 1965). Petrography also provided a more scientific way for technical aspects of ceramic materials to be compared within and between cultural regions. Most importantly, petrography allows the “petrologist [to] describe in detail the fabric of the pottery, thus enabling the archaeologist to recognize in hand specimen characteristic inclusions for future identification of similar fabrics” (Williams 1983: 301). An accurate and reproducible method for identifying and defining basic technological attributes is a necessary “first step toward reconstructing the cultural behavior involved in ceramic production and distribution” (Bishop and Lange 1991: 1). In short, petrographic methods provide basic information on the material under study and provides a starting point for artifact analysis.

The advantage of petrography is that it provides a detailed, more objective description of the object being studied, and therefore a more precise classification (Young 2003: 143). "To the ceramic petrologist, a sherd of pottery can be regarded as a metamorphosed sedimentary rock, for the fabric of a sherd consists principally of clastic grains held in a clay matrix, both partially altered during firing" (Williams 1983: 302). One of the downfalls of petrography is that the mineral composition of the clay matrix is not visible with a petrographic microscope. Ceramic petrologists must rely on the type and relative percentage of inclusions within the matrix in order to classify ceramic pastes. Thermal or chemical analyses are required to analysis individual constitutes within the clay matrix (Rice 1987: 386-389).

Microscopic analysis of ceramic fabrics can provide significant technological information that cannot be easily discerned, if at all, through macroscopic analyses. The adoption of the petrographic method has lagged in the Northeast, despite the early introduction of the technique into Southwestern archaeology by Anna O. Shepard and her colleagues (Thompson 1991: 11). The technologic information obtained through the petrographic point counting method provides a descriptive account of how a vessel was constructed. This basic data can be used in conjunction with most any theoretical paradigm to provide explanation for why variation and change occurs in technology. Topics of interest for technological studies often include building relative chronologies for the purposes of establishing the origin and exchange of materials between social groups (Kempe and Harvey 1983; Matson 1935, 1936, 1937, 1939; Shepard 1936, 1942) or for looking at artifacts as optimally designed systems that function for specific tasks (Bleed 1986; Binford 1977, 1979; Konz 1979; Ostrofsky 1977; Schiffer and Skibo 1989, 1997; Schiffer et al. 1994, 2001).

The History of Petrography

Surprisingly, petrography has its antecedents in the field of paleontology, not Geology. The first microscope was designed during the 17th century by Robert Hooke (1635-1703). Hooke was interested in examining the structure of petrified wood (Young, 2003: 144). Hooke's research was years ahead of his time; it was decades before geologists would become interested in his technique. In 1668, while on an Icelandic expedition, Erasmus Bartholin (1625-1698) discovered Icelandic spar, which is a nearly translucent calcite. Bartholin discovered that when two pieces of calcite where stacked upon each other the mineral would give off a double refraction light. He called these two rays of lights 'ordinary' and 'extraordinary'. Essentially, the calcite became polarized when stacked and the color of the light moving through the mineral changed (Young 2003: 144).

The true value of Bartholin's discovery was not appreciated until 1814, when Jean-Baptiste Biot (1774-1862) put reason and name to the ordinary and extraordinary lights, i.e. he discovered the value of the index of refraction. The index of refraction is "the ratio of the velocity of light in a vacuum to the velocity of light in a mineral, [which is] associated with the "ordinary ray" is less than the value of the index of refraction associated with the "extraordinary ray" in minerals" with the exception of calcite (Young 2003: 144).

After Biot's publication, the development of petrology was set at a rapid pace. In 1816, Sir David Brewster (1781-1868) established which minerals where uniaxial and which were biaxial. He also created some of the first thin sections, made from crushed minerals. Brewster's work created the foundation of optical mineralogy (Young 2003: 145). In 1828, William Nicol (1768-1868) designed the first prism out of cut and polished Iceland Spur. Today this is known as the "Nicols prism" and produces plain-polarized light (Young 2003: 145). To summarize, Nicols used the discovery of Bartholin's two-rays of light created by stacked pieces of translucent Iceland Spur, which was redefined by Biot as the index of refraction, to create an artificial prism that could be set into microscopes for optical analysis of minerals. Nicols is also credited with the creation of the first method for producing petrographic rock thin-sections (Young 2003: 147).

The field of thin-section petrography in mineralogy and petrology flourished under the Germans by the 1860s. The Germans were the first to actively use polarized light to analyze geologic samples. Leaders of the field included Ferdinand Zirkel (1838-1912) and Henry Rosenbusch (1836-1914) (Young 2003: 151). Zirkel wrote the first published optical text in 1873 and Zirkel and Rosenbusch worked together to teach petrography to students of geology from Europe and America. Petrography became popular in America during the 1870s-1890s, with formal petrography programs established at the leading universities by 1892. The petrographic method was also adopted by the United States Geological Survey in the late 19th century (Young 2003: 163).

The Adoption of Petrography into Archaeology

Like the discipline of Mineralogy, the adoption of the polarized-light microscope and thin-section technique in archaeology revitalized the field by providing improved technical information. In mineralogy, the technique provided better "identification of minerals, the analysis and interpretation of rock texture, the estimation of mineral abundances of minerals within rocks, and the determination of the order of crystallization of minerals" (Young 2003: 143). Today, with the exception of the Northeast, petrographic analysis of ceramic material is a routine aspect of post-excavation analysis. The adoption of the thin-section technique allowed archaeologists to establish relative chronologies, establish the origin of materials, indicate exchange mechanisms, and compare the technical aspects of ceramic materials. Most importantly, petrography allows the "petrologist [to] describe in detail the fabric of the pottery, thus enabling the archaeologist to recognize in hand specimen characteristic inclusions for future identification of similar fabrics" (Williams 1983: 301) "and determining objective parameters to measure these properties is a first step toward reconstructing the cultural behavior involved in ceramic production and distribution" (Bishop and Lange 1991: 1). "To the ceramic petrologist, a sherd of pottery can be regarded as a metamorphosed sedimentary rock, for the fabric of a sherd consists principally of clastic grains held in a clay matrix, both partially altered during firing" (Williams 1983: 302). However, this was not always the case; the adoption of the petrographic method in archaeology was slow and lagged decades behind geology and paleontology.

The earliest known application of ceramic petrography occurred in Belgium in the 1880s. Wilheim Prinz looked at a large collection of pottery from the New World however, little interest in ceramic petrography developed from his work (Thompson 1991: 17). The three individuals primarily responsible for the adoption of the petrographic thin-section method into ceramic analysis are Anna O. Shepard, Wayne Felts, and Frederick Matson in the 1930-1940s (Thompson 1991: 11, Quinn 2013: 10). Shepard's work focused in Mesoamerica and the American Southwest; Felts worked in ceramic material recovered from the city of Troy in Turkey, and Matson worked in various areas of the ancient Near East.

Shepard is credited with changing the interpretation of the archaeological site of Pecos, which was excavated by Alfred Vincent Kidder (1885-1963) (Shepard 1936). Kidder had postulated that all the pottery at the Pecos site was produced on site because of its general similar decorative style. Through the examination of the technical aspects of the Pecos pottery, Shepard determined that most of the pottery from the site was actually produced elsewhere and then traded into the site. Shepard's legacy in archaeology is greater than the pottery at Pecos. Shepard strongly believed in the interdisciplinary cooperation of researchers to analyze archaeological materials. Shepard set high standards for the field of archaeology; she "wanted to see the integration of ceramic technological data within a broader archaeological framework" (Bishop and Lange 1991: 3).

Ceramic petrography became more common with the development of the interdisciplinary field of Geoarchaeology in the 1970s (Kempe and Harvey 1983: xiii) and the American Processual Archaeology paradigm (Quinn 2013: 12). The first full volume in geoarchaeology was published in 1983. *The Petrology of Archaeological Artefacts* was an edited text that focused on the diverse application of petrology to archaeological artifacts. By the 1980s, ceramic thin section analysis was routine for many academic-based archaeological investigations in the American Southwest, Europe, and the Mediterranean.

The advantage of petrography is that it provides a detailed, more objective description of the object being studied, and therefore a more precise classification than many other approaches (Young 2003: 143). "The true value of petrography lies in its ability to investigate both the provenance and technology of ancient ceramics" (Quinn 2013: 9). One of the downfalls of petrography is that the mineral composition of the clay matrix is not visible with a petrographic microscope (Williams 1983: 303). Ceramic petrologists must rely on the type and relative percentage of temper inclusions within the matrix in order to classify ceramic pastes. Geo-chemical tests, such as instrumental neutron activation analysis (INAA) and X-ray fluorescence (XRF), are required to analyze individual constitutes within the clay matrix (Rice 1987, Quinn 2013: 1).

CHAPTER FIVE:

Methodology

"Cultural practices involved in resource procurement, paste preparation, vessel forming, decoration, vessel firing, and use of the finished product affect measurable properties of archaeological ceramics"

R. Bishop and F. Lange (1991:1).

As discussed in Chapter 2, this study is interested in examining the relationship of Vinette 1 pottery to steatite stone bowl technology using the concept of technological style. The theories of social and technology style were discussed in Chapter 4. To date, Vinette 1 pottery has been investigated and described using a typological method only; the biases and shortcomings of the culture-historical approach were observed in Chapter 3. Before a reanalysis of early pottery can begin, the key attributes used by Ritchie and MacNeish (1949) to define Vinette 1 and their associated assumptions, must be examined. For this reason, the methodology of this project was designed to probe the three main technological traits used by Ritchie and MacNeish (1949) to distinguish the Vinette pottery series from later ceramic sequences: temper, forming technique, and firing conditions. The methodology was also set up to examine two important characteristics of Vinette 1 pottery identified by Taché (2005). Firstly, that nearly all Vinette 1 vessels are tempered predominately by quartz, feldspar, and mica minerals, and secondly, that these vessels were exchanged between sites.

This chapter is divided into three sections. The first part will discuss the dataset, the second part will discuss the technical aspects of the sampling procedure and the point counting method used to describe each sample, and the final section will relay which aspects of early ceramic technologies were examined by this study. The final group of technological attributes studied are divided into two subgroups: inclusions and matrix appearance.

As discussed earlier, one of the main tasks of ceramic analysis is to determine which inclusions in the clay matrix are natural and which have been intentionally added by the potter. Temper identification is the topic of Chapter 6 and requires multiple lines of evidence in addition to the petrographic description of inclusions. The methodology for describing aplastic inclusions outlined in the final pages of this chapter are designed to quantify the data so that fabric patterns and ceramic recipes can be later identified.

Part I: Ritchie and MacNeish's Vinette Series

This study included 30 undecorated Vinette 1 vessels, three decorated Vinette 1 vessels, eight undecorated Vinette Dentate vessels, nine decorated Vinette Dentate vessels, two Vinette Complex Dentate vessels, one Vinette Variant vessel. The author considers cord-wrapped-stick impressions decoration and not surface treatment when it appears in zoned or banded areas below the rim on either the interior or exterior of the sherd. The author differentiates Vinette Dentate from Vinette 1 by the presence of interior wiping or smoothing marks in the place of fabric-impressions. Vinette Dentate vessels often also have more pointed rims that flare outwards, rather than rolled and flattened lips (Ritchie and MacNeish 1949:100). The exterior of Vinette Dentate can be either fabric-impressed, with or without smoothing is sometimes decorated with a dentate comb or dentate stamped decoration. Variations of Vinette Dentate were identified by the author and look exactly like Ritchie and MacNeish's traditional form of Vinette Dentate but have incised decoration in the place of dentate stamping or in addition to the dentate impressions. Exterior surfaces are often fabric-impressed and smoothed, interior surfaces show horizontal wiping impressions. The author chose to list these variations as Vinette Dentate, rather than Point Peninsula Plain because, according to Ritchie and MacNeish, Point Peninsula Plain vessels are smoothed on both sides, decorated with incised lines only on the rim, have outflaring rims, a laminated matrix with both sandy and grit temper less than 2 mm in size (1949:103). The single Vinette Variant (Riverhaven No. 2 Vessel #3) in the sample, had only one fabric-impressed surface, crush rock grit 2 mm in size or larger, and often lacked a laminated interior structure. These attributes make this vessel appear more like the Vinette series than the Point Peninsula series. This sherd could also fit Richie and Funk's definition of Vinette 2 (1973: 117).

Using the funds granted by the Funk Foundation and the Elfrieda Frank Foundation, the author was able to purchase 120 petrographic slides. These slides included 90 archaeological samples from 25 different archaeological sites and 30 geologic rock samples. The rock samples were created as part of a series of experimental tests run by the author to assist in separating probable temper from naturally ocuring aplastic inclusions within the clay matrix (see Chapter 6). Archaeological samples were taken from the following sites: Broken Clock, Blue Jay Ridge, Cottage, Egli, Felix, Ferguson, Gardepel, MacCauley Complex 4-8, Martin, McKendry, Mouth of Cattaraugus Creek, Nine Mile Road, Renaissance House, Riverhaven No. 2, Scaccia, Simmons, Sinking Ponds, St. Bonaventure, Vinette, Vine Valley, and Wickham. Figure 5.1 shows the general location of each site discussed throughout this project. In order to be selected for analysis, samples need to be a body sherd from the Vinette series that lacked encrustations, and had to measure larger than a 0.70 x 0.70 in (17.8 mm x 17.8 mm) in diameter. Diagnostic samples of Ritchie and MacNeish's (1949) Vinette Type were selected from each site, including Vinette 1, Vinette Dentate, Vinette Complex Dentate, and Vinette Variant (Vinette 2).

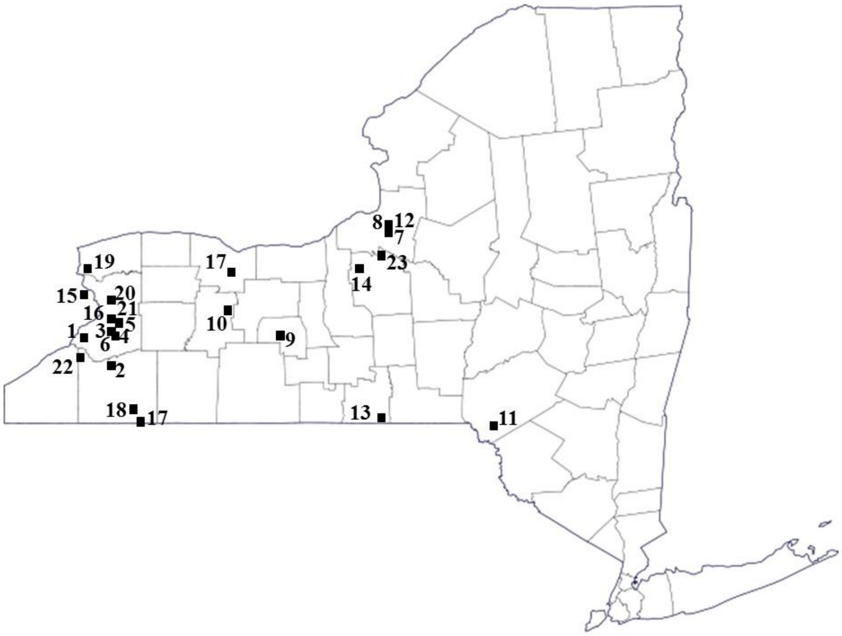


Figure 5.1 Location of sites mentioned in the text: 1. McKendry, 2. Zoar Valley, 3. Sinking Ponds Wildlife Sanctuary/the Sinking Ponds site, 4. Hunter's Creek County Park, 5. Como Lake County Park, 6. Chestnut Ridge County Park, 7. Vinette, 8. Wickham, 9. Vine Valley, 10. Scaccia, 11. Gardepel, 12. Ferguson, 13. Cottage, 14. Felix, 15. Riverhaven No. 2, 16. Broken Clock, 17. Macauley Complex, 18. Ninemile Road, 19. Saint Bonaventure, 20. Portage, 21. Renaissance House, 22. Mouth of Cattaraugus Creek, and 23. Simmons.

All samples underwent traditional typological and macro-attribute analysis. The results of the descriptive analysis are presented in Appendix A. Vessel attributes examined included rim and lip shape, type and placement of decoration, type and placement of surface treatment, presence or absence of encrustations, interior and exterior Munsell color and firing core color, length, width, and depth of each sherd and lip, and sherd weight. General macroscopic observations regarding the color and type of temper present were also made. Thick sections and sherds with fresh breaks where preferred for descriptive analysis over dirty or rough-edged sherds because the flat surface made it easier to examine the entire surface of clay matrix and its inclusions.

Since thin section production is a destructive process, the author chose to record both physical and stylistic attributes of each sherd. Each sample was also photographed prior to destruction. Vessel attributes examined included type, size, and placement of decoration and surface treatment, interior and exterior Munsell color and firing core color, length, width, and depth and weight of each sherd. The dimensions of each sample were always measured from the longest and widest point on the sherd. General macroscopic observations regarding the color and type of temper present were also made. Thick sections and high-resolution scans of each sample where preferred for descriptive analysis over dirty or rough-edged sherds because the flat, clean surface made it easier to examine the clay matrix and its inclusions (Photo 5.1). All samples sent to National Petrographic, Inc. where they were cut in blue oil and impregnated with epoxy. During thin section production, samples were cut perpendicular to the rim so that exterior surface treatments are visible at the top of the slide and the exterior surface profile is on the top of the image (Figure 5.2).

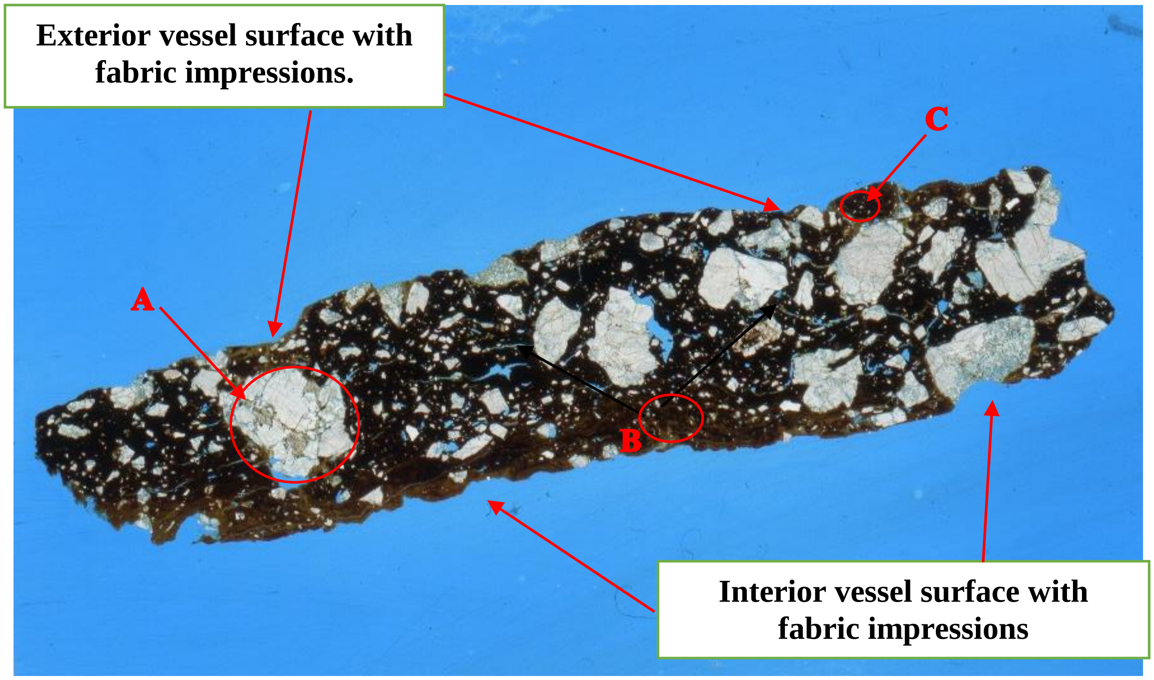


Figure 5.2. A high-resolution scan of Mac5V1B1 showing the orientation of the slide cut perpendicular to the rim and the different types of aplastic inclusions. The blue background is the remaining oil that the sherd was cut in. The exterior of the vessel is located at the top of the slide. The black arrows point to different surface treatments visible on the slide. Letter A is encircling a large, angular grit fragment. Letter B indicates an area of small, angular and rounded glacial flour. And Letter C is pointing out a fragment of grog. Image courtesy of the New York State Museum.

Photo 5.1. Image of a thick section take of Sinking Ponds V2B1. Note the two different types of temper present, isolated quartz and crushed rock fragments. Thick sections are useful for making general observations about each sample. Image taken with a DinoLite microscope, at 10x.

Part II: Sampling Procedure and the Technical Aspects of Point Counting

Microscope Magnification and Scale Calibration

Prior to any detailed analytical study, microscopes must be calibrated to scale. The scale is determined by the object under study. Silt-sized objects (2 μm-0.05 mm) require higher magnifications and smaller scales than larger objects. As this study was not interested in the silt-sized particles within the clay matrix, a 10x (100 zoom) reticule was selected with a scale of 40 ocular divisions. Reticules are scales built into the ocular eyepiece of a microscope; they are removable and interchangeable between microscopes of the same type. Reticules allow for the measurement of mounted objects. The microscope stage rotates 360 to allow any object within the slide to be measured.

In order to measure an object on a slide, one needs to simply count the number of ocular divisions spanned by the object of interest, then multiple it by the magnification being used. Since the reticule scale will change length depending on the magnification, a stage micrometer must be used to calibrate the reticule scale prior to any recorded measurements. A stage micrometer is a slide with a scale etched onto it. Like reticules, stage micrometers vary based on the needs of the analyzer. It is important that the analyst always record the length of the individual ocular divisions prior to the start of any project. The scale used by this project is one ocular division equals 0.14 mm (140µm or 0.0055 in) at 10x magnification. The reticule used by this project contained 25 ocular divisions, therefore the largest object that could be accurately measured with 10x magnification was 3.5 mm (0.14 in). All analysis was conducted at 10x using the above described scale.

Sample Control

Prior to petrographic analysis, a general overview was taken on each sample using high-resolution scans of the individual slides (Figure 5.2). The scans were taken on an Epson Perfection V600 Photo Scanner. Each individual sample was set into the photo slide flatbed holder and scanned at 2400 dpi. These high-resolution images were especially helpful in making the generalized summaries of each sample because they allowed for the examination of the entire sample at once. The author took note of each general inclusion type and frequency, the void type and frequency, the matrix color, matrix homogeneity (on a scale of poor to well-sorted) the matrix appeared, and the presence or absence of inclusion alignment. The author compared the high-resolution scans with standardized charts for estimating the relative percentage of inclusions (Barraclough 1992; Matthew et al. 1991; Power 1953; Stoops 2003). The extant and location of plucking was also noted. The final petrographic results were compared with the visual notes to check for discrepancies.

Lastly, in order to avoid erroneously dividing samples into different fabric groups that are part of the same vessel, the author selected four control vessels with at least two known sherds that could be individually sampled. The author definitively knew that these samples belonged to the same vessel because they could be mended back together without breaks or spaces in the surface of the sherds. The purpose of this step of the analysis was to see how much variation exists within a single vessel. The four vessels selected as a control included Blue Jay Ridge V1B1-V1B3, Broken Clock V2B1-V2B2, Broken Clock V4B1-V4B2, and MacCauley Complex No. 4 V2B1-V2B2. The fabric results of these four vessels are listed in Table 5.2. Differences between the lowest and highest percent of each category were calculated and their mean taken to determine the variation within a single vessel.

The results show that the greatest variation between samples of the same vessel stems from the identification of isolated, natural minerals (rock flour). The differences in the amount of rock flour identified within a single vessel varies from about 6% to greater than 17%. This variation is likely due to errors in the slide preparation process and count pointing method. The average distance between calculations is 3.4%. In two vessels, BCV4B1/B2 and Mac4V2B1/B2, several small-sized, isolated minerals were missed during point counting but were identifiable by general sample scans and through the high-resolution image scans. To summarize, different samples examined from the same vessel appear visually analogous and have closely-related point counting data.

Table 5.1. Summary of the Variation Between Samples from the Control Vessels

Sample #	*CR %*	*Largest CR Size (mm)*	*Grog %*	*Matrix %*	*Void %*	*Isol. Min. %*	*Rock Flour (1.645σ)*	*Minor Minerals*
BJRV1B1	33.2	4	0.3	15.7	8.7	24.8	65.7	Amphibole, biotite, chlorite, clinopyroxene, epidote, hornblende, orthopyroxene, opaque
BJRV1B2	30.1	5	0.0	19.4	6.8	26.2	60.3	Amphibole, biotite, chlorite, clinopyroxene, epidote, hornblende, orthopyroxene, opaque
BJRV1B3	30.5	5	0.0	18.5	8.0	26.5	77.5	Amphibole, biotite, chlorite, clinopyroxene, epidote, hornblende, orthopyroxene, opaque
Difference	**2.7**	**1**	**0.3**	**3.7**	**1.9**	**1.7**	**17.2**	**Same**
BCV2B1	27.2	4	0.0	31.9	10.6	29.4	66.0	Amphibole, biotite, chlorite, clinopyroxene, epidote, hornblende, orthopyroxene, opaque
BCV2B2	30.5	4	0.3	30.8	6.8	30.2	77.7	Amphibole, biotite, chlorite, clinopyroxene, epidote, hornblende, orthopyroxene, opaque
Difference	**3.3**	**0**	**0.3**	**1.1**	**3.8**	**0.8**	**11.7**	**Same**
BCV4B1	13.3	2.5	0.0	41.1	13.0	32.0	53.1	**Amphibole**, biotite, muscovite, sercite
BCV4B2	14.7	2.5	0.0	34.6	14.3	35.9	68.7	Biotite, calcite, clinopyroxene, flourite, muscovite
Difference	**1.4**	**0**	**0**	**6.5**	**1.3**	**3.9**	**15.6**	**One mineral missed**
Mac4V2B1	21.7	3	0.0	35.8	12.8	29.8	68.5	Augite, biotite, clinopyroxene, hornblende, olivine, opaque
Mac4V2B2	17.6	3	0.0	36.3	11.0	35.1	74.4	Augite, biotite, **clinopyroxene, hornblende, olivine,** sercite, opaque
Difference	**4.1**	**0**	**0**	**0.5**	**1.8**	**5.3**	**5.9**	**Three minerals missed**

Note. Minerals listed in bold were not identified during the point count but were seen through general sample screening and/or with the high-resolution scans.

The Petrographic Point Counting Method

There are two basic approaches to the petrographic examination of pottery fabrics: visual comparison and point counting. Visual comparison requires the analyst to estimate the frequency, shape, and size of inclusions and voids within a clay matrix through the use of a series of standardized comparison charts (Stoltman 1989: 148). Common reference charts include Barraclough's (1992) Scale for Pebble Sorting (Cited in Orton and Hughes 2013: 284 Figure A.6), Power's Scale of Roundness (Power's 1953), and Percentage inclusion estimation charts (Matthew et al. 1991). Point counting procedures often utilize the same standardized reference charts for petrographic analysis; however, visual comparison methods seek to determine whether or not a particular inclusion is present or absent within a sample, while point counting is a "systematic sampling procedure by which thin section constituents are estimated from a series of observations made at fixed intervals" (Stoltman 1989: 148). Point counting allows the analyst to describe and record a number of points on the slide without repetition. These points can later be statistically compared and contrasted for significance. The assumption behind the point counting method is that the procedure is less biased and therefore the data it produces is more accurate because it is based on a fixed grid (Orton and Hughes 2013: 163). Stoltman (1989) determined a 1 mm point counting interval in archaeology allows an analyst to collect between 200-300 points per slide, which is enough to adequately describe a ceramic fabric (148). Stoltman divides inclusion size by matrix/silt (0.0625mm or less), sand (fine, medium, coarse, very coarse, and gravel), and grit (fine, medium, coarse, very coarse, and gravel). Sand and grit are distinguished by their shape, rather than size (Figure 5.3).

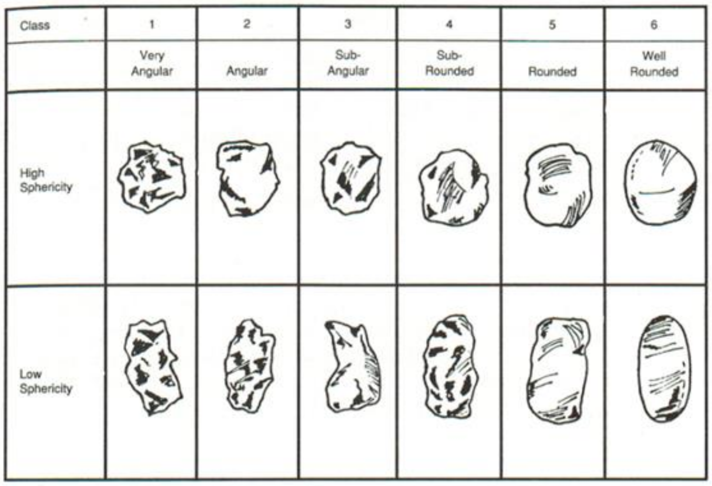


Figure 5.3. Powers' Scale of Roundness; a reference chart used for determining the level of angularity of inclusions (after Orton et al 1993: Appendix, Figure A.5). Note: sub-rounded to well-rounded inclusions were assumed to be natural, sand inclusions. Sub-angular to very angular shaped inclusions were assumed to be intentionally added grit.

Several issues with Stoltman's petrographic approach became apparent during the process of this research. Three concerns became immediately obvious: the size of the standard interval, how intentionally added versus natural inclusions are determined, and the plucking of inclusions in very coarse textured fabrics. Any individual familiar with subsurface interval testing in archaeology understands the problems inherent within the standardized grid system. Depositions of cultural material, including artifacts and features, do not always align with the standard 15 m grid. For example, the author once worked at a site where a 15 m grid system was used to investigate a field in western New York. The Phase I results indicated a scattering of lithic remains across a large area. During the Phase II, the testing interval was reduced around positive find spots and several dozen decorated pottery fragments were found in addition to more lithic remains. The plow zone was removed with heavy machinery during the Phase III investigations. The surface of the subsoil was hand-scraped and quickly illuminated that all of the subsurface testing conducted during the Phase I and II barely managed to completely miss a small-sized house structure, which was perfectly situated between the numerous shovel test pits.

The case of the almost-missed house is a perfect example of the problems associated with standardized interval testing; these same problems apply to petrographic analysis. All of the archaeological samples tested in this study contain poorly mixed fabrics. According to Barraclough (1992), fabrics are considered very poorly sorted when inclusions of different shapes and sizes occur mixed together (cited in Orton and Hughes 2013: 284, Figure A.6). A poorly sorted fabric has areas of densely clustered inclusions separated by areas containing few to zero inclusions. The problem with a 1 mm interval is that entire groups of inclusions may be missed, or reversely, counted more often than the empty spaces. While all samples within this study had a minimum of 200 total points taken, the number of points on angular aplastic inclusions varied considerably. The author questioned if this variation is possibly an inflated or deflated percentage of aplastic material due to the 1 mm counting interval, rather than being an actual cultural phenomenon. Figure 5.4, is a high-resolution scan of a ceramic sample from the Simmons site (Vessel 1, body sherd 3). This sample contains aplastic inclusions that range in size from 0.0625 mm to greater than 2.0 mm in diameter. In order to show how the choice of grid size affects which inclusions are counted and how many times they are counted, a 2.0mm (0.8 in) grid was placed over the right-hand side of the sample in Figure 5.4 and a 1.0 mm (0.4 in) grid over left side of the sample.

Secondly, the interval size of 1 mm is large enough that it is frequently not possible to obtain an accurate description of the type of rock present within the matrix beyond general family categories of “granitoid,” “sandstone” or “gneiss.” In order to accurate class a rock, geologists typically collect between 300-500 points per thin section sample (Conway Valley Systems 2016: Point Counting in Geology), because they use an interval smaller than 1 mm. One of the most useful attributes of the petrographic method is the understanding that ceramics can provide valuable clues about the source of the clay body or its constitutes, which in turn, may allow an archaeologist to determine whether the object is locally produced or is exotic (Orton and Hughes 2013: 163).

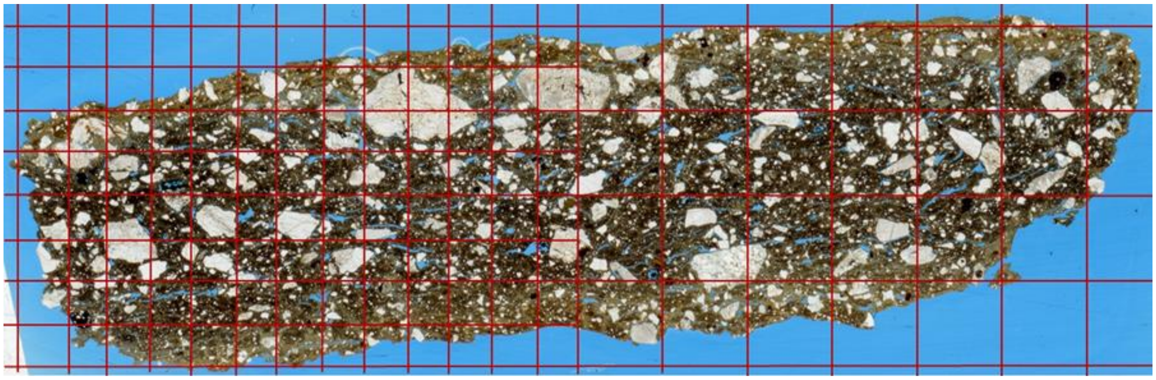


Figure 5.4. A high-resolution scan of Vessel 1, Body Sherd 3, from the Simmons site illustrating how the choice of grid size in point counting can drastically affect which inclusions are counted, as well as the number of times each inclusion is counted. The scale on the right side of the sample is set to 2.0 mm (0.8 in) and 1.0 mm (0.4 in) on the left. Note that a point is counted at every line intersection. Image courtesy of the New York State Museum.

The next issue identified by this study concerns how to identify naturally versus intentionally added materials in the clay body. When this study began, the author had adopted Stoltman's position that all rounded inclusions that occur in the clay matrix are naturally found in the clay and all angular inclusions were likely intentionally added by potters (1989:149). The author no longer maintains this position because she feels it is too simplistic to be completely accurate. Freestone notes that "the success of a project is…. determined by what may be termed the resolution of the petrographic technique, that is the degree to which the petrographies of the ceramics under study allow discrimination between production groups or potential raw material sources” (1995: 114). In this statement, Freestone is inferring that the success of a petrographic project is based on a series of variables, such as the geology and scale of the project area, the type/s of ceramic technology being examined (and the kinds of behaviors that created them), the ability of the petrographer to understand the geologic environment in which the minerals and rocks under question formed, and most importantly, that the petrographer is able to identify and separate natural background “noise” from cultural behavior (Freestone 1995: 114-115). Petrographers are trained to interpret the appearance of minerals (alteration, fracturing, and weathering) in order to determine the environment in which they formed. Stoltman’s method for describing minerals is good in that it includes a description of the type of inclusion, its roundness, and its size but it lacks information regarding whether or not the mineral has evidence of chemical or physical alteration or the presence of fractures and warping. When combined, these attributes may assist in providing a better understanding of the original clays used for ceramic production as well as the methods used to form them into vessels.

The final problem is not related to the point counting method itself and is instead related to the plucking of coarse aplastic inclusions during slide production. Thin sections are produced by vacuum-impregnating low-fired, sensitive sherds with epoxy glue, and then smoothing one edge with a series of abrasives in liquid. Oil is used in the place of water for sensitive materials because it helps to reduce friction (National Petrographic Services, Inc.). The epoxy glue and oil are used to ensure that any damage that occurs to the sherd during surface grinding is minimal. Despite these procedures, early pottery in New York State is extremely fragile and some degree of damage is notable in almost all samples within the study.

Amended Petrographic Methodology

This study adopted the basic point counting technique described by Stoltman (1989) with modifications to account for both the weaknesses within the method described above and to test the variation identified by Taché (2005). Adjustments to the methodology included 1) conducting visual comparison of each sample in addition to petrographic analysis through the use of high-resolution scan images, 2) testing the identified rock type by recounting a sample of sherds with low (less than 100) points on crushed rock inclusions, using a reduced standard interval of 0.25 mm, 3) identifying natural inclusions from intentionally added aplastic material by size, shape, and overall mineral appearance, 4) removal of sherds from the data pool with greater than 10% damage caused by plucking, and 5) testing for the amount of variation that exists within a single vessel by point counting two different body sherds known to be from the same vessel.

Part III: Examining Ritchie and MacNeish's (1949) and Taché's (2005) Type Traits

Matrix Classification: Homogeneity versus Heterogeneity

Almost all clays require some form of preparation before they can be used for vessel building. Some clays require more preparation than others. Clays are made workable by removing unwanted material, such as large inclusions and organic materials, and/or by adding (tempering) the clay with pliable materials that alter the original clay's plasticity (Orton and Hughes 2013: 125). Clays can be prepared for potting by the simplest technique of kneading by hand or they can undergo a series of complex processes (Druc 2016; Rice 1987: 72-75).

Most potters use secondary clays simply because they are more common than primary clays. Sedimentary clays often contain naturally diverse, finely stratified layers with proportionally high organic inclusions ranging between 5 and 10% (Rice 1987: 37; Quinn

2013: 42). Clay matrix heterogeneity can therefore be caused by poorly mixing a sedimentary clay during vessel production, thereby leaving an insufficiently homogenized clay matrix. Variegated clay matrixes can also be created by the combining two or more different clays together (Quinn 2013: 42-44). Very few clays naturally consist of only clay-sized particles; very small fragments of rock and isolated minerals are commonly occurring in the natural clay matrix (Orton and Hughes 2013: 76).

Matrix Classification: Macroscopic Grain-size Distribution

Textural analysis examines the distribution and size of inclusions and voids within the matrix (Orton and Hughes 2013: 164-166). Macroscopic textural analysis in this study was conducted using a metric ruler, high-resolution scans of thin sectioned samples, the physical slides, and standardized textural comparison charts (Barraclough 1992; Matthew et al. 1991; and Stoops 2003). The high-resolution scans were brought up on an 18" high-resolution computer monitor for examination. Visual comparison with the standardized inclusion and void charts were made with the high-resolution scans and observations were recorded into an Excel file. Textural aspects of each slide examined included the general type and frequency of voids and crushed rock inclusions. Estimates of inclusion sizes were taken with the physical slide laid on a white surface next to a metric ruler. The purpose of this step was to guestimate the size of the largest inclusions present and the frequency of overall inclusions within the sample. It is important to remember that the apparent inclusion rate of minerals in a clay matrix can be affected by the thickness of the thin section sample. Slight inconsistencies in the sample preparation can cause some of the smaller inclusions to be less visible, and therefore indistinguishable from the groundmass (Orton and Hughes 2013: 76).

Matrix Classification: Variability Caused by Natural Inclusions

Since this study is the first large-scale petrographic analysis of early ceramics in New York State it has been difficult for the author to determine what attributes of the fabrics are background "noise" and which are evidence of human behavior. As original research, this projects lacks a comparable dataset and the results of this research will likely have to be updated in the future. At this time, the author sees only one consistent trait that all samples in the project share and that is the presence of angular to rounded isolated minerals consisting of quartz, orthoclase feldspar, and opaques in the size class of 0.0625-0.25 mm. All fabrics in the study are made up of at least 10% of these isolated mineral fragments (Photo 5.2). In almost all cases, these minerals are stained red, suggesting the presence of iron through either oxidization, leaching, or heating (Thompson and Thompson 1996: 62; Perkins 1998: 120-122).

The work of geologist Robert LaFleur supports the author's hypothesis that these minerals are evidence of background minerals commonly found in glacial clay. LaFleur mapped and tested glacial soils throughout southern Erie county and the glaciated areas of Cattaraugus County for the US Geological Survey using X-ray diffraction. LaFleur's work included taking soil cores from known glacial deposits dating to the Lavery glacial advance; these deposits were laid down sometime shortly after 20,000 BP. LaFleur discovered that the aplastic minerals composing the glacial soils included quartz (24-33%), K-feldspars (0-3%), plagioclase Feldspar (5-10%), clacite (7-11%), dolomite (3-11%), and chlorite (0-12%). The highest densities of quartz and feldspars occur in the glacial lakebeds (LaFleur 1979: 12, Table 1). Interestingly, crushed rock fragments never occur smaller than 0.25 mm in any of the samples, supporting the theory that these fragments are intentionally added (Photo 5.3).

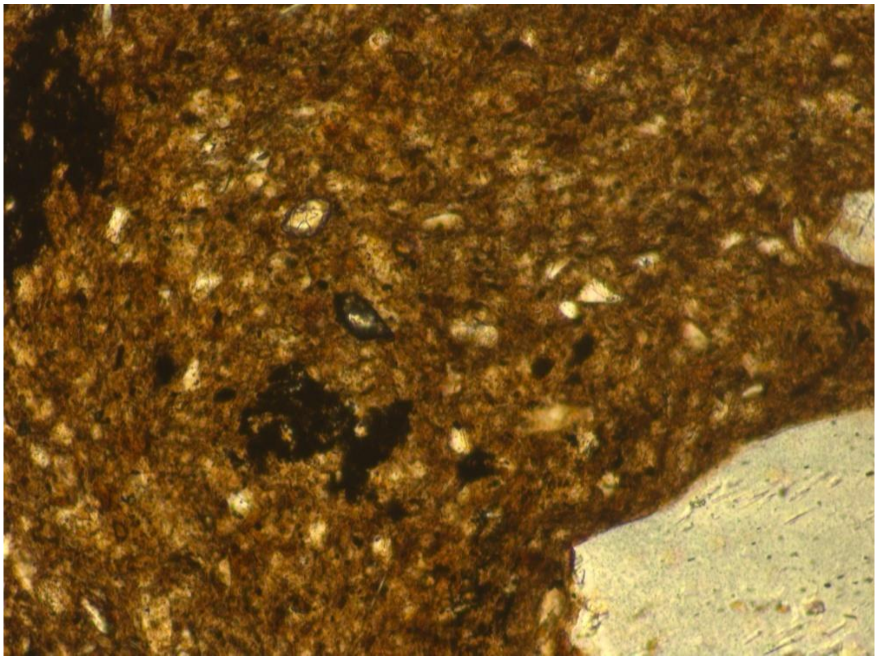


Photo 5.2. Image of the rounded and angular isolated mineral fragments (0.0625-0.25 mm in size) that are ubiquitous in every sample. Note the slightly blurred and reddened (oxidized) edges of each mineral, suggesting they undergone weathering. This sample is from McKendry V1B2, image taken at 100x in plain polarized light.

Photo 5.3. Low-power magnification of crushed rock inclusions from Portage Vessel 1, Body Sherd 1. Note that none of the crushed rock inclusions occur in sizes smaller than 0.25 mm in diameter and have angular to very angular edges. Image taken at 5x in plain polarized light.

Matrix Classification: Evidence of Manufacturing Technique and Void Analysis

Stoops provides a reference chart for analyzing voids (empty spaces) within ceramic fabrics (2003: 64-67). Stoops explains how raw materials and the steps in the ceramic forming and firing processes create different types of voids. Voids in this study that did not match any of Stoop's identified types were classed as "plucking voids." It is impossible to know exactly what was torn from the sample by plucking, therefore, samples with 10% or greater damage were removed from the data pool. A total of six archaeological samples were taken out of the final results of this study.

Manufacturing technique of ceramic vessels can sometimes be ascertained through petrographic analysis because forming techniques leave marks in the matrix (Druc 2016: 119; Thér 2016). In the Northeast, vessels are traditionally assumed to be formed by either the coiling or paddle-and-anvil modeling technique (Ritchie and MacNeish 1949). Coiling techniques cause inclusions to be oriented perpendicular to the direction of the coil (Rye 1981: 68; see Figure 5.5). Slides that are cut perpendicular to the vessel axis cut the coil vertically, which results in the perpendicular orientations through the core (Thér 2016: 230). Additionally, coiling produces hairline fissures in the fired matrix; and the fissures often have the same general alignment as the inclusions. These fissures can cause the vessel to fail along parallel planes (Rice 1987: 128). The paddle-and-anvil molding technique applies pressure to the clay surface with each strike of the paddle. This manufacturing technique creates spider-webbing or "star-shaped cracks around large mineral inclusions" (Rye 1981: 85).

The following terms were used to describe voids in order to determine the type of manufacturing processes used: packing voids, channels, chambers, vughes, and planes.

Simple and complex packing voids are essentially air bubbles formed by released gasses. Channels and chambers are caused by material being burnt out of the matrix. They have smooth walls and occasionally residual organic material is visible. Vughes and planes are irregularly shapes fissures, often caused by shrinkage during unequal drying and firing. Potters often combine multiple different types of manufacturing techniques during vessel production (Rice 1987: 124). Some secondary techniques, such as scraping, paddling, and wheel throwing, may obliterate evidence of primary techniques (Thér 2016: 228; Rice 1987: 127).

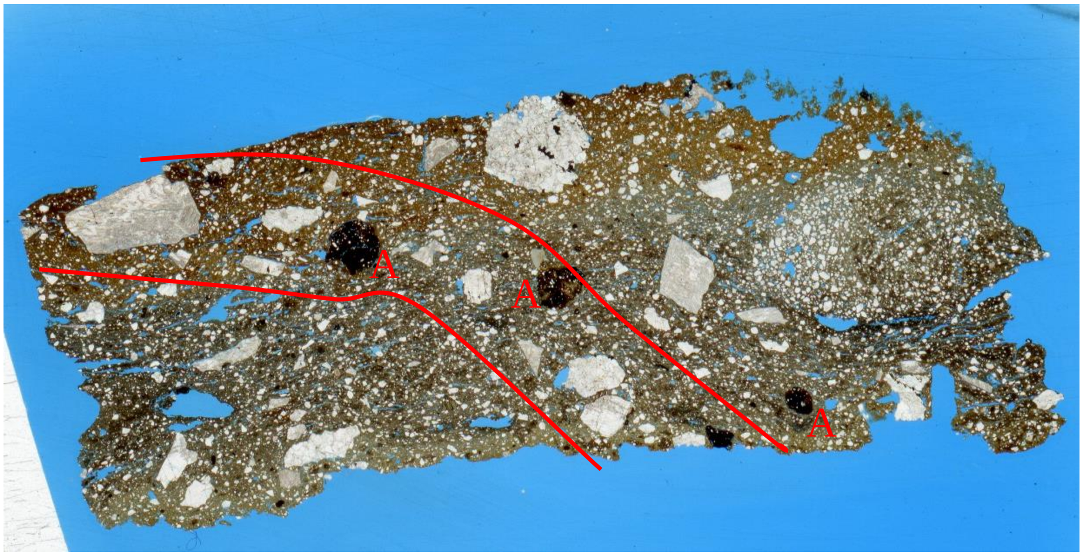


Figure 5.5. High-resolution scan of Vinette Vessel 3, Body Sherd 1 showing the alignment of a coil. The coil is located between the two red lines. The Letter A indicates a grog inclusion. Image courtesy of the New York State Museum.

Matrix Classification: Firing Atmosphere and Temperature

The firing temperature, duration, and atmosphere causes physical and chemical alterations in clays and their inclusions (Rice 1987: 80). All pre-Contact pottery in North America was fired openly, without kilns. Open firing creates uncontrolled variation in ceramic vessels because pots are not protected from the fire, drafts or spikes in temperature. Opening firings often have quick, but short-lived rises in temperature. Because of this, rapid and uneven temperature changes in a vessel can cause warping, fractures and shrinkage, and can lead to vessel failure (Rice 1987: 155-156). The duration of an open firing, also known as a ‘soaking period’ is usually very short because steady temperatures are difficult to maintain. In this situation, firing atmospheres are either oxidizing or reducing. In an oxidizing atmosphere, oxygen is abundant and free-flowing. In reducing environments, oxygen is restricted. In an open setting, the atmosphere can change several times during a single firing, which can have a major effect on a vessel’s final appearance (Orton and Hughes 2013: 153).

Open flame temperatures can vary significantly depending on the proximity of an object to a continuous flame. Recent research on Anasazi pottery from northern Arizona indicates Moapa Gray Ware pottery (an olivine-tempered fabric) appears to have been consistently fired in open flame settings between 950-1000°C (1742-1832°F) (Niespolo 2013). While the exact temperature needed to melt a rock is a product of a rock’s chemistry, material, and environmental pressure and presence of gases, all isolated minerals will melt above 1000°C (1832°F). High quartz contents means that granitic rocks are extremely resistant to weathering (Schumman 1993:202) but susceptible to melting at temperatures as low as 650°C (1202°F) (Perkins 1998: 114). Niespolo’s research provides evidence that Native Americans had the capability to heat rocks to temperatures sufficient to melt all mafic minerals plus amphibole, quartz, and all feldspar formations.

Indirect evidence of firing temperatures, duration, and atmosphere can also be found in a ceramic paste and its inclusions. It is important to understand how a vessel was fired because similarities in firing conditions for a collection of vessels suggests control and intentionality. Control over vessel production suggests that specific type of final product is envisioned by the potter, perhaps for a particular function (Orton and Hughes 2013: 152).

Physical and chemical alterations of a clay fabric and its inclusions begins with the drying process (Rice 1987: 86). Drying refers to the movement of water and organic material from the interior of the clay to the exterior surfaces. This process begins at very low temperatures (550-600°C) and continues throughout the entire firing process (Orton and Hughes 2013: 134). Water and organic material is transformed into carbon dioxide as it is heated, the gases then force their way to the surface of the vessel to escape. This causes weight loss and shrinkage in the clay matrix (Rice 1987: 86). Sedimentary clays contain large proportions of organic material, so when they are heated in an oxidizing atmosphere, they bubble and bloat as the carbon dioxide leaves the matrix (Orton and Hughes 2013: 152). In a reducing atmosphere, excess carbon becomes trapped in the interior of the vessel and turns the matrix black. In thicker sherds, this trapped carbon appears as a diffused or sharp firing core (Photo 5.4).

Above 900°C physical and chemical alterations in the mineral inclusions begin and the matrix starts to vitrify (Rice 1987: 86). Vitrification refers to the fusing of materials together into a nonporous, glassy surface. The lacking vitrification isn’t surprising since consistently high temperatures are required to melt quartz minerals and fuse them together in the matrix. Unlike vitrification, sintering of clay materials begins as low as 600°C (Quinn 2013: 190). Sintering refers to small pockets of materials that are beginning to stick together. Fused clay minerals are easiest to see around void edges.

Photo 5.4. High-resolution scan of Cottage Vessel 1, Body Sherd 1, showing a dark, carbon-rich, firing core in the center of the sherd. Note the elongated vertical voids that move between and around each of the larger crushed rock inclusions. Image courtesy of the New York State Museum.

Aplastic Inclusions: Point Counts

The total of point counts collected on crushed rock inclusions varied considerably between samples. The greatest number of points taken on crushed rock within a single sample was 142 (MK2594V6B2) and the lowest number totaled 21 points (Wickham V1B1). The average number of points collected on crushed rock in this study is 73.6 points per sample. A recount was conducted on the crushed rock inclusions only with a reduced counting interval of 0.25 mm on three different samples. The purpose of the recount was to determine how many points are needed to accurately identify the type of crushed rock present within the sample. Samples included in the recount: Scaccia V1B2, Blue Jay Ridge V1B1, and Mouth of Cattaraugus Creek V1B1. Scaccia and the vessel found at the mouth of Cattaraugus Creek were chosen since they represent one of the lowest and highest points taken on crushed rock in the study. Blue Jay Ridge V1B1 was selected since the original points collected equaled about 100.

For the recount, the largest fragment of crushed rock (CR) within each sample was recounted on a 0.25 mm grid. The count began on the furthest possible right edge of the inclusion and moved up and downwards 0.25 mm until the inclusion's leftmost edge was reached. The summary of original point counts (PC) and recounts on the three vessels tested, plus the crushed rock identification, are presented in Table 5.2.

Table 5.2. Summary of Original and Recounted Points on a Sample of Crushed Rock Inclusions from Three Sites

Sample	Original PC	Total Composition of Rock (%)	Original CR Designation	Total CR (%)	Recounted PC	Total Composition of Rock (%)	Final CR Designation
Scaccia V1B2	21	93.6	Syenite	15.2	153	86.3	Monzonite
BJR V1B1	99	82.8	Monzonite	33.2	207	73	Amphibolite
Mo. Cat Crk V1B1	125	87.2	Syenite	33.4	150	75.3	Granite

This study found that a minimum of 150 points, taken only on crushed rock inclusions, is necessary to accurately identify the type general category of each rock, more detailed analyses of the rock is not possible without significantly more point counts. The results of the point recounting test highlight several important facts. Firstly, the total percentage of crushed rock inclusions within a sample are dependent upon both the size of the actual inclusions and how much of the inclusions are present within the matrix. The 1 mm point counting grid is more likely to miss inclusions smaller than 1.0 mm and count inclusions larger than 1.0 mm multiple times. This is problematic when a single sample contains inclusions in a wide range of sizes. A reduced counting interval of 0.25 mm or less provides more detailed information on the condition of the minerals composing a single rock fragment. This is especially true of rocks that are composed of minerals less than 1 mm in size or rocks consisting of a combination of mineral sizes. Higher point counts reshuffle the frequency of the calculated overall mineral composition, which can change the identification of the rock.

The identification of the rock is important because rocks are classified firstly by the environment in which they form (igneous, sedimentary, or metamorphic) and secondly by the types and percentages of minerals that compose the rock. Rock-forming minerals are described as essential or primary when they dominate the overall mineral assemblage. For example, quartz, K-feldspar and plagioclase feldspar are the main ingredients in silicic igneous rocks. Silicic rocks are subdivided into types (granite, rhyolite, granodiorite, etc.) by each rock's relative percentage of plagioclase and K-feldspar. A mineral is titled accessory or secondary when present in rocks as a minor ingredient. The presence of accessory minerals usually does not affect the properties of the rock (Perkins 1998: 36). As explained in Chapter 1, minerals form under specific conditions and those conditions determine the physical properties of the mineral, including its resistance to weathering, fracturing, and melting. This is why it is important to be able to identify the key minerals which form the crushed rock temper.

Aplastic Inclusions: Sphericity, Angularity, and Evidence of Weathering

Weathering is a destructive process that affects the physical appearance and chemical composition of minerals and rocks. The purpose of this section of the analysis was twofold, firstly the degree of weathering and alteration of the minerals within a rock can tell the petrographer what kind of environment the rock was collected from; meaning whether or not the rock was freshly removed from a bedrock source or collected as an eroded fragment. Secondly, this step of the analysis helps to determine the degree of metamorphism the rock has undergone, and in theory, it's origin.

Exposed surfaces of rocks and minerals undergo physical alteration. Weathering can cause jagged fractures to appear or it can cause a rock to become smoothed and polished. Unlike mechanical weathering, weathering through either long-term exposure or submersion of rocks into water causes angular edges to become smoothed, rounded, and polished. Additionally, weathering of any type can cause minerals to appear drab and their boundaries obscured or removed altogether, making identification of the rock type without a microscope extremely difficult. While petrographic analysis is extremely useful for examining weathering and alteration in minerals, chemical analysis may provide stronger evidence of whether or not a rock recently cut from an outcrop or eroded from it (see Owen et al. 2016).

Certain types of rocks are more susceptible to weathering and alteration due to their chemical composition. For example, when granitic rocks undergo hydrothermal alteration, two minerals commonly change; biotite alters to chlorite, and potassic feldspar to sercite and kaolinite (Blatt and Tracy 1996: 45). These mineral alterations occur because the rock was exposed for long periods of time to hot fluids. The fluid composition and resultant alterations are dependent upon the heat source, the surrounding rock, and the type of rock affected. Additionally, new minerals, termed secondary minerals, can form as a product of some weathering environments. For example, biotite and muscovite micas are common byproducts of chemical weathering of rocks into clay (Rice 1987: 36). Finally, minerals are altered throughout the steps of a vessel's firing production and even thin section sample production. In order to attempt to separate metamorphic alteration from weathering caused by long-term exposure to air, wind, water, and ice, the author noted the type and amount of alteration present on each point count collected on every piece of crushed rock analyzed in the study.

CHAPTER SIX:

Identifying Temper in Early Ceramic Recipes

"Defining temper is more than a semantic quibble, because the deliberate combining of raw materials into a pottery paste has significant stylistic, technological, and functional implications for the pottery-making process and for the uses of the products."

Prudence Rice (1987: 409).

The Definition and Importance of Temper in Ceramic Analysis

The term 'temper' has several connotations in ceramic analysis. According to Rice (1987), temper is both a "noun and a verb," which causes disagreement amongst analysts of how it should be analyzed (406). Temper is any substance that modifies the properties of a clay body. Temper affects the workability of wet clay, as well as the strength, durability, and porosity of finished products. It is because of the affects that temper has on clay that archaeologists seek to identify, describe, and measure it in painful detail. The definition of temper "implies intentionality," suggesting potters selected materials specifically to alter the properties of their clay (Rice 1987: 408). Therefore, the term 'temper' "should be restricted to inclusions that were intentionally added by the potter" (Quinn 2013: 156).

Problematically, clays contain many natural inclusions that can act as a temper. Ceramicists are left to determine whether or not the temper is naturally or culturally occurring and how much temper is enough to significantly alter the properties of the clay body. The combination of two or more raw materials, such as glacial marine clay plus crushed rock temper, equals a 'recipe' that "allows for the control of certain technofunctional features" (Quinn 2013: 156). Recipes are formatted for many different reasons, not all of which may be comprehensible to archaeologists.

Before ceramic recipes can be identified, inclusions that occur naturally in any clay source must be separated from those that are intentionally added. However, this can be extremely difficult to determine (Orton and Hughes 2013: 123; Rice 1987: 409; Quinn 2013: 156-168). Archaeologists frequently use the following to assist them in their determination: temper type, shape, size, and frequency. It is important to compare the type of inclusions present with the environment from which the clay was collected before final determinations of whether or not the inclusions are intentionally added. For example, mica is a common alteration product of secondary clays (Perkins 1998: 121) and is therefore likely to be naturally occurring, while grog, bone, shell, plant material, dung, volcanic ash, and sometimes rock fragments are considered to be intentional (Rice 1987: 409; Quinn 2013: 156). An archaeologist should use several lines of evidence to support the identification of temper (Quinn 2013: 168). The evidence used to identify temper from naturally occurring materials in early ceramic vessels include:

1. The type of rock present in the matrix and it relative natural distribution,
2. Comparison of the type of crushed rock identified with the type of glacial flour present in the matrix, and
3. The presence of natural weathering/decomposition, oxidization, metamorphic versus heat alteration, fracturing, and overall physical appearance of the minerals of the rock and isolated minerals within the matrix.

Once temper is identified, the next steps are to examine the variation in temper types and to attempt to understand why a particular material was added to a recipe. Archaeologists assume that temper can have spatial, temporal, social, symbolic, and technofunctional significances, which is why it is often used to create regional ceramic chronologies and to outline social interactions and exchanges. Temper choice "is assumed to represent a consistent or normative pattern, and thus the regular covariation of particular tempering agents with particular vessel forms or styles is seen as culture specific" (Rice 1987: 409).

The Classification of Clays

Clay is defined as materials less than 0.002 mm (2 μm) in diameter. Clays form from the chemical and physical weathering of rocks (Orton and Hughes 2013: 122); which is why it is important to have an expansive understanding the formation and composition of rocks. Clays are a product of rock weathering and are therefore, their makeup is related to the relative resistance of rock-building minerals to disintegration and alteration (Rice 1987: 34; see Figure 2.2: The Rock Cycle). Rocks are broken down through mechanical, chemical, and biochemical processes. Silica rocks are much less resistant to decomposition than rocks with low alumina (Al_2O_3) contents, therefore feldspar-rich rocks alter faster to clays than quartz-rich rocks (Rice 1987: 34). All rock-forming minerals, except quartz and olivine, disintegrate into clay particles (Rice 1987: 35).

Clays are broadly divided into two groups, primary and secondary (also known as sedimentary) clays. Technically, all clays are sedimentary in nature because they form from the decomposition of older rocks. The small size and fine-texture allows all types of clay to become plastic or malleable when wet (Rice 1987: 36). The key difference between primary and secondary clays is that primary clays reside in the same location as their parent bedrock. In other words, primary clays develop insitu while secondary clays are transported and redeposited. Primary clays contain up to 90% of "coarse, unaltered fragments of the parent material" (Rice 1987: 37).

Sedimentary clays are more abundant than primary clays because they are transported by wind, waves, tides, streams, glaciers, erosion, and many other processes. Secondary clays can be subdivided into groups based on their method of transportation: aeolian, fluvatile, glacial, lacustrine, and marine. Due to their nature of deposition, sedimentary clays are often finer textured and more homogenous than primary clays, and they contain higher rates of organic material, 5-10% (Rice 1987: 37). Glacial clays are an exception to this rule. Sediments that are transported by glacial processes are generally unsorted, coarse, and high in impurities. Varves or alternating bands of light and dark sediments, are common in glacial lake clays. The bands are seasonal depositions. Darker, higher organic and finer-particles, are laid down during colder periods, when the glacial meltwater slows or stops completely. Lighter bands contain larger inclusions and fewer organics because they are deposited during warmer weather when the water rushes into the lakes (Pretola 2000: 64-65).

