Summer 8-14-2020

Identity in the Late Woodland Northeast: interpreting communities of practice from paste composition at the Thomas/Luckey and the Losey 3 sites

Douglas S. Riethmuller
Binghamton University--SUNY, driethmuller@gmail.com

IDENTITY IN THE LATE WOODLAND NORTHEAST: INTERPRETING COMMUNITIES OF PRACTICE FROM PASTE COMPOSITION AT THE THOMAS/LUCKEY AND THE LOSEY 3 SITES

BY

DOUGLAS S. RIETHMULLER

BS, Mercyhurst University, 2015

THESIS

Submitted in partial fulfillment of the requirements for
the degree of Master of Arts in Anthropology
in the Graduate School of
Binghamton University
State University of New York
2020

Accepted in partial fulfillment of the requirements for
the degree of Master of Arts in Anthropology
in the Graduate School of
Binghamton University
State University of New York
2020

July 25, 2020

Nina M. Versaggi, Faculty Advisor
Department of Anthropology, Binghamton University

Laurie E. Miroff, Reader
Department of Anthropology, Binghamton University

Abstract

Thomas/Luckey's 13th -15th and Losey 3's 14th-17th century occupations in the Late Woodland Northeast contain assemblages with incongruous regional pottery types; Kelso Corded and an assumed non-local Shenks Ferry.

I argue the presence of Shenks Ferry vessels at these two sites indicates the movement of people who reproduced their natal designs upon arrival, rather than trade. The question of whether identity and communities of practice can be discerned from pottery decorations and paste was answered by analyzing sherds with pXRF.

While pottery types are based on visual attributes, pXRF looks at elemental composition. Decoration is mimicable, but paste is not; paste accurately illustrates a vessel's origin. Cultural groups are not static entities, and internal development or outgroup interaction indicates change. Communities of practice recreate themselves in a new environment and in relation to others. The results of this analysis add new depth to conceptions of group movement and identity construction.

For my family and for the potters who made the vessels that I studied.

Acknowledgements

As research does not occur in a vacuum, there are a great many people who helped produce this work. I thank them all for their time, talents, materials, knowledge, and patience. Dr. Tim De Smet provided many good articles and helped with out-of-the-box thinking. Dr. Jeff Pietras and Josh Novello guided me through the pXRF, Geology Department and processing the data. Dr. Claire Horne, Sam Kudrle, and all of the Public Archaeology Facility staff for insight and the loan of equipment for getting clay and for the storage of artifacts. I would like to thank Dan Rhodes and his efforts and knowledge to get clay. Tim Knapp and Binghamton University's field school of days past deserve a special thanks, because without them, this thesis and the artifacts would not here. The highest level of thanks that I can give goes to my committee. Dr. Nina Versaggi deserves thanks for her tireless aid in making me a better archaeologist. I appreciate your wisdom, direction, and guidance and hope I have absorbed some of it. I especially thank Dr. Laurie Miroff for her insights into not only Thomas/Luckey itself, but her wealth of knowledge of pottery and Northeastern precontact archaeology. I thank Dr. BrieAnna Langlie for use of the Laboratory of Ancient Food and Farming facilities, and guidance when I needed it. I thank Sam Bourcy for his edits, perspective, and willingness to share some coffee. I thank my cohort in the Binghamton University Class of 2020 for distractions, stress relief, camaraderie, and constructive comments. My thanks go out to members of the State Museum of Pennsylvania; Jim Herbstritt, and Janet Johnson for helping along the Pennsylvania side of the border and providing access and aid for the collection of the Losey 3 artifacts. I thank the many members of Skelly and Loy, Inc.; the field crews for excavating the site and Thomas East and Chris Espenshade for their work in heading the report preparation. I would like to thank Lisa Anderson of the New York State Museum for her help with the pXRF when I needed it most. Additionally, Scott Shaffer deserves thanks for supplying a copy of the consultation video and final artifact catalogs from Skelly. I thank Mara for making me a better writer, despite my best attempts to the contrary. Finally, my family deserves thanks for everything, without whom I would not be where I am.

Table of Contents

List of Tables

List of Figures

List of Photos

CHAPTER 1. INTRODUCTION

The Late Woodland period (AD 900-1550) in the Northeastern United States represents a time of community and identity formation. Groups established small dispersed villages within defined regions and later formed larger more central villages with related surrounding communities (Knapp 2009; Miroff 2002; Prezzano 1992; Ritchie and Funk 1973; Snow 1996). Pottery decorations became more diverse and refined during this period, illustrating possible expressions of identity. While pottery was decorated before the Late Woodland his change is evidenced by more stylized decorations found over a broad area (Engelbrecht 1971; Lucy 1959; MacNeish 1952; Niemczycki 1984; Rieth 1997; Ritchie and MacNeish 1949).

Pottery is one of the best artifactual markers for understanding the similarities and differences between groups, as the designs are thought to be indicative of potters decorating vessels to show a shared group identity (Custer 1987; Engelbrecht 1971; Rice 2015; Skibo 2013). Late Woodland sites often are assumed to have been occupied by a homogenous group sharing a singular cultural identity as interpreted from their artifact assemblage, which includes pottery created and decorated in similar ways. Sites with multiple identity markers offer challenges for interpreting the presence of “foreign” or extra-local artifact types in Late Woodland communities. This is especially true for understanding the possible identities of each group and proposing anthropological interpretations for why such communities with mixed markers formed.

For my research, I addressed the research question of whether identity and communities of practice can be discerned from pottery decorations and paste. I have selected two sites to examine, as they both possess clay vessels thought by archaeologists to be from distinctly different regional groups. The sites include Thomas/Luckey, located in the Chemung River Valley of New York, and Losey 3 within the Tioga River Valley of Pennsylvania. Both sites contain Shenks Ferry and Kelso Corded pottery. Shenks Ferry is assumed to be non-local at each site. While Shenks Ferry does occur almost exclusively in Pennsylvania, and Kelso Corded almost exclusively in New York, the Losey 3 site is far north from the assumed heartland of the Shenks Ferry and awfully close to the New York state line. These state boundaries are modern constructions, and not based on landscape features and thus would have had no bearing on the Indigenous occupants of the time.

The Thomas/Luckey site (SUBi-888) is located north of the Chemung River in what is now Chemung County, New York (Figure 1). The village was occupied between the 13th and 15th centuries AD as determined from multiple radiometric dates (Knapp 1996:218; Miroff 2002:183). Archaeologists recovered pottery with decorations representing different regional types, including Kelso Corded and Oak Hill Corded from the New York pottery series, and non-local sherds classified as Shenks Ferry within the Pennsylvania series (Knapp 1996, 2009; Miroff 1997, 2002).

Figure 1. Thomas/Luckey and Losey 3 general site locations.

The Losey 3 site (36Ti0028) is located near the present town of Lawrenceville in Tioga County, Pennsylvania (Figure 1). The site's chronology (cal AD 1300-1640) is akin to Thomas/Luckey(Dorland 2018; East et al. 2006c; Espenshade 2014). Researchers classified pottery as Shenks Ferry and Kelso Corded following excavations prior to a roadway improvement project (East et al. 2006a; Espenshade 2006).

Broadly speaking, there is usually a dominant type of decorated pottery on Late Woodland sites leading archaeologists to assume that the site was occupied by one group sharing a single tradition of pottery decoration. When vessels are found that are visually different from the dominant type, the explanation for their presence is either movement of people carrying the pots with them, or trade. Trade would presumably not have been for the vessels themselves, but whatever the vessels may have held. Since the Shenks Ferry vessels are far from their heartland in central Pennsylvania, researchers have argued that their presence at Thomas/Luckey and Losey 3 can be explained by trade/exchange or migration, either through the movement of small groups of people or through the exchange of marriage partners. Previous studies have generally considered foreign pottery to be an example of direct or indirect trade, and therefore an economic interaction, across a wide distance (Kuhn 1986; Rieth 1997, 2002).The non-local pottery is assumed to be the result of production and decoration at a distant site that is then traded in its finished state. These arguments have been challenged by researchers illustrating that what were previously thought to be examples of extra-local production are actually vessels produced from similar clay indicating that two distinct types of decoration are being created alongside one another (Kuhn 1986; Rieth 1997, 2002; Rieth et al. 2007). If vessels with different decorations are created from the same clay this more strongly supports the movement of people bringing the decoration method and technique to their new community and not the trade of finished vessels.

In this thesis, I propose to test these two alternate arguments for the Thomas/Luckey and Losey 3 sites. While typological separations are based on visible characteristics only, the composition of ceramic paste can more accurately indicate the vessel's region of origin. Decorations can be copied, but paste cannot. Both sites contain different pottery[1] styles in the same temporal and physical contexts, which indicates that the vessels were deposited contemporaneously.

---

[1] . For geographic reference "Northeast, Pennsylvania, New York will be used throughout this thesis to broadly describe the region in question that Native Americans would have inhabited at that time. I recognize that this is not how they may have conceived of the area, but the terms are used in the modern context in which we live and will be used here for ease of reference. Additionally, "pottery" and "precontact or prehistoric ceramics" will be used interchangeably as well.

I frame this study within the context of communities of practice. I recognize that there is not a one-to-one connection of designs on pots to groups of people. The notion of "pots as people" has often been replaced by more nuanced understandings of how people created and decorated pots, such as through shared teaching lineages (e.g., Braun 1991; Sanger 2017). Communities of practice, as introduced by Lave and Wenger (1991), is more suitable to understanding the people at the sites than thinking of them purely as distinct groups. However, it is difficult to separate the individual potter from the pot. Pots are made by individuals and these individuals are guided by their social norms, intentions, and their training. There is at least an association between potters and their work, despite it not being a perfect one-to-one correlation. Potters make choices throughout production: choices of form, temper, construction technique, firing, decoration, and pertinent to this research, paste. In addition to the context of communities of practice, I will use the methodological *chaîne opératoire* to aid in interpretations of how pots were created in the past (Roux 2016; Sellet 1993). This method allows an analysis not only of the choices made by the potter at each stage of the creation of a vessel, but also the restrictions placed on those choices by those who instructed the potter, i.e., their community of practice. Studies of pottery production that look beyond the similarity of surficial decoration and examine chemical compositions of vessel paste give researchers a better understanding of where these vessels were produced and particular preferences for clay selection. In turn, this will give archaeologists a better understanding of how different identities are constructed and maintained within Late Woodland communities within the Northeast.

Research Objectives

In the following, I present a detailed study of paste composition and its implications for precontact ceramic vessel origins at Thomas/Luckey in the Chemung Valley, New York and Losey 3 in Lawrenceville, Pennsylvania. The first objective is to determine if Shenks Ferry vessels at the two sites are examples of trade or the movement of people. The analysis of paste composition of ceramics gives a more accurate view of their place of creation than inferring point of origin from ceramic types or expected regional distributions. Designs on vessels can be reproduced or copied, but the chance of independent invention is extremely low especially given the proximity of these communities. Reproduction of identity after an interregional movement is important to maintain connections between the new arrivals and their natal communities and traditions. To collect data to address this objective, I analyzed the chemical composition of the pottery from the two sites using portable X-ray Fluorescence (pXRF) to determine whether different sources of clay were used for pots with different decorations, or if the same clay was used.

For the second research objective I discuss the interconnectivity of groups in the precontact Northeast, and how decorations exemplify the communities of practice that tie the maker into larger networks of people. Additionally, this research discusses the construction of identity in shared occupational settings. Understanding this interconnectivity will help researchers to better understand pathways for interaction and movements of people and ideas within a region.

Finally, I examine existing types and their assumed regional provenience and argue that regional production models do not always capture the true nature of the origin of ceramic production. While necessary at some level for mutual understanding, types can become unwieldy and problematic if adopted too strictly. These types help archaeologists understand trade and exchange, movements and migration, and how the landscape was occupied prior to European contact. Shenks Ferry, Kelso Corded, and Oak Hill Corded vessels are assumed to be manufactured in different regions, though this assumption has been challenged in other studies (Kuhn 1986; Rieth 1997; Wright 2019). Ideally, this assumption should be tested at all sites leading to more informed interpretations of trade and migration at sub-regional levels. Types are traditionally based on surficial characteristics and become very engrained in the archaeological literature and communication. These groupings, and what they encapsulate can become difficult to replace and change. Types coupled with analyst bias can create many methodological problems (See Hart and Brumbach 2003; Knapp 2009; Miroff 2002). Shenks Ferry and Kelso Corded, while visually distinct, do share similarities, and this has led to possible complications during analysis. The modern state borders may artificially bias both the identification and assignation of vessels into extant types.

The nature of pottery's additive construction and decorative process best suits it for informing all three research objectives. The source(s) of clay for vessel paste and the decorations on pots speak to the decisions people made during the construction process. Characterizing potential pathways for interconnections is important for understanding the relationships between and among regional communities.

Organization of Thesis

Throughout this introductory chapter, I have provided an overview of the existing context of relevant precontact pottery types in New York and Pennsylvania. Additionally, I have provided a discussion of the research objectives guiding this thesis, particularly related to analysis of paste characteristics, the creation and reproduction of identity, and the interconnections between regions.

In Chapter Two I will present the theoretical concepts that guide data collection and analysis and provide the context for understanding the implications of the results for this research. This chapter will discuss concepts related to the study's research objectives, particularly communities of practice, the formation of identity in relation to pottery production, *chaîne opératoire,* and the influence of interactions between communities.

In Chapter Three I will describe the regional context for the Thomas/Luckey and Losey 3 sites. This context includes: a brief description of each site, regional culture history, and a timeline of the pertinent ceramic types present. Prior evidence of networks and movements of people will be introduced here as well.

I document the archaeological contexts for the two sites in Chapter Four. Details will be provided on the excavations at the Losey 3 and Thomas/Luckey sites, as well as previous research based on these investigations.

In Chapter Five I will discuss the methods used to collect the data needed to address the research objectives of this thesis. I will cover the selection of the pottery, the preparation for testing, the testing parameters, and the methodology. I will also describe the equipment used to collect data from sherds. Finally, I will discuss the statistics necessary to interpret the data.

I will present the results of the elemental analysis of the sherds in Chapter Six, presented in several formats. Also included will be the statistical validation of the data using *k*-means analysis.

In Chapter Seven I discuss the implications of the elemental signature analysis and attempt to tie in ideas of cultural affiliation/presentation, networks of practice, and identity construction. The physical avenues that may have been utilized to transport the pots or clay and people will be discussed as to their feasibility. I will place the data in the broader theoretical, temporal, and environmental contexts within which each site exists.

I present the conclusions of this research in Chapter Eight, and how my research contributes to existing models and the archaeology of New York and Pennsylvania. Finally, I offer avenues for future research.

CHAPTER 2. THEORETICAL ORIENTATION

Central to this thesis is understanding identity and how identities are maintained when individuals or groups move to different communities. Communities of practice best encapsulates the changing and multiplicity of communities within which an individual participates. To foster a community of practice is to observe it, know it, and understand it. While archeological studies of identity have taken many different forms in the past, this thesis focuses primarily on how identity is created, not in relation to oneself, but in relation to other out-group members. Identity is dependent on the producer and the consumer. Both must have an idea of what is being communicated and the ability to recognize the identity that a design or symbol conveys (Nieuwenhuyse 2017).

The people who lived within the Thomas/Luckey and Losey 3 communities expressed multiple identities as seen in distinct pottery decorations at each site. These distinctions could be the result of multiple potters choosing different decoration styles within villages, or they could be the work of an individual or several related individuals who moved into a new village from outside. Additionally, differently decorated vessels could be the result of trade, be it from the introduction of foreign vessels or decoration styles. Within all communities there are smaller communities of practice, such as individual lineages or groups of experts, who follow methods of production that may differ from others in their community. Potters make up one such community of producers who are emblematic of an internal community division of practice. The pots they produce have often been used by archaeologists to differentiate groups in the past, illustrate trading alliances, and create models of the movement of individuals and communities.

Communities of Practice

Archaeologists create typologies that group artifacts together based on similar temporal and physical characteristics, usually designs and motifs (Gilboa et al. 2004; Masucci 2000; Rouse 1960; Scarcella 2011; Suluvan III et al. 1992; Vaughn et al. 2014) These analytical constructions require a more informed understanding of how these might be related to a precontact cultural group or community. People can be members of multiple groups and communities each day, and their participation can change by activity or circumstance. These structures consist of everything from the banal to the grandiose and are repeatedly reinforced through constant action and reconstruction of the structures. Archaeologically, these structures can include how pots are created and the design motifs applied to them. *Habitus,* socially ingrained habits, skills, and general dispositions that govern conscious and unconscious behavior, guide how things are created, and what they convey (Bourdieu 1972; Roux 2016). This presents a challenge for archaeologists, as we cannot know the reasons behind everything in the past. Thus, a more flexible definition of identity is required. That definition defines communities as those formed by practice of a certain skill, activity, or belief (Lave and Wenger 1991; Wenger 1998).

While archaeologists typically examine singular events in time or specific roles, many individuals are members of more than one such community. Archaeologically defined cultures in the Northeast do not always correlate to the lived experiences or social boundaries of past people. Types and the cultures that they are assumed to represent often fail to fully encapsulate the nuances of daily life and fluid group affiliation in the past.

Therefore, a more flexible notion of archaeological cultures is needed, one that includes individuals at different times, places, and degrees of inclusion.

The concept of communities of practice was introduced by Lave and Wenger (1991) to describe how individuals learn their role within a group. These authors did this through a discussion of apprenticeship of meat cutters, tailors, recovering alcoholics, and midwives. This learning theory arose out of discussions of practice and how individuals arrive at the body of knowledge that they possess:

> …a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice. A community of practice is an intrinsic condition for the existence of knowledge, not least because it provides the interpretive support necessary for making sense of its heritage (Lave and Wenger 1991:98).

These relations are constructed by this intrinsic condition, here defined as the right way of learning, analogous to *Habitus* (Bourdieu 1972). Socially discrete entities operate within their own specific sphere of influence (Wright 2019). Using the creation of pottery as an example, to remain included in these socially distinct bodies, a potter actively establishes their training community in the selection of raw clay, the selection of temper, the combination of raw clay and temper to form paste, the method of vessel formation or, most importantly to this research, the decorative patterns applied to the vessel.

Communities of practice do not exist in isolation; they reflect characteristics of the systems in which they are situated, but they are the "simplest social unit that has the characteristics of a social learning system" (Wenger 2010:1). As noted by Wenger

(2010:1) “Such communities are not to be thought of as synonymous with ethnicity; they are networks of knowledge that are distinct from one another. They are placeholders for groups that we cannot know the full story of.” All these groups of individuals maintain their individuality, while situated within a body of knowledge that shapes their actions. This situated learning encompasses the understandings, skills, or knowledge gained by participation. The situated learning aspect of communities of practice informs *chaîne opératoire* (Roux 2016). The steps that ultimately culminate in the production of a vessel are learned by active participation. Since this learning is passed on and then reproduced, it is traceable through the material culture that is left behind. Archaeologists in the present hope to successfully converse with these potters to understand the life histories of the pots, and the instructions of the potters (Espenshade 2001). These connections can situate the potter in a larger community, one that is predicated on understanding connections involving movements. Larger still than communities are constellations of practice.

Constellations of practice illustrate the larger spheres that communities can evolve into, such as women potters in the Amazon (Bowser 2000; Bowser and Patton 2008; Roddick and Stahl 2016) or hunter-gatherers of the Late Archaic Southeastern United States (Sassaman 2016). Bowser (2000) and Patton (2008) discuss how women potters in the Ecuadorian Amazon will modify the designs on the ceramics that they produce to signal affiliation with larger constellations of practice. This is done to convey political affiliation and balance the competing dichotomies of the public and home spheres, as well as gender and political roles. Sassaman (2016) discusses disparate communities and how a shared environment of sea-level rise and the movement that it necessitated tethered otherwise distant groups together in the Southeastern United States as evidenced by the trade of soapstone vessels. While individuals or small groups can exist in multiple communities of practice, the maintenance of such identities can mark themselves as part of the larger constellations of practice. For the research in this thesis, these constellations may not be as visible as the smaller scale communities in the daily practice of the people at either site. The constellations would be reflected in how they reproduced this knowledge when they made their vessels. The reproduction of traditionally taught designs exhibited in the vessels at Thomas/Luckey and Losey 3 maintain connections to other prior or related group affinities. The knowledge learned in the communities of practice within which these potters were situated were reproduced in their pots, reminding them, and binding them to these connections.

The maintenance and reproduction of identity are both passive and active; the active considerations, and what they signify about the Thomas/Luckey and Losey 3 sites, are the focus of this research. Potters certainly would be united by communities of practice through the way they form the vessels, as this is a hands-on skill. Such skills require informal physical learning or even training under the tutelage of someone who knows the artform already. Due to the nature of pottery instruction, many idiosyncrasies, individual or otherwise, are observable and can be carried over from master to apprentice. As such, seeing evidence of a community does not necessarily mean the presence of many individual members at a site; one member (a potter) can encapsulate the larger community that they are a part of. While there are many aspects of pottery production that are not visible, the final decoration and overall vessel shape are readily seen by even casual observers. This is important for group signaling, and to be a member of these communities, it is important to understand these signals.

Identity Construction and Signaling

Identity is a flexible commodity, being actively or passively produced by an individual and consumed by viewers (Nieuwenhuyse 2017). Identity can come from location, shared values, preferences, etc. The preservation of a potting heritage, and the land it was connected to, was possibly important to the members of both the Thomas/Luckey and Losey 3 sites. This identity must be constantly reproduced as vessels break and new ones need to be produced to replace them. While signaling can be active (e.g., how a vessel is decorated), other elements may be less active or at least constrained by nature and the physical environment. The most practical considerations are available clay selection, vessel forming, and temper selection. While a group can travel to acquire raw clay or temper, they are limited to the available resources in an area, unless others are traded in. Vessels cannot be fired or used in unlimited forms; the shape of a vessel is partially constrained by its intended use and the method of manufacture. Passive construction comes from cultural standbys, or appropriate behaviors. *Habitus* governs unintentional action and forms the background of what is considered culturally normal (Roux 2016). These underlying rules are encapsulated in the teaching of potters relayed from teacher to student. This relationship was not always formalized as such and ethnographically and historically pottery manufacture in this area was done from mothers and aunts to daughters, nieces, etc.