Definitions of Aplastic and Plastic Inclusions

Fabric inclusions frequently provide the best means of distinguishing between different groups of ceramics (Orton and Hughes 2013: 158). Inclusions may be naturally derived or intentionally added during the manufacturing process. All of the samples in this study contain isolated mineral grains in addition to the crushed rock temper. Aplastic, meaning non-organic inclusions, survive the manufacturing process better than plastic inclusions because organic materials burn out at significantly lower temperatures than required for aplastic inclusions to melt. For this reason, an important aspect of fabric analysis is the examination of voids (empty spaces) within the matrix. There are several ways voids in ceramic bodies are created: they can be naturally present in the clay as a byproduct of clay formation, they can form during the firing process when gases are released from the clay, and finally by the burning off of carbonate material (Quinn 2013: 61-65).

Line of Evidence No. 1: Natural Distribution of Coarse-Crystalline Rock

The experimental geo-archaeology aspect of this project began as a pilot study in 2012 and was an attempt to identify temper in early ceramic vessels in New York State (Mitchell 2014). The results of the pilot study indicated that early ceramic tempers were composed primarily of crushed coarse-crystalline rock, which led the author to wonder why these particular rocks were selected over other materials and how they might have been processed into temper.

Additional experimental geo-archaeology tests were performed to answer the following questions: what is the relative distribution of metamorphic and igneous rocks available to ancient potters and to what extent were these materials utilized? The hypothesis of these tests is, coarse-crystalline rocks are intentionally selected by potters because they provide desirable affects as temper. The null hypothesis is that the type of rock selected as temper is not important and therefore individual potters will collect readily available materials that require little effort to process into temper.

The results of these tests show that cobble-sized, coarse-grained metamorphic and igneous rocks make up 17% or less of the glacial distribution and were therefore likely intentionally selected. Additionally, the highest frequencies of coarse-crystalline rock are found in and around glacially-formed landscape features and occur as very dense, water-worn pebbles, cobbles, and boulders. The easiest way to break these materials into gravel-sized fragments is to heat them in a fire between 600-800°C long enough to weaken the bonds holding the individual minerals together. The time needed to accomplish this is dependent on the type and size of the rock in question. The weakened bonds can then be easily destroyed (i.e. the rock crushed) with a hammerstone cobble in a few simple strikes. The null hypothesis that Native American potters randomly selected rocks for vessel production, was rejected.

In order to determine the relative distribution of nonlocal igneous and metamorphic rocks, a geologic pilot study was performed at five different types of glacial deposits across western New York in October 2013 (Figure 5.1). In an effort to avoid areas of modern disturbance, natural environment preserves and parks located within or nearby glacial formations were selected for analysis. A total of five deposit areas were examined: Zoar Valley, Sinking Ponds Wildlife Sanctuary, Como Lake County Park, Hunter's Creek County Park, and Chestnut Ridge County Park. Permission was obtained from each organization prior to the start of research. One hundred cobbles were collected from each site. The study targeted exposed ridge surfaces, slopes, and creek beds where loose, cobble-sized surface rocks could be found (Photo 6.1). A total of 500 rock samples were analyzed. For consistency, cobbles picked up from the ground were between 60-100 mm (2.3-3.9 in) in diameter. To reduce the amount of bias towards a particular rock color or shape, a large Hula Hoop, measuring 1.067 m (42 in) in diameter was used to collect rock samples (Photo 6.2). The hoop was tossed to the ground several feet in front of the author and all rocks within the hoop between 60-100 mm were collected. With the assistance of Geologist, Dr. Mark Noll, the author identified the collected rocks using macroscopic inspection. A summary of the results of rocks types recovered from each geologic formation is presented in Table 6.1.

Two biases are inherent in the glacial distribution study conducted by this study. First is the size of the rocks analyzed. The relative distribution of non-local igneous and metamorphic rock is likely to slightly change when all size categories (from grit to erratic) are considered. Secondly, it is unclear how digging below the ground surface for rocks might affect the available distribution.

Table 6.1. Summary of Rock Distribution Analysis by Glacial Feature

Collection Site	**Glacial Feature**	**Total Sedimentary**	**Total Igneous & Metamorphic**	**Total Samples Collected**	**Relative Distribution of Metamorphic/ Igneous Rocks (%)**
Hunter's Creek	About 1 mile from moraine	95	5	100	5
Zoar Valley	Gorge	90	10	100	10
Como Lake County Park	About 1 mile from moraine	98	2	100	2
Sinking Ponds	Kettle and Kame	83	17	100	17
Chestnut Ridge County Park	About 0.5 mile from moraine	94	6	100	6

*Note. All parks present in the glacial distribution test are located within the Ontario glacial lobe.

Photo 6.1. A view of a small stream located inside Hunter's Creek Park, one of the collection sites used to collect cobbles for the glacial distribution study.

Photo 6.2. The Hula Hoop used to collect random rock samples during the glacial distribution study. Note the hoop measures 1.067 m (42 in) in diameter and all cobbles laying inside the hoop were collected each time it was thrown, until all 100 cobbles were gathered.

Distribution Data Collected

All of the rocks were washed with tap water to remove excess dirt prior to analysis. Once the rocks air-dried, they were lettered (initials corresponding to the collection site) and numbered (1-100). For example, rocks collected from Zoar Valley were initialed, ZV #1-100. This numbering system allowed the author to make generalizations about rock types within and between collection sites. The washed and numbered rocks were then divided into types. This allowed the author to determine the percentage of each rock type present within and between each of the collection sites. Natural erosion processes can make identifying rocks by their exterior surfaces difficult. In order to classify more specifically the type of igneous and metamorphic rock (granite, gneiss, gabbro, etc.), each rock was cut into three pieces using a rock saw. One portion of the sawed rock was set aside as a baseline sample, and the two remaining sections were set aside for additional experimental testing. Sedimentary rocks were not identified as a temper source for early potters during the pilot study; therefore, only one rock sample from each sedimentary family (shale, mudstone, siltstone, limestone, sandstone, etc.) was cut for additional testing. This step was taken in the event that sedimentary rocks are identified as a temper source at a later date.

Photo 6.3. An example of a granite cobble collected from Sinking Ponds that was cut into three thick sections using a diamond rock saw. From left to right: the remaining fragment of the original cobble, a thick section removed from the center of the cobble that later underwent thermal exposure through Firing Test #3, and the final remaining thick section that underwent firing during Firing Test #2 (see Line of Evidence No. 3, below).

Although there are no igneous or metamorphic outcrops of rocks in western New York, these materials are available in small quantities, relative to the local bedrock, because of glacial deposits. Most of New York is covered in a thick layer of glacial till, defined as an "unsorted mixture of boulders, gravel, sand, silt, and clay" that was gathered and deposited during the movement of glaciers (The Paleontological Research Institution 2002). Other important sources for metamorphic and igneous rocks in western New York include areas of glacial outwash. Outwash refers to areas where water streamed off from, or beneath, the melting glacier, and left behind well-sorted layers of sediment (The Paleontological Research Institution 2002). Examples of meltwater features include: eskers, kettles, kames, and erratically placed boulders. These glacial processes account for the presence of nonlocal, metamorphic and igneous rocks in western New York. The glacial distribution test conducted in 2013 revealed that igneous and metamorphic rocks are present in the glacial deposits throughout western New York. However, these rocks represent a small portion, 17% or less of the total available rock. The actual amount of igneous and metamorphic rock varies depending on one's location within western New York (Table 6.1). Higher percentages of nonlocal material can be found on glacial formations, such as gorges, kettle and kame systems, moraines, and drumlins.

Line of Evidence No. 2: Comparison of Isolated Minerals Within the Clay Matrix

In Chapter 5, the author explained how she determined that many of the isolated minerals are naturally occurring in sedimentary glacial clay deposits. Commonly occurring minerals in glacial clays include: iron-rich opaques, quartz, feldspars, muscovite mica, and chlorite. Greater quantities of these isolated minerals can be found in sedimentary clays formed from fast-moving water deposits, such as glacial outwash streams. Slower-moving bodies of water will have greater quantities of organic material. Photo 6.3 is an image from McKendry Vessel 3, Body Sherd 1, showing alternating light (organic-poor) and dark (organic-rich) bands within the poorly mixed matrix.

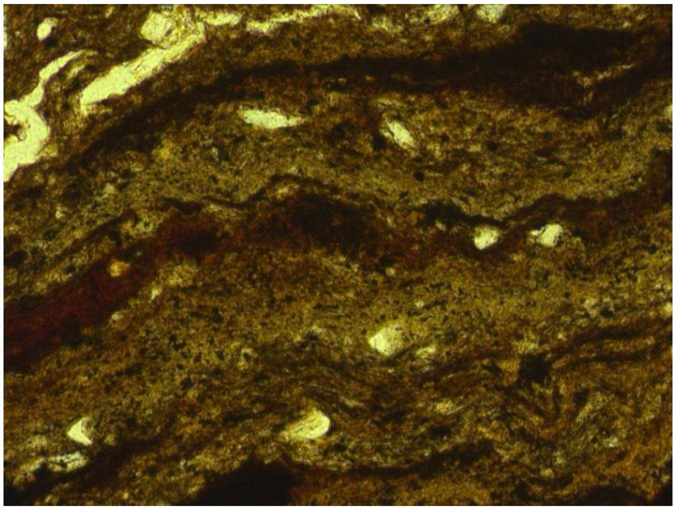


Photo 6.4. Image of the matrix from McKendry V3B1 showing a poorly mixed sedimentary clay, 100x, plain polarized light.

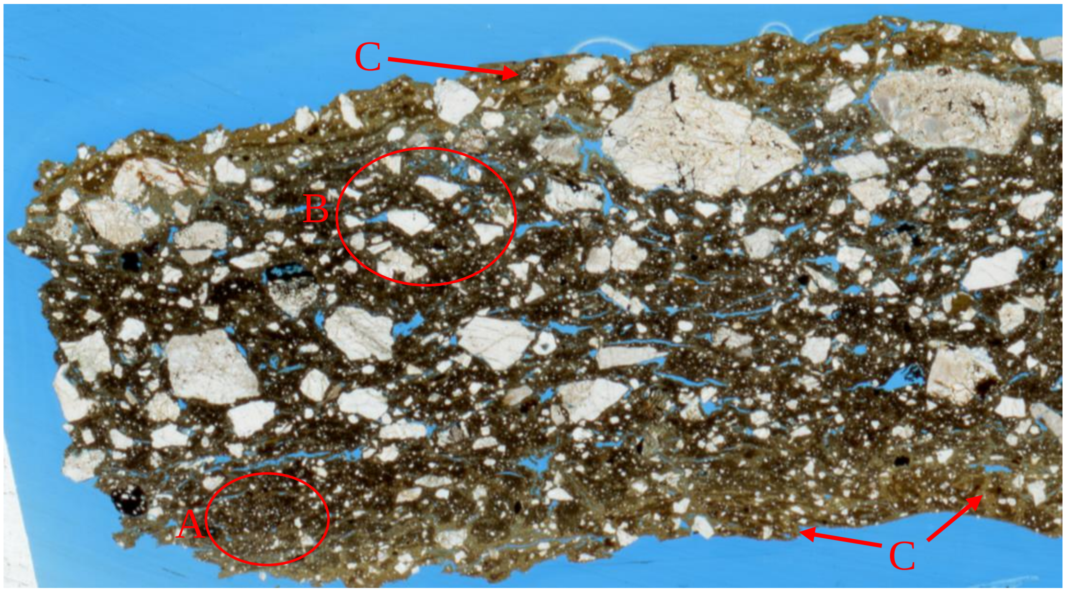


Figure 6.1. High resolution scan of Scaccia Vessel 1, Body Sherd 1. Letter A is encircling a pocket of glacial dust, which includes isolated minerals <0.25 mm in diameter. Letter B highlights an area of angular isolated minerals that likely broke off the larger fragments of crushed rock during temper production. The red arrows of Letter C are pointing to areas where the sedimentary clay was poorly mixed; the darker areas of the clay contain higher proportions of organic materials. Image courtesy of the New York State Museum.

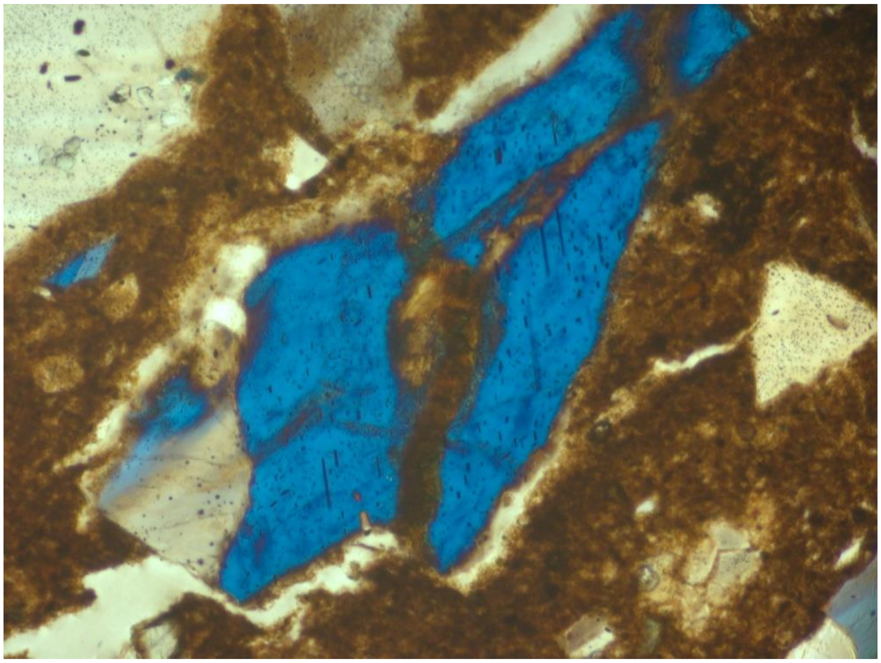


Photo 6.5. Shows an isolated amphibole mineral that has broken off a larger fragment of crushed rock in sample Sinking Ponds, V2B4. Note the mineral has actually fractured through the center and was partially separated during vessel production. Image taken at 100x, crossed polarized light.

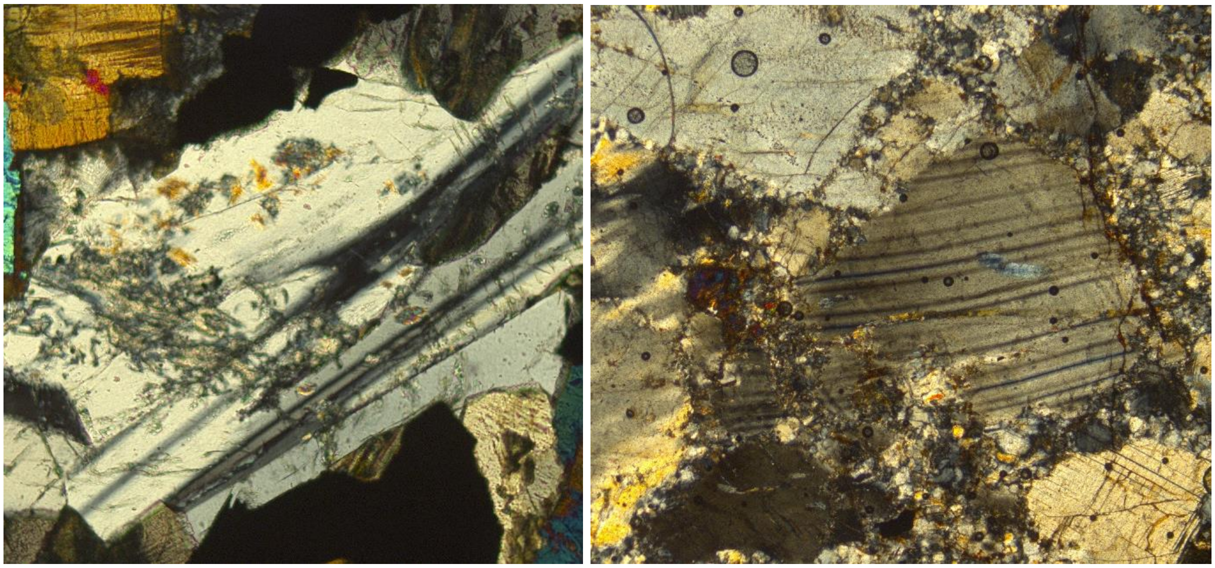
Isolated mineral inclusions may also be present in the matrix because the minerals broke off from a larger rock fragment during temper processing (Figure 6.1 and Photo 6.4). If the isolated minerals are one of the five minerals listed above, then at this time, it is not possible to determine which minerals are naturally occurring and which may have been added as temper since glacial clays naturally contain rounded and angular mineral inclusions. One possible way to distinguish natural versus culturally added minerals may be by examining the appearance and decree of ‘freshness’ of the mineral (Quinn 2013: 165; however, see section: Line of Evidence No. 3, below).

The total amount of isolated minerals varies significantly in the ceramic assemblage, from 11.4-49.1% of the total matrix. Once one removes the percentage of iron-rich opaques, quartz, feldspar, muscovite mica, and chlorite, the total content of isolated minerals drops to 0-32.0% of each sample. Once the ambiguous minerals are removed, one can then compare the remaining isolated minerals to the composition of the crushed rock. If the isolated minerals don’t match the composition of the rock, then one can assume that the crushed rock was culturally added to the clay body as temper. Also, the unique isolated mineral may be able to be used to eventually identify specific clay sources or groups of vessels produced from the same clay source.

All but four vessels show considerable variation between the composition of the crushed rock and isolated mineral components in the matrix, which supports the hypothesis that the rocks were crushed and added as temper. The four vessels include Broken Clock, vessel 1 (sample vessel #4), Vine Valley, vessel 1 (#17), MacCauley Complex No. 4, vessel 2 (#32), and MacCauley Complex No. 8, vessel 1 (#34). All four vessels contain crushed rock with predominately felsic minerals, including granite, monzonite, and quartz monzonite that lack enough unique minerals to make a determination.

Line of Evidence No. 3: Experimental Heating and Crushing

The final step in the determination of the presence of temper in the archaeological samples is the appearance of the minerals and crushed rock fragments. Through the use of a petrographic microscope, it is possible to see the minerals within the archaeological fabrics are frequently fractured and unnaturally bent (Photo 6.5-6.6; also see Chapter 7, Table 7.8). In the case of McKendry Vessel 2 (sample #37), the crushed rock inclusions are damaged enough as to make identification nearly impossible (Photo 6.7). According to Kempe and Templeman (1983), "potters tend to choose disintegrated weathered material," which can make identification of individual rock types used as temper difficult (302). However, weathered crushed rock (Photo 6.8) will appear drab in appearance compared to freshly fractured (Photo 6.9) material (Quinn 2013: 165).



Photos 6.6-6.7 illustrate plagioclase minerals showing characteristic twinning. **Left:** Geologic baseline sample from Zoar Valley, probably a Gabbro/Diorite rock, showing a sodium plagioclase feldspar with a normal Carlsbad twin. **Right:** Geologic sample, most likely a biotite granite, containing a plagioclase feldspar mineral showing a bent twin after undergoing open firing tests.

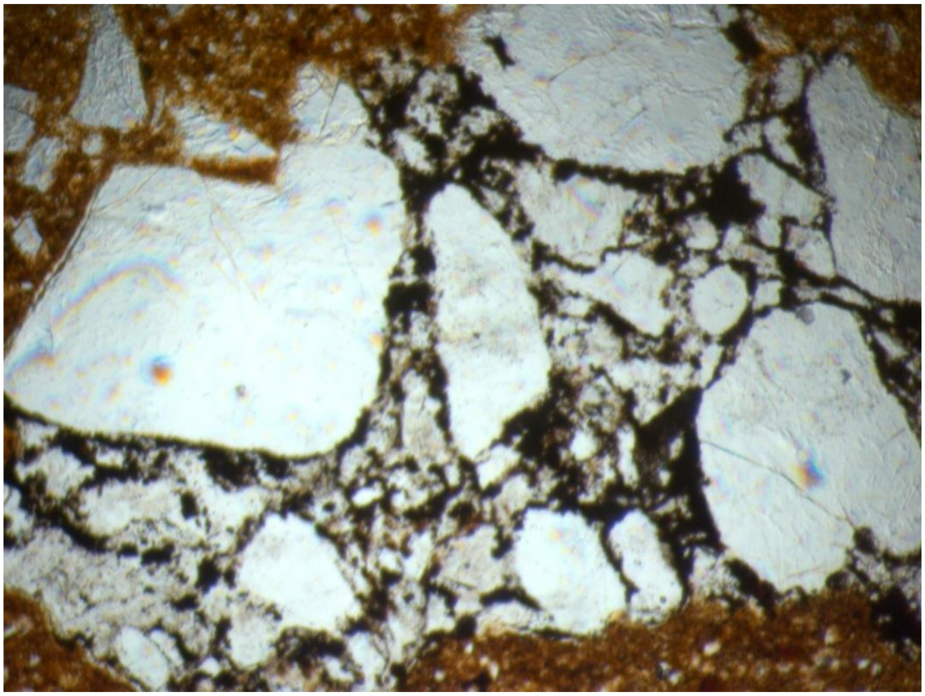


Photo 6.8. Indeterminate crushed rock inclusion from McKendry Vessel 2, Body Sherd 2. Rock may be a quartzofeldspathic gneiss but thermal and mechanical pressure have made identification difficult. Image taken at 100x, plain polarized light.

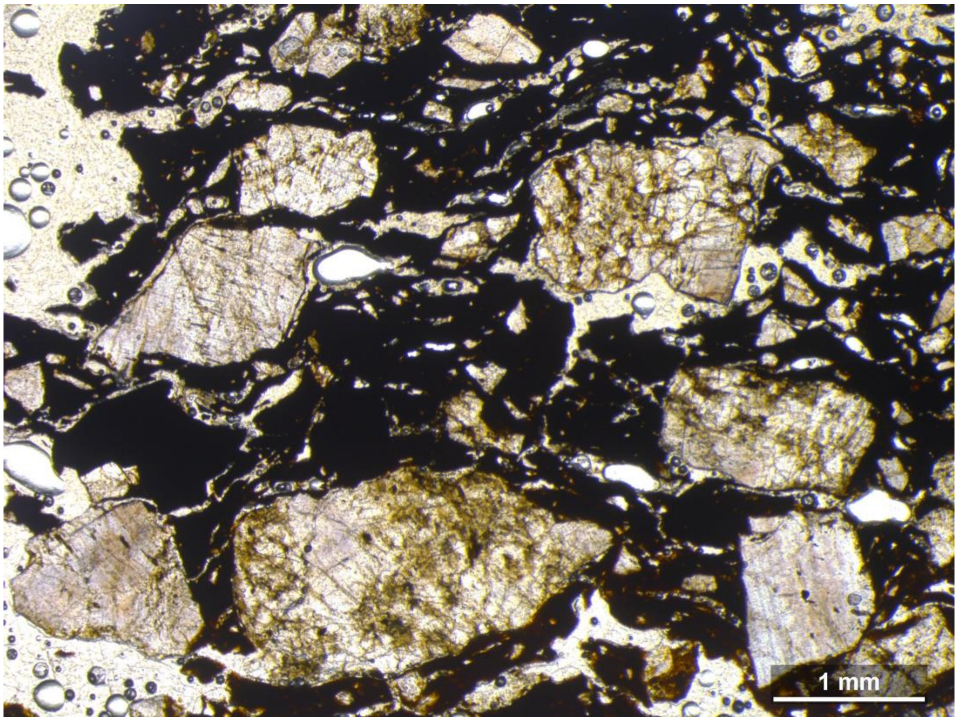


Photo 6.9. Image of a highly weathered rock from Portage Vessel 2, Body Sherd 3. Note the dark brownish-red tinge on the minerals is oxidization. Image taken at 100x, crossed polarized light.

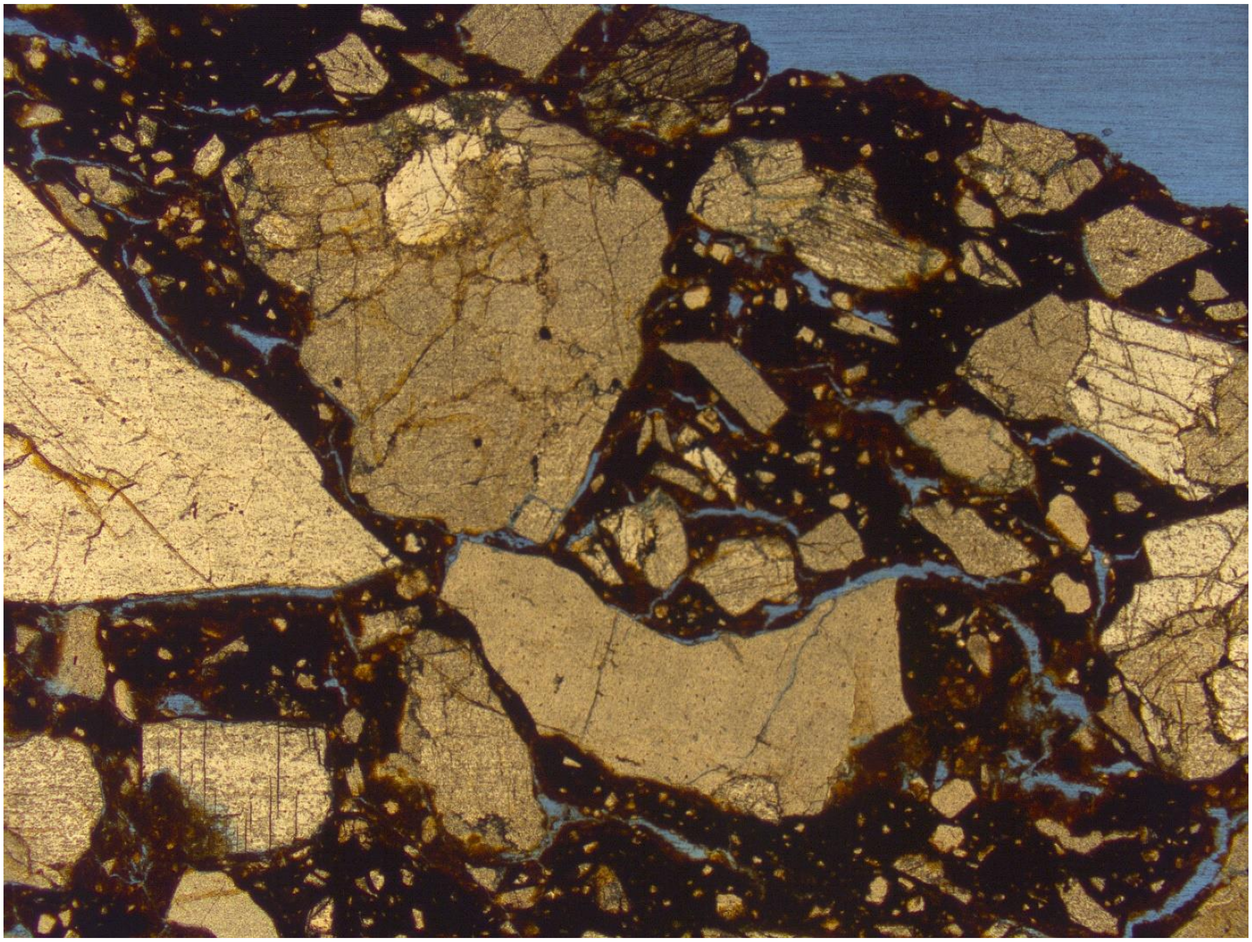


Photo 6.10. Image of a freshly broken fragment of crushed rock temper fragment in Vessel 4, Body Sherd 2 from the MacCauley Complex #4 site. Note the minimumal amount of oxidization across the mineral surfaces. Image courtesy of the New York State Museum.

The alteration, weathering, and melting of minerals is dependent on their chemical composition (mafic or felsic) and surrounding pressure (Nave 2001, and see Table 6.2). In 1950, N.L. Bowen theorized the rate and order of mineral formation and magma crystallization was based on a series of discontinuous and continuous reactions plus pressure and temperature. This is known as the Bowen's Reaction Series (Perkins 1998: 93). Metamorphism causes the minerals of rocks to be reshuffled; minerals can alter in texture, phenocryst size, and chemical composition through the removal and addition of substances from the parent rock and/or degree of temperature and pressure. Bowen theorized that abrupt, discontinuous changes can occur when one mineral reacts with another or with the groundmass to form another, new mineral. For example, the mineral olivine will alter to pyroxene under low pressure and cooler temperature conditions, altering the final chemical composition and appearance of the metamorphosed rock (Perkins 1998:93-94). Mineral alterations in the continuous series are more stable because plagioclase feldspar remains present throughout the process.

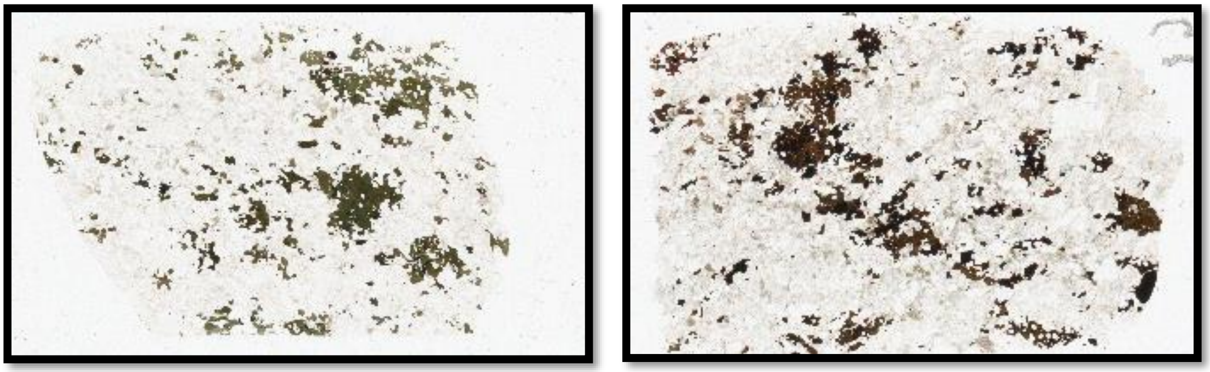
Table 6.2. Summary of the Melting Points of Minerals (Nave 2001)

Mineral Type	**Degrees in Celsius**	**Degrees in Fahrenheit**
Quartz, K-Feldspars, Na-Plagioclase Feldspars, and Mica	600	1112
Amphibole	800	1472
Olivine, pyroxene, and Ca-rich plagioclase Feldspars	1000	1832
All minerals	1200	2192

In order to distinguish natural versus culturally-caused damage to the minerals, experimental archaeology tests were conducted by the author that attempted to reconstruct the forces that may have caused the mineral crystals to warp and fragment. This portion of this dissertation tested the hypothesis that potters intentionally processed rocks into temper for ceramic production by first heating and then crushing the rocks prior to adding it into their clays. The null hypothesis of this test was that rocks naturally break down and their appearance in the clay matrix is from natural chemical and mechanical weathering that occurs as rocks break down into sedimentary clays.

This experimental test was conducted in two phases. Phase 1 examined the natural condition of igneous and metamorphic rocks collected during the glacial distribution study. No additional mechanical stresses were applied. The purpose of this section was to establish a baseline for the appearance of minerals in glacial till rocks (Photo 6.10). Phase 2 examined the condition of minerals in these same rocks after they underwent additional significant mechanical stresses. Samples of rocks from both phases underwent petrographic analysis in order to determine how heating at specific temperatures affects the minerals within each rock type (Photo 6.11).

The results of these experimental tests suggest that the glacial cobbles were likely heated at high temperatures in open fire pits and then later beaten or ground into grit-sized fragments. The appearance of individual accessory minerals in the overall matrix is likely caused by the breakage of the glacial cobble during temper production. These unique minerals are not those identified as commonly occurring in glacial clays and they are frequently mafic minerals, which means they should have weathered or show significant signs of weathering, had they been part of the natural clay body.



Photos 6.11-6.12. High-resolution scans of a thin section made from a biotite granite cobble. **Left:** baseline sample. **Right:** same sample after Firing Test #3 800°C (1472°F). Note the biotite has darkened from green to brown and degraded with firing.

Photo 6.13. Low magnification (7.5x) of the same biotite granite from Sinking Ponds, as shown in Photos 6.10-6.11. Note the green biotite and clear-colored felsic minerals (mostly quartz and feldspar).

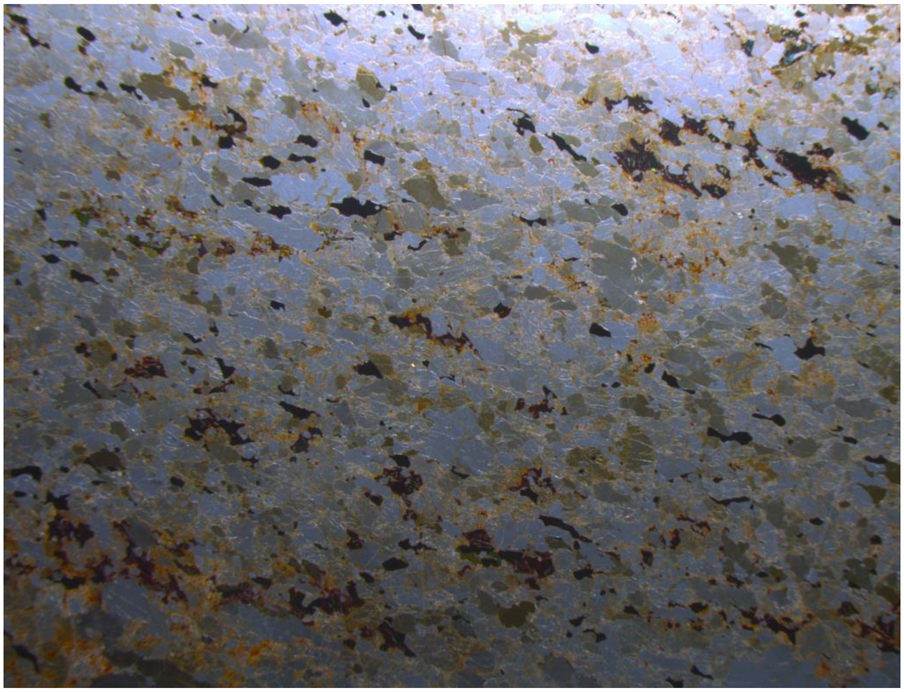


Photo 6.14. Low magnification (7.5x) of the same biotite granite from Sinking Ponds, as shown in Photos 6.10-6.12. Note how the biotite has darkened to brown and the felsic minerals have become greenish-brown from the iron released by heating.

Heating Methodology

A total of 60 metamorphic, igneous, and sedimentary rock samples were fired in the SUNY College at Brockport, Art Department's indoor electric kiln (Photos 6.14-6.15). This kiln is a Bartlett, model V6-CF and has a digital temperature controller that allows the kiln to be heated up to 1200°C (2300°F), for as long as thirteen hours (Bartlett Instrument Company). The thermal properties of the Bartlett kiln are sufficient to melt the minerals in igneous and metamorphic rocks. In order to account for the full range of possible temperatures in an open flame, rock samples underwent a range of different firing temperatures from 300-1200°C (Table 6.3). For consistency, the kiln was arbitrary set to rise at 250°F (121°C) per hour for every firing event. This temperature was chosen because a rapid temperature rise in the Bartlett kiln can cause rocks to explode and could potentially damage the kiln and lower temperatures would require greater than nine hours to reach holding temperature per firing event (Lori Mills, Personal communication, 2014). All samples were placed in handmade ceramic ramekins, produced by the author, for firing, in order to keep the sample from melting onto the kiln surface (Photo 6.14). Once at temperature, the kiln was programmed to hold the desired temperature steady for two full hours. The kiln was set to then shut off and for safety reasons, was allowed to slowly cool for 48 hours or more.

Firing Test Results

The results of the controlled experimental kiln firing are summarized in Table 6.3. At 600°C (1112°F) all rock samples were noticeably reddened and a single, metamorphic sample cracked. At 800°C (1472°F), all samples showed signs of stress fractures, cracks and fragmentation (Photo 6.16). At 1000°C (1832°F), all samples could easily be pulled apart and crumbled in the author's hand and a single sample exploded into gritty dust in the kiln (Photos 6.17-6.18). In summary, the easiest way to break down rocks, is to heat them above 600°C (1112°F).

Table 6.3. Summary of Experimental Heating Test Results

Firing Event	*Hours to Max Temp.	Max. Temp. in °C (°F)	Kiln Holding Time at Max. Temp.	Notes
1	2	300 (572)	2	All rocks showed a slight reddening of exterior surfaces. No signs of stress fractures or cracking.
2	4.5	600 (1112)	2	All samples are noticeably reddened and range from bright pink to strong brown. One metamorphic sample from Zoar Valley cracked into two pieces.
3	5.8	800 (1472)	2	Samples have changed from greys to strong browns, reds, and reddish yellows. All samples are showing signs stress fractures.
4	7.3	1000 (1832)	2	Coarse-grained metamorphic and sandstone samples are falling apart, can easily be crushed with fingers. One coarse-grained sample turned into gritty sand during firing.
5	8.5	1200 (2192)	2	Samples are falling apart and can easily be crushed with fingers. One sample partially melted to testing crucible.

*For consistency, the kiln was set to rise at 250°F (121°C) for every firing event.

Photo 6.15. Image of a round of samples prepared for firing. Prior to firing, 100 round ceramic stoneware ramekins were produced by the author in order to hold samples during firing. Each ramekin was incised with a number on the bottom corresponding to the sample information. Samples were also labeled with whiteout and a sharpie, but all the labels melting off during firing.

Photo 6.16. Image of the Bartlett kiln prepped for firing. Brick was placed around the edges of the kiln to protect it in the event that samples exploded during firing. The samples were kept spaced apart to avoid them melting together.

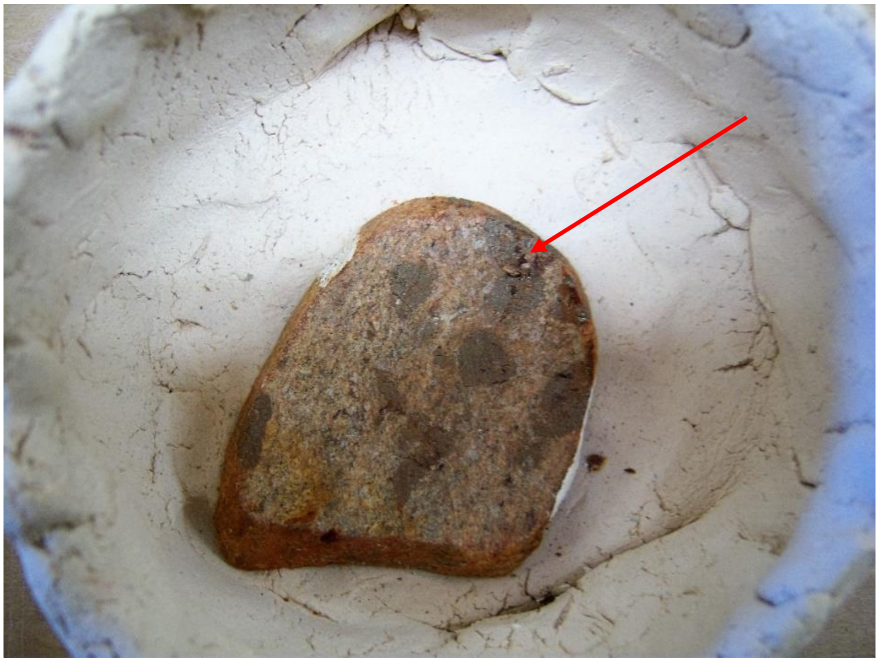


Photo 6.17. Sample from Firing Test #3, showing a large stress fracture (red arrow) and reddening.

Photo 6.18. Image of samples from Firing Test #4 showing the samples in place within the kiln directly after firing, note the red arrow is pointing to a coarse-grained igneous rock that exploded during firing. **Right:** The same sample that exploded pictured with another thick section and the original cobble that the sections were cut from.

Photos 6.19. The same sample that exploded during Firing Test #4 pictured with another thick section and the original cobble that both of the sections were cut from.

Petrographic Methodology

Twenty of the experimental samples from test Phases 1 and 2 were sent to National Petrographic for thin sectioning. These samples included a selection of metamorphic, igneous and sedimentary rocks collected from glacial formations across western New York (see above). The thin sectioned samples included six baseline samples, three samples from each of the four controlled firing tests, and two samples from the open pit firing event.

The samples from each test phase and the baseline rocks included two sedimentary rocks, three metamorphic rocks, and one igneous rock. The baseline samples were all point counted using a 0.5 mm interval. A minimum of 400 points were taken on each sample and all mineral irregularities were recorded (Photos 6.17-6.21). The closed and open firing samples were not point counted again but were examined in detail, microphotographed and visually described. Changes in the mineral and matrix appearances were noted. High-resolution scans were also taken of each sample for comparative analysis.

Petrographic Results

Numerous types of alterations were seen in the glacial cobbles. The types of alteration and weathering found include: mineral zoning, alteration impurities, and undulating extinction (Photos 17-19). These abnormalities are to be expected in minerals that have been recrystallized, weathered, and altered (Perkins 1998:30). No evidence mineral fracture, which is identifiable by discoloration and bending of colors in crossed polarized light, was noted in any of the baseline samples. To the author’s knowledge, there is no common literature on the natural causes of mineral fracture. According to geologic petrographer Dr. Gary Solar, minerals might fracture under extreme pressure, such as high-pressure metamorphism like that present in the Grenville rocks (Personal communication, 2016). The Grenville rocks are the youngest part of the rock formation that makes up the Canadian Shield. The high-grade metamorphism associated with the Canadian Shield may be able to cause minerals to fracture unevenly (see Chapter 1), however, the author has thus far failed to find any evidence of this in the tested baseline samples.

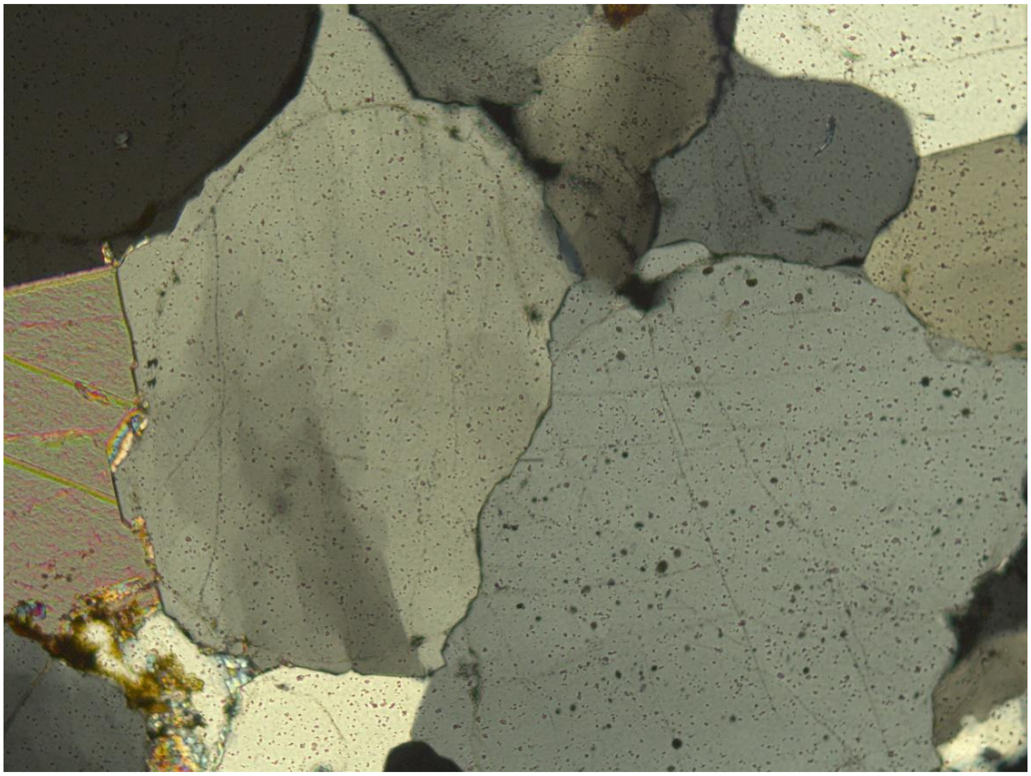


Photo 6.20. Image taken of a quartz minerals displaying undulose extinction from a baseline sample collected from Hunter’s Creek. Photo taken at 40x, XPL.

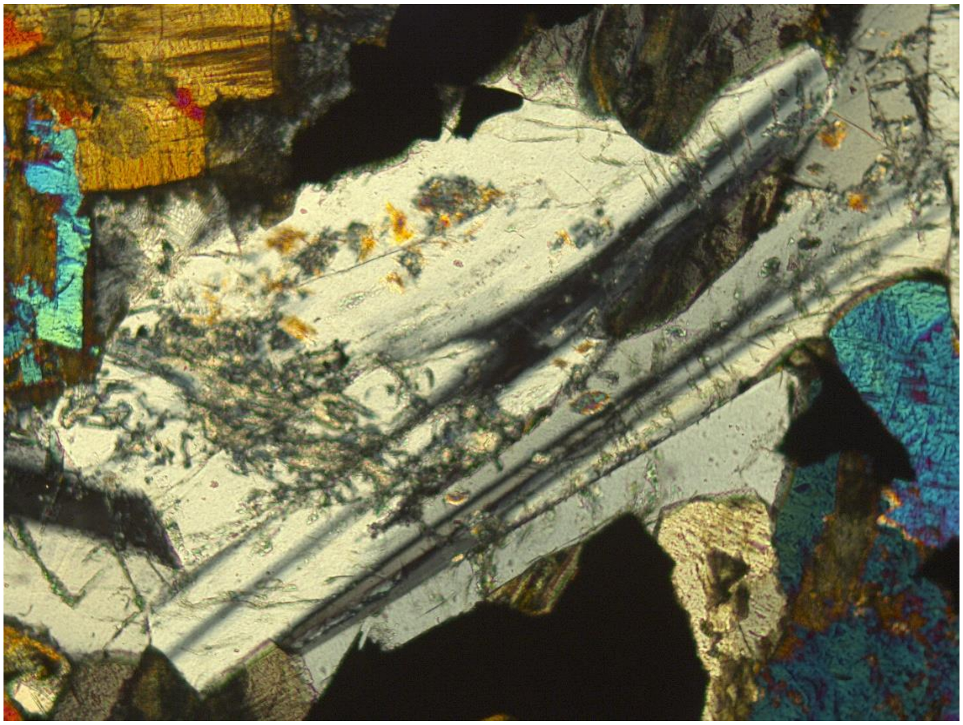


Photo 6.21. Image of a plagioclase feldspar containing sercite alteration. Photo taken at 40x, XPL from a Gabbro/diorite sample collected from Zoar Valley.

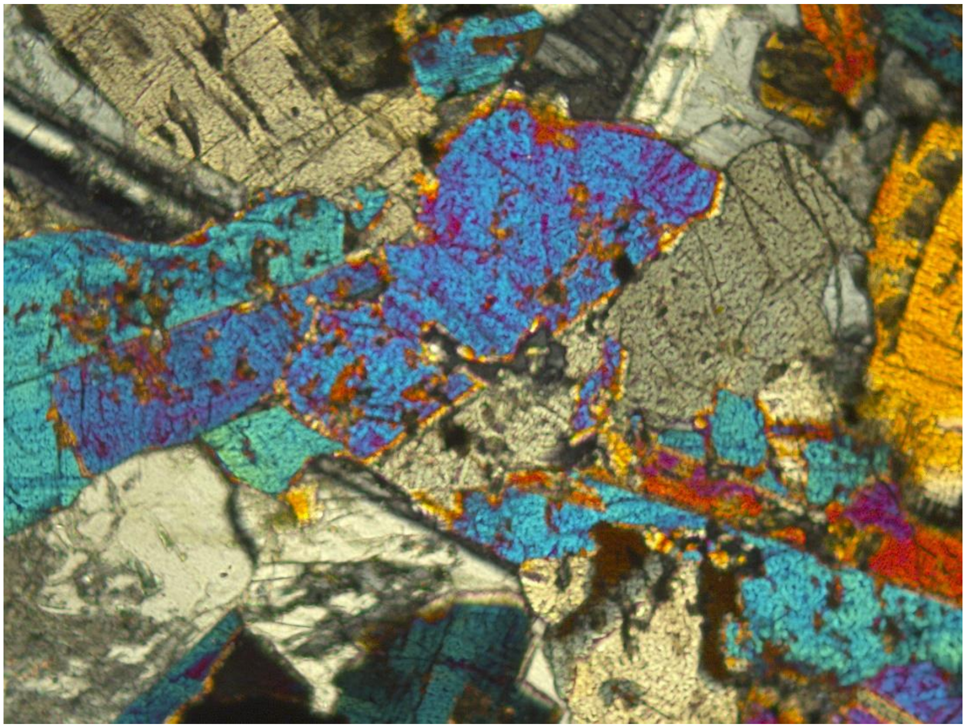


Photo 6.22. Image of an clinopyroxene undergoing alteration. Photo taken at 40x, XPL from a Gabbro/diorite sample collected from Zoar Valley.

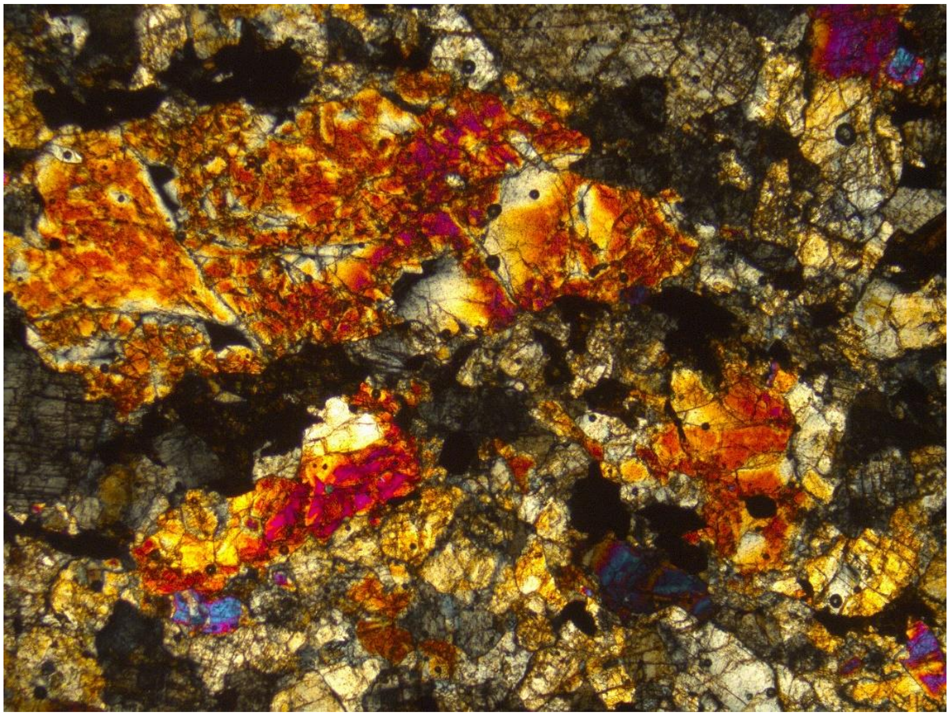


Photo 6.23. Image of the darkening and reddening of mafic minerals from a probable granodiorite after undergoing firing during Firing Test #4.

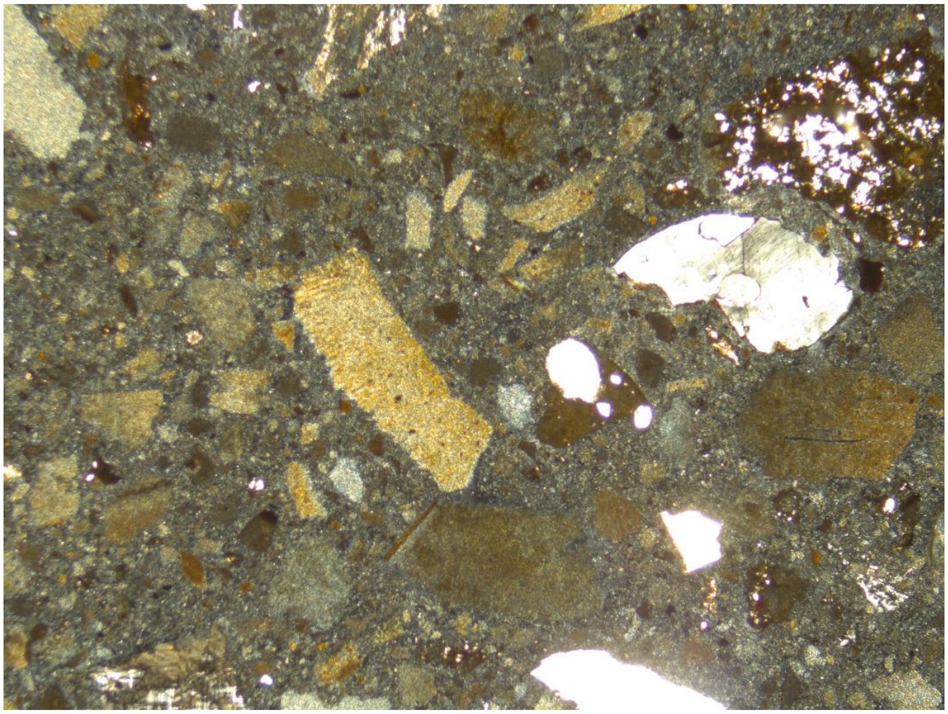


Photo 6.24. Image of a sedimentary rock, probably limestone, after undergoing firing during Firing Test #4. Note the clastic material binding the minerals together is beginning to break down. Photo taken at 40x, XPL.

Experimental Crushing Tests

The final part of the experimental tests involved crushing a sample of different rocks from the baseline samples and from each firing test with a granite hammerstone and anvil. The purpose of this step was to examine the physical properties of these rocks and the ways in which they can be altered by humans. The results show that the easiest way to reduce a coarse-crystalline rock to grit is to directly heat it in a fire between the temperature 600-800°C. At these temperatures, even granite is reduced to grit-sized fragments when hit by a harder boulder in a matter of seconds. Temperatures higher than 800°C lead to a failure in the rock's internal structural integrity, which causes the rock to fall to powder, occasionally with little or no additional mechanical stress. Temperatures lows than 600°C make these dense rocks much more difficult to break apart. The author thinks it likely that potters took fire-cracked-rocks from hearths and recycled them for use in pots.

Crushing Test Methodology

To begin the crushing tests, a large granite block and cobble (Photo 6.25) were located that could be used as an anvil and hammer. The block was brushed clean with a small hand broom before any crushing tests were begun and between each test. An unmodified granite cobble was used as a hammerstone. Each individual rock sample was placed on the center of the anvil and photographed before being smashed with the hammerstone. Safety goggles and gloves were worn to protect against flying shards of rock. The author recorded the time (in seconds) it took to reduce each cobble into temper-sized grit (1-5 mm). All tests were recorded using the video application on an IPhone 6. After crushing, the time was recorded in a table alongside the firing test and information regarding the rock type and size. Once crushed, the grit was swept up with a small hand brush and dustpan and returned to a bag for storage (Photo 6.26).

Photo 6.25. The mechanical pressure tests were conducted on a large piece of cut granite with an unmodified granite hammerstone, safety equipment, and a small hand broom for cleanup. All tests were video recorded using an IPhone 6.

Photo 6.26. Image of the remnants of a coarse-crystalline rock from Firing Test #4 after mechanical pressure was applied with the granite hammerstone. Note the rock turned to gritty dust with impact.

Crushing Test Results

The samples that underwent mechanical pressure are listed by site, rock type, firing test, and time required to crush in Table 6.4. A limitation of this study is the sample size tested. Small sections of each rock were cut from the larger cobble, fired, and crushed. Due to the variation in size of the original cobble collected (6-25 cm in diameter), samples were not always the same size. Rough estimates of the size of each sample were taken prior to being crushed. Samples were compared to being about the same size as an American quarter (2-3 cm), American half dollar (3-6 cm), or a small cobble (larger than 6 cm in diameter). The amount of crushed rock needed to temper a large early ceramic vessel in New York would have been considerably greater and therefore, would have taken the potter longer to process than the samples in this study.

The author also attempted to tear apart a rock, rather than smash, in order to examine its ease and appearance. A sample of granite about the size of a half dollar was selected from Firing Test #4 and the time needed to rip it into grit-sized temper was recorded. The sample was reduced in about 16 seconds, which is faster than the time needed to pulverize other samples of similar size in this testing category. However, ripping the rock apart created tabular fragments (Photo 6.27), rather than gritty flour (Photo 6.26). Samples fired below 800°C (1472°F) could not be pulled apart into grit-sized fragments with the author’s bare hands.

Table 6.4. Results of the Experimental Crushing Tests

Site	Firing Test	Rock Type	Time (seconds)	Sample Size	Notes
Zoar Valley	1	Sedimentary	121.50	Half Dollar	Samples in were hard enough to break the edges of the hammerstone. Fragments of crushed rock flew everywhere each time a sample was struck, creating a zone of debris around the author.
Zoar Valley	1	Igneous	45.50	Quarter	
Hunter's Creek	1	Metamorphic	20.50	Quarter	
Como Lake	1	Metamorphic	51.0	Half Dollar	
Sinking Ponds	2	Sedimentary	31.94	Half Dollar	Samples were still hard enough to break the edges of the hammerstone and required significant force behind each strike, creating a zone of debris.
Sinking Ponds	2	Igneous	17.03	Quarter	
Zoar Valley	2	Sedimentary	90.0	Half Dollar	
Zoar Valley	2	Metamorphic	30.30	Quarter	
Sinking Ponds	3	Sedimentary	26.48	Quarter	Rocks could be easily pulverized and turned into gritty dust mixed with small (<1.0 cm) rock fragments. No debris zone.
Sinking Ponds	3	Metamorphic	41.02	Small Cobble	
Sinking Ponds	3	Igneous	29.0	Small Cobble	
Zoar Valley	3	Metamorphic	23.32	Small Cobble	
Hunter's Creek	3	Sedimentary	35.11	Small Cobble	
Zoar Valley	4	Igneous	12.60	Quarter	Pulverized rocks turned into very fine dust mixed with small (<0.50 mm) mineral fragments. Much of the dust couldn't be removed from the surface of the anvil, even with the hand whisk. No debris zone.
Zoar Valley	4	Metamorphic	34.06	Small Cobble	
Zoar Valley	4	Metamorphic	28.0	Small Cobble	
Hunter's Creek	4	Metamorphic	43.0	Small Cobble	
Hunter's Creek	4	Igneous	26.38	Half Dollar	
Sinking Ponds	4	Metamorphic	25.10	Half Dollar	

Photo 6.27. Remnants of a cobble fired during Firing Test #4 that the author attempted to pull apart with her bare hands. Note the difference in texture. This test created tabular fragments of rock inside the gritty dust formed from hammering the cobble.

Origin of Crushed Rock Temper

Although there are no igneous or metamorphic outcrops of rocks in western New York, these materials are available in small quantities, relative to the local bedrock, because of glacial deposits (see Chapter 1). Most of New York is covered in a thick layer of glacial till that was gathered and deposited during the movement of glaciers (The Paleontological Research Institution 2002). Other important sources for metamorphic and igneous rocks in western New York include glacial outwash features. Examples of these include: eskers, kettles, kames, and erratically placed boulders.

The orientation of glacial till formations, including terminal moraines and drumlins, and striations on bedrock allow geologists to determine the direction of ice movement (Raymo and Raymo 2007: 137; Kendall 1987: 25). During the last ice age, the Laurentide Ice Sheet spread from the Hudson Bay area in Canada into northern America. The ice sheet was composed of numerous ice lobes, which moved independently of the larger mass (Figure 6.2). These ice lobes are important for understanding how igneous and metamorphic rocks were able to naturally (versus being brought in by humans) accumulate in New York State.