An analysis of these above practical considerations, or non-visible elements of a vessel, and the process by which vessels are created provide further insight into group choices and decisions. This *chaîne opératoire* allows us to illustrate unconscious decisions. These decisions would not vary from master to apprentice and would be visible as clear lineages of production methods (Sanger 2017:104).

How this common identity is constructed is less important than the cumulative result of such common identity. Information is not produced and consumed in an even ratio; more is consumed than is produced (David et al. 1988). Common identity is an important factor for both practical and abstract reasons. Practically, common identity keeps like-minded and similar individuals with a shared social sense together in a self-referential loop. In relation to pottery, decorations are applied to visible parts of cooking/storage vessels; they may represent ownership over what is contained in the vessel, or broadcast membership into the larger community, such as a lineage, or even natal group if they were not born into their present community.

Culturally shared identity unifies groups, provides them a support network, and signifies kinship, either fictive, consanguineal, or affinal. This requires the understanding of relationships that are embedded/encoded into the designs. Oliver Nieuwenhuyse (2017) examined Neolithic vessels in the Levant, and illustrated that the motifs are designed to be actively seen, not just passively observed, and carry information about who possesses them or who makes them. The arrangement of lines and the arrangement of the space between the lines encode messages that can be decoded by observers who know what such arrangements mean. These motifs are governed by a shared grammar and recognized by other groups in the area, conveying production and value (Nieuwenhuyse 2017:124). The idea that motifs are designed to be seen and understood, especially when vessels are kept in a visible place, features prominently when examining how different groups may identify one another. While groups can identify one another through the consumption and understanding of symbols, the distance at which those symbols can be readily seen is also important.

The consumption of symbols as carriers for identity is discussed by Martin Wobst (1977:332) in his study of the recognition of style and stylistic behavior and its ability to convey information on hats in Yugoslavia. This former country possessed many different ethnic groups, religions, languages, and nationalities, which were exceedingly mixed. Homogenous communities existed in only a few small areas (Wobst 1977). The large amount of admixture of these diverse communities and the complex geopolitical climate that the inhabitants found themselves in resulted in frequent conflict over the period of his study (1910s – 1970s). Wobst (1977:330) focused on how stylistic choices, among other things, broadcast messages that show group affiliation and enter processes of boundary maintenance. The greatest focus was that of headdresses. The reason headdresses encoded identity, he surmised, was that they could be seen from far away, and this prevented members of conflicting groups from accidentally firing on one another. More hats were produced by hat makers in areas with more heterogeneous populations, indicating that identity needs to be signaled more when outgroup members are present (Wobst 1977:333).

Wobst also noted the role that distance played in identifying someone. He realized that the hats allowed such identity to be decoded from a greater distance than other articles of clothing. This study of distance may have undue importance in his study as rifles were commonly used for security. The farther away “friendly” or “nonhostile” people could be ascertained, the safer a person could be. Additionally, headwear would or could be worn regardless of weather or season.

Absent any other markings, the vessel designs at Losey 3 and Thomas/Luckey could not be distinguished from more than a handful of meters away. To see the designs as different and enforce a community identity the viewer would need to be looking at them from close quarters, or even perhaps purposefully touching them. If designs were meant to warn others away, they would likely be larger and perhaps more readily identifiable. The implications for such closely observed designs are that such a message is meant to be observed from a short distance, and possibly only noticed by a limited audience. Such detailed designs could also broadcast a pride in lineage or pride in constructive ability. They also may be multi-purposed, with different signals for different beholders.

While ceramic decorations are not as portable or visible from great distances as something like hats, the conceptions of identity being displayed for a purpose is important to my research. Archaeologists interpret these decorations, along with other characteristics of a vessel as indicative of the larger ethnicity and where that group is from. This is, of course, not always the case; just because a flag is of a certain country, does not mean it was produced in that country. Determining the approximate distance at which that identity marker can be ascertained, and how it illustrates a shared relationship is important when interpreting patterns in pottery. Possessing a distinct or recognizable identity is vital when these elements are made visible to other groups. Symbols indicating identity are paramount when considering ownership or group affiliation. Identity signaling broadcasts group affiliation when exposed and compared to others (Dorland

2018:906). If there is no external group to be differentiated, it is less important to signal group affiliation as that affiliation is already known to fellow group members.

Recognition depends on the knowledge of the beholder and the creator. These social markers could mean anything, including the contents of the vessel, where it comes from, who made it, or when it was made. Simply, there is no limit to what can be encoded and decoded for those familiar with the symbology. Decorations at the whim of an individual potter would likely be more idiosyncratic and less formalized. Seeing widespread motifs would therefore be indicative of a prolific potter, in craft or teaching, or a group of like-minded individuals that create vessels in the same way. The creation of a particular identity, as manifested in designs on vessels, can be important when a group moves either by necessity or choice. Adding visible identity markers, such as decorations, is a final stage of identity signaling during the production sequence and can link the individual to a broader constellation. The start of the process, such as clay selection, also involves decisions related to communities of practice and signaling.

Pottery making is a skill that is taught from one person to another and encompasses both gathering of resources and construction. While there are many unbound choices in forming a vessel, there are also practical and cultural considerations guiding a potter’s actions. The potter’s unconscious decisions, which are guided in part by *Habitus,* are also reinforced by a mentor’s instructions (Bourdieu 1972:72). This instruction is constrained by what is considered culturally appropriate, feasible, and traditional. The quirks and particularities of a given teacher are seen in their student’s works, solidifying techniques, and styles of construction. These idiosyncrasies can be cultural ways of pottery creation and are traceable from student to teacher and offer insight into what rules govern a community. I use c*haîne opératoire* here to form the middle ground between communities of practice and component materials. While it has been defined by many following Leroi-Gourhan's coinage of the term, I borrow Creswell's (1976:13; as cited in Roux 2016) definition: "a series of operations that transform raw material into finished product, either consumption object or tool."

Learning these operations requires a tutor and a model; this personal method of teaching illustrates both the desired form and the desired process. The manufacturing process begins with the acquisition of suitable clay and culminates in the patterns applied to the rims of the vessels at Thomas/Luckey and Losey 3. *Chaîne opératoire* is how these socially constructed behaviors are codified into the material and can be interpreted by archaeologists (Rice 2015; Roux 2016). Classifying an assemblage through the ceramic *chaîne opératoire* approach can lead to different groupings than existing types. C*haîne opératoire* allows for an understanding of how communities of practice can be linked to the clay. The selection of clay of acceptable quality is a learned skill that leaves a detectable imprint on the vessel.

The ability to make pottery is a tiered and nuanced skill. Not only must the potter be proficient at forming vessels, they must also understand how to add temper, and the correct way to fire the pots. Equally important is the selection of quality clay from which to prepare the paste. While designs applied to the final products can be reproduced and taught to others, locating and harvesting quality clay is a skill that also can be taught. Not all clay that is available in the world is of equal quality; some raw clay requires more processing and alterations than others. As such, when potters discover a suitable clay outcrop, it is often utilized extensively and sometimes shared among members of the same group (Gosselain and Livingstone Smith 2005).

While the techniques available for teaching a novice potter are limited by knowledge, *chaîne opératoire,* and *Habitus,* are also importantly constrained by material considerations Figure 2).

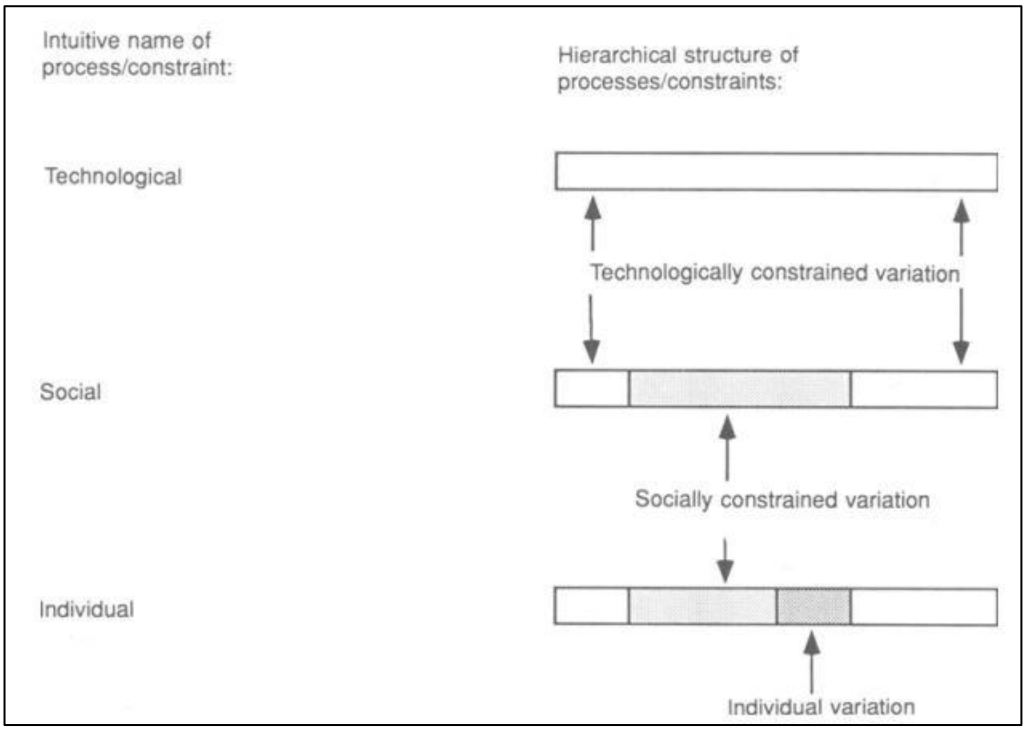


Figure 2. A visualization of the levels of constraint (adapted from Carr 1995).

For this study, one such material consideration is the availability of quality raw clay. A potter's discovery of a high quality source can lead to the use of that clay quarry for generations (Rice 2015:130). The location of the quarry would likely be passed down from teacher to student, and some locales may even have been considered sacred, or at least reserved for use by a specific group. An outcrop that possesses clay with high levels of workability and thermal resistance with minimal processing would be highly valued. This research seeks to identify if a relationship between potters and clay outcrops existed in the past in Chemung River Valley of New York, and Tioga River Valley of Pennsylvania.

Sourcing vessels in the Northeast was previously accomplished based solely on the characteristics of paste visible to the naked eye (Parker 1907; Tuck 1971; Weber 1971). This primarily involved looking at the color of the paste of a fired vessel. This method was very subjective since many factors influence the color of a vessel (Hunt 2017; Rice 2015). Clay does not remain the same color when fired. The presence or absence of oxygen, the temperature at which it was fired, and the type of firing it was subjected to all govern the resultant color of a vessel (Rice 2015:100).

Adding temper to raw clay prior to formation of a vessel is another step in the process of vessel construction. The type of temper used in vessels can help in differentiating provenience and dating of vessels (Rice 2015). Temper choice was once thought to parallel the refinement of construction methods for vessels, with grit tempered vessels being replaced by shell tempered vessels, but this has been disproved in the Northeast (Custer 1987; Engelbrecht 1971). While temper type and vessel color are not considered good indicators of group affiliation, the decoration of a vessel is a better indicator, but some researchers suggest it is only marginally so (Custer 1987; Espenshade and Kennedy 2002; Skibo et al. 1989).

Understanding symbols and designs aid group cohesion through shared cultural motifs. They can distinguish relatives and show alignment over distances great and small. Individuals and groups in the past did not simply occupy a village or longhouse, and many of these motifs were important when traveling through one area to the next for resources, visitation of extended lineages, or for other purposes.

Group Movement and Resource Procurement

There is more to travel than just the shortest distance between two points. Understanding how travelers negotiated the terrain, whether it was least cost paths or routes that went through difficult to traverse terrain, can give a new and multifaceted approach to the processes of group movement, trade, conflict, and cooperation. Least Cost Path (LCP) modelling has been used extensively in archaeology since the advent of computational mapping (Conolly and Lake 2006). A least cost path is the route that accumulates the lowest "cost" given by a currency such as time, calories, flatness, etc. Basically, it is the easiest route between two points. While not a perfect model of human behavior and decision making, these paths do allow archaeologists to predict where people may have traveled, and pertinent for this research, how they may have brought back heavy goods and items such as clay.

Travelers frequently did not take the lowest cost paths between sites, or in the pursuit of resources. There are any number of unknown and unknowable reasons for these cultural preferences. In the Northeast, due to its heavy forestation, and hilly and mountainous terrain, waterways would have been key to travel (Ritchie and Funk 1973). Extensive damming, channelization, runoff, and other modern infrastructure development projects have significantly altered waterways from what they were in the past. Yet they can still provide an understanding of past travel along riverways.

In 2005, members of the State Museum of Pennsylvania (SMOP) created a dugout canoe using approximations of traditional construction techniques, and they were able to navigate it along the Susquehanna River near Harrisburg, Pennsylvania. Using a combination of paddling down river and poling upriver, the two employees were able to canoe with relative ease, despite their own admission of not being expert watermen (Baker Personal Communication, July 2019). While not a direct comparison, this experimental research shows that such waterways were relatively easy to navigate with little experience and would have been even easier with more experienced canoers. The Northeast has winters that freeze slow-moving waterways and periodically even has winters that are cold enough to freeze fast-moving waterways (Mullins et al. 2011). Despite this, these routes are better able to transport people and materials than overland routes. Clay is very dense, and therefore difficult to transport overland. Waterborne transportation allows for a wider range of resource procurement, as well as an easier time transporting those procured resources.

Travel outside a home region to obtain resources is one explanation for the presence of non-local vessels on a site, while the movement of people is another. Abandonment or migration is not found in a single, easily identified way, as the conditions of departure vary (Adler et al. 1996; Cameron 1991). When people or individuals move and leave an area permanently, more is left behind than their memories and discarded goods, and what is kept and carried by the travelers speaks about the cultural implications of illustrating identity. Arkush (2017:242) describes three abandonment scenarios: 1) planned permanent abandonment, 2) planned temporary abandonment, or 3) catastrophic abandonment.

If the individual or group has time to plan and leave (first and second scenarios), and knows the resources of the destination, less goods need to be carried, as more could be produced upon arrival. There would be less reason to bring fragile and heavy ceramic vessels and more reason to bring valuables with them in the first and possibly the second scenarios, though the value of goods is a culturally dependent variable. This intention also may closely mirror that of the third scenario, possibly complicating interpretations of the circumstance of departure. Carrying fewer goods into a new area and reproducing a shared cultural identity once there is an outcome that requires a willing host who accepts multiple cultural or community identities. In short, the conditions under which Shenks Ferry decorated pottery arrived on the New York and northern Pennsylvania sites is less important than the nature of why these non-local decorated vessels were introduced or persisted. It is important to note that the vessels may represent the work of a group or an individual as a single potter could keep reproducing the designs and pass that knowledge along others in the community.

Reproducing identity markers is a way to maintain group cohesion or to keep displaced individuals tied to their former communities and keep a sense of self when in an adverse environment. Of course, this is entirely dependent on the environment as the idea of “captive brides” would preclude the reproduction of natal designs. Also, while the Haudenosaunee, and many other groups were matrilocal, this practice could have been modified or suspended due to hardship (Engelbrecht 2003). While this is especially true during times of stress, catastrophic events and unrest are also catalysts for identity construction, and these may challenge preexisting identities. New identities, or forms thereof, can be more easily created in stressful times (Velasco 2018). Under these conditions, *Habitus* can be suspended or disrupted allowing new communities of practice to be forged. Identity that survives movement and unrest is either a strong linkage that is maintained or illustrates that there were no adverse conditions.

The desire or need for groups or individuals to move can occur for many reasons: hostile environment, lack of resources, marriages, adoption, seasonality, etc. Casual movements seem less likely when a group has established agricultural practices and material culture that ties them more to a sedentary lifestyle (Chilton 1999). This established lifestyle may preclude the movement of larger groups but would not be the case for individuals marrying into another equally established group. Archaeologists try to recognize the movement of groups or individuals to and from areas and seek to interpret how individuals and communities were impacted by such movements. Movement to a new area comes with great cost in both time and effort. People would have sought the easiest method of travel, and in the Northeast that was most likely waterways, though this may have changed through time and with the seasons.

Traveling along these waterways and paths would most likely not have been done in solitude nor would the travelers have moved through entirely unoccupied territories. Travelers would likely cross paths with others; understanding who an ally, trading partner, or friend was would be critical for safe travel. When moving into a new and unfamiliar territory, seeing a familiar design or motif could have conveyed security, alliance, family, or shared worldviews. Familiar exterior decorations would mean the vessels were associated with people who followed similar pottery traditions of decoration. While not an exact proxy for identity, markers, decorations, and stylistic decisions have meaning and make an impact on the maker and the observer (Nieuwenhuyse 2017).

My research is based on the premise that while decoration can be copied, paste cannot (Stark et al. 2000). The composition of ceramic paste can more accurately illustrate the origin of the vessels and answer questions about natal regions, trade, or the adoption of foreign designs in new communities. Potters may travel far to gather raw materials but not all movement is unidirectional or permanent. Potters frequently made forays from their villages to gather materials necessary for creating pottery. The distance that an individual or a group might travel for resources, such as clay, can vary depending on environmental conditions and access.

Prudence Rice (2015) discusses a meta-study by Dean Arnold (1985) comparing distances that clay is sourced. Arnold (in Rice 2015:131) examined over 110 cases from around the world and found that distance to quarries ranged from ”in their own backyard” to almost 50 km (31.1 mi) away. Closer is much more common, with an average distance of 7 km (4.3 mi). These data are difficult to interpret as many factors influence how far away a potter may acquire clay. The distance traveled depends on the landscape and the potter’s knowledge of it, how many vessels are to be produced, the quality of the clay as well as cultural constraints such as territoriality. These constraints are hard to assess in the past. Additionally, available transportation technology is important when assessing distance and movement; the extant waterways of the Northeast would have facilitated easy travel (Rice 2015:132).

Donald Lathrap (1973) discussed procurement of clay in the Shipibo community of San Francisco de Yarinacocha near Pucallpa, Peru. He found that the bulk of the clay harvested for paste comes from a “half day’s journey” (Lathrap 1973:171). If the potter is decorating the vessel, she will require other certain specific clays to form her slip. These are the result of down-the-line trade from 129 km (80 miles) away for the inferior quality source to 160.9 km (100 miles) away for the high-quality source (Lathrap 1973:172). This was not done all by a single potter. Most groups are not alone on a landscape and are connected to vast networks of people. How these groups are connected is a matter of degree, and varies intensely by place, but groups need not be highly connected to successfully trade. In the Peruvian Andes, members of an *ayllu* (an extended support network of both fictive and real kinships) can provide access to pastes, slips, and temper from up to 128.7 km (80 mi) away (Goldstein 2000; Lathrap 1973:172). An *ayllu* can be conceived of as a formalized constellation of practice as it unites disparate smaller communities of practice and is periodically refreshed through shared interaction.

This willingness to travel for resources is not restricted to South America; it is relevant across the globe. The willingness to travel is inhibited by practical constraints in the surrounding world. Clay that is close by may not be useable or may not be accessible for some reason. Extended networks of trade or cooperation can bring resources from far away. These connections can be based on economies, familial relations, or other reasons, but these relations tie groups together. While ethnographic analogy and ethnohistorical accounts cannot fully illustrate the past, they do allow scholars to approximate past decisions.

Summary

Identity is emblematic of communities of practice, which link small groups into larger constellations of practice. The decorations on the vessel which are produced are meant to be seen, and the distance at which they are seen allows for inferences of the condition of the relationship between the groups seeing the designs. Decorations on pottery vessels are relatively small and detailed, and an observer would need to be close to see them. Since this is the case, it is unlikely that there was a need for them to be decoded at a distance. In a modern analogy, danger signs are large and bold and easily read for safety, however the directions on a package of food are small and do not warn you away. While there are many passive rules and practices governing the production of pottery, there are also very practical concerns, such as clay harvesting. Neither Thomas/Luckey nor Losey 3 has any known clay outcrops in the immediate vicinity of these sites. Clay was likely procured from a nearby source, or where easy transportation to quality clay existed. In the next chapter I will discuss the physical and cultural landscape of the Late Woodland. The Northeast has had many distinct geological events that impact the amount and quality of clay that can be extracted, as well as other factors that could have influenced the location of villages, and agricultural productivity.

CHAPTER 3. THE PHYSICAL AND CULTURAL CONTEXT

People and their communities are situated in a particular environmental and cultural context. While the environment does not dictate everything that defines the precontact period, it does play a role in shaping how communities interacted with the natural world, and in how archaeologists interpret sites.

Environmental Context

The environmental context includes the geology, hydrology, and soils related to the Thomas/Luckey and Losey 3 sites. This context influences where people built their village, and the proximity to food and other resources, such as clay deposits.

Geology

Repeated events of glaciation and retreat, and millennia of both colluvial and fluvial erosion led to the present geological context in this region. The Northeast was heavily impacted by various glacial events, leading to the disconformity between bedrock and surficial geology. Most clays are not primary clays and are instead secondary clays, which are formed from sediment deposited from elsewhere and, thus, may not be the same as the bedrock (Cadwell et al. 2003).

The Thomas/Luckey site falls in the Chemung River Valley and is part of the Appalachian Plateau physiographic province (Denny et al. 1963). The site is underlain by the Gardeau Formation. This formation is Upper Devonian in age, and consists predominantly of shale, with minor inclusions of siltstone (Rickard et al. 1970). In parts of the Chemung River Valley, the glaciofluvial till that makes up the ground surface is underlain by lake deposits. These lakes were reservoirs for fine-grained sediments and could lead to the accumulation of secondary clay deposits. These clay deposits are visible eroding from the streambanks near the towns of Sayre, Pennsylvania and Chemung, New York (Denny et al. 1963:12). These may have been ideal quarries for collecting raw clay suitable for vessel manufacture. Additionally, historic documents and surveys note clay outcrops along the Susquehanna River (Ries 1903).