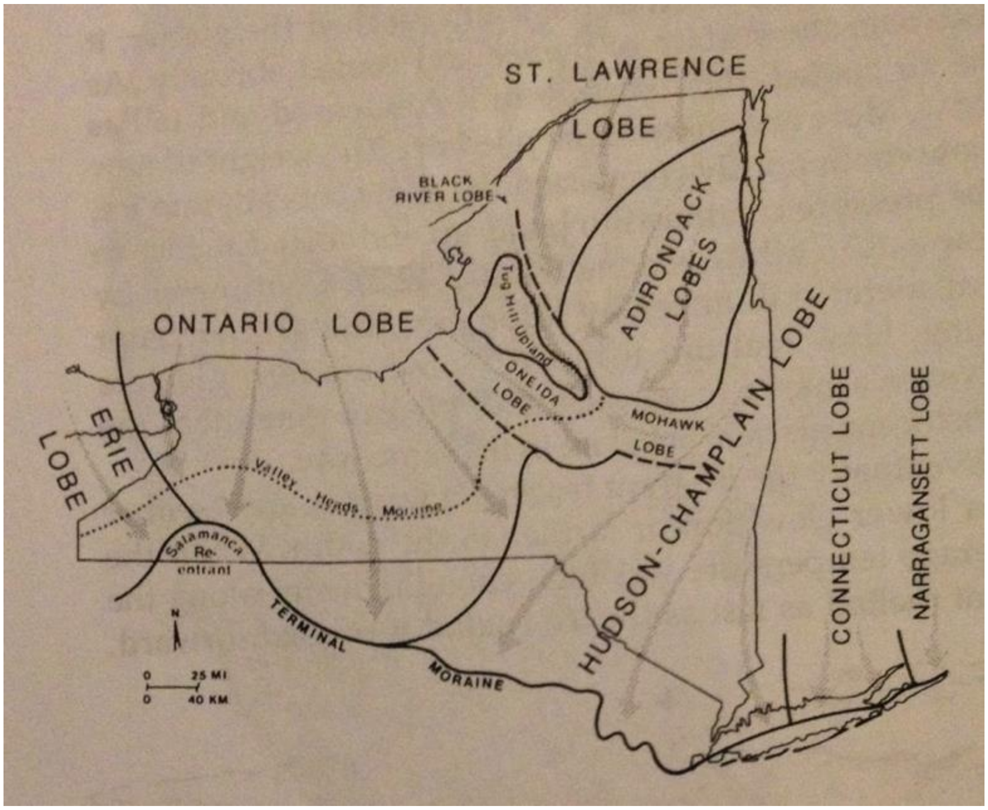


Figure 6.2. Schematic representation of the direction of ice flow movement during the last glaciation (after Isachsen, 2000).

Figure 6.2, shows all of the known ice lobes during the last glacial advance in New York State. Several lobes are of particular importance to this study, these include: Erie, Ontario, Champlain, St. Lawrence, Hudson-Champlain, and the Oneida lobes. These lobes are examined in greater detail because the archaeological sites in this study are located within their paths. The Erie Lobe, radiated outwards from its center, pushing material in all directions. In western New York, material from southwestern and central Ontario would have been pushed all the way to the northwestern corner of Pennsylvania (Sevon et. al 1999: 17 Figure). The Ontario Lobe was adjacent to the east and south sides of the Erie Lobe and radiated outwards towards the south, southwest, and southeast. This lobe would have dragged material from central and eastern Ontario towards the Finger Lakes region and central New York. The St. Lawrence Lobe pushed almost directly south from Quebec and halted at the base of the Adirondack Mountains in northern New York. The Hudson-Champlain Lobe moved southwest, dragging material from Vermont and western Massachusetts into lower New York State. The Oneida Lobe is squished between the three much larger Ontario, St. Lawrence, and Hudson-Champlain lobes, creating a narrow channel of movement from the southeastern edge of Ontario to the southern corner of the Adirondacks in New York. With the exception of the smaller valley glaciers, which were located on very large mountains in high altitudes, such as Mount Katahdin in Maine, the ice movement across the rest of the Northeast was in a southeasterly direction (Caldwell 1998: 14-20; Kendall 1987; The Paleontological Research Institution 2002: 61).

Combining the local bedrock maps with the known location and direction of ice lobe movement allows one to easily see how various types of igneous and metamorphic material was brought into the different regions of New York. Sources of mafic and ultramafic plutonic rocks are located north of Lake Ontario and into Ottawa. Smaller pockets of intrusive felsic plutonic rock, gneisses and migmatites, metavolcanics and metasedimentary rocks can be found in the center and northwest of the mafic outcrop. There are also two sources of gabbro/diorite rock. Syenite rocks are found north of northern New York, near the Adirondacks. All of the bedrock from western New England, including Vermont and Massachusetts, is heavily metamorphosed from continental building (see Chapter 1).

To summarize, quartz-rich rocks should appear in the glacial train in all regions of New York State, since sources of quartz-rich rocks, such as granite and metamorphosed granite, occur in both the Canadian Shield and in Vermont. Feldspar-rich rocks have limited sources in the Canadian Shield. A large outcrop of syenite can be found north of the Adirondacks and small intrusive pockets north/northeast of Lake Huron and Lake Michigan. It is possible that the Erie Lobe may have dragged syenite from north of Lake Huron, but it is more likely to be found throughout the paths of the St. Lawrence and Oneida glacial lobes. Metamorphic rocks, specifically gneisses and schists, can be found in very large quantities from the entire length of Lake Ontario to the western edge of Quebec province, and south into the mountains of Vermont. Within these densely metamorphosed rocks, there are small outcrops of mafic rock, such as gabbro/diorite. One final origin of gabbro/diorite mafic rocks can be found north of Lake Huron, in Canada. Gabbro/diorite rocks are in general rare in the Great Lakes region.

CHAPTER SEVEN:

Results: Identifying Technological Style in Early Ceramic Vessels

> *"The discovery that 'earth' can be turned to 'stone' through intentional heating allowed early humans to create one of the first true synthetic substances"*
>
> Patrick Sean Quinn (2013: 188).

This chapter is divided into five parts. In Part I, all results were gathered using high-resolution scans of the slides. Part II describes the results of the petrographic technique. Part III compares the results of the first two sections with the type attributes used by Ritchie and MacNeish (1949) and Taché (2005) to define the Vinette series. The petrographic results of this study show that the Vinette series terms for classifying early pottery do not hold up when examined using scientific methods. The Vinette series terms are not useful and should be discarded. Part IV lists the new division of fabrics in association with the patterns identified in this study and examines the variation within early ceramic technology.

Part I: Macroscopic Results from High-Resolution Images of Thin Section Slides

Matrix Heterogeneity and Macroscopic Grain-size Distribution

The results of the macroscopic texture analysis show that most all of the archaeological samples tested in this study consist of poorly to very poorly mixed fabrics that contain inclusions 2.5 mm in diameter or larger (see Table 7.1). According to Barraclough (1992), fabrics are considered poorly sorted when inclusions of different shapes and sizes occur mixed together (Cited in Orton and Hughes 2013: 284 Figure A.6). A poorly sorted fabric has areas of densely clustered inclusions separated by areas containing few to zero inclusions. Of the 90 samples, 34 were poorly mixed, 40 showed some signs of mixing, and 16 samples were well-mixed and homogenous. It is important to note, that ceramics that undergo higher firing, may have more homogenous matrixes than those that are lower-fired because the individual clay minerals sinter and blend together (Quinn 2013: 44).

The largest aplastic inclusions in each sample varied from 2.5 mm to about 8.0 mm in diameter. Sites with the largest aplastic inclusions (6.0 mm or larger) are Riverhaven No. 2, Sinking Ponds, McKendry, MacCauley Complex No. 5, Portage, Martin, and the Mouth of Cattaraugus Creek. Sites containing vessels with crushed rock inclusions less than 3.0 mm in diameter include Renaissance House, Broken Clock, Egli, MacCauley Complex No. 4, Vine Valley, Vinette, and Wickham. The remaining sites contained inclusions falling between 3.0-6.0 mm in size.

Evidence of Manufacturing Technique

Evidence of coiling was searched for through the alignment of aplastic minerals and voids in the matrix of each sample. Definitive coils were identified in 59 of the 90 samples (see Table 7.2). Twenty-nine additional samples may have had coils that were later partially removed by secondary treatment processes. Two samples, Gardepe V1B1 and Scaccia V2B1 lacked any evidence of coiling and therefore, were likely either not produced by the coiling method, or the coils were completely removed by later techniques.

Firing Atmosphere and Temperature

Thin sections of ceramic pastes are required to see mineral alterations and sintering. Sixteen samples lacked evidence of matrix sintering (Table 7.2). Sites containing one or more samples lacking evidence of sintering include Broken Clock, Felix, Ferguson, MacCauley Complex No. 4, Riverhaven No. 2, Scaccia, and Sinking Ponds.

Table 7.1. Summary of Macroscopic Textural Aspects of Ceramic Samples

Sample	***Inclusion Sorting***	***Amount of Inclusions***	***Largest Inclusion Size (mm)***	***Amount of Voids***	***Lamentation***
BCV1B1	Very Poor	20-40%	2.5	Moderate	No
BCV1B2	Very Poor	20-40%	3	Moderate	No
BCV1B3	Very Poor	20-40%	5	Moderate	No
BCV2B1	Poor	<20%	2.5	High	Yes
BCV2B2	Poor	<20%	3	High	Yes
BCV4B1	Poor	<20%	2.5	Moderate	No
BCV4B2	Poor	<20%	2.5	Moderate	No
BJRV1B1	Very Poor	20-40%	4	Moderate/High	Probable
BJRV1B2	Very Poor	20-40%	5	Moderate/High	Probable
BJRV1B3	Very Poor	20-40%	5	Moderate/High	Probable
CatCrkV1B1	Poor	<40%	6	Moderate/High	Probable
CotV1B1	Very Poor	20-40%	3.5	Moderate/High	No
EgV1B1	Very Poor	<20%	2.5	High/Very High	Yes
FergV1B1	Very Poor	<20%	3	Moderate	No
FexV1B1	Poor	<40%	3	Moderate/High	no
GardV1B1	Poor	<20%	3	Low	No
Mac4V1B1	Poor	<20%	4	Moderate/High	Probable
Mac4V1B2	Very Poor	<20%	3	High	Yes
Mac4V1B3	Very Poor	<20%	4	Moderate	Probable
Mac4V2B1	Very Poor	20-40%	3	High	Probable
Mac4V2B2	Very Poor	<20%	3	High	No
Mac4V2B3	Very Poor	<20%	2.5	High	Probable
Mac4V3B1	Very Poor	20-40%	3	High	Probable
Mac4V4B1	Very Poor	20-40%	3	Moderate	Probable
Mac4V4B2	Very Poor	20-40%	4	Moderate	No
Mac4V4B3	Very Poor	20-40%	5.5	Moderate	Probable
Mac4V5B1	Very Poor	20-40%	2.5	Moderate	Probable
Mac4V5B2	Very Poor	20-40%	3	Moderate	Probable
Mac5V1B1	Very Poor	20-40%	3	High	Probable
Mac5V1B2	Poor	<40%	5.5	Moderate	No
Mac5V1B3	Very Poor	<40%	7	Moderate	No
Mac5V1B4	Very Poor	20-40%	4	Moderate	No
Mac6V1B1	Very Poor	<20%	3	Moderate	No
Mac6V1B2	Very Poor	<20%	4	Moderate	No
Mac7V1B1	Very Poor	20-40%	3	Moderate	No
Mac8V1B2	Very Poor	<20%	3	Moderate	Probable
MartV1B1	Very Poor	<20%	4	High	Probable
MartV2B1	Very Poor	<20%	3.5	Moderate/High	No
MartV2B2	Very Poor	<20%	6	Moderate/High	No
MartV2B3	Very Poor	<20%	3.5	Moderate/High	No
MartV3B2	Very Poor	<20%	3	Moderate/High	No
Mk2594V1B1	Very Poor	<20%	4	Low	No
Mk2594V1B2	Very Poor	20-40%	7	Low/Moderate	No
MK2594V1B3	Very Poor	20-40%	4	Moderate	No
Mk2594V2B1	Very Poor	20-40%	4	Moderate/High	No
Mk2594V2B2	Very Poor	<20%	5	Moderate	No
Mk2594V3B1	Very Poor	20-40%	3.5	Moderate	No
Mk2594V3B2	Very Poor	<40%	4	Moderate	No
Mk2594V4B1	Very Poor	<20%	4.5	Low/Moderate	No
Mk2594V4B2	Very Poor	20-40%	4	Moderate/High	No
Mk2594V5B2	Very Poor	20-40%	5	Moderate/High	No
Mk2594V6B1	Very Poor	<40%	5	Moderate	No

Sample	***Inclusion Sorting***	***Amount of Inclusions***	***Largest Inclusion Size (mm)***	***Amount of Voids***	***Lamentation***
Mk2594V6B2	Very Poor	<40%	7	Moderate	No
NineMRV4B1	Poor	<20%	4	Moderate	No
NineMRV4B2	Very Poor	20-40%	3.5	Moderate/High	No
PortgV1B1	Very Poor	<20%	6	Moderate	No
PortgV2B2	Very Poor	<20%	6	Moderate	No
RenHsV1B1	Very Poor	<20%	2.5	Moderate/High	Yes
RenHsV1B2	Very Poor	<20%	2.5	Moderate/High	Yes
RvHv2V1B1	Very Poor	20-40%	4.5	Moderate/High	Yes
RvHv2V1B2	Very Poor	<40%	4.5	High	Yes
RvHv2V2B1	Very Poor	<20%	8	High	Probable
RvHv2V2B2	Very Poor	<20%	5	High	No
RvHv2V2B3	Very Poor	20-40%	6.5	High/Very High	Yes
RvHv2V3B1	Very Poor	20-40%	4	High	Yes
RvHv2V3B2	Very Poor	20-40%	7.5	High	Yes
RvHv2V3B3	Very Poor	20-40%	6	High	Yes
ScacV1B2	Very Poor	<20%	3.5	Low	No
ScacV2B1	Poor	20-40%	5.5	High	Yes
ScacV3B1	Very Poor	<40%	5	High	No
SimV1B1	Very Poor	<40%	3.5	High/Very High	No
SimV1B2	Poor	<40%	4	High/Very High	No
SimV1B3	Very Poor	20-40%	4	Moderate	No
SP262V1B1	Very Poor	20-40%	6	Low	No
SP262V1B2	Very Poor	20-40%	7	Low	No
SP262V2B1	Very Poor	<40%	5.5	Low/Moderate	No
SP262V2B2	Very Poor	<40%	5	Low	No
SP262V2B3	Very Poor	<40%	5	Low	No
SP262V2B4	Very Poor	20-40%	6.5	Low/Moderate	No
StBnvV1B1	Poor	20-40%	4	Moderate/High	No
StBnvV1B2	Poor	20-40%	3	Moderate/High	No
VintV1B1	Poor	<20%	2.5	Moderate	Probable
VintV2B1	Very Poor	20-40%	2.5	Moderate	No
VintV2B2	Very Poor	<20%	4	High	No
VintV3B1	Poor	<20%	4.5	Moderate/High	No
VinVV1B2	Poor	<40%	5	Moderate/High	No
VinVV1B1	Very Poor	<40%	2.5	Moderate	No
VinVV1B3	Very Poor	<40%	4.5	Moderate/High	Probable
WickhV1B1	Poor	<20%	2.5	High	Probable
WickhV2B1	Poor	<40%	4	High	Probable

Table 7.2. Summary of Manufacturing Technique and Firing Atmosphere

Sample	*Coiling Visible*	*Matrix Sintering*	*Firing Atmosphere*
GardV1B1	No	Yes	Reduced, cooled rapidly in air; sharp core margins
ScacV2B1	No	Yes	Oxidized, organics likely not originally present; no core
BCV2B1	Possible	Yes	Reduced, organics not originally present; diffuse core margins
BCV2B2	Possible	Yes	Reduced, organics not originally present; diffuse core margins
BJRV1B2	Possible	Yes	Oxidized, organics originally present
CatCrkV1B1	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
EgV1B1	Possible	Yes	Oxidized, organics likely not originally present; no core
Mac4V1B2	Possible	Yes	Oxidized, organics likely not originally present; no core
Mac4V2B1	Possible	Yes	Oxidized, organics likely not originally present; no core
Mac4V3B1	Possible	Yes	Oxidized, organics likely not originally present; no core
Mac4V4B3	Possible	No	Reduced, organics may/may not have been originally present; no core
Mac6V1B1	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
Mac6V1B2	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
Mac8V1B2	Possible	Yes	Oxidized, organics likely not originally present; no core
MartV3B2	Possible	Yes	Oxidized, organics likely not originally present; no core
MK2594V1B3	Possible	Yes	Reduced, organics not originally present; diffuse core margins
Mk2594V2B1	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
NineMRV4B1	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
NineMRV4B2	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
RenHsV1B1	Possible	Yes	Oxidized, organics likely not originally present; no core
RenHsV1B2	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
RvHv2V2B1	Possible	Yes	Oxidized, organics likely not originally present; no core
RvHv2V3B1	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
RvHv2V3B2	Possible	Yes	Oxidized, organics likely not originally present; no core
RvHv2V3B3	Possible	No	Reduced, cooled rapidly in air; sharp core margins
SimV1B1	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
SimV1B3	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
StBnvV1B1	Possible	Yes	Reduced, organics not originally present; diffuse core margins
StBnvV1B2	Possible	Yes	Reduced, organics not originally present; diffuse core margins
VinVV1B1	Possible	Yes	Reduced, cooled rapidly in air; sharp core margins
WickhV2B1	Possible	Yes	Reduced, organics not originally present; diffuse core margins
BCV1B1	Yes	Yes	Oxidized, organics originally present
BCV1B2	Yes	Yes	Oxidized, organics originally present
BCV1B3	Yes	Yes	Oxidized, organics originally present
BCV4B1	Yes	No	Oxidized, organics likely not originally present; no core
BCV4B2	Yes	No	Oxidized, organics likely not originally present; no core
BJRV1B1	Yes	Yes	Oxidized, organics originally present
BJRV1B3	Yes	Yes	Oxidized, organics originally present
CotV1B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
FergV1B1	Yes	No	Reduced, cooled rapidly in air; sharp core margins
FexV1B1	Yes	No	Reduced, organics not originally present; diffuse core margins
Mac4V1B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mac4V1B3	Yes	Yes	Oxidized, organics likely not originally present; no core
Mac4V2B2	Yes	No	Reduced, cooled rapidly in air; sharp core margins
Mac4V2B3	Yes	No	Oxidized, organics likely not originally present; no core
Mac4V4B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mac4V4B2	Yes	No	Reduced, cooled rapidly in air; sharp core margins
Mac4V5B1	Yes	Yes	Reduced, organics may/may not have been originally present; no core

Sample	***Coiling Visible***	***Matrix Sintering***	***Firing Atmosphere***
Mac4V5B2	Yes	Yes	Reduced, organics not originally present; diffuse core margins
Mac5V1B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mac5V1B2	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mac5V1B3	Yes	Yes	Oxidized, organics likely not originally present; no core
Mac5V1B4	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mac7V1B1	Yes	Yes	Oxidized, organics likely not originally present; no core
MartV1B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
MartV2B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
MartV2B2	Yes	Yes	Oxidized, organics likely not originally present; no core
MartV2B3	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mk2594V1B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mk2594V1B2	Yes	Yes	Oxidized, organics likely not originally present; no core
Mk2594V2B2	Yes	Yes	Reduced, organics not originally present; diffuse core margins
Mk2594V3B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mk2594V3B2	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mk2594V4B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mk2594V4B2	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mk2594V5B2	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mk2594V6B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
Mk2594V6B2	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
PortgV1B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
PortgV2B2	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
RvHv2V1B1	Yes	Yes	Reduced, organics not originally present; diffuse core margins
RvHv2V1B2	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
RvHv2V2B2	Yes	No	Reduced, organics may/may not have been originally present; no core
RvHv2V2B3	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
ScacV1B2	Yes	No	Oxidized, organics likely not originally present; no core
ScacV3B1	Yes	No	Oxidized, organics likely not originally present; no core
SimV1B2	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
SP262V1B1	Yes	Yes	Oxidized, organics likely not originally present; no core
SP262V1B2	Yes	No	Oxidized, organics likely not originally present; no core
SP262V2B1	Yes	No	Oxidized, organics likely not originally present; no core
SP262V2B2	Yes	No	Oxidized, organics likely not originally present; no core
SP262V2B3	Yes	Yes	Oxidized, organics likely not originally present; no core
SP262V2B4	Yes	No	Oxidized, organics likely not originally present; no core
VintV1B1	Yes	Yes	Oxidized, organics likely not originally present; no core
VintV2B1	Yes	Yes	Reduced, organics not originally present; diffuse core margins
VintV2B2	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
VintV3B1	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
VinVV1B2	Yes	Yes	Reduced, organics not originally present; diffuse core margins
VinVV1B3	Yes	Yes	Reduced, cooled rapidly in air; sharp core margins
WickhV1B1	Yes	Yes	Oxidized, organics likely not originally present; no core

Part II: Petrographic Results

Crushed Rock Size

The results of the size category breakdown of the crushed rock inclusions from the 90 archaeological samples can be found in Table 7.5. The purpose of this measurement was to determine which size categories crushed rock occurs in and therefore, how frequently the crushed rock would be macroscopically visible when a ceramic sample was held as a hand sample. A single piece of sand is 0.50-2.0 mm and a fragment of gravel is 2.0-75 mm in size. Both sand and gravel are easily visible macroscopically. Anything smaller than the size of sand would be too difficult to identify accurately without magnification. Petrographic samples containing at least one inclusion per size category, regardless of how many total inclusions within that size category were present in the individual sample, were counted only once. In other words, this table does not tally the percentage of how much crushed rock temper was identified microscopically per sample in each size category, only whether or not the size category was present within each sample (see Table 7.3). The results of this analysis are that the most common size categories for crushed rock inclusions are between 0.50 mm to greater than 2.0 mm.

Most samples within this study fell between the three largest size categories: 0.50-1.0, 1.0-2.0, and >2.0 (n=75 or 83.3%). Two samples contained unique sizes of crushed rock. Sample Mac4V1B2 contained only crushed rock sized larger than 2.0 mm and Mk2594V3B2 contained crushed rock that varied in size from 0.0625 mm to greater than 2.0 mm. All remaining samples in the study contained crushed rock between 0.25 mm to greater than 2.0 mm. The remaining samples can be broken into three different size categories of crushed rock. Fifteen samples (16.7%) contained crushed rock 0.25 to greater than 2.0 mm in size, 68 samples contain crushed rock between 0.50-<2.0 mm, and 5 slides (5.6%) contain crushed rock 1.0 mm and larger. In summary, nearly all of the samples contain crushed rock greater than 1.0 mm in size and two-thirds of the assemblage contains crushed rock greater than 0.50 mm in size. Therefore, most of crushed rock found in the ceramic samples is the size of sand and gravel and is visible for identification without magnification.

Table 7.3. Summary of Common Crushed Rock Inclusions by Size Categories

Size Category	**0.0625-0.25**	**0.25-0.50**	**0.50-1.0**	**1.0-2.0**	**>2.0**
Number of samples	1	15	68	89	90
Percentage	1.1%	16.7%	75.5%	98.9%	100%

Table 7.5 presents the percentage of crushed rock broken down by size category for each archaeological sample. The purpose of this step of the analysis was to determine the frequently of each size category of crushed rock occurred in per sample. The results of this analysis show that the rushed rock occurs in varying amounts as gravel-sized fragments in all samples. The relative occurrence of crushed rock sized 2.0 mm or greater differed from about 64 to 100% of the total crushed rock within each sample. Crushed rock greater than 2.0 mm in size composed 90-100% of the total crushed rock inclusions in the slides, n=51 or 56.7%. The crushed rock >2.0 mm made up the total inclusions 80-89%, about a third of the time (32.2% or n=29). To summarize, crushed rock inclusions 2.0 mm or greater in size made up 80-100% of the total crushed rock temper in 88.9% (n=80) of the samples examined. The remaining 10 samples contain approximately 64-79.9% crushed rock inclusions greater than >2.0 mm in size (11.1%). These results show that there is clearly a preference towards larger-sized crushed rock fragments as temper.

Total Amount of Crushed Rock Inclusions

There is a large amount of variation in how much crushed rock is present within each archaeological sample. The total amount of aplastic inclusions present in a vessel affects the technology and functionality of the final product produced (Rice 1987: 231). Table 7.4, presents the percentage of total crushed rock inclusions per sample in 5% increments. Dividing the relative amount of crushed rock into arbitrary groups is useful at this stage of the analysis to look for possible clusters of samples in small segments, hence the choice of a 5% stepped increase. Table 7.4, shows a clustering of samples (n=71 or 78.9%) in the 15.1-35% category of total crushed rock inclusions. A calculation of the population standard deviation ($\sigma=8.3605$), has a variance of $\sigma^2=69.898$ and a mean of 26.3. Therefore, at one standard deviation (68.3% confidence level), samples with a combined crushed rock inclusion count of 17.92-34.73% are similar. This confidence level includes 56 (or 62.2%) of all of the archaeological samples (Table 7.5). In this model, samples containing less than 17.9% crushed rock inclusions would be categorized as having a low temper content. Samples with 17.9-34.7% crushed rock would be labeled as moderate and samples with greater than 34.7%, as high. At the 90% confidence level (1.645σ), samples containing 12.5-40.2% crushed rock inclusions are lumped together (Table 7.6). This analysis includes 83 (92.2%) of the total ceramic assemblage. With this more inclusive analysis, samples with less than 12.5% crushed rock inclusions would be labeled as low temper; samples between 12.5-40.2% as moderate, and greater than 40.2% as high.

Table 7.4. Arbitrary Breakdown of the Percentage of Crushed Rock Inclusions in a 5% Stepped Grade.

	0.50-10.0%	10.1-15%	15.1-20%	20.1-25%	25.1-30%	30.1-35%	35.1-40%	40.1-45.0%	45.1-50%
No.	1	6	17	16	19	19	8	2	2
Percentage	1.1	6.7	18.9	17.8	21.1	21.1	8.9	2.2	2.2

Types of Crushed Rock Inclusions

The 90 archaeological samples can be divided into three broad petrographic groups based on the type of crushed rock inclusions (Table 7.6). Using only the type of crushed rock present within each sample, there is a minimum of 46 vessels represented by the 90 slides. Table 7.6 presents the most basic division possible for the assemblage. Pottery samples in Group I are tempered with quartz-rich rocks, the rocks in Group II are felspar-rich, and the rocks in Group III are dominated by mafic minerals. A total of 11 different types of rocks were identified in the 90 samples: Gabbro/diorite, granite, granite schist, granodiorite, indeterminate feldspar-based schist, monzonite, pyroxene gneiss, pyroxene schist, syenite, quartzofeldspathic gneiss, and talc schist. Of these rocks, six are metamorphic (granite schist, pyroxene gneiss, pyroxene schist, quartzofeldspatic gneiss, talc schist, and the indeterminate feldspar-rich schist) and the remaining rocks are plutonic igneous. All of the igneous rocks examined in this study showed signs of moderate to high levels of metamorphism, which is to be expected with the geologic history of the Northeastern American basement rocks (see Chapter 1). All four types of igneous rocks are represented in the sample: felsic, intermediate, mafic, and ultramafic.

Diorite and gabbro rocks are mafic igneous rocks which are so macroscopically similar that they are often combined into a single group. Petrographic analysis is required to distinguish these rock types apart. Diorite forms intrusive continental magmas while gabbro is usually part of the oceanic crust (Pidwirny 2013a). Dark-colored minerals are common in all mafic rocks, especially hornblende and clinopyroxene; however, “hornblende is more common in diorite and andesite, and clinopyroxene is more common in gabbros and basalts” (Perkins 1998: 115). The relatively high percentages of mafic minerals in these rocks produce dark-colored matrixes. Colors include light to very dark greys, greens, blues, blue-greens, and blacks. Both diorite and gabbro lack K-feldspar, this makes them easy to distinguish from granitoids. Diorite is composed of 50-85% light-colored minerals, of which, 80-100% are plagioclase feldspars. Dark-colored minerals in diorite include hornblende, pyroxenes, sphene, apatite, zircon, and garnets; these minerals make up 15-50% of the total rock matrix (Schumann 1993: 220). Gabbro is the darkest of the plutonic igneous rocks because of the presence of plagioclase feldspar, orthopyroxene, clinopyroxene and olivine minerals. Gabbro is composed of 35-80% light-colored minerals, of these plagioclase feldspars consist of 80-100%. Gabbro has 0-20% quartz inclusions and 20-65% mafic minerals (Schumann 1993: 220).

Granite is a coarse-grained, silica-rich, plutonic (intrusive felsic) igneous rock (Perkins 1998: 114). Granite is the most abundant rock on the planet (Bjornerud 2005:40); it forms through continental magma (Pidwirny 2013a). All granites have a coarse texture with minerals easily visible without a microscope (larger than 1 mm in size). The granite family also includes granodiorite. Granitoids or quartz-feldspar-rich plutonic rocks appear light-colored because of their high proportions of quartz and feldspar inclusions (Schumann 1993: 201). By definition, granite is a rock with greater than 80% light-colored quartz and feldspar mineral inclusions, and has more k-feldspar (35-100%) than plagioclase feldspar (0-65%). Accessory minerals that make up a granitoid include dark-colored hornblende, augite, apatite, zircon, magnetite and brightly-colored biotite and muscovite micas (Schumann 1993: 201). Granite rocks can vary in color (white, yellow, grey, brown, red, and blue) because of the oxidization of iron within the feldspars and minor mineral inclusions (Perkins 1998: 114). Variations of granite are typed by their minor mineral constitutions, i.e. biotite-granite.

Granodiorite is part of the granite family and appears extremely similar to granite; its major differentiating attribute from granite is that granodiorite contains more plagioclase feldspar than K-feldspars (Perkins 1998: 114). Granodiorite is considered a light-colored, coarse-crystalline rock (intrusive felsic) but it often appears darker than granite because of larger proportions of mafic minerals and plagioclase feldspars (Schumann 1993: 214). Light-colored minerals make up

60-95% of the total body, of which 20-60% includes quartz and 40-80% includes feldspars. Plagioclase feldspars make up 65-100% of the total feldspar inclusions, thus it is the major distinguisher of granodiorite from granite (Schumman 1993: 214). Like granite, granodiorite forms from continental magma flows (Pidwirny 2013a).

The Syenite family includes syenite, monzonite, and foyiate. This group of rocks looks very similar to granitoids, except that they lack the elevated proportions of quartz. Syenite is a medium-to coarse-grained, light-colored (plutonic felsic) igneous rock (Perkins 1998: 115). Light-colored minerals, including 80-100% feldspars and 0-20% quartz, make up 60-100% of the total mineral composition of syenite (Schumann 1993: 216). Syenite is classified as an intermediate rock because it contains more alkali feldspars than plagioclase feldspars (Perkins 1998: 115). When quartz occurs in quantities greater than 5%, the rock is classified as Quartz Syenite. The colors of syenite vary from light to dark grey, red, and blue (Schumann 1993: 216).

Monzonite is part of the Syenite family of rocks. Like syenite, monzonite is a plutonic intermediate rock that varies in color from light to dark grey, green, brown, and red. Unlike syenite, monzonite has roughly equal proportions of alkali and plagioclase feldspar (Perkins 1998: 115). Light-colored minerals, including feldspar (80-100%) and quartz (0-20%) make up the majority of the rock’s composition. When quartz occurs in quantities greater than 5%, the rock is classified as Quartz Monzonite. Minor mineral components include pyroxenes, hornblende, and biotite; these minerals make up 10-45% of the total composition (Schumann 1993: 218).

Metamorphosed igneous rocks are schists and gneisses. Schist and gneiss have moderate to coarse grain sizes due to recrystallization of the minerals during metamorphism. Schist is differentiated from gneiss by texture (Blatt and Tracy 1996: 365). Schist is a medium-to-coarse-grained foliated rock that forms during moderate to high metamorphism. Primary minerals of schist include micas, chlorite, quartz, plagioclase, garnet, staurolite, kyanite, cordierite, sillimanite, and hematite (Pidwirny 2012b). Schist has a layered texture. Gneiss is a coarse-grained, foliated rock formed under very high metamorphic processes. Minerals in gneiss have been recrystallized into alternating light- and dark-colored bands (Pidwirny 2012b). Primary minerals of gneiss include biotite, quartz, plagioclase, orthoclase, sillimanite, garnet, cordierite, and iron oxides (Blatt and Tracy 1996: Table 18-1).

Table 7.5. Division of Crushed Rock Inclusions at the 68.3% and 90.0% Confidence Intervals

Sample	*Total Crushed Rock (%)*	*Low Temper (σ)*	*Moderate Temper (σ)*	*High Temper (σ)*	*Low Temper (1.65σ)*	*Moderate Temper (1.65σ)*	*High Temper (1.65σ)*
WickhV1B1	8.3	X			X		
PortgV2B2	11.7	X			X		
GardV1B1	11.7	X			X		
BCV4B1	13.3	X				X	
VintV3B1	13.5	X				X	
Mac4V5B2	14.5	X				X	
BCV4B2	14.7	X				X	
ScacV1B2	15.2	X				X	
Mac8V1B1	15.2	X				X	
Mac4V4B1	15.3	X				X	
RenHsV1B1	15.3	X				X	
MartV2B3	15.4	X				X	
MartV2B2	15.8	X				X	
BCV1B1	16.0	X				X	
Mac4V1B2	16.3	X				X	
Mac4V1B1	16.5	X				X	
VintV1B1	17.0	X				X	
MartV1B1	17.2	X				X	
FexV1B1	17.5	X				X	
Mac4V2B2	17.6	X				X	
RenHsV1B2	18.2		X			X	
CotV1B1	18.4		X			X	
EgV1B1	19.0		X			X	
BCV1B2	19.9		X			X	
VintV2B1	21.1		X			X	
VintV2B2	21.2		X			X	
VinVV1B1	21.2		X			X	
Mac4V2B1	21.7		X			X	
MartV2B1	22.3		X			X	
StBnvV1B2	22.5		X			X	
SimV1B3	22.7		X			X	
NineMRV4B2	22.9		X			X	
RvHv2V2B1	22.9		X			X	
Mac4V5B1	23.0		X			X	
Mac4V2B3	23.1		X			X	
MartV3B2	23.4		X			X	
Mk2594V4B1	24.2		X			X	
FergV1B1	25.0		X			X	
Mk2594V2B1	25.0		X			X	
RvHv2V3B2	25.0		X			X	
Mac6V1B1	25.2		X			X	
NineMRV4B1	25.8		X			X	
VinVV1B3	25.9		X			X	
Mac4V1B3	26.2		X			X	
PortgV1B1	26.3		X			X	
BCV2B1	27.2		X			X	
RvHv2V1B1	27.3		X			X	
Mac4V3B1	28.2		X			X	
Mac5V1B1	28.7		X			X	
SP262V2B4	28.9		X			X	

Sample	***Total Crushed Rock (%)***	***Low Temper (σ)***	***Moderate Temper (σ)***	***High Temper (σ)***	***Low Temper (1.65σ)***	***Moderate Temper (1.65σ)***	***High Temper (1.65σ)***
Mac5V1B4	29.3		X			X	
RvHv2V2B3	29.3		X			X	
Mac5V1B2	29.4		X			X	
RvHv2V2B2	29.4		X			X	
WickhV2B1	29.6		X			X	
MK2594V1B3	29.6		X			X	
Mk2594V1B1	29.7		X			X	
RvHv2V3B1	29.8		X			X	
SimV1B2	30.0		X			X	
BJRV1B2	30.1		X			X	
VinVV1B2	30.1		X			X	
BJRV1B3	30.5		X			X	
BCV2B2	30.5		X			X	
Mac4V4B3	31.0		X			X	
ScacV2B1	31.5		X			X	
Mac4V4B2	31.6		X			X	
Mk2594V2B2	32.1		X			X	
Mk2594V5B2	32.3		X			X	
BJRV1B1	33.2		X			X	
CatCrkV1B1	33.4		X			X	
SP262V2B1	33.7		X			X	
Mk2594V6B1	34.0		X			X	
Mk2594V3B1	34.4		X			X	
Mk2594V4B2	34.4		X			X	
Mac7V1B1	34.6		X			X	
StBnvV1B1	34.7		X			X	
Mk2594V1B2	34.9			X		X	
SP262V2B3	35.0			X		X	
SP262V1B2	35.4			X		X	
BCV1B3	35.5			X		X	
Mac6V1B2	35.6			X		X	
SimV1B1	35.9			X		X	
Mk2594V3B2	36.2			X		X	
RvHv2V1B2	36.3			X		X	
RvHv2V3B3	37.6			X		X	
ScacV3B1	39.9			X		X	
SP262V2B2	42.3			X			X
Mk2594V6B2	43.8			X			X
SP262V1B1	45.3			X			X
Mac5V1B3	46.9			X			X

Table 7.6. Division of Ceramic Vessel Lots into Basic Groups According to Crushed Rock Composition

Sample	*Vessel Lot*	*Glacial Region*	*Group I (Quartz-rich)*	*Group II (Feldspar-rich)*	*Group III (Mafic-rich)*
BCV1B1	4	Ontario	X		
BCV1B2	4	Ontario	X		
BCV1B3	18	Ontario		X	
BCV2B1	1	Ontario			X
BCV2B2	1	Ontario			X
BCV4B1	18	Ontario		X	
BCV4B2	18	Ontario		X	
BJRV1B1	31	Ontario			X
BJRV1B2	31	Ontario			X
BJRV1B3	31	Ontario			X
CatCrkV1B1	5	Erie		X	
CotV1B1	6	Hudson	X		
EgV1B1	2	Hudson			X
FergV1B1	7	Oneida	X		
FexV1B1	19	Oneida		X	
GardV1B1	8	Hudson	X		
Mac4V1B1	32	Ontario		X	
Mac4V1B2	20	Ontario			X
Mac4V1B3	20	Ontario			X
Mac4V2B1	45	Ontario			X
Mac4V2B2	45	Ontario			X
Mac4V2B3	20	Ontario			X
Mac4V3B1	9	Ontario			X
Mac4V4B1	16	Ontario			X
Mac4V4B2	16	Ontario			X
Mac4V4B3	16	Ontario			X
Mac4V5B1	16	Ontario			X
Mac4V5B2	16	Ontario			X
Mac5V1B1	14	Ontario			X
Mac5V1B2	14	Ontario			X
Mac5V1B3	14	Ontario			X
Mac5V1B4	14	Ontario			X
Mac6V1B1	28	Ontario			X
Mac6V1B2	28	Ontario			X
Mac7V1B1	33	Ontario		X	
Mac8V1B1	34	Ontario		X	
MartV1B1	21	Ontario			X
MartV2B1	21	Ontario			X
MartV2B2	21	Ontario			X
MartV2B3	41	Ontario	X		
MartV3B2	41	Ontario	X		
Mk2594V1B1	10	Erie	X		
Mk2594V1B2	10	Erie	X		
MK2594V1B3	10	Erie	X		
Mk2594V2B1	10	Erie	X		
Mk2594V2B2	37	Erie	X		
Mk2594V3B1	10	Erie	X		
Mk2594V3B2	10	Erie	X		
Mk2594V4B1	22	Erie		X	
Mk2594V4B2	42	Erie			X
Mk2594V5B2	29	Erie			X

Sample	*Vessel Lot*	*Glacial Region*	*Group I (Quartz-rich)*	*Group II (Feldspar-rich)*	*Group III (Mafic-rich)*
Mk2594V6B1	44	Erie		X	
Mk2594V6B2	44	Erie		X	
NineMRV4B1	40	Erie		X	
NineMRV4B2	40	Erie		X	
PortgV1B1	11	Ontario			X
PortgV2B2	11	Ontario			X
RenHsV1B1	15	Ontario		X	
RenHsV1B2	15	Ontario		X	
RvHv2V1B1	30	Ontario			X
RvHv2V1B2	23	Ontario			X
RvHv2V2B1	30	Ontario			X
RvHv2V2B2	46	Ontario			X
RvHv2V2B3	35	Ontario		X	
RvHv2V3B1	38	Ontario		X	
RvHv2V3B2	38	Ontario		X	
RvHv2V3B3	38	Ontario		X	
ScacV1B2	12	Ontario			X
ScacV2B1	12	Ontario			X
ScacV3B1	24	Ontario			X
SimV1B1	25	Oneida		X	
SimV1B2	25	Oneida		X	
SimV1B3	25	Oneida		X	
SP262V1B1	26	Erie		X	
SP262V1B2	26	Erie		X	
SP262V2B1	3	Erie		X	
SP262V2B2	26	Erie		X	
SP262V2B3	3	Erie		X	
SP262V2B4	3	Erie		X	
StBnvV1B1	36	Erie			X
StBnvV1B2	36	Erie			X
VintV1B1	27	Oneida	X		
VintV2B1	43	Oneida			X
VintV2B2	39	Oneida			X
VintV3B1	39	Oneida			X
VinVV1B1	17	Ontario		X	
VinVV1B2	17	Ontario		X	
VinVV1B3	17	Ontario		X	
WickhV1B1	13	Oneida	X		
WickhV2B1	13	Oneida	X		

Sphericity, Angularity, and Evidence of Weathering of Crushed Rock Inclusions

Each aplastic inclusion was measured for its sphericity and degree of roundness (see Chapter 5). All crushed rock inclusions analyzed in the archaeological samples had low sphericity and a varying degree of angularity. None of the crushed rock inclusions from any of the samples had rounded edges. However, six samples contained crushed rock with sub-angular edges (n=6.70%) mixed with angular and very angular edges. The remaining samples had either only very angular (n=27 or 30.0%) or angular combined with very angular edges (n=57 or 63.3%).

All samples in the study showed at least one trait of minor weathering and alteration processes including iron staining, mineral surface dilution and/or boundary damage, and mineral alteration (Table 7.8). Thirty-six samples (40%) contained evidence of moderate to severe mineral weathering and decomposition. Sites which lack one or more samples containing disintegrating minerals are Cottage, Egli, Ferguson, Felix, Gardepel, Ninemile Road, Portage, and Vinette.

Size of Isolated Minerals

Isolated minerals can be divided into two groups, those with sub-rounded to well-rounded edges (sand) and those with sub-angular to very angular edges (grit). Both sand and grit occurred in all size categories from 0.0625 mm to greater than 2.0 mm in diameter. Table 7.7, summaries the frequency of isolated minerals by size category. All 90 ceramic samples contained sand and grit in the 0.0625-0.50 mm size category. The frequency of sand drops dramatically above 0.50 mm in diameter, reducing down to 62.22%; 56 samples contain sand 0.50-1.0 mm in size, and six samples (6.6%) contain sand greater than 1.0 mm in size. The relative frequency of isolated angular grit fragments remains fairly stable in all size categories, never dropping below 93%.

Table 7.7. Summary of Isolated Angular and Rounded Mineral Inclusions by Size Category.

Size Category	Grit (Total No. Samples)	Grit (%)	Sand (Total No. Samples)	Sand (%)
0.0625-0.25	90	100	90	100
0.25-0.50	90	100	90	100
0.50-1.0	89	98.9	56	62.2
1.0-2.0	86	95.6	4	4.4
>2.0	84	93.3	2	2.2

Table 7.8. Evidence of Weathering, Alteration and Fracturing in the Ceramic Samples

Sample	***Minor Mineral Oxidization***	***Major Mineral Oxidization***	***Dilution and/or Damage of Mineral Surfaces***	***Metamorphic Alteration***	***Mineral Fracturing***
BCV1B1		X		X	
BCV1B2	X		X		
BCV1B3		X	X	X	
BCV2B1		X		X	
BCV2B2		X	X	X	
BCV4B1		X		X	
BCV4B2		X	X	X	
BJRV1B1		X	X	X	X
BJRV1B2		X	X	X	X
BJRV1B3		X	X	X	X
CatCrkV1B1		X	X	X	
CotV1B1	X		X	X	
EgV1B1	X			X	
FergV1B1	X		X	X	
FexV1B1	X		X	X	X
GardV1B1			X	X	
Mac4V1B1		X	X	X	X
Mac4V1B2	X			X	X
Mac4V1B3		X		X	
Mac4V2B1		X		X	
Mac4V2B2		X		X	
Mac4V2B3		X		X	
Mac4V3B1	X			X	X
Mac4V4B1	X			X	X
Mac4V4B2	X		X	X	X
Mac4V4B3	X		X	X	X
Mac4V5B1	X			X	X
Mac4V5B2	X		X	X	X
Mac5V1B1			X	X	X
Mac5V1B2			X	X	X
Mac5V1B3	X		X	X	X
Mac5V1B4		X	X	X	X
Mac6V1B1	X		X	X	X
Mac6V1B2		X	X	X	X
Mac7V1B1		X	X	X	X
Mac8V1B1			X	X	X
MartV1B1	X		X	X	
MartV2B1	X		X	X	
MartV2B2	X		X	X	
MartV2B3	X		X	X	
MartV3B2	X		X	X	
Mk2594V1B1	X		X	X	X
Mk2594V1B2	X		X	X	X
MK2594V1B3	X		X	X	
Mk2594V2B1		X	X	X	
Mk2594V2B2		X		X	
Mk2594V3B1		X		X	X
Mk2594V3B2		X		X	X
Mk2594V4B1		X	X	X	X
Mk2594V4B2	X			X	
Mk2594V5B2		X		X	

Sample	***Minor Mineral Oxidization***	***Major Mineral Oxidization***	***Dilution and/or Damage of Mineral Surfaces***	***Metamorphic Alteration***	***Mineral Fracturing***
Mk2594V6B1	X		X		
Mk2594V6B2	X		X	X	X
NineMRV4B1	X			X	
NineMRV4B2	X				
PortgV1B1	X			X	
PortgV2B2	X			X	
RenHsV1B1	X		X	X	
RenHsV1B2	X		X	X	
RvHv2V1B1		X	X	X	X
RvHv2V1B2		X	X	X	
RvHv2V2B1		X		X	X
RvHv2V2B2	X			X	
RvHv2V2B3	X			X	
RvHv2V3B1	X			X	
RvHv2V3B2	X			X	
RvHv2V3B3		X		X	
ScacV1B2	X		X	X	X
ScacV2B1		X	X	X	
ScacV3B1		X	X	X	X
SimV1B1	X		X	X	
SimV1B2		X	X	X	
SimV1B3		X	X	X	X
SP262V1B1	X			X	X
SP262V1B2	X			X	X
SP262V2B1	X			X	X
SP262V2B2	X			X	X
SP262V2B3		X		X	X
SP262V2B4	X			X	X
StBnvV1B1		X	X	X	X
StBnvV1B2		X	X	X	
VintV1B1	X		X	X	
VintV2B1	X		X	X	
VintV2B2	X		X	X	
VintV3B1	X		X	X	
VinV1B2	X		X	X	
VinVV1B1		X	X	X	X
VinVV1B3	X			X	X
WickhV1B1	X		X	X	
WickhV2B1	X		X	X	

Frequency of Isolated Minerals

The average sand content for the assemblage was 9.1%. The lowest frequency of sand recorded was 2.7% (SP262V2B3), and the highest was 22.0% (Mac4V2B2). A population standard deviation of sand frequency was conducted at the 68.3% and 90% confidence intervals (Table 7.10). At the 68.3% confidence interval, samples containing less than 5.2% sand are consider low-sand, 5.2-13% moderate-sand, and more than 13% high-sand. At this interval, five samples would be considered low-sand, 71 are moderate, and 14 are high-sand content. At the 90% confidence level, moderate-sand category would include percentages between 2.7-15.5%. Since the lowest sand content recorded was 2.7%, the low-sand group at the 90% percentile does not exist. Six samples would fall into the high-sand group and the remaining 84 samples would be considered moderate-sand.

Grit was generally about twice more common than sand, consisting of 7.2-33.7 % of the total fabric of each individual sample. On average, isolated grit fragments made up about 20% of each sample. A population standard deviation of the frequency of isolated angular fragments was conducted at the 68.3% and 90% confidence intervals (Table 7.11). Samples at the 68.3% confidence interval are divided into low-grit (n=15), moderate-grit (n=59), and high-grit (n=16) categories. The moderate-grit category is expanded at the 90%, including 80 of the samples. Low-grit samples are reduced to two, and the high-grit category includes eight samples.

The minimum amount of total isolated inclusions recorded for any sample was 11.4% (SP262V2B3). The highest combined rounded and angular inclusion rate for a single sample was 49.1% (GrdpeV1B1). Combining the frequency of isolated inclusions with the divisions of size, one sees two important trends. Firstly, both rounded and angular isolated minerals occur most commonly (100%) in the first two size classes (0.0625-0.50 mm). Secondly, the amount of variation in the frequency of inclusions is greater in the first two size classes, then it decreases as the size category increases (Table 7.9). To summarize, the variation in the frequency of isolated minerals significantly decreases above 0.50 mm in size.

Table 7.9. Summary of Total Isolated Rounded and Angular Inclusions.

Size Category	*Mean*	*Pop. Standard Dev.*	*Variance σ^2*	*68.3% (σ)*	*90% (1.65σ)*
0.0625-0.25	48.1	12.8	163.3	35.28-60.98	26.98-69.27
0.25-0.50	23.4	7.92	62.74	15.5-31.4	10.3-36.5
0.50-1.0	13.83	7.19	51.74	6.6-21.06	1.93-25.73
1.0-2.0	6.65	4.22	17.77	2.41-10.89	-0.32-13.63
>2.0	7.97	6.87	47.17	1.07-14.88	-3.38-19.34

Types of Isolated Mineral Inclusions

Rounded and angular isolated minerals were very common in all ceramic samples examined by this study. Twenty-five different types of minerals were identified in the 90 samples, many of the same minerals were found in almost every sample and occurred as both angular and rounded inclusions. Feldspars, quartz, and iron-rich opaque minerals occurred in all samples. Quartz was the most common mineral identified; quartz minerals averaged about 43.6% of the total isolated mineral content in each sample. The second-most common isolated mineral was k-feldspar (34.6%), including microcline, orthoclase, and perthite. Iron-rich opaques averaged 8.7% of all isolated minerals. On average, these three minerals together make-up approximately 87% of the isolated minerals within each sample. Other regularly occurring, low-frequency minerals, meaning less than 5% of the total isolated inclusions per sample, listed in order of commonality include: muscovite, clinopyroxene, hornblende, orthopyroxene, biotite, amphibole, spinel, chlorite, and flourite.

Table 7.10. Breakdown of Isolated Rounded Sand Inclusions at the 68.3% and 90% Confidence Levels

Sample	***Total Rounded Inclusions (%)***	***Low Sand (σ)***	***Moderate Sand (σ)***	***High Sand (σ)***	***Low Sand (1.65σ)***	***Moderate Sand (1.65σ)***	***High Sand (1.65σ)***
SP262V2B3	2.7	X				X	
RvHv2V2B3	3.5	X				X	
Mac5V1B3	3.5	X				X	
PortgV2B2	4.9	X				X	
Mk2594V3B2	4.9	X				X	
RvHv2V2B2	5.2		X			X	
Mac7V1B1	5.2		X			X	
MartV1B1	5.3		X			X	
SP262V1B1	5.4		X			X	
NineMRV4B2	5.5		X			X	
SimV1B1	5.5		X			X	
Mac5V1B4	5.6		X			X	
Mac4V2B3	5.6		X			X	
WickhV2B1	5.6		X			X	
Mac6V1B2	5.8		X			X	
Mk2594V6B2	5.9		X			X	
SimV1B2	5.9		X			X	
ScacV2B1	6.0		X			X	
BCV1B3	6.1		X			X	
Mk2594V6B1	6.1		X			X	
Mk2594V3B1	6.1		X			X	
Mac4V1B2	6.2		X			X	
Mac6V1B1	6.4		X			X	
MartV2B2	6.4		X			X	
PortgV1B1	6.4		X			X	
SimV1B3	6.4		X			X	
VinV1B2	6.5		X			X	
Mac4V4B2	6.6		X			X	
MartV3B2	6.7		X			X	
Mk2594V2B1	6.8		X			X	
BJRV1B2	6.8		X			X	
SP262V2B4	7.0		X			X	
Mac5V1B2	7.1		X			X	
BCV1B2	7.1		X			X	
MartV2B3	7.3		X			X	
Mk2594V4B2	7.3		X			X	
Mk2594V5B2	7.3		X			X	
Mac4V5B1	7.5		X			X	
VintV2B2	7.5		X			X	
ScacV3B1	7.5		X			X	
RvHv2V3B3	7.7		X			X	
Mac4V1B3	7.8		X			X	
VinVV1B3	7.9		X			X	
WickhV1B1	7.9		X			X	
BJRV1B3	8.0		X			X	
StBnvV1B1	8.0		X			X	
SP262V2B2	8.1		X			X	
BCV1B1	8.2		X			X	
RvHv2V1B2	8.3		X			X	
SP262V1B2	8.4		X			X	

Sample	***Total Rounded Inclusions (%)***	***Low Sand (σ)***	***Moderate Sand (σ)***	***High Sand (σ)***	***Low Sand (1.65σ)***	***Moderate Sand (1.65σ)***	***High Sand (1.65σ)***
Mk2594V1B2	8.7		X			X	
BCV4B2	8.7		X			X	
FexV1B1	8.7		X			X	
BJRV1B1	8.7		X			X	
NineMRV4B1	8.9		X			X	
RvHv2V1B1	9.1		X			X	
MK2594V1B3	9.1		X			X	
SP262V2B1	9.2		X			X	
EgV1B1	9.3		X			X	
FergV1B1	9.5		X			X	
Mk2594V2B2	9.6		X			X	
BCV4B1	9.6		X			X	
Mac5V1B1	10.1		X			X	
StBnvV1B2	10.2		X			X	
Mac4V2B1	10.2		X			X	
Mac4V4B3	10.5		X			X	
Mk2594V4B1	10.7		X			X	
CatCrkV1B1	11.0		X			X	
Mk2594V1B1	11.2		X			X	
RvHv2V3B1	11.6		X			X	
Mac4V5B2	12.1		X			X	
BCV2B1	12.2		X			X	
MartV2B1	12.6		X			X	
VinVV1B1	12.7		X			X	
Mac4V3B1	12.7		X			X	
RvHv2V2B1	12.7		X			X	
CotV1B1	13.2			X		X	
VintV2B1	13.2			X		X	
RvHv2V3B2	13.4			X		X	
VintV1B1	13.7			X		X	
RenHsV1B2	14.0			X		X	
Mac8V1B1	14.3			X		X	
BCV2B2	15.0			X		X	
GardV1B1	15.4			X		X	
VintV3B1	16.0			X			X
RenHsV1B1	16.8			X			X
Mac4V1B1	17.5			X			X
ScacV1B2	19.6			X			X
Mac4V4B1	22.0			X			X
Mac4V2B2	22.0			X			X

Table 7.11. Breakdown of Isolated Angular Grit Inclusions at the 68.3% and 90% Confidence Levels

Sample	***Total Grit Inclusions (%)***	***Low Grit (σ)***	***Moderate Grit (σ)***	***High Grit (σ)***	***Low Grit (1.65σ)***	***Moderate Grit (1.65σ)***	***High Grit (1.65σ)***
Mk2594V1B2	7.2	X			X		
SP262V2B3	8.6	X			X		
MartV2B3	11.0	X				X	
ScacV2B1	11.3	X				X	
StBnvV1B1	11.3	X				X	
Mac4V2B3	11.8	X				X	
RvHv2V2B2	12.1	X				X	
BCV1B3	12.4	X				X	
MartV1B1	12.8	X				X	
Mac4V2B2	13.1	X				X	
SP262V1B1	13.1	X				X	
Mk2594V1B1	13.4	X				X	
RvHv2V3B1	13.4	X				X	
Mac4V1B2	13.4	X				X	
Mk2594V5B2	13.8	X				X	
VinVV1B3	14.1		X			X	
PortgV1B1	14.3		X			X	
RvHv2V3B3	14.6		X			X	
NineMRV4B1	14.7		X			X	
BCV1B1	15.0		X			X	
RvHv2V3B2	15.2		X			X	
RvHv2V2B3	15.3		X			X	
BCV2B2	15.3		X			X	
Mk2594V6B1	15.3		X			X	
Mk2594V6B2	15.4		X			X	
Mk2594V4B1	15.5		X			X	
BJRV1B1	15.7		X			X	
Mk2594V3B2	15.8		X			X	
Mac4V1B3	16.0		X			X	
Mk2594V2B1	16.0		X			X	
Mac5V1B1	16.1		X			X	
MartV3B2	16.4		X			X	
Mk2594V3B1	16.4		X			X	
Mac4V1B1	16.5		X			X	
ScacV3B1	16.7		X			X	
VinV1B2	17.1		X			X	
BCV2B1	17.2		X			X	
SP262V2B1	17.5		X			X	
CatCrkV1B1	17.9		X			X	
SP262V1B2	18.5		X			X	
BJRV1B3	18.5		X			X	
SP262V2B2	18.6		X			X	
NineMRV4B2	19.1		X			X	
RenHsV1B2	19.2		X			X	
StBnvV1B2	19.3		X			X	
BJRV1B2	19.4		X			X	
Mk2594V4B2	19.5		X			X	
Mac4V2B1	19.6		X			X	
BCV1B2	19.9		X			X	
Mac6V1B1	20.0		X			X	

Sample	***Total Grit Inclusions (%)***	***Low Grit (σ)***	***Moderate Grit (σ)***	***High Grit (σ)***	***Low Grit (1.65σ)***	***Moderate Grit (1.65σ)***	***High Grit (1.65σ)***
FergV1B1	21.1		X			X	
MK2594V1B3	21.5		X			X	
Mac5V1B2	21.5		X			X	
SP262V2B4	21.7		X			X	
Mac5V1B4	22.1		X			X	
Mac5V1B3	22.3		X			X	
PortgV2B2	22.4		X			X	
BCV4B1	22.6		X			X	
RvHv2V2B1	22.6		X			X	
VintV1B1	22.7		X			X	
RvHv2V1B2	23.0		X			X	
Mac4V5B1	23.2		X			X	
VintV2B2	23.5		X			X	
MartV2B2	23.9		X			X	
RvHv2V1B1	24.1		X			X	
SimV1B1	24.2		X			X	
MartV2B1	24.2		X			X	
WickhV1B1	24.2		X			X	
Mac4V3B1	24.4		X			X	
SimV1B2	24.7		X			X	
WickhV2B1	24.9		X			X	
VinVV1B1	25.0		X			X	
Mk2594V2B2	25.2		X			X	
VintV3B1	25.8		X			X	
Mac4V4B1	26.2			X		X	
Mac8V1B1	26.3			X		X	
EgV1B1	27.3			X		X	
SimV1B3	27.3			X		X	
BCV4B2	27.5			X		X	
Mac7V1B1	28.2			X		X	
RenHsV1B1	28.4			X		X	
ScacV1B2	29.9			X		X	
FexV1B1	30.9			X			X
VintV2B1	31.5			X			X
Mac4V4B3	31.6			X			X
Mac4V5B2	32.0			X			X
Mac4V4B2	32.4			X			X
Mac6V1B2	33.6			X			X
CotV1B1	33.7			X			X
GardV1B1	33.7			X			X

Origin of Isolated Mineral Inclusions

All fabrics in the study are made up of at least 10% of these isolated mineral fragments. In almost all cases, these minerals are stained red, suggesting the presence of iron through either oxidization, leaching, or heating (Thompson and Thompson 1996: 62; Perkins 1998: 120-122). The work of geologist Robert LaFleur (1979) supports the author's hypothesis that these minerals are evidence of background minerals commonly found in glacial clay (Chapter 5). All 90 samples contain some proportion of quartz, feldspars, and opaque minerals. A population standard deviation was conducted on the combined total of these three mineral categories for the size groups of 0.0625-0.25 mm and 0.25-0.50 mm. The results show a population standard deviation of 10.88, with a variance of 118.36 and a mean of 63.45. At the 90% confidence interval (1.45σ), the average rate of quartz, feldspars, and opaque minerals by sample is 45.45-81.44%. Sites containing one or more samples consisting of low (less than 45.5%) natural isolated minerals include Broken Clock, Ninemile Road, Portage, and Riverhaven No. 2. Sites containing or more samples with high (greater than 81.4%) background noise: MacCauley Complex No. 4, McKendry, Riverhaven No. 2, Scaccia, and Sinking Ponds. All the remaining sites contain only samples with average (45.45-81.44%) amounts of glacial rock flour.

Two additional minerals are important to identify as probable background noise in the ceramic samples, muscovite mica and chlorite. Neither of these minerals were found in all samples but they do occur frequently throughout the data assemblage. Rounded and angular fragments of muscovite were identified in 87 samples and averaged about 3.2% of the total isolated mineral composition. Sites containing samples lacking muscovite: Broken Clock, MacCauley Complex No. 4, McKendry, Riverhaven No. 2, Simmons, Sinking Ponds, and Wickham. Chlorite was less commonly identified than muscovite; 15 samples contain isolated chlorite minerals. When present, chlorite composed approximately 0.5% of the total isolated mineral assemblage per sample. Sites with one or more samples containing chlorite minerals include Broken Clock, McKendry, MacCauley Complex No. 5, Ninemile Road, Portage, Riverhaven No. 2, Scaccia, Simmons, Sinking Ponds, and Vine Valley.

Part III: Division of Ceramic Fabrics

The author attempted to apply K-means clustering to the petrographic data in an attempt to create statistical groupings of early ceramic fabrics. The following groups of data were initially inputted into SPSS: glacial region, group, vessel lot, sample number, clay type, temper frequency, matrix, manufacturing technique, sintering, firing atmosphere, size of largest inclusion, grog, and void frequency. Despite all efforts by the author, no amount of removing data groups provided satisfactory clustering of fabrics that did not break up the four known control vessels (see Chapter 5). In the absence of a reliable statistical approach, the author chose to divide the fabrics based on the following groups of data: crushed rock, clay source, forming technique, ceramic texture, and firing atmosphere, duration, and temperature. The results of the division of fabrics analyzed by this study are listed in Table 7.12.