While ethnographic studies have illustrated that clay was often obtained from deposits near the site of vessel production, I was not successful in locating such deposits near Thomas/Luckey despite several search attempts. The Chemung River south of the Thomas/Luckey site bears evidence of industrial channelization on its southern bank. Poured concrete and riprap are concentrated near the bridge carrying Lowman Crossover Road (C.R. 8) across the Chemung River. It is possible that any clay outcrops once accessible here in the past would have been destroyed or covered over by construction.

The Losey 3 site falls in the Tioga River Valley and, like Thomas/Luckey, is part of the Appalachian Plateau physiographic province (Denny et al. 1963). The site is underlain by the Lock Haven formation. This formation is Devonian in age, and consists of sandstone, mudstone, and siltstone, with a minor inclusion of conglomerate (Berg et al. 1980).

I did not look for clay deposits near the Losey 3 site, but the creation of Cowanesque Lake and other modifications of the shoreline are present from aerial/satellite imagery. These alterations would have obscured and restricted access to quarries that Indigenous people may have had access to in the past in that area.

Hydrology

Both sites are located within the Chemung Subbasin, which is part of the greater Susquehanna River Basin (SRBC 2006). Losey 3 is in the Cowanesque River watershed, close to the western edge of the Tioga River Subbasin (Figure 3).

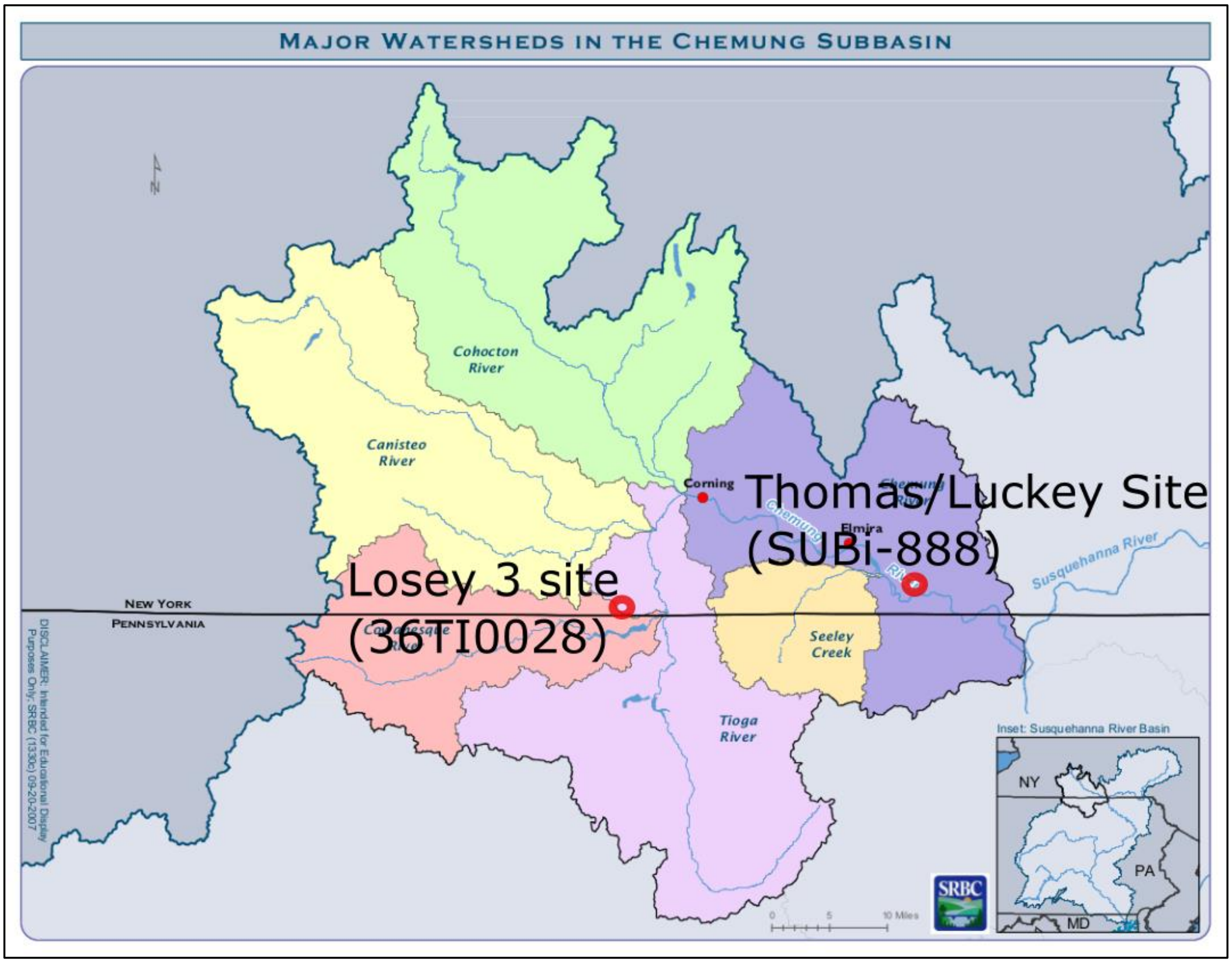


Figure 3. Chemung River Subbasin (SRBC 2006).

Both sites are located along rivers that eventually flow into the Susquehanna River. The Tioga River flows north where it meets the Cohocton River and forms the Chemung River at the village of Painted Post, New York. The Chemung then flows generally south from the Thomas/Luckey site where it meets the Susquehanna River in the present-day town of Sayre, Pennsylvania. These rivers connect both sites to a larger network of precontact villages, communities, and resources that were located along these rivers. The rivers also created fertile soils from terrace creation and overbank events leading to deposition of soils and other materials (Kirkland 1993).

Soils

The soils at the Thomas/Luckey site are Tioga fine sandy loams. These soils are consistent with fluvial deposition and are well drained. The United States Department of Agriculture (USDA) classifies this soil as prime farmland, a fact documented by centuries of farming by precontact and historic period communities (NRCS and USDA 2009). The immediate site landscape shows some microtopography, described as ridges separated by swales (Knapp 1996). The alluvial soils are deeper in the low troughs, and thinner on the crests (Knapp 1996; Miroff 1997; 2002:195). Table 1 illustrates the typical soil sequence present at the site. The soil has granular structure with very diffuse boundaries. These boundaries were reportedly difficult to identify in plan, and were sometimes only noticed in profile (Miroff 2002:196).

Table 1. Thomas/Luckey Site Stratigraphy (Miroff 2002:193; NRCS and USDA 2009)

Strata	**Munsell**	**Munsell color**	**Thickness**	**Texture**
Ap	10YR 3/3	Dark Brown	30 cm (11.8 in)	Silt Loam
Ap2	10YR 5/4	Brown	3-5 cm (1.18 -1.96 in)	Silt Loam
A2	10YR 3/2	Very Dark Grayish-Brown	20 cm (7.87 in)	Sandy Silt Loam
B1	2.5Y5/4 to 4/4	Light Olive Brown to Olive Brown	5 cm (1.96 in)	Silt Loam
A3	10YR 3/2	Very Dark Grayish-Brown	5 cm (1.96 in)	Silt Loam
B2	2.5Y5/4 to 4/4	Light Olive Brown to Olive Brown	5-10 cm (1.96 –3.93 in)	Silt Loam

All the identified soils lack noticeable clay content, suggesting the raw clay for the vessels was not procured on or near the site. However, the proximity of the Chemung River greatly extends the range that occupants could have traversed to procure clay, temper, and other necessary materials for pottery production.

The Losey 3 site is located on the T1 and T2 terraces of the Tioga River (East et al. 2006a:V-31). The soils at the Losey 3 site are: Pope fine sandy loam, Alluvial Land (by the river), Philo silt loam, Orville silt loam, Chenango gravelly loam, and Braceville gravelly loam (NRCS and USDA 2009). Gravelly deposits are found beneath the site, varying in depth (East et al. 2006a). Standard soil surveys of the area and excavations at the site were complemented by a geomorphological investigation by Margaret Sams, who examined 13 backhoe trenches to determine the underlying soil structure (Table 2).

Table 2. Losey 3 Site Stratigraphy (East et al. 2006b).

Horizon/Depth	**Matrix**	**Texture**	**Structure**
Ap/0-23.0 cm (0-9.1 in) Stratum 1	10YR 3/2 Very Dark Grayish Brown	Silt Loam	Weak to Moderate Medium Granular
A2/23.0-28.0 cm (9.1-11.0 in) Stratum 8	10YR 3/1 Very Dark Gray	Silt Loam	Weak Fine Subangular Blocky
BE/28.0-48.0 cm (11.0-18.9 in) Stratum 3	Mixed: 10YR 4/3 Brown 10YR 4/2 Dark Grayish Brown	Fine Sandy Loam	Weak Fine Subangular Blocky
2Bw1/48.0-93.0 cm (18.9-36.6 in) Strata 6A, 6B	10YR 4/4 Dark Yellowish Brown	Light Silt Loam	Weak To Moderate Fine Subangular Blocky
2Bw2/93.0-126.0 cm (36.6-49.6 in) Stratum 4	10YR 4/4 Dark Yellowish Brown	Silt Loam	Weak Medium Subangular Blocky
2C/126.0 cm+ (49.6 in+)		Channel Lag Gravels	

Areas surrounding the Losey 3 site are classified as prime farmland, or farmland of state importance (NRCS and USDA 2009). The riparian land is currently deemed unsuitable for farming; however, this may be related to the damming and subsequent creation of Cowanesque Lake. Prior to damming, this land would likely have been able to be farmed successfully during both the precontact and historic periods. As with Thomas/Luckey, the suitability of the soils for farming was probably a major factor influencing the selection of this landscape for placement of a Late Woodland village.

Cultural Context: The Late Woodland Period (AD 900-1550)

Archaeologists in the Northeast have focused on the study of the Late Woodland period and its associated material culture since the beginnings of American Archaeology. Northeastern archaeologists typically date the Late Woodland period to AD 900-1550 (Carr and Moeller 2015; Miroff 2002) though this can vary ca. AD 1000-contact (Ritchie and Funk 1973:165) . This definition and chronology have been identified by archaeologists based on consistent artifact traits and radiometric dates to facilitate broad comparisons and easier discussions.

The Late Woodland period is broadly characterized by changes in settlement patterns, social complexity, subsistence patterns, and technology (pottery especially) (Ritchie and Funk 1973). The size of groups increased as larger villages were formed from smaller groups coming together. Settlements become larger, and during the later parts of the Late Woodland, some villages moved to higher ground and had evidence of palisades. These emplacements are interpreted as defensive structures, which some archaeologists attributed to conflict and warfare. These palisades could also be other types of markers, specifically between "within village" places and "beyond the village walls" denoting different spheres of community spaces (Prezzano 1992; Spence 1999). As far as defensive fortifications, palisades would have been mostly effective, but not insurmountable, implying other functions. They would have been prominent signals to travelers about what group's territory they had entered, they practically kept garbage and latrines outside of living spaces when desired, and they kept wildlife out. Additionally, they may have functioned as windbreaks and snow fences (Engelbrecht 2003:99).

From these villages, individuals would venture out to gather materials for hunting, tools, housing, or for clay, and firewood, among other resources. While farming was a relatively new addition to this period, it did not suddenly arise. Cooccurring with this habitation and social change were developmental changes in the agricultural economy; the cultivation of undomesticated foods and larger gardens of domesticates was replaced by field based agriculture with an eventual focus on corn, beans, and squash around AD 1300 (Hart 2011).

The change from smaller gardens during the Middle Woodland to the eventual focus of larger field-based agriculture focusing on the Three Sisters is reflected in both settlement patterns and material culture. Cooking dried maize requires extensive boiling and often included the addition of an alkaline material (such as wood ash) for the kernels to be fully digested and release more vitamins and minerals (Mt. Pleasant 2016). This necessitated vessels that could withstand hours of boiling over a fire.

Technologically this time period saw a more widespread adoption of the bow and arrow and the broad adoption and refinement of pottery technology (Carr and Moeller 2015:141). Archaeologists note that pottery production became more complex with well-made vessels with distinct patterns of decoration becoming commonplace. With this came more pronounced identity markers or at least markers that are better interpreted through the material culture (Carr and Moeller 2015:171).

Following an attribute analysis of the Pine Hill site, Chilton (1996) argued that Iroquoian vessels were intended for cooking maize and were well suited for the task when compared to Algonquian vessels. Algonquian speaking people's vessels were more functionally diverse, but less well suited to cooking maize as a result of thicker vessel walls (Chilton 1996, 1999; Hart 2012).This specialization of vessel use parallels the intensification of maize based agriculture, and led to an increasing complexity in the production of pots. While the connection between the two is indirect and may be coincidental, vessel decorations became more complex as vessels became more specialized for cooking in the Northeast.

Cultural Context: Pottery, Tradition, and Research

Pottery types, based on form and decoration, provide our baseline data to understand what cultural groups lived in the Northeast before European Contact. Pioneer archaeologists William Ritchie and Richard S. MacNeish were the first to classify New York clay vessels and smoking pipes into a typological system. Their typology was based on decorative style and relative dates. They built upon previous work, much of which was conducted by Arthur C. Parker, an early Seneca historian and archaeologist who later became the State Archaeologist of New York and first president of the Society for American Archaeology. The vessel shape and styles that researchers recognize from the archaeological record are not always indicative of groupings that existed in the past. Groups in the past, as well as archaeological conceptions of them, were rigid, static, and binding; however, this was not always the case. Following decades of excavation and study, not only has the idea that such groups were sperate been replaces, but the recategorization of artifacts and sites has also taken place.

Owasco, for a long time, was used as a chronological marker, but this has been challenged by researchers in recent years (Hart 2011; Hart and Brumbach 2003; Schulenberg 2002). These researchers argued that Owasco is a problematic temporal term, as sites should be considered on their own merits with a sliding scale for dates instead of rigid categories. They also argue that previous distinctions between Point Peninsula and Owasco are not as apparent as they had appeared to previous researchers who lacked the analytical and chronological tools that we have today.

In this thesis I use the term Owasco as a descriptor, not for chronology, but to refer to the grouping of pottery types that it represents. First identified by Arthur C. Parker from excavations at Owasco Lake in Cayuga County New York, it was not codified until later comparisons to other sites were conducted by Ritchie and MacNeish (Ritchie 1965; Ritchie and MacNeish 1949). Owasco vessels have distinct decorative patterns. They are typically cord-impressed; decorations made with cord-wrapped sticks or paddles. Decorative motifs include herringbones, and oblique, vertical, and horizontal lines (MacNeish 1952; Ritchie and MacNeish 1949).

Owasco settlements are often found on T2 terraces of large streams, as well as floodplains, though to a lesser extent. The placement of their settlements likely was to take advantage of the fertile crop land found along streams. These locations held the dual advantage of providing access to water for farming, and fishing, through the use of nets, spears, or hook and line (Ritchie 1965). The fields and gardens would have produced extensive varieties of corn, beans, and squash (Hart 1999; Ritchie 1965; Snow 1996). Additionally, many wild fruits, nuts, and vegetables would have been procured (Ritchie 1965). Many of these foods would have necessitated cooking over a fire, which can be accomplished in clay pots, often decorated in distinct ways.

Shenks Ferry

Shenks Ferry was first described in 1952 by Witthoft and Farver (1971). While first codified by Donald Cadzow as "Third Period Algonkian" with an influence of minor Iroquoian contact, he was not the first to note such designs in the archaeological record (Kinsey and Graybill 1971). Cadzow built upon the previous work of S. S. Haldeman who first illustrated vessels from central Pennsylvania in 1877, and Christopher Wren who, in 1914, illustrated and described what is now Shenks Ferry (Kinsey and Graybill 1971:1). This type description arose from excavations of the Summy site (36LE0001) and the Miller site (36LE0002) along with the Shenk's Ferry site[2] (36LA0002), all located in Lancaster County in Central Pennsylvania. Witthoft and Farver (1971) placed the ceramic materials from all three sites into a new culture that was between the earlier Clemsons Island culture, and the subsequent Susquehannock culture.

Shenks Ferry is presently dated between AD 1250 and 1550, placing it within the Late Woodland period (Carr and Moeller 2015). Graybill segmented the Shenks Ferry into three phases, Blue Rock/Stewart, Lancaster, and Funk (Kinsey and Graybill 1971). The earliest, the Blue Rock/Stewart phase, has a temporal affiliation of AD 1250-1400. The Stewart complex is the northern variety of the two, coming from above central Dauphin County. It has been identified in the North Branch and West Branch Valley of the Susquehanna, and also along the lower Juniata (Witthoft and Farver 1971:426). The Blue Rock phase comes from south central Pennsylvania, being identified in Lancaster, Lebanon, and lower Dauphin Counties. (Figure 4). The Shenks Ferry culture is found in

---

[2] For this thesis, I elected to follow Kinsey and Graybill's approach to naming of the culture. The apostrophe in Shenks Ferry is dropped when referring to the culture, however it is retained in the site name.

central Pennsylvania in palisaded villages that are typically found in the Upper Susquehanna Valley for the fertile farming lands present (Herbstritt 2019a; Herbstritt and Kent 1989; Kinsey and Graybill 1971; Ritchie and Funk 1973).

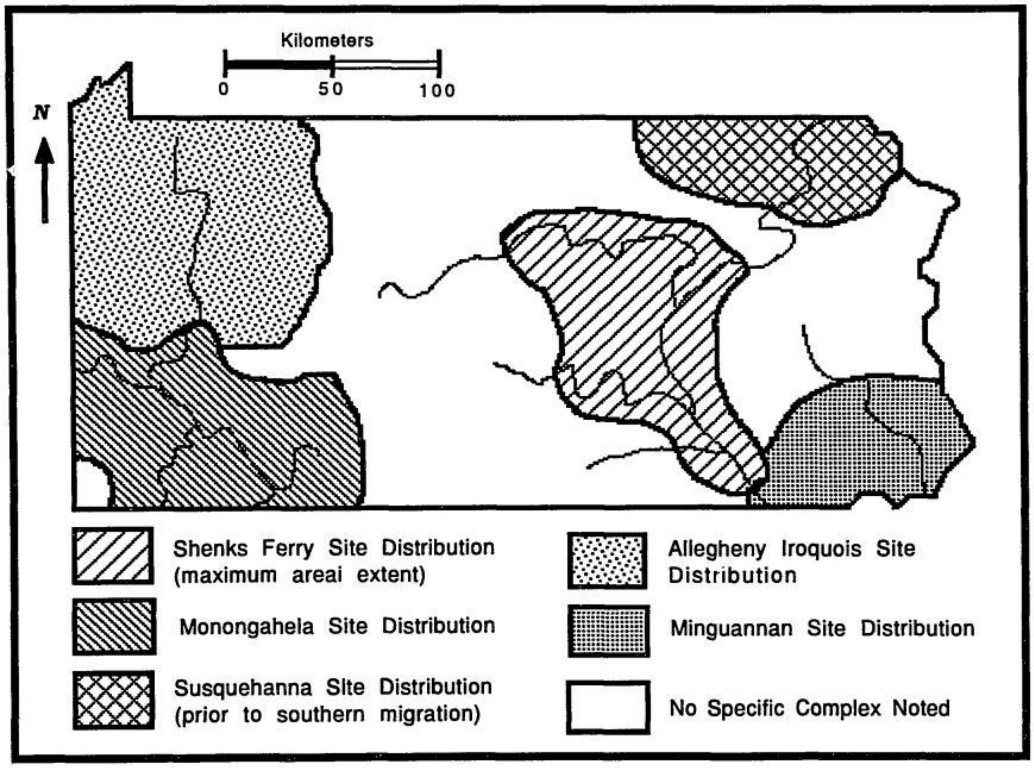


Figure 4. Shenks Ferry distribution map (from Ericksen 1995:17).

The diet of Shenks Ferry groups was like that of other groups, with the Eastern Agricultural Complex being replaced by corn-beans-squash agriculture. This was a widespread change of the dominate dietary practices of the Late Woodland period. They also relied heavily on other terrestrial and riverine resources for food, supplies, and other materials.

Our understanding of the Shenks Ferry people is that they are related to the preceding Clemsons Island and the following Susquehannock culture (Witthoft and Farver 1971). Though Shenks Ferry has been found at sites in association with

Susquehannock this has been interpreted as Shenks Ferry refugees being taken in by the Susquehannock due to disease, warfare, and intentional displacement by European colonialist actions. Alternatively, there is another hypothesis as to their disappearance. The *in-situ* hypothesis is that the loss is one of material culture and not necessarily one of the end of the people. The artifacts we associate with their culture changed unrelated to outside influences to the point where it is unrecognizable to archaeologists as Shenks Ferry (Herbstritt 2020; Witthoft and Farver 1971:464). Their ultimate disposition is unknown at present and the subject of debate among archaeologists.

Ceramic Typologies

Originally broken into three divisions, each a century in length (Table 3), the Late Woodland phases were thought to be indicative of cultural changes and were in part defined by changes in pottery. Many recent studies have illustrated that these distinct chronologies are inaccurate (Hart 1999, 2011; Hart and Brumbach 2003; Knapp 2009; Miroff 2002, 2009; Schulenberg 2002).

Table 3. New York Woodland Date Ranges and Phases.

<table>
<tr><td>Early Woodland</td><td colspan="3">1000 BC-- AD 300</td></tr>
<tr><td>Middle Woodland</td><td colspan="3">AD 300-900</td></tr>
<tr><td rowspan="6">Late Woodland</td><td rowspan="3">Owasco</td><td>Carpenter Brook</td><td>AD 900-1100</td></tr>
<tr><td>Canandaigua</td><td>AD 1100-1200</td></tr>
<tr><td>Castle Creek</td><td>AD 1200-1300</td></tr>
<tr><td rowspan="3">Iroquois</td><td>Oak Hill</td><td>AD 1300-1400</td></tr>
<tr><td>Chance</td><td>AD 1400-1500</td></tr>
<tr><td>Garoga</td><td>AD 1500-1550</td></tr>
</table>

Thomas/Luckey and Losey 3 each possess assemblages with multiple ceramic types. These two sites do not have all of the same types represented, but Kelso Corded and Shenks Ferry vessels were identified at both. The importance of knowing what these descriptive categories encapsulate is essential for understanding the occupants of both sites. While I do not intend to recreate or rehash these types, some understanding of the specific criteria is necessary to contextualize my results in relation to previous work. The following discussion describes the three types of pottery that are the focus of this thesis: Shenks Ferry, Kelso Corded, and Oak Hill Corded.

Shenks Ferry Incised Pottery

These vessels have been described by Witthoft and Farver (1971:452-455) as collared, flat lipped, with moderate neck constrictions, egg-shaped bodies, and rounded bases. Vessel interiors are smoothed, while exteriors are cord marked except for the neck (Photo 1). The most diagnostic aspect of Shenks Ferry Incised vessels is horizontal bands of oblique, vertical, or horizontal lines on the neck and/or collar. It is grit tempered.

Photo 1. Shenks Ferry Incised sherd, exterior, from Thomas/Luckey (TL96-146-600).

Shenks Ferry Cord-Impressed Pottery

This type is broken up into three sub varieties: Cord-Marked Collared (also known as Levanna Corded Collar), Cord-Marked Collarless, and Shenks Ferry Cord-Marked Collared, Cord-Impressed subtype. The overall styles and motifs of decoration are akin to Shenks Ferry Incised, as is the overall morphology of the vessel. Cord-Marked Collared is like the Cord-Marked Collarless; both possess cord-marked surfaces (Photo 2). The main difference is that the collared subtype has a thickened rim. Cord-Marked Collared vessels possess undecorated cord-marked surfaces. Shenks Ferry Cord-Marked Collared, Cord-Impressed subtype differs only with a supplementary rim strip welded to the base with paddle-edge impressions.

Photo 2. Shenks Ferry Cord-Impressed sherd from Thomas/Luckey (TL98-217-786).

Kelso Corded Pottery

The type Kelso Corded arose from Donald Lenig (1965:6) lumping several of Ritchie and MacNeish's (1949) pottery types. Kelso Corded includes the types Owasco Corded Collar, Bainbridge Collared Incised, Hummel Corded, Dansville Corded, and all horizontal motif types formerly included in Oak Hill Corded (Table 4). The excavation of the Kelso site in 1963, following its identification in 1951, led to the reassessment of the types presented in Table 4 as they all appeared to relate to late Owasco and early Iroquoian wares.

Table 4. Pottery Types Included in the Type Kelso Corded.

Type	**Original Reference**
Owasco Corded Collar	(Ritchie and MacNeish 1949:115)
Bainbridge Collared Incised	(Ritchie and MacNeish 1949:115)
Hummel Corded	(MacNeish 1952:53)
Dansville Corded	(MacNeish 1952:45)
Horizontal motif formerly included in Oak Hill Corded	(MacNeish 1952:79)

This reassessment helped to clarify and further delineate cultural groups of the Oak Hill Horizon and the Mohawk Valley region of New York (Figure 5).

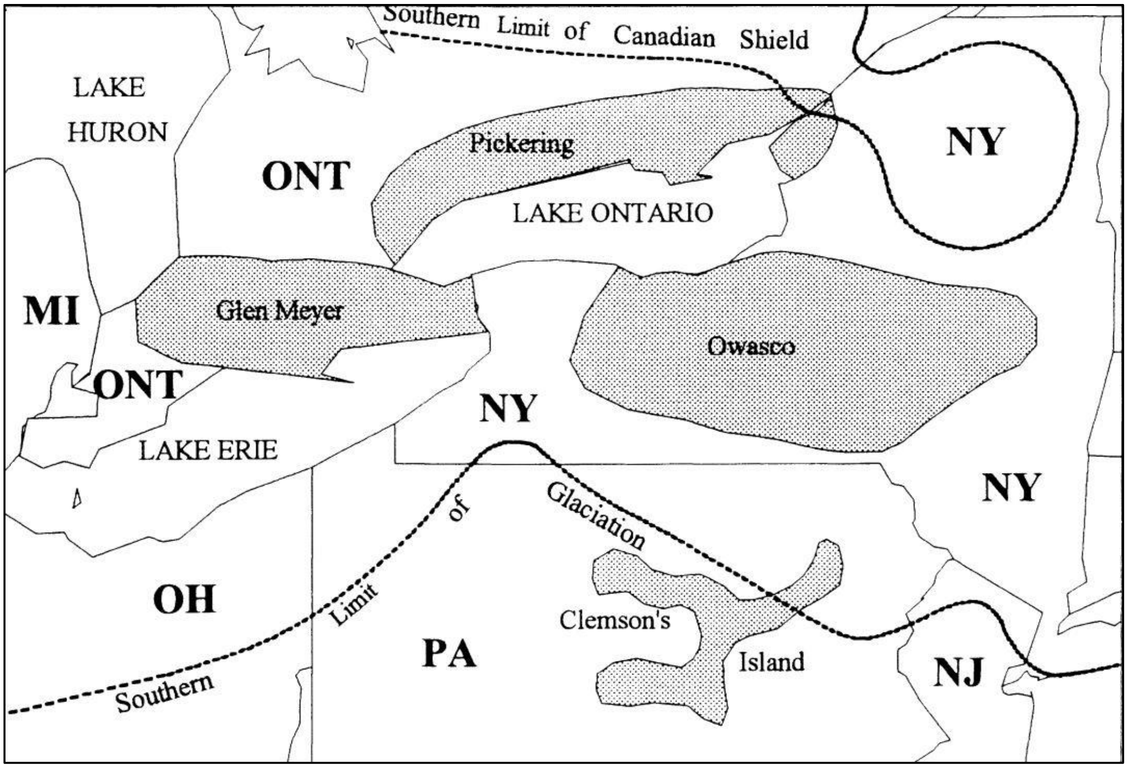


Figure 5. Owasco distribution map (Snow 1995).

Decoratively, Kelso Corded is distinguished by cord-impressed horizontal line motifs on the collar (Photo 3). These motifs consist of vertical, oblique, and opposed oblique or opposed filled triangles (Lenig 1965:6). It is a collared ware with flat lips, constricted necks, short to medium collars, and elongated to globular bodies. The bases are rounded. The exterior is cord marked but smoothed before decorating, and the interior is smoothed. Kelso Corded is grit tempered (Lenig 1965; MacNeish 1952). This type is typically dated to the Oak Hill phase, though contextual radiocarbon evidence at Thomas/Luckey and others has forced a reconsideration of this range.

Photo 3. Kelso Corded sherd from Losey 3 (Vessel 128, Cat. # 10325.1).

Oak Hill Corded Pottery

The type Oak Hill Corded was defined based on excavations in the Mohawk Valley region of New York at the Oak Hill 1, 2 , 3, and 7 sites (Figure 5). Of principal interest is Oak Hill 2 where Ritchie, Lenig, William Marvin, and Henry Wemple excavated a midden feature, uncovering sherds that led to the definition of this type (Lenig 1965:24). Ritchie and MacNeish (1949) mention the similarity of Oak Hill Corded to other types they defined, such as Owasco Corded Oblique, but do not describe Oak Hill Corded in depth. While originally a singular type when first described from excavations at the site, it came to include Lanorie Corded as defined by MacNeish in 1952 (Lenig 1965:6).

Oak Hill Corded vessels are described by Lenig as collared with "cord-impressed decorations on the collar that consist of vertical oblique, opposed oblique or opposed filled triangles"(Photo 4) (Lenig 1965:4). Oak Hill Corded vessels possess globular bodies with constricted necks and short to medium collars. Collars possess interior channeling. Lips are flat. Vessel interiors are smoothed with the exteriors being impressed by the edge of a cord-wrapped paddle after smoothing the surface (Lenig 1965; MacNeish 1952).

Photo 4. Oak Hill Corded sherd from the Thomas/Luckey site (F75 Zone 1).

Summary

The period after AD 900, known as the Late Woodland, represents a time of change and coalescence. Despite researchers generally moving away from the broad chronological periods in favor of exact date ranges, these periods are used to situate this research into the existing literature. Settlement and subsistence patterns changed to sedentary villages surrounded by agricultural fields, pottery traditions developed and were refined and decorative traditions emerged that differentiated regions in the Northeast, and dispersed small villages merged in some regions to become a confederation of communities that are ancestral to the Haudenosaunee today. Careful examination of the Losey 3 and Thomas/Luckey sites will shed light on some of these details of Late Woodland communities and interconnectedness of these past groups by not looking solely at the visual characteristics of pottery. Additionally, I will show how individuals may have interacted with outside groups and reproduced their identity through a continuation of their community of practice based on their pottery traditions, and how they may be differentiated or linked together.

CHAPTER 4. SITE CONTEXTS

In this chapter I discuss excavations at the Thomas/Luckey and Losey 3 sites to provide a background for understanding the analysis of sherds from these contexts. The Public Archaeology Facility (PAF), a research center on the Binghamton University campus, conducted multiple field schools at the Thomas/Luckey site beginning in 1994 and concluding in 1998 (Knapp 1996, 2009; Miroff 1997, 2002, 2009). The excavation strategies involved multiple techniques and protocols to maximize data recovery. The site was originally identified during cultural resource management (CRM) investigations for a proposed New York State Department of Transportation (NYSDOT) project (Versaggi and Ewing 1979) .

Skelly and Loy, Inc. is a private firm that works as engineering and environmental consultants throughout the mid-Atlantic region. While they did not identify the Losey 3 site, the company became involved with work at the site following the Pennsylvania Department of Transportation's (PennDOT's) decision to improve Pennsylvania S.R. 0049 (East et al. 2006c). PennDOT was unable to avoid impacts to the site and they authorized final excavations in consultation with the tribal groups, including the Seneca Nation. The extensive field investigations were halted before completion and plans for alternative mitigation were implemented.

The following sections describe the work at each site in more detail.

Thomas/Luckey, 1976-1978: NYSDOT Surveys along County Route 8

The Public Archaeology Facility first identified the Thomas/Luckey site in 1978 during a cultural resource management survey (CRM) of new alignments for County Road 8 (CR 8) (Versaggi and Ewing 1979). PAF investigations (Figure 6) found that the original route of CR 8 bisected the general site area (Miroff 2002:180). During the initial survey, archaeologists found diagnostic artifacts from the Late Woodland period, representing the Owasco and Iroquois phases (Table 3). Radiocarbon dating of a storage feature containing botanical remains of maize, beans, squash, and sunflower produced a date of 250±50 BP (cal AD 1653, 2 sigma, OxCal 4.3), suggesting a Protohistoric period occupation as well (Versaggi and Ewing 1979). Excavations revealed a single post mold, with a rock presumably to support the post, indicative of a structure or other supported construction. Due to the presence of intact features, diagnostic artifacts, and intact stratigraphy, the site was declared eligible for the National Register of Historic Places. Following this determination of eligibility, construction avoided impacts to a triangular slice of land containing the site adjacent to the east side of C.R. 0008. NYSDOT selected an alternative route that avoided impacts to the site.

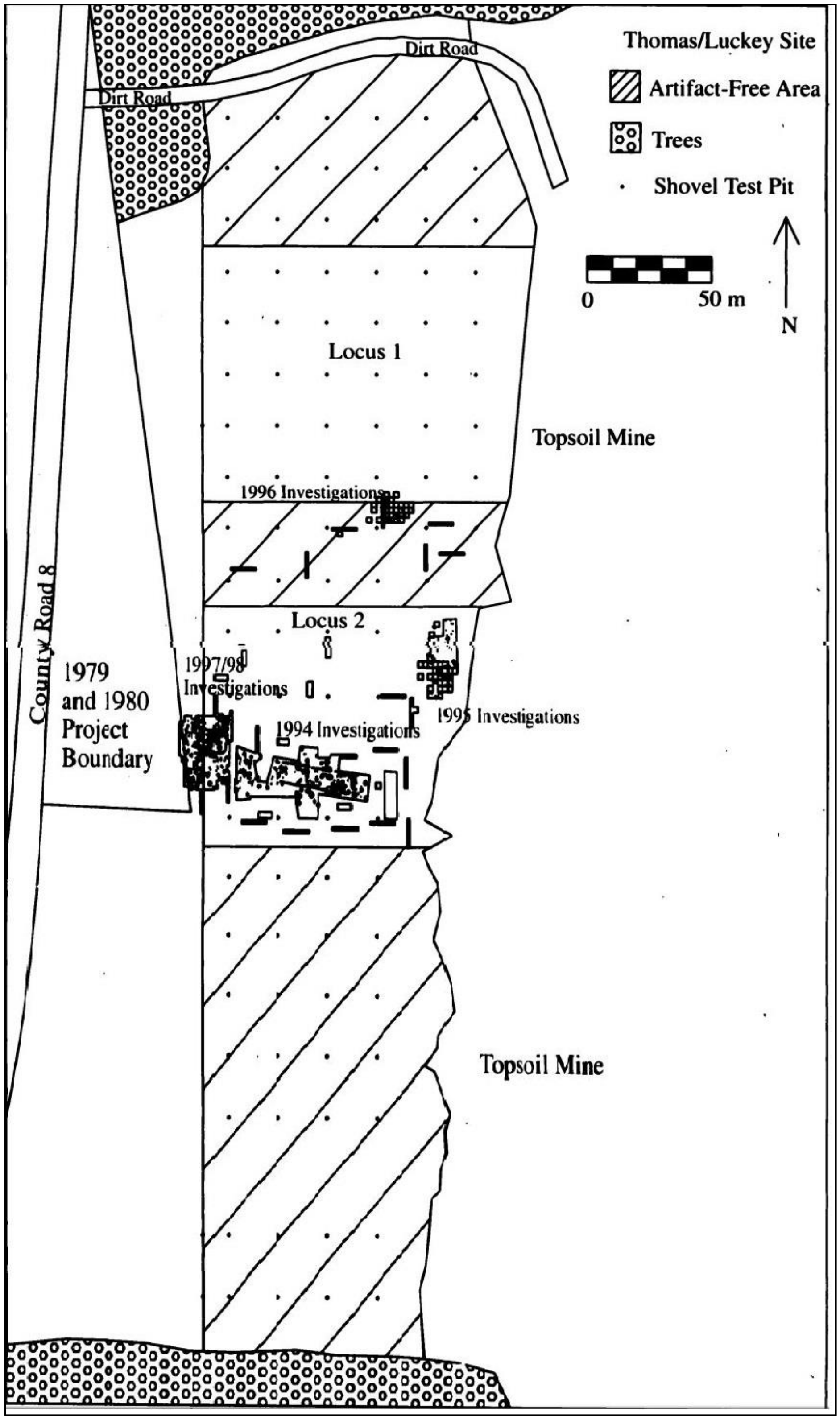


Figure 6. Thomas/Luckey site map (from Miroff 2002:177).

In 1991, Mr. Roland Thomas (the "Thomas" of the Thomas/Luckey site) applied for a permit to mine topsoil from a parcel to the east of the preserved section of the site. PAF received the Phase I contract and completed 106 STPs at 20 m intervals, following a systematic surface survey. This reconnaissance level survey identified an extension of the Thomas/Luckey site that covered 2.2 hectares (5.43 acres) divided into two loci. These concentrations both consisted of pottery, flakes, tools, and chert nodules. Locus 1 was approximately 1.2 hectares (2.96 acres). This locus produced a single feature containing bone and shell in the base of an STP. Locus 2 was approximately 0.76 hectares (1.87 acres), and contained a possible feature consisting of four pieces of fire-cracked rock (FCR). Features were mapped and photographed both in plan and in profile after cross sectioning when possible. All cultural materials were bagged by provenience and assigned Field Specimen (FS) numbers. The site extension had the potential to be eligible for the National Register.

In 1993, PAF conducted Phase II investigations at Locus 2 consisting of a series of 0.5 x 1.2 m (1.6 x 3.9 ft) backhoe trenches, one within each of several 20 x 20 m (65.6 x 65.6 ft) blocks. These trenches were excavated down to the sterile B horizon. Random portions of each trench were screened through 0.64 cm (1/4 in) mesh hardware cloth. No additional features were identified. The New York State Historic Preservation Office determined that the Thomas/Luckey site was eligible for the National Register. Mr. Thomas was unable to avoid impacts to the site and a final Phase III data recovery was authorized. Since Mr. Thomas, a local farmer, did not have the resources to fund an extensive Phase III investigation, Binghamton University offered to conduct the work with University field schools under an approved Data Recovery Plan. Tim Knapp, Binghamton doctoral student, directed the first and second summer field schools (Knapp 1996). Laurie Miroff directed subsequent field school students as well as the Community Archaeology Program (CAP) and completed her dissertation on the site (Miroff 1997, 2002) This work was above and beyond that of the initial permit and was conducted through his generosity.

Thomas/Luckey 1994-1998: Binghamton University Field Schools

Field investigations in 1994 investigated 1026 m^2 (3366 ft^2) from Locus 2 (Knapp 1996). The first method of excavation consisted of 16 exploratory trenches each measuring 10 m^2 (32.8 ft^2). After the mechanical stripping, the subsoil was exposed, and features were identified and excavated. Excavators screened a sample of the plow zone matrix through 3/8" mesh. Following this "trench and excavate" method, students, and members of PAF hand cleaned 81 m^2 (265.7 ft^2) of the subsoil that the trenches had uncovered to find features. Finally, this locus was also mechanically stripped of the plow zone with a backhoe around feature concentrations identified from the trenching. This mechanically removed material was not screened as the focus of the investigation was on features rather than artifacts. The mechanical stripping exposed 785 m^2 (2575.4 ft^2) of subsoil (Knapp 1996:36). The 1994 field school students uncovered a 6.5 x 32 m (21.3 x 104.9 ft) longhouse as well as additional post molds, storage pits, and hearth features. The arrangement of the post molds indicated that the longhouse was originally 19.5 m (63.9 ft) long, but was enlarged at some point during occupation (Knapp 1996; Miroff 2002).

In 1995, Knapp again directed field investigations, though at a smaller scale. Students excavated a combined 221 m^2 (725 ft^2) through stripping and test units. These investigations found additional features and artifacts. Knapp (1996) summarized the 1994 and 1995 summer data in the Data Recovery report presented to Roland Thomas.

Excavations continued during the summer of 1996 with a field school directed by Laurie Miroff, a doctoral student at Binghamton University. Based on examination of preliminary data from the 1995 field season, Miroff expected to uncover a second longhouse. The field school goal was to investigate this potential longhouse location and to provide data that would be compared with the first longhouse, allowing a discussion of community patterning. The excavation protocols were altered slightly, with test units hand excavated in 10 cm arbitrary levels, within natural stratigraphy and screened through 3/8 in (0.95 cm) mesh. Students and participants in PAF's Community Archaeology Program (CAP) completed a total of 112 m^2 (367.4 ft^2) with 28 2 x 2 m (6.4 x 6.4 ft) units, and a single 1 x 2 m (3.2 x 6.4 ft) unit. Excavations revealed many additional features, including 48 post molds, which lacked the patterning to suggest a structure. Excavations also revealed two hearths. The artifacts recovered included many pottery types, which added to the large assemblage from previous seasons of excavations.

In 1997, field school students and CAP members continued field investigations directed by Miroff. They completed seven trenches totaling 65 m^2 (213.2 ft^2), and 72 test units, excavating a total of 246 m^2 (807.1 ft^2). The excavation protocols were the same as the previous year. The field crew identified 50 additional features, including over 400 post molds. The posts formed a 16.5 x 6.3 m (54.1 x 20.6 ft) longhouse, referred to as

Structure 2. A possible expansion to this longhouse was noted as well but was not as clearly defined as Structure 1, the longhouse identified in 1994 (Miroff 2002:189).

The final year of archaeological excavations was 1998 (field school and CAP) directed by Miroff. Work continued near Structure 2 and crews completed 122 m^2 (Miroff 2002:191). Excavations identified 15 new features, some of which overlapped one another, and 84 additional post molds. Artifacts of all classes were recovered. All seasons of excavation and analysis were summarized in Miroff's 2002 doctoral dissertation.

Thomas/Luckey Summary

Archaeologists excavated more than 1729 m^2 (5672 ft^2), and identified two complete structures, and more than 140 features. The artifact assemblage included approximately 8780 ceramic sherds, 7368 flakes, and thousands of faunal and floral remains. Archaeologists identified 11 ceramic types at the site and obtained radiometric dates ranging from AD 662-1439. Wood from a feature with both Shenks Ferry and Kelso Corded ceramics was dated to AD 910, Beta-82473 (Feature 57 Maximum Calibration 2σ Range AD 723-1152) and wood from a feature with Kelso Corded and Oak Hill Corded was dated to AD 1263 Beta-82474 (Feature 75 Maximum Calibration 2σ Range AD 1159-1376). AMS dates for maize from three other features with Kelso Corded and Shenks Ferry Incised pottery types ranged from AD 1409-1434 (Maximum Calibration 2σ AD 1331-1483, Beta-144728; AD 1304-1446, Beta-144729; AD 1302-1443 Beta 144730) (Miroff 2002:182-183). The Thomas/Luckey produced dates that are outside the expected date ranges for those types.

The two structures would have contained at least one extended family in each. The longhouses have overlapping radiocarbon dates suggesting overlapping occupations, though the dates for Structure 1 extend further into the past (Knapp 1996; 2009:110; Miroff 2009). Excavations did not expose a palisade, which is not always present at Late Woodland villages and perhaps speaks to the relationship this community had with other groups.

Apart from post molds, storage pits of various types make up the most significant ways of informing archaeological study of the site. Smudge pits evidence the processing of animal hides into usable leather, amongst other uses. Feature contents revealed a varied diet at the site. Dietary remains include corn, beans, squash, elderberry, blueberry, and other wild foods. These foods were eaten, used medicinally or otherwise used as containers, as is often the case with certain varieties of gourds. Mammal, fish, and bird bones, as well as freshwater shells, also indicate a varied diet. Farm fields were likely nearby, benefitting from the overbank flooding events of the Chemung River depositing minerals and other nutrients into the soil. This setting was also home to the many animals used for food and other resources.