1) Crushed rock inclusions were divided based on the primary minerals that form the rock, e.g. feldspar, quartz, amphibole, etc. The size and frequency of the crushed rock is also very important and subgroups are divided based on low, moderate, or high proportions of crushed rock temper.
2) Clay sourcing through chemical analysis is an important aspect of ceramic studies (Rice 1987: 374, Table 13.1), however, very little chemical analysis of clay sources for early ceramic has been conducted in New York State. This is an avenue for future research. For the purposes of the current study, clays were divided by their frequency and types of isolated mineral inclusions <0.50 mm in size and by the original presence or absence of organics.
3) The forming technique of a vessel can be seen through the presence of specific types of voids (such as star-shaped vughes, or linear fissures) and the alignment of aplastic

inclusions. Fabrics with obvious coils were separated from fabrics with modified coils and those without coils. The assumption being that additional secondary techniques were applied to the later vessels, which removed all evidence of prior coils.

4) The firing temperature, duration, and atmosphere of any vessel can be indirectly seen in a petrographic vessel. Matrix vitrification, sintering, and mineral alteration are all evidence of elongated exposure to high temperatures. Organics begin to burn out of clays and move away from the center of the vessel wall, towards the outer surfaces the longer a vessel is exposed to heat. Firing cores suggest inadequate firing episodes.

Group I (Quartz-rich Crushed Rock)

Fabric Group I consists of 17 samples (9 total vessels) of quartz-rich ceramic vessels. Crushed rock inclusions in Group I consist of granite, metamorphosed granites (mostly granite schists) and metamorphic quartz-rich sandstones. All crushed rock inclusions show evidence of minor alteration and three vessels have crushed rock with major mineral damage and alteration. The frequency of crushed rock varies from 8.3-36.2% (average 23.9%) of the total matrix. A population standard deviation of the crushed rock totals in Group I at the 90% confidence interval shows a normal distribution of 9.8-38.0, which is slightly lower than the total assemblage population standard deviation of 12.5-40.2. These results suggest the frequencies of crushed rock in Group I are lower than average when measured against the total assemblage. Samples in Group I can be subdivided into three smaller groups based on the frequency of glacial rock flour and presence of organic material.

Group IA. Group IA contains a single sample, MartV2B3. This sample has low proportions of glacial rock flour (<13.9%), sedimentary rock, and moderately-well mixed with grog and low (15%) frequencies of crushed rock temper up to 3.5 mm in diameter. The vessel is formed with the coiling technique, lacks a laminated texture, and was fired in a reducing atmosphere long enough to begin sintering the matrix minerals.

Group IB. Fabrics in Group IB contain moderate rock flour (14.0-24.5%), mixed with 8-36% crushed rock inclusions, occasional degrading sedimentary rock fragments and occasional grog. The largest inclusions range from fine (2.5 mm) to coarse (7.0 mm) in size. The clays range from poorly-mixed to well-mixed variegated sedimentary clays that originally contained organic matter. Vessels are produced by the coiling technique and lack a laminated texture. Firing atmosphere and temperature conditions vary per vessel. All vessels except, FergV1B1 show signs of sintering.

Group IC. Fabrics in Group IC contain the highest proportions of rock flour in Group I, ranging between 31.4-41.4%. Crushed rock is relatively low, measuring about 11-32% of the total matrix ranging in size 3-5.0 mm. The glacial clays are moderately to well-mixed with some sedimentary rock. This subgroup lacks grog inclusions and is not laminated. Manufacturing techniques include coiling and one sample (GardV1B1) that lacks any evidence of coiling. GardV1B1 was either constructed without coiling or was modified to remove the coils by secondary forming techniques. All of the vessels were fired in a reducing atmosphere and all the samples show evidence of sintering except Mk2594V2B2, which was underfired.

Group II (Feldspar-rich Crushed Rock)

Fabric Group II consists of 27 samples (15 vessels) tempered with feldspar-rich crushed rock. Types of rock present in the sample include monzonite, quartz monzonite, syenite, quartz syenite, nepheline syenite, talc schist, and an indeterminate feldspar-rich schist. Most of the feldspar-rich rocks are heavily metamorphosed. All crushed rock inclusions show minor to moderate levels of weathering, alteration, and damage. The frequency of crushed rock varies from

13-45.3%, with a group average of 27.9%. Frequencies of crushed rock inclusions for Group I are average for the entire assemblage. Inclusion size varies widely from 2.5 mm to 7.0 mm per vessel.

Group IIA. Fabrics in Group IIA contain low amounts of glacial rock flour (9.2-13.6%), mixed with occasional degrading sedimentary rock and organics. Crushed rock are coarse (5-6.5 mm) in size and constitute 21-45.3% of the total fabric matrix. Grog is not present. Vessels are formed with the coiling technique and some laminated fabrics occur. Mixing of the clay prior to vessel production varies considerably from very poorly mixed to well-mixed. Most of the vessels in the subgroup are fired in a reducing atmosphere, except SP262V1B1.

Group IIB. Subgroup IIB are distinguishable by moderate glacial rock flour in proportions of 14-28%, mixed with organics and some sedimentary rock. Grog inclusions are occasionally present in this group and crushed rock temper occurs in proportions of 14-44% of the total fabric. The size of aplastic inclusions per sample range from finely tempered (2.5 mm) to coarse (7.5 mm). Clays are poorly to well-mixed prior to vessel forming and coils show alignment in the matrix. About half the vessels have additional secondary forming techniques that reduce the visibility of the original coils. Firing atmospheres, temperatures, and conditions vary by sample.

Group IIC. Two samples are represented in Group IIC (RnHsV1B1 and Mac8V1B1). This group is characterized by a high percentage of rock flour (32-38%). The fabric lacks grog but sometimes has sedimentary rock inclusions. This sedimentary clay is poorly mixed, laminated, and had fine-sized (2.5-3.0 mm) crushed rock temper, which makes up about 15% of the total matrix. The vessels were fired in an oxidizing environment and the clay may not have had organic material originally present.

Group III (Mafic-rich Crushed Rock)

Group III consists of 26 vessels (46 samples) tempered with mafic-rich crushed rock. The majority of crushed rock inclusions in this category are metamorphic schists and gneiss. There are also two examples of a metamorphosed gabbro/diorite. The metamorphic rocks include amphibolite (hornblende schist) and pyroxene gneiss. Most of the schist is badly damaged and altered. The gabbro/diorite and gneiss shows considerably less damage. The frequency of crushed rock varies from 11.7-46.9% of the total matrix and occurs in sizes of 2.5-8.0 mm in diameter. The average variation of the crushed rock frequency in Group III is slightly higher than the total assemblage population standard deviation of 12.5-40.2. To summarize, samples in Group III contain on average more and larger-sized fragments than the total ceramic assemblage average.

Group IIIA. There are five samples in subgroup IIIA. These samples contain approximately 7-12% rock flour, and organics may not have originally been present in the clay source. Sedimentary rock is rare and appears only in the MacCauley Complex No. 4 sample. None of the samples contain grog inclusions. The largest crushed rock fragments per sample range from about 3.0-5.5 mm in size and makes up 16-35% of the total fabric. Manufacturing techniques vary in this subgroup. About half the clays are poorly mixed and the other moderately to well-mixed. Laminated textures are common.

Group IIIB. Group IIIB contains the most variation in crushed rock frequency, aplastic inclusion size, and manufacturing techniques than in the rest of Group III. The original clay source varies in rock flour content and organic material. Rock flour makes up approximately 15-27% of the matrix. Sedimentary rock inclusions appear limited to the Sinking Ponds, Martin, and MacCauley No. 4 sites. Grog is present in the McKendry and Vinette site samples only. All of the samples show coiling as a primary manufacturing technique and approximately half the samples had secondary forming techniques to smooth over the coils and half the samples have laminated textures. Crushed rock inclusions vary from 17-47% of the total fabric and occur in sizes ranging from 2.5 mm to 7.0 mm in diameter.

Group IIIB can be further divided into three smaller groups based on the relative frequencies of crushed rock inclusions (low, medium, and high). However, asides from reducing the variation of crushed rock inclusions, the additional subgroups do not illuminate any new technological patterns in the Group IIIB data.

Group IIIC. This group includes seven samples, all with high proportions of glacial rock flour (28-41%). Inclusions vary from fine (2.5 mm) to very coarse (8.0 mm). Crushed rock varies from 14.5-28% of the total fabric. Sedimentary rock is commonly occurring in the samples and about half the samples have one or more fragments of grog. The ceramics often have laminated textures produced from poorly to well-mixed clays. Organics may or may not have been originally present in the clay and many of the vessels are fired in a reducing atmosphere.

Table 7.12. Summary of Fabric Types

	Petrographic Groups								
Inclusions	***Group I***			***Group II***			***Group III***		
Crushed Rock	***IA***	***IB***	***IC***	***IIA***	***IIB***	***IIC***	***IIIA***	***IIIB***	***IIIC***
Quartz-rich									
Granite		X	X						
Granite Schist	X	X	X						
Q.feldspathic Gneiss			X						
Feldspar-rich									
Monzonite				X	X				
Q. Monzonite					X	X			
Q. Syenite				X	X				
N. Syenite					X				
Talc Schist					X				
Indet. Schist				X	X	X			
Mafic-Rich									
Amphibolite							X	X	X
Gabbro/Diorite							X	X	
Pyroxene Gneiss								X	X
Isolated Minerals									
Quartz									
Myrmekite	X	X					X	X	X
Feldspar									
Plagioclase	X	X	X	X	X	X	X	X	X
K-Feldspar	X	X	X	X	X	X	X	X	X
Perthite	X	X	X	X	X	X	X	X	X
Mica									
Biotite		X			X	X	X	X	X
Muscovite	X	X	X	X	X	X	X	X	X
Sericite	X	X	X	X	X	X	X	X	X
Amphiboles		X	X	X	X	X	X	X	X
Pyroxenes	X	X	X	X	X	X	X	X	X
Other									
Grog	X	X		X	X			X	X
Sedimentary Rock	X	X	X	X	X		X	X	X

Part III: Comparison of Petrographic Fabrics with Ritchie and MacNeish's Types

The 51 vessels sampled by this study were originally broken into traditional type categories, including three categories defined by Ritchie and MacNeish in 1949 (Vinette 1, Vinette Dentate, and Vinette Complex Dentate), and two subcategories defined by the author, which are loosely based on Ritchie's original types (see Chapter 5). The two subgroups defined by this study includes undecorated Vinette Dentate vessels and a single Vinette Variant vessel. Undecorated Vinette Dentate vessels appear morphologically and characteristically similar to Ritchie's Vinette Dentate type, except that they lack the simple bands of dentate decoration on the exterior vessel surface. The Vinette Variant vessel doesn't fall nicely into any of Ritchie and MacNeish's type categories but its attributes suggest stronger similarities with the Vinette series than with the authors' other ceramic sequences.

Vessels are listed according to the traditional type categories in association with the newly designated fabric groups in Table 7.13. The 90 samples examined in this study are uneven broken into the traditional type categories. Even samples from each traditional type were not possible due to the dearth of early ceramic vessels in New York State in general and limitations put on this study by the granting institutions that own the collections. Rim sherds and any sherd with visible encrustations were off limits for petrography because of the analysis' destructive nature. Vinette 1 vessels are the most heavily represented in the current assemblage (n=58), followed by Undecorated Vinette Dentate (n=14), Vinette Dentate (n=12), Vinette Complex Dentate (n=3), and Vinette Variant (n=3).

Table 7.13. Summary of Samples Listed by Ritchie and MacNeish's (1949) Types and Petrographic Designations

Sample #	*Group*	*Ritchie's Type*
BCV1B1	IB	Vinette Dentate
BCV1B2	IB	Vinette Dentate
BCV1B3	IIB	Vinette Dentate
BCV2B1	IIIB	Undecorated Vinette Dentate
BCV2B2	IIIB	Undecorated Vinette Dentate
BCV4B1	IIB	Undecorated Vinette Dentate
BCV4B2	IIB	Undecorated Vinette Dentate
BJRV1B1	IIIB	Vinette I
BJRV1B2	IIIB	Vinette I
BJRV1B3	IIIB	Vinette I
CatCrkV1B1	IIB	Vinette I
CotV1B1	IC	Vinette Dentate
EgV1B1	IIIB	Vinette I
FergV1B1	IB	Vinette I
FexV1B1	IIB	Vinette Dentate
GardV1B1	IC	Vinette I
Mac4V1B1	IIB	Undecorated Vinette Dentate
Mac4V1B2	IIIA	Undecorated Vinette Dentate
Mac4V1B3	IIIB	Undecorated Vinette Dentate
Mac4V2B1	IIIB	Undecorated Vinette Dentate
Mac4V2B2	IIIB	Undecorated Vinette Dentate
Mac4V2B3	IIIB	Undecorated Vinette Dentate
Mac4V3B1	IIIC	Undecorated Vinette Dentate
Mac4V4B1	IIIC	Vinette I
Mac4V4B2	IIIB	Vinette I
Mac4V4B3	IIIB	Vinette I
Mac4V5B1	IIIB	Vinette I
Mac4V5B2	IIIC	Vinette I
Mac5V1B1	IIIB	Vinette I
Mac5V1B2	IIIB	Vinette I
Mac5V1B3	IIIB	Vinette I
Mac5V1B4	IIIB	Vinette I
Mac6V1B1	IIIB	Vinette I
Mac6V1B2	IIIB	Vinette I
Mac7V1B1	IIIB	Vinette I
Mac8V1B1	IIC	Vinette I
MartV1B1	IIIA	Undecorated Vinette Dentate
MartV2B1	IIIC	Vinette I
MartV2B2	IIIB	Vinette I
MartV2B3	IA	Vinette I
MartV3B2	IB	Undecorated Vinette Dentate

Sample #	***Group***	***Ritchie's Type***
Mk2594V1B1	IB	Vinette I
Mk2594V1B2	IB	Vinette I
MK2594V1B3	IB	Vinette I
Mk2594V2B1	IB	Vinette I
Mk2594V2B2	IC	Vinette I
Mk2594V3B1	IB	Vinette I
Mk2594V3B2	IB	Vinette I
Mk2594V4B1	IIB	Vinette I
Mk2594V4B2	IIIB	Vinette I
Mk2594V5B2	IIIB	Undecorated Vinette Dentate
Mk2594V6B1	IIB	Vinette I
Mk2594V6B2	IIB	Vinette I
NineMRV4B1	IIB	Vinette I
NineMRV4B2	IIB	Vinette I
PortgV1B1	IIIB	Vinette Dentate
PortgV2B2	IIIB	Vinette Dentate
RenHsV1B1	IIC	Vinette Complex Dentate
RenHsV1B2	IIB	Vinette Complex Dentate
RvHv2V1B1	IIIB	Vinette I
RvHv2V1B2	IIIB	Vinette I
RvHv2V2B1	IIIC	Vinette I
RvHv2V2B2	IIIA	Vinette I
RvHv2V2B3	IIA	Vinette I
RvHv2V3B1	IIB	Vinette Variant
RvHv2V3B2	IIB	Vinette Variant
RvHv2V3B3	IIB	Vinette Variant
ScacV1B2	IIIC	Vinette I
ScacV2B1	IIIA	Vinette I
ScacV3B1	IIIB	Vinette I
SimV1B1	IIB	Vinette I
SimV1B2	IIB	Vinette I
SimV1B3	IIB	Vinette I
SP262V1B1	IIA	Vinette I
SP262V1B2	IIB	Vinette I
SP262V2B1	IIIB	Vinette I
SP262V2B2	IIB	Vinette I
SP262V2B3	IIIA	Vinette I
SP262V2B4	IIIB	Vinette I
StBnvV1B1	IIIB	Vinette I
StBnvV1B2	IIIB	Vinette I
VintV1B1	IB	Vinette I
VintV2B1	IIIC	Vinette Dentate
VintV2B2	IIIB	Vinette Dentate
VintV3B1	IIIB	Vinette Dentate

Sample #	***Group***	***Ritchie's Type***
VinVV1B1	IIB	Vinette Dentate
VinVV1B2	IIA	Vinette I
VinVV1B3	IIA	Vinette I
WickhV1B1	IB	Vinette Complex Dentate
WickhV2B1	IB	Vinette Dentate

Part IV: Variation and Evidence of Trade

Two sites within the data assemblage contained enough early ceramic vessels that at least five different vessels could be petrographically tested; the two sites included MacCauley Complex No. 4 and the McKendry site. Five potentially different vessels from the MacCauley site and six vessels were selected from McKendry. Three samples from each vessel per site were originally selected for this analysis. Unfortunately, several samples were too damaged by the production process for analysis. The five vessels at the Mac 4 site are represented by 12 slides and the six vessels at McKendry by 12 samples. The purpose of the detailed analysis of vessels from two sites was to examine how much variation exists between vessels of the same general time period in the same site in the hopes that the scale of production for early vessels can be determined.

Similarities across the different vessels at the McKendry site include the type of firing atmosphere and condition, clay texture, and manufacturing technique. All of the McKendry clays are poorly to moderately mixed, fine-textured clays. The relative lack of isolated minerals 0.0625-0.50 mm in diameter, combined with the light and dark banded matrix suggests a lacustrine origin for the clays. None of the McKendry samples show signs of having laminated bodies, coils are present in all samples however; two vessels show additional secondary forming techniques that have reduced the visibility of the coils. All of the McKendry clays originally had organics present and were fired for short time periods in a reducing atmosphere, which produced very dark gray firing cores. The firing temperature was high enough in all the samples to begin the vitrification process through sintering along the edges of the voids and smaller mineral inclusions.

Variation in the McKendry ceramics is apparent in the type, size, and frequency of the crushed rock temper and isolated minerals, and the presence of grog. Three different types of rock were identified: quartz monzonite, granite, and granitic gneiss. Two vessels are represented by the feldspar-rich rocks, and three by the quartz-rich granite. Both granite-tempered vessels and the one of the quartz monzonite vessels contain grog. The frequency of crushed rock temper varies considerably across the vessels, from 24-43.8% of the total matrix. The granitic-tempered vessels contain slightly higher proportions (24.0-43.8%) of crushed rock temper than the feldspar-rich samples (29.6-35%). However, the size of the granite temper was smaller overall than the feldspar-rich temper. The largest inclusion sizes of granite temper are about 4.0 mm and the feldspar ranges from 2.5-5.5 mm in diameter.

The petrographic results of the McKendry samples suggest all of the vessels present in the assemblage are relatively similar to one another from a technological perspective. The vessels were all formed from the same types of clay, molded by the coiling technique and were consistently fired in a reduced atmosphere. In general, the McKendry fabrics range 67-81% aplastic inclusions, 10-19% voids, and the remainder of the matrix is fine-to-medium textured clay minerals.

Vessels within the Mac 4 assemblage showed considerably more variation than the McKendry ceramics. Of the six vessels identified, five contain feldspar-rich rock, and the final vessel is granite-tempered. Three different clay sources are apparent in the Mac 4 ceramics. The three clays vary in the frequency and type of aplastic inclusions and presence of sedimentary rock. All three are variegated sedimentary clays with clear light and dark bands within the matrix and all originally contained organic material. Clay One has very low levels of isolated quartz and opaque minerals 0.0625-0.50 mm in diameter. No other minerals are present within the matrix and this clay lacks sedimentary rock inclusions. The second clay has low levels of quartz, feldspar, opaque, and mica inclusions in addition to sedimentary rock fragments and organic material. The final clay has moderately high levels of inclusions similar to Clay Two but with the addition of hornblende and occasionally orthopyroxene.

To summarize, the vessels analyzed from the Mac 4 ceramic assemblage contain moderate variation in raw material sources (clay and crushed rock) and ceramic technology. All vessels at the Mac 4 site were formed with the coiling technique and all of the clays were poorly to moderately mixed prior to vessel production. The firing atmosphere and duration varied at the Mac 4 site. Exactly half the vessels (all containing quartz monzonite temper) were produced in an oxidizing atmosphere and the other half in a reducing. Additionally, Vessels 16 and 20 lacked any signs of matrix vitrification while the remaining four vessels all had sintering. The three vessels containing grog (16, 16a, 32a) were also tempered with quartz monzonite crushed rock. No other vessels contained grog. Crushed rock temper in the granite-tempered vessel was less than 4.0 mm in diameter. The nepheline syenite-tempered vessel (20) contained the smallest crushed rock inclusions of the site (<2.5 mm). The crushed rock in the remaining vessels varied between 3.0 and 5.5 mm in diameter. All samples except Vessel 16 have laminated textures caused by numerous long, horizontal fissures that cut through the center of each body sherd.

Imported Versus Locally Produced Vessels

In Chapter 6, this study divided the archaeology sites into their respective glacial zones (Erie, Ontario, Oneida, and Hudson) as a way of determining what types of rock one might expect to be present within each glacial train. This section has now discussed what type of land formations will hold the majority of glacial cobbles. With this established, it is now possible to begin to determine which fabrics may be exotic and which are most likely locally produced. Until a larger petrographic database is established for early ceramic fabrics in New York State, it is unwise to select fabrics as exotic based on anything other than their temper content because not enough is known about how these fabrics change over time. The author believes it will someday be possible to determine exotic fabrics based on their general technology (raw clay materials, inclusion arrangement, and forming and firing conditions) in addition to the temper type.

Tables 7.6 and 7.13 summarize the ceramic by fabric groups into their respective glacial lobes. As expected, quartz-rich rocks appear in all glacial regions within New York State. Unexpectedly, quartz-rich rocks in general were clearly less favored than their feldspar and mafic-rich counterparts. Of the 47 vessels examined, only nine (19.6%) contained quartz-rich crushed rock. The author expected quartz-rich rock to be much more commonly occurring as temper considering the sheer amount of quartz and allied plutonic rocks present throughout the Canadian Shield (Figure 6.2). Most interestingly, Group I fabrics are least common throughout the Ontario lobe, where quartz-rich rock should contain the highest natural distribution frequencies for the current study area.

Group II fabrics should be present in all ice lobes except for Erie and the highest frequencies of feldspar-rich rock should be present throughout the Ontario lobe. Instead, this study found that Erie and Ontario were tied for the highest proportions of feldspar-rich temper (n=6 vessels or 42.9% respectively). Two vessels (14.3%) were identified in the Oneida lobe containing feldspar-rich crushed rock. The Hudson lobe contained zero feldspar-rich tempered vessels but the author believes this is due to poor sampling, rather than cultural distribution.

The most commonly occurring fabric is Group III, mafic-rich crushed rock. These rocks should be present in all glacial ice lobes except Erie. As expected, Group III fabrics were most common throughout the Ontario lobe. Mafic-rich rocks were the second-most common fabric type in the Erie lobe (n=4 or 33.3%).

A total of 10 vessels in this study may be identified as possible cultural imports; either the pots were physically moved into the region or the rocks used for temper were carried in and then produced into temper. The majority of rocks within the Erie lobe should primarily consist of sedimentary rock with some quartz-rich plutonic rocks. The presence of feldspar- and mafic-rich temper at sites within the path of the Erie lobe suggests cultural importation. Ten of the 12 vessels in the Erie lobe contain rocks that have been carried into the region. Five of these vessels were recovered from the McKendry site, two from Sinking Ponds, two from Ninemile Road, and the final vessel is from the Saint Bonaventure site. The types of imported rock include talc schist (steatite), quartzofeldspathic gneiss, nepheline syenite, quartz syenite, quartz monzonite, hornblende schist, gabbro/diorite, and pyroxene gneiss.

Table 7.14. Breakdown of Fabric Groups by Glacial Lobe

Ice Lobe	*Group I (Quartz-rich)*	*Group II (Feldspar-rich)*	*Group III (Mafic-rich)*	*Total Vessels*
Erie	2 (16.7)	6 (50.0)	4 (33.3)	**12 (100)**
Hudson	2 (66.7)	0 (0)	1 (33.3)	**3 (100)**
Oneida	3 (42.3)	2 (28.6)	2 (28.6)	**7 (100)**
Ontario	2 (8.0)	6 (24.0)	17 (68.0)	**25 (100)**
Total Vessels	**9 (19.2)**	**14 (29.8)**	**24 (51.1)**	**47 (100)**

Syenite, monzonite, and gabbro/diorite rocks are found north of the Adirondacks in Ontario and southwestern Quebec, and were likely moved into upper New York by the Saint Lawrence, Ontario and Oneida ice lobes. The quartzofeldspathic gneiss, hornblende schist, and pyroxene gneiss may have derived from the metamorphosed bedrock in either Ontario or Vermont and therefore may have been dragged in by any of the glacial lobes besides Erie.

Chronology

Taché and Hart (2013) provided a solid range of dates on early pottery by dating residues adhering to the surface of sherds (Chapter 2). The authors determined that early pottery appears between 1495-1313 BC and is gone sometime around 395-261 B.C. Early ceramic body sherds from three of sites dated by Taché and Hart were included in this study for petrographic analysis: Scaccia, Vinette, and Vine Valley. In addition, two AMS dates were retrieved from encrustations on Vinette sherds from the Sinking Ponds site by this study. A summary of these AMS dates are presented in Table 7.14. The two AMS dates on body sherds from Sinking Ponds fit into Taché and Hart's chronology, appearing towards the end of the early ceramic spectrum.

Using the dates from the four sites below, the author attempted to place the fabrics in this study into relative chronological order. As stated earlier, the only consistent trait of early ceramics is the presence of crushed coarse-crystalline rock temper; the author relied on this category to build the relative chronology. Table 7.15 summarizes the crushed rock traits for the dated eight vessels. The combined totals are listed when more than one petrographic sample was available per vessel. The results show two trends over time: the overall percentage of crushed rock inclusions very gradually increases from 15-40% to 20-45% and the overall size of the inclusions get larger through time, increasing from an average 3.5-5.5 mm to 5.5-7.0 mm in diameter. This seems somewhat counterintuitive, however, these results concur with Schulenberg's (2002) research (Chapter 3). Schulenberg found that the amount of aplastic inclusions generally increases in time from the Point Peninsula to Owasco vessels (Ibid 2002: 86-87). There may also be a change in the treatment of the rocks being used as temper. The Scaccia and Vinette temper shows high degrees of metamorphic alteration, thermal alteration, and weathering, while the Sinking Ponds and Vine Valley lack this.

Additionally, gabbro, quartz syenite, and monzonite are feldspar-rich rocks, indicating a possible later preference for feldspar, rather than quartz.

Table 7.15 Summary of AMS Dates on Pottery Sherds

Site	Lab Identification	^{14}C B.P.	Cal. B.C. (median probability)
Scaccia	A0541	2905 ± 35	1256 (1096) 998
Scaccia		2820 ± 60	1189 (982) 830
Scaccia		2760 ± 15	970 (901) 842
Vinette	A0456	2510 ± 35	770 (638) 519
Vine Valley	A0746	2455 ± 30	754 (579) 412
Vine Valley	A1375	2435 ± 20	745 (505) 407
Vine Valley	A1379	2415 ± 20	724 (474) 404
Sinking Ponds	Beta-315580	2420 ± 30	550 (475) 400
Sinking Ponds	Beta-315579	2300± 30	400 (380) 360

Dates on Scaccia, Vinette, and Vine Valley after Taché and Hart (2013: 361, Table 1).

Table 7.16 Summary of Crushed Rock Traits for AMS Dated Ceramic Sherds

Site	Vessel #	Total CR %	Largest CR Size	CR Appearance	CR Type
Scaccia	12	15.2-31.5	3.5-5.5	Weathered/Altered	Amphibolite
Scaccia	24	39.9	5	Very Weathered/Altered	Amphibolite
Vinette	27	17	2.5	Very Weathered/Altered	Granite
Vinette	43	21.1	2.5	Very Weathered/Altered	Amphibolite
Vinette	39	13.5-21.2	4-4.5	Very Weathered/Altered	Amphibolite
Vine Valley	17	21.2-30.1	2.5-5.0	Minor Weathering/Altering	Monzonite
Sinking Ponds	3	28.9-35.0	5-6.5	Minor Weathering/Altering	Quartz Syenite
Sinking Ponds	26	35.4-45.3	5.5-7.0	Minor Weathering/Altering	Gabbro

Summary: Challenging the Foundation of the Vinette Types

Ritchie’s main argument for the ceramic series division is that he believed there was a significant technological change between the early Vinette series, middle Point Peninsula, and later Owasco ceramic series. Ritchie believed these changes could be seen through several changing technological attributes, specifically the amount and size of temper, and forming and firing techniques in relation to surface treatments and design techniques. According to their traditional typology, decorative techniques become more elaborate throughout the Middle Woodland and into the Late Woodland period. Additionally, early ceramics are traditionally thought to have been built with a coiling technique and later vessels with the paddle-and-anvil modeling technique (Ritchie and Funk 1973: 165). Ritchie and MacNeish record that the general trend through time is a reduction in the amount and overall temper size.

In order to challenge Ritchie and MacNeish's Vinette pottery series, this study has taken an in-depth examination of early ceramic technology. This study has focused on scientifically analyzing the technological traits recognized by Ritchie and MacNeish as key identifiers of the Vinette pottery types: Vinette I, Vinette Dentate, and Vinette Complex Dentate. This study has shown how each of Ritchie's assumptions regarding the differences that delineate the Vinette types are false. Ritchie's key traits focused on by this study include aplastic size, type and frequency, manufacturing technique, and firing atmosphere. Table 7.16 summaries the traits by type as defined by Ritchie and MacNeish, alongside the results of this study. Ritchie and MacNeish's types are too general to fully define early ceramic technology. In addition, the descriptive method used by the authors is subjective and difficult to accurately reproduce.

This study then went beyond the work of Ritchie and MacNeish to reclassify early pottery using a more scientific approach, namely petrographic analysis, to identify potential technological patterns. The remainder of this dissertation will focus on a) discussing variation within early ceramic technology, and b) explaining why early ceramic vessels were shaped in the ways that they were.

The final chapters of this dissertation will examine possible explanations for the use of crushed coarse-crystalline rock as temper in early ceramic vessels. The author suggests that potters intentionally selected coarse-grained metamorphic and igneous rocks for temper from a wide array of available materials because these rocks represent a continued practice of earthoven cooking transformed into portable vessels.

Table 7.17. Summary of Traits Used by Ritchie and MacNeish (1949) to Divide Types Within the Vinette Series

Type	*Attribute*	*Ritchie and MacNeish's Description*	*Petrographic Result*	*Assumption*
	Temper-Size			
Vinette 1		>3.0 mm	2.0-8.0 mm	FALSE
Vinette Dentate		1.0-3.0 mm	2.0-7.0 mm	FALSE
Vinette Complex Dentate		"small to medium"	2.0-6.0 mm	FALSE
	Temper-Amount			
Vinette 1		"rather large amounts"	occurs from less than 12% to greater than 40% of the total matrix	FALSE
Vinette Dentate		"large amounts"	occurs from less than 12% up to 40% of the total matrix	FALSE
Vinette Complex Dentate		Not described	occurs from less than 12% up to 40% of the total matrix	N/A
	Temper-Type			
Vinette 1		Quartz crystalline rock	Quartz-rich, feldspar-rich, and mafic-rich rocks common	FALSE
Vinette Dentate		"Quartz or similar aplastic"	Quartz-rich, feldspar-rich, and mafic-rich rocks common	FALSE
Vinette Complex Dentate		Quartz	Quartz-rich and feldspar-rich rocks common	FALSE
	Forming Technique			
Vinette 1		Coiled	67.2% coiled, 29.3% coiled with secondary treatments, and 3.45% not coiled	FALSE
Vinette Dentate		Coiled	73.0% coiled, 27% coiled with secondary treatments	FALSE
Vinette Complex Dentate		Coiled	33.3% coiled, 66.7% coiled with secondary treatments	FALSE
	Firing Atmosphere			
Vinette 1		Dark interiors that gradually lighten to surfaces	All firing conditions present, with and without original organics	FALSE
Vinette Dentate		Black interiors	All firing conditions present, with and without original organics	FALSE
Vinette Complex Dentate		very dark interiors	All firing conditions present, with and without original organics	FALSE

CHAPTER EIGHT:

Hot Rock Cooking Practices and the Development of Ceramic Technology in the Northeast

“Agency concerns events of which an individual could, at any phase in a given sequence of conduct, have acted differently”

Anthony Giddens (1984: 9).

The purpose of this chapter is to review the important theoretical terms used to describe technology in archaeology and to apply those terms to early ceramic technology in New York State in order to provide an understanding for *why* ceramic vessels were created in the ways that they were. The previous chapters of this dissertation established *how* early ceramic recipes were structured: the key ingredients those recipes included, the ways in which glacial cobbles were collected and processed into temper, and how the temper was mixed with sedimentary clays, formed, and fired into finished vessels. Based on the presence and treatment of the coarse-crystalline crushed rock used as a tempering agent, the author believes that early ceramic technology in New York State arose from the older practice of earth oven cooking and not steatite stone bowl technology, as suggested by William Ritchie and others (Manson 1948; Mason 1981:209; Ritchie 1965:151; Ritchie and Funk 1973:96-98; Truncer 2004, 2005). Understanding the means by which a specific ceramic recipe arose provides a better understanding of past social processes because, “a technological system tangibly manifests worldviews and even contributes to their articulation” (Dobres and Hoffman 1994: 220). In this way, technological styles are evidence of agency because each step of the production process is actively and intentionally chosen from a range of possibilities within a specific group's symbolic and social worldview (Lechtman and Steinberg 1979; Dobres and Hoffman 1994: 218).

The Scale of Ceramic Production and Freedom of Expression to Alter the Recipe

Archaeologists spend considerable time examining the scale, organization, and specialization of ceramic production in order to investigate social, political, and economic facets of ceramic communities (Arnold 1987, 2000; Arnold III 1991; Arnold and Nieves 1992; Brumfiel and Earle 1987; Costin 1986, 1991; Costin and Hagstrum 1985; De la Fuente 2011; Feinman 1985; Hagstrum 1985; Kramer 1985; Nelson and Kehoe 1990; Rice 1985, 1987; Simon and Burton 1998; Sinopoli 1988; Stark 1991, 2003; Stark et al. 2000). The organization of ceramic production examines the strategies used by potters to meet the demands of their consumers. However, before the scale of early ceramic technology can be determined for the northeast, it is important to review terms related to ceramic production.

The organization of ceramic production is often determined through the analysis of ceramic assemblage technical traits, including standardization, labor investment, and skill because these aspects are believed to "reflect specific characteristics of distinctive forms of specialization" (Costin and Hagstrum 1995: 619). Standardization of ceramic production is judged through four aspects of specialization: the context of production, the concentration of production, the constitution of production, and the intensity of production (Costin 1986, 1991). Each of these aspects of production are viewed as an idealized scale between two extremes. On the lower end of the scale is a lack of control of resources, including raw materials, technological recipes, and markets for sale of items, often because the production of pottery is autonomous and part-time, used only in a domestic setting (as opposed to State), and produced by numerous potters in any single community. At the other end of the scale is the complete control of resources, often by a state or other political entity, full-time labor resources, designated zones (workshops or factories) for ceramic production, and production is carried out by a limited number of highly trained individuals. Diversity in ceramic vessels is often seen as "reflecting comparatively greater inter-group interaction," while homogeneity reflects "comparatively little group interaction, as in limited post-marital residential mobility among potters." (Kramer 1985: 118). In other words, less variation means fewer potters, which is turn is often equated to "specialized, larger-scale production, while a less-standardized product indicates smaller-scale pottery making" (Arnold III 1991: 364).

Using comparative data from the Batiscan site, Taché (2005) notes that when present, early pottery at most sites is infrequent, with very few vessels represented per occupation. The Batiscan site had a long history of early ceramic period settlement and a probable population of 45-50 individuals per seasonal occupation. Despite the long duration of repeated occupation, Taché was only able to identify approximately 220 vessels for the 40-50 years the site was lived at. She estimates that anywhere from 0-5 vessels were deposited into the archaeological record at any particular habitation cycle; suggesting early ceramic technology represents low-level consumption through household-based production. Taché also suggests that these early vessels were manufactured by only a few individuals (2005: 198; Taché at al. 2008).

One of the key results of this study is that descriptive techniques cannot always accurately identify body sherds belonging to the same vessel. This study began with 90 archeological samples representing 38 vessels (based on macroscopic decorative traits and Ritchie and MacNeish's type system). With the completion of this study, it is clear that there are a minimum of 46 vessels present. Descriptive analysis is good for making generalizations regarding the external appearance of pottery vessels, and bad for identifying minute patterns in a technology's style. It is the details of a vessel's production that provide insight into past human agency and practice.

Vessels in this study were divided into fabric groups based on specific distinctions in their ceramic recipes (Chapter 7). Three main types of fabrics were found, Group I (quartz-rich), Group II (feldspar-rich), and Group III (mafic-rich) rocks. Subgroups within each of the main fabric groups were devised based on the overall percentage of crushed rock included in the sample. Samples with low amounts of crushed rock were placed into subgroup A, moderate amounts of rock in B, and high amounts of temper into C. It is likely that the samples in this study are not representative of all the rocks selected by early potters. It is also unlikely that the samples selected by this study are representative of all the different types of fabrics ever present during the early ceramic period in New York. Variation in early ceramic technology exists in the clay sources selected, the type of rock (quartz, feldspar or mafic-rich varieties), the amount of crushed rock added to the matrix, the ways in which vessels were formed (coiled or coiled with secondary smoothing treatments), and firing atmosphere and temperature conditions.

The results of this division showed that some sites, including McKendry, Broken Clock, and MacCauley No. 5, have low amounts of variation; while vessels are tempered with different types of coarse-crystalline rock, but the general recipe remains the same because all samples fall into the same subgroup. However, sites much more frequently fall into a two or more subgroups: MacCauley No. 4, Martin, Riverhaven No. 2, Scaccia, Sinking Ponds, Vinette, and Vine Valley. Additional petrographic testing of sites containing large ceramic assemblages need to be conducted but it seems that early ceramic production was not controlled by a limited amount of individuals; there appears to be a high degree of perceived freedom for potters to alter their ceramic recipes. This study agrees with Taché that early pottery does appear to be small-scale production and had limited uses; the reasons of which, were probable socially derived, rather than a functional aspect regarding the ways in which these early vessels were used.

Origins of the Practice of Tempering with Coarse Crystalline Rock

The production of ceramic technology is neither haphazard nor opportunistic, as some have suggested (Ritchie and Funk 1973: 71-73; Truncer 2004). The repeated pattern of crushed coarse-crystalline metamorphic and igneous rock as temper in early ceramic vessels across the State of New York (and much of the surrounding region) is evidence of structured agency and practice in motion.

> Structured agency is exercised in sequences that we can recognize as structures at scales from the individual technical practice to the collective coordinated experience of long-enduring landscapes. Structuration is simultaneously the exercise of agency and the constitution of society. Over the long term, structuration constitutes those chains of continued, repeated, stylistically similar actions we recognize as traditions [Joyce and Lopiparo 2005: 365-366].

The central concept behind agency is that all individuals have the “capability” of being able make different types of choices, regardless of whether or not he or she is aware of the reasons for or results of those actions (Hegmon 2003: 219). Practice theory adds to this that any choices individuals do make, are culturally based (Dobres and Hoffman 1994: 224). In other words, individuals make decisions based on cultural rules that are simultaneously implicit, explicit, and reflexive towards his or her wants and needs. Structures include an individual's "perceptions, lived experiences, ideological and symbolic factors that serve as structures within which decisions are made" (Dobres and Hoffman 1994: 224).

This study has shown how the appearance of crushed coarse crystalline metamorphic and igneous rock temper in ceramic vessels in a landscape lacking large outcrops of this material, is unique and begs explanation. With the exception of the Adirondack region, coarse-crystalline metamorphic and igneous rocks are easiest to obtain from glacial outwash features as scattered, rounded pebbles, cobbles, and boulders across the landscape. These materials were dragged across the region and dropped by the ice lobes during the last glacial retreat. Today they form the numerous glacial outwash and till features that dot the New York landscape. This research has already established that the appearance of this rock as temper was intentional and evidence of the agency of ancient potters; therefore, it can be assumed that these rocks played a part of the worldview of ancient potters. The research seeks to answer the question, how do these rocks fit into this ancient worldview? One explanation for the presence and appearance of these rocks as temper can be found in a much older cooking technology, specifically the practice of cooking with thermally altered rocks.

Hot Rock Cooking Practices

Cooking technology is often broken down into two broad groups: wet and dry cooking. Wet cooking (also known as convection cooking) implies the use of water or other liquid to boil, simmer, sauté, etc., while dry cooking lacks liquids which are intentionally added by the practitioner (Black and Thoms 2014; Graesch et al. 2014; Jackson 1998; Neubauer 2016). These two categories can be further divided into two additional subgroups, indirect and direct heat cooking. Direct heat cooking refers to cooking techniques that require the flame to come into direct contact with the cooking receptacle. Indirect heat cooking means heating an element, such as a rock, and then placing that object beside or within the cooking receptacle (Jackson 1998; Neubauer 2016; Wilson and VanDerwarker 2015). Examples of direct, dry cooking are roasting and drying/smoking techniques. These cooking practices are conducted via hearths, firing pits, drying racks, and/or with artificial/stone griddles (Neubauer 2016: 417-419). An example of direct, wet cooking would be boiling or simmering with a liquid added to a food container, when the food container is placed directly in contact with the open flame. Indirect cooking activities require a medium between the open flame and the food receptacle. The thermal medium between the flame and food keeps the food from charring while simultaneously heating it slowly in a baking environment (if dry cooking). Indirect heat cooking includes stone boiling and earth oven cooking.

Of all the above listed types of cooking practices, earth ovens are by far the most labor intensive (Black and Thoms 2014: 206) and are much more likely to leave confirmation in the ground (via soil alteration and artifacts) that is interpretable to archaeologists as direct evidence of past cooking practices, over the less substantial forms of hot rock cooking (Neubauer 2016: 418). Unlike many other types of cooking methods, baking allows complex carbohydrates to turn into sugar and removes harmful, inedible toxins that reside in certain types of plant, nut, and meat products. Longer periods of convection cooking at lower temperatures allows humans to access these fiber-rich foods that would typically be inedible, such as roots and tubers (Black and Thoms 2014: 206; Neubauer 2016: 394; Sullivan and Bonorden 2014; Wilson and VanDerwarker 2015: 167).

Earth oven technology was present in Europe between 35,000-31,000 years ago and appears in North America approximately 10,000 years ago (Black and Thoms 2014: 205-206; Thoms 2009). Hearths and earth ovens can be misidentified by archaeologists because they sometimes appear similar. The key differences between hearths and earth ovens are important for understanding different cooking practices. Hearths are shallow, short-term, dry-heat features that can be used for a variety of purposes, including light, warmth, and cooking (Black and Thoms 2014: 204). Earth ovens require significantly more labor and resources to create and use than hearths. In order to build an earth oven, a pit must first be dug into the ground. A fire is then built inside the pit and large stones are placed throughout its base. A substantial bed of coals is required for an earth oven to cook properly because the rocks are heated by the embers (Graesch et. al 2014: 176). These rocks eventually become the thermal elements that bake the food once the fire is extinguished. Once the rocks are heated, a dense layer of fiber-rich packing materials are placed on top of the rocks. The fibers provide moisture for the convection cooking and separate the food from the thermal element so it cannot burn. The food is loaded onto this lower level and then covered with additional layer of fiber-rich packing material. Finally, the entire oven is buried with a layer of sediment. The soil cap reduces the amount of heat and steam that escapes from the oven while the food is cooking (Sullivan and Bonorden 2014). A single cooking event in an earth oven can range in time from a few hours to several days (Thoms 2009: 588; Wilson and VanDerwarker 2015: 168). The temperatures within the earth oven spike rapidly, and may initially climb up to 900°C when the fire is first built, then they fall slowly, maintaining an internal temperature for the food of about 100°C for the duration of the cooking event (Neubauer 2016: 407). Once the oven has cooled, the pit is uncovered, the internal layers are removed and discarded, and the food is retrieved.

In many ways, earth ovens are specialized features, created for the single purpose of convection baking. Earth ovens can be rebuilt and recycled for use many times (Black and Thoms 2014: 210). Variation occurs in the size and structure of earth ovens across North America, but all earth ovens have key features in common. Black and Thoms (2014) terms these features, “primary” and “secondary” traits. Primary features of earth oven include the heating element, the shape and size of the pit that is excavated, and the thermally altered, carbon-rich soils and sediments that surround the pit’s boundaries. Secondary features include any remnants of the internal layered remains of the oven, which are often found as discarded piles of thermally-altered rocks and sediments and exhausted fire-cracked-rocks (2014: 213). The key to identifying piles of thermally altered and cracked rock associated with earth ovens as opposed to stone boiling, is the presence of carbonized and oxidized soils in association with the thermally altered rock. Stone boiling techniques do not create oxidized soils, charcoal, or evidence of insitu burning (Neubauer 2016: 392).

Numerous experimental, ethnographic, and archaeological studies on the thermally-altered and fire-cracked-rocks recovered from earth oven features shows two key aspects of the practice of earth oven cooking: 1) specific types and sizes of rocks are intentionally selected as thermal elements within the pit (Black and Thoms 2014: 208; Graesch 2014; Homsey 2009: 101; Neubauer 2016: 355-356), 2) rocks are recycled and reused until they are too small to be useful and are discarded (Black and Thoms 2014: 218; Heisinger 2015; Neubauer 2016: 433).

As illustrated in Chapters 1 and 6, any rock when significantly heated, will fail structurally. The point at which failure occurs depends on the size, shape, composition, and texture of the rock, the conditions under which it was heated (and subsequently cooled), as well as the presence of liquid. In general, the larger, rounder, denser, and more homogenous a rock is, the longer it will take to break (Black and Thoms 2014: 208; Custer 2017; Graesch et. al. 2014: 191). Therefore, rounded cobbles are preferred over other shapes for stone cooking.

> Holding mass equal, rocks with smaller ratios of surface area to mass (like rounded cobbles) cool more slowly than those with larger ratios (such as thin slabs), and relatively dense, solid stones are superior to porous or fractured stones. Dense, solid rocks of any geologic region absorb and hold heat reasonably well, releasing it slowly over periods of hours, or days, if properly insulated [Black and Thoms 2014: 208].

Less dense, heterogeneous types of rocks, such as sedimentary and coarse-grained igneous rocks, fracture much faster other rock types and are prone to forceful explosion under certain conditions (see Chapter 6, Photo 6.15; Homsey 2009: 111). Using experimental thermal tests on a variety of sedimentary, igneous and metamorphic rocks, Graesch and collogues (2014) found that fine-grained igneous and dense metamorphic rocks withstand thermal weathering better than both medium and coarse-grained igneous rock varieties (183). A main cause for the structural failure of sedimentary rock is the breakdown of the cement that holds the individual particles of clastic rocks together (Neubauer 2016: 356; Homsey 2009: 111). Repeated episodes of alternating periods of rapidly heating and cooling rocks with liquid (e.g. through stone boiling or producing steam for sweat lodges), causes rocks to fail faster than other methods of thermal rock practices (Graesch et. al. 2014: 191). Coarse-grained igneous rocks are very porous compared to medium- and fine-grained igneous varieties, and when they are submerged into water while hot, water seeps into the pores, expands, and then causes the rock to crumble.

Recycling of materials is a common practice in ancient North America. “Recycling extends the utility of tools beyond their original design or purpose” (Shott 1996: 265). Stone tools, debitage, and thermally altered rock were frequently recycled until they were exhausted (meaning too small to be of any further use) and then the objects were discarded permanently (Amick 2007; Ascher 1968; Gould et al. 1971; Goodwin 1960; McAnany 1988; Neubauer 2016: 433; Sassaman 1993; Schiffer 1987; Whyte 2014). All rocks begin to break down into smaller pieces as they undergo repeated cycles of use, including periods of heating and cooling. Smaller, fragmented pebbles cannot conduct heat as well as larger rocks, therefore, as earth ovens and other hot rock cooking features were rebuilt, small fragments were often collected, discarded, and replaced with fresh specimens (Black and Thoms 2014: 218; Heisinger 2015).

Evidence of the Practice of Cooking with Earth Ovens in New York

Three examples of earth oven features will be presented from the Lamoka Lake, O’Neil, and Sinking Ponds sites in New York. Each of these sites were chosen because together, they span more than 4,000 years of the continued practice of earth oven technology. These sites were also chosen because they have been extensively studied and published throughout the years (Curtin 2015; Mitchell et. al. 2016; Granger 1978; Gramly 1983; Ritchie 1932; 1936; 1944; 1965; Ritchie and Funk 1973; Sassaman 2010) and they are traditionally believed to represent different cultures. The earth ovens at the Lamoka Lake site are the oldest, and are attributed to Ritchie’s Archaic Lamoka phase (Ritchie 1932; 1936; 1944; 1965; Ritchie and Funk 1973). As defined by Granger (1978), Sinking Ponds is the type site for the Early Woodland Meadowood people. The O’Neil site was excavated and presented by Ritchie as key site for understanding the late Archaic Frost Island culture, actually contains several earth ovens that date to his later Middle and Late Woodland periods (Ritchie and Funk 1973: 74-

95). Ritchie assumed the upper and most extensively occupied levels of the site (labeled Stratum 1), which he associated with the Point Peninsula and Owasco cultures, contained mixed assemblages and were therefore unreliable (1973: 79). However, the recent research conducted by Gates St. Pierre, Janet Schulenberg, John Hart, and Hettty Jo Brumbach amongst others, has determined there are no obvious discontinuities between the Point Peninsula and Owasco groups, and cultural material frequently overlaps chronologically (see Chapter 3). This suggests Stratum 1 at the O'Neil site may be more archaeologically useful than frustrating as Ritchie once proposed.

As explained earlier in this chapter, earth oven technology begins early in North America, c. 10,000 years ago, clearly predating the appearance of either soapstone or ceramic vessels by a significant period of time (see Taché and Hart 2013: 367, Table 4 for the most recent published dates on steatite and early pottery vessels). Earth oven technology continued to be practiced throughout New York, even after the appearance and wide-spread adoption of soapstone and ceramic vessels. In fact, the practice of earth oven cooking continues today throughout coastal New England in the form of Clam Bakes. While the New England Clam Bake is likely conducted today for very different reasons from the past, the essential technology needed for constructing the earth oven remains the same. In short, the appearance of newer, faster, cheaper, easier, less-labor intensive (etc.), technologies do not mean that older practices will be abandoned completely. Some traditions are tightly held practices whose symbolism greatly outweighs any western concept of inconvenience and therefore, they can continue for thousands of years, and even transcend cultural groups.

The Lamoka Lake site in Schuyler County, is one of the largest Archaic period sites in New York State (Chapter 3). Ritchie recorded the site at more than 700x300 ft (213x91

m) in size. With the assistance of the Rochester Museum and the New York Society of Archaeological Association, Ritchie conducted large-scale excavations at the Lamoka Lake site throughout later 1920s and 1930s. Radiocarbon dates from Lamoka Lake suggest an occupation around 4400-4600 years ago, 5383 ± 250 BP (Curtin 2015a). Stratified cultural deposits varied from about a foot to nearly five feet in thickness (Ritchie 1980: 71). The site contained burials, numerous post molds, suggesting overlaying structures (possibly related to numerous houses), shell middens, 380 storage pits, hearths, and 13 massive “fire beds” (Curtin 2015a). The storage pits ranged from three to five feet (0.91-1.5 m) in diameter, which suggests long-term subsurface storage (Ibid). Ritchie described the “fire beds” as essentially massive earth ovens that extended as much as 55 ft (16.8m) in length and 10 ft (3 m) in width. The depth of these pits varied and Ritchie noted there was “some suggestion of irregular lineal positioning of [hearth] fires along a central major axis” (1980: 74). These beds of fire-cracked-rock were likely used for smoking and drying fish and meat (Curtin 2015a) or for producing acorn meal (Ritchie 1969: 59).

There is no mention whether or not any materials asides from FCR, faunal and floral remains were recovered from the interior of any of the earth ovens at the Lamoka Lake site. Ritchie does mention that neither steatite, nor pottery were recovered from the site, and suggests that it was occupied prior to the appearance of either technology.

The Sinking Ponds (UB 262) site is a multi-component pre-contact archaeological site located in Erie County, New York. The site was investigated as a part of a series of annual archaeological investigations conducted by the State University of New York (SUNY) at Buffalo, Anthropology Department’s Field School, first under the direction of Granger in the (1964-1967) and later by Mitchell and Perrelli (2011-2013). The single massive earth oven identified by Mitchell and Perrelli as composite Feature 21, was located on the eastern edge of the site, in Block A, Test Units 42-43, 46-47, and 66. The earth oven feature was surrounded by numerous “rock piles” or “rock heaps,” identified by both Granger (1978: 93-95) and Mitchell and Perrelli (2016: 42). Rock pile features are “characterized by unmodified cobbles mixed with fire-cracked-rocks piled into a small basin cut into the subsoil. The mixed rocks were frequently piled higher than the occupation level. Numerous rock pile features were visible on the surface of the ground as a condensed scatter of fire-cracked-rock and chipped stone debitage” (Mitchell and Perrelli 2016: 42). These features lacked the carbon-rich and thermally altered soils typically associated with hearths and earth ovens. These rock pile features likely represent the excavation and dumping of exhausted fire-cracked rock and other debris from the earth oven as the oven was rebuilt and recycled for use over time (see Black and Thoms 2014). A total of 5,359 fragments of FCR were recovered from both feature and non-feature contexts during the 2011-2013 excavations The structure of the earth oven and its associated artifacts are described as:

> A large, densely concentrated circular surface scatter of both unmodified and FCR marked the top of Feature 21 [Figure 8.2]. A 2x2 m (6.6x6.6 ft) block was placed over the scatter to catch as much of the feature as possible. Due to its size, the feature was bisected along both axes in all test units and numerous samples were collected for floatation. Features 19 (charcoal concentration), 20 (FCR concentration), 21a (FCR concentration) and numerous additional soil anomalies were noted within this feature. A number of medium and large-sized roots disturbed the feature on its eastern and northern halves and two rodent burrows were also

noted in Tu 43. Including all types of feature fill, Feature 21 produced: one Meadowood projectile point (Artifact #44), four biface fragments, seven cores, five netsinkers, four hammerstones, one possible anvil, 1,347 FCR, and 916 flakes. The debitage consisted of mostly micro (n=564) and small (n=243) flakes. One hundred and five large and four macro flakes were also found…..Feature 21 was shaped as a very large basin of stratified burnt and oxidized soils cut into the surrounding dark yellow brown subsoil…..The basin angles down sharply and has a flattened, rock-lined bottom. The FCR laying on the surface of the feature appeared in the shape of a very large oval, approximately 1.4x2 m (4.6x6.6 ft) in diameter. The long axis of the oval was aligned east-west [Figure 8.1]. Fire-cracked-rock was present throughout the entire feature though in varying quantities but was greatest at the surface of the feature, where it made up 30% or more of the soil matrix….At the edges of the feature, the dark gray, ash-filled upper soil was about 12-14 cm (4.7-5.5 in) in depth. The ash-filled gray soil was deepest in the center of the feature at 24 cm (9.6 in)…..The base of Feature 21 was composed of burnt, oxidized soils…. which extended throughout the entire excavation block and beyond the test unit limits. Burnt soil extended beneath Feature 21 as much as 25 cm (9.8 in). Deeper burnt soils were located near the center of the feature. A few artifacts were recovered from non-burnt subsoil beneath Feature 21. These included a possible adze (Tu 46, level five, feature level four), 36 FCR, and 27 flakes [Mitchell and Perrelli 2016: 71-72].

The final example of pre-Contact earth oven cooking in New York comes from the O'Neil site in the Town of Cato, Cayuga County. The O'Neil site was excavated by Ritchie through the New York State Museum and Science Service in 1961-1962. The site is multi-occupational, however, Ritchie was primarily concerned with the lowest levels of the site because he was searching for the connection between the Late and Transitional Archaic periods, specifically for the archaeological group he called the Frost Island culture (Ritchie and Funk 1973: 74; see Chapter 3). Earth oven features were found in both Stratum 1 and 2 (Ritchie and Funk 1973: 80 and 87). These features appeared as "stone bed[s] or platform[s] of irregular oval shape" and were lined with thermally-altered and cracked cobbles, including "quartzite, sandstone, granite, and metamorphic crystalline rocks" (Ritchie and Funk 1973: 80). The diameter of the cobbles varied in size 5.1-17.8 cm (2-7 in) and some showed signs of vitrification from thermal exposure. The cobbles were tightly packed with charcoal-rich, oxidized sand and lacked artifacts. A conventional radiocarbon date was recovered from charcoal found within Feature 15 (an earth oven in Stratum 1) of AD 1150 ± 80 years (Y-1275, Stuiver 1969: 607, cited in Ritchie and Funk 1973: 81).

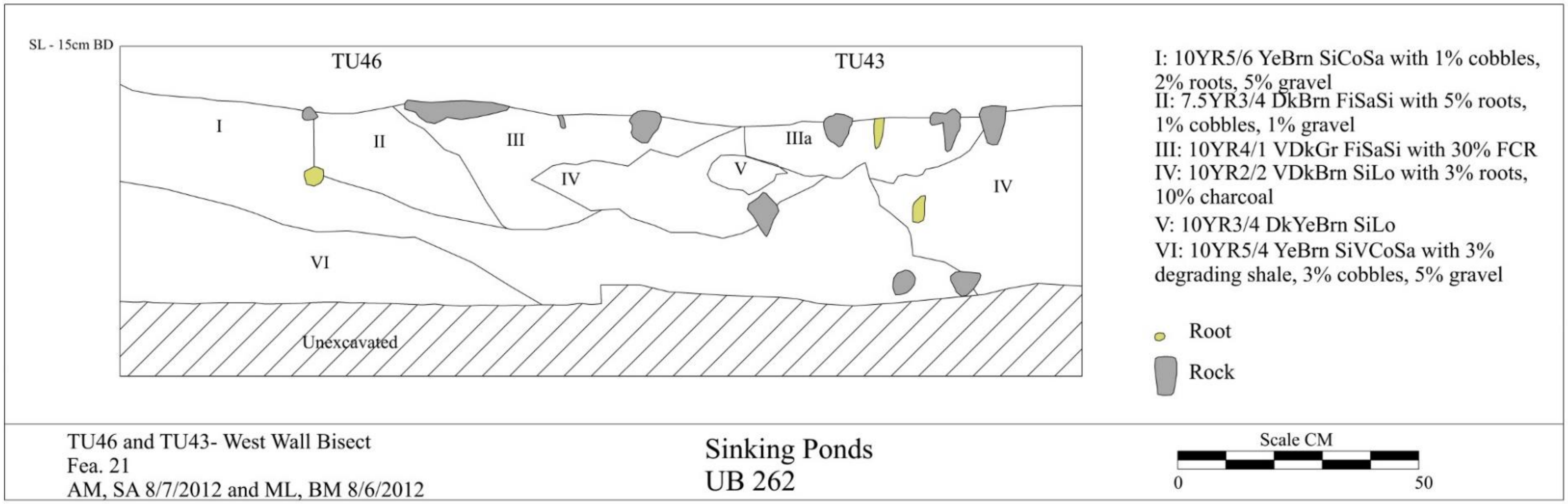
Ceramic refuse was recovered from soils adjacent to the earth oven features in Stratums 1 and 2. These materials included ceramic sherds belonging to Ritchie's Point Peninsula and Owasco types (Ritchie and Funk 1973: 81). Vinette 1 sherds were also found in all three stratums, in soils surrounding the earth ovens and/or hearths. Vinette 1 sherds were occasionally mixed with steatite fragments and in four occasions, with steatite and Susquehanna projectile points (Ibid: 87-91). A single feature in Stratum 3, Feature 8, consisted of a circular mass of FCR, a single broken tool, debitage, and both green and calcined animal bone (Ibid: 91). The feature lacked the characteristic burnt soils typical of earth ovens and therefore likely represents a cleaning and dumping episode of one of the other earth ovens present at the site.