Losey 3

The Losey 3 site (Figure 7) was first recorded during John Witthoft's precontact site survey from 1948-1951(East et al. 2006c). It was identified then as the Locy site and designated as 36TI0023 by the Pennsylvania Historical and Museum Commission (PHMC). This site map that was recorded in the Pennsylvania Site Survey (PASS) files in 1976 only marginally touched the project's area of potential effect (APE), but the map was based on approximate and verbal recordation. Additionally, local informants indicated overlapping site concentrations which were confirmed through Phase I excavations. These concentrations met the Pennsylvania criteria for site status and they were designated the Losey 1 (36TI0129), Losey 3 (36TI0028), and Losey 4 (36TI0130) sites (East et al. 2006c). The alteration of the spelling of the name is not known, however, Losey 3 retains the original site number and is the largest of the identified sites from these investigations.

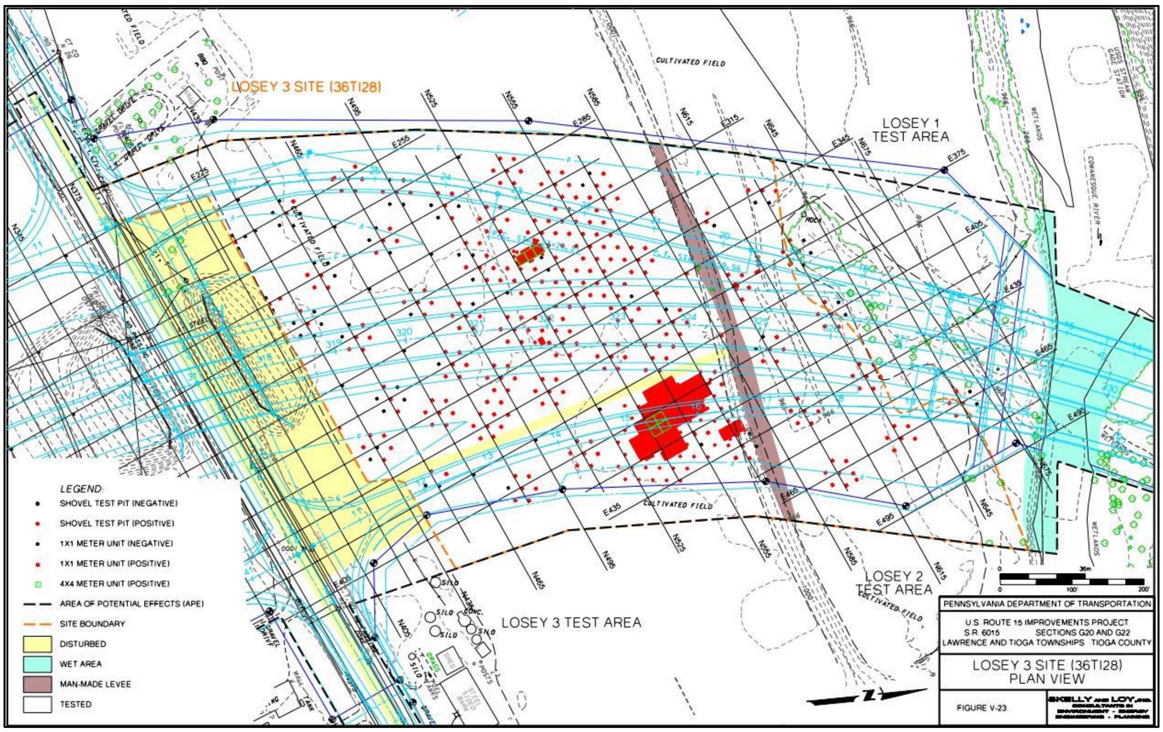


Figure 7. Losey 3 site map (from East et al. 2006b:V-23).

Losey 3 Phase I

In 2001 archaeologists conducted Phase I investigations north of Pennsylvania S.R. 00049 and these confirmed the cultural deposits noted by Witthoft and local informants. The Phase I investigations included geomorphological investigations conducted by Project Geomorphologist Margaret G. Sams to identify appropriate places for Phase IB testing. For investigations on the Cowanesque River floodplain where the Losey 3 site is located, Dr. Frank Vento, formerly of Clarion University, served as a geomorphological consultant aiding in preliminary soil characterizations of the area (East et al. 2006c:103). This investigation consisted of eight backhoe trenches on the T2 terrace, three on the T1 terrace, and two on the T0 terrace. The Phase IA excavations in the Losey 3 test area consisted of 32 tests units, measuring 1.0 x 1.0 m (3.3 x 3.3 ft) and abbreviated as 1x1s (East et al. 2006c:132). All but nine were positive for precontact artifacts. Deep testing (to gravels) was employed within all alluvial deposits (East et al. 2006c). All soil was dry screened through 0.64 cm (1/4 in) hardware cloth. Features were mapped and photographed both in plan and in profile after cross sectioning when possible. All cultural materials were bagged by provenience and assigned Field Specimen (FS) numbers.

Losey 3 Phase II

This testing consisted of 1x1s in areas that were untested in the prior phase. These 1x1 units were centered in a square formed by four prior test units and excavated to gravels. Other test units were added and eventually opened into two larger block excavations. These blocks (East and West) began with the removal of 4.0 x 4.0 m (13.1 x 13.1 ft) sections of plowzone and bulk screened. On February 1, 2002 a meeting occurred between Skelly and Loy, Inc., PHMC, and PennDOT representatives from Engineering District 3-0 to discuss interim results and plan for the Phase III Mitigation (East et al. 2006c:137). This date marks the “end” of the Phase II excavations. During both Phases I and II, archaeologists excavated numerous post molds, and over 60 features. Excavations produced thousands of artifacts including Late and Middle Woodland projectile points and pottery.

Losey 3 Phase III

The Phase III field methods were the same as that of the two prior phases, though concentrated into two larger areas: Area A (Eastern) and Area B (Western) consisting of multiple blocks. Crews removed the plowzone in 5.0 x 5.0 m (16.4 x 16.4 ft) units (5x5s), and bulk screened. Within these larger blocks any sub-plowzone work was conducted in 1x1s. Features were excavated and documented in the same manner as the previous phases. Additional 5.0 m (16.4 ft) long trenches were placed to locate features and feature clusters across the site. Once mechanically stripped by smooth-bladed heavy machinery, these trenches were shovel scraped by archaeologists to look for features.

Losey 3 Completion of Excavation

The end of excavations came soon after May 27th, 2004, following another meeting, after human remains were discovered at the site (East et al. 2006b:28-29). This led to limited excavations while a path forward was figured out. Federal consultation with the Seneca Nation and other tribes and groups, led by the Federal Highway Administration (FHWA), resulted in the termination of excavation to respect the burial places of their ancestors and to comply with the Native American Graves Protection and Repatriation Act (NAGPRA). Dar Dhody, Seneca Nation Faithkeeper, declared the site as hallowed ground (Snow 2007). Disturbed burials were reburied on site, and the site was covered with geotextile and fill. No vessel sherds from those features were retained as part of the analyzed collection, and as such no vessels from burials were analyzed during my research.

Losey 3 Summary

Archaeologists excavated 1,187.0 m^2 (12,777.2 ft^2) at Losey 3, with an additional 5,750.0 m^2 (61,894.5 ft^2) of mechanized plowzone removal. Excavations, directed by Skelly and Loy, Inc., collected a total of 77,485 lithics and 40,426 sherds (representing a minimum of 154 vessels), uncovering 341 features and 1,622 post molds. Importantly for comparison to Thomas/Luckey, this site also identified two longhouse structures, as well as several keyhole structures. Excavators collected 31 samples for radiometric dating, of which 20 were sent out for Accelerator Mass Spectrometry (AMS) dating. While Kelso Corded and Shenks Ferry vessels that were sampled for this research co-occurred in three features (37, 71, and 149) and one unit (N540 E410) none of these contexts were radiocarbon dated providing no directly comparable dates to similar features at Thomas/Luckey. However, these specific vessels were directly dated through Optically Stimulated Luminescence (OSL). These dates are presented in Table 5 as performed by the University of Oxford Luminescence Dating Laboratory. The eastern longhouse was dated from AD 1300-1450 and the western longhouse was dated to AD 1450-1640 (East et al. 2006a; Espenshade 2014).

Table 5. Selected Losey 3 OSL Dates (Adapted From Table V-21 East et al. 2006b).

FS. No.	**Type, Vessel Number, TL Sample Number**	**Context**	**OSL Age Estimate**
1403.12, 1403.13, 1403.17	Shenks Ferry Incised, Vessel 35, TL-3	In upper fill of Feature 74 (keyhole), 10-20 cm level. This should represent refuse from later occupation, not from use of keyhole. From same vessel as TL-4. Expected date of A.D. 1300-1400.	A.D. 1254±120 (AD 1134-1374)
1403.15, 1405.1	Shenks Ferry Incised, Vessel 35, TL-4	In upper fill of Feature 74 (keyhole), 10-20 cm level. This should represent refuse from later occupation, not from use of keyhole. From same vessel as TL-3. Expected date of A.D. 1300-1400.	A.D. 1364±90 (AD 1274-1454)
4960.1	Shenks Ferry Incised, Vessel 86, TL-5	Feature 149, small pit which also contains Kelso and Shenks Ferry-Kelso hybrid. Expected date of A.D. 1300-1400.	A.D. 1284±180 (AD 1104-1464)
4954.1	Kelso Corded Collar, Vessel 85, TL-6	Feature 149, small pit which also contains Kelso and Shenks Ferry-Kelso hybrid. Expected date of A.D. 1300-1400.	A.D. 1394±80 (AD 1314-1474)
1064.1	Kelso Corded Collar, Vessel 2, TL-7	Feature 71, small pit near Feature 74 (keyhole). Shenks Ferry Incised also found in this feature. Expected date of A.D. 1300- 1400.	A.D. 1304±140 (AD 1164-1444)
896.1	Kelso Corded Collar, Vessel 1, TL-8	Feature 37, large pit near Feature 74 (keyhole). Shenks Ferry Incised also found in this feature. Expected date of A.D. 1300- 1400.	A.D. 1264±100 (AD 1164-1364)
1026.1	Kelso Corded Collar, Vessel 11, TL-9	Feature 61, large pit near Feature 74 (keyhole). Shenks Ferry Incised also occurred in this feature. Expected date of A.D. 1300-1400.	A.D. 1084±110 (AD 974-1194)

The site is currently listed as between 11% and 49% intact and is considered eligible for listing on the National Register of Historic Places by the PHMC.

While the site has a deep history of occupation, with components from the Late Archaic to the Late Woodland and even possibly into the Contact period, the occupation of the Late Woodland is of interest to this thesis research. Excavations revealed a portion of a palisade, a feature often found on Late Woodland settlements, but that is absent at Thomas/Luckey. The palisade would have contained the heart of the settlement, the longhouse, and other structures. The palisade crosses the southern part of the longhouse, creating an entrance to the palisade segment. The construction order of the palisade and the longhouses is difficult to determine as the palisade appears to predate the longhouse, or at least the intersected portion of the longhouse. What is unknown is if a smaller longhouse was initially enclosed in the palisade, and the longhouse was expanded with the construction of the palisade.

One of the small keyhole structures (Feature 74) was located within the Eastern longhouse in Area A (East et al. 2006b:39). These types of structures are primarily located within the valleys of central and southern Pennsylvania and are of unknown use. They have been variously interpreted as sweat lodges, housing structures, or smokehouses. Keyhole structures may have been storage structures, though they also may have had varied functions (MacDonald 2008).

Analysis showed that the site contained evidence of two longhouse structures, based on the arrangement of post-molds, fire pits, and other key features of the building. Based on historical accounts and modern information, several family groups would have inhabited each longhouse and conducted family life there. Faunal remains indicate a varied diet. Features yielded evidence of corn, beans, and squash in the floated samples from storage pits, as well as residues from the inside of some ceramic vessel sherds. Storage pits make up many of the cultural features found at the site, and while initially used for storage, they ended their use life as refuse or burial pits. Other more purpose-built pits include smudge pits, used for burning of plants or bark to help prepare hides for processing, and hearths which were used for cooking, illumination, resource processing and pottery production. These are primarily differentiated by the depth and intensity of charred plant materials.

The rich artifact and sample assemblages provide insight for food and resource procurement and preparation as well as how the community situated itself in and on the landscape. The site illuminates the manufacturing of lithics, both chipped stone tools and ground stone. Important to my research is the evidence of regional interactions through the Kelso Corded and Shenks Ferry pottery at the site.

Summary

The research for this thesis relied on the field investigations and analyses conducted on previously excavated sites. This chapter outlined previous investigations at the Thomas/Luckey and Losey 3 sites. The two sites share similar investigations; they were professionally excavated and analyzed with great care taken during the excavation to map and record the context of the field operations. Both sites are the result of regulative compliancy driven projects but have benefitted from further investigations from agreed upon mitigation, and continued research projects. While longhouses are present at each site, the keyhole structures and larger size of Losey 3 overall suggest a more diverse occupation, though the two sites share agricultural economies and habitation strategies. Additionally, the sites have evidence for pottery from two cultural traditions, with no clear separation of Kelso Corded and Shenks Ferry tradition vessels at either site. For the present study, a sample of sherds from the two pottery types was analyzed using pXRF to establish the similarity or dissimilarity of paste used to construct each type and understand what that, in turn, means for how identity may be expressed in the construction of pottery vessels.

CHAPTER 5. METHODS OF ANALYSIS

The research presented in this thesis is largely based on existing artifact collections, with a minor field component of raw clay collection. The Thomas/Luckey assemblage is housed at Binghamton University and curated by the Public Archaeology Facility, in Binghamton, New York; the Losey 3 assemblage is curated at the State Museum of Pennsylvania by the Pennsylvania Historical and Museum Commission. In this chapter I present a description of the relevant artifact assemblages, including the rationale for selecting these sites and sherds. This is followed by an account of the raw clay sample collection. I continue with a discussion of the methods used to pretreat the sherds and clay prior to analysis. Finally, I describe the instrumentation selected for the analysis of sherds and raw clay followed by an explanation of the statistical validation of resulting data.

Rationale for Selected Methods

Researchers (East et al. 2006; Knapp 1996, 2009; Miroff 2002, 2009) have demonstrated that artifacts and features from Thomas/Luckey and Losey 3 reflect important facets of Late Woodland life on the Allegheny Plateau. While all artifact classes are important to understanding the communities and the individuals living within these villages, this thesis focuses on pottery. Archaeological investigations and decades of analysis show that ceramic types generally can be tied to specific regions, with some amount of overlap of types and regions. It is not as clear if ceramic paste is tied to pottery types and regions. I propose to test this possibility with the methods presented in this chapter.

The typologies developed to classify pottery in the Northeastern United States rely heavily on the decoration of rims, necks, and collars. Therefore, I selected rim, neck, and collar sherds from Shenks Ferry, Kelso Corded, and Oak Hill Corded vessels since these sections of a vessel contain the most diagnostic elements. Body sherds generally cannot be assigned to an existing type since they are remarkably similar in appearance and lack distinguishing characteristics.

In terms of the regional distribution of these types, Shenks Ferry Incised is a major type on many sites within the valleys of Pennsylvania. In contrast, Oak Hill Corded is found mostly on sites within the valleys of New York. Kelso Corded occurs in both contexts. Shenks Ferry Incised pottery is discussed in the Pennsylvania literature more frequently than in New York (Espenshade 2014; Graybill and Herbstritt 2014; Heisey 1971; Herbstritt 2019b, 2020; Herbstritt and Kent 1989; Kinsey and Graybill 1971; Lucy 1959). Thus, Shenks Ferry Incised is often interpreted as a non-local pottery type when recovered from sites in New York. The opposite is true for Oak Hill Corded, which is widely discussed in New York literature but rarely across the state's southern border, while Kelso Corded is widely discussed in New York but also found in Pennsylvania. (Lenig 1965; MacNeish 1952; Rieth 2004; Ritchie and MacNeish 1949). Kelso Corded is less commonly tracked in Pennsylvania, and therefore researchers may be less likely to identify it outside of its expected territory. This may contribute to obscuring its presence. As discussed further below, Oak Hill Corded was included in this analysis to provide a measure of a compositional control at the site. Oak Hill Corded is rarely identified in

Pennsylvania. These vessels were included because they are definitively a New York type. They are essentially a control group and provide another type to examine. The current borders of each state are, of course, modern inventions and had no cultural meaning in the past. Cultural boundaries are more permeable, allowing for overlap of ethnic groups, while communities of practice are fluid and allow for an individual to participate in multiple communities, especially at the periphery of a territory. This would be exhibited by typically New York types at the same site as typically central Pennsylvania types, such as is the case at Thomas/Luckey and Losey 3.

The basic premise of this thesis is that while decorations on clay vessels can be copied, imitated, or emulated, paste composition cannot. Paste composition is tied to a clay source, which could, in turn, be part of group tradition and communities of practice. Studying paste composition can tell researchers where the clay for a vessel was collected and similarly, if differently decorated vessels were made from the same clay. Shenks Ferry and Kelso Corded, while cooccurring in the same states, do not overlap significantly, and therefore different elemental compositions are expected and should be discernable through pXRF analysis. These expectations can be presented in the form of alternative hypotheses that will be tested with pXRF analysis and statistical validation.

The **null hypothesis** I am testing is that there is no difference in the clay used for either type, meaning that both the Thomas/Luckey and Losey 3 potters made both Shenks Ferry and Kelso Corded vessels from clay collected from elementally similar quarries in the region.

Alternatively, a **second hypothesis** would propose a difference between the two sites in terms of the clay used for both types of pottery but no distinction between vessels within a site's assemblage suggesting a tradition of using nearby regional clay quarries for all vessels manufactured by a community at each site.

A **third hypothesis** would propose that the different types of pottery styles within each site used clay from different sources, suggesting that the potters participated in their own traditional communities of practice regarding where to acquire clay. This hypothesis begets more interpretation as differences in composition between types at sites could also signify that these non-local vessels were brought in or traded in. The paste of the assemblages may differ by stream valley, which may imply that the Kelso Corded and Shenks Ferry vessels were made from the same quarries at each site but that potters did not travel very far from either site to gather clay. Alternatively, the Shenks Ferry potters may have returned to their natal clay sources. Determining which of these two sub-hypotheses best fit is accomplished through the gathering of local clay samples for testing.

A **fourth hypothesis** is that Shenks Ferry vessels and Kelso Corded vessels are not elementally similar within assemblages, and the site assemblages are also distinct. This would assume at least four distinct sources of clay, with Losey 3's assemblage and Thomas/Luckey's assemblage sharing no clay.

If the difference between the vessels' composition is profound and not like the clay samples gathered, it could indicate a different regional provenience for the Shenks Ferry and Kelso Corded vessels outside my collection areas.

The inclusion of Oak Hill Corded vessels in this study provides an example of distinctly New York pottery. The Oak Hill Corded pottery is a control sample.

The raw clay samples recently acquired are included to provide examples of elemental signatures for local clays that could be related to the production of pots at the two sites. Elemental similarity among the three pottery types does not necessarily show that were made from clays found near the sites; it only shows that they are made from similar clay. However, an elemental similarity to the raw clay samples illustrates a geographical connection of the vessels to this region.

Thomas/Luckey and Losey 3 were selected for comparison because of the similarity of their pottery assemblages, a similar time frame of occupation, and because Losey 3 is situated in a different drainage from Thomas/Luckey. While modern borders are artificial and tend to ignore the landscape, natural boundaries often governed or guided occupations in the past (Feuer 2016). Although two different drainages are represented, both are on the Appalachian Plateau. This comparison between the two sites presented an opportunity to address the research question about how pottery paste might provide evidence for how communities of practice created identities that influenced the selection of clay. Comparing the two sites illuminates differing levels of involvement of these individuals in a community of practice in the Late Woodland Northeast and will address how individuals reproduced identity when situated near a different cultural boundary or when absorbed into another community (Figure 4).

To answer the question about sourcing, archaeologists have used a variety of techniques to examine the composition of pottery paste. While visual identification of paste is possible, this approach is not measurable, and therefore less accurate than other techniques. Ceramic petrography is one method that has been used in pottery analysis, specific to sourcing. This form of analysis relies on slicing a very thin section of a pot and examining it under cross polarized light. Minerals in the clay and the temper will be illuminated in unique ways, be it color, plating, or reflectance at a given position of the light (Rice 2015). This aids the researcher in identifying the component minerals of the pot. However, this technique, like some others, is destructive and therefore less desirable for the analysis of some collections. Destructive techniques were not considered for my research, as the pottery analyzed is rare and should be preserved for future researchers. Given its destructive nature, examination of temper makes thin sectioning unsuitable for my research here, though it has been useful for sourcing pottery elsewhere (Wright 2019).

A second destructive method that has been widely used is that of acid digestive Inductively Coupled Plasma Mass Spectrometry (ICP MS). This method begins with powdering the sample to be assayed allowing for bulk analysis. This offers a very fine-grained view of the elemental composition of a sample at the cost of replicability, as the sample is destroyed.

It is no longer the place of the archaeologist to decide what should be sacrificed in the pursuit of science. Until recently, archaeologists have been the sole controllers of past knowledge without input from descendant communities or the lay public. Unique specimens and culturally valuable objects and human remains have been lost because of the overzealous nature of scholars (Colwell-Chanthaphonh et al. 2010; Deloria 1969; Watkins 2000). I have chosen to adopt less destructive techniques for this thesis, following in the same vein as other Northeastern researchers (Kuhn 1986; Rieth 1998; Rieth et al. 2007).

My research utilizes portable X-Ray Fluorescence (pXRF) to investigate the chemical composition of the pottery paste and assess the origin of non-local vessels at each site. Details of operation and principles behind its effectiveness are addressed in Chapter 6. While studying the composition of vessels and the motifs or decorations present are accomplished in different ways, both tell us about trading, group relations, and, in turn, identity. Also, using this method is supported by similar research into the composition of pottery (Hawkins et al. 2016; Kuhn 1986; Rieth 1997; Rieth et al. 2007). In other regions, researchers such as Stoner (2016), Wright et al. (2008), and Wright (2019) have demonstrated the validity and utility of combining techniques, such as pXRF and Neutron Activation Analysis (NAA), or pXRF and ICP MS to leverage strengths and compensate for weaknesses in each. The protocols and research results of these authors helped guide the analytical process for this thesis, despite only pXRF being used for this research.

Assemblage Selection

Both the Thomas/Luckey and Losey 3 sites contained mixed assemblages of decorated pottery. Thomas/Luckey contained Shenks Ferry Corded, Kelso Corded, and Oak Hill Corded pottery. Losey 3 did not contain Oak Hill Corded sherds but produced a large assemblage of classic Shenks Ferry and Kelso Corded pottery with ratios of Shenks Ferry to Kelso Corded similar to those at Thomas/Luckey (Table 6). While the proportion of Shenks Ferry to Kelso Corded vessels at each site is similar, this could be happenstance related to preservation, sampling strategies, or the inhabitants' disposal patterns. While important to note, this alone does not mean the proportions of the groups at each site were the same.

Table 6. Proportions of Kelso Corded to Shenks Ferry at Losey 3 and Thomas/Luckey.

Pottery Type	**Thomas/Luckey**		**Losey 3**	
Kelso Corded	33 Vessels	41%	37 Vessels	46%
Shenks Ferry Incised	47 Vessels	59%	44 Vessels	54%

Sherd Sample Selection Process

The sample selection from Thomas/Luckey included sherds from Shenks Ferry Corded and Shenks Ferry Incised, Kelso Corded, and Oak Hill Corded vessels. The resulting sample included 130 sherds representing 87 vessels for testing[3] All positively typed, diagnostic sherds of Kelso Corded, Shenks Ferry (Incised, Cord-Impressed, Multi-Banded), and Oak Hill Corded from Thomas/Luckey were included because of the small sample size. Decoration for these types is most prominent at the neck and rim of a vessel and, thus, the sample consists of those fragments. The Shenks Ferry sample consisted of 76 sherds from 47 vessels across 30 contexts (e.g., features, units, surface, etc.). The Kelso Corded sample included 46 sherds from 33 vessels across 28 contexts. Oak Hill Corded was represented by eight sherds from seven vessels across seven contexts (Table 7).

Table 7. Thomas/Luckey Sherd Provenience Distribution.

Thomas/Luckey	**Number of Contexts (Sherd Count)**		
Context	**Shenks Ferry**	**Kelso Corded**	**Oak Hill Corded**
Within Feature	15 (51 sherds)	7 (20 sherds)	1 (1 sherd)
Within Unit	14 (21 sherds)	21 (26 sherds)	5 (6 sherds)
On Surface	1 (3 sherds)	0	1 (1 sherd)
In Trench	1 (1 sherd)	0	0
Total sherds	30 (76 sherds)	28 (46 sherds)	7 (8 sherds)

[3] While the sample size is statistically small, and minor variations may skew the data excessively, as I am using all available Shenks Ferry ceramics from the site and hope that these preliminary data spur further work on this subject.

Shenks Ferry and Kelso Corded vessels both occur inside Structures 1 and 2 at the Thomas/Luckey site (Table 8). Due to a cross mend as well as consistent radiometric dates, the structures were likely occupied contemporaneously, though Structure 1 did produce dates that are older than those obtained from in and around Structure 2 (Miroff 2002).

Table 8. Thomas/Luckey Distribution of Vessels in Structures.

Thomas/Luckey	Sherd Count from within Structures		
Provenience	Kelso	Shenks Ferry	Oak Hill
Structure 1	5	7	0
Structure 2	2	1	1
Total Sherds	7	8	1

The Losey 3 site presented a complex assemblage of materials, vessels, and contexts and although only the east longhouse in area A was excavated, Shenks Ferry and Kelso corded pottery cooccurred, illustrating that at Losey 3 as well as Thomas/Luckey there was a mixture of both pottery types in habitation spaces.

To facilitate comparison, a single sherd from each Losey 3 vessel was selected for analysis because there were more sherds per vessel than at Thomas/Luckey and because of transport and storage concerns while the collection was away from the SMOP. The Losey 3 analytical sample was based on vessels that were positively assigned to either Shenks Ferry or Kelso Corded. Included in the assemblage was a hybrid Shenks Ferry/Kelso Corded vessel fragment. This was analyzed to better understand where such a hybrid should have been assigned and what the hybridization might represent. The total number of vessels/sherds analyzed from Losey 3 was 57 (Table 9). The Kelso Corded sample included 30 sherds from 30 vessels across 26 contexts. Vessels fitting into the

Shenks Ferry type were represented by 27 sherds from 27 vessels across 24 contexts The Shenks Ferry/Kelso Hybrid is included in the Kelso counts, and was found in a feature in the eastern longhouse (East et al. 2006a). No sherds typed as Oak Hill Corded were identified at the Losey 3 site.

Table 9. Losey 3 Vessel Provenience Distribution.

Losey 3	**Count**	
Provenience	**Kelso**	**Shenks Ferry**
Features	10	12
Surface	0	0
Units	20	15
Total sherds	30	27

As with the Thomas/Luckey sherds, I relied on previous typing of each site's assemblage (East 2006; Knapp 1996; Miroff 2002). No attempt was made to reexamine sherd types.

Raw Clay Collection Process

In addition to analyzing vessel paste, I collected raw clay samples from four sources for analysis. Daniel Rhodes, Education Coordinator of the Bradford County Conservation District, helped with the identification of the clay sources and collection of the clay (Figure 8).

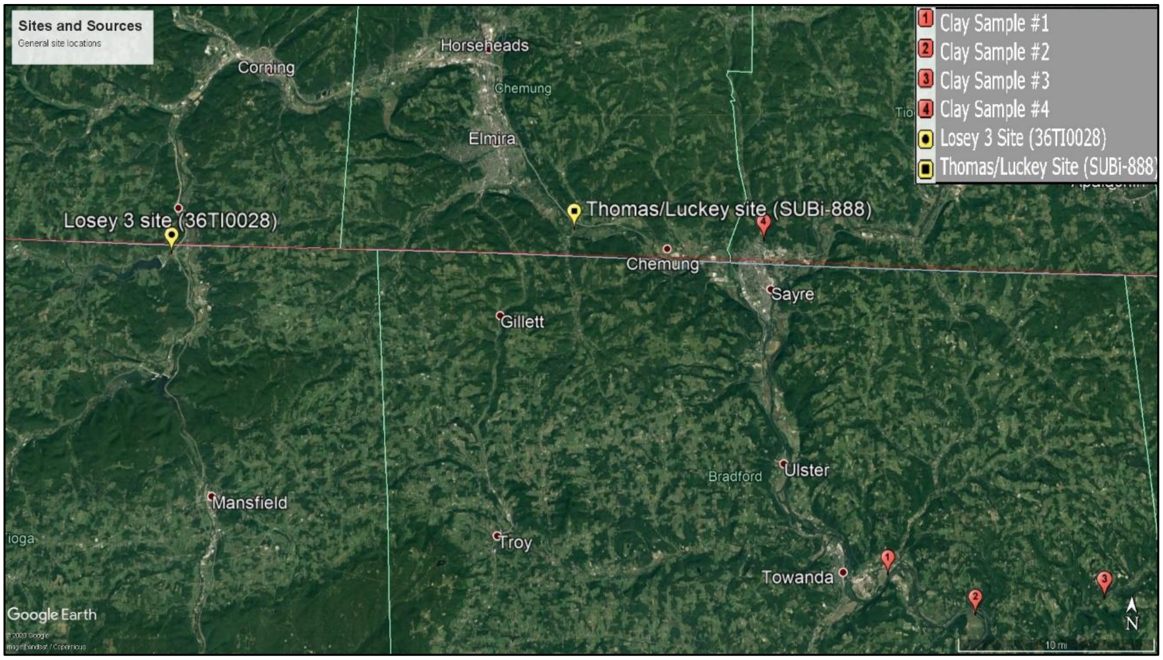


Figure 8. Study area with both sites and the sampled clay outcrops.

On January 10th, 2020 Rhodes guided me to two sources of raw clay (Sources #1 and #2). Source #1 is located on Laning Creek near Towanda, Pennsylvania, and we collected 2.3 kg (4.7 lb.) of raw clay. Source #2 is located on the Susquehanna River, near French Azilum, a historic site near the town of Wyalusing, Pennsylvania. We collected 1.5 kg (3.5 lb.) of clay at this source. Source #3 is positioned on Wyalusing Creek, near Stevensville, Pennsylvania; we visited this source on January 24th 2020 and obtained 3.4 kg (7.6 lb.) of clay. Finally, Source #4, located on Cayuta Creek, near Waverly, New York, was sampled on January 31st, 2020 and we collected 1.5 kg (3.2 lb.) of clay. The closest source from either site is 16.1 km (10 mi) and the furthest is 83.6k (52 mi; Table 10). Clay from each source was bagged individually and marked with its source number, provenience, and content to prevent contamination.

Table 10. Distance to Sites from Clay Sources.

Source	**Coordinates**	**Distance to Thomas/Luckey**	**Distance to Losey 3**
Source #1	(41.767313, -76.398330)	38.6 km (24 mi)	65 km (41 mi)
Source #2	(41.740552, -76.312436)	45.1 km (28 mi)	74 km (46 mi)
Source #3	(41.754437, -76.183939)	53.1 km (33mi)	83.6 km (52 mi)
Source #4	(42.018159, -76.523078)	16.1 km (10 mi)	49.8 km (31 mi)

Source #1 (41.767313, -76.398330) is located at the mouth of Laning Creek, a tributary channel of the Susquehanna River near the Wysox SR 187 Bridge Boat Launch east of Towanda, PA (Figure 9). A clear vein of clay was known to exist here in the stratigraphy of the cut bank, but it could not be located at the time of survey. Therefore, I augured the clay from the stream bottom and submerged bank (Photo 5).

Photo 5. Author extracting clay from Source #1.

Source #2 (41.740552, -76.312436) is in the southern bank of the Susquehanna River, northwest of French Asylum, Pennsylvania (Figure 9). The visibility of this source is dependent on the river's water level, and luckily it was visible in the bank at the time of our visit. The clay formed a channel for runoff from the fields above. We excavated clay from this source with a shovel (Photo 6).

Photo 6. Clay Source #2 after removal.

Source #3 (41.754437, -76.183939) is located on the eastern bank of Wyalusing Creek, southwest of the town of Stevensville, Pennsylvania near the headwaters of Wyalusing Creek (Figure 9). Wyalusing Creek is a tributary of the Susquehanna River, north of Rush Township, Susquehanna County. This source protrudes from the bank into the stream and is accessible from the shore (Photo 7). The stream was shallow and not navigable when we visited, but seasonal fluctuation can change that. In the past the creek may have been more accessible with a higher average water level. No other clay was observed within 100 m (328 ft) north or south of the outcrop. The extent of the clay that is still buried is unknown, but it likely extends into the hill embankment.

Photo 7. Clay Source #3.

Source #4 (42.018159, -76.523078) is located on the western bank of a meander of Cayuta Creek, north of Waverly, NY (Figure 9). Cayuta Creek is a tributary of the Susquehanna River, and the creek flows from its origin, Cayuta Lake. This source was visible in the bank and extended into the river, where it was perched above the creek bed, but still submerged (Photo 8). Some portions of the meander were frozen, but the clay was not below ice. Past individuals, including those from Thomas/Lucky and Losey 3, would have been able to navigate from the Susquehanna River to the outcrop.

Photo 8. Clay Source #4.

While the four sources sampled are not located near the Thomas/Luckey site or the Losey 3 site, they would have been accessible during the sites' occupations by canoe. The Susquehanna River provides a linkage for all the clay outcrops in this study and both sites. The Chemung River flows into the Susquehanna, and Wyalusing and Cayuta Creek are tributaries of the Susquehanna. These connections would have allowed easy waterborne navigation and transport of large quantities of high-quality clay for potters. Additionally, all quarries are along or near historically documented Native American paths; the Great Warriors Path, the Horseheads Path, the Wysaukin Path, and the Tioga Path are all located nearby (Wallace 1965;Figure 9).

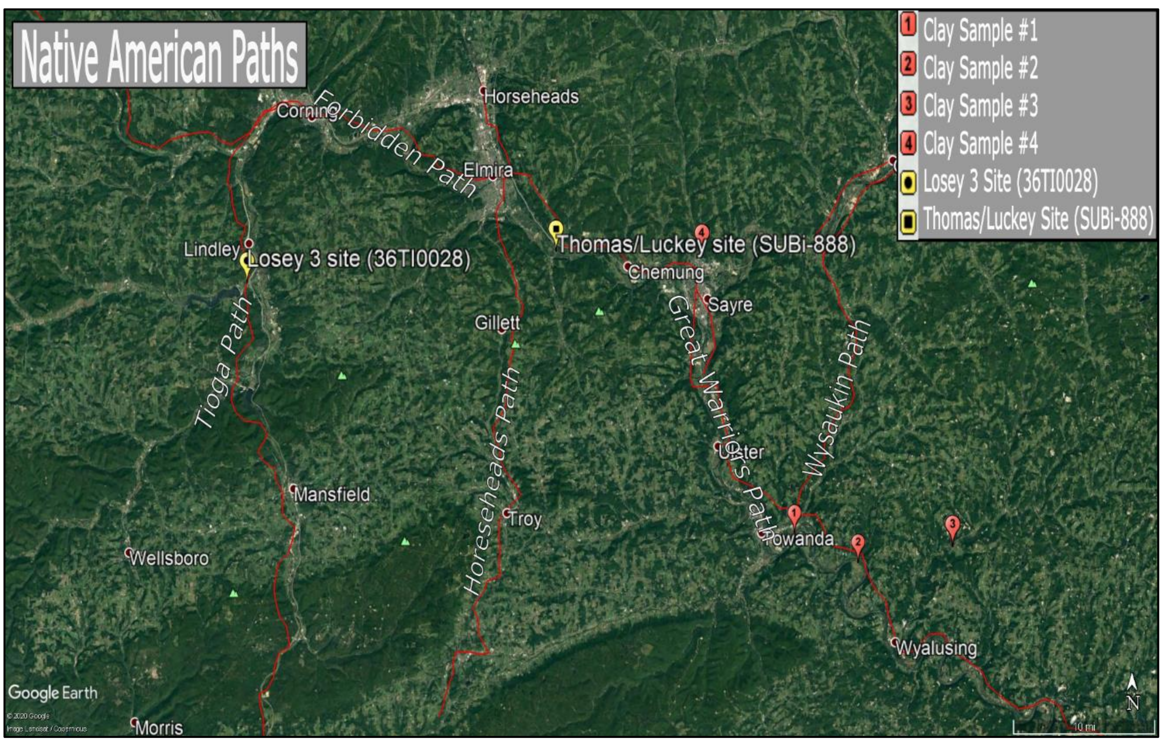


Figure 9. Paths in proximity to study area as documented by Wallace (1965).

Pretreatments

Sherds from both sites and the clay samples needed to be treated prior to analysis to prevent contamination of the sample, instrument, or data. These pretreatments varied by sample as described in the following sections. While vessel sherds are dry and clean, apart from any surface residue, raw clay requires some refinement before testing. Clay must be dried, homogenized by grinding, and pelletized to be useful in analysis. These steps also prevent contamination of the instrumentation when it is processed.

Thomas/Luckey Assemblage

The Thomas/Luckey assemblage derived from CRM and field school excavations. Students and staff cleaned artifacts with dry brushes or tap-water dampened brushes, as necessary. The principal investigators cataloged the artifacts and then placed them in 3 mil plastic bags with provenience tags.

Prior to pXRF analysis, I rewashed all the sherds with deionized water to remove any surface contaminants. The sherds were then brushed with a new and unused toothbrush. Artifacts were dried on ¼” (6.35mm) drying racks and placed into 3 mil (.1 in) bags. Following these pretreatments, the artifacts were kept in the PAF laboratory for secured storage between analyses.

Losey 3 Assemblage

All artifacts were excavated and cleaned according to State Museum of Pennsylvania curation guidelines at Skelly and Loy’s processing lab (Commission 2006). In compliance with these guidelines, the sherds were cleaned with dry brushes or tap-water dampened brushes, as necessary. The artifacts were catalogued with provenience information and kept in 3 mil plastic bags. All SMOP artifacts were kept in the PAF laboratory for secured storage between analyses. I did not clean the artifacts after receiving them from the SMOP as I realized it was unnecessary after having cleaned the Thomas/Luckey assemblage.

Clay

Like the sherds, raw clay should not be analyzed without first removing its impurities, such as grass, roots, rocks, etc. Once visible impurities are removed, the clay needs to be processed in such a way as to allow analysis via pXRF. A slab of wet raw clay on top of the pXRF will contaminate the sensor or require new sensor protective film to be used each time, as the clay will leave a residue. As such, the raw clay was subjected to pretreatment protocols prior to application of analytical techniques.

A portion of each clay sample was dried in an oven for two hours at 250° F to remove moisture. All samples were then air dried overnight to ensure that all moisture was removed. The clay was pulverized in a hand operated mortar and pestle to powderize the dried sample. The powder was then placed into the KJ group, 12 ton, ½ inch die and placed into the hydraulic press (KJ group TMI YLJ -15-ton press). The device applied pressure of 4000 to 4500 psi. This produced a compacted pellet that was placed into a clean 3 mil bag. Standard practices, described below, were followed between each analysis to prevent contamination (Josh Novello, personal communication, February, 2020). The die was stored in mineral oil between uses. This mineral oil was removed with 91% isopropyl alcohol. Between each compaction, all components were cleansed with the isopropyl alcohol. After the separation of a pure sample free from any other visible contaminates, each processed sample was analyzed via pXRF at the New York

State Museum (NYSM). These tests were conducted with the same parameters as the pottery sherds, discussed below.

pXRF Analysis

Portable X-Ray Fluorescence (pXRF) is a non-destructive method that has seen broad adoption as well as broad debate over accuracy, replicability, and resolution in archaeology (Frahm and Doonan 2013; Shackley 2010). There is no single factor that has precipitated its adoption; it is the culmination of many factors: comparatively low cost for both ownership and operation, portability, and suitability for broad and rapid testing. The ability of pXRF to test all the available sherds in my sample aids in generating a broader and more accurate understanding of the chemical composition of the assemblage.

The pXRF involves bombarding the sample with charged photons or X-rays. When this energy interacts with the sample, it displaces electrons from different valence shells in the sample. When the bombardment is interrupted, the electrons will fall back into place and give off a burst of energy (Frahm and Doonan 2013). This outburst is known as *bremsstrahlung* radiation and is identified by the device and then later correlated into elemental presence. This correlates to a given element and is interpreted by a sensor housed within the machine.

The NYSM generously provided me with access to their Bruker Tracer III-V for analysis. This series of pXRF devices is limited to viewing elements with atomic weights heavier than that of titanium (Ti), but only up through niobium (Nb). The device cannot capture this range of elements in one configuration of settings, necessitating multiple assays (Shackley 2012).While several settings are adjusted, the principal difference is the addition of the Bruker yellow (Ti and Al) filter. This means that each sample is analyzed twice, once with each parameter. These two settings are necessary to measure both “light’ and “heavy” elements. The first set of assays was conducted with the voltage 15 kV and a current of 28.00 μA for a 60 second assay. No filter was utilized. Speakman (2011) illustrates that this arrangement allows for the identification of copper (Cu) and below except sulfur (S) and chlorine (Cl).

The second set was conducted with a voltage setting of 40 kV and a current of 22.00 μA for a 60 second assay, using a yellow filter. This yellow filter is made of thin sheets of aluminum (Al) (12 mil) and titanium (Ti) (1 mil). This blocks lighter elements and allows the machine to be operated at a higher voltage to examine heavier elements in the sample (Figure 10). This arrangement allows for the identification of titanium (Ti) through silver (Ag) and tungsten (W) through bismuth (Bi) (Speakman 2011).

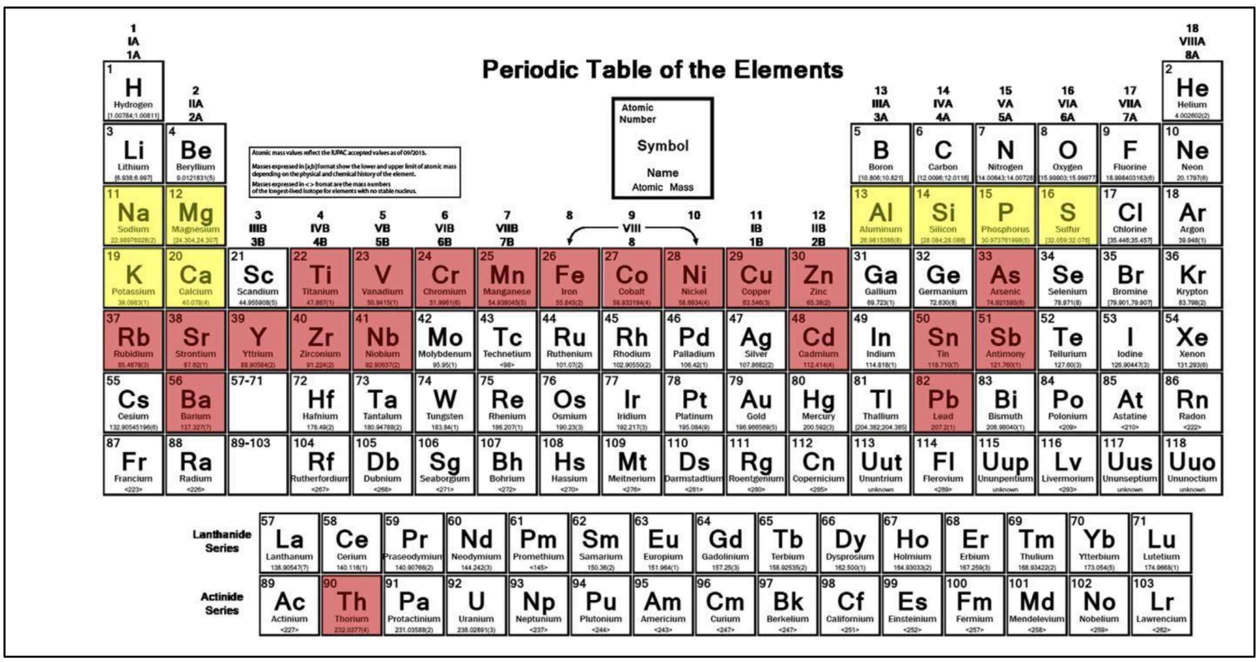


Figure 10. Periodic Table of the elements. (Adapted from Hunt and Speakman 2015).