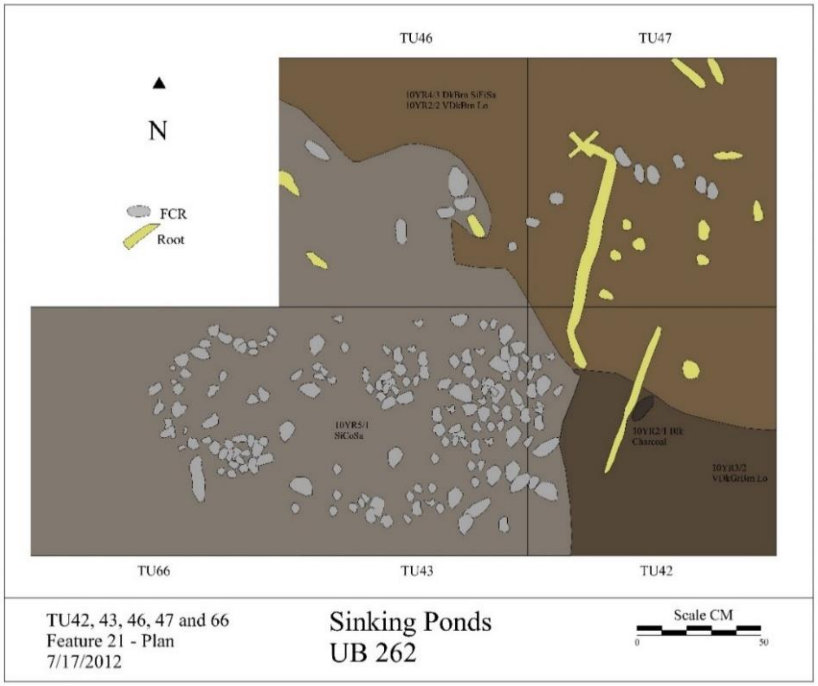
The three presented case studies from the Lamoka Lake, Sinking Ponds, and O'Neil sites are neither unique examples of earth ovens, nor are they characteristic of the entire span of earth oven use, but they *do* illustrate that the length of time that earth oven technology was actively practiced in New York was extensive. In each example, minor variations in the structure of the earth oven are apparent, including the size of the oven, associated artifacts, and the number of times the ovens were cleaned out, rebuilt, and reused. In reference to the amount and types of artifacts associated in and around earth ovens, Black and Thoms remind us that these structures, because of the way that they are created and maintained, are "palimpsest deposits in which earth oven deposits may be commingled with refuse from unrelated activities that predate and postdate oven use" (2014: 210).

Earth ovens were used prior to the appearance of portable containers and were continued to be used long after. These structures represent significantly more labor to build and cook with when compared to other forms of cooking practices because they have to be manually dug out and rebuilt with fresh and/or recycled resources prior to each use. Ethnographic evidence shows that earth ovens are often constructed in areas of shared space within a group of individuals and that the size of the earth oven can be useful for determining the relative size of the load of food that was cooked (Wilson and VanDerwarker 2015: 168). According to Black and Thoms (2014), earth ovens are typically between 0.5-3.0 m (1.6-10 ft) in diameter (205). The earth ovens identified at the Sinking Ponds and Lamoka Lake sites were both greater than 2 m (6.6 ft) in diameter, which puts these features on the larger side of the known earth oven scale. Additionally, the rock piles and pits of FCR lacking carbon-rich, oxidized soils at Sinking Ponds and the O’Neil site provides evidence for the reuse of the pit. This means that (possibly large) groups of individuals returned to these sites over time, used combined efforts to excavate the old refuse and exhausted materials from the pit, collect new and/or recycled old materials, and refurbish the oven for the production of a communal meal.

The practice of communal earth oven construction and meals continues today in the Northeast in the form of the New England Traditional Clam Bake. The author, having been born and raised in Maine, grew up with the knowledge of how to build earth ovens on the beach for the purpose of steam-cooking lobster, clams, mussels, crab, potatoes, and corn for large family gatherings/reunions, weddings, or any other special event that allowed for large groups of people to come together during the warmer months of the year, when seafood is plentiful in Maine. In the author’s family, a Clam Bake was often preceded by the arrival of extended family members one or two days before the feast. Everyone in the family brought food to share and the construction of the pit itself was assisted by nearly everyone. A secondary fire was often set up, slightly away from the earth oven, for people to gather around and talk. There was almost always music, whether in the form of a live instrument or by a radio. The second fire remained lit well into the night, after the earth oven was extinguished and the meal was consumed, so people could continue to talk and snack on s’mores and leftovers, until everyone went home exhausted. The adults cleaned up the mess.

A simple google search for Traditional New England Clam Bake will provide the researcher with numerous special-occasion catering and seafood companies that will not only provide the food (at no small cost) but will also the supplies required to build an earth oven for a Clam Bake; although in reality, all one needs is a place for a pit, rocks, seaweed, fuel for the fire, and food to cook; all of which are easily available along the mud flats and rocky beaches of New England. Despite the modern availability of inexpensive cookware for steaming seafood, potatoes and corn, the Clam Bake remains a charming normality in New England. In the author’s opinion, the Clam Bake remains a tradition because of the social aspects involved in it.





Above, Figure 8.1: Schematic of the interior structure of the earth oven, Feature 21 (after Mitchell and Perrelli 2016: Figure 28).

Left, Figure 8.2. Plan view of the earth oven after the upper layer of thermally-altered rock was exposed (after Mitchell and Perrelli 2016: Figure 27).

The Symbolism of Non-Sedimentary Coarse Crystalline Rock Temper

Social practices, social meaning, and cultural worldviews can be seen in artifacts and landscapes (Dobres and Robb 2005; Dobres and Hoffman 1994; Hegmon 2003; Lechtman 1984; Trigger 1998). Unlike Western cultures, many Native American groups maintain a holistic view of the world, meaning "the 'natural landscape' was regarded as a cultural landscape bound together, shaped and given meaning by the presence of spiritual power and mythology" (Saunders 2004: 119). The physical landscape, ancestral spirits and human beings were intricately linked through symbols, ritual, and myth (Hamell 1992; Miller and Hamell 1986; Saunders 2004). Cultural landscapes are made up of natural features including but not limited to water formations, mountains, gorges, rocks, and minerals. "The geological components of cultural landscapes were not inanimate physical matter, but rather were imbued with cosmological significance" (Saunders 2004: 119). Possessing, welding, or imbibing an object from the cultural landscape could be used to "maintain a desired state-of-being, or to transform one state-of-being into an at least temporary more desirable state-of-being" (Hamell 1992: 456).

According to Saunders (2004), by 5000 BP nearly all Native American groups utilized minerals, rocks, and geologic formations as "symbols of social status and spiritual and ethnic identity" (119). An example of the symbolic nature of rocks can be found in a study on bannerstones from New York (Rataul 2006). Rataul's research on bannerstones from 24 sites revealed that garnetiferous gneiss may have been favored over other rocks because of its symbolic associations with raptors in flight. The coloration of the garnetiferous gneiss appears to mimic the feathers of birds of prey and the stones were fashioned into a stylized form of raptor's wings and may have been kept as hunting charms. The symbolic importance of the stone outweighed its impracticalities (Rataul 2006:34-35).

Minerals and rocks were valued for their luster, sheen, color and crystal structure (Hamell 1992; Miller and Hamell 1986: 318, 323-325; Rataul 2006; Saunders 2004: 120). In additional to their shine and luster, minerals and rocks were also valued for their color. Hamell (1992) shows the same color pattern has been in place in the Northeastern Woodlands from the Terminal Archaic until Contact (457). The pattern is tripartite and groups colors into white, black, and red (Mark and Hamell 1986: 323). "Light (sources), bright (reflective), and white things are tangible metaphors for abstractions of greatest cultural value: for life itself, and for positive states of physical, social, and spiritual well-being" (Hamell 1992: 455). The Iroquois term for the color white included many light colors, such as pale blues (sky and water) and greens (living things) and "seem to have been interchangeable in most mythic and ritual contexts" (Miller and Hamell 1986: 324). White is the term for all things living. The color black (including very dark shades of green, indigo, and blue) was seen as the contrast to white (lightness) and life. Black was also associated with "death, mourning, and the confinement of the womb" (Miller and Hamell 1986: 324). The color red often acted as a mediator between the contrasting white and black, light and darkness; it also stood for the "blood of life" (Hamell 1992: 456) intense emotion, and war (Miller and Hamell 1986: 325). In ritual contexts, red could be combined with either white or black in order to achieve a particular state-of-being. Red is both a positive and a negative color, depending on its complimentary color (Hamell 1992: 456).

Another concept important to understanding how objects can become imbued with symbolic power comes from the Andean cultures of Peru, Bolivia, Ecuador, and Colombia.

Lechtman (1984) examined the development and spread of metallurgy in Andean prehistoric cultures. She was particularly interested in how objects were fashioned from or decorated with gold, silver, and copper, and how these objects related to other important Andean technologies, such as textiles. Through her research, Lechtman discovered that the everyday practice textile production and use was of immense importance to Andean peoples, "cloth was undoubtably the item of greatest value, imbued with ritual significance, a symbol of rank, wealth, and power. It was not only used as a tool of war, both offensively and defensively, it also had a magico-military significance of its own, embodying the idea of strength and force" (1984: 4). Similar to textiles, objects fashioned with metal also operated in the secular, religious, political, and nonpolitical spheres. Oddly, what seemed most important to the Andean people wasn't the amount of gold, silver, or copper present an object was made from but rather that the metal was minimally present within the object and that the color of the metal was visible on the object's surface (1984: 14-15).

> It was important that metal objects have the appearance of gold and silver—their colors and their reflectivity—even if they incorporated very little of these precious metals in their structure…..a large proportion of the gold- and silver-*looking* objects we have from the Andes are not made of the pure metals [Lechtman 1984: 15, emphasis in original].

Using pictomicrographs, Lechtman found that objects were uniformly covered with 0.5-2.0 microns of the three precious metals and that the metals had been heated to achieve the desired coloring. The uniformity shows excellent control and standardization over the metal gilding of objects by the Inca dynasty (1984: 36). Lechtman suggests that the reason for the particular development of metallurgy in the Andean cultures was a direct result of their worldview:

> The basis of Andean enrichment systems is the incorporation of the essential ingredient—the gold or the silver—into the very body of the object. The essence of the object, that which appears superficially to be true of it, must also be inside it. In fact, the object is not that object unless it contains within it the essential quality, even if the essence is only minimally present [Lechtman 1984: 30].

This case study highlights the ways in which artifacts made for relatively simple, everyday use, such as clothing, and incredibly complex items designed with copper, gold and silver, all contain arguably equal amounts of intrinsic symbolism because they encompassed "the act of infusing life spirit into an inanimate object" and this essence helped to continually maintain and redefine the Andean worldview (Lechtman 1984: 33).

Pauketat and Emerson (1991) employed petrography to examine the technological style and symbolism within the Ramey Incised Pots of the central Mississippi River floodplain in southwestern Illinois. Ramey Incised Pots were produced during the 11th-12th centuries A.D. in pre-state Cahokia. Pauketat and Emerson examined a series of thin sections cut from Ramey Incised jars and used point counting to describe the technological style of these highly decorated vessels. The authors found that Ramey Incised jars have significantly low variation in paste composition when compared to other contemporaneous vessels in this region. Based on the uniformity of the pastes, the authors suggest that Ramey Incised vessels "may have been centralized—controlled by elites—rather than being a task conducted by numerous potters using a diversity of raw materials within the American Bottom region" (1991: 923).

The vessel surfaces contained numerous symmetrical motifs associated with cosmological themes common to central and eastern North American Native Americans (Pauketat and Emerson 1991: 924). The vessel designs included symbols of the Upper and Lower cosmos and may have conveyed the order of the universe, as seen by the elites of Cahokia. "The pots were imbued with the symbolism of order, hierarchy, and religiosity and were thus an active medium for this discourse" (Ibid: 935). Ramey Incised jars contained goods used during the Green Corn ceremony, which was a "rite of intensification" that played a critical role in the physical redistribution of materials by the elites as well as the symbolic reaffirmation and legitimatization of chiefly power.

Summary

In summary, agency is easiest to describe as the ability to choose (Hegmon 2003: 219; Giddens 1984). For the purposes of this study, agency involves the choices of raw material and the method of production for each individual vessel examined. What choices are perceived of as available are socially generated; this is the structure behind the technology. Finally, practice is what people actually do (Hegmon 2003: 220). The practice identified by this project is the selection of non-sedimentary coarse-crystalline rock as temper. The repeated selection of this rock over any other material across all of New York suggests continuity in knowledge between potters within the *chaîne opératoire* production. The intentionally selection of this type of rock is the key to understanding early ceramic technology in New York State. "Material culture is how people create, experience, give meaning to, negotiate, and transform their world" (Dobres and Robb 2005: 161). All of human behavior is “symbolically mediated and is both action and meaning” (Trigger 1998, quoted in Hegmon 2003: 222). Therefore, all practices are symbolic in nature (Dobres and Hoffman 1994: 212) and require some form of explanation for their origin, continuation, and meaning.

The only consistent similarity between early ceramic vessels is across New York State is the tempering agent. Individuals producing pottery between 3000-2100 BP (1000-100 BC), appear to have restricted themselves to the use of non-sedimentary, coarse-crystalline rocks as temper for their ceramic vessels. However, there is still a significant degree of freedom of expression for these potters; individuals do not always choose coarse-crystalline rocks dominated by quartz. It is unclear if all coarse crystalline rocks were viewed as equal in the eyes of the ancient potters or if quartz-based rocks were viewed as a separate technological style from either feldspar- or mafic-rich rocks. The results of the current study suggest dark colored, mafic-rich metamorphic rocks (Group III) were more commonly sought after than either feldspar or quartz-rich rock combined.

The experimental tests conducted by this study illustrate some of the ways non-sedimentary coarse-crystalline rock can be broken down for use as temper. The easiest way to break these materials into gravel-sized fragments is to heat them in a fire between 600-800°C long enough to weaken the bonds holding the individual minerals together. The time needed to accomplish this is dependent on the type and size of the rock in question. Mafic-rich rocks are stronger and more resistant to thermal pressure and therefore take longer to melt than feldspar or quartz-based rocks. Once adequately heated, the weakened bonds can be quickly crushed with a hammerstone cobble in a few simple strikes or it can be pulled apart into tabular fragments with bare hands.

This study demonstrates that there is a connection between fire-cracked rock, earth-ovens, direct heat cooking and early temper sources in the Northeast. Like the Southeast, early ceramic technologies in the Northeast are closer linked to pit, earth oven, and ‘stone boiling’ cooking technologies, then they are to the steatite technology of the Middle Atlantic region (Sassaman 1993:113-114). As a very fine-grained metamorphic rock, steatite (talc schist) lacks crystalline structure and its weak bonds do not require heating or smashing to break down. One of the attractive qualities of steatite is that it can be carved into bowls, pots, figurines, slabs, jewelry, etc. Steatite is therefore a completely different practice from coarse-crystalline tempered vessels. Non-sedimentary coarse-crystalline rock may have originally been selected for use in earth ovens for its thermal properties. Non-clastic sedimentary rocks will sheer horizontally when heated while plutonic rocks exploded or crumble into gritty dust. Rocks selected for temper were likely collected and repeatedly used in hearths and earth ovens before they were weak enough to smash and were recycled for vessel construction.

Geologic materials of interest to this study include clay, minerals, and rocks and the physical formations (rivers, mountains, etc.) from which they were retrieved. One possible explanation for why individuals would choose dense, very hard metamorphic and igneous rocks for temper over other sources may be found in the potential symbolism of the rocks and the landscape itself. According to Saunders (2004), by 5000 BP nearly all Native American groups utilized minerals, rocks, and geologic formations as “symbols of social status and spiritual and ethnic identity” (119). This returns us to the idea present in many Native American societies; that geologic objects could be transformed from mundane to otherworldly through “fire, technology and ritual knowledge” (Saunders 2004: 120). This is the ‘technological essence’ described by Lechtman to explain the development of metallurgy in the Andean cultures. "The point behind the "technology of essences" is that the essence must be part of the structure of the item in order to be realized and made visible on its surface" (Lechtman 1984: 35). Crushed coarse-crystalline rock temper may have been selected by early potters in the Northeast as a symbolic link to their landscape and long-term practice of earthoven cooking.

Future Directions for Ceramic Analysis in the Northeast

The current research and the recent work conducted by Gates St-Pierre (2001), Hart and Brumbach (2003, 2009), Hart (2011), Schulenberg (2002a, 2002) have cast serious doubt on the validity of the typologies created during the mid-20th century, as well as the archaeological cultures attributed to those cultures. These case studies illustrate how descriptive approaches limit our ability to organize and analyze ceramic material and therefore limits our understanding of past peoples. This is especially problematic since pottery is nearly ubiquitous throughout most of the Americas after 2500 BP. Efforts by Hegmon (1995), Lechtman (1984), Pauketat (1998, 2001, 2004, 2005), Pauketat and Emerson (1991), Peelo (2011), Zedeño (1997), and others have shown the importance of understanding symbolically charged landscapes and meaning-laden artifacts. It is important for archeologists to remember that the Native American landscape was a cultural landscape, full of spirits and mythology and their artifacts will reflect their worldviews. Archaeological sites containing multiple variations of early pottery should not be explained in terms of migration, diffusion or processes of trial and error. These variations in temper are evidence of the individual participation of different practices and intentional choices made by individuals to maintain and recreate social processes.

Petrographic analysis is required to identify temper and technological features of ceramic recipes. Ideally in every archaeological project a budget should be set aside for petrographic testing, just as funds are set aside for AMS ^{14}C dating. However, it may not always be possible to do so. Using high-resolution scans of thin sections and standardized reference charts significantly increases the amount of information available to archaeologists without the need for specialized training. Types of technological information that can be obtained from high-resolution images include matrix heterogeneity, grain-size distribution, manufacturing technique through the alignment of inclusions, firing atmosphere and maximum temperature, and estimates of the percentage of temper and isolated mineral present in the matrix.

The current lack of a dataset of petrographic fabrics makes conversation about why and when specific materials may have been selected for or avoided through time remains unclear. Future petrographic thin section analysis on ceramic material across New York State, when coupled with radiocarbon assay on pot residue, may establish a more reliable chronology and understanding of ceramic technology through time. Standard-sized petrographic slides can be purchased from a number of public and private institutions across North America for a reasonable fee, usually less than about $20 per sample. Once created, a thin section represents a permanent record of the artifact that can be reanalyzed. The creation of a new ceramic database, which contains information regarding the type, amount, and appearance of temper, natural inclusions, and voids, forming techniques, and firing atmospheres, can be combined with morphological and surface treatment data, and give archaeologists the freedom to move past the restrictive type system and its associated complications.

APPENDIX A: TRADITIONAL TYPE ANALYSIS

Sample #	Prov.	Rim	Body	Other	Total Rim Weight (g)	Thickness at Sherd Base (mm)	Thickness at Rim (mm)	Sherd Length (cm)	Length of intact Rim (cm)
BCV2	Tr.1, Ft 7, West Half Bisect	4	28+	0	11.2, 19.9, 11.8, 22.9	7.6, 5.8, 7, 6.7	8.1, 8.9, 8.6, 8.3	3.45, 4.67, 3.59, 2.76	2.75, 3.93, 3.46, 2.79
BCV3	Ft. 7, Bottom 15cm, East Bisect	2	1	0	22.1	11	8.6	3.95	4.53
BCV4	Tr. 4, Dark Stain by Feature 23, and backdirt pile	0	2	0					
BJRV1	8" East of W10, 2' 0" North of N0, Cat 1233-20S70W 29", Near	1	30+	5	4.6	11	9.6	1.34	2.84
BSV1	Kochan Excavations, Locus S	3			24.4, 48.8	N/A, 11	9.7, 11.6	3.51, 4.5	6.05, 5.5
BSV2	Kochan Excavations, Locus S	4	7	0	59.8	11	7.5-9	7	6.14
Mac4V1	Loc. 2 N5/E10	2	2	0	128.1	12	9	8.4	9.35
Mac4V2	Loc. 2 N5/E20	1	2	0	50.2	9.9	8	6.6	4.7
Mac4V3	Loc. 2 N5/E20	1	0	0	52	8.5	8.5	8	4.1

Sample #	Prov.	Rim	Body	Other	Total Rim Weight (g)	Thickness at Sherd Base (mm)	Thickness at Rim (mm)	Sherd Length (cm)	Length of intact Rim (cm)
Mac4V4	Unprov	1	10+	0	19.9	N/A	8.5	1.3	2.7
Mac4V5	S15W55 171/2" Loc. 2. Location 0"N of S15W55-S15W50 6"E	1	1	0	12.2	8	5.5	3.2	3.3
Mac5V1	ONOE 7 1/2" 17" E of 0N0E-5S0E and 6.5"N of 5N0E-5S5E, found	3	3	0	6.2, 3, 6.7	7, 7.5, 8.5	8, 8, 8	2.85, 1.75, 3.4	3.2, 2.4, 1.3
Mac6V1	N20E0 6 1/4" 10 1/2"E of N20E0-N25E0 2'1/2"N of	3	1	0	4.6, 5, 4	N/A, 8.4, 9	8, 8, 8.5	1.45, 2.05, 2.15	3.56, 2.36, 2.84
Mac7V1	7.221 recovered from Loc. 2, N5E50 4 3/4" deep; 7" North of N15, 17" West of E55. 7.304	2	3	0	13.9	8.5	8.6	2.91	3.86
Mac8V1	Loc. 3 N5W10 4" 0" North N10 17" West of W5	2	30+	4	13.3	7.5	7.8	3.13	1.8
MK2594V1	N25E4 30-60 cm	0	3	0	N/A	9.45-13	N/A	N/A	N/A
MK2594V2	N27E4 (Fea 14) and N21E8 0-30	0	3	0	N/A	12.65-15.78	N/A	N/A	N/A
MK2594V3	N21E6 30-50 cm	3	2	0	104.4	11.5-12.6	4.16-5.78	7.93	6.7
MK2594V4	N21E6 30-60 cm	0	1	0	N/A	13.45-15.71	N/A	N/A	N/A

Sample #	Prov.	Rim	Body	Other	Total Rim Weight (g)	Thickness at Sherd Base (mm)	Thickness at Rim (mm)	Sherd Length (cm)	Length of intact Rim (cm)
MK2594V5	N21E6 30-50 cm	3	2	0	50.3	8.45-11.39	7.42-7.59	6.55	2.52
MK2594V6	Found near Fea 1, 30-60 cm (1990)	1	1	0	17.1	10.54-13.73	7.45-7.64	4.36	1.82
MK2594V7	N21E6 30-60 cm	0	1	0	N/A	14.77-15.64	N/A	N/A	N/A
MK2594V8	N21E6 30-50 cm	0	1	0	N/A	13.9-14.71	N/A	N/A	N/A
MV1	Unprov	1	0	0	10.9	10.69	6.94-7.11	2.8	4.3
MV2	Unprov	0	4	0	N/A	10.3, 10.9, 11.6	N/A	N/A	N/A
MV3	Unprov	1	1	0	8.1	8-8.5	7.8-8.7	3	3.9
NMRV1	Tr. 4, TU 24, Level 9 and Tr. 4, TU 25, Lv 10	0	10+	0	N/A	12.2-13	N/A	N/A	N/A
NMRV2	Tr. 2, TU 4, Level 3	0	1	0	N/A	12-12.3	N/A	N/A	N/A
NMRV3	Tr. 2, TU 4, Level 2	0	4	0	N/A	8.86-9.97	N/A	N/A	N/A
NMRV4	Tr 2, TU 1, PM # 7	0	2	0	N/A	8.91-10.88	N/A	N/A	N/A
SP262V1	Fea 2	0	4	0	N/A	10.3-10.77, 13.64-14.25	N/A	N/A	N/A

Sample #	**Prov.**	**Rim**	**Body**	**Other**	**Total Rim Weight (g)**	**Thickness at Sherd Base (mm)**	**Thickness at Rim (mm)**	**Sherd Length (cm)**	**Length of intact Rim (cm)**
SP262V2	Fea 2	0	3	0	N/A	11.98-12.2, 9.72-11.35, 9.51-10.15	N/A	N/A	N/A
SP262V3	Fea 2	0	1	0	N/A	8.5-9.52	N/A	N/A	N/A
RvHv2V1	Cat. 64.15-2751	2	4	2	75.4	1.48	0.65	8.35	4.24
RvHv2V2	Cat. 64.15-2623 R2E626	1	3	0	12.9	1.15	1	2.56	2.83
RvHv2V3	Cat 64.15 27.09 R2E971, 852, 654, 2752	1	3	0	6.3	1	0.9	3.01	1.82
BCV1	180752 and 180829	2	1	0	22.1	1	0.8	4	4.81
StBonvV1	STP 1.10, Lv 1, Cat 10.08 185850	2	44	0	10.7	1.51	0.83	3.31	3.21

Sample #	Rim Description	Exterior Munsell Color	Interior Munsell Color	Exterior Surface Treatment
BCV2	Rim varies slightly from straight to slightly curving outwards. Rim is rolled and flattened. Lip is decorated with vertical incising.	Not taken	Not taken	Cord-wrapped stick, slightly oblique (/) pattern.
BCV3	Rim slightly flares outwards on exterior, interior rim is straight. Lip is rolled and flattened. Lip has oblique incisions (/).	Not taken	Not taken	Fabric-impressed with incised decoration. Zoned oblique below rim (\\\\). Then circular design below.
BCV4	N/A	Not taken	Not taken	Smoothed fabric-impressed with horizontal bands of dentate (zoned) stamping. More dentate below (partially missing) in a vertical or circular direction.
BJRV1	Very small rim/lip piece. Straight-sided, undecorated int/ext. Lip is rolled and flattened.	5 YR 6/6 to 7.5 YR 6/3	10 YR 5/3, no firing core	Fabric impressed, undecorated, dark temper and mica sand visible.
BSV1	Rim curves outward, lip and rolled and rounded. Undecorated. Dentate oblique (///) on interior rim.	Not taken	Not taken	Cord-wrapped stick with simple dentate patterns on exterior collar/neck sherds. Smooth lower body.
BSV2	Slightly flares outwards, lip is flat. Oblique (///) incisions on lip.	Not taken	Not taken	Fabric impressed, possibly check stamp? Impressed.
Mac4V1	Pinched and flattened, lip undulates slightly. Has thin vertical incisions along lip of rim.	5 YR 5/8 to 5 YR 7/6 (varies with dirt	2.5 YR 6/8 to 5 YR 7/6	Undecorated fabric-imp. Small temper frags visible across surface.
Mac4V2	Rim is pinched and not flattened towards rim. Worn but slightly visible vertical incisions along lip.	10 YR 6/3 to 10 YR 7/2	10 YR 6/4	Undecorated fabric-imp. Small mica and small, angular med-dk grit visible. Poss shell?
Mac4V3	Sherd slightly thins and flares outwards at the rim. Rim has been rolled and flattened. Lip is smooth.	10 YR 7/3 to 10 YR 5/2	10 YR 7/4 to 10 YR 5/3	Fabric-imp, possible cord-wrapped stick. Appears very faintly and in horizontal lines, not straight bands. Undecorated

Sample #	Rim Description	Exterior Munsell Color	Interior Munsell Color	Exterior Surface Treatment
Mac4V4	Straight with a rolled and flattened lip. Horizontal incised dec on flat lip.	7.5 YR 7/3 to 5 YR 6/4 to 7.5	5 YR 6/5 and half 7.5 YR	Undecorated, fabric-imp with areas that appear more smoothed/worn than others.
Mac4V5	Rim thins towards lip, flattened with slightly right-oblique incised dec on lip.	5 YR 6/6 to 10 YR 6/4	5 YR 6/4 with dark core of 7.5 YR 4/4	Coarse fabric-impressed, not tightly knitted, with lots of dark and light temper and mica sand visible on surface.
Mac5V1	Slightly thickened rim, flares outwards, rolled lip and flattened, undecorated lip.	10 YR 6/4 to 5 YR 6/4	10 YR 8/3, sometimes a firing core, 10	Fabric-imp, some smoothing/wear
Mac6V1	Rolled and flattened, interior exterior fabric impressed up to lip. Lip is flat and undec.	10 YR 6/3 to 10 YR 6/4	10 YR 7/4	Vertical fabric-impressed, undecorated
Mac7V1	Straight walled, rolled and flattened rim. Undecorated lip and rim.	7.5 YR 6/3 to 10 YR 6/3	10 YR 6/3, no firing core visible	Multi-direction fabric-impressed. Undecorated. Dark temper and some mica sand visible on surface.
Mac8V1	Very fragile rim, straight walled, rolled and flattened lip, undecorated rim and lip. Poss stamping (zoned) below rim on exterior.	7.5 YR 6/4	5 YR 6/6 to 7.5 YR 6/3	Oblique, left-right (\). Interior, exterior fabric-impressed up to lip
MK2594V1	N/A	10 YR 8/4	10 YR 6/3, core is 10 YR 5/3	Fabric-impressed, no visible sand or temper on surface. Exterior is slightly smoothed/worn.
MK2594V2	N/A	10 YR 5/3 mottled with 7.5 YR 6/8	mottled with 7.5 YR 6/8 and core is 10 YR 3/1	Fabric-impressions, undecorated, mica sand and temper visible on surfaces.
MK2594V3	Slightly flares outwards, lip is pinched thin and slightly pointed with slight flattening right at the lip, undecorated.	10 YR 7/2-8/4	10 YR 7/1-7/3 with varying core 10 YR 3/1-10 YR 4/1-10 7/2	Mixed oblique (\\\) and almost perpendicular to that (net pattern) fabric impressed. Areas have been smoothed/worn across the surface. Dark sand temper visible on surface.
MK2594V4	N/A	10 YR 6/4 to 7.5 YR 6/8	10 YR 6/4 to 7.5 YR 6/8, no core	Fabric impressed, undecorated, Temper and mica sand visible on surface.

Sample #	Rim Description	Exterior Munsell Color	Interior Munsell Color	Exterior Surface Treatment
MK2594V5	Straight walled with rolled and flattened lip, faint oblique (///) incisions 2-3 mm apart on lip.	2.5 YR 3/1-2.5 YR 7/4-10 YR 7/4	2.5 YR 7/2-10 YR 6/2, core 10 YR 7/4-2.5 YR	Oblique, left-right (\). Interior, exterior fabric-impressed up to lip with parrallel (cross-hatching), net-like, incisions, undecorated. Dark mica sand is visible on
MK2594V6	Straight-walled with the barest hint of flaring out right near the base of the rim. Lip is rolled and flattened, undecorated, large pieces of temper visible even at the	10 YR 6/4	10 YR 7/2, no core	Fabric-impressed, undecorated, temper is visible on surface and a few mica sands.
MK2594V7	N/A	10 YR 7/4	10 YR 6/3, core is 10 YR 5/1	Fabric-impressed with wear/smoothing. Mica flakes visible.
MK2594V8	N/A	10 YR 7/3-10 YR 7/4	10 YR 5/1-10 YR 5/2, no	Fabric-impressed with wear/smoothing. Mica flakes aned few light temper are
MV1	interior of the sherd. Lip is rolled and flattened. Has oblique (\\\) dentate incisions on lip spaced 4.88-10.5 mm apart.	10 YR 2/1 (encrusted sherd)	7.5 YR 5/2, no core present	Fabric impressed, probably vertical but difficult to see because of possible encrustations.
MV2	N/A	7.5 YR 6/2-7.5 YR 7/3-	7.5 YR 3/0-10 YR 2/1 with firing	Fabric impressions, undecorated. Appears in a slightly oblique direction (\\\)
MV3	Fabric impressed with a rolled/flattened rim, lip is fabric-impressed and impressions continue on inside vessels about 12 mm below lip.	7.5 YR 2/0-7.5 YR 3/3	7.5 YR 5/3 with thin core of 10 YR 2/1	Fabric-impressed, vertical, undecorated.
NMRV1	N/A	7.5 YR 7/4	2.5 YR 5/0, No core	Sherd has a light, soapy feel, very worn and difficult to see surface treatment. May have some fabric-impressions or could just be wearing/erosion. Temper is very visible on surfaces. Shows up shiny even though its dark material.
NMRV2	N/A	10 YR 6/3	10 YR 4/1, core 10 YR	Fabric impressed, undecorated, few mica sand flakes visible
NMRV3	N/A	7.5 YR 6/2--7.5 YR 5/6	7.5 YR 5/0, No core	Fabric impressed, impressions are smoothed or worn partly away, undecorated, few mica sand flakes visible
NMRV4	N/A	7.5 YR 6/3	7.5 YR 4/0, No Core	Fabric impressed, mica sand visible on surface, undecorated
SP262V1	N/A	10 YR 5/3	10 YR 3/1-10 YR 5/1, core 10 YR 5/1	Exterior smoothed/worn, may have had fabric impressions but they're completely gone. Temper is visible on surface.

Sample #	Rim Description	Exterior Munsell Color	Interior Munsell Color	Exterior Surface Treatment
SP262V2	N/A	7.5 YR 4/4-6/4 and sometimes 10 YR 5/1	10 YR 3/1 with core 10 YR 2/1	Fabric impressed with lots of smoothing/wear so impressions are barely visible. No temper visible on surface.
SP262V3	N/A	7.5 YR 4/4-6/4 and sometimes 10 YR 5/1	10 YR 4/1-4/4, 10 YR 5/3-6/3 and core 7.5 YR	Fabric impressed with lots of smoothing/wear so impressions are barely visible. No temper visible on surface.
RvHv2V1	Slightly outflaring, thins towards the lip. The rim is pinched and slightly pointed w/oblique left and right impressions	Epoxyed	Epoxyed	Fabric-impressed, mostly horizontal, undecorated with dark temper visible on the surface
RvHv2V2	Rim is flat and lip is smooth. Undecorated. Straight without flaring. Thins slightly towards the lip.	Epoxyed	Epoxyed	Smoothed fabric-impressed, undecorated. Temper, mostly mica visible on surface.
RvHv2V3	Pinched and thinned towards lip, interior/exterior encrustations, appears undecorated, lip is slightly pointed with vertical impressions, partially exfoliated	Yellow-pinkish	Darker gray	Fabric-impressed in interlocking horizontal and vertical lines
BCV1	Straight, slightly convex (outflaring), rolled and flattened rim w/oblique right-light /// impresions on lip. Left to right encircling oblique beneath rim. Circular incised dec. Interior oblique right-left impressions with horizontal wiping smoothed. Temper is visible on the			Smooth, with dentate
StBonvV1	Slightly outflaring rim, rim/lip are rolled and flattened. Lip is undecorated. Many body sherds are partially to fully exfoliated.			Fabric-impressed

Sample #	Interior Surface Treatment	Temper Color	Est. Temper Size (mm)	Additional Notes
BCV2	Smoothed with horizontal wiping impressions.	Light colored temper	2.0-6.0	Some sherds with encrustations
BCV3	Smoothed with horizontal wiping impressions. Partially zonned oblique (///) with two crooked incised lines above and below incisions. Poss fabric or cord-wrapped stick interior below incised decoration	Dark, coarse crystalline and light crystalline and mica sand	dark 2-5 and light 2-3	Dark temper and mica sand visible on surfaces.
BCV4	Smooth with wiping impressions, undecorated.	Light temper and lots of mica sand	2	Site also has clay wasters, also with light temper.
BJRV1	Cording near rim (zoned) then fabric-impressed below.	Dark temper and mica sand	2.0-4.0	No encrustations. Site has soapstone as well.
BSV1	Smooth with wiping impressions, undecorated.	White crystalline	2.0-4.0	Lots of exfolation of body sherds, sherds tend to split vertically. White temper is visible on surfaces.
BSV2	Smooth with wiping impressions, undecorated.	Light with chunks of mica	2.0-5.0	Chosen because technology on surface mimics Vinette. Corded pottery is ext. common (big temper) smooth int. Has encrustations and can be dated.
Mac4V1	Undecorated, smooth with horizontal wiping marks	Ang, Dark Coarse Crystalline	2	No evidence of encrustations, additional poss body sherds associated with vessel
Mac4V2	Undecorated, Smooth with very faint horizontal wiping marks.	Ang, dark and light crystalline grit and mica sand	4.0-5.0	No encrustations, two solid body sherds, rim is eroded and rough
Mac4V3	Smoothed with horizontal wiping impressions. Undecorated.	Very dark crystalline grit and mica sand	2	Mica sand is visible on exterior surface of vessel, no encrustations.

Sample #	Interior Surface Treatment	Temper Color	Est. Temper Size (mm)	Additional Notes
Mac4V4	Undecorated, fabric-impressed with smoothed areas	Dark and light crystalline rock, very coarse looking.	3.0-4.0	Dark and light temper visible on surface, no encrustations.
Mac4V5	Coarse fabric-impressions, undecorated	Light and dark crystalline and mica sand	2	No obvious encrustations
Mac5V1	Ridged cording, cord-wrapped stick impressed, horizontal. Undecorated.	Light and dark crystalline rock	4	Light and dark rock visible on surfaces, no encrustations
Mac6V1	Undecorated, fabric-impressed with few dark, coarse crystalline temper visible	Dark crystalline	4	No encrustations, dark temper visible on surface. Site has steatite and gneiss stone bowls, lots of pipes, later pottery as well. Also unfired lumps of clay.
Mac7V1	Horizontal cording, less temper visible.	Dark crystalline temper with mica sand	2.0-3.0	No obvious encrustations
Mac8V1	Fabric-impressed	Light and dark temper and mica sand visible.	2.0-4.0	Many sherds are partially or fully exfoliated, laminated sherd texture. No encrustations.Site has lots of unfired clay chunks as well and steatite vessels.
MK2594V1	Fabric-impressed, no visible sand or temper on surface.	Light and dark temper and very few rounded, red inclusions, possibly sandstone	2.8-5.0	No encrustations
MK2594V2	Fabric-impressed, undecorated, mica and temper fragments visible	White crystalline temper in V2B1 and light and dark temper in V2B2, mica sand in both	1.84-3.06 and 2.0-5.7	V2B2 does not look like V2B1, may need to be renamed to another vessel number. Both have firing cores, difference is in the temper color.
MK2594V3	Horizontal fabric impressions, similar to cording but fabric is almost visible across interior. Undecorated. Might be cord-wrapped-stick held horizontally and rolled up the vessel. Rim and lip are not fabric-impressed. White temper visible on	White temper, mica sand, and dark sand visible. White temper looks more chalky then crystalline.	1.62-4.29	Mended rim sherd, does show signs of lamination on breaks. Also large coil breaks evident
MK2594V4	Fabric-impressed, undecorated, signs of wear/smoothing in patches, temper and mica sand visible	Ligtht dark temper but it looks more dark than light and dark temper	2.10-4.64 and 2.82-4.03	No encrustations

Sample #	Interior Surface Treatment	Temper Color	Est. Temper Size (mm)	Additional Notes
MK2594V5	Smoothed with faint wiping horizontal in patches, temper is visible.	Red and white and black temper and dark mica sand	2.13-3.01	No encrustations
MK2594V6	Fabric-impressed with patches of smoothing/wear, temper and mica sand are visible	Light and dark temper and mica sand visible.	3.73-6.34	No visible firing core, not laminated or flaky, matrix is crumbly.
MK2594V7	Fabric-impressed with wear/smoothing. Mica flakes visible.	Red and white and black temper and dark mica sand	2.5-4.07	Temper is probably granite, oriingally listed with Vessel 4, definitely not the same.
MK2594V8	Fabric-impressed, undecorated, mica and few temper pieces visible	light and red and dark temper	3.13-3.78 and 2.03-3.22	No encrustations
MV1	Horizontal wiping impressions, smooth, undecorated	Light crystalline with white sand visible	4.65-4.88	Temper is visible on interior surfaces. Obscured on exterior to due encrustations. Laminated.
MV2	Fabric-impressed, all directions	Light and dark coarse grit and white sand	3-6.5	One body sherd has encrustations, temper is barely visible on surfaces, laminated surface.
MV3	Smooth, undecorated below zonned, horizontal wiping marks.	Light crystalline with white sand visible	2.7-4.11	Very laminated and flaky structure. Rim is very fragile and crumbly.
NMRV1	Sherd has a light, soapy feel, very worn and difficult to see surface treatment. May have some fabric-impressions or could just be wearing/erosion. Temper is very visible on surfaces. Shows up shiny even though its dark material.	Dark, steatite	1.65-4.45	Not laminated, very chunky material. Very loaded with steatite.
NMRV2	Fabric-impressed, undecorated, mica flakes	Light and dark crystalline and mica sand	2.76-4.7	Somewhat laminated structure, crumbles and exfoliates, no encrustations.
NMRV3	Fabric-impressed, undecorated, mica flakes	Light and dark and red temper visible and mica sand	3.87-4.75	Somewhat laminated structure, crumbles and exfoliates, no encrustations.
NMRV4	Fabric-impressed, undecorated, mica flakes	Light and dark and red temper visible and mica sand	3.15-5.14	Somewhat laminated structure, crumbles and exfoliates, no encrustations.
SP262V1	Fabric impressed but worn/smoothed. Temper visible.	Light and dark and light temper.	2.25-4.74 and 2.34-6.7	Surface is not laminated, very solid, crumbles in large chunks. Has been AMS dated.

Sample #	**Interior Surface Treatment**	**Temper Color**	**Est. Temper Size (mm)**	**Additional Notes**
SP262V2	Fabric impressed with lots of smoothing/wear so impressions are barely visible. No temper visible on surface.	Light and dark and dark temper	2.97-4.25 and 1.70-4.90	Fabric is not laminated, dense matrix, crumbles in large chunks. No temper visible on surfaces.
SP262V3	Fabric impressed with lots of smoothing/wear so impressions are barely visible. No temper visible on surface.	Light and dark and light temper.	1.58-2.65 and 1.55-1.66	Matrix is not laminated, dense, no temper visible on surfaces, no encrustations.
RvHv2V1	Fabric-impressed with multi-directions, undecorated, has encrustations	dark coarse crystalline	4	The rim and four body sherds mend, two additional body sherds taken for analysis as well
RvHv2V2	Horizontal fabric-impressed, undecorated. Possible interior surface encrustations. Sandstone and bits of clay visible	Light and dark coarse grit with mica	2.0-6.0	Sherds are reddish-yellow on exterior with dark interior. Rim too small to test.
RvHv2V3	Single direction fabric (cording)	light and dark coarse crystalline, pinkish in color	3.0-5.0	Body sherds are lamianted and many are exfoliated, No core but has half/half colors.
BCV1	Smooth	light and dark coarse cystalline	2.0-5.0	vessels originally named V2, renamed to V1. Vinette Dentate (decorated) vessel. Rim sherds are mended, body sherd is too small to test
StBonvV1	Fabric-impressed and very worn (usewear?)	Light (reds) and whites with very few dark minerals. Probably granite with high sand.	2.0-3.0	Poorly fired with a firing core present in the lower body sherds.

APPENDIX B: DATA SHEETS FOR PETROGRAPHIC ANALYSIS

Broken Clock Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	45
Matrix	117
Mineral	65
Plucking Void	10
Void	44
Grand Total	**281**

Row Labels	Count of Rock Type #1
Crushed Rock	**45**
Grit	**45**
Angular	3
Low Sphercity	3
Very Angular	42
Low Sphercity	42
Matrix	**1**
Silt	**1**
Rounded	1
High Sphercity	1
Mineral	**65**
Grit	**42**
Angular	22
Low Sphercity	22
Rounded	1
Low Sphercity	1
sub-angular	6
Low Sphercity	6
Very Angular	13
Low Sphercity	13
Sand	**23**
Rounded	11
High Sphercity	2
Low Sphercity	9
sub-angular	1
Low Sphercity	1
Sub-rounded	6
High Sphercity	4
Low Sphercity	2
Well Rounded	5
High Sphercity	4
Low Sphercity	1
Grand Total	**111**

Row Labels	Count of Type
Crushed Rock	**45**
>2.0	37
0.50-1.0	3
1.0-2.0	5
Matrix	**117**
<0.0625	117
Mineral	**65**
>2.0	3
0.0625-0.25	34
0.25-0.50	8
0.25-5.0	1
0.50-1.0	8
1.0-2.0	11
Plucking Void	**10**
>2.0	9
0.50-1.0	1
Void	**44**
>2.0	30
0.0625-0.25	2
0.25-0.50	4
0.50-1.0	3
1.0-2.0	5
Grand Total	**281**

Row Labels	Count of Type
Crushed Rock	**45**
Biotite	1
Clinopyroxene	3
Microcline	1
Opaque	4
Perthite	19
Plagioclase	9
Quartz	8
Matrix	**1**
Quartz	1
Mineral	**65**
Chlorite	1
Muscovite	1
Opaque	5
Orthoclase	10
Orthopyroxene	2
Perthite	7
Plagioclase	3
Quartz	36
Void	**44**
Chamber	1
Channel	5
Plane	35
Vughe	3
Grand Total	**155**

Broken Clock Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	45
Matrix	75
Mineral	61
Plucking Void	15
Void	30
Grand Total	**226**

Row Labels	Count of Rock Type #1
Crushed Rock	**45**
Grit	**45**
Angular	1
Low Sphercity	1
Very Angular	44
Low Sphercity	44
Mineral	**61**
Grit	**45**
Angular	20
Low Sphercity	20
Sub-angular	13
Low Sphercity	13
Very Angular	12
Low Sphercity	12
Sand	**16**
Rounded	3
High Sphercity	1
Low Sphercity	2
Sub-rounded	1
Low Sphercity	1
Well Rounded	11
High Sphercity	4
Low Sphercity	7
Well-Rounded	1
High Sphercity	1
Grand Total	**106**

Row Labels	Count of Type
Crushed Rock	**45**
>2.0	38
0.25-0.50	1
0.50-1.0	2
1.0-2.0	4
Matrix	**75**
<0.0625	75
Mineral	**61**
>2.0	3
0.0625-0.25	21
0.25-0.50	19
0.50-1.0	16
1.0-2.0	2
Plucking Void	**15**
>2.0	15
Void	**30**
>2.0	16
0.0625-0.25	3
0.25-0.50	5
0.50-1.0	1
1.0-2.0	5
Grand Total	**226**

Row Labels	Count of Type
Crushed Rock	**45**
Amphibole	15
Biotite	1
Clinopyroxene	3
Hornblende	2
Microcline	2
Orthoclase	3
Perthite	1
Plagioclase	15
Quartz	3
Mineral	**61**
Amphibole	4
Biotite	2
Clinopyroxene	1
Opaque	7
Orthoclase	11
Perthite	1
Plagioclase	3
Quartz	32
Void	**30**
Chamber	2
Channel	5
Plane	21
simple packing void	1
vughe	1
Grand Total	**136**

Broken Clock Vessel 1 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	123
Matrix	94
Mineral	64
Plucking Void	5
Void	61
Grand Total	**347**

Row Labels	Count of Rock Type #1
Crushed Rock	**123**
Grit	**123**
Angular	12
Low Sphercity	12
sub-angular	6
Low Sphercity	6
Very Angular	105
Low Sphercity	105
Mineral	**64**
Grit	**43**
Angular	26
High Sphercity	1
High Sphercity	1
Low Sphercity	24
sub-angular	8
Low Sphercity	8
Very Angular	9
Low Sphercity	9
Sand	**21**
Angular	1
High Sphercity	1
Rounded	13
High Sphercity	3
Low Sphercity	10
Sub-rounded	4
Low Sphercity	4
Well Rounded	3
High Sphercity	2
Low Sphercity	1
Grand Total	**187**

Row Labels	Count of Type
Crushed Rock	**123**
>2.0	117
0.50-1.0	1
1.0-2.0	5
Matrix	**94**
<0.0625	94
Mineral	**64**
>2.0	2
0.0625-0.25	34
0.25-0.50	11
0.50-1.0	8
1.0-2.0	9
Plucking Void	**5**
>2.0	4
0.50-1.0	1
Void	**61**
>2.0	32
0.0625-0.25	10
0.20-1.0	1
0.25-0.50	7
0.50-1.0	5
1.0-2.0	6
Grand Total	**347**

Row Labels	Count of Type
Crushed Rock	**123**
Amphibole	11
Biotite	14
Clinopyroxene	4
Hornblende	8
Microcline	4
Myrmekite	2
Opaque	10
Orthoclase	17
Orthopyroxene	1
Perthite	26
Plagioclase	15
Quartz	11
Mineral	**64**
Amphibole	1
Clinopyroxene	7
Hornblende	1
Muscovite	1
Opaque	4
Orthoclase	20
Orthopyroxene	1
Perthite	7
Quartz	22
Void	**61**
Chamber	4
Plane	40
Simple packing void	7
Vughe	10
Grand Total	**248**

Broken Clock Vessel 2 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	87
Matrix	102
Mineral	94
Plucking Void	3
Void	34
Grand Total	**320**

Row Labels	Count of Rock Type #1
Crushed Rock	**87**
Grit	**87**
Angular	8
Low Sphercity	8
Very Angular	79
Low Sphercity	79
Matrix	**1**
Silt	**1**
Rounded	1
Low Sphercity	1
Mineral	**94**
Grit	**55**
Angular	47
Low Sphercity	47
Rounded	1
Low Sphercity	1
Sub-angular	2
Low Sphercity	2
Very Angular	5
Low Sphercity	5
Sand	**39**
Rounded	36
High Sphercity	10
Low Sphercity	26
Sub-rounded	1
Low Sphercity	1
Well Rounded	2
High Sphercity	1
Low Sphercity	1
Grand Total	**182**

Row Labels	Count of Type
Crushed Rock	**87**
>2.0	79
0.50-1.0	4
1.0-2.0	4
Matrix	**102**
<0.0625	102
Mineral	**94**
>2.0	7
0.0625-0.25	58
0.25-0.50	12
0.50-1.0	14
1.0-2.0	3
Plucking Void	**3**
>2.0	3
Void	**34**
>2.0	23
0.25-0.50	1
0.50-1.0	8
1.0-2.0	2
Grand Total	**320**

Row Labels	Count of Type
Crushed Rock	**87**
Amphibole	6
Biotite	5
Chlorite	2
Clinopyroxene	8
Epidote	1
Hornblende	7
Opaque	15
Orthoclase	16
Orthopyroxene	2
Perthite	6
Plagioclase	17
Quartz	2
Matrix	**1**
Opaque	1
Mineral	**94**
Amphibole	1
Hornblende	2
Microcline	2
Muscovite	8
Opaque	4
Orthoclase	29
Perthite	6
Plagioclase	2
Quartz	40
Void	**34**
Channel	3
Plane	30
Vughe	1
Grand Total	**216**

Broken Clock Vessel 2 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	104
Grog	1
Matrix	105
Mineral	103
Plucking Void	5
Void	23
Grand Total	**341**

Row Labels	Count of Rock Type #1
Crushed Rock	**104**
Grit	**104**
Angular	5
Low Sphercity	5
Very Angular	99
Low Sphercity	99
Grog	**1**
Grit	**1**
Angular	1
Low Sphercity	1
Mineral	**103**
Grit	**52**
Angular	46
Low Sphercity	46
Very Angular	6
Low Sphercity	6
Sand	**51**
Rounded	46
High Sphercity	6
Low Sphercity	40
sub-rounded	2
High Sphercity	1
Low Sphercity	1
Well Rounded	3
High Sphercity	1
Low Sphercity	2
Grand Total	**208**

Row Labels	Count of Type
Crushed Rock	**104**
>2.0	97
0.50-1.0	3
1.0-2.0	4
Grog	**1**
>2.0	1
Matrix	**105**
<0.0625	105
Mineral	**103**
>2.0	1
0.0625-0.25	67
0.25-0.50	22
0.50-1.0	7
0.5-1.0	1
1.0-2.0	5
Plucking Void	**5**
>2.0	4
1.0-2.0	1
Void	**23**
>2.0	15
0.0625-0.25	1
0.25-0.50	1
0.50-1.0	4
1.0-2.0	2
Grand Total	**341**

Row Labels	Count of Type
Crushed Rock	**104**
Amphibole	1
Biotite	1
Chlorite	7
Clinopyroxene	22
Hornblende	2
Microcline	4
Myrmekite	1
Opaque	9
Orthoclase	9
Orthopyroxene	3
Perthite	14
Plagioclase	27
Quartz	4
Grog	**1**
Opaque	1
Mineral	**103**
Biotite	4
Flourite	4
Hornblende	2
Muscovite	1
Opaque	7
Orthoclase	20
Perthite	4
Plagioclase	5
Quartz	56
Void	**23**
Chamber	2
Plane	19
Vughe	2
Grand Total	**231**

Broken Clock Vessel 4 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	47
Matrix	145
Mineral	113
Plucking Void	2
Void	46
Grand Total	**353**

Row Labels	Count of Rock Type #1
Crushed Rock	**47**
Grit	**47**
Angular	4
Low Sphercity	4
Very Angular	43
Low Sphercity	43
Mineral	**113**
Grit	**79**
Angular	66
High Sphercity	1
Low Sphercity	65
Sub-angular	1
Low Sphercity	1
Very Angular	12
Low Sphercity	12
Sand	**34**
Rounded	32
High Sphercity	7
Low Sphercity	25
Well Rounded	2
High Sphercity	2
Grand Total	**160**

Row Labels	Count of Type
Crushed Rock	**47**
>2.0	41
0.50-1.0	3
1.0-2.0	3
Matrix	**145**
<0.0625	145
Mineral	**113**
>2.0	2
0.0625-0.25	42
0.25-0.50	27
0.50-1.0	31
1.0-2.0	11
Plucking Void	**2**
>2.0	1
0.50-1.0	1
Void	**46**
<2.0	2
>2.0	27
0.0625-0.25	2
0.25-0.50	5
0.50-1.0	5
1.0-2.0	5
Grand Total	**353**

Row Labels	Count of Type
Crushed Rock	**47**
Biotite	2
Microcline	2
Muscovite	1
Orthoclase	26
Perthite	8
Plagioclase	3
Quartz	4
Sercite	1
Matrix	**1**
Muscovite	1
Mineral	**113**
Biotite	4
Microcline	3
Muscovite	11
Opaque	3
Orthoclase	29
Perthite	3
Plagioclase	3
Quartz	57
Plucking Void	**1**
Chamber	1
Void	**46**
Chamber	4
Channel	3
Plane	35
Vesicle	1
Vughe	3
Grand Total	**208**

Broken Clock Vessel 4 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	34
Matrix	80
Mineral	83
Plucking Void	1
Void	33
Grand Total	**231**

Row Labels	Count of Rock Type #1
Crushed Rock	**34**
Grit	**34**
Angular	2
Low Sphercity	2
Very Angular	32
Low Sphercity	32
Mineral	**82**
Grit	**62**
Angular	45
Low Sphercity	45
sub-angular	1
Low Sphercity	1
Very Angular	16
Low Sphercity	16
Sand	**20**
Rounded	19
High Sphercity	5
Low Sphercity	14
Well Rounded	1
High Sphercity	1
Grand Total	**116**

Row Labels	Count of Type
Crushed Rock	**34**
>2.0	28
0.50-1.0	3
1.0-2.0	3
Matrix	**80**
<0.0625	80
Mineral	**83**
>2.0	2
0.0625-0.2	1
0.0625-0.25	38
0.25-0.50	22
0.50-1.0	14
1.0-2.0	6
Plucking Void	**1**
>2.0	1
Void	**33**
>2.0	23
0.0625-0.25	1
0.25-0.50	4
0.50-1.0	3
1.0-2.0	2
Grand Total	**231**

Row Labels	Count of Type
Crushed Rock	**34**
Biotite	4
Calcite	1
Clinopyroxene	1
Flourite	1
Microcline	3
Muscovite	1
Orthoclase	7
Perthite	9
Plagioclase	4
Quartz	3
Mineral	**82**
Biotite	1
Flourite	1
Muscovite	6
Opaque	1
Orthoclase	25
Perthite	3
Plagioclase	4
Quartz	41
Void	**33**
Chamber	1
Channel	1
Flourite	1
Plane	29
Simple packing void	1
Grand Total	**149**

Blue Jay Ridge Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	99
Grog	1
Matrix	91
Mineral	74
Void	33
Grand Total	**298**

Row Labels	Count of Rock Type #1
Crushed Rock	**99**
Grit	**99**
Very Angular	99
Low Sphercity	99
Grog	**1**
Grit	**1**
Very Angular	1
Low Sphercity	1
Mineral	**73**
Grit	**47**
Angular	38
Low Sphercity	38
Very Angular	9
Low Sphercity	9
Sand	**26**
Rounded	15
High Sphercity	4
Low Sphercity	11
Sub-rounded	5
Low Sphercity	5
Well Rounded	6
High Sphercity	4
Low Sphercity	2
Grand Total	**173**

Row Labels	Count of Type
Crushed Rock	**99**
>2.0	91
0.50-1.0	4
1.0-2.0	4
Grog	**1**
>2.0	1
Matrix	**91**
<0.0625	91
Mineral	**74**
1.0-2.0	1
<0.0625	1
>2.0	5
0.0625-0.25	41
0.25-0.50	11
0.50-1.0	9
1.0-2.0	6
Void	**33**
>2.0	29
0.25-0.50	2
0.50-1.0	2
Grand Total	**298**

Row Labels	Count of Type
Crushed	**99**
amphibole	1
biotite	1
Chlorite	1
Clinopyroxene	2
Microcline	2
Opaque	4
Orthoclase	10
Orthopyroxene	8
Perthite	16
Plagioclase	40
Quartz	14
Grog	**1**
Opaque	1
Matrix	**13**
Muscovite	1
Opaque	5
Quartz	7
Mineral	**74**
amphibole	2
Apatite	1
Clinopyroxene	5
Flourite	3
Muscovite	3
Opaque	5
Orthoclase	1
Perthite	4
Plagioclase	5
Quartz	45
Grand Total	**187**

Blue Jay Ridge Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	84
Matrix	91
Mineral	73
Void	31
Grand Total	**279**

Row Labels	Count of Rock Type #1
Crushed Rock	**84**
Grit	**84**
Very Angular	84
Low Sphercity	84
Matrix	**1**
Sand	**1**
Rounded	1
Low Sphercity	1
Mineral	**73**
Grit	**54**
Angular	43
Low Sphercity	43
Very Angular	11
Low Sphercity	11
Sand	**19**
Rounded	1
High Sphercity	1
Rounded	12
High Sphercity	3
Low Sphercity	9
Sub-rounded	3
High Sphercity	1
Low Sphercity	2
Well Rounded	3
High Sphercity	1
Low Sphercity	2
Grand Total	**158**

Row Labels	Count of Type
Crushed Rock	**84**
>2.0	81
0.50-1.0	2
1.0-2.0	1
Matrix	**91**
<0.0625	91
Mineral	**73**
>2.0	5
0.0625-0.25	37
0.25-0.50	15
0.50-1.0	13
1.0-2.0	3
Void	**31**
>2.0	26
0.25-0.50	1
0.50-1.0	1
1.0-2.0	3
Grand Total	**279**

Row Labels	Count of Type
Crushed Rock	**84**
Calcite	1
Clinopyroxene	3
Epidote	1
Hornblende	1
Olivine	2
Opaque	5
Orthoclase	17
Orthopyroxene	4
Perthite	16
Plagioclase	18
Quartz	16
Matrix	**91**
Opaque	5
Quartz	4
(blank)	82
Mineral	**73**
Clinopyroxene	2
Flourite	4
Fluorite	1
Muscovite	7
Olivine	1
Opaque	3
Orthoclase	1
Orthopyroxene	2
Perthite	3
Plagioclase	6
Quartz	43
Void	**31**
(blank)	31
Grand Total	**279**

Blue Jay Ridge Vessel 1 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	92
Matrix	84
Mineral	80
Plucking Void	8
Void	38
Grand Total	**302**

Row Labels	Count of Rock Type #1
Crushed Rock	**92**
Grit	**92**
Angular	1
Low Sphercity	1
Very Angular	91
Low Sphercity	91
Matrix	**9**
Silt	**9**
Angular	4
High Sphercity	1
Low Sphercity	3
Well Rounded	5
High Sphercity	5
Mineral	**80**
Grit	**56**
Angular	49
Low Sphercity	49
sub-angular	2
Low Sphercity	2
Very Angular	5
Low Sphercity	5
Sand	**24**
Rounded	15
High Sphercity	4
Low Sphercity	11
Sub-rounded	5
Low Sphercity	5
Well Rounded	4
High Sphercity	4
Grand Total	**181**

Row Labels	Count of Type
Crushed Rock	**92**
>2.0	85
0.50-1.0	2
1.0-2.0	5
Matrix	**84**
<0.0625	84
Mineral	**80**
>2.0	4
0.0625-0.25	51
0.25-0.50	20
0.50-1.0	3
1.0-2.0	2
Plucking Void	**8**
>2.0	8
Void	**38**
<0.0625	1
>2.0	21
0.0625-0.25	3
0.25-0.50	3
0.50-1.0	6
1.0-2.0	4
Grand Total	**302**

Row Labels	Count of Type
Crushed Rock	**92**
Chlorite	1
Clinopyroxene	3
Epidote	3
Myrmekite	5
Opaque	4
Orthoclase	14
Perthite	19
Plagioclase	34
Quartz	9
Matrix	**9**
Muscovite	1
Opaque	4
Quartz	4
Mineral	**80**
Apatite	2
Biotite	1
Clinopyroxene	1
Epidote	1
Muscovite	5
Opaque	11
Orthoclase	4
Orthopyroxene	3
Plagioclase	4
Quartz	48
Void	**26**
Chamber	3
Channel	1
Plane	18
Simple Packing Void	3
Vughe	1
Grand Total	**207**

Mouth of Cattaragus Creek Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	125
Matrix	93
Mineral	108
Plucking Void	6
Void	42
Grand Total	**374**