The location of the assay on each sherd was based on distance from the sherd edge, interior/exterior, and where the aperture of the pXRF could be closest to the sherd (i.e., flattest). This area was recorded so that the second assay could be applied to the same location. This assured a degree of consistency in the data. The Bruker was used in its desktop configuration and connected to a computer via a USB cable.

The program used to display the results and control the machine is S1PXRF, a proprietary program developed by Bruker for use with the Tracer III-V. The program generates spectra, which is displayed as a line graphic showing the concentrations of wavelengths of X-rays returned from the sample. The height of each line peak correlates to the *bremsstrahlung* radiation returned and, therefore, the element present. After each run, the files (.pdz and .csv) were saved.

File Names

Each file was named with a unique file name based on a common file naming structure with small variations for each site. For Thomas/Luckey the file naming structure consists of Site.Type.Catalog Number.Vessel number (where applicable).Filter Type. Those files with vessel numbers represent the averaged peak heights of multiple sherds. For example, TL.SF.F81.V66.NF equates to Thomas/Luckey.Shenks Ferry.Feature 81.Vessel 66.No filter. The file naming structure for Losey 3 consists of Site.Type.Vessel Number.Catalog Number.Filter Type. For example, L3.SF.V35.8100.2.NF equates to Losey 3.Shenks Ferry.Vessel 35.Catalog #8100.2.No filter. While all Shenks Ferry, Kelso Corded, and Oak Hill Corded sherds were assayed, multiple sherds from a vessel were averaged into a single data point. This allows for a more accurate comparison between the two sites, as a comparison between total sherds from Thomas/Luckey and vessels from Losey 3 is not a realistic assessment. Clay sample files were named simply "Sample #."

Raw Data Analysis

While peak heights in the spectra are not quantified at this stage, the presence of a peak indicates the presence of its corresponding element. The height of each peak does correlate, albeit roughly, to the intensity of the return. These results are presented not as percent of total of the composition of the material but as energy returned. The peak height value was extracted from the appropriate channel in Microsoft Excel via the XLOOKUP tool to quantify the dataset.

The values are directly compared to both singular elements, and elemental ratios through cross plots for general trends and statistical validation for confirmation of these trends. Elements that were anticipated are: Al, Si, K, Ti, Ca, Mn, Fe, Ni, Cu, Zn, Rb, Sr, Zr, and Mg. This selection was adapted from Christina Rieth's dissertation (1997) with additional input from Jeff Pietras of Binghamton University's Geology Department. In addition to the presence or absence, and similar ratios, more visual illustrations of relatedness were sought, coming in the form of cross plotted graphs.

I placed results into cross plots of each elemental ratio, which included: Si-Al, Rb-K, Ca-K, Ca-Sr, Al-K, and Ti-Al. These ratios were selected after consultation with Pietras. They represent the most likely way to positively identify associations as the replacement of minerals in parent clay material is unlikely to be the same in different parent quarry beds (Kylander et al. 2011; Pietras and Spiegel 2018) The clay beds in the study area are made from detrital sediments deposited from glaciers (Denny et al. 1963). Those sediments could have been carried by wind, river, and gravity, in ratios unlikely to be replicated. While cross plots can show relationships between data, here the sources and the vessel composition, cross plots alone are subjective and can be misleading. Less subjective methods are required to confirm the relationships that are visible. *K*-means was selected to statistically validate the relationships.

Statistical Validation

To facilitate the statistical analysis of the raw data, I selected *k*-means statistical analysis. *K*-means is a form of cluster analysis, measuring the relative quality of clustering of a dataset given several clustering solutions (Baxter 1994). This form of statistical modeling was used to identify clusters of sherds characterized by a similar elemental composition portrayed as the relative percentages of elements present in each given sample. The relationships that it reveals aid in illustrating the importance of given elements as defining characteristics of the clay content. The data are unsorted prior to the addition of clustering points. Each time a cluster point is added, the data are rotated to form a "best fit." Each new cluster recalculates the best fit of the dataset. There is diminishing return to adding points; when the number of clusters approaches the total data number, the accuracy diminishes (Baxter 1994). For example, a dataset with 100 data points but 100 clusters would be as inaccurate as the same 100 data-point set with one cluster. Data will cluster according to the degree of similarity of elements in the sample. The samples that share similar compositions will group accordingly and each cluster is therefore indicative of vessels with similar elemental composition. Tighter clusters indicate higher degrees of similarity. The statistics package for Excel, XLSTAT, was used to perform *k*-means analysis.

Two datasets were collected from each sherd one with no filter and one with a yellow filter. Each run was standardized through Excel's STANDARDIZE function with elements. The parameters for *k*-means are included in Table 11.

Table 11. XLSTAT Parameters for YF* and NF Runs.

Cluster rows
Clustering criterion: Trace(W)
Stop conditions: Iterations = 500 / Convergence = 0.00001
Number of classes: from:1 to:20
Center: No
Reduce: No
Initial partition: Random
Repetitions: 10

*YF=yellow filter; NF=no filter.

Summary

The selection of the three pottery types from two regionally separate sites, and the raw clay samples recently acquired will be used to test the four hypotheses related to identity and communities of practice. The raw clay samples have the potential to tie the data from the Shenks Ferry and Kelso Corded types to a point in space, based on paste, and determine similarities or differences in paste to a definitively New York type through Oak Hill Corded. The sherd selection represents a minimum number of vessels and allows for a comparison of elemental ratios between the sites that would have been skewed if sherds alone were examined. Raw clay was collected from four different locations, processed, and pelletized for analysis. Finally, *k*-means cluster analysis was selected as the analytical method used to validate the data. In the following chapter, I will present the results of these analyses of the collected clay, and the results for the Thomas/Luckey and Losey 3 assemblages.

CHAPTER 6. RESULTS OF ANALYSIS

Following pXRF analysis of sherds and clay, the data were examined to identify which chemical elements were present and useful for an interpretation of sourcing. The elements Al, Si, K, Ti, Ca, Mn, Fe, Ni, Cu, Zn, Rb, Sr, Zr, and Mg were sought and anticipated, but their presence in any samples or artifacts was not guaranteed until the analysis had been completed. Elemental presence is measured by peak height which is the measure of intensity of an elemental return. All peak height data were cursorily examined in their raw form to assess general similarities between pottery types and sites. While 382 total assays were conducted, the ultimate size of the dataset is 298 as Thomas/Luckey had multiple sherds from the same vessel available which were averaged into a single value. The number of assays characterizes two runs of different device settings that represent 145 unique vessels. Additionally, four raw clay samples are included to tie the reported values to a place and provide a baseline to illustrate the potential similarity of the vessel paste to the clay samples from the region.

Scatterplots

Scatterplots were created to illustrate the deviation of elemental values from the mean for these values to better understand the relatedness of the samples. These scatterplots show the standard deviation of standardized values for selected elements in each artifact or clay sample. Not all elements were compared in this way, only selected elements, Al, Si, Rb, Ca, K, Sr, and Ti (Ti only with yellow filter runs), were plotted

These ratios are indicative of the parent material from which the secondary clay deposits originated. These parent materials would then erode into detrital sediment and be transported before deposition. These ratios therefore are indicative of different parent material that would be unlikely to be the same for such disparate types (Pietras and Spiegel 2018).

The goal of these scatterplots was threefold; first to determine if the pottery types within each site showed similar elemental values to one another (meaning they were made from the same clay); second to determine if each site's assemblage differed from the other (meaning the Thomas/Luckey and Losey 3 communities used different clay sources); and third to determine if the raw clay samples matched any or all of the vessel pastes (connecting vessels to a local source). For the following scatterplots, the abbreviations in the legend are: Site.Pottery type.Elemental (e.g., TL.KC.Al = ThomasLuckey.KelsoCorded.Aluminum). The density of data and the limitations of the page prohibit labeling each point with its identifying name; however, it can be drawn out from the data tables in Appendix B. Each series starts from zero and is placed along the X-axis in ascending order, with the X-axis representing individual vessel sherds. Distance along the vertical axis illustrates the degree of similarity of elemental values. For example, the samples further from zero are more dissimilar, while those closer to zero are more similar. Scatterplots with both sites are included in the text. Scatterplots of each site broken out are included in Appendix A.

No Filter (NF) All Data Points

The Shenks Ferry and Kelso Corded vessels have very similar standardized values as seen in and are mostly distributed within one standard deviation above and below the mean (Figure 11). No one type possesses a distinctly homogenous distribution though there are outliers. Oak Hill Corded sherds do not vary greatly from the other types. The Hybrid Kelso Corded/Shenks Ferry vessel is first on the X-axis and has a similar composition to both the other types. Both sites have similar values for their assemblages. The mixture of Thomas/Luckey and Losey 3 values illustrates a similarity in the vessels from each site although visually (not statistically) it appears that there is some separation between the two. The Si values for raw clay Samples 1, 3, and 4 are drastically different than both Sample 2 and all tested artifacts. These three samples possibly have a higher amount of sand (SiO_2) which would present as a high Si value. All vessels possess similar Al and Si values, though the Thomas/Luckey and Losey 3 Kelso Corded separate above and below the mean, respectively.

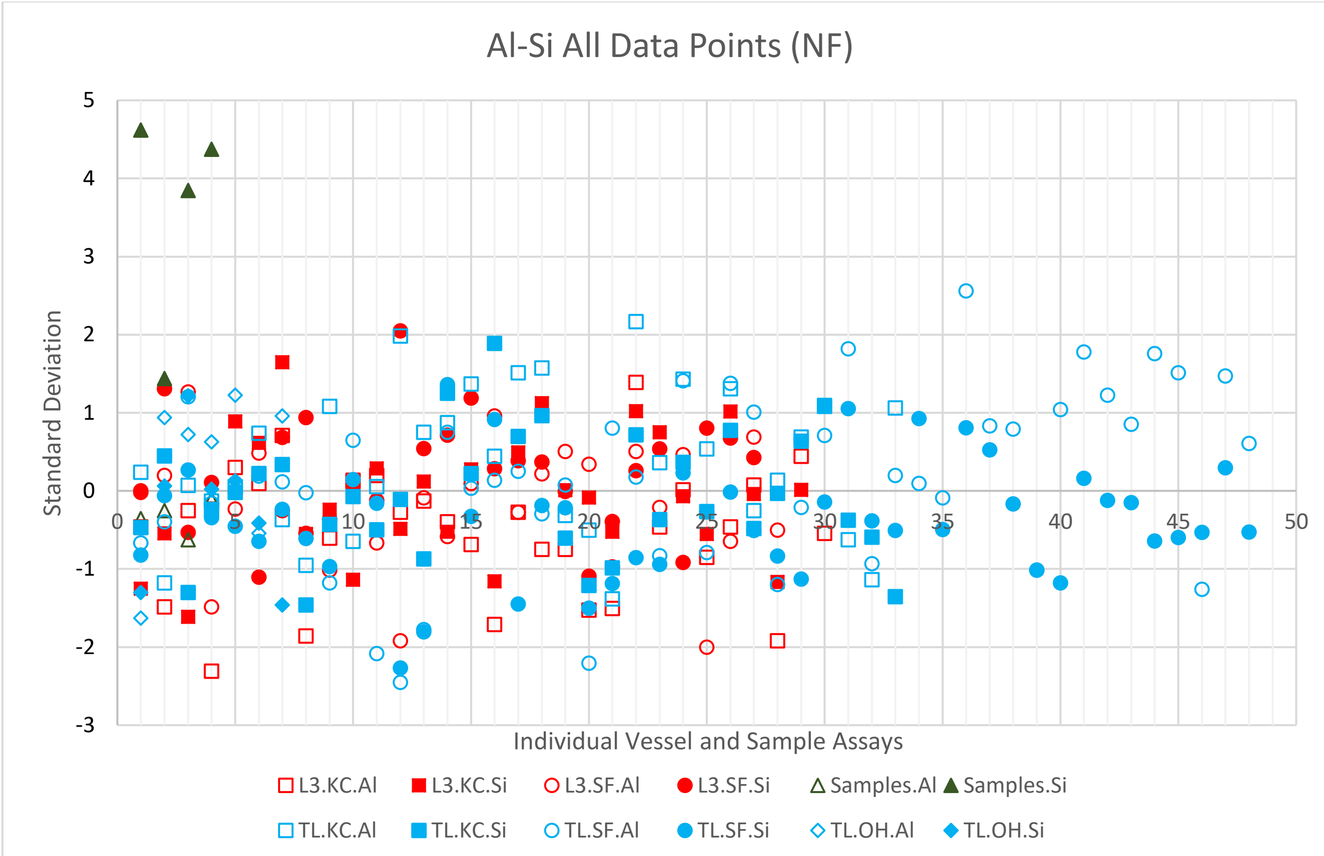


Figure 11. Al-Si ratio of all sites and samples, no filter (NF) run.

To best clarify and keep separate the sites and the types a number of acronyms and shortened identifiers was used in a manner similar to the file naming format. The following site and type abbreviations were used: L3= Losey 3, TL= Thomas/Luckey, SF= Shenks Ferry (all types), KC= Kelso Corded, OH=Oak Hill Corded.

All data points show wide variability based on their scatter within two to three standard deviations of the mean for this ratio as seen in Figure 12. The outlying sherds do not indicate patterning since Oak Hill Corded, Shenks Ferry, and Kelso Corded all are represented in the outliers. The Thomas/Luckey and Losey 3 results overlap considerably with little distinction between each. The clay values are more simlar than the Al-Si scattterplot for this ratio, though the samples are again separated with Samples 1, 3, and 4 more similar than Sample 2. The Rb-K values of the entire dataset overlap considerably and are highly variable. This ratio lacks clustering within the scatterplot according to site or type. This illustrates a relatively heterogeneous range of values present.

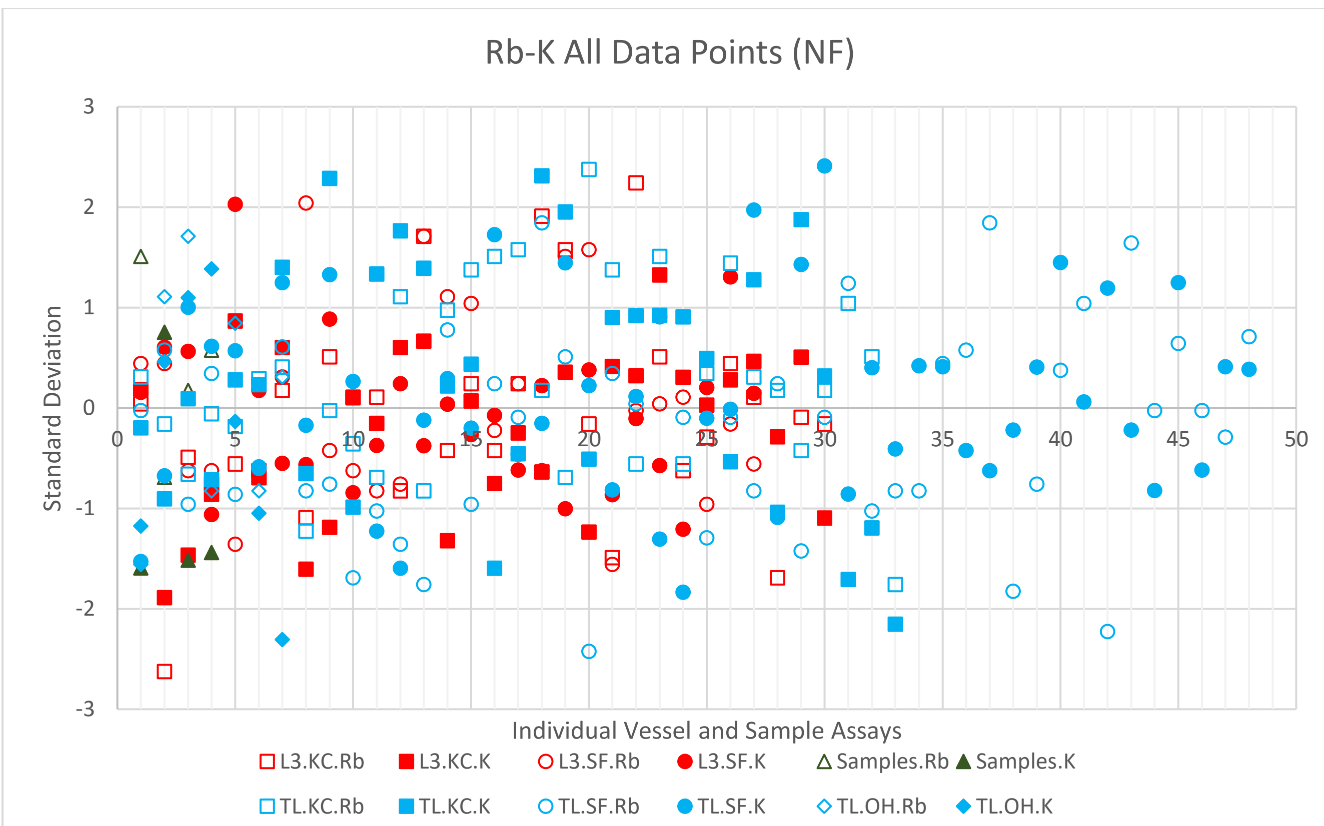


Figure 12. Rb-K ratio of all sites and samples, NF run.

All pottery types share similar values and most conform tightly to the mean for the samples. Figure 12 shows that one Shenks Ferry sherd (V4 1063.1) and one Kelso Corded sherd (V72 733.3), both from Losey 3, are highly aberrant. It is unknown why these two sherds possess such high calcium values. In other site assemblages, a high calcium value in a sherd is the result of shell tempering, though this is not the case here. Raw clay samples are again distributed in the same fashion, with Sample 2 appearing distinct from Samples 1, 3, and 4. This scatterplot does not show much separation between pottery types or site assemblage values.

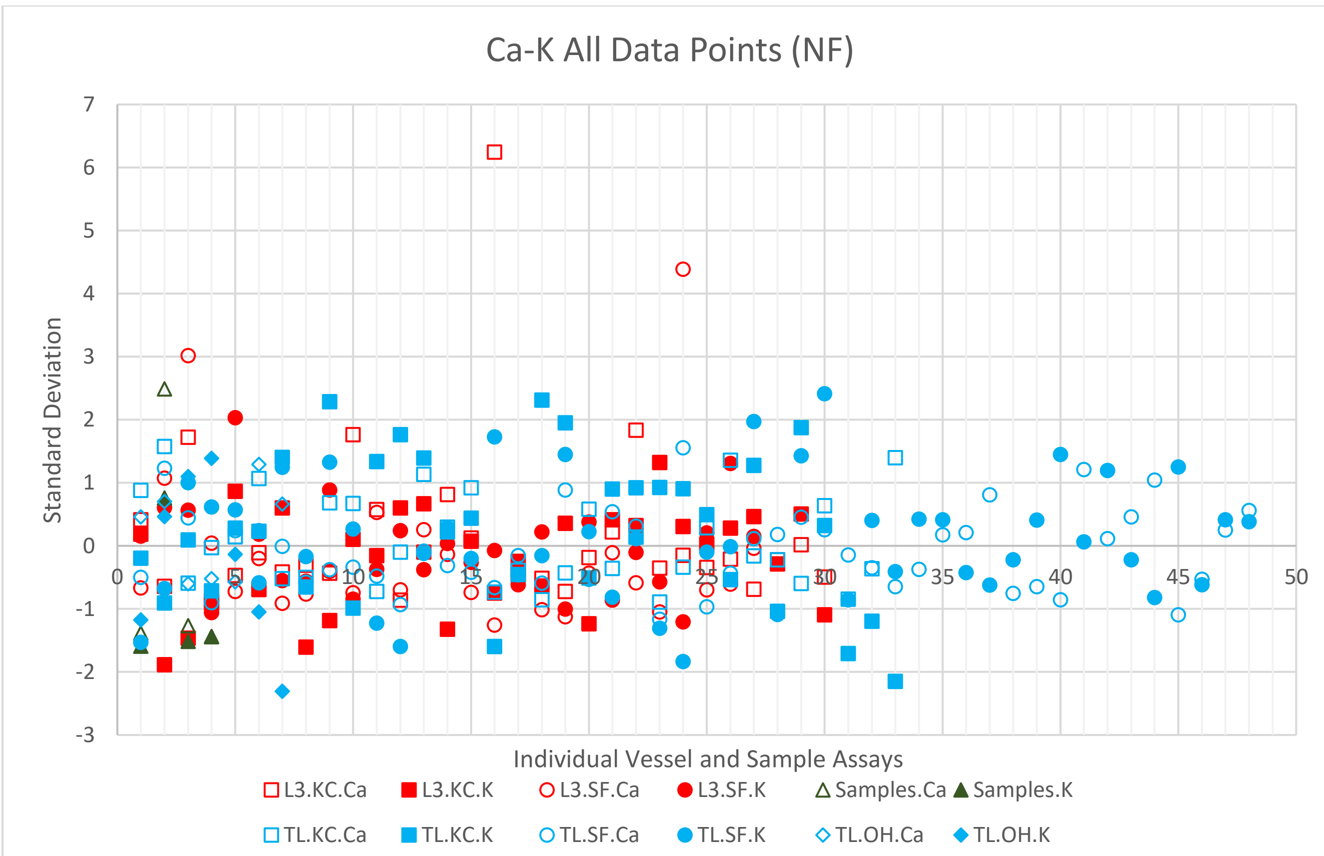


Figure 13. Ca-K ratio of all sites and samples, NF run.