Row Labels	Count of Rock Type #1
Crushed Rock	**125**
Grit	**125**
Low Sphercity	125
Angular	1
Very angular	124
Matrix	**2**
Sand	**1**
High Sphercity	1
Well Rounded	1
Silt	**1**
High Sphercity	1
Well Rounded	1
Mineral	**107**
Grit	**66**
High Sphercity	1
Angular	1
Low Sphercity	65
Angular	57
Rounded	2
Very angular	6
Sand	**41**
High Sphercity	10
Rounded	6
Well Rounded	4
Low Sphercity	31
Rounded	31
Grand Total	**234**

Row Labels	Count of Type
Crushed Rock	**125**
>2.0	119
1.0-2.0	6
Matrix	**93**
<0.0625	93
Mineral	**108**
>2.0	2
0.0625-0.25	68
0.25-0.50	27
0.50-1.0	10
1.0-2.0	1
Plucking Void	**6**
>2.0	6
Void	**42**
>2.0	29
0.0625-0.25	4
0.25-0.50	1
0.50-1.0	7
1.0-2.0	1
Grand Total	**374**

Row Labels	Count of Type
Crushed Rock	**125**
Amphibole	1
Biotite	2
Clinopyroxene	3
Hornblende	1
Microcline	2
Opaque	4
Orthoclase	36
Orthopyroxene	4
Perthite	28
Plagioclase	24
Quartz	19
sercite	1
Matrix	**2**
Quartz	2
Mineral	**108**
Amphibole	1
Clinopyroxene	1
Muscovite	6
Opaque	3
Orthoclase	33
Perthite	4
Plagioclase	5
Quartz	55
Void	**42**
Chamber	2
Channel	3
Plane	35
Simple Packing void	2
Grand Total	**277**

Cottage Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	46
Matrix	41
Mineral	117
Plucking Void	7
Void	39
Grand Total	**250**

Row Labels	Count of Rock Type #1
Crushed Rock	**46**
Grit	**46**
Angular	4
Low Sphercity	4
Very Angular	42
Low Sphercity	42
Mineral	**116**
Grit	**83**
Angular	60
High Sphercity	2
Low Sphercity	58
Sub-angular	2
Low Sphercity	2
Very Angular	21
Low Sphercity	21
Sand	**33**
Rounded	30
High Sphercity	7
Low Sphercity	23
Sub-angular	1
Low Sphercity	1
sub-rounded	1
Low Sphercity	1
Well Rounded	1
Low Sphercity	1
Grand Total	**162**

Row Labels	Count of Type
Crushed Rock	**46**
>2.0	35
0.50-1.0	1
1.0-2.0	10
Matrix	**41**
<0.0625	41
Mineral	**117**
>2.0	4
0.0625-0.25	52
0.25-0.50	31
0.50-1.0	22
1.0-2.0	8
Plucking Void	**7**
>2.0	7
Void	**39**
>2.0	12
0.0625-0.25	6
0.25-0.50	7
0.50-1.0	9
1.0-2.0	5
Grand Total	**250**

Row Labels	Count of Type
Crushed Rock	**46**
Biotite	1
Hornblende	3
Microcline	3
Muscovite	1
Opaque	1
Orthoclase	17
Perthite	9
Plagioclase	2
Quartz	9
Mineral	**117**
Biotite	4
Flourite	1
Hornblende	2
Muscovite	2
Opaque	2
Orthoclase	57
Perthite	5
Plagioclase	3
Quartz	41
Void	**39**
Channel	2
Plane	33
Vughe	4
Grand Total	**202**

Egli Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	39
Matrix	66
Mineral	73
Plucking Void	1
Void	25
Grand Total	**204**

Row Labels	Count of Rock Type #1
Crushed Rock	**39**
Grit	**39**
Angular	2
Low Sphercity	2
Very Angular	37
Low Sphercity	37
Matrix	**2**
Silt	**2**
Well Rounded	2
High Sphercity	2
Mineral	**73**
Grit	**54**
Angular	45
Low Sphercity	45
Sub-angular	2
Low Sphercity	2
Very Angular	7
Low Sphercity	7
Sand	**19**
Rounded	16
High Sphercity	3
Low Sphercity	13
Sub-rounded	1
Low Sphercity	1
Well Rounded	2
High Sphercity	1
Low Sphercity	1
Grand Total	**114**

Row Labels	Count of Type
Crushed Rock	**39**
>2.0	32
0.50-1.0	1
1.0-2.0	6
Matrix	**66**
<0.0625	65
<0.14	1
Mineral	**73**
>2.0	1
0.0625-0.25	30
0.25-0.50	25
0.50-1.0	16
1.0-2.0	1
Plucking Void	**1**
>2.0	1
Void	**25**
>2.0	15
0.25-0.50	3
0.50-1.0	4
1.0-2.0	3
Grand Total	**204**

Row Labels	Count of Type
Crushed Rock	**39**
Amphibole	2
Biotite	3
Clinopyroxene	6
Hornblende	8
Muscovite	1
Opaque	2
Orthoclase	7
Orthopyroxene	1
Perthite	1
Plagioclase	2
Quartz	2
Wollastonite	4
Matrix	**2**
Opaque	2
Mineral	**73**
Clinopyroxene	1
Muscovite	3
Opaque	7
Orthoclase	23
Perthite	6
Plagioclase	4
Quartz	28
Wollastonite	1
Void	**25**
Channel	3
Plane	21
Vughe	1
Grand Total	**139**

Ferguson Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	66
Grog	5
Matrix	71
Mineral	78
Plucking Void	10
Void	34
Grand Total	**264**

Row Labels	Count of Rock Type #1
Crushed Rock	**66**
Grit	**66**
Angular	2
Low Sphercity	2
Very Angular	64
Low Sphercity	64
Grog	**5**
Grit	**5**
Angular	2
Low Sphercity	2
Sub-angular	2
Low Sphercity	2
Very Angular	1
Low Sphercity	1
Matrix	**1**
Silt	**1**
Well Rounded	1
Low Sphercity	1
Mineral	**78**
Grit	**53**
Angular	47
Low Sphercity	47
Very Angular	6
Low Sphercity	6
Sand	**25**
Rounded	1
High Sphercity	1
Rounded	18
High Sphercity	4
Low Sphercity	14
Sub-rounded	2
High Sphercity	1
Low Sphercity	1
Well Rounded	4
High Sphercity	3
Low Sphercity	1
Grand Total	**150**

Row Labels	Count of Type
Crushed Rock	**66**
>2.0	51
0.50-1.0	5
1.0-2.0	10
Grog	**5**
>2.0	1
0.50-1.0	4
Matrix	**71**
<0.0625	71
Mineral	**78**
>2.0	4
0.0625-0.25	39
0.250.50	1
0.25-0.50	18
0.50-1.0	14
1.0-2.0	2
Plucking Void	**10**
>2.0	10
Void	**34**
>2.0	15
0.0625-0.25	3
0.25-0.50	3
0.50-1.0	5
1.0-2.0	8
Grand Total	**264**

Row Labels	Count of Type
Crushed Rock	**66**
Amphibole	1
Biotite	1
Clinopyroxene	1
Hornblende	4
Microcline	4
Myrmekite	1
Opaque	1
Orthoclase	27
Perthite	8
Plagioclase	6
Quartz	12
Grog	**5**
Opaque	4
Orthoclase	1
Matrix	**1**
Quartz	1
Mineral	**78**
Hornblende	4
Muscovite	5
Opaque	7
Orthoclase	32
Perthite	2
Plagioclase	2
Quartz	26
Void	**34**
Chamber	6
Channel	3
Plane	21
Simple packing void	2
Vughe	2
Grand Total	**184**

Felix Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	42
Matrix	64
Mineral	94
Plucking Void	4
Void	37
Grand Total	**241**

Row Labels	Count of Rock Type #1
Crushed Rock	**42**
Grit	**42**
Very Angular	42
Low Sphericty	42
Matrix	**2**
Silt	**2**
Well Rounded	2
High Sphercity	2
Mineral	**94**
Grit	**72**
Angular	56
Low Sphericty	56
Sub-angular	2
Low Sphericty	2
Very Angular	14
Low Sphericty	14
Sand	**21**
Angular	1
Low Sphericty	1
Rounded	14
High Sphercity	3
Low Sphericty	11
Sub-rounded	2
Low Sphericty	2
Well Rounded	4
High Sphercity	3
Low Sphericty	1
Silt	**1**
Well Rounded	1
High Sphercity	1
Grand Total	**138**

Row Labels	Count of Type
Crushed Rock	**42**
>2.0	37
0.50-1.0	3
1.0-2.0	2
Matrix	**64**
<0.0625	64
Mineral	**94**
<0.0625	1
>2.0	13
0.0625-0.25	37
0.25-0.50	20
0.50.1.0	1
0.50-1.0	12
1.0-2.0	10
Plucking Void	**4**
>2.0	4
Void	**37**
<0.0625	1
>2.0	13
0.0625-0.25	5
0.25-0.50	6
0.50-1.0	9
1.0-2.0	3
Grand Total	**241**

Row Labels	Count of Type
Crushed Rock	**42**
Hornblende	4
Myrmekite	1
Orthoclase	14
Perthite	12
Plagioclase	3
Quartz	8
Matrix	**2**
Opaque	1
Orthoclase	1
Mineral	**94**
Clinopyroxene	1
Hornblende	1
Muscovite	1
Opaque	7
Orthoclase	38
Perthite	10
Plagioclase	2
Quartz	34
Void	**36**
Chamber	1
Plane	32
Simple packing void	1
Vughe	2
Grand Total	**174**

Gardepe Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	32
Matrix	63
Mineral	134
Plucking Void	1
Void	43
Grand Total	**273**

Row Labels	Count of Rock Type #1
Crushed Rock	**32**
Grit	**32**
Angular	1
Low Sphercity	1
Very Angular	31
Low Sphercity	31
Matrix	**1**
Silt	**1**
Rounded	1
Low Sphercity	1
Mineral	**134**
Grit	**92**
Angular	83
Low Sphercity	83
Very Angular	9
Low Sphercity	9
Sand	**42**
Well Rounded	1
Low Sphercity	1
Rounded	36
High Sphercity	6
Low Sphercity	30
Well Rounded	5
High Sphercity	3
Low Sphercity	2
Grand Total	**167**

Row Labels	Count of Type
Crushed Rock	**32**
>2.0	30
0.50-1.0	1
1.0-2.0	1
Matrix	**63**
<0.0625	63
Mineral	**134**
>2.0	3
0.0625-0.22	1
0.0625-0.25	76
0.25-0.50	36
0.50-1.0	18
Plucking Void	**1**
>2.0	1
Void	**43**
>2.0	10
0.0625-0.25	11
0.25-0.50	11
0.50-1.0	5
1.0-2.0	6
Grand Total	**273**

Row Labels	Count of Type
Crushed Rock	**32**
Biotite	2
Hornblende	3
Opaque	1
Orthoclase	11
Orthopyroxene	1
Perthite	5
Plagioclase	2
Quartz	7
Matrix	**1**
Muscovite	1
Mineral	**134**
Hornblende	1
Muscovite	2
Opaque	8
Orthoclase	68
Perthite	11
Quartz	44
Void	**43**
Channel	1
Complex packing voids	2
Orthoclase	1
Plane	29
Simple packing void	8
Vughe	2
Grand Total	**210**

MacCauley Complex #4 Vessel 1 Body Sherd 1

Count of Type	
Row Labels	**Total**
Crushed Rock	39
Matrix	84
Mineral	82
Void	30
Grog	1
Grand Total	**236**

Count of Rock Type #1	
Row Labels	**Total**
Crushed Rock	39
Grit	39
Angular	1
Low-Sphercity	1
Very Angular	38
Low-Sphercity	38
Mineral	80
Grit	39
Angular	10
High Sphericity	2
Low-Sphercity	8
Sub-Angular	10
High Sphericity	4
Low-Sphercity	6
Very Angular	19
Low-Sphercity	19
Quartz	1
Very Angular	1
Low-Sphercity	1
Sand	38
Rounded	16
High Sphericity	11
Low-Sphercity	5
Sub-Rounded	11
High Sphericity	7
Low-Sphercity	4
Well-Rounded	11
High Sphericity	10
Low-Sphercity	1
sand	1
Well-Rounded	1
High Sphericity	1
Single chamber	1
Sub-Rounded	1
Low-Sphercity	1
Grog	
Grit	
Very Angular	
Low-Sphercity	
Grand Total	**119**

Count of Type	
Row Labels	**Total**
Crushed Rock	39
<2.0	1
>2.0	37
0.25-0.50	1
Matrix	84
(blank)	84
Mineral	82
<0.0625	4
>0.025	1
>0.0625	3
>0.625	1
>2.0	9
0.0625-0.25	47
0.25-0.5	2
0.25-0.50	8
0.50-1.0	4
1.0-2.0	3
Void	30
<2.0	6
>2.0	14
0.0625-0.25	4
0.25-0.50	1
0.50-1.0	2
1.0-2.0	3
Grog	1
0.50-1.0	1
Grand Total	**236**

Count of Type	
Row Labels	**Total**
Crushed Rock	39
Microcline	1
Muscovite Mica	1
Opaque	2
Perthite	13
Plagioclase	16
Quartz	6
Mineral	80
Microcline	3
Opaque	8
Opaque	1
Perthite	1
Plagioclase	2
Quartz	65
Grand Total	**119**

MacCauley Complex #4 Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	34
Matrix	111
Mineral	41
Void	23
Grand Total	**209**

Row Labels	Count of Rock Type #1
Crushed Rock	**34**
Mineral	**41**
Grit	**27**
Angular	6
Low Sphercity	6
Sub-angular	3
Low Sphercity	3
Very Angular	18
Low Sphercity	18
Grit	**1**
Very Angular	1
Low Sphercity	1
Sand	**13**
Rounded	4
High Sphercity	1
Low Sphercity	3
Sub-rounded	3
High Sphercity	2
Low Sphercity	1
Well-rounded	6
High Sphercity	6
Grand Total	**75**

Row Labels	Count of Type
Crushed Rock	**34**
>2.0	34
Matrix	**107**
<0.0625	107
Mineral	**41**
>2.0	6
0.0625-0.25	11
0.25-0.50	8
0.25-5.0	1
0.50-1.0	5
0.5-1.0	1
0.625-0.25	3
1.0-2.0	6
Void	**23**
<2.0	3
>2,0	1
>2.0	15
1.0-2.0	4
Grand Total	**205**

Row Labels	Count of Type
Crushed Rock	**34**
Bioite	2
Biotite	1
Clinopyroxene	1
Microcline	2
Microcline Feldspar	1
Perthite	7
Pertite	1
Plagioclase	11
Plagoclase	2
Quartz	6
Matrix	**28**
Opaque	16
Quartz	12
Mineral	**41**
K-Feldspar	2
Opaque	4
Perthite	4
Plagioclase	2
Quartz	29
Grand Total	**103**

MacCauley Complex #4 Vessel 1 Body Sherd 3

Count of Type	
Row Labels	**Total**
Crushed Rock	74
Matrix	116
Mineral	67
Rock	2
Sed Rock	3
Void	20
Grand Total	**282**

Count of Rock Type #1	
Row Labels	**Total**
Crushed Rock	74
Grit	74
Angular	1
Low-sphercity	1
Very Angular	73
Low-sphercity	73
Mineral	67
Grit	45
Angular	12
Low-sphercity	12
Sub-angular	8
Low-sphercity	8
Very Angular	25
Low-sphercity	25
Sand	22
Rounded	4
High-sphercity	3
Low-sphercity	1
Sub-rounded	6
High-sphercity	5
Low-sphercity	1
Well-rounded	12
High-sphercity	11
Low-sphercity	1
Rock	2
Sand	2
Sub-angular	1
High-sphercity	1
Sub-rounded	1
High-sphercity	1
Sed Rock	3
Sand	3
Rounded	1
High-sphercity	1
Sub-rounded	2
High-sphercity	**2**

Count of Type	
Row Labels	**Total**
Crushed Rock	74
>2.0	66
0.50-1.0	2
1.0-2.0	6
Matrix	116
<0.0625	115
<0.625	1
Mineral	67
>0.0625	1
>2.0	14
0.025-0.25	2
0.0625-0.25	25
0.25-0.50	9
0.25-5.0	1
0.50-1.0	7
1.0-2.0	8
Rock	2
1.0-2.0	2
Sed Rock	3
>2.0	1
1.0-2.0	2
Void	20
>2.0	13
0.0625-0.25	1
0.50-1.0	3
1.0-2.0	3
Grand Total	**282**

Count of Type	
Row Labels	**Total**
Crushed Rock	**74**
Biotite	**9**
Hornblende	**4**
Myrmekite	**2**
Opaque	**2**
Orthoclase	**11**
Perhite	**2**
Perthite	**19**
Plagioclase	**3**
Quartz	**21**
Tourmaline	**1**
Matrix	**34**
Opaque	**15**
Quartz	**19**
Mineral	**67**
Biotite	**2**
Hornblende	**1**
Muscovite	**1**
Myrmekite	**1**
Opaque	**8**
Orthoclase	**4**
Perthite	**10**
Plagioclase	**1**
Quartz	**39**
Rock	**2**
Quartz	**2**
Sed Rock	**3**
Quartz	**3**
Grand Total	**180**

MacCauley Complex #4 Vessel 2 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	51
Matrix	84
Mineral	70
Void	30
Grand Total	**235**

Row Labels	Count of Rock Type #1
Crushed Rock	**51**
Grit	**51**
Angular	2
Low Sphercity	2
Very Angular	49
1.0-2.0	1
Low Sphercity	48
Matrix	**20**
Sand	**3**
Rounded	2
High Sphericity	2
Well-rounded	1
High Sphericity	1
Silt	**17**
Rounded	1
High Sphericity	1
Sub-rounded	3
High Sphericity	3
Well-rounded	13
High Sphericity	13
Mineral	**69**
Grit	**45**
Angular	20
High Sphericity	2
Low Sphercity	18
Sub-angular	9
High Sphericity	1
Low Sphercity	8
Very Angular	16
Low Sphercity	16
Sand	**24**
Rounded	9
High Sphericity	9
Sub-rounded	11
High Sphericity	9
Low Sphercity	2
Well-rounded	4
High Sphericity	4
Grand Total	**140**

Row Labels	Count of Type
Crushed Rock	**51**
>2.0	49
0.50-1.0	1
1.0-2.0	1
Matrix	**84**
<0.0625	83
0.0625-0.25	1
Mineral	**70**
<0.0625	1
>2.0	16
0.0625-0.25	39
0.20-0.50	1
0.25-0.50	7
0.50-1.0	4
1.0-2.0	2
Void	**30**
>2.0	21
0.25-0.50	2
0.50-1.0	3
1.0-2.0	4
Grand Total	**235**

Row Labels	Count of Type
Crushed Rock	**51**
Augite	2
Biotite	1
Clinopyroxene	1
Hornblende	2
Muscovite	1
Olivine	2
Opaque	1
Orthoclase	5
Perthite	4
Plagioclase	15
Quartz	17
Matrix	**20**
Opaque	2
Quartz	18
Mineral	**69**
Augite	1
Olivine	1
Opaque	8
Orthoclase	4
Perthite	1
Plagioclase	2
Quartz	52
Grand Total	**140**

MacCauley Complex #4 Vessel 2 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	43
Matrix	89
Mineral	86
Void	27
Grand Total	**245**

Row Labels	Count of Rock Type #1
Crushed Rock	**43**
Grit	**43**
Angular	1
Low Sphercity	1
Very Angular	42
Low Sphercity	42
Mineral	**86**
Grit	**32**
Angular	11
Low Sphercity	11
Rounded	1
High Sphercity	1
Sub-angular	7
High Sphercity	2
Low Sphercity	5
Very Angular	13
Low Sphercity	13
Sand	**54**
Rounded	20
High Sphercity	14
Low Sphercity	6
Sub-rounded	13
High Sphercity	7
Low Sphercity	6
Well-Rounded	21
High Sphercity	17
Low Sphercity	4
Grand Total	**129**

Row Labels	Count of Type
Crushed Rock	**43**
>2.0	37
1.0-2.0	6
Matrix	**89**
<0.0625	89
(blank)	
Mineral	**86**
<0.0625	1
>2.0	11
0.0625-0.25	44
0.25-0.50	22
0.50-1.0	6
1.0-2.0	2
Void	**27**
>2.0	16
0.25-0.50	3
0.25-5.0	1
0.50-1.0	5
1.0-2.0	2
Grand Total	**245**

Row Labels	Count of Type
Crushed Rock	**43**
Augite	2
Biotite	1
Microcline	1
Muscovite	1
Myrmekite	2
Opaque	3
Perthite	6
Plagioclase	8
Quartz	18
Sericite	1
Matrix	**35**
Biotite	2
Opaque	14
Quartz	19
Mineral	**86**
Biotite	2
Muscovite	2
Opaque	28
Orthoclase	2
Perthite	2
Plagioclase	1
Quartz	49
Grand Total	**164**

MacCauley Complex #4 Vessel 2 Body Sherd 3

Object	Count of Type
Crushed Rock	78
Matrix	153
Mineral	59
Plucking Void	10
Sed Rock	1
Void	37
Grand Total	**338**

Object	Count of Rock Type #1
Crushed Rock	**78**
Grit	**78**
Angular	1
Low Sphercity	1
Very Angular	77
Low Sphercity	77
Mineral	**59**
Grit	**40**
Angular	20
Low Sphercity	20
sub-angular	4
Low Sphercity	4
Very Angular	16
Low Sphercity	16
Sand	**19**
Rounded	12
High Sphercity	2
Low Sphercity	10
Sub-rounded	6
High Sphercity	1
Low Sphercity	5
Well Rounded	1
Low Sphercity	1
Sed Rock	**1**
Sand	**1**
Sub-rounded	1
Low Sphercity	1
Grand Total	**138**

Object	Count of Type
Crushed Rock	**78**
>2.0	68
0.25-0.50	1
0.50-1.0	2
1.0-2.0	7
Matrix	**153**
<0.0625	153
Mineral	**59**
>2.0	1
0.0625-0.25	24
0.25-0.50	27
0.50-1.0	4
1.0-2.0	3
Plucking Void	**10**
>2.0	8
1.0-2.0	2
Sed Rock	**1**
1.0-2.0	1
Void	**37**
<0.0625	1
>2.0	15
0.0625-0.25	1
0.25-0.50	7
0.50-1.0	7
1.0-2.0	6
Grand Total	**338**

Object	Count of Type
Crushed Rock	**78**
Biotite	8
Clinopyroxene	1
Hornblende	2
Microcline	2
Myrmekite	2
Opaque	1
Orthoclase	14
Perthite	34
Plagioclase	4
Quartz	10
Mineral	**59**
Biotite	4
Hornblende	1
Microcline	2
Muscovite	2
Opaque	6
Orthoclase	21
Perthite	7
Quartz	16
Sed Rock	**1**
Quartz	1
Void	**37**
Chamber	4
Channel	3
Plane	19
Simple Packing Void	1
Vughe	10
Grand Total	**175**

MacCauley Complex #4 Vessel 3 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	71
Matrix	49
Mineral	93
Sed Rock	1
Void	38
Grand Total	**252**

Row Labels	Count of Rock Type #1
Crushed Rock	**71**
Grit	**71**
Low Sphercity	71
Very Angular	71
Matrix	**23**
Grit	**2**
Low Sphercity	2
Angular	1
Very Angular	1
Sand	**1**
High Sphercity	1
Well Rounded	1
Silt	**20**
High Sphercity	14
Angular	1
Rounded	4
Sub-rounded	1
Well Rounded	8
Low Sphercity	6
Angular	1
Rounded	5
Mineral	**93**
Grit	**61**
High Sphercity	1
Angular	1
Low Sphercity	60
Angular	42
sub-angular	2
Very Angular	16
Sand	**32**
High Sphercity	17
Angular	1
Rounded	8
sub-angular	2
Sub-rounded	2
Well Rounded	4
Low Sphercity	15
Rounded	12
Sub-rounded	3
Sed Rock	**1**
Sand	**1**
High Sphercity	1
Well Rounded	1
Grand Total	**188**

Row Labels	Count of Type
Crushed Rock	**71**
>2.0	64
1.0-2.0	7
Matrix	**49**
<0.0625	47
0.0625-0.25	2
Mineral	**93**
>2.0	6
0.0625-0.25	61
0.25-0.50	20
0.50-1.0	1
1.0-2.0	5
Sed Rock	**1**
>2.0	1
Void	**38**
>2.0	32
0.25-0.50	3
0.50-1.0	2
1.0-2.0	1
Grand Total	**252**

Row Labels	Count of Type
Crushed Rock	**71**
Augite	2
Biotite	4
Microcline	3
Myrmekite	3
Opaque	5
Orthoclase	15
Orthopyroxene	2
Perthite	9
Plagioclase	13
Quartz	15
Matrix	**24**
Opaque	5
Quartz	19
Mineral	**93**
Augite	1
Muscovite	4
Myrmekite	1
Opaque	11
Orthoclase	2
Perthite	3
Plagioclase	1
Quartz	70
Sed Rock	**1**
Opaque	1
Grand Total	**189**

MacCauley Complex #4 Vessel 4 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	32
Grog	9
Matrix	43
Mineral	100
Void	25
Grand Total	**209**

Row Labels	Count of Rock Type #1
Crushed Rock	**32**
Grit	**32**
Low Sphercity	32
Angular	1
Very Angular	31
Grog	**9**
Grit	**9**
High Sphercity	3
Angular	2
Rounded	1
Low Sphercity	6
Angular	2
Very Angular	4
Matrix	**19**
Silt	**19**
High Sphercity	16
Angular	6
Rounded	3
Well Rounded	7
Low Sphercity	3
Rounded	2
Very Angular	1
Mineral	**100**
Grit	**54**
Low Sphercity	54
Angular	37
Sub-angular	5
Very Angular	12
Sand	**45**
High Sphercity	31
Angular	4
Rounded	7
Sub-angular	1
sub-rounded	5
Well Rounded	14
Low Sphercity	14
Rounded	9
sub-rounded	2
Well Rounded	3
Silt	**1**
High Sphercity	1
Rounded	1
Grand Total	**160**

Row Labels	Count of Type
Crushed Rock	**32**
>2.0	31
1.0-2.0	1
Grog	**9**
>2.0	4
0.25-0.50	1
0.50-1.0	1
1.0-2.0	3
Matrix	**43**
<0.0625	43
Mineral	**100**
<0.0625	1
>2.0	7
0.0625-0.25	64
0.25-0.50	21
0.50-1.0	5
1.0-2.0	2
Void	**25**
>2.0	10
0.0625-0.25	3
0.25-0.50	3
0.50-1.0	5
1.0-2.0	4
Grand Total	**209**

Row Labels	Count of Type
Crushed Rock	**32**
Clinopyroxene	1
Microcline	2
Muscovite	2
Myrmekite	3
Opaque	2
Orthoclase	1
Plagioclase	14
Quartz	7
Grog	**9**
Opaque	6
Quartz	3
Matrix	**19**
Opaque	9
Quartz	10
Mineral	**100**
Biotite	4
Microcline	1
Muscovite	9
Opaque	19
Orthoclase	3
Plagioclase	5
Quartz	59
Grand Total	**160**

MacCauley Complex #4 Vessel 4 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	77
Grog	2
Matrix	39
Mineral	94
Void	30
Sed Rock	2
Grand Total	**244**

Row Labels	Count of Rock Type #1
Crushed Rock	**77**
Grit	**77**
Low Sphercity	77
Very Angular	77
Grog	**2**
Grit	**2**
Low Sphercity	2
Angular	1
Very Angular	1
Matrix	**17**
Silt	**17**
High Sphercity	16
Angular	5
Rounded	5
Well Rounded	6
Low Sphercity	1
Rounded	1
Mineral	**94**
Grit	**78**
Low Sphercity	78
Angular	54
Sub-angular	1
Very Angular	23
Sand	**16**
High Sphercity	7
Rounded	2
Sub-angular	1
sub-rounded	1
Well Rounded	3
Low Sphercity	9
Rounded	9
Sed Rock	**2**
Grit	**2**
Low Sphercity	2
Very Angular	2
Grand Total	**192**

Row Labels	Count of Type
Crushed Rock	**77**
>2.0	72
1.0-2.0	5
Grog	**2**
>2.0	1
1.0-2.0	1
Matrix	**39**
<0.0625	39
Mineral	**94**
>2.0	15
0.0625-0.25	31
0.25-0.50	19
0.50-1.0	21
1.0-2.0	8
Void	**30**
>2.0	23
0.0625-0.25	2
0.25-0.50	1
0.50-1.0	3
1.0-2.0	1
Sed Rock	**2**
>2.0	1
1.0-2.0	1
Grand Total	**244**

Row Labels	Count of Type
Crushed Rock	**77**
Biotite	2
Clinopyroxene	4
Microcline	1
Opaque	1
Orthoclase	16
Perthite	2
Plagioclase	35
Quartz	16
Grog	**2**
Opaque	1
Quartz	1
Matrix	**17**
Opaque	5
Quartz	12
Mineral	**94**
Clinopyroxene	3
Microcline	1
Muscovite	1
Myrmekite	1
Opaque	5
Orthoclase	5
Orthopyroxene	1
Perthite	3
Plagioclase	15
Quartz	59
Sed Rock	**2**
Quartz	2
Grand Total	**192**

MacCauley Complex #4 Vessel 4 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	81
Grog	1
Matrix	42
Mineral	110
Void	27
Grand Total	**261**

Row Labels	Count of Rock Type #1
Crushed Rock	**81**
Grit	**81**
Angular	2
Low Sphercity	2
Very Angular	79
Low Sphercity	79
Grog	**1**
Grit	**1**
Angular	1
Low Sphercity	1
Mineral	**109**
Grit	**82**
Angular	61
Low Sphercity	61
Rounded	1
Low Sphercity	1
sub-angular	1
Low Sphercity	1
Very Angular	19
Low Sphercity	19
Sand	**27**
Rounded	19
High Sphercity	7
Low Sphercity	12
sub-rounded	1
High Sphercity	1
Well Rounded	7
High Sphercity	5
Low Sphercity	2
Grand Total	**191**

Row Labels	Count of Type
Crushed Rock	**81**
>2.0	77
0.50-1.0	2
1.0-2.0	2
Grog	**1**
1.0-2.0	1
Matrix	**42**
<0.0625	42
Mineral	**110**
<0.0625	1
>2.0	19
0.0625-0.25	44
0.25-0.50	17
0.50-1.0	26
1.0-2.0	3
Void	**27**
>2.0	16
0.0625-0.25	4
0.25-0.50	1
1.0-2.0	6
Grand Total	**261**

Row Labels	Count of Type
Crushed Rock	**81**
Microcline	1
Muscovite	1
Orthoclase	20
Orthopyroxene	3
Perthite	15
Plagioclase	26
Quartz	15
Grog	**1**
Opaque	1
Matrix	**20**
Opaque	3
Quartz	17
Mineral	**110**
Biotite	2
Hornblende	1
Muscovite	3
Myrmekite	4
Opaque	9
Orthoclase	4
Orthopyroxene	4
Perthite	11
Plagioclase	16
Quartz	56
Grand Total	**212**

MacCauley Complex #4 Vessel 5 Body Sherd 1

Count of Type	
Object	**Total**
Mineral	1
Crushed Rock	46
Matrix	68
Mineral	63
Void	23
Grand Total	201

Count of Rock Type #1	
Row Labels	**Total**
Mineral	1
Grit	1
Very Angular	1
Low Sphercity	1
Crushed Rock	46
Grit	46
Very Angular	46
Low Sphercity	46
Mineral	60
Grit	46
Angular	10
Low Sphercity	10
Sub-angular	3
Low Sphercity	3
Sub-rounded	1
Low Sphercity	1
Very Angular	32
Low Sphercity	32
Sand	14
Angular	1
High Sphercity	1
Rounded	3
High Sphercity	1
Low Sphercity	2
Sub-rounded	1
High Sphercity	1
Very Angular	1
Low Sphercity	1
Well-rounded	8
High Sphercity	7
Low Sphercity	1
Grand Total	**107**

Count of Type	
Row Labels	**Total**
Mineral	1
>2.0	1
Crushed Rock	46
>2.0	40
0.50-1.0	2
1.0-2.0	3
(blank)	1
Matrix	68
<0.0625	68
Mineral	63
<0.0625	2
>2.0	10
0.0625-0.25	30
0.25-0.50	11
0.50-1.0	5
1.0-2.0	5
Void	23
>2.0	10
0.25-0.50	2
0.50-1.0	4
1.0-2.0	7
Grand Total	**201**

Count of Type	
Row Labels	**Total**
Mineral	1
Perthite	1
Crushed Rock	46
Augite	1
Biotite	1
Myrmekite	1
Opaque	1
Orthoclase	11
Perthite	8
Plagioclase	12
Quartz	11
Matrix	12
Opaque	4
Quartz	8
Mineral	62
Augite	1
Microcline	1
Opaque	5
Orthoclase	5
Perthite	4
Plagioclase	8
Quartz	38
Grand Total	**121**

MacCauley Complex #4 Vessel 5 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	41
Matrix	81
Mineral	126
Sed Rock	2
Void	32
Grand Total	**282**

Row Labels	Count of Rock Type #1
Crushed Rock	**41**
Grit	**41**
Very Angular	41
Low Sphercity	41
Matrix	**41**
Silt	**41**
Angular	5
High Sphercity	2
Low Sphercity	3
Rounded	13
High Sphercity	9
Low Sphercity	4
Sub-rounded	2
High Sphercity	2
Well Rounded	21
High Sphercity	21
Mineral	**126**
Grit	**89**
Angular	50
High Sphercity	4
Low Sphercity	46
Sub-angular	4
Low Sphercity	4
Very Angular	35
Low Sphercity	35
Sand	**34**
Angular	3
High Sphercity	3
Rounded	14
High Sphercity	8
Low Sphercity	6
Sub-rounded	11
High Sphercity	8
Low Sphercity	3
Very Angular	1
High Sphercity	1
Well Rounded	5
High Sphercity	5
Silt	**3**
Angular	2
High Sphercity	2
Sub-angular	1
High Sphercity	1
Sed Rock	**2**
Sand	**2**
Rounded	1
Low Sphercity	1
Sub-angular	1
High Sphercity	1
Grand Total	**210**

Row Labels	Count of Type
Crushed Rock	**41**
>2.	1
>2.0	36
0.50-1.0	1
1.0-2.0	3
Matrix	**81**
<0.0625	81
Mineral	**126**
<0.0625	3
>2.0	25
0.0625-0.25	56
0.25-0.50	24
0.50-1.0	12
1.0-2.0	6
Sed Rock	**2**
>2.0	2
Void	**32**
>2.0	22
0.25-0.50	4
0.50-1.0	3
1.0-2.0	3
Grand Total	**282**

Row Labels	Count of Type
Crushed Rock	**41**
Biotite	3
Epidote	1
Microcline	1
Muscovite	1
Myrmekite	1
Opaque	1
Orthoclase	4
Perthite	4
Plagioclase	17
Quartz	8
Matrix	**41**
Opaque	17
Quartz	24
Mineral	**126**
Hornblende	6
Indet.	1
Microcline	1
Muscovite	2
Myrmekite	2
Opaque	15
Orthoclase	4
Perthite	6
Plagioclase	23
Quartz	66
Sed Rock	**2**
Quartz	2
Grand Total	**210**

MacCauley Complex #5 Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	100
Grog	4
Matrix	116
Mineral	97
Void	23
Grand Total	**340**

Row Labels	Count of Rock Type #1
Crushed Rock	**100**
Grit	**100**
Low Sphercity	100
Very Angular	100
Grog	**4**
Grit	**4**
Low Sphercity	4
Angular	1
Rounded	1
Sub-angular	2
Matrix	**38**
Silt	**38**
High Sphercity	29
Angular	1
Rounded	5
Well Rounded	23
Low Sphercity	9
Angular	3
Rounded	5
Well Rounded	1
Mineral	**97**
Grit	**73**
High Sphercity	4
Angular	4
Low Sphercity	69
Angular	54
Very Angular	15
Sand	**24**
High Sphercity	12
Rounded	6
Sub-rounded	1
Well Rounded	5
Low Sphercity	12
Rounded	7
Well Rounded	5
Grand Total	**239**

Row Labels	Count of Type
Crushed Rock	**100**
>2.0	94
1.0-2.0	6
Grog	**4**
>2.0	3
0.50-1.0	1
Matrix	**116**
<0.0625	116
Mineral	**97**
>2.0	5
0.0625-0.25	56
0.25-0.50	13
0.50-1.0	16
1.0-2.0	7
Void	**23**
>2.0	15
0.25-0.50	3
0.50-1.0	1
1.0-2.0	4
Grand Total	**340**

Row Labels	Count of Type
Crushed Rock	**100**
Clinopyroxene	1
Microcline	1
Muscovite	2
Opaque	1
Orthoclase	30
Orthopyroxene	3
Perthite	12
Plagioclase	34
Quartz	16
Grog	**4**
Opaque	2
Quartz	2
Matrix	**38**
Opaque	4
Quartz	34
Mineral	**97**
Clinopyroxene	2
Muscovite	1
Opaque	7
Orthoclase	15
Orthopyroxene	2
Perthite	5
Plagioclase	4
Quartz	61
Grand Total	**239**

MacCauley Complex #5 Vessel 1 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	118
Grog	2
Matrix	44
Mineral	65
Rock #2	1
Void	24
Grand Total	**254**

Row Labels	Count of Rock Type #1
Crushed Rock	**118**
Grit	**118**
Angular	2
High Sphercity	1
Low Sphercity	1
Very Angular	116
Low Sphercity	116
Grog	**2**
Grit	**2**
Angular	2
Low Sphercity	2
Matrix	**8**
Silt	**8**
Angular	1
High Sphercity	1
Rounded	3
High Sphercity	1
Low Sphercity	2
Well Rounded	4
High Sphercity	4
Mineral	**65**
Grit	**56**
Angular	41
High Sphercity	1
Low Sphercity	40
Very Angular	15
Low Sphercity	15
Sand	**9**
Rounded	3
High Sphercity	2
Low Sphercity	1
Sub-rounded	5
High Sphercity	4
Low Sphercity	1
Well Rounded	1
High Sphercity	1
Rock #2	**1**
Grit	**1**
Very Angular	1
Low Sphercity	1
Grand Total	**194**

Row Labels	Count of Type
Crushed Rock	**118**
>2.0	112
0.50-1.0	3
1.0-2.0	3
Grog	**2**
>2.0	2
Matrix	**44**
<0.0625	44
Mineral	**65**
>2.0	3
0.0625-0.25	17
0.25-0.50	17
0.50-1.0	19
1.0-2.0	9
Rock #2	**1**
>2.0	1
Void	**24**
>2.0	17
0.50-1.0	2
1.0-2.0	5
Grand Total	**254**

Row Labels	Count of Type
Crushed Rock	**118**
Amphibole	3
Biotite	3
Chlorite	3
Clinopyroxene	10
Epidote	2
Hornblende	6
muscovite	2
Olivine	4
Opaque	1
Orthoclase	15
Orthopyroxene	19
Perthite	5
Plagioclase	16
Quartz	29
Grog	**2**
Opaque	2
Matrix	**8**
Opaque	2
Quartz	6
Mineral	**65**
Biotite	1
Clinopyroxene	3
Hornblende	3
muscovite	1
Opaque	1
Orthoclase	6
Orthopyroxene	2
Perthite	7
Plagioclase	6
Quartz	34
Spinel	1
Rock #2	**1**
Biotite	1
Grand Total	**194**

MacCauley Complex #5 Vessel 1 Body Sherd 4

Row Labels	Count of Type
Matrix	1
Crushed Rock	62
Grog	2
Matrix	69
Mineral	58
Void	20
Grand Total	**212**

Row Labels	Count of Rock Type #1
Crushed Rock	**62**
Grit	**62**
Low Sphercity	62
Very Angular	62
Grog	**2**
Grit	**2**
High Sphercity	2
Angular	2
Matrix	**20**
Silt	**20**
High Sphercity	15
Angular	3
Rounded	3
Sub-angular	1
Well Rounded	8
Low Sphercity	5
Angular	3
Rounded	2
Mineral	**58**
Grit	**46**
Low Sphercity	46
Angular	36
Sub-angular	2
Very Angular	8
Sand	**12**
High Sphercity	5
Rounded	2
Sub-angular	2
Well Rounded	1
Low Sphercity	7
Rounded	7
Grand Total	**142**

Row Labels	Count of Type
Matrix	**1**
<0.0625	1
Crushed Rock	**62**
>2.0	60
1.0-2.0	2
Grog	**2**
1.0-2.0	2
Matrix	**69**
<0.0625	69
Mineral	**58**
>2.0	2
0.0625-0.25	33
0.25-0.50	7
0.50-1.0	13
1.0-2.0	3
Void	**20**
>2.0	17
0.25-0.50	1
0.50-1.0	1
1.0-2.0	1
Grand Total	**212**

Row Labels	Count of Type
Crushed Rock	**62**
Amphibole	1
clinopryoxene	9
Hematite	2
Muscovite	1
Opaque	2
Orthoclase	9
Orthopyroxene	1
Perthite	8
Plagioclase	12
Quartz	17
Grog	**2**
Opaque	2
Matrix	**20**
Opaque	7
Quartz	13
Mineral	**58**
clinopryoxene	1
Muscovite	1
Opaque	2
Orthoclase	1
Orthopyroxene	2
Perthite	3
Plagioclase	8
Quartz	38
Spinel	2
Grand Total	**142**

MacCauley Complex #6 Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	91
Matrix	141
Mineral	95
Sed Rock	1
Void	33
Grand Total	**361**

Row Labels	Count of Rock Type #1
Crushed Rock	**91**
Grit	**91**
Low Sphercity	91
Very Angular	91
Matrix	**29**
Silt	**29**
High Sphercity	22
Rounded	9
Well Rounded	13
Low Sphercity	7
Angular	4
Rounded	3
Mineral	**95**
Grit	**72**
High Sphercity	1
Angular	1
Low Sphercity	71
Angular	62
sub-rounded	1
Very Angular	8
Sand	**23**
High Sphercity	13
Rounded	5
sub-rounded	2
Well Rounded	6
Low Sphercity	10
Rounded	7
sub-rounded	1
Well Rounded	2
Sed Rock	
Sand	
High Sphercity	
Rounded	
Grand Total	**215**

Row Labels	Count of Type
Crushed Rock	**91**
>2.0	87
1.0-2.0	4
Matrix	**141**
<0.0625	141
Mineral	**95**
>2.0	5
0.0625-0.25	56
0.25-0.50	11
0.50-1.0	18
1.0-2.0	5
Sed Rock	**1**
1.0-2.0	1
Void	**33**
>2.0	22
0.25-0.50	2
0.50-1.0	2
1.0-2.0	7
Grand Total	**361**

Row Labels	Count of Type
Crushed Rock	**91**
Clinopyroxene	6
Microcline	3
Orthoclase	10
Orthopyroxene	7
Perthite	8
Plagioclase	43
Quartz	14
Matrix	**29**
Opaque	3
Quartz	26
Mineral	**95**
Microcline	2
Muscovite	3
Opaque	6
Orthopyroxene	2
Perthite	2
Plagioclase	11
Quartz	69
Grand Total	**215**

MacCauley Complex #6 Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	80
Matrix	47
Mineral	86
Sed Rock	1
Void	11
Grand Total	**225**

Row Labels	Count of Rock Type #1
Crushed Rock	**80**
Grit	**80**
Low Sphercity	80
Angular	1
Very Angular	79
Matrix	**7**
Silt	**7**
High Sphercity	4
Angular	2
Well Rounded	2
Low Sphercity	3
Angular	2
Roudned	1
Mineral	**86**
Grit	**73**
Low Sphercity	73
Angular	53
sub-angular	1
Very Angular	19
Sand	**13**
High Sphercity	1
Well Rounded	1
Low Sphercity	12
Roudned	3
Rounded	8
Sub-rounded	1
Sed Rock	**1**
Grit	**1**
Low Sphercity	1
Very Angular	1
Grand Total	**174**

Row Labels	Count of Type
Crushed Rock	**80**
>2.0	76
0.25-0.50	1
1.0-2.0	3
Matrix	**47**
<0.0625	47
Mineral	**86**
>2.0	21
0.0625-0.25	28
0.25-0.50	17
0.50-1.0	9
1.0-2.0	11
Sed Rock	**1**
>2.0	1
Void	**11**
>2.0	6
0.25-0.50	2
0.50-1.0	2
1.0-2.0	1
Grand Total	**225**

Row Labels	Count of Type
Crushed Rock	**80**
Clinopyroxene	1
Microcline	6
Opaque	1
Orthoclase	7
Perthite	8
Plagioclase	50
Quartz	7
Matrix	**7**
Opaque	2
Quartz	5
Mineral	**86**
Microcline	3
Muscovite	2
Opaque	4
Orthoclase	2
Orthopyroxene	1
Perthite	7
Plagioclase	25
Quartz	42
Sed Rock	**1**
Opaque	1
Grand Total	**174**

MacCauley Complex 7 Vessel 1 Body Sherd 1

Row Labels	Count of Type
Mineral	87
Crushed Rock	93
Matrix	55
Sed Rock	2
Void	31
Grand Total	**268**

Row Labels	Count of Rock Type #1
Mineral	**1**
Sand	**1**
High Sphercity	1
Rounded	1
Mineral	**87**
Grit	**74**
Low Sphercity	74
Angular	71
Very Angular	3
Sand	**13**
High Sphercity	5
Rounded	4
Sub-angular	1
Low Sphercity	8
Rounded	7
sub-rounded	1
Crushed Rock	**93**
Grit	**93**
High Sphercity	1
Angular	1
Low Sphercity	92
Very Angular	92
Matrix	**5**
Silt	**5**
High Sphercity	4
Angular	1
Well Rounded	3
Low Sphercity	1
Rounded	1
Sed Rock	**2**
Grit	**2**
Low Sphercity	2
Angular	2
Grand Total	**188**

Row Labels	Count of Type
Mineral	**1**
0.0625-0.25	1
Mineral	**87**
>2.0	1
0.0625-0.25	48
0.25-0.50	19
0.50-1.0	15
1.0-2.0	4
Crushed Rock	**93**
>2.0	87
0.25-0.50	1
0.50-1.0	2
1.0-2.0	3
Matrix	**55**
<0.0625	55
Sed Rock	**2**
>2.0	1
0.50-1.0	1
Void	**31**
>2.0	23
0.0625-0.25	1
0.25-0.50	2
0.50-1.0	1
1.0-2.0	4
Grand Total	**269**

Row Labels	Count of Type
Mineral	**1**
Quartz	1
Mineral	**87**
Muscovite	4
Opaque	3
Orthopyroxene	1
Perthite	11
Plagioclase	6
Quartz	62
Crushed Rock	**93**
Amphibole	1
Clinopyroxene	3
Muscovite	1
Opaque	1
Orthoclase	27
Perthite	16
Plagioclase	31
Quartz	12
Sercite	1
Matrix	**6**
Opaque	3
Quartz	3
Sed Rock	**2**
Opaque	2
Grand Total	**189**

MacCauley Complex #8 Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	32
Matrix	67
Mineral	85
Sed Rock	4
Void	22
Grand Total	**210**

Row Labels	Count of Rock Type #1
Crushed Rock	**32**
Grit	**31**
Very Angular	31
Low Sphercity	31
Sand	**1**
Sub-rounded	1
High Sphercity	1
Matrix	**18**
Silt	**18**
Angular	3
Low Sphercity	3
Rounded	6
High Sphercity	3
Low Sphercity	3
Well Rounded	9
High Sphercity	8
Low Sphercity	1
Mineral	**85**
Grit	**55**
Angular	49
High Sphercity	1
Low Sphercity	48
Sub-angular	4
High Sphercity	1
Low Sphercity	3
Very Angular	2
Low Sphercity	2
Sand	**30**
Rounded	17
High Sphercity	9
Low Sphercity	8
Sub-angular	3
High Sphercity	3
Sub-rounded	2
Low Sphercity	2
Well Rounded	8
High Sphercity	7
Low Sphercity	1
Sed Rock	**4**
Grit	**4**
Very Angular	4
Low Sphercity	4
Grand Total	**139**

Row Labels	Count of Type
Crushed Rock	**32**
>2.0	26
0.25-0.50	3
0.50-1.0	1
1.0-2.0	2
Matrix	**67**
<0.0625	67
Mineral	**85**
>2.0	4
0.0625-0.25	55
0.25-0.0625	1
0.25-0.50	13
0.50-1.0	8
1.0-2.0	4
Sed Rock	**4**
>2.0	4
Void	**22**
>2.0	17
0.50-1.0	1
1.0-2.0	4
Grand Total	**210**

Row Labels	Count of Type
Crushed Rock	**32**
Microcline	1
Orthoclase	2
Perthite	10
Plagioclase	9
Quartz	10
Matrix	**18**
Muscovite	1
Opaque	5
Quartz	12
Mineral	**85**
Clinopyroxene	1
fluorite	3
Muscovite	7
Opaque	12
Orthoclase	1
Orthopyroxene	2
Perthite	4
Plagioclase	4
Quartz	51
Sed Rock	**4**
Quartz	4
Grand Total	**139**

Martin Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	35
Grog	2
Matrix	72
Mineral	37
Plucking Void	14
Void	43
Grand Total	**203**

Row Labels	Count of Rock Type #1
Crushed Rock	**35**
Grit	**35**
Low Sphercity	35
Very Angular	35
Grog	**2**
Grit	**2**
High Sphercity	1
Very Angular	1
Low Sphercity	1
Very Angular	1
Matrix	**1**
Silt	**1**
High Sphercity	1
Well Rounded	1
Mineral	**37**
Grit	**26**
Low Sphercity	26
Angular	10
Sub-angular	4
Very Angular	12
Sand	**11**
High Sphercity	2
Well Rounded	2
Low Sphercity	9
Rounded	6
Well Rounded	3
Grand Total	**75**

Row Labels	Count of Type
Crushed Rock	**35**
>2.0	33
0.25-0.50	1
1.0-2.0	1
Grog	**2**
>2.0	1
1.0-2.0	1
Matrix	**72**
<0.0625	72
Mineral	**37**
>2.0	7
0.0625-0.25	16
0.25-0.50	8
0.50-1.0	4
1.0-2.0	2
Plucking Void	**14**
>2.0	14
Void	**43**
>2.0	30
0.0625-0.25	5
0.25-0.50	1
0.50-1.0	5
1.0-2.0	2
Grand Total	**203**

Row Labels	Count of Type
Crushed Rock	**35**
Amphibole	8
Biotite	1
Clinopyroxene	3
Microcline	3
Myrmekite	1
Opaque	1
Orthoclase	9
Perthite	8
Quartz	1
Grog	**2**
Opaque	2
Matrix	**1**
Opaque	1
Mineral	**37**
Amphibole	1
Biotite	1
Clinopyroxene	2
Microcline	3
Muscovite	1
Opaque	5
Orthoclase	10
Perthite	1
Quartz	13
Void	**43**
Chamber	2
Channel	3
Packing Voids	2
Plane	34
Simple packing void	2
Grand Total	**118**

Martin Vessel 2 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	46
Grog	1
Matrix	42
Mineral	76
Plucking Void	1
Void	42
Grand Total	**208**

Row Labels	Count of Rock Type #1
Crushed Rock	**45**
Grit	**45**
Low Sphercity	45
Angular	1
Very Angular	44
Grog	**1**
Grit	**1**
High Sphercity	1
Angular	1
Mineral	**76**
Grit	**50**
High Sphercity	1
Angular	1
Low Sphercity	49
Angular	30
Sub-angular	4
Very Angular	15
Sand	**26**
High Sphercity	10
Rounded	4
Sub-rounded	1
Well Rounded	5
Low Sphercity	16
Rounded	12
Sub-rounded	2
Well Rounded	2
Grand Total	**122**

Row Labels	Count of Type
Crushed Rock	**46**
>2.0	41
0.50-1.0	4
1.0-2.0	1
Grog	**1**
>2.0	1
Matrix	**42**
<0.0625	42
Mineral	**76**
>2.0	2
0.0625-0.25	38
0.25-0.50	28
0.50-1.0	4
1.0-2.0	4
Plucking Void	**1**
>2.0	1
Void	**42**
>2.0	25
0.0625-0.25	1
0.25-0.50	4
0.50-1.0	5
1.0-2.0	7
Grand Total	**208**

Row Labels	Count of Type
Crushed Rock	**46**
Amphibole	2
Biotite	1
Opaque	4
Orthoclase	7
Perthite	25
Plagioclase	2
Quartz	5
Grog	**1**
Opaque	1
Mineral	**76**
Amphibole	2
Clinopyroxene	2
Muscovite	3
Opaque	6
Orthoclase	22
Perthite	4
Quartz	37
Void	**42**
Chamber	1
Channel	3
Plane	37
Simple Packing	1
Grand Total	**165**

Martin Vessel 2 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	47
Grog	14
Matrix	77
Mineral	89
Plucking Void	27
Void	44
Grand Total	**298**

Row Labels	Count of Rock Type #1
Crushed Rock	**47**
Grit	**47**
Low Sphercity	47
Very Angular	47
Grog	**14**
Grit	**14**
High Sphercity	1
Angular	1
Low Sphercity	13
Very Angular	13
Mineral	**89**
Grit	**70**
High Sphercity	3
Angular	2
Very Angular	1
Low Sphercity	67
Angular	46
Very Angular	21
Sand	**19**
High Sphercity	6
Angular	1
Rounded	3
Well Rounded	2
Low Sphercity	13
Rounded	11
Well Rounded	2
Grand Total	**150**

Row Labels	Count of Type
Crushed Rock	**47**
>2.0	45
0.50-1.0	2
Grog	**14**
>2.0	10
0.50-1.0	1
1.0-2.0	3
Matrix	**77**
<0.0625	77
Mineral	**89**
>2.0	5
0.0625-0.25	38
0.25-0.50	32
0.50-1.0	7
1.0-2.0	7
Plucking Void	**27**
>2.0	26
0.25-0.50	1
Void	**44**
>2.0	19
0.0625-0.25	2
0.25-0.50	8
0.50-1.0	10
1.0-2.0	5
Grand Total	**298**

Row Labels	Count of Type
Crushed Rock	**47**
Amphibole	3
Clinopyroxene	10
Microcline	2
Muscovite	1
Myrmekite	1
Orthoclase	6
Perthite	17
Plagioclase	3
Quartz	4
Grog	**14**
Opaque	10
Quartz	4
Mineral	**89**
Amphibole	1
Biotite	2
Clinopyroxene	2
Muscovite	3
Opaque	6
Orthoclase	24
Perthite	6
Plagioclase	1
Quartz	42
Spinel	2
Void	**44**
Chamber	2
Channel	2
Plane	40
Grand Total	**194**

Martin Vessel 2 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	47
Grog	5
Matrix	122
Mineral	56
Plucking Void	14
Void	62
Grand Total	**306**

Row Labels	Count of Rock Type #1
Crushed Rock	**47**
Grit	**47**
Low Sphercity	47
Angular	4
Very Angular	43
Grog	**5**
Grit	**5**
Low Sphercity	5
Angular	1
Very Angular	4
Mineral	**56**
Grit	**34**
High Sphercirty	1
Very Angular	1
Low Sphercity	33
Angular	28
Sub-angular	1
Very Angular	4
Sand	**22**
High Sphercirty	9
Rounded	7
Sub-rounded	1
Well Rounded	1
Low Sphercity	13
Rounded	13
Grand Total	**108**

Row Labels	Count of Type
Crushed Rock	**47**
>2.0	40
0.50-1.0	4
1.0-2.0	3
Grog	**5**
>2.0	3
0.50-1.0	2
Matrix	**122**
<0.0625	122
(blank)	
Mineral	**56**
>2.0	4
0.0625-0.25	29
0.25-0.50	12
0.50-1.0	7
1.0-2.0	4
Plucking Void	**14**
>2.0	12
0.50-1.0	1
1.0-2.0	1
Void	**62**
<0.0625	5
>2.0	30
0.0625-0.25	7
0.25-0.50	7
0.50-1.0	8
1.0-2.0	5
Grand Total	**306**

Row Labels	Count of Type
Crushed Rock	**47**
Amphibole	3
Clinopyroxene	9
Opaque	1
Orthoclase	4
Perthite	20
Plagioclase	1
Quartz	9
Grog	**4**
Opaque	4
Mineral	**56**
Clinopyroxene	6
Muscovite	3
Myrmekite	1
Opaque	7
Orthoclase	16
Perthite	2
Quartz	20
Spinel	1
Void	**62**
Chamber	3
Channel	5
Plane	42
Simple packing	4
Simple packing void	2
Vughe	6
Grand Total	**169**

Martin Vessel 3 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	73
Matrix	93
Mineral	72
Plucking Void	10
Void	64
Grand Total	**312**

Row Labels	Count of Rock Type #1
Crushed Rock	**73**
Grit	**73**
Low Sphercity	73
Angular	3
Very Angular	70
Mineral	**72**
Grit	**51**
High Sphercity	1
Very Angular	1
Low Sphercity	50
Angular	32
Sub-angular	2
Very Angular	16
Sand	**21**
High Sphercity	1
Rounded	1
High Sphercity	9
Rounded	5
Well Rounded	4
Low Sphercity	11
Rounded	10
Sub-rounded	1
Grand Total	**145**

Row Labels	Count of Type
Crushed	**73**
>2.0	65
0.25-0.50	1
1.0-2.0	7
Matrix	**93**
<0.0625	93
Mineral	**72**
>2.0	5
0.0625-0.25	44
0.25-0.50	14
0.50-1.0	4
1.0-2.0	5
Plucking Void	**10**
>2.0	8
0.50-1.0	2
Void	**64**
<0.0625	3
>2.0	30
0.0625-0.25	8
0.25-0.50	6
0.50-1.0	13
1.0-2.0	4
Grand Total	**312**

Row Labels	Count of Type
Crushed Rock	**73**
Amphibole	6
Clinopyroxene	4
Flourite	1
Microcline	5
Myrmekite	4
Orthoclase	9
Perthite	19
Plagioclase	3
Quartz	22
Mineral	**72**
Amphibole	1
Clinopyroxene	2
Microcline	1
Muscovite	5
Opaque	6
Orthoclase	17
Orthopyroxene	1
Perthite	4
Plagioclase	1
Quartz	32
Spinel	2
Void	**64**
Chamber	4
Channel	5
Plane	37
Simple packing void	5
Vughe	13
Grand Total	**209**

McKendry Vessel 5 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	110
Matrix	112
Mineral	72
Plucking Void	2
Sed Rock	1
Void	44
Grand Total	**341**

Row Labels	Count of Rock Type #1
Crushed Rock	**110**
Grit	**110**
Low Sphercity	110
Very Angular	110
Mineral	**72**
Grit	**47**
High Sphercity	2
Sub-angular	2
Low Sphercity	45
Angular	28
Sub-angular	7
Very Angular	10
Sand	**25**
High Sphercity	10
Rounded	8
Sub-rounded	1
Well Rounded	1
Low Sphercity	15
Rounded	10
Sub-rounded	4
Well Rounded	1
Sed Rock	**1**
Grit	**1**
Low Sphercity	1
Angular	1
Grand Total	**183**

Row Labels	Count of Type
Crushed Rock	**110**
>2.0	104
0.25-0.50	1
0.50-1.0	3
1.0-2.0	2
Matrix	**112**
<0.0625	112
Mineral	**72**
0.0625-0.25	40
0.25-0.50	20
0.50-1.0	10
1.0-2.0	2
Plucking Void	**2**
>2.0	2
Sed Rock	**1**
>2.0	1
Void	**44**
<0.0625	5
>2.0	16
0.0625-0.25	1
0.25-0.50	5
0.50-1.0	15
1.0-2.0	2
Grand Total	**341**

Row Labels	Count of Type
Crushed Rock	**110**
Amphibole	7
Biotite	2
Chlorite	6
Clinopyroxene	5
Hornblende	3
Microcline	1
Muscovite	1
Myrmekite	3
Opaque	8
Orthoclase	11
Orthopyroxene	3
Perthite	36
Plagioclase	10
Quartz	14
Mineral	**72**
Chlorite	1
Clinopyroxene	5
Muscovite	6
Opaque	6
Orthoclase	17
Orthopyroxene	1
Perthite	1
Quartz	31
Spinel	3
Tourmaline	1
Sed Rock	**1**
Quartz	1
Void	**44**
Chamber	4
Channel	2
Plane	17
Simple Packing Void	5
Vughe	16
Grand Total	**227**

McKendry Vessel 6 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	89
Matrix	78
Mineral	56
Plucking Void	3
Void	36
Grand Total	**262**

Row Labels	Count of Rock Type #1
Crushed Rock	**89**
Grit	**89**
Low Sphercity	89
Very Angular	89
Mineral	**56**
Grit	**40**
High Sphercity	2
Sub-angular	1
Very Angular	1
Low Sphercity	38
Angular	25
Sub-angular	5
Very Angular	8
Sand	**16**
High Sphercity	11
Rounded	8
Sub-Rounded	1
Well Rounded	2
Low Sphercity	5
Rounded	3
Well Rounded	2
Grand Total	**145**

Row Labels	Count of Type
Crushed Rock	**89**
>2.0	88
0.50-1.0	1
Matrix	**78**
<0.0625	78
Mineral	**56**
0.0625-0.25	44
0.25-0.50	10
0.50-1.0	2
Plucking Void	**3**
>2.0	2
1.0-2.0	1
Void	**36**
<0.0625	3
>2.0	14
0.0625-0.25	1
0.25-0.50	9
0.50-1.0	3
1.0-2.0	6
Grand Total	**262**

Row Labels	Count of Type
Crushed Rock	**89**
Amphibole	3
Clinopyroxene	19
Microcline	2
Opaque	6
Orthoclase	5
Orthopyroxene	2
Perthite	6
Plagioclase	24
Quartz	22
Mineral	**56**
Amphibole	4
chlorite	2
Clinopyroxene	4
Hornblende	1
Muscovite	2
Opaque	5
Orthoclase	10
Plagioclase	1
Quartz	26
Spinel	1
Void	**36**
Chamber	7
Channel	2
Plane	12
Simple Packing	4
Vughe	11
Grand Total	**181**

McKendry Vessel 6 Body Shard 2

Row Labels	Count of Type
Crushed Rock	142
Matrix	70
Mineral	69
Plucking Void	9
Void	34
Grand Total	**324**

Row Labels	Count of Rock Type #1
Crushed Rock	**142**
Grit	**142**
Low Sphercity	142
angular	1
Very Angular	141
Mineral	**69**
Grit	**50**
High Sphercity	1
Sub-angular	1
Low Sphercity	49
angular	32
Sub-angular	9
Very Angular	8
Sand	**19**
High Sphercity	6
Rounded	3
Sub-rounded	2
Well Rounded	1
Low Sphercity	13
Rounded	7
Sub-rounded	5
Well Rounded	1
Grand Total	**211**

Row Labels	Count of Type
Crushed Rock	**142**
>2.0	136
0.50-1.0	1
1.0-2.0	5
Matrix	**70**
<0.0625	70
Mineral	**69**
>2.0	2
0.0625-0.25	48
0.25-0.50	15
0.50-1.0	1
1.0-2.0	3
Plucking Void	**9**
>2.0	9
Void	**34**
<0.0625	3
>2.0	21
0.0625-0.25	1
0.25-0.50	3
0.50-1.0	3
1.0-2.0	3
Grand Total	**324**

Row Labels	Count of Type
Crushed Rock	**142**
Amphibole	21
Clinopyroxene	50
Microcline	1
Opaque	8
Orthoclase	3
Orthopyroxene	10
Perthite	20
Plagioclase	20
Quartz	9
Mineral	**69**
Amphibole	4
Chlorite	3
Clinopyroxene	10
Hornblende	1
Muscovite	3
Opaque	5
Orthoclase	11
Orthopyroxene	1
Perthite	1
Plagioclase	1
Quartz	29
Void	**34**
Chamber	2
Plane	20
Simple Packing	4
Vughe	8
Grand Total	**245**

McKendry Vessel 1 Body Sherd 1

Row Labels	Count of Object
Amphibole	6
Chlorite	2
Clinopyroxene	4
Microcline	7
Opaque	1
Orthoclase	18
Perthite	3
Plagioclase	27
Quartz	32
Grand Total	**100**

Row Labels	Count of Rock Type #1
Crushed Rock	**80**
Grit	**80**
Low Sphercity	80
Angular	3
Very Angular	77
Mineral	**66**
Grit	**36**
Low Sphercity	36
Angular	26
Sub-angular	7
Very Angular	3
Sand	**30**
High Sphercity	3
Rounded	2
Well Rounded	1
Low Sphercity	27
Rounded	21
Sub-rounded	4
Well Rounded	2
Grand Total	**146**

Row Labels	Count of Type
Crushed Rock	**80**
>2.0	74
0.50-1.0	2
1.0-2.0	4
Matrix	**88**
<0.0625	88
Mineral	**66**
0.0625-0.25	41
0.25-0.50	18
0.50-1.0	6
1.0-2.0	1
Plucking Void	**2**
>2.0	2
Void	**33**
<0.0625	3
>2.0	10
0.0625-0.25	6
0.25-0.50	10
0.50-1.0	3
1.0-2.0	1
Grand Total	**269**

Row Labels	Count of Type
Crushed Rock	**80**
Amphibole	2
Chlorite	1
Clinopyroxene	3
Microcline	5
Opaque	1
Orthoclase	4
Perthite	24
Plagioclase	27
Quartz	13
Mineral	**66**
Chlorite	4
Clinopyroxene	3
Flourite	2
Hornblende	1
Opaque	11
Orthoclase	3
Perthite	4
Plagioclase	2
Quartz	33
spinel	3
Void	**33**
Chamber	3
Channel	3
Complex Packing Void	1
Plane	9
Simple Packing Void	4
Vughe	13
Grand Total	**179**

McKendry Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	117
Matrix	121
Mineral	53
Plucking Void	4
Void	40
Grand Total	**335**

Row Labels	Count of Rock Type #1
Crushed Rock	**116**
>2.0	
Low Sphercity	
Very Angular	
Grit	**116**
Low Sphercity	116
Angular	5
Very Angular	111
Mineral	**53**
Grit	**24**
Low Sphercity	24
Angular	18
Sub-angular	6
Sand	**29**
High Sphercity	9
Rounded	7
Sub-rounded	1
Well Rounded	1
Low Sphercity	20
Rounded	9
Sub-rounded	10
Well Rounded	1
Grand Total	**169**

Row Labels	Count of Type
Crushed Rock	**117**
>2.0	110
0.50-1.0	5
1.0-2.0	1
Microcline	1
Matrix	**121**
<0.0625	121
Mineral	**53**
0.0625-0.25	37
0.0625-0.26	1
0.25-0.50	15
Plucking Void	**4**
>2.0	4
Void	**40**
<0.0625	2
>2.0	17
0.0625-0.25	7
0.25-0.50	7
0.50-1.0	4
1.0-2.0	3
Grand Total	**335**

Row Labels	Count of Type
Crushed Rock	**116**
Biotite	4
Clinopyroxene	2
Hornblende	1
Microcline	11
Muscovite	1
Orthoclase	15
Perthite	28
Plagioclase	41
Quartz	13
Mineral	**53**
Biotite	2
Hornblende	2
Microcline	1
Muscovite	1
Opaque	6
Orthoclase	19
Orthopyroxene	2
Perthite	1
Plagioclase	5
Quartz	12
Spinel	2
Void	**40**
Chamber	1
Channel	4
Complex Packing	1
Compound Packing Void	1
Plane	18
Simple Packing Void	6
Vughe	9
Grand Total	**209**

McKendry Vessel 1 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	104
Matrix	82
Mineral	106
Plucking Void	15
Sed Rock	1
Void	43
Grand Total	**351**

Row Labels	Count of Rock Type #1
Crushed Rock	**103**
Grit	**103**
Low Sphercity	103
Angular	7
Very Angular	96
Mineral	**106**
Grit	**74**
High Sphercity	1
Angular	1
Low Sphercity	73
Angular	47
Very Angular	26
Sand	**32**
High Sphercity	6
Rounded	3
Well Rounded	3
Low Sphercity	26
Rounded	17
Sub-rounded	8
Well Rounded	1
Sed Rock	**1**
Grit	**1**
Low Sphercity	1
Angular	1
Grand Total	**210**

Row Labels	Count of Type
Crushed Rock	**103**
>2.0	90
0.50-1.0	5
1.0-2.0	8
Matrix	**82**
<0.0625	82
Mineral	**106**
>2.0	12
0.0625-0.25	48
0.25-0.50	28
0.50-1.0	11
1.0-2.0	7
Plucking Void	**15**
>2.0	15
Sed Rock	**1**
>2.0	1
Void	**43**
<0.0625	5
>2.0	18
>22.0	1
0.0625-0.25	7
0.25-0.50	2
0.50-1.0	5
1.0-2.0	5
Grand Total	**350**

Row Labels	Count of Type
Crushed Rock	**103**
Amphibole	1
Biotite	5
Clinopyroxene	2
Hornblende	8
Microcline	1
Myrmekite	2
Opaque	3
Orthoclase	30
Orthopyroxene	1
Perthite	28
Plagioclase	4
Quartz	18
Mineral	**106**
Biotite	7
Chlorite	1
Hornblende	4
Microcline	1
Muscovite	1
Myrmekite	1
Opaque	12
Orthoclase	35
Perthite	11
Plagioclase	6
Quartz	26
Spinel	1
Sed Rock	**1**
Opaque	1
Void	**43**
Channel	2
Compound packing	1
Plane	24
Simple Packing Void	6
Vughe	10
Grand Total	**253**

McKendry Vessel 2 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	100
Grog	1
Matrix	115
Mineral	91
Plucking Void	18
Void	75
Grand Total	**400**

Row Labels	Count of Rock Type #1
Crushed Rock	**100**
Grit	**100**
Low Sphercity	100
Very Angular	100
Grog	**1**
Grit	**1**
Low Sphercity	1
Very Angular	1
Mineral	**91**
Grit	**64**
Low Sphercity	64
Angular	48
Sub-angular	3
Very Angular	13
Sand	**27**
High Sphercity	6
Rounded	5
Well Rounded	1
Low Sphercity	21
Rounded	17
Sub-rounded	3
Well Rounded	1
Grand Total	**192**

Row Labels	Count of Type
Crushed Rock	**100**
>2.0	93
0.50-1.0	2
1.0-2.0	5
Grog	**1**
0.50-1.0	1
Matrix	**115**
<0.0625	115
Mineral	**91**
>2.0	1
0.0625-0.25	58
0.25-0.50	25
0.50-1.0	3
1.0-2.0	4
Plucking Void	**18**
>2.0	16
1.0-2.0	2
Void	**75**
<0.0625	2
>2.0	33
0.0625-0.25	9
0.25-0.50	11
0.50-1.0	14
1.0-2.0	6
Grand Total	**400**

Row Labels	Count of Type
Crushed Rock	**100**
Biotite	5
Hornblende	3
Myrmekite	6
Orthoclase	21
Perthite	46
Plagioclase	4
Quartz	15
Grog	**1**
Opaque	1
Mineral	**91**
Biotite	2
Hornblende	5
Microcline	1
Muscovite	6
Myrmekite	1
Opaque	15
Orthoclase	28
Perthite	10
Plagioclase	4
Quartz	19
Void	**75**
Chamber	2
Channel	9
Double packing	1
Double packing void	1
Plane	43
Simple packing	3
Simple packing	1
Vughe	15
Grand Total	**267**

McKendry Vessel 2 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	100
Grog	1
Matrix	62
Mineral	109
Plucking Void	10
Void	30
Grand Total	**312**

Row Labels	Count of Rock Type #1
Crushed Rock	**100**
Grit	**100**
Low Sphercity	100
Angular	3
Very Angular	97
Grog	**1**
Grit	**1**
Low Sphercity	1
Angular	1
Mineral	**109**
Grit	**79**
High Sphercity	2
Angular	2
Low Sphercity	77
Angular	58
Sub-angular	5
Very Angular	14
Sand	**30**
High Sphercity	5
Rounded	3
Well Rounded	2
Low Sphercity	25
Rounded	17
Sub-rounded	6
Well Rounded	2
Grand Total	**210**

Row Labels	Count of Type
Crushed Rock	**100**
>2.0	82
0.50-1.0	8
1.0-2.0	10
Grog	**1**
0.25-0.50	1
Matrix	**62**
<0.0625	62
Mineral	**109**
>2.0	1
0.0625-0.25	63
0.25-0.50	35
0.50-1.0	7
1.0-2.0	3
Plucking Void	**10**
>2.0	10
Void	**30**
<0.0625	1
>2.0	8
0.0625-0.25	7
0.25-0.50	6
0.50-1.0	2
1.0-2.0	6
Grand Total	**312**

Row Labels	Count of Type
Crushed Rock	**100**
Chlorite	1
Clinopyroxene	2
Hornblende	3
Opaque	11
Orthoclase	32
Perthite	20
Plagioclase	8
Quartz	20
Sercite	3
Grog	**1**
Opaque	1
Mineral	**109**
Clinopyroxene	2
Hornblende	7
Muscovite	5
Opaque	13
Orthoclase	43
Perthite	4
Plagioclase	12
Quartz	23
Void	**30**
Chamber	2
Channel	4
Complex packing void	1
Plane	11
Simple Packing Void	4
Vughe	8
Grand Total	**240**

McKendry Vessel 3 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	110
Matrix	86
Mineral	63
Plucking Void	6
Void	39
Grand Total	**304**

Row Labels	Count of Rock Type #1
Crushed Rock	**110**
Grit	**110**
Low Sphercity	110
Angular	7
Sub-angular	1
Very Angular	102
Mineral	**63**
Grit	**48**
High Sphercity	2
Angular	2
Low Sphercity	46
Angular	35
Sub-angular	5
Very Angular	6
Sand	**15**
High Sphercity	4
Rounded	2
Well Rounded	2
Low Sphercity	11
Rounded	11
Grand Total	**173**

Row Labels	Count of Type
Crushed Rock	**110**
>2.0	86
0.0625-0.25	1
0.25-0.50	2
0.50-1.0	12
1.0-2.0	9
Matrix	**86**
<0.0625	86
Mineral	**63**
0.0625-0.25	31
0.25-0.50	21
0.50-1.0	7
1.0-2.0	4
Plucking Void	**6**
>2.0	5
1.0-2.0	1
Void	**39**
<0.0625	2
>2.0	4
0.0625-0.25	10
0.25-0.50	9
0.50-1.0	11
1.0-2.0	3
Grand Total	**304**

Row Labels	Count of Type
Crushed Rock	**110**
Clinopyroxene	3
Microcline	6
Opaque	6
Orthoclase	24
Perthite	16
Plagioclase	29
Quartz	26
Mineral	**63**
Biotite	3
Clinopyroxene	2
Hornblende	1
Microcline	1
Muscovite	1
Opaque	6
Orthoclase	10
Perthite	10
Plagioclase	11
Quartz	17
Spinel	1
Void	**39**
Chamber	3
Channel	4
Complex packing void	1
Plane	17
Void	4
Vughe	10
Grand Total	**212**

McKendry Vessel 4 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	86
Grog	3
Matrix	109
Mineral	93
Plucking Void	10
Void	55
Grand Total	**356**

Row Labels	Count of Rock Type #1
Crushed Rock	**86**
Grit	**86**
Low Sphericty	86
Angular	4
Very Angular	82
Grog	**3**
Grit	**3**
Low Sphericty	3
Angular	3
Mineral	**93**
Grit	**55**
High Sphercity	1
Angular	1
Low Sphericty	54
Angular	40
Sub-angular	2
Very Angular	12
Sand	**38**
High Sphercity	10
Rounded	6
Sub-rounded	1
Well Rounded	3
Low Sphericty	28
Rounded	23
Sub-rounded	3
Well Rounded	2
Grand Total	**182**

Row Labels	Count of Type
Crushed Rock	**86**
>2.0	74
0.50-1.0	3
1.0-2.0	9
Grog	**3**
0.50-1.0	3
Matrix	**109**
<0.0625	109
Mineral	**93**
>2.0	3
0.0625-0.25	54
0.25-0.50	20
0.50-1.0	13
1.0-2.0	3
Plucking Void	**10**
>2.0	10
Void	**55**
<0.0625	5
>2.0	3
0.0625-0.25	18
0.25-0.50	10
0.50-1.0	12
1.0-2.0	7
Grand Total	**356**

Row Labels	Count of Type
Crushed Rock	**86**
Amphibole	2
Clinopyroxene	16
Microcline	12
Opaque	2
Orthoclase	9
Orthopyroxene	2
Perthite	16
Plagioclase	26
Quartz	1
Grog	**3**
Opaque	3
Mineral	**93**
Chlorite	3
Hornblende	2
Microcline	4
Muscovite	5
Opaque	22
Orthoclase	29
Plagioclase	13
Quartz	11
Spinel	4
Void	**55**
Chamber	8
Channel	9
Plane	15
Simple Packing Void	8
Vughe	15
Grand Total	**237**

McKendry Vessel 4 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	104
Grog	1
Matrix	57
Mineral	81
Plucking Void	13
Void	46
Grand Total	**302**

Row Labels	Count of Rock Type #1
Crushed Rock	**104**
Grit	**104**
Low Sphercity	104
Angular	6
Very Angular	98
Grog	**1**
Grit	**1**
Low Sphercity	1
Angular	1
Mineral	**81**
Grit	**59**
Low Sphercity	59
Angular	46
Very Angular	13
Sand	**22**
High Sphercity	4
Rounded	3
Well Rounded	1
Low Sphercity	18
Rounded	17
Sub-rounded	1
Grand Total	**186**

Row Labels	Count of Type
Crushed Rock	**104**
>2.0	91
0.25-0.50	1
0.50-1.0	6
1.0-2.0	6
Grog	**1**
1.0-2.0	1
Matrix	**57**
<0.0625	57
Mineral	**81**
>2.0	2
0.0625-0.25	35
0.25-0.50	22
0.50-1.0	15
1.0-2.0	7
Plucking Void	**13**
>2.0	13
Void	**46**
<0.0625	4
<0.0625-0.25	1
>2.0	23
0.0625-0.25	5
0.25-0.50	2
0.50-1.0	7
1.0-2.0	4
Grand Total	**302**

Row Labels	Count of Type
Crushed Rock	**104**
Biotite	4
Hornblende	8
Myrmekite	3
Opaque	4
Orthoclase	33
Perthite	36
Plagioclase	5
Quartz	11
Grog	**1**
Opaque	1
Mineral	**81**
Biotite	1
Hornblende	6
Muscovite	1
Myrmekite	1
Opaque	9
Orthoclase	41
Perthite	10
Plagioclase	1
Quartz	11
Void	**46**
Chamber	3
Channel	3
Plane	26
Simple Packing Void	8
Vughe	6
Grand Total	**232**

Nine Mile Road Vessel 4 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	58
Matrix	68
Mineral	53
Plucking Void	16
Void	30
Grand Total	**225**

Row Labels	Count of Rock Type #1
Crushed Rock	**58**
Grit	**58**
Low Sphercity	58
Very Angular	58
Mineral	**53**
Grit	**33**
Low Sphercity	33
Angular	23
Sub-angular	2
Very Angular	8
Sand	**20**
High Sphercity	4
Rounded	3
Sub-rounded	1
Low Sphercity	16
Rounded	13
Sub-rounded	3
Grand Total	**111**

Row Labels	Count of Type
Crushed Rock	**58**
>2.0	56
1.0-2.0	2
Matrix	**68**
<0.0625	68
Mineral	**53**
>2.0	1
0.0625-0.25	37
0.25-0.50	10
0.50-1.0	5
Plucking Void	**16**
>2.0	16
Void	**30**
<0.0625	3
>2.0	13
0.0625-0.25	3
0.25-0.50	3
0.50-1.0	6
1.0-2.0	2
Grand Total	**225**

Row Labels	Count of Type
Crushed Rock	**58**
Amphibole	6
Biotite	1
Clinopyroxene	9
Hornblende	2
Microcline	1
Myrmekite	4
Olivine	1
Opaque	1
Orthopyroxene	2
Perthite	18
Plagioclase	3
Quartz	10
Mineral	**53**
Chlorite	6
Clinopyroxene	12
Muscovite	3
Opaque	7
Orthoclase	4
Perthite	2
Quartz	19
Void	**30**
Chamber	1
Channel	4
Plane	15
Simple Packing	4
Vughe	6
Grand Total	**141**

Ninemile Road Vessel 4 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	67
Matrix	81
Mineral	72
Plucking Void	17
Void	56
Grand Total	**293**

Row Labels	Count of Rock Type #1
Crushed Rock	**67**
Grit	**67**
Low Sphercity	67
Angular	2
Very Angular	65
Mineral	**72**
Grit	**56**
Low Sphercity	56
Angular	36
Sub-angular	4
Very Angular	16
Sand	**16**
High Sphercity	8
Rounded	5
Sub-rounded	3
Low Sphercity	8
Rounded	4
Sub-rounded	4
Grand Total	**139**

Row Labels	Count of Type
Crushed Rock	**67**
>2.0	64
0.25-0.50	1
1.0-2.0	2
Matrix	**81**
<0.0625	81
Mineral	**72**
>2.0	7
0.0625-0.25	33
0.25-0.50	15
0.50-1.0	10
1.0-2.0	7
Plucking Void	**17**
>2.0	17
Void	**56**
<0.0625	1
>2.0	33
0.0625-0.25	5
0.25-0.50	5
0.50-1.0	10
1.0-2.0	2
Grand Total	**293**

Row Labels	Count of Type
Crushed Rock	**67**
Amphibole	15
Chlorite	1
Clinopyroxene	10
Flourite	1
Microcline	2
Muscovite	1
Opaque	1
Orthoclase	2
Orthopyroxene	1
Perthite	4
Plagioclase	2
Quartz	26
Steatite	1
Mineral	**72**
Amphibole	3
Biotite	4
Chlorite	1
Clinopyroxene	5
Muscovite	1
Opaque	8
Orthoclase	9
Orthopyroxene	2
Perthite	1
Quartz	33
Spinel	2
Steatite	3
Void	**56**
Chamber	6
Channel	5
Compound Packing Void	1
Double packing void	1
Plane	32
Simple packing void	2
Vughe	9
Grand Total	**195**

Portage Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	70
Matrix	85
Mineral	55
Sed Rock	2
Void	54
Grand Total	**266**

Row Labels	Count of Rock Type #1
Crushed Rock	**70**
Grit	**70**
Low Sphercity	70
Very Angular	70
Mineral	**55**
Grit	**38**
High Sphercity	2
Angular	2
Low Sphercity	36
Angular	24
Very Angular	12
Sand	**17**
High Sphercity	12
Rounded	7
Sub-angular	1
Well Rounded	4
Low Sphercity	5
Rounded	4
Sub-rounded	1
Sed Rock	**2**
Grit	**2**
Low Sphercity	2
Very Angular	2
Grand Total	**127**

Row Labels	Count of Type
Crushed Rock	**70**
>2.0	66
1.0-2.0	4
Matrix	**85**
<0.0625	85
Mineral	**55**
>2.0	3
0.0625-0.25	27
0.25-0.50	18
0.50-1.0	4
1.0-2.0	3
Sed Rock	**2**
>2.0	2
Void	**54**
<0.0625	1
>2.0	44
0.50-1.0	4
1.0-2.0	5
Grand Total	**266**

Row Labels	Count of Type
Crushed Rock	**70**
Amphibole	7
Chlorite	3
Clinopyroxene	10
Microcline	8
Muscovite	1
Opaque	1
Orthoclase	12
Perthite	1
Plagioclase	20
Quartz	7
Mineral	**55**
Amphibole	3
Clinopyroxene	4
Muscovite	6
Opaque	3
Orthoclase	8
Plagioclase	4
Quartz	27
Sed Rock	**2**
Opaque	2
Void	**53**
Channel	1
Plane	51
Simple packing void	1
Grand Total	**180**

Portage Vessel 2 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	36
Grog	4
Matrix	105
Mineral	84
Plucking Void	6
Void	74
Grand Total	**309**

Row Labels	Count of Rock Type #1
Crushed Rock	**36**
Grit	**36**
Low Sphercity	36
Very Angular	36
Grog	**4**
Grit	**4**
Low Sphercity	4
Very Angular	4
Mineral	**84**
Grit	**69**
Low Sphercity	69
Angular	29
Sub-angular	1
Very Angular	39
Sand	**15**
High Sphercity	5
Rounded	4
Well Rounded	1
Low Sphercity	10
Rounded	8
Well Rounded	2
Grand Total	**124**

Row Labels	Count of Type
Crushed Rock	**36**
>2.0	25
0.50-1.0	2
1.0-2.0	9
Grog	**4**
>2.0	3
0.50-1.0	1
Matrix	**105**
<0.0625	105
Mineral	**84**
>2.0	6
0.0625-0.25	19
0.25-0.50	27
0.50-1.0	20
1.0-2.0	12
Plucking Void	**6**
>2.0	5
0.50-1.0	1
Void	**74**
<0.0625	1
>2.0	47
0.0625-0.25	1
0.25-0.50	12
0.50-1.0	7
1.0-2.0	6
Grand Total	**309**

Row Labels	Count of Type
Crushed Rock	**36**
Amphibole	1
Biotite	3
Chlorite	2
Clinopyroxene	5
Hornblende	2
Microcline	1
Myrmekite	1
Opaque	3
Orthoclase	3
Orthopyroxene	1
Perthite	4
Plagioclase	1
Quartz	9
Grog	**4**
Opaque	4
Mineral	**84**
Biotite	6
Chlorite	3
Clinopyroxene	1
Hornblende	3
Microcline	2
Muscovite	2
Myrmekite	1
Opaque	13
Orthoclase	17
Perthite	2
Quartz	33
Staurolite	1
Void	**74**
Chamber	3
Channel	6
Plane	63
Simple packing	2
Grand Total	**198**

Portage Vessel 2 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	97
Matrix	80
Mineral	38
Plucking Void	36
Sed Rock	1
Void	42
Grand Total	**294**

Row Labels	Count of Rock Type #1
Crushed Rock	**97**
Grit	**97**
Low Sphercity	97
Angular	1
Very Angular	96
Mineral	**38**
Grit	**30**
Low Sphercity	30
Angular	13
Sub-angular	1
Very Angular	16
Sand	**8**
High Sphercity	2
Rounded	1
Sub-rounded	1
Low Sphercity	6
Rounded	5
Sub-rounded	1
Sed Rock	**1**
Sand	**1**
Low Sphercity	1
Rounded	1
Grand Total	**136**

Row Labels	Count of Type
Crushed Rock	**97**
>2.0	78
0.50-1.0	8
1.0-2.0	11
Matrix	**80**
<0.0625	80
Mineral	**38**
>2.0	2
0.0625-0.25	2
0.25-0.50	11
0.50-1.0	12
1.0-2.0	11
Plucking Void	**36**
>2.0	35
0.50-1.0	1
Sed Rock	**1**
>2.0	1
Void	**42**
>2.0	26
0.25-0.50	6
0.50-1.0	7
1.0-2.0	3
Grand Total	**294**

Row Labels	Count of Type
Crushed Rock	**97**
Amphibole	2
Biotite	1
Clinopyroxene	34
Flourite	1
Microcline	6
Muscovite	1
Myrmekite	1
Opaque	1
Orthoclase	7
Perthite	7
Plagioclase	17
Quartz	19
Mineral	**38**
Amphibole	1
Biotite	1
Clinopyroxene	7
Microcline	1
Opaque	3
Orthoclase	4
Perthite	2
Plagioclase	3
Quartz	16
Sed Rock	**1**
Opaque	1
Void	**42**
Chamber	2
Channel	5
Plane	33
Vughe	2
Grand Total	**178**

Riverhaven No. 2 Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	51
Grog	1
Matrix	88
Mineral	150
Plucking Void	2
Void	41
Grand Total	**333**

Row Labels	Count of Rock Type #1
Crushed Rock	**51**
Grit	**51**
Low Sphercity	51
Angular	2
Very Angular	49
Grog	**1**
Grit	**1**
Low Sphercity	1
Very Angular	1
Matrix	**6**
Silt	**6**
High Sphercity	4
Well Rounded	4
Low Sphercity	2
Rounded	2
Mineral	**150**
Grit	**94**
High Sphercity	2
Angular	1
Sub-angular	1
Low Sphercity	92
Angular	80
Sub-angular	7
Very Angular	5
Sand	**56**
High Sphercity	22
Rounded	16
sub-rounded	1
Well Rounded	5
Low Sphercity	34
Rounded	28
sub-rounded	6
Grand Total	**208**

Row Labels	Count of Type
Crushed Rock	**51**
>2.0	45
0.50-1.0	3
1.0-2.0	3
Grog	**1**
>2.0	1
Matrix	**88**
<0.0625	88
Mineral	**150**
>2.0	3
0.0625-0.25	94
0.0625-025	1
0.25-0.50	32
0.50-1.0	19
1.0-2.0	1
Plucking Void	**2**
>2.0	2
Void	**41**
>2.0	24
0.0625-0.25	1
0.25-0.50	6
0.50-1.0	8
1.0-2.0	2
Grand Total	**333**

Row Labels	Count of Type
Crushed Rock	**51**
Biotite	1
Clinopyroxene	2
Microcline	2
Opaque	1
Orthoclase	15
Orthopyroxene	2
Perthite	2
Plagioclase	17
Quartz	9
Grog	**1**
Opaque	1
Matrix	**6**
Microcline	1
Opaque	2
Quartz	3
Mineral	**150**
Amphibole	1
Epidote	1
Muscovite	4
Opaque	5
Orthoclase	43
Orthopyroxene	2
Perthite	6
Plagioclase	9
Quartz	79
Void	**41**
Chamber	7
Channel	7
Compound packing voids	1
Plane	25
Vesicle	1
Grand Total	**249**

Renassiance House Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	39
Matrix	74
Mineral	71
Plucking Void	4
Void	26
Grand Total	**214**

Row Labels	Count of Rock Type #1
Crushed Rock	**39**
Grit	**39**
Low Sphercity	39
Angular	6
Very Angular	33
Matrix	**3**
Silt	**3**
High Sphercity	1
Well Rounded	1
Low Sphercity	2
Angular	1
Rounded	1
Mineral	**71**
Grit	**41**
Low Sphercity	41
Angular	32
Sub-angular	3
Sub-rounded	1
Very Angular	5
Sand	**30**
High Sphercity	11
Rounded	7
Well Rounded	4
Low Sphercity	19
Rounded	17
Sub-rounded	2
Grand Total	**113**

Row Labels	Count of Type
Crushed Rock	**39**
>2.0	31
0.50-1.0	2
1.0-2.0	6
Matrix	**74**
<0.0625	74
Mineral	**71**
>2.0	1
0.0625-0.25	39
0.25-0.50	13
0.50-1.0	14
1.0-2.0	4
Plucking Void	**4**
>2.0	4
Void	**26**
>2.0	18
0.0625-0.25	1
0.50-1.0	6
1.0-2.0	1
Grand Total	**214**

Row Labels	Count of Type
Crushed Rock	**39**
Amphibole	2
Clinopyroxene	2
Kyanite	2
Orthoclase	15
Perthite	1
Plagioclase	12
Quartz	5
Matrix	**3**
Opaque	1
Quartz	2
Mineral	**71**
Flourite	2
Muscovite	1
Opaque	6
Orthoclase	27
Orthopyroxene	1
Perthite	2
Plagioclase	2
Quartz	30
Void	**26**
Chamber	3
Channel	1
Plane	20
Vesicle	2
Grand Total	**139**

Riverhaven No. 2 Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	57
Grog	2
Matrix	55
Mineral	69
Plucking Void	1
Void	25
Grand Total	**209**

Row Labels	Count of Rock Type #1
Crushed Rock	**57**
Grit	**57**
Low Sphercity	57
Very Angular	57
Grog	**2**
Grit	**2**
Low Sphercity	2
Angular	2
Matrix	**1**
Silt	**1**
High Sphercity	1
Angular	1
Mineral	**69**
Grit	**50**
Low Sphercity	50
Angular	43
Sub-angular	2
Very Angular	5
Sand	**19**
High Sphercity	7
Rounded	5
sub-rounded	1
Well Rounded	1
Low Sphercity	12
Rounded	10
sub-rounded	2
Grand Total	**129**

Row Labels	Count of Type
Crushed Rock	**57**
>2.0	55
0.25-0.50	1
1.0-2.0	1
Grog	**2**
>2.0	1
1.0-2.0	1
Matrix	**55**
<0.0625	55
Mineral	**69**
>2.0	4
0.0625-0.25	39
0.25-0.50	18
0.50-1.0	6
1.0-2.0	2
Plucking Void	**1**
>2.0	1
Void	**25**
>2.0	20
0.0625-0.25	1
0.25-0.50	1
1.0-2.0	3
Grand Total	**209**

Row Labels	Count of Type
Crushed Rock	**57**
Amphibole	3
Augite	1
Clinopyroxene	3
Epidote	2
Oligoclase	1
Opaque	3
Orthoclase	16
Orthopyroxene	2
Perthite	1
Plagioclase	24
Quartz	1
Grog	**2**
Opaque	2
Matrix	**1**
Quartz	1
Mineral	**69**
Amphibole	1
Muscovite	3
Opaque	1
Orthoclase	9
Orthopyroxene	1
Perthite	5
Plagioclase	4
Quartz	45
Grand Total	**129**

Riverhaven No. 2 Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	109
Grog	1
Matrix	59
Mineral	93
Plucking Void	17
Void	21
Grand Total	**300**

Row Labels	Count of Rock Type #1
Crushed Rock	**109**
Grit	**109**
Low Sphercity	109
Angular	1
Very Angular	108
Grog	**1**
Grit	**1**
Low Sphercity	1
Angular	1
Matrix	**9**
Silt	**9**
High Sphercity	4
Angular	1
Rounded	1
Well Rounded	2
Low Sphercity	5
Angular	5
Mineral	**93**
Grit	**68**
Low Sphercity	68
Angular	55
Sub-angular	1
Very Angular	12
Sand	**25**
High Sphercity	10
Rounded	3
Sub-angular	3
Well Rounded	4
Low Sphercity	15
Rounded	11
Sub-rounded	4
Grand Total	**212**

Row Labels	Count of Type
Crushed Rock	**109**
>2.0	104
0.50-1.0	1
1.0-2.0	4
Grog	**1**
1.0-2.0	1
Matrix	**59**
<0.0625	59
Mineral	**93**
>2.0	4
0.0625-0.25	53
0.25-0.50	17
0.50-1.0	8
1.0-2.0	11
Plucking Void	**17**
>2.0	17
Void	**21**
>2.0	19
0.0625-0.25	1
0.25-0.50	1
Grand Total	**300**

Row Labels	Count of Type
Crushed Rock	**109**
Biotite	2
Chlorite	1
Clinopyroxene	1
Hornblende	5
Muscovite	1
Myrmekite	12
Opaque	4
Orthoclase	30
Perthite	31
Plagioclase	12
Quartz	9
sercite	1
Grog	**1**
Opaque	1
Matrix	**9**
Muscovite	1
Opaque	1
Quartz	7
Mineral	**93**
Amphibole	1
Biotite	1
Chlorite	1
Clinopyroxene	1
Fluorite	1
Hornblende	1
Muscovite	2
Myrmekite	1
Opaque	4
Orthoclase	8
Orthopyroxene	4
Perthite	7
Plagioclase	6
Quartz	55
Grand Total	**212**

Riverhaven No. 2 Vessel 2 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	72
Grog	2
Matrix	84
Mineral	111
Plucking Void	3
Void	42
Grand Total	**314**

Row Labels	Count of Rock Type #1
Crushed Rock	**72**
Grit	**72**
Low Sphercity	72
Very Angular	72
Grog	**2**
Grit	**2**
High Sphercity	1
Angular	1
Low Sphercity	1
Angular	1
Matrix	**5**
Silt	**5**
High Sphercity	4
Well Rounded	4
Low Sphercity	1
Rounded	1
Mineral	**111**
Grit	**71**
Low Sphercity	71
Angular	57
Sub-angular	4
Very Angular	10
Sand	**40**
High Sphercity	12
Rounded	5
Sub-rounded	3
Well Rounded	4
Low Sphercity	28
Rounded	18
Sub-rounded	6
Well Rounded	4
Grand Total	**190**

Row Labels	Count of Type
Crushed Rock	**72**
>2.0	69
1.0-2.0	3
Grog	**2**
0.0625-0.25	1
0.50-1.0	1
Matrix	**84**
<0.0625	84
Mineral	**111**
>2.0	2
0.0625-0.25	62
0.25-0.50	28
0.50-1.0	13
1.0-2.0	6
Plucking Void	**3**
>2.0	3
Void	**42**
>2.0	22
0.0625-0.25	7
0.25-0.50	2
0.50-1.0	6
1.0-2.0	5
Grand Total	**314**

Row Labels	Count of Type
Crushed Rock	**72**
Albite	1
Amhibole	1
Amphibole	7
Augite	2
Calcite	4
Chlorite	3
Clinopyroxene	6
Epidote	1
Hornblende	3
Microcline	1
Opaque	4
Orthoclase	3
Orthopyroxene	2
Perthite	1
Plagioclase	26
Quartz	7
Grog	**2**
Opaque	2
Matrix	**5**
Opaque	4
Quartz	1
Mineral	**111**
Biotite	1
Calcite	1
Flourite	6
Muscovite	3
Opaque	13
Orthoclase	17
Orthopyroxene	6
Perthite	3
Plagioclase	12
Quartz	48
Staurolite	1
Void	**26**
Chamber	9
channel	1
Plane	11
Vesicle	4
Vugh	1
Grand Total	**216**

Riverhaven No. 2 Vessel 2 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	80
Grog	1
Matrix	107
Mineral	47
Plucking Void	5
Void	32
Grand Total	**272**

Row Labels	Count of Rock Type #1
Matrix	**3**
Silt	**3**
High Sphercity	2
Well Rounded	2
Low Sphercity	1
Rounded	1
Mineral	**14**
Sand	**14**
High Sphercity	7
Rounded	6
Well Rounded	1
Low Sphercity	7
Rounded	6
Well Rounded	1
Grand Total	**17**

Row Labels	Count of Type
Crushed Rock	**80**
>2.0	76
0.50-1.0	2
1.0-2.0	2
Grog	**1**
1.0-2.0	1
Matrix	**107**
<0.0625	107
Mineral	**47**
>2.0	4
0..50-1.0	1
0.0625-0.25	17
0.25-0.50	11
0.50-1.0	8
1.0-2.0	6
Plucking Void	**5**
>2.0	4
1.0-2.0	1
Void	**32**
>2.0	19
0.0625-0.25	1
0.25-0.50	1
0.50-1.0	8
1.0-2.0	3
Grand Total	**272**

Row Labels	Count of Type
Crushed Rock	**80**
Clinopyroxene	1
Microcline	3
Orthoclase	36
Orthopyroxene	6
Plagioclase	24
Quartz	10
Grog	**1**
opaque	1
Matrix	**3**
opaque	1
Quartz	2
Mineral	**47**
Flourite	2
Microcline	1
opaque	1
Orthoclase	10
Orthopyroxene	3
Perthite	1
Plagioclase	7
Quartz	22
Void	**32**
Chamber	4
Channel	1
Plane	23
Vesicle	3
vugh	1
Grand Total	**163**

Riverhaven No. 2 Vessel 2 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	100
Grog	2
Matrix	112
Mineral	64
Plucking Void	16
Void	47
Grand Total	**341**

Row Labels	Count of Rock Type #1
Matrix	**3**
Sand	**1**
High Sphercity	1
Well Rounded	1
Silt	**2**
High Sphercity	2
Well Rounded	2
Mineral	**12**
Sand	**12**
High Sphercity	4
Rounded	4
Low Sphercity	8
Rounded	4
sub-rounded	3
Well Rounded	1
Grand Total	**15**

Row Labels	Count of Type
Crushed Rock	**100**
>2.0	93
0.50-1.0	3
1.0-2.0	4
Grog	**2**
>2.0	1
1.0-2.0	1
Matrix	**112**
<0.0625	111
0.0625-0.25	1
Mineral	**64**
>2.0	6
0.0625-0.25	21
0.25-0.50	14
0.50-1.0	13
1.0-2.0	10
Plucking Void	**16**
>2.0	16
Void	**47**
>2.0	27
0.25-0.50	1
0.50-1.0	12
1.0-2.0	7
Grand Total	**341**

Row Labels	Count of Type
Crushed Rock	**100**
Microcline	2
Myrmekite	1
Opaque	1
Orthoclase	40
Perthite	26
Plagioclase	18
Quartz	12
Grog	**2**
Opaque	2
Matrix	**4**
Opaque	2
Quartz	2
Mineral	**64**
Opaque	7
Orthoclase	20
Perthite	9
Plagioclase	7
Quartz	20
Sercite	1
Void	**47**
Chamber	6
Channel	4
Plane	34
Vesicle	2
Vugh	1
Grand Total	**217**

Riverhaven No. 2 Vessel 3 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	100
Grog	1
Matrix	95
Mineral	84
Plucking Void	25
Void	31
Grand Total	**336**

Row Labels	Count of Rock Type #1
Crushed Rock	**100**
Grit	**100**
Low Sphercity	100
Angular	1
Very Angular	99
Grog	**1**
Grit	**1**
Low Sphercity	1
Very Angular	1
Matrix	**5**
Sand	**1**
Low Sphercity	1
Well Rounded	1
Silt	**4**
High Sphercity	4
Rounded	1
Well Rounded	3
Mineral	**84**
Grit	**45**
High Sphercity	2
Sub-angular	1
Very Angular	1
Low Sphercity	43
Angular	28
Rounded	1
Sub-angular	3
Sub-rounded	1
Very Angular	10
Sand	**39**
High Sphercity	9
Rounded	1
Sub-angular	1
Sub-rounded	3
Well Rounded	4
Low Sphercity	30
Round	1
Rounded	23
Sub-rounded	3
Well Rounded	3
Grand Total	**190**

Row Labels	Count of Type
Crushed Rock	**100**
>2.0	95
1.0-2.0	5
Grog	**1**
1.0-2.0	1
Matrix	**95**
<0.0625	94
0.0625-0.25	1
Mineral	**84**
>2.0	4
0.0625-0.25	45
0.25-0.50	18
0.50-1.0	8
1.0-2.0	9
Plucking Void	**25**
>2.0	25
Void	**31**
>2.0	18
0.0625-0.25	4
0.50-1.0	5
1.0-2.0	4
Grand Total	**336**

Row Labels	Count of Type
Crushed Rock	**100**
Amphibole	3
Chlorite	1
Clinopyroxene	5
Microcline	6
Muscovite	2
Orthoclase	17
Orthopyroxene	8
Perthite	20
Plagioclase	36
Quartz	2
Grog	**1**
Opaque	1
Matrix	**5**
Opaque	2
Quartz	3
Mineral	**84**
Clinopyroxene	1
Microcline	1
Muscovite	3
Opaque	8
Orthoclase	16
Orthopyroxene	1
Perthite	4
Plagioclase	12
Quartz	38
Void	**31**
Chamber	1
Compound Packing Void	1
Plane	23
Vesicle	5
Vugh	1
Grand Total	**221**

Riverhaven No. 2 Vessel 3 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	69
Matrix	107
Min	1
Mineral	78
Plucking Void	6
Void	15
Grand Total	**276**

Row Labels	Count of Rock Type #1
Crushed Rock	**69**
Grit	**69**
Low Sphercity	69
Very Angular	69
Min	**1**
Sand	**1**
Low Sphercity	1
Rounded	1
Mineral	**78**
Grit	**42**
High Sphercity	2
Angular	1
Very Angular	1
Low Sphercity	40
Angular	33
Very Angular	7
Sand	**36**
High Sphercity	12
Rounded	8
Well Rounded	4
Low Sphercity	24
Rounded	19
Sub-rounded	4
Well Rounded	1
Grand Total	**148**

Row Labels	Count of Type
Crushed Rock	**69**
>2.0	66
1.0-2.0	3
Matrix	**107**
<0.0625	107
Min	**1**
0.0625-0.25	1
Mineral	**78**
>2.0	7
0.0625-0.25	37
0.25-0.50	18
0.50-1.0	14
1.0-2.0	2
Plucking Void	**6**
>2.0	6
Void	**15**
>2.0	10
0.50-1.0	3
1.0-2.0	2
Grand Total	**276**

Row Labels	Count of Type
Crushed Rock	**69**
Orthoclase	28
Perthite	5
Plagioclase	26
Quartz	10
Min	**1**
Orthoclase	1
Mineral	**78**
Flourite	4
Muscovite	2
Opaque	8
Orthoclase	18
Orthopyroxene	1
Perthite	12
Plagioclase	3
Quartz	30
Void	**15**
Chamber	2
Plane	13
Grand Total	**163**

Riverhaven No. 2 Vessel 3 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	103
Grog	1
Matrix	61
Mineral	61
Plucking Void	25
Void	23
Grand Total	**274**

Row Labels	Count of Rock Type #1
Crushed Rock	**103**
Grit	**103**
Low Sphercity	103
Angular	4
Sub-angular	1
Very Angular	98
Grog	**1**
Grit	**1**
Low Sphercity	1
Angular	1
Mineral	**61**
Grit	**40**
Low Sphercity	40
Angular	31
Sub-angular	4
Very Angular	5
Sand	**21**
High Sphercity	6
Rounded	1
Sub-rounded	2
Well Rounded	3
Low Sphercity	15
Rounded	11
Sub-rounded	4
Grand Total	**165**

Row Labels	Count of Type
Crushed Rock	**103**
>2.0	91
0.25-0.50	2
0.50-1.0	8
1.0-2.0	2
Grog	**1**
0.25-0.50	1
Matrix	**61**
<0.0625	61
Mineral	**61**
>2.0	1
0.0625-0.25	40
0.25-0.50	17
0.50-1.0	2
1.0-2.0	1
Plucking Void	**25**
>2.0	25
Void	**23**
>2.0	11
0.0625-0.25	2
0.25-0.50	3
0.50-1.0	7
Grand Total	**274**

Row Labels	Count of Type
Crushed Rock	**103**
Amphibole	7
Chlorite	1
Clinopyroxene	10
Microcline	4
Opaque	2
Orthoclase	17
Perthite	16
Plagioclase	40
Quartz	4
Titanite	2
Grog	**1**
Opaque	1
Mineral	**61**
Amphibole	1
Clinopyroxene	3
Microcline	1
Opaque	4
Orthoclase	27
Plagioclase	9
Quartz	16
Void	**23**
Chamber	1
Channel	4
Plane	14
Simple packing void	1
Vughe	3
Grand Total	**188**

Saint Bonaventure Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	104
Grog	1
Matrix	95
Mineral	58
Plucking Void	5
Void	37
Grand Total	**300**

Row Labels	Count of Rock Type #1
Crushed Rock	**104**
Grit	**104**
Low Sphercity	104
Angular	8
Sub-angular	1
Very Angular	95
Grog	**1**
Grit	**1**
Low Sphercity	1
Angular	1
Matrix	**2**
Silt	**2**
High Sphericty	2
Well Rounded	2
Mineral	**58**
Grit	**34**
Low Sphercity	34
Angular	31
Sub-angular	1
Very Angular	2
Sand	**24**
High Sphericty	9
Rounded	7
Well Rounded	2
Low Sphercity	15
Rounded	13
Well Rounded	2
Grand Total	**165**

Row Labels	Count of Type
Crushed Rock	**104**
>2.0	99
0.50-1.0	1
1.0-2.0	4
Grog	**1**
>2.0	1
Matrix	**95**
<0.0625	95
Mineral	**58**
>2.0	5
0.0625-0.25	25
0.25-0.50	8
0.50-1.0	12
1.0-2.0	8
Plucking Void	**5**
>2.0	4
1.0-2.0	1
Void	**37**
<0.0625	1
>2.0	15
0.0625-0.25	1
0.25-0.50	6
0.50-1.0	6
1.0-2.0	8
Grand Total	**300**

Row Labels	Count of Type
Crushed Rock	**104**
Amphibole	5
Clinopyroxene	4
Microcline	2
Muscovite	1
Myrmekite	1
Opaque	6
Orthoclase	19
Orthopyroxene	2
Perthite	30
Plagioclase	13
Quartz	20
sercite	1
Grog	**1**
Opaque	1
Matrix	**2**
Opaque	1
Quartz	1
Mineral	**58**
Clinopyroxene	3
Flourite	1
Muscovite	4
Opaque	6
Orthoclase	12
Perthite	14
Quartz	18
Void	**37**
Chamber	5
Channel	3
Complex packing voids	1
Plane	24
Simple Packing Void	1
Vesicle	1
Vughe	2
Grand Total	**202**

Saint Bonaventure Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	64
Matrix	88
Mineral	84
Plucking Void	2
Void	47
Grand Total	**285**

Row Labels	Count of Rock Type #1
Crushed Rock	**64**
Grit	**64**
Low Sphercity	64
Angular	15
Very Angular	49
Matrix	**8**
Silt	**8**
High Sphercity	8
Well Rounded	8
Mineral	**84**
Grit	**55**
Low Sphercity	55
Angular	41
Very Angular	14
Sand	**29**
High Sphercity	9
Rounded	7
Well Rounded	2
Low Sphercity	20
Rounded	17
Sub-rounded	3
Grand Total	**156**

Row Labels	Count of Type
Crushed Rock	**64**
>2.0	60
0.50-1.0	3
1.0-2.0	1
Matrix	**88**
<0.0625	88
Mineral	**84**
>2.0	14
0.0625-0.25	36
0.25-0.50	13
0.50-1.0	12
1.0-2.0	9
Plucking Void	**2**
>2.0	1
1.0-2.0	1
Void	**47**
>2.0	25
0.0625-0.25	10
0.25-0.50	3
0.50-1.0	6
1.0-2.0	3
Grand Total	**285**

Row Labels	Count of Type
Crushed Rock	**64**
Clinopyroxene	5
Microcline	4
Myrmekite	2
Opaque	1
Orthoclase	23
Orthopyroxene	1
Perthite	14
Plagioclase	10
Quartz	4
Matrix	**8**
Opaque	4
Orthoclase	1
Quartz	3
Mineral	**84**
Microcline	2
Muscovite	3
Opaque	7
Orthoclase	24
Orthopyroxene	1
Perthite	18
Plagioclase	5
Quartz	24
Void	**47**
Chamber	4
Channel	2
Complex packing voids	1
Plane	33
Vesicle	7
Grand Total	**203**

Scaccia Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	31
Grog	6
Matrix	54
Mineral	98
Void	15
Grand Total	**204**

Row Labels	Count of Rock Type #1
Crushed Rock	**31**
Grit	**31**
Low Sphercity	31
Angular	2
Very Angular	29
Grog	**6**
Grit	**6**
Low Sphercity	6
Angular	5
Very Angular	1
Matrix	**4**
Silt	**4**
High Sphercity	3
Angular	1
Well Rounded	2
Low Sphercity	1
Rounded	1
Mineral	**98**
Grit	**58**
High Sphercity	2
Angular	2
Low Sphercity	56
Angular	51
sub-angular	1
Very Angular	4
Sand	**40**
High Sphercity	6
Rounded	2
Sub-rounded	2
Well Rounded	2
Low Sphercity	34
Rounded	27
Sub-rounded	5
Well Rounded	2
Grand Total	**139**

Row Labels	Count of Type
Crushed Rock	**31**
>2.0	27
0.50-1.0	2
1.0-2.0	2
Grog	**6**
>2.0	2
0.50-1.0	2
1.0-2.0	2
Matrix	**54**
<0.0625	54
Mineral	**98**
>2.0	8
0.0625-0.25	49
0.25-0.50	30
0.50-1.0	9
1.0-2.0	2
Void	**15**
>2.0	4
0.0625-0.25	3
0.25-0.50	2
0.50-1.0	3
1.0-2.0	3
Grand Total	**204**

Row Labels	Count of Type
Crushed Rock	**31**
Microcline	6
Myrmekite	2
Opaque	2
Orthoclase	7
Perthite	1
Plagioclase	8
Quartz	5
Grog	**6**
Opaque	3
Perthite	1
Quartz	2
Matrix	**54**
Opaque	1
Orthoclase	1
Quartz	2
(blank)	50
Mineral	**98**
Chlorite	4
Hornblende	1
Microcline	1
Muscovite	3
Opaque	12
Orthoclase	36
Perthite	1
Plagioclase	6
Quartz	32
Spinel	2
Void	**15**
Chamber	2
Channel	1
Plane	8
Simple packing void	1
Vugh	3
Grand Total	**204**

Scaccia Vessel 2 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	100
Grog	2
Matrix	100
Mineral	55
Plucking Void	24
Void	37
Grand Total	**318**

Row Labels	Count of Rock Type #1
Crushed Rock	**100**
Grit	**100**
Low Sphercity	100
Angular	4
Very Angular	96
Grog	**2**
Grit	**2**
High Sphericty	1
Angular	1
Low Sphercity	1
Angular	1
Matrix	**4**
Silt	**4**
High Sphericty	3
Well Rounded	3
Low Sphercity	1
Well Rounded	1
Mineral	**55**
Grit	**36**
High Sphericty	1
Angular	1
Low Sphercity	35
Angular	29
Rounded	1
Very Angular	5
Sand	**19**
High Sphericty	3
Rounded	2
Well Rounded	1
Low Sphercity	16
Rounded	15
Well Rounded	1
Grand Total	**161**

Row Labels	Count of Type
Crushed Rock	**100**
>2.0	94
0.50-1.0	2
1.0-2.0	4
Grog	**2**
>2.0	1
0.50-1.0	1
Matrix	**100**
<0.0625	100
Mineral	**55**
>2.0	5
0.0625-0.25	25
0.25-0.50	11
0.50-1.0	9
1.0-2.0	5
Plucking Void	**24**
>2.0	24
Void	**37**
>2.0	19
0.0625-0.25	5
0.25-0.50	3
0.50-1.0	7
1.0-2.0	3
Grand Total	**318**

Row Labels	Count of Type
Crushed Rock	**100**
Biotite	5
Chlorite	1
Clinopyroxene	2
Hornblende	3
Microcline	8
Muscovite	1
Myrmekite	11
Opaque	8
Orthoclase	21
Perthite	13
Plagioclase	7
Quartz	20
Grog	**2**
Opaque	2
Matrix	**4**
Opaque	1
Quartz	3
Mineral	**55**
Biotite	3
Muscovite	3
Myrmekite	1
Opaque	4
Orthoclase	17
Perthite	3
Plagioclase	1
Quartz	23
Void	**37**
Chamber	2
Channel	1
Plane	29
Simple packing void	3
Vughe	2
Grand Total	**198**

Scaccia Vessel 2 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	84
Matrix	125
Mineral	49
Plucking Void	39
Void	19
Grand Total	**316**

Row Labels	Count of Rock Type #1
Crushed Rock	**84**
Grit	**84**
Low Sphercity	84
Angular	3
Very Angular	81
Matrix	**4**
Silt	**4**
High Sphercity	2
Well Rounded	2
Low Sphercity	2
Rounded	1
Sub-rounded	1
Mineral	**49**
Grit	**25**
High Sphercity	1
Angular	1
Low Sphercity	24
Angular	20
Rounded	1
Very Angular	3
Sand	**24**
High Sphercity	10
Rounded	5
Well Rounded	5
Low Sphercity	14
Rounded	12
Well Rounded	2
Grand Total	**137**

Row Labels	Count of Type
Crushed Rock	**84**
>2.0	80
1.0-2.0	4
Matrix	**125**
<0.0625	125
Mineral	**49**
>2.0	4
0.0625-0.25	37
0.25-0.50	5
0.50-1.0	1
1.0-2.0	2
Plucking Void	**39**
>2.0	38
1.0-2.0	1
Void	**19**
>2.0	10
0.0625-0.25	6
0.25-0.50	1
0.50-1.0	2
Grand Total	**316**

Row Labels	Count of Type
Crushed Rock	**84**
Amphibole	4
Augite	1
Biotite	6
Clinopyroxene	3
Hornblende	1
Microcline	1
Myrmekite	2
Opaque	5
Orthoclase	23
Perthite	2
Plagioclase	22
Quartz	12
Wollastinite	2
Matrix	**4**
Opaque	3
Quartz	1
Mineral	**49**
Amphibole	1
Muscovite	4
Opaque	8
Orthoclase	9
Plagioclase	2
Quartz	25
Void	**19**
Chamber	2
Channel	1
Plane	10
Simple packing void	6
Grand Total	**156**

Scaccia Vessel 3 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	117
Grog	2
Matrix	57
Mineral	71
Plucking Void	17
Void	29
Grand Total	**293**

Row Labels	Count of Rock Type #1
Crushed Rock	**117**
Grit	**117**
Low Sphercity	117
Angular	3
Very Angular	114
Grog	**2**
Grit	**2**
Low Sphercity	2
Angular	1
Very Angular	1
Mineral	**71**
Grit	**49**
Low Sphercity	49
Angular	35
Very Angular	14
Sand	**22**
High Sphercity	8
Rounded	2
Sub-rounded	2
Well Rounded	4
Low Sphercity	14
Rounded	14
Grand Total	**190**

Row Labels	Count of Type
Crushed Rock	**117**
>2.0	113
>2.0	1
0.50-1.0	1
1.0-2.0	2
Grog	**2**
>2.0	2
Matrix	**57**
<0.0625	57
Mineral	**71**
>2.0	6
0.0625-0.25	34
0.25-0.50	10
0.50-1.0	14
1.0-2.0	7
Plucking Void	**17**
>2.0	17
Void	**29**
>2.0	15
0.0625-0.25	2
0.50-1.0	6
1.0-2.0	6
Grand Total	**293**

Row Labels	Count of Type
Crushed Rock	**117**
Amphibole	2
Biotite	2
Clinopyroxene	8
Hornblende	4
Microcline	1
Muscovite	1
Myrmekite	1
Opaque	2
Orthoclase	30
Orthopyroxene	1
Perthite	18
Plagioclase	35
Quartz	12
Grog	**2**
Opaque	2
Mineral	**71**
Amphibole	1
Muscovite	2
Opaque	2
Orthoclase	29
Plagioclase	7
Quartz	30
Void	**29**
Chamber	2
Channel	1
Plane	23
Simple Packing void	2
Vughe	1
Grand Total	**219**

Simmons Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	85
Matrix	50
Mineral	70
Plucking Void	7
Void	25
Grand Total	**237**

Row Labels	Count of Rock Type #1
Crushed Rock	**85**
Grit	**85**
Low Sphercity	85
Angular	5
Very Angular	80
Mineral	**69**
Grit	**56**
Low Sphercity	56
Angular	51
Very Angular	5
Sand	**13**
High Sphercity	6
Rounded	6
Low Sphercity	7
Rounded	7
Grand Total	**154**

Row Labels	Count of Type
Crushed Rock	**85**
>2.0	77
0.50-1.0	3
1.0-2.0	5
Matrix	**50**
<0.0625	50
Mineral	**70**
>2.0	6
0.0625-0.25	24
0.25-0.50	10
0.50-1.0	22
1.0-2.0	8
Plucking Void	**7**
>2.0	7
Void	**25**
>2.0	6
0.0625-0.25	4
0.25-0.50	5
0.50-1.0	5
1.0-2.0	5
Grand Total	**237**

Row Labels	Count of Type
Crushed Rock	**85**
Biotite	1
Flourite	1
Hornblende	1
Microcline	13
Orthoclase	20
Perthite	12
Plagioclase	12
Quartz	25
Mineral	**69**
Microcline	2
Muscovite	1
Opaque	4
Orthoclase	31
Orthopyroxene	1
Perthite	2
Plagioclase	3
Quartz	25
Void	**25**
Chamber	6
Channel	4
Complex packing	1
Plane	12
Simple Packing Void	2
Grand Total	**179**

Simmons Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	81
Matrix	63
Mineral	82
Plucking Void	5
Void	39
Grand Total	**270**

Row Labels	Count of Rock Type #1
Crushed Rock	**81**
Grit	**81**
Low Sphercity	81
Angular	6
Very Angular	75
Matrix	**1**
Silt	**1**
High Sphercity	1
Well Rounded	1
Mineral	**82**
Grit	**66**
Low Sphercity	66
Angular	55
Sub-angular	1
Very Angular	10
Sand	**16**
High Sphercity	2
Rounded	2
Low Sphercity	14
Rounded	14
Grand Total	**164**

Row Labels	Count of Type
Crushed Rock	**81**
>2.0	65
0.50-1.0	6
1.0-2.0	10
Matrix	**63**
<0.0625	63
Mineral	**82**
>2.0	10
0.0625-0.25	25
0.25-0.50	19
0.50-1.0	15
1.0-2.0	13
Plucking Void	**5**
>2.0	4
1.0-2.0	1
Void	**39**
>2.0	22
0.25-0.50	2
0.50-1.0	10
1.0-2.0	5
Grand Total	**270**

Row Labels	Count of Type
Crushed Rock	**81**
Microcline	7
Orthoclase	26
Orthopyroxene	1
Perthite	10
Plagioclase	17
Quartz	20
Matrix	**1**
Quartz	1
Mineral	**82**
Biotite	1
Chlorite	1
Microcline	3
Opaque	4
Orthoclase	28
Perthite	6
Plagioclase	3
Quartz	36
Void	**39**
Chamber	9
Plane	30
Grand Total	**203**

Simmons Vessel 1 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	60
Matrix	88
Mineral	89
Void	27
Grand Total	**264**

Row Labels	Count of Rock Type #1
Crushed Rock	**60**
Grit	**60**
Low Sphercity	60
Angular	4
Very Angular	56
Matrix	**2**
Silt	**2**
High Sphercity	2
Well Rounded	2
Mineral	**89**
Grit	**72**
High Sphercity	1
Angular	1
Low Sphercity	71
Angular	65
Very Angular	6
Sand	**17**
High Sphercity	7
Rounded	5
Well Rounded	2
Low Sphercity	10
Rounded	9
Well Rounded	1
Grand Total	**151**

Row Labels	Count of Type
Crushed Rock	**60**
>2.0	43
0.50-1.0	10
1.0-2.0	7
Matrix	**88**
<0.0625	88
Mineral	**89**
>2.0	5
0.0625-0.25	37
0.0625-025	1
0.25-0.50	26
0.50-1.0	18
1.0-2.0	2
Void	**27**
>2.0	17
0.25-0.50	3
0.50-1.0	4
1.0-2.0	3
Grand Total	**264**

Row Labels	Count of Type
Crushed Rock	**60**
Hornblende	1
Microcline	4
Myrmekite	1
Opaque	5
Ortho	1
Orthoclase	28
Orthopyroxene	1
Perthite	9
Plagioclase	3
Quartz	7
Matrix	**2**
Orthoclase	1
Quartz	1
Mineral	**89**
Biotite	1
Hornblende	1
Muscovite	2
Opaque	5
Orthoclase	54
Perthite	7
Plagioclase	3
Quartz	16
Void	**27**
Channel	1
Plane	25
Vughe	1
Grand Total	**178**

Sinking Ponds Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	100
Matrix	56
Mineral	41
Plucking Void	3
Void	21
Grand Total	**221**

Row Labels	Count of Rock Type #1
Crushed Rock	**98**
Grit	**98**
Low Sphercity	98
Angular	7
Very Angular	91
Mineral	**41**
Grit	**29**
Low Sphercity	29
Angular	24
Very Angular	5
Sand	**12**
High Sphercity	2
Rounded	2
Low Sphercity	10
Rounded	8
Sub-rounded	1
Well Rounded	1
Grand Total	**139**

Row Labels	Count of Type
Crushed Rock	**100**
>2.0	77
0.50-1.0	7
1.0-2.0	16
Matrix	**56**
<0.0625	56
Mineral	**41**
>2.0	4
0.0625-0.25	10
0.25-0.50	20
0.50-1.0	1
1.0-2.0	6
Plucking Void	**3**
>2.0	3
Void	**21**
>2.0	2
0.0625-0.25	7
0.25-0.50	5
0.50-1.0	4
1.0-2.0	3
Grand Total	**221**

Row Labels	Count of Type
Crushed Rock	**100**
Clinopyroxene	3
Microcline	11
Orthoclase	18
Perthite	22
Plagioclase	39
Quartz	7
Mineral	**41**
Clinopyroxene	1
Microcline	1
Opaque	4
Orthoclase	15
Perthite	4
Plagioclase	6
Quartz	10
Void	**21**
Channel	3
Complex packing void	1
Plane	7
Simple packing void	1
Vughe	9
Grand Total	**162**

Sinking Ponds Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	109
Matrix	72
Mineral	83
Plucking Void	1
Void	43
Grand Total	**308**

Row Labels	Count of Rock Type #1
Crushed Rock	**109**
Grit	**109**
Low Sphercity	109
Very Angular	109
Mineral	**83**
Grit	**57**
Low Sphercity	57
Angular	47
Sub-angular	2
Very Angular	8
Sand	**26**
High Sphercity	9
Rounded	8
Well Rounded	1
Low Sphercity	17
Rounded	14
Sub-rounded	1
Well Rounded	2
Grand Total	**192**

Row Labels	Count of Type
Crushed Rock	**109**
>2.0	99
0.50-1.0	6
1.0-2.0	4
Matrix	**72**
<0.0625	72
Mineral	**83**
>2.0	5
0.0625-0.25	39
0.25-0.50	19
0.50-1.0	13
1.0-2.0	7
Plucking Void	**1**
>2.0	1
Void	**43**
<0.0625	4
>2.0	9
0.0625-0.25	9
0.25-0.50	10
0.50-1.0	7
1.0-2.0	4
Grand Total	**308**

Row Labels	Count of Type
Crushed Rock	**109**
Clinopyroxene	2
Microcline	12
Opaque	2
Orthoclase	20
Perthite	24
Plagioclase	40
Quartz	9
Mineral	**83**
Amphibole	1
Clinopyroxene	1
Microcline	1
Muscovite	2
Opaque	9
Orthoclase	34
Perthite	3
Plagioclase	5
Quartz	27
Void	**43**
Chamber	4
Channel	1
Void	3
Plane	22
Simple Packing Void	6
Vughe	7
Grand Total	**235**

Sinking Ponds Vessel 2 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	106
Matrix	87
Mineral	84
Plucking Void	3
Sed Rock	4
Void	31
Grand Total	**315**

Row Labels	Count of Rock Type #1
Crushed Rock	**106**
Grit	**106**
Low Sphercity	106
Angular	10
Very Angular	96
Mineral	**84**
Grit	**55**
Low Sphercity	55
Angular	42
Sub-angular	7
Very Angular	6
Sand	**29**
High Sphercity	9
Rounded	7
Sub-rounded	1
Well Rounded	1
Low Sphercity	20
Rounded	16
Sub-rounded	3
Well Rounded	1
Sed Rock	**4**
Grit	**2**
Low Sphercity	2
Sub-angular	1
Very Angular	1
Sand	**2**
Low Sphercity	2
Rounded	2
Grand Total	**194**

Row Labels	Count of Type
Crushed Rock	**106**
>2.0	90
0.25-0.50	1
0.50-1.0	7
1.0-2.0	8
Matrix	**87**
<0.0625	87
Mineral	**84**
>2.0	7
0.0625-0.25	31
0.25-0.50	29
0.50-1.0	11
1.0-2.0	6
Plucking Void	**3**
>2.0	3
Sed Rock	**4**
>2.0	1
0.50-1.0	1
1.0-2.0	2
Void	**31**
<0.0625	5
>2.0	7
0.0625-0.25	4
0.25-0.50	5
0.50-1.0	8
1.0-2.0	1
Plane	1
Grand Total	**315**

Row Labels	Count of Type
Crushed Rock	**106**
Microcline	16
Myrmekite	9
Opaque	3
Orthoclase	30
Perthite	3
Plagioclase	38
Quartz	7
Mineral	**84**
Amphibole	4
Clinopyroxene	1
Microcline	4
Muscovite	3
Myrmekite	1
Opaque	5
Orthoclase	27
Orthopyroxene	1
Perthite	2
Plagioclase	19
Quartz	17
Sed Rock	**4**
Opaque	2
Quartz	2
Void	**31**
>2.0	1
Chamber	5
Complex Packing Void	1
Plane	12
Simple Packing	6
Vughe	6
Grand Total	**225**

Sinking Ponds Vessel 2 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	105
Matrix	46
Mineral	66
Plucking Void	1
Sed Rock	5
Void	25
Grand Total	**248**

Row Labels	Count of Rock Type #1
Crushed Rock	**105**
Grit	**105**
Low Sphercity	105
Angular	1
Very Angular	104
Mineral	**66**
Grit	**46**
High Sphercity	1
Angular	1
Low Sphercity	45
Angular	37
Sub-angular	1
Very Angular	7
Sand	**20**
High Sphercity	5
Rounded	4
Well Rounded	1
Low Sphercity	15
Rounded	13
Sub-rounded	2
Sed Rock	**5**
Grit	**5**
Low Sphercity	5
Angular	2
Sub-angular	1
Very Angular	2
Grand Total	**176**

Row Labels	Count of Type
Crushed Rock	**105**
>2.0	94
0.50-1.0	4
1.0-2.0	7
Matrix	**46**
<0.0625	46
Mineral	**66**
>2.0	6
0.0625-0.25	26
0.25-0.50	24
0.50-1.0	7
1.0-2.0	3
Plucking Void	**1**
>2.0	1
Sed Rock	**5**
>2.0	5
Void	**25**
<0.0625	4
>2.0	13
0.0625-0.25	4
0.50-1.0	3
1.0-2.0	1
Grand Total	**248**

Row Labels	Count of Type
Crushed Rock	**105**
Biotite	1
Clinopyroxene	1
Microcline	16
Myrmekite	2
Opaque	2
Orthoclase	29
Perthite	13
Plagioclase	31
Quartz	10
Mineral	**66**
Amphibole	2
Hornblende	1
Microcline	4
Muscovite	3
Opaque	8
Orthoclase	18
Perthite	2
Plagioclase	9
Quartz	18
Spinel	1
Sed Rock	**5**
Opaque	1
Orthoclase	3
Quartz	1
Void	**25**
Chamber	1
Plane	13
Simple Packing Void	5
Vughe	6
Grand Total	**201**

Sinking Ponds Vessel 2 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	77
Matrix	83
Mineral	25
Plucking Void	3
Void	32
Grand Total	**220**

Row Labels	Count of Rock Type #1
Crushed Rock	**77**
Grit	**77**
Low Sphercity	77
Angular	3
Very Angular	74
Mineral	**25**
Grit	**19**
Low Sphercity	19
Angular	15
Sub-angular	1
Very Angular	3
Sand	**6**
High Sphercity	3
Rounded	1
Well Rounded	2
Low Sphercity	3
Rounded	3
Grand Total	**102**

Row Labels	Count of Type
Crushed Rock	**77**
>2.0	68
0.50-1.0	5
1.0-2.0	4
Matrix	**83**
<0.0625	83
Mineral	**25**
>2.0	1
0.0625-0.25	5
0.25-0.50	12
0.50-1.0	6
1.0-2.0	1
Plucking Void	**3**
>2.0	3
Void	**32**
<0.0625	2
>2.0	8
0.0625-0.25	3
0.25-0.50	8
0.50-1.0	5
1.0-2.0	6
Grand Total	**220**

Row Labels	Count of Type
Crushed Rock	**77**
Amphibole	4
Biotite	1
Chlorite	2
Clinopyroxene	11
Hornblende	2
Myrmekite	1
Opaque	11
Orthoclase	7
Orthopyroxene	4
Perthite	1
Plagioclase	31
Quartz	2
Matrix	**83**
(blank)	83
Mineral	**25**
Amphibole	1
Biotite	1
Clinopyroxene	5
Muscovite	1
Opaque	3
Orthoclase	4
Orthopyroxene	1
Plagioclase	3
Quartz	6
Plucking Void	**3**
(blank)	3
Void	**32**
Chamber	6
Channel	1
Plane	18
Simple Packing Void	2
Vughe	5
Grand Total	**220**

Sinking Ponds Vessel 2 Body Sherd 4

Row Labels	Count of Type
Crushed Rock	70
Matrix	75
Mineral	69
Plucking Void	1
Sed Rock	2
Void	25
Grand Total	**242**

Row Labels	Count of Rock Type #1
Crushed Rock	**70**
Grit	**70**
Low Sphercity	70
Angular	7
Very Angular	63
Mineral	**69**
Grit	**52**
Low Sphercity	52
Angular	40
Sub-angular	3
Very Angular	9
Sand	**17**
High Sphercity	4
Rounded	2
Sub-rounded	1
Well Rounded	1
Low Sphercity	13
Rounded	8
Sub-rounded	3
Well Rounded	2
Sed Rock	**2**
Grit	**2**
Low Sphercity	2
Angular	2
Grand Total	**141**

Row Labels	Count of Type
Crushed Rock	**70**
>2.0	63
0.25-0.50	1
0.50-1.0	2
1.0-2.0	4
Matrix	**75**
<0.0625	75
Mineral	**69**
>2.0	5
0.0625-0.25	23
0.25-0.50	29
0.50-1.0	6
1.0-2.0	6
Plucking Void	**1**
0.50-1.0	1
Sed Rock	**2**
>2.0	2
Void	**25**
<0.0625	3
>2.0	5
0.0625-0.25	9
0.25-0.50	4
0.50-1.0	2
1.0-2.0	2
Grand Total	**242**

Row Labels	Count of Type
Crushed Rock	**70**
Amphibole	1
Clinopyroxene	2
Microcline	3
Orthoclase	14
Perthite	5
Plagioclase	45
Mineral	**69**
Chlorite	1
Clinopyroxene	1
Hornblende	2
Microcline	1
Muscovite	2
Opaque	6
Orthoclase	26
Perthite	11
Plagioclase	10
Quartz	8
Spinel	1
Sed Rock	**2**
Opaque	1
Orthoclase	1
Void	**25**
Chamber	1
Channel	1
Compound Packing Void	4
Plane	12
Simple packing void	1
Vughe	6
Grand Total	**166**

Vine Valley Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	36
Grog	2
Matrix	62
Mineral	77
Plucking Void	2
Void	33
Grand Total	**212**

Row Labels	Count of Rock Type #1
Crushed Rock	**35**
Grit	**35**
High Sphercity	1
Very Angular	1
Low Sphercity	34
Angular	2
Very Angular	32
Grog	**2**
Grit	**2**
Low Sphercity	2
Angular	2
Matrix	**4**
Silt	**4**
High Sphercity	4
Rounded	2
Well Rounded	2
Mineral	**77**
Grit	**48**
Low Sphercity	48
Angular	36
Sub-angular	2
Very Angular	10
Sand	**29**
High Sphercity	8
Rounded	5
Sub-rounded	1
Well Rounded	2
Low Sphercity	21
Rounded	19
Sub-rounded	1
Well Rounded	1
Grand Total	**118**

Row Labels	Count of Type
Crushed Rock	**36**
>2.0	23
0.25-0.50	1
0.50-1.0	6
1.0-2.0	6
Grog	**2**
>2.0	1
0.25-0.50	1
Matrix	**62**
<0.0625	62
Mineral	**77**
>2.0	7
0.0625-0.25	41
0.25-0.50	11
0.50-1.0	11
1.0-2.0	7
Plucking Void	**2**
>2.0	2
Void	**33**
>2.0	18
0.0625-0.25	6
0.25-0.50	3
0.50-1.0	2
1.0-2.0	4
Grand Total	**212**

Row Labels	Count of Type
Crushed Rock	**36**
Biotite	1
Microcline	1
Myrmekite	2
Opaque	4
Orthoclase	9
Perthite	2
Plagioclase	5
Quartz	12
Grog	**2**
Opaque	2
Matrix	**4**
Opaque	1
Orthoclase	2
Quartz	1
Mineral	**77**
Biotite	4
Hornblende	1
Muscovite	1
Opaque	8
Orthoclase	38
Perthite	5
Plagioclase	1
Quartz	19
Void	**33**
Channel	3
Plane	26
Simple packing void	3
Vughe	1
Grand Total	**152**

Vine Valley Vessel 2 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	43
Grog	4
Matrix	45
Mineral	90
Void	22
Grand Total	**204**

Row Labels	Count of Rock Type #1
Crushed Rock	**43**
Grit	**43**
Low Sphercity	43
Angular	8
Very Angular	35
Grog	**4**
Grit	**4**
High Sphercity	1
Angular	1
Low Sphercity	3
Angular	1
Sub-angular	1
Very Angular	1
Mineral	**90**
Grit	**63**
High Sphercity	1
Angular	1
Low Sphercity	62
Angular	45
Sub-angular	3
Very Angular	14
Sand	**27**
High Sphercity	7
Rounded	4
Well Rounded	3
Low Sphercity	20
Rounded	19
Sub-rounded	1
Grand Total	**137**

Row Labels	Count of Type
Crushed Rock	**43**
>2.0	30
0.50-1.0	6
1.0-2.0	7
Grog	**4**
0.25-0.50	1
0.50-1.0	2
1.0-2.0	1
Matrix	**45**
<0.0625	45
Mineral	**90**
>2.0	8
0.0625-0.25	42
0.0625--0.25	1
0.0625-5-0.25	1
0.25-0.50	16
0.50-1.0	15
1.0-2.0	7
Void	**22**
>2.0	9
0.0625-0.25	6
0.25-0.50	2
0.50-1.0	1
1.0-2.0	4
Grand Total	**204**

Row Labels	Count of Type
Crushed Rock	**43**
Amphibole	1
Biotite	1
Chlorite	2
Clinopyroxene	1
Hornblende	1
Opaque	1
Orthoclase	10
Perthite	5
Plagioclase	11
Quartz	10
Grog	**4**
Opaque	4
Mineral	**90**
Amphibole	1
Hornblende	1
Muscovite	2
Myrmekite	1
Opaque	6
Orthoclase	39
Perthite	5
Plagioclase	3
Quartz	32
Void	**22**
Chamber	1
Channel	2
Plane	15
Simple Packing Void	1
Vughe	3
Grand Total	**159**

Vine Valley Vessel 2 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	51
Matrix	81
Mineral	74
Plucking Void	7
Void	28
Grand Total	**241**

Row Labels	Count of Rock Type #1
Crushed Rock	**51**
Grit	**51**
Low Sphercity	51
Very Angular	51
Mineral	**74**
Grit	**56**
Low Sphercity	56
Angular	41
Very Angular	15
Sand	**18**
High Sphercity	5
Rounded	2
Well Rounded	3
Low Sphercity	13
Rounded	13
Grand Total	**125**

Row Labels	Count of Type
Crushed Rock	**51**
>2.0	50
1.0-2.0	1
Matrix	**81**
<0.0625	81
Mineral	**74**
>2.0	17
0.0625-0.25	30
0.25-0.50	12
0.50-1.0	9
1.0-2.0	6
Plucking Void	**7**
>2.0	5
1.0-2.0	2
Void	**28**
>2.0	15
0.0625-0.25	1
0.25-0.50	2
0.50-1.0	7
1.0-2.0	3
Grand Total	**241**

Row Labels	Count of Type
Crushed Rock	**51**
Amphibole	1
Chlorite	1
Microcline	1
Opaque	1
Orthoclase	10
Perthite	20
Plagioclase	11
Quartz	6
Mineral	**74**
Microcline	2
Muscovite	1
Opaque	1
Orthoclase	36
Perthite	2
Plagioclase	7
Quartz	25
Void	**28**
Plane	25
Vughe	3
Grand Total	**153**

Vine Valley Vessel 3 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	44
Grog	9
Matrix	79
Mineral	134
Plucking Void	7
Void	52
Grand Total	**325**

Row Labels	Count of Rock Type #1
Crushed Rock	**44**
Grit	**44**
Low Sphercity	44
Very Angular	44
Grog	**9**
Grit	**9**
Low Sphercity	9
Angular	5
Very Angular	4
Matrix	**3**
Silt	**3**
High Sphercity	3
Well Rounded	3
Mineral	**134**
Grit	**82**
Low Sphercity	82
Angular	67
Sub-angular	3
Very Angular	12
Sand	**50**
High Sphercity	11
Rounded	7
Well Rounded	4
Low Sphercity	39
Rounded	36
Sub-rounded	1
Well Rounded	2
Snad	**2**
High Sphercity	1
Rounded	1
Low Sphercity	1
Rounded	1
Grand Total	**190**

Row Labels	Count of Type
Crushed Rock	**44**
>2.0	42
0.50-1.0	1
1.0-2.0	1
Grog	**9**
>2.0	5
0.50-1.0	1
1.0-2.0	3
Matrix	**79**
<0.06225	1
<0.0625	78
Mineral	**134**
>2.0	5
0.0625-0.25	44
0.25-0.50	36
0.50-1.0	35
1.0-2.0	14
Plucking Void	**7**
>2.0	7
Void	**52**
>2.0	23
0.0625-0.25	8
0.250.50	1
0.25-0.50	8
0.50-1.0	6
1.0-2.0	6
Grand Total	**325**

Row Labels	Count of Type
Crushed Rock	**44**
Hornblende	1
Microcline	2
Opaque	3
Orthoclase	7
Perthite	23
Plagioclase	4
Quartz	4
Grog	**9**
Opaque	9
Matrix	**3**
Opaque	1
Quartz	2
Mineral	**134**
Amphibole	1
Hornblende	1
Muscovite	1
Opaque	6
Orthoclase	74
Perthite	9
Plagioclase	5
Quartz	37
Void	**52**
Chamber	2
Channel	4
Plane	41
Simple packing void	4
Vughe	1
Grand Total	**242**

Vine Valley Vessel 1 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	52
Matrix	68
Mineral	92
Void	33
Grand Total	**245**

Row Labels	Count of Rock Type #1
Crushed Rock	**52**
Grit	**52**
Low Sphercity	52
Very Angular	52
Matrix	**1**
Silt	**1**
High Sphercity	1
Well Rounded	1
Mineral	**92**
Grit	**61**
High Sphercity	1
Angular	1
Low Sphercity	60
Angular	40
Very Angular	20
Sand	**31**
High Sphercity	5
Rounded	4
Well Rounded	1
Low Sphercity	26
Rounded	26
Grand Total	**145**

Row Labels	Count of Type
Crushed Rock	**52**
>2.0	51
0.50-1.0	1
Matrix	**68**
<0.0625	68
Mineral	**92**
>2.0	22
0.0625-0.25	29
0.25-0.50	20
0.50-1.0	15
1.0-2.0	6
Void	**33**
>2.0	19
0.0625-0.25	2
0.25-0.50	2
0.50-1.0	3
1.0-2.0	7
Grand Total	**245**

Row Labels	Count of Type
Crushed Rock	**52**
Clinopyroxene	1
Microcline	4
Opaque	3
Orthoclase	3
Orthopyroxene	1
Perthite	7
Plagioclase	32
Quartz	1
Matrix	**1**
Opaque	1
Mineral	**92**
Calcite	1
Chlorite	1
Muscovite	3
Opaque	5
Orthoclase	44
Perthite	4
Plagioclase	24
Quartz	10
Void	**33**
Chamber	9
Channel	1
Plane	21
Simple packing void	1
Vughe	1
Grand Total	**178**

Vine Valley Vessel 1 Body Sherd 2

Row Labels	Count of Type
Crushed Rock	88
Matrix	93
Mineral	69
Plucking Void	4
Void	38
Grand Total	**292**

Row Labels	Count of Rock Type #1
Crushed Rock	**88**
Grit	**88**
Low Sphercity	88
Angular	1
Very Angular	87
Matrix	**1**
Silt	**1**
High Sphercity	1
Well Rounded	1
Mineral	**69**
Grit	**50**
Low Sphercity	50
Angular	26
Very Angular	24
Sand	**19**
High Sphercity	2
Rounded	1
Well Rounded	1
Low Sphercity	17
Rounded	17
Grand Total	**158**

Row Labels	Count of Type
Crushed Rock	**88**
>2.0	86
1.0-2.0	2
Matrix	**93**
<0.0625	93
Mineral	**69**
>2.0	20
0.0625-0.25	16
0.25-0.50	11
0.50-1.0	14
1.0-2.0	8
Plucking Void	**4**
>2.0	4
Void	**38**
>2.0	23
0.0625-0.25	3
0.25-0.50	2
0.50-1.0	7
1.0-2.0	3
Grand Total	**292**

Row Labels	Count of Type
Crushed Rock	**88**
Biotite	1
Clinopyroxene	1
Microcline	9
Opaque	1
Orthoclase	18
Perthite	18
Plagioclase	39
Quartz	1
Matrix	**1**
Opaque	1
Mineral	**69**
Microcline	4
Muscovite	2
Opaque	5
Orthoclase	38
Perthite	3
Plagioclase	11
Quartz	6
Void	**38**
Chamber	4
Channel	2
Plane	30
Simple packing void	2
Grand Total	**196**

Vine Valley Vessel 1 Body Sherd 3

Row Labels	Count of Type
Crushed Rock	79
Matrix	100
Mineral	67
Plucking Void	10
Void	49
Grand Total	**305**

Row Labels	Count of Rock Type #1
Crushed Rock	**79**
Grit	**79**
Low Sphercity	79
Angular	2
Very Angular	77
Matrix	**1**
Silt	**1**
High Sphercity	1
Rounded	1
Mineral	**67**
Grit	**43**
Low Sphercity	43
Angular	34
Very Angular	9
Sand	**24**
High Sphercity	7
Rounded	3
Well Rounded	4
Low Sphercity	17
Rounded	15
Well Rounded	2
Grand Total	**147**

Row Labels	Count of Type
Crushed Rock	**79**
>2.0	77
0.50-1.0	1
1.0-2.0	1
Matrix	**100**
<0.0625	99
<0.625	1
Mineral	**67**
>2.0	17
0.0625-0.25	14
0.25-0.50	14
0.50-1.0	16
1.0-2.0	6
Plucking Void	**10**
>2.0	10
Void	**49**
>2.0	32
0.0625-0.25	3
0.25-0.50	3
0.50-1.0	3
1.0-2.0	8
Grand Total	**305**

Row Labels	Count of Type
Crushed Rock	**79**
Microcline	5
Orthoclase	5
Perthite	20
Plagioclase	49
Matrix	**1**
Orthoclase	1
Mineral	**67**
Hornblende	2
Microcline	3
Muscovite	2
Opaque	7
Orthoclase	21
Orthopyroxene	2
Perthite	5
Plagioclase	17
Quartz	8
Void	**49**
Chamber	3
Channel	5
Plane	38
Simple packing void	3
Grand Total	**196**

Wickham Vessel 1 Body Sherd 1

Object	Count of Type
Crushed Rock	21
Grog	4
Matrix	102
Mineral	81
Plucking Void	8
Void	36
Grand Total	**252**

Object	Count of Rock Type #1
Crushed Rock	**21**
Grit	**21**
Low Sphercity	21
Very Angular	21
Grog	**4**
Grit	**4**
High Sphercity	1
Sub-angular	1
Low Sphercity	3
Angular	1
Very Angular	2
Mineral	**81**
Grit	**61**
Low Sphercity	61
Angular	49
Very Angular	12
Sand	**20**
High Sphercity	12
Rounded	6
Well Rounded	6
Low Sphercity	8
Rounded	4
sub-rounded	3
Well Rounded	1
Grand Total	**106**

Object	Count of Type
Crushed Rock	**21**
>2.0	18
0.50-1.0	1
1.0-2.0	2
Grog	**4**
>2.0	2
0.50-1.0	2
Matrix	**102**
<0.0625	102
Mineral	**81**
>2.0	11
0.0625-0.25	42
0.25-0.50	13
0.50-1.0	10
1.0-2.0	5
Plucking Void	**8**
>2.0	7
1.0-2.0	1
Void	**36**
>2.0	24
0.25-0.50	3
0.50-1.0	6
1.0-2.0	3
Grand Total	**252**

Object	Count of Type
Crushed Rock	**21**
Muscovite	1
Opaque	1
Orthoclase	7
Orthopyroxene	1
Perthite	5
Plagioclase	2
Quartz	4
Grog	**4**
Opaque	4
Mineral	**81**
Biotite	2
Hornblende	1
Muscovite	3
Opaque	1
Orthoclase	19
Perthite	7
Plagioclase	3
Quartz	45
Void	**36**
Chamber	1
Channel	6
Plane	28
Vugh	1
Grand Total	**142**

Wickham Vessel 2 Body Sherd 1

Row Labels	Count of Type
Crushed Rock	84
Grog	1
Matrix	62
Mineral	86
Plucking Void	4
Void	47
Grand Total	**284**

Row Labels	Count of Rock Type
Crushed Rock	**84**
Grit	**84**
Low Sphercity	84
Angular	5
Very Angular	79
Grog	**1**
Grit	**1**
Low Sphercity	1
Very Angular	1
Matrix	**3**
Silt	**3**
High Sphercity	1
Well Rounded	1
Low Sphercity	2
Angular	1
Well Rounded	1
Mineral	**86**
Grit	**70**
Low Sphercity	70
Angular	57
Very Angular	13
Sand	**16**
High Sphercity	9
Rounded	8
Sub-rounded	1
Low Sphercity	7
Rounded	7
Grand Total	**174**

Row Labels	Count of Type
Crushed Rock	**84**
>2.0	71
0.50-1.0	6
1.0-2.0	7
Grog	**1**
>2.0	1
Matrix	**62**
<0.0625	62
Mineral	**86**
>2.0	12
0.06250.25	1
0.0625-0.25	29
0.25-0.50	10
0.50-1.0	31
1.0-2.0	3
Plucking Void	**4**
>2.0	4
Void	**47**
>2.0	17
0.0625-0.25	6
0.25-0.50	8
0.50-1.0	14
1.0-.0	1
1.0-2.0	1
Grand Total	**284**

Row Labels	Count of Type
Crushed Rock	**84**
Biotite	4
Hornblende	2
Microcline	1
Myrmekite	4
Opaque	5
Orthoclase	25
Perthite	14
Plagioclase	12
Quartz	17
Grog	**1**
Opaque	1
Matrix	**3**
Opaque	3
Mineral	**86**
Biotite	4
Hornblende	2
Microcline	2
Opaque	7
Orthoclase	40
Orthopyroxene	1
Perthite	5
Plagioclase	5
Quartz	19
Wollastinite	1
Void	**47**
Channel	2
Plane	38
Simple packing voids	4
Vughe	3
Grand Total	**221**

APPENDIX C: DATA SHEETS FOR RECOUNTS ON SELECTED CRUSHED ROCK

Blue Jay Ridge Vessel 1 Body Sherd 1

Row Labels	Count of Object
Myrmekite	**11**
>2.0	11
Opaque	**8**
0.50-1.0	4
1.0-2.0	4
Orthoclase	**4**
1.0-2.0	4
Perthite	**58**
>2.0	58
Plagioclase	**3**
0.25-0.50	1
0.50-1.0	2
Quartz	**16**
>2.0	15
0.25-0.50	1
Grand Total	**100**

Broken Clock Vessel 1 Body Sherd 2

Row Labels	Count of Object
Hornblende	**4**
0.50-1.0	2
1.0-2.0	2
Opaque	**1**
0.0625-0.25	1
Orthoclase	**29**
>2.0	1
0.0625-0.25	5
0.25-0.50	5
0.50-1.0	6
1.0-2.0	12
Perthite	**9**
0.25-0.50	4
1.0-2.0	5
Plagioclase	**30**
>2.0	27
0.25-0.50	2
0.50-1.0	1
Quartz	**27**
0.0625-0.25	6
0.25-0.50	5
0.50-1.0	10
1.0-2.0	6
Grand Total	**100**

Broken Clock Vessel 2 Body Sherd 1 Crushed Rock Recount

Row Labels	Count of Object
Amphibole	**1**
0.0625-0.25	1
Biotite	**22**
>2.0	22
Clinopyroxene	**24**
>2.0	21
0.25-0.50	1
0.50-1.0	2
Opaque	**15**
0.0625-0.25	6
0.25-0.50	3
0.50-1.0	4
1.0-2.0	2
Orthoclase	**1**
0.25-0.50	1
Perthite	**12**
>2.0	10
0.25-0.50	1
1.0-2.0	1
Plagioclase	**2**
0.0625-0.25	1
0.25-0.50	1
Quartz	**1**
0.25-0.50	1
Staurolite	**22**
>2.0	19
0.0625-0.25	1
0.50-1.0	2
Grand Total	**100**

Broken Clock Vessel 4 Body Sherd 1

Row Labels	Count of Object
Amphibole	**3**
1.0-2.0	3
Microcline	**10**
0.0625-0.25	1
0.25-0.50	1
0.50-1.0	6
1.0-2.0	2
Orthoclase	**12**
0.0625-0.25	1
0.25-0.50	6
0.50-1.0	2
1.0-2.0	3
Perthite	**52**
>2.0	43
0.50-1.0	2
1.0-2.0	7
Plagioclase	**1**
0.25-0.50	1
Quartz	**18**
0.0625-0.25	2
0.25-0.50	4
0.50-1.0	1
1.0-2.0	11
Sercite	**4**
0.50-1.0	4
Grand Total	**100**

Broken Clock Vessel 4 Body Sherd 2

Row Labels	Count of Object
Biotite	**6**
0.25-0.50	1
1.0-2.0	5
Clinopyroxene	**1**
0.25-0.50	1
Microcline	**8**
0.25-0.50	1
0.50-1.0	4
1.0-2.0	3
Muscovite	**10**
0.0625-0.25	1
0.50-1.0	5
1.0-2.0	4
Opaque	**6**
>2.0	1
0.0625-0.25	3
1.0-2.0	2
Orthoclase	**11**
0.25-0.50	8
0.50-1.0	3
Perthite	**13**
>2.0	1
0.50-1.0	1
1.0-2.0	11
Plagioclase	**19**
>2.0	13
0.25-0.50	5
1.0-2.0	1
Quartz	**11**
0.0625-0.25	1
0.25-0.50	1
1.0-2.0	9
Staurolite	**15**
>2.0	14
0.50-1.0	1
Grand Total	**100**

Blue Jay Ridge Vessel 1 Body Sherd 1

Row Labels	Count of Object
Amphibole	**36**
1.0-2.0	36
Biotite	**2**
1.0-2.0	2
Calcite	**6**
1.0-2.0	6
Microcline	**2**
0.50-1.0	2
Opaque	**12**
>2.0	3
0.25-0.50	7
0.50-1.0	1
1.0-2.0	1
Orthoclase	**12**
>2.0	1
0.50-1.0	3
1.0-2.0	8
Perthite	**30**
>2.0	28
0.50-1.0	2
Plagioclase	**107**
>2.0	48
0.25-0.50	4
0.50-1.0	3
1.0-2.0	52
Grand Total	**207**

Row Labels	Count of Object
Opaque	**4**
0.0625-0.25	1
0.50-1.0	3
Orthoclase	**2**
0.25-0.50	2
Perthite	**74**
>2.0	69
1.0-2.0	5
Plagioclase	**19**
>2.0	13
1.0-2.0	6
Quartz	**1**
0.25-0.50	1
Grand Total	**100**

Blue Jay Ridge Vessel 1 Body Sherd 3

Row Labels	Count of Object
Microcline	**4**
0.25-0.50	1
1.0-2.0	3
Orthoclase	**11**
>2.0	2
0.25-0.50	1
0.50-1.0	3
1.0-2.0	5
Perthite	**75**
>2.0	71
1.0-2.0	4
Plagioclase	**8**
>2.0	5
0.0625-0.25	1
0.50-1.0	2
Quartz	**1**
0.25-0.50	1
Sercite	**1**
0.25-0.50	1
Grand Total	**100**

Mouth of Cataragus Creek Vessel 1 Body Sherd 1

Row Labels	Sum of Object
augite	1
biotite	1
chlorite	5
clinopyroxene	1
hornblende	12
microcline	1
Myrmekite	5
Opaque	16
Orthoclase	22
orthopyroxene	1
perthite	25
Plagioclase	6
quartz	54
Grand Total	**150**

Cottage Vessel 1 Body Sherd 1

Row Labels	Count of Object
>2.0	**33**
Perthite	23
Quartz	10
0.0625-0.25	**7**
Microcline	1
Orthoclase	3
Quartz	3
0.25-0.50	**30**
Microcline	1
Orthoclase	19
Perthite	3
Quartz	7
0.50-1.0	**11**
Microcline	3
Orthoclase	5
Quartz	3
1.0-2.0	**19**
Orthoclase	8
Perthite	3
Quartz	8
Grand Total	**100**

Egli Vessel 1 Body Sherd 1

Row Labels	Count of Object
Amphibole	**9**
>2.0	6
0.50-1.0	1
1.0-2.0	2
Biotite	**8**
0.0625-0.25	1
0.25-0.50	1
0.50-1.0	6
Chlorite	**11**
0.0625-0.25	4
0.25-0.50	4
1.0-2.0	3
Hornblende	**21**
>2.0	5
0.25-0.50	5
0.50-1.0	8
1.0-2.0	3
Microcline	**4**
>2.0	4
Opaque	**8**
0.0625-0.25	1
0.25-0.50	2
0.50-1.0	4
1.0-2.0	1
Orthoclase	**6**
0.25-0.50	4
0.50-1.0	2
Perthite	**6**
>2.0	1
0.50-1.0	2
1.0-2.0	3
Plagioclase	**25**
>2.0	13
0.25-0.50	4
0.50-1.0	5
1.0-2.0	3
Quartz	**1**
0.0625-0.25	1
Spinel	**1**
0.0625-0.25	1
Grand Total	**100**

Ferguson Vessel 1 Body Sherd 1

Object	(All)

Row Labels	Count of Number
Amphibole	**4**
0.25-0.50	4
Biotite	**1**
0.25-0.50	1
Clinopyroxene	**12**
>2.0	11
0.0625-0.25	1
Muscovite	**5**
0.0625-0.25	1
0.25-0.50	4
Opaque	**2**
0.0625-0.25	2
Orthoclase	**36**
0.0625-0.25	5
0.25-0.50	7
0.50-1.0	4
1.0-2.0	20
Plagioclase	**10**
0.0625-0.25	1
0.25-0.50	4
0.50-1.0	5
Quartz	**30**
>2.0	22
0.0625-0.25	2
0.25-0.50	3
0.50-1.0	3
Grand Total	**100**

Felix Vessel 1 Body Sherd 1

Row Labels	Count of Object
Opaque	**1**
0.0625-0.25	1
Perthite	**90**
>2.0	90
Quartz	**4**
0.0625-0.25	1
0.25-0.50	1
0.50-1.0	2
Sercite	**5**
0.25-0.50	4
0.50-1.0	1
Grand Total	**100**

Gardepe Vessel 1 Body Sherd 1

Row Labels	Count of Object
Biotite	**2**
0.0625-0.25	1
0.25-0.50	1
Hornblende	**2**
0.0625-0.25	1
0.25-0.50	1
Muscovite	**9**
0.0625-0.25	5
0.25-0.50	2
0.50-1.0	2
Opaque	**8**
>2.0	1
0.25-0.50	1
0.50-1.0	3
1.0-2.0	3
Orthoclase	**26**
0.0625-0.25	6
0.25-0.50	10
0.50-1.0	10
Perthite	**10**
1.0-2.0	10
Plagioclase	**2**
0.50-1.0	2
Quartz	**41**
>2.0	20
0.0625-0.25	4
0.25-0.50	12
0.50-1.0	5
Grand Total	**100**

MacCauley Complex #4 Vessel 1 Body Sherd 1

Row Labels	Count of Object
Epidote	**2**
0.25-0.50	2
Microcline	**4**
0.25-0.50	2
0.50-1.0	2
Opaque	**4**
>2.0	2
0.25-0.50	1
0.50-1.0	1
Orthoclase	**25**
>2.0	21
0.25-0.50	1
1.0-2.0	3
Perthite	**23**
>2.0	23
Plagioclase	**44**
>2.0	39
0.25-0.50	2
0.50-1.0	3
Quartz	**10**
>2.0	7
0.0625-0.25	2
0.50-1.0	1
Grand Total	**112**

MacCauley Complex #4 Vessel 1 Body Sherd 2

Row Labels	Count of Object
Amphibole	**2**
0.0625-0.25	2
Muscovite	**5**
0.0625-0.25	1
0.25-0.50	4
Opaque	**6**
0.0625-0.25	3
0.25-0.50	3
Orthoclase	**61**
>2.0	43
0.0625-0.25	5
0.25-0.50	10
0.50-1.0	3
Perthite	**5**
>2.0	4
0.0625-0.25	1
Plagioclase	**16**
>2.0	14
0.25-0.50	1
0.50-1.0	1
Quartz	**11**
0.0625-0.25	3
0.25-0.50	8
Sercite	**1**
0.0625-0.25	1
Grand Total	**107**

MacCauley Complex #4 Vessel 1 Body Sherd 3

Row Labels	Count of Object
Biotite	**10**
>2.0	7
0.25-0.50	2
0.50-1.0	1
Chlorite	**1**
0.0625-0.25	1
Myrmekite	**9**
0.25-0.50	1
0.25-0.51	1
0.50-1.0	3
1.0-2.0	4
Opaque	**6**
0.25-0.50	3
0.50-1.0	3
Orthoclase	**32**
>2.0	19
0.25-0.50	4
0.50-1.0	2
1.0-2.0	7
Perthite	**37**
>2.0	31
0.50-1.0	5
1.0-2.0	1
Quartz	**5**
0.25-0.50	3
0.50-1.0	2
Grand Total	**100**

MacCauley Complex #4 Vessel 2 Body Sherd 1

Row Labels	Count of Object
Amphibole	**1**
0.25-0.50	1
Clinopyroxene	**2**
0.50-1.0	2
Epidote	**27**
>2.0	27
Opaque	**11**
>2.0	2
0.25-0.50	3
0.50-1.0	6
Orthoclase	**13**
0.0625-0.25	2
0.50-1.0	11
Plagioclase	**46**
>2.0	31
0.0625-0.25	2
0.25-0.50	5
0.50-1.0	8
Grand Total	**100**

MacCauley Complex #4 Vessel 2 Body

Row Labels	Count of Object
Microcline	**28**
>2.0	10
0.25-0.50	2
0.50-1.0	7
1.0-2.0	9
Orthoclase	**20**
>2.0	17
1.0-2.0	3
Perthite	**42**
>2.0	34
0.0625-0.25	1
0.25-0.50	2
1.0-2.0	5
Plagioclase	**9**
0.0625-0.25	1
0.25-0.50	3
0.50-1.0	5
Quartz	**1**
0.25-0.50	1
Grand Total	**100**

MacCauley Complex #4 Vessel 2 Body Sherd 3

Row Labels	Count of Object
Amphibole	**2**
0.25-0.50	2
Biotite	**9**
>2.0	1
0.0625-0.25	2
0.50-1.0	3
1.0-2.0	3
Epidote	**1**
0.25-0.50	1
Hornblende	**3**
0.50-1.0	3
Muscovite	**1**
0.25-0.50	1
Opaque	**9**
0.0625-0.25	4
0.25-0.50	4
0.50-1.0	1
Orthoclase	**47**
0.0625-0.25	8
0.25-0.50	18
0.50-1.0	6
1.0-2.0	15
Perthite	**8**
>2.0	8
Quartz	**18**
>2.0	13
0.25-0.50	1
1.0-2.0	4
Sercite	**2**
0.0625-0.25	2
Grand Total	**100**

MacCauley Complex #4 Vessel 3 Body Sherd 1

Row Labels	Count of Object
Biotite	**15**
>2.0	8
0.25-0.50	1
0.50-1.0	2
1.0-2.0	4
Clinopyroxene	**2**
0.50-1.0	2
Opaque	**3**
0.0625-0.25	1
1.0-2.0	2
Orthoclase	**33**
0.0625-0.25	3
0.25-0.50	11
0.50-1.0	14
1.0-2.0	5
Perthite	**11**
0.0625-0.25	1
0.25-0.50	4
0.50-1.0	6
Plagioclase	**13**
>2.0	9
0.50-1.0	4
Quartz	**23**
>2.0	9
0.0625-0.25	3
0.25-0.50	4
0.50-1.0	7
Grand Total	**100**

MacCauley Complex #4 Vessel 4 Body Sherd 1

Row Labels	Count of Object
Opaque	**5**
0.0625-0.25	3
0.25-0.50	2
Orthoclase	**20**
0.0625-0.25	3
0.25-0.50	5
0.50-1.0	7
1.0-2.0	5
Plagioclase	**68**
>2.0	68
Quartz	**7**
0.0625-0.25	3
0.25-0.50	4
Grand Total	**100**

MacCauley Complex #4 Vessel 4 Body Sherd 2

Row Labels	Count of Object
Orthoclase	**4**
0.50-1.0	4
Plagioclase	**96**
>2.0	96
Grand Total	**100**

MacCauley Complex #4 Vessel 4 Body Sherd 3

Row Labels	Count of Object
Microcline	**4**
>2.0	3
0.25-0.50	1
Orthoclase	**21**
>2.0	16
0.0625-0.25	4
0.25-0.50	1
Plagioclase	**75**
>2.0	72
0.50-1.0	3
Grand Total	**100**

MacCauley Complex #4 Vessel 5 Body Sherd 1

Mineral Type	Count of Object
Amphibole	**21**
>2.0	8
0.50-1.0	1
1.0-2.0	12
Biotite	**3**
0.25-0.50	3
Clinopyroxene	**46**
>2.0	40
0.25-0.50	1
0.50-1.0	5
Opaque	**4**
0.0625-0.25	3
0.25-0.50	1
Orthoclase	**2**
0.25-0.50	2
Plagioclase	**18**
>2.0	7
0.25-0.50	6
0.50-1.0	5
Quartz	**6**
0.25-0.50	2
0.50-1.0	4
Grand Total	**100**

MacCauley Complex #4 Vessel 5 Body Sherd 2

Row Labels	Count of Object
Microcline	**11**
>2.0	10
0.50-1.0	1
Perthite	**11**
>2.0	11
Plagioclase	**78**
>2.0	74
0.25-0.50	2
0.50-1.0	2
Grand Total	**100**

MacCauley Complex #5 Vessel 1 Body Sherd 4

Row Labels	Count of Object
Amphibole	**2**
>2.0	1
0.25-0.50	1
Clinopyroxene	**13**
>2.0	3
0.0625-0.25	3
0.25-0.50	7
Microcline	**27**
>2.0	27
Opaque	**12**
>2.0	8
0.25-0.50	2
1.0-2.0	2
Orthoclase	**21**
>2.0	19
0.0625-0.25	2
Perthite	**11**
>2.0	11
Plagioclase	**14**
>2.0	9
0.0625-0.25	1
0.25-0.50	1
0.50-1.0	3
Grand Total	**100**

MacCauley Complex #6 Vessel 1 Body Sherd 1

Row Labels	Count of Object
Clinopyroxene	**1**
0.0625-0.25	1
Microcline	**30**
>2.0	21
0.50-1.0	9
Orthoclase	**2**
0.0625-0.25	1
0.25-0.50	1
Plagioclase	**67**
>2.0	62
0.25-0.50	2
1.0-2.0	3
Grand Total	**100**

MacCauley Complex #6 Vessel 1 Body Sherd 2

Row Labels	Count of Object
Opaque	**3**
0.0625-0.25	1
0.25-0.50	2
Orthoclase	**17**
>2.0	16
0.25-0.50	1
Plagioclase	**80**
>2.0	72
0.25-0.50	6
0.50-1.0	2
Grand Total	**100**

MacCauley Complex #7 Vessel 1 Body Sherd 1

Row Labels	Count of Object
Opaque	**1**
0.0625-0.25	1
Orthoclase	**17**
>2.0	11
0.0625-0.25	2
0.50-1.0	2
1.0-2.0	2
Perthite	**25**
>2.0	24
0.0625-0.25	1
Plagioclase	**49**
>2.0	43
0.50-1.0	2
1.0-2.0	4
Quartz	**2**
0.0625-0.25	1
0.25-0.50	1
Sercite	**6**
>2.0	1
0.0625-0.25	1
0.25-0.50	2
0.50-1.0	1
1.0-2.0	1
Grand Total	**100**

MacCauley Complex #8 Vessel 1 Body Sherd 2

Row Labels	Count of Object
Orthoclase	**31**
>2.0	7
0.0625-0.25	10
0.25-0.50	5
0.50-1.0	9
Orthopyroxene	**1**
0.0625-0.25	1
Perthite	**22**
>2.0	19
1.0-2.0	3
Plagioclase	**43**
>2.0	30
0.0625-0.25	3
0.50-1.0	4
1.0-2.0	6
Quartz	**3**
0.0625-0.25	1
0.50-1.0	2
Grand Total	**100**

McKendry Vessel 1 Body Sherd 1

Row Labels	Count of Object
Amphibole	**6**
>2.0	1
0.0625-0.25	2
0.50-1.0	3
Chlorite	**2**
0.0625-0.25	2
Clinopyroxene	**4**
0.0625-0.25	2
0.25-0.50	1
0.50-1.0	1
Microcline	**7**
0.0625-0.25	2
0.25-0.50	4
0.50-1.0	1
Opaque	**1**
0.0625-0.25	1
Orthoclase	**18**
0.0625-0.25	3
0.25-0.50	8
0.50-1.0	7
Perthite	**3**
0.0625-0.25	1
0.25-0.50	2
Plagioclase	**27**
>2.0	1
0.0625-0.25	3
0.25-0.50	20
0.50-1.0	2
1.0-2.0	1
Quartz	**32**
>2.0	9
0.0625-0.25	7
0.25-0.50	11
0.50-1.0	4
1.0-2.0	1
Grand Total	**100**

McKendry Vessel 4 Body Sherd 1

Row Labels	Count of Object
Microcline	**34**
>2.0	28
0.50-1.0	4
1.0-2.0	2
Opaque	**5**
0.0625-0.25	1
0.25-0.50	4
Orthoclase	**21**
>2.0	13
0.0625-0.25	1
0.25-0.50	3
0.50-1.0	3
1.0-2.0	1
Perthite	**31**
>2.0	28
0.25-0.50	3
Plagioclase	**8**
0.25-0.50	3
0.50-1.0	1
1.0-2.0	4
Quartz	**1**
0.25-0.50	1
Grand Total	**100**

Renaissance House Vessel 1 Body Sherd 1

Row Labels	Count of Object
Microcline	2
Opaque	1
Orthoclase	31
Plagioclase	44
Quartz	22
Grand Total	**100**

Renassiance House Vessel 1 Body Sherd 2

Row Labels	Count of Object
Microcline	**6**
0.25-0.50	5
0.50-1.0	1
Opaque	**6**
0.0625-0.25	1
0.25-0.50	2
0.50-1.0	3
Orthoclase	**37**
0.0625-0.25	14
0.25-0.50	17
0.50-1.0	3
1.0-2.0	3
Perthite	**8**
0.0625-0.25	2
0.25-0.50	3
0.50-1.0	3
Plagioclase	**25**
0.0625-0.25	3
0.25-0.50	13
0.50-1.0	3
1.0-2.0	6
Quartz	**17**
0.0625-0.25	5
0.25-0.50	4
0.50-1.0	8
Grand Total	**99**

Riverhaven No. 2 Vessel 1 Body Sherd 1

Row Labels	Count of Object
Microcline	**2**
1.0-2.0	2
Orthoclase	**3**
0.0625-0.25	1
0.25-0.50	1
1.0-2.0	1
Perthite	**34**
>2.0	32
0.25-0.50	2
Plagioclase	**59**
>2.0	51
0.50-1.0	3
1.0-2.0	5
Quartz	**2**
0.0625-0.25	1
0.50-1.0	1
Grand Total	**100**

Riverhaven No. 2 Vessel 2 Body Sherd 1

Row Labels	Count of Object
Clinopyroxene	**44**
>2.0	38
0.0625-0.25	1
0.25-0.50	2
0.50-1.0	1
1.0-2.0	2
Opaque	**2**
0.25-0.50	2
Orthoclase	**12**
>2.0	5
0.0625-0.25	2
0.25-0.50	1
0.50-1.0	4
Plagioclase	**40**
>2.0	33
0.25-0.50	1
0.50-1.0	6
Quartz	**2**
0.25-0.50	2
Grand Total	**100**

Riverhaven No. 2 Vessel 2 Body Sherd 2

Row Labels	Count of Object
Amphibole	**10**
0.0625-0.25	4
0.25-0.50	1
1.0-2.0	5
Biotite	**1**
0.25-0.50	1
Clinopyroxene	**29**
>2.0	21
0.0625-0.25	5
0.25-0.50	3
Hornblende	**3**
>2.0	3
Opaque	**3**
0.0625-0.25	2
0.50-1.0	1
Orthoclase	**24**
>2.0	4
0.0625-0.25	2
0.25-0.50	4
0.50-1.0	10
1.0-2.0	4
Perthite	**22**
>2.0	18
0.25-0.50	1
1.0-2.0	3
Plagioclase	**8**
0.0625-0.25	1
0.25-0.50	2
0.50-1.0	2
1.0-2.0	3
Grand Total	**100**

Riverhaven No. 2 Vessel 3 Body Sherd 2

Row Labels	Count of Object
Microcline	**23**
>2.0	17
0.50-1.0	3
1.0-2.0	3
Opaque	**1**
0.25-0.50	1
Orthoclase	**29**
>2.0	13
0.0625-0.25	6
0.25-0.50	1
0.50-1.0	2
1.0-2.0	7
Perthite	**23**
>2.0	23
Plagioclase	**24**
>2.0	11
0.0625-0.25	3
0.50-1.0	3
1.0-2.0	7
Grand Total	**100**

Saint Bonaventure Vessel 1 Body Sherd 2

Row Labels	Count of Object
Amphibole	**1**
0.25-0.50	1
Microcline	**7**
0.0625-0.25	1
0.25-0.50	4
0.50-1.0	1
1.0-2.0	1
Muscovite	**3**
0.0625-0.25	2
0.25-0.50	1
Opaque	**9**
>2.0	4
0.0625-0.25	1
0.25-0.50	1
0.50-1.0	2
1.0-2.0	1
Orthoclase	**4**
0.0625-0.25	1
0.25-0.50	1
1.0-2.0	2
Perthite	**61**
>2.0	61
Plagioclase	**4**
0.25-0.50	3
0.50-1.0	1
Quartz	**10**
0.25-0.50	4
0.50-1.0	1
1.0-2.0	5
Staurolite	**1**
0.25-0.50	1
Grand Total	**100**

Scaccia Vessel 1 Body Sherd 2

Row Labels	Count of Object
Biotite	15
microcline	3
Myrmekite	31
Opaque	4
Orthoclase	16
Perthite	22
Plagioclase	59
Quartz	1
Sercite	2
Grand Total	**153**

Scaccia Vessel 2 Body Sherd 2

Row Labels	Count of Object
Microcline	**1**
1.0-2.0	1
Myrmekite	**2**
>2.0	1
0.25-0.50	1
Opaque	**4**
0.0625-0.25	2
0.25-0.50	1
1.0-2.0	1
Orthoclase	**76**
>2.0	62
0.25-0.50	3
0.50-1.0	2
1.0-2.0	9
Perthite	**4**
>2.0	4
Plagioclase	**2**
0.0625-0.25	2
Quartz	**11**
0.0625-0.25	6
0.25-0.50	3
0.50-1.0	2
Grand Total	**100**

Simmons Vessel 1 Body Sherd 1

Row Labels	Count of Object
Clinopyroxene	**1**
0.0625-0.25	1
Microcline	**9**
0.0625-0.25	1
0.25-0.50	8
Orthoclase	**22**
0.0625-0.25	18
0.25-0.50	3
1.0-2.0	1
Perthite	**31**
>2.0	20
0.0625-0.25	2
0.25-0.50	3
0.50-1.0	6
Plagioclase	**32**
>2.0	25
0.0625-0.25	6
0.25-0.50	1
Quartz	**5**
0.0625-0.25	4
0.25-0.50	1
Grand Total	**100**

Simmons Vessel 1 Body Sherd 2

Row Labels	Count of Object
Biotite	**1**
0.25-0.50	1
Microcline	**20**
>2.0	15
0.0625-0.25	4
0.50-1.0	1
Opaque	**11**
0.0625-0.25	4
0.50-1.0	5
1.0-2.0	2
Orthoclase	**17**
0.0625-0.25	5
0.25-0.50	5
0.50-1.0	7
Perthite	**22**
>2.0	17
1.0-2.0	5
Plagioclase	**26**
>2.0	16
0.0625-0.25	2
0.25-0.50	1
0.50-1.0	3
1.0-2.0	4
Quartz	**3**
0.0625-0.25	3
Grand Total	**100**

Simmons Vessel 1 Body Sherd 3

Row Labels	Count of Object
Hornblende	**6**
0.0625-0.25	1
0.50-1.0	5
Myrmekite	**15**
1.0-2.0	15
Opaque	**1**
0.0625-0.25	1
Orthoclase	**23**
0.0625-0.25	8
0.25-0.50	15
Perthite	**45**
>2.0	38
0.25-0.50	2
1.0-2.0	5
Quartz	**10**
0.0625-0.25	4
0.25-0.50	3
1.0-2.0	3
Grand Total	**100**

Sinking Ponds Vessel 1 Body Sherd 1

Row Labels	Count of Object
Channel	**3**
Interconnected	3
Clinopyroxene	**4**
Grit	4
Complex packing void	**1**
Interconnected	1
Microcline	**12**
Grit	12
Opaque	**4**
Sand	4
Orthoclase	**33**
Grit	27
Sand	6
Perthite	**26**
Grit	26
Plagioclase	**45**
Grit	45
Plane	**7**
Interconnected	7
Quartz	**17**
Grit	15
Sand	2
Simple packing void	**1**
Interconnected	1
Vughe	**9**
Interconnected	6
Isolated	3
Grand Total	**162**

Vine Valley Vessel 1 Body Sherd 1

Row Labels	Count of Object
Biotite	**6**
0.0625-0.25	2
0.25-0.50	1
0.50-1.0	1
1.0-2.0	2
Microcline	**31**
>2.0	29
0.0625-0.25	2
Myrmekite	**1**
0.25-0.50	1
Opaque	**1**
0.0625-0.25	1
Orthoclase	**26**
0.0625-0.25	4
0.25-0.50	14
0.50-1.0	8
Perthite	**12**
>2.0	9
0.25-0.50	3
Plagioclase	**4**
0.50-1.0	4
Quartz	**19**
0.0625-0.25	11
0.25-0.50	4
1.0-2.0	4
Grand Total	**100**

Vine Valley Vessel 2 Body Sherd 1

Row Labels	Count of Object
Biotite	**33**
>2.0	7
0.0625-0.25	6
0.25-0.50	9
0.50-1.0	4
1.0-2.0	7
Microcline	**1**
0.25-0.50	1
Myrmekite	**6**
0.25-0.50	3
1.0-2.0	3
Opaque	**3**
0.0625-0.25	3
Orthoclase	**12**
0.0625-0.25	3
0.25-0.50	4
0.50-1.0	4
1.0-2.0	1
Perthite	**45**
>2.0	9
0.25-0.50	8
0.50-1.0	1
1.0-2.0	27
Grand Total	**100**

Vine Valley Vessel 2 Body Sherd 2

Row Labels	Count of Object
Opaque	**2**
0.0625-0.25	1
0.25-0.50	1
Perthite	**60**
>2.0	60
Plagioclase	**37**
>2.0	37
Quartz	**1**
0.0625-0.25	1
Grand Total	**100**

Vine Valley Vessel 3 Body Sherd 1

Row Labels	Count of Object
Biotite	**4**
0.0625-0.25	3
0.25-0.50	1
Hornblende	**2**
0.25-0.50	1
0.50-1.0	1
Microcline	**3**
>2.0	3
Opaque	**6**
>2.0	2
0.0625-0.25	3
0.50-1.0	1
Orthoclase	**52**
>2.0	21
0.0625-0.225	1
0.0625-0.25	4
0.25-0.50	8
0.50-1.0	9
1.0-2.0	9
Perthite	**9**
>2.0	9
Plagioclase	**20**
>2.0	5
0.25-0.50	7
0.50-1.0	3
1.0-2.0	5
Quartz	**4**
>2.0	1
0.0625-0.25	1
0.25-0.50	1
0.50-1.0	1
Grand Total	**100**

Vine Valley Vessel 1 Body Sherd 1

Row Labels	Count of Object
Amphibole	**2**
0.50-1.0	2
Microcline	**1**
0.25-0.50	1
Opaque	**4**
>2.0	4
Orthoclase	**13**
>2.0	11
1.0-2.0	2
Perthite	**13**
>2.0	13
Plagioclase	**67**
>2.0	61
1.0-2.0	6
Grand Total	**100**

Vine Valley Vessel 1 Body Sherd 2

Row Labels	Count of Object
Microcline	**18**
>2.0	17
1.0-2.0	1
Muscovite	**1**
0.0625-0.25	1
Orthoclase	**4**
0.0625-0.25	1
1.0-2.0	3
Plagioclase	**60**
>2.0	58
0.0625-0.25	1
1.0-2.0	1
Quartz	**17**
>2.0	15
0.0625-0.25	2
Grand Total	**100**

Vine Valley Vessel 1 Body Sherd 3

Row Labels	Count of Object
Microcline	**9**
>2.0	8
0.50-1.0	1
Orthoclase	**59**
>2.0	36
0.0625-0.25	4
0.25-0.50	4
0.50-1.0	10
1.0-2.0	5
Plagioclase	**28**
>2.0	17
0.25-0.50	1
0.50-1.0	4
1.0-2.0	6
Quartz	**4**
0.0625-0.25	2
0.50-1.0	2
Grand Total	**100**

Wickham Vessel 1 Body Sherd 1

Row Labels	Count of Object
Hornblende	**3**
0.25-0.50	3
Microcline	**5**
0.50-1.0	5
Orthoclase	**3**
0.25-0.50	3
Perthite	**33**
>2.0	30
0.50-1.0	3
Plagioclase	**29**
>2.0	23
0.0625-0.25	3
0.50-1.0	3
Quartz	**27**
>2.0	20
1.0-2.0	7
Grand Total	**100**

Wickham Vessel 2 Body Sherd 1

Row Labels	Count of Object
Biotite	**6**
>2.0	1
0.25-0.50	2
0.50-1.0	3
Hornblende	**1**
0.0625-0.25	1
Microcline	**5**
0.25-0.50	3
0.50-1.0	2
Opaque	**5**
>2.0	5
Orthoclase	**7**
0.0625-0.25	1
0.25-0.50	5
0.50-1.0	1
Perthite	**34**
>2.0	30
0.50-1.0	4
Plagioclase	**5**
>2.0	1
0.25-0.50	1
0.50-1.0	3
Quartz	**37**
>2.0	36
0.25-0.50	1
Grand Total	**100**

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