Figure 14 illustrates a very tight clustering sherds around the mean, except for Ca values of the two sherds as discussed above. There is a slight separation of Losey 3 values and Thomas/Luckey values, though they are remarkably similar overall for these elements. There is no breakout of raw clay, and it follows the same pattern as presented in Figure 11, Figure 12, and Figure 13. Clays are correspondingly like the overall values. Other than the few discussed under Ca-K outliers (Figure 13), the results appear to be mostly consistent and similar to one another.

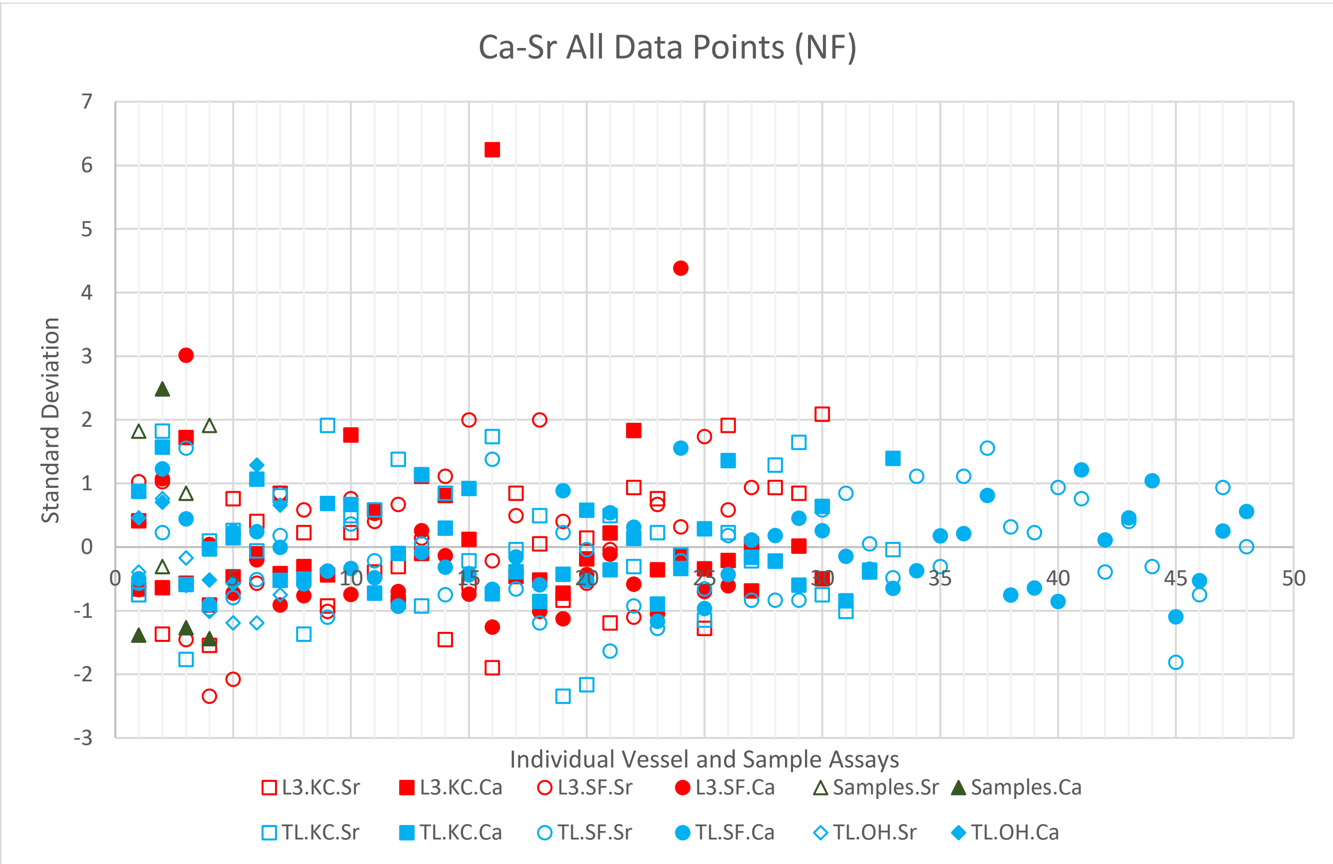


Figure 14. Ca-Sr ratio of all sites and samples, NF run.

Figure 15 illustrates a high degree of variability for the Al-K ratio with wide dispersal of values around the mean. There is a high degree of overlap among the sherds from each site, with no values presenting outside of three standard deviations. Thomas/Luckey has more sherds of both Kelso Corded and Shenks Ferry that are above +2, though it is unclear why this is the case. The sites are relatively similar, though this scatterplot shows the largest separation between the two because of the high similarity and little deviation from the mean. No clear separation between Kelso Corded, Oak Hill Corded, and Shenks Ferry vessels for this ratio is evident, with minor separation between Losey 3 and Thomas/Luckey sites.

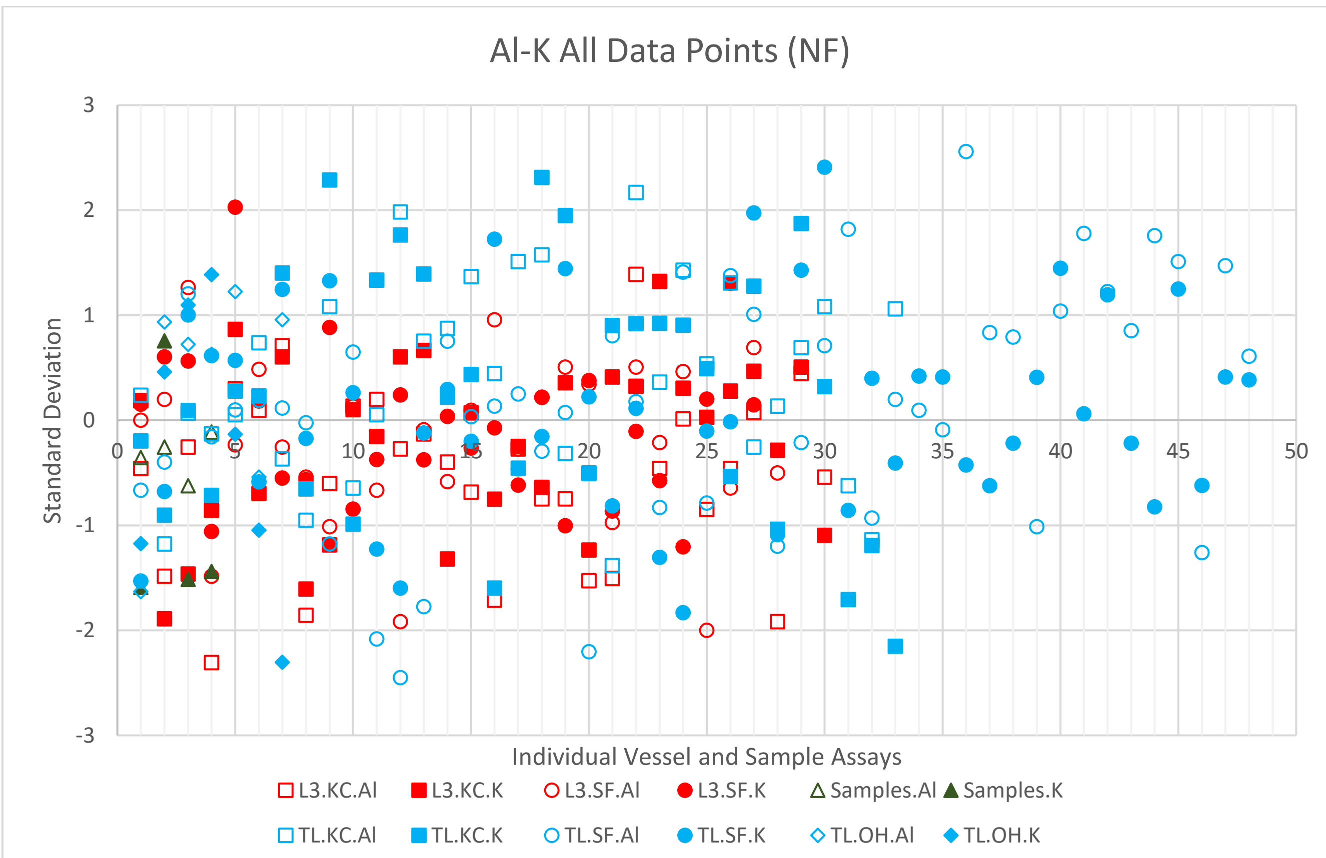


Figure 15. Al-K ratio of all sites and samples, NF run.

Operating the pXRF only with NF settings will not return all of the necessary elements. A filter must be added, as well as settings adjusted to return other elements, including Titanium (Ti). The yellow filter (YF) is composed of Ti and Al and helps return indications of certain metals present in the sample.

Yellow Filter (YF) All Data Points

Figure 16 illustrates the Al-Si ratio present and shows wide variability around the mean with a slight separation of Shenks Ferry Si values from Kelso Corded. This is possibly related to differences in the amount of sand (SiO_2) in the clay used to create the vessels. Overall, the values of the Losey 3 site are marginally separated from those of the Thomas/Luckey site with the Losey 3 site tending to be more positive and Thomas/Luckey tending to be more negative. Although this is driven in a greater part by Si values, the Al values follow suit. The clay samples are similarly related to each other as in the prior assays, with Samples 1, 3, and 4 clustering independently of Sample 2 for both elements. Several Shenks Ferry vessels from Losey 3 are far from the mean; this could be related to a different source or preparation, though these same vessels are not always separate, making this unlikely.

There is no clear separation of any of the types, the sites are marginally separated, and the clay values, while not entirely homogenous, are in line with many values of both sites indicating an overall elemental similarity.

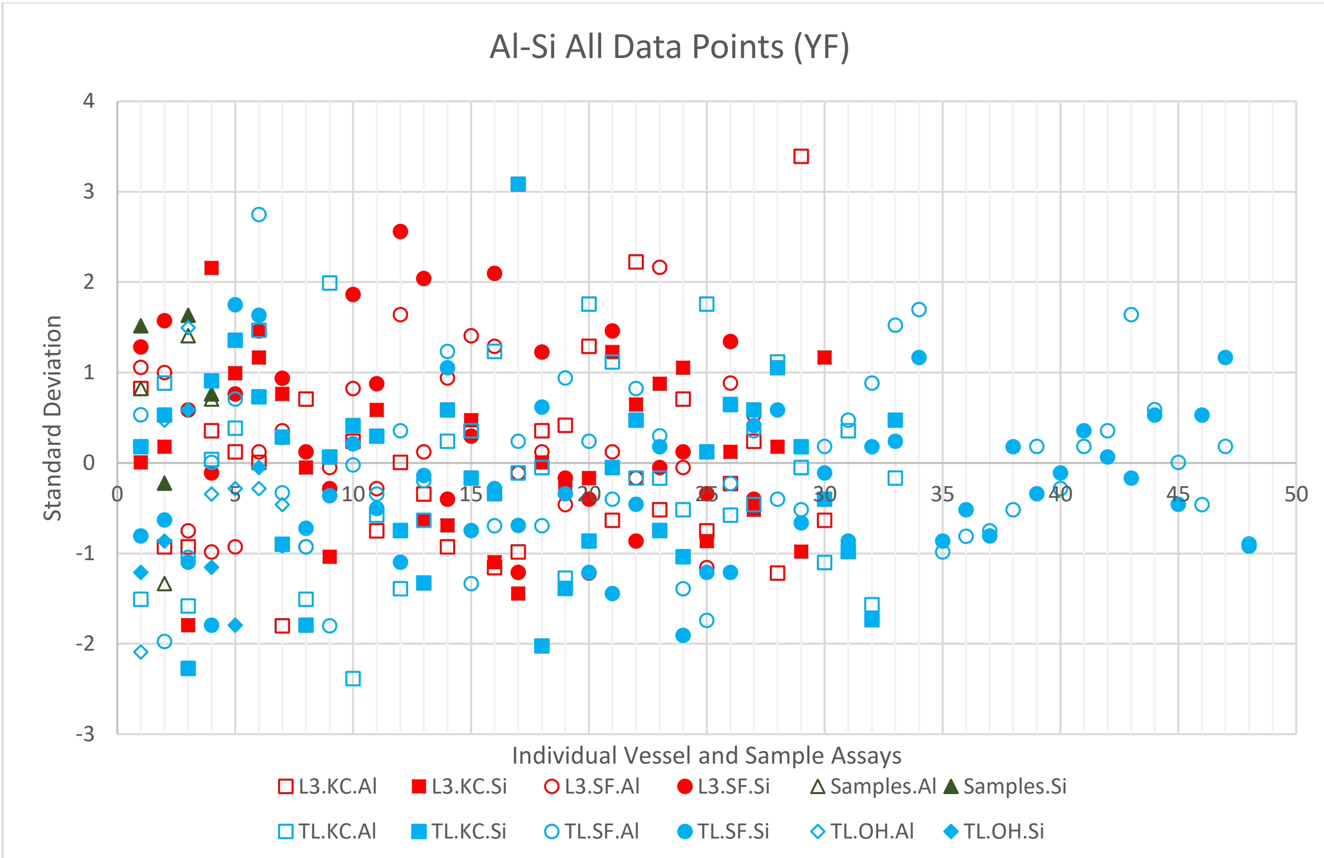


Figure 16. Al-Si ratio of all sites and samples, yellow filter (YF) run.

The Rb-K YF assay as depicted below in Figure 17 shows some minor separation of the sites but an overall similarity between them. While Thomas/Luckey does present four samples that are extreme outliers, they are not all Shenks Ferry vessels or all Kelso Corded vessels, which would be expected if the Shenks Ferry vessels were not produced from the same clay as the Kelso Corded vessels. The types within each site are evenly distributed and do not appear to cluster by type. The site assemblages are also intermixed and do not separate by site, illustrating similar compositions between the two. Clay samples continue to present Sample 2 as distinct from the other three. Figure 17 illustrates the interrelatedness within sites and between the sites.

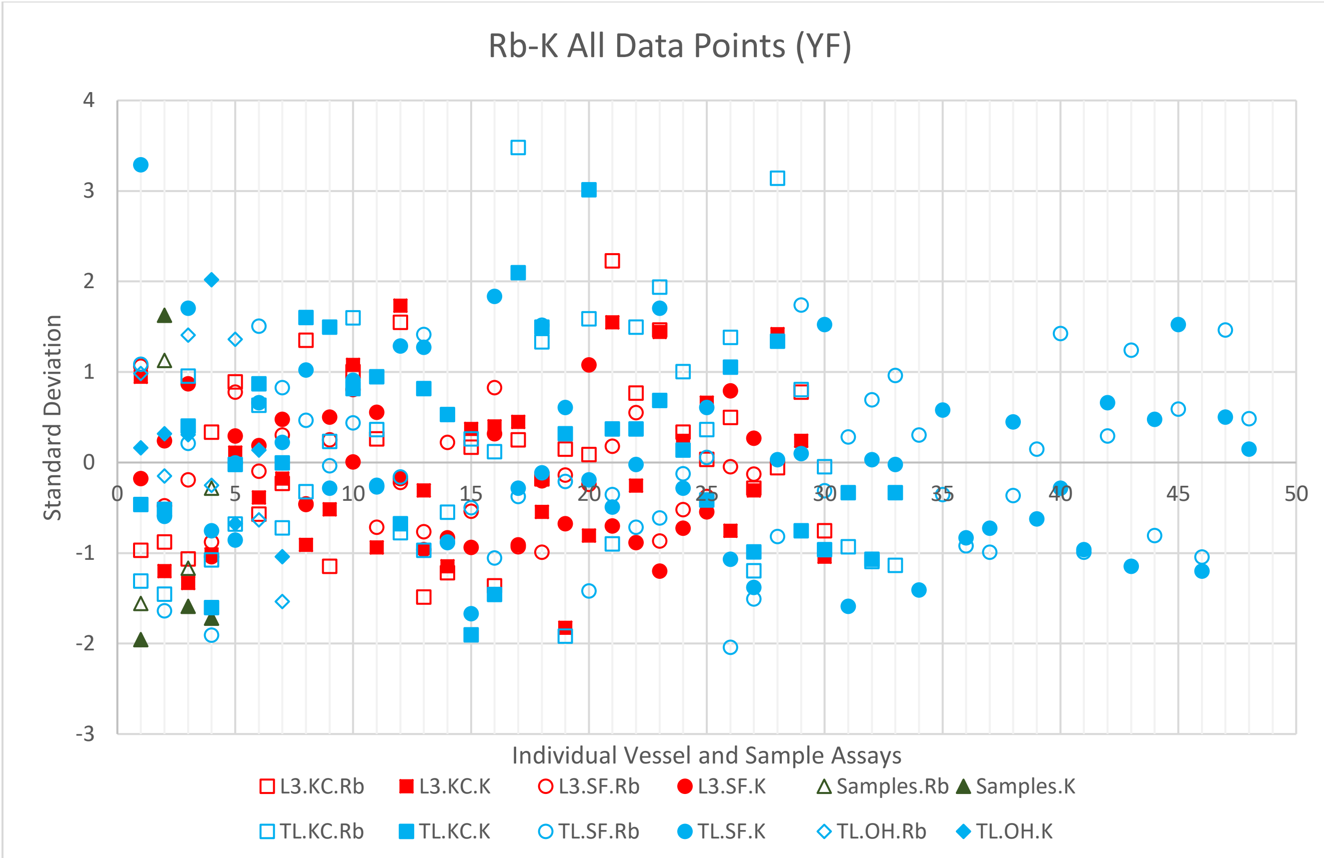


Figure 17. Rb-K ratio of all sites and samples, YF run.

All types at both sites share similar values for the Ca-K ratio (Figure 18). One Shenks Ferry (V4 1063.1) and one Kelso Corded sherd (V72 733.3), both from Losey 3, are highly aberrant in their calcium values. The values presented are even higher than the NF assay because of the use of the yellow filter. Sites are similarly associated, though there is some minor separation between Thomas/Luckey and Losey 3. Clay values continue their trend of Samples 1, 3, 4 showing more relation than Sample 2. Apart from the two vessels noted above, the overall pattern remains the same as prior assays with no clear distinctions between intra- and inter-site pottery.

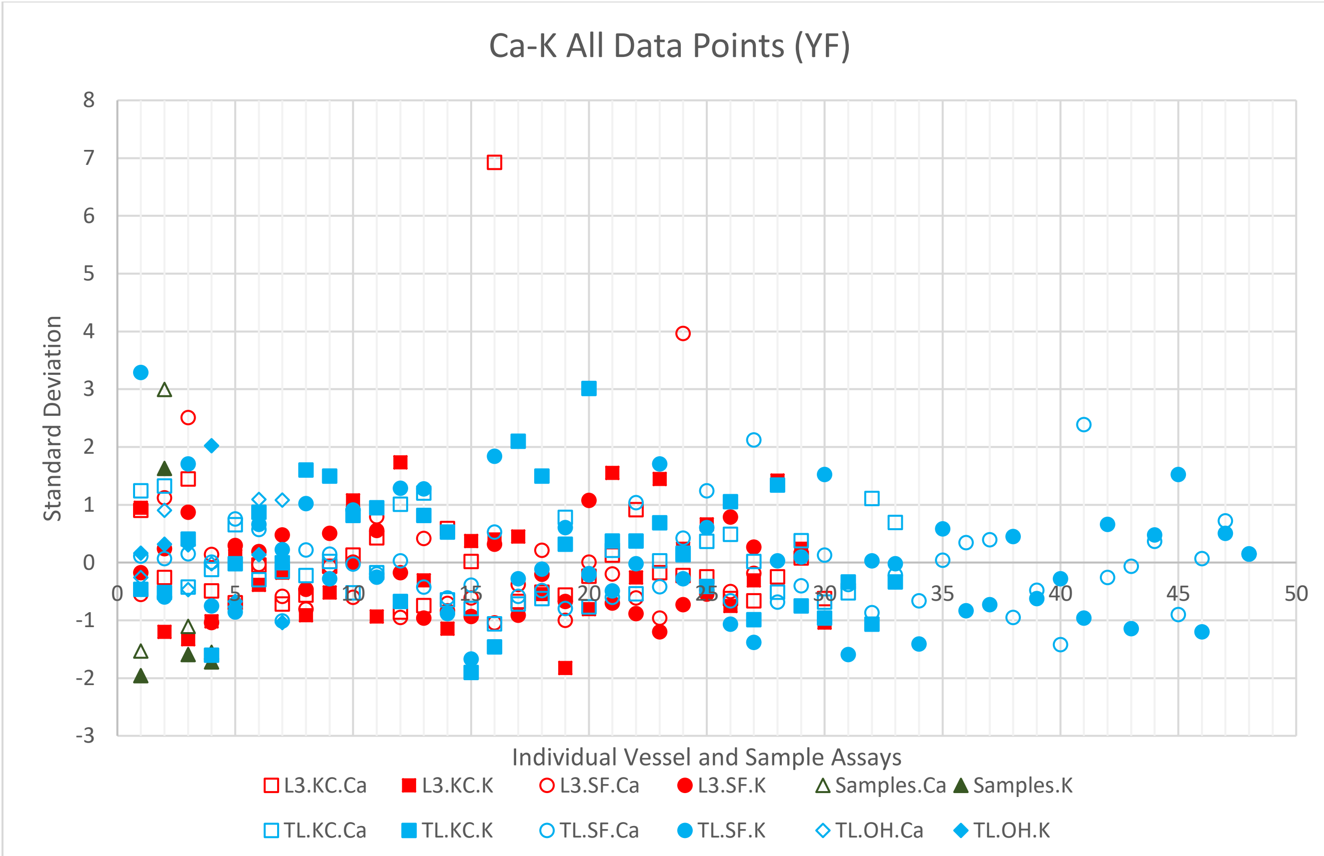


Figure 18. Ca-K ratio of all sites and samples, YF run.

Figure 19 illustrates that the Ca-Sr values of Oak Hill Corded, Kelso Corded, and Shenks Ferry are all similar at both Thomas/Luckey and Losey 3. No one type groups together. Each site overlaps the other and does not cluster individually. Clay Sample 2 possesses very dissimilar Ca values, though highly similar Sr values to the average value. Ca-Sr ratios illustrate a high degree of similarity with close values for all samples and artifacts tested.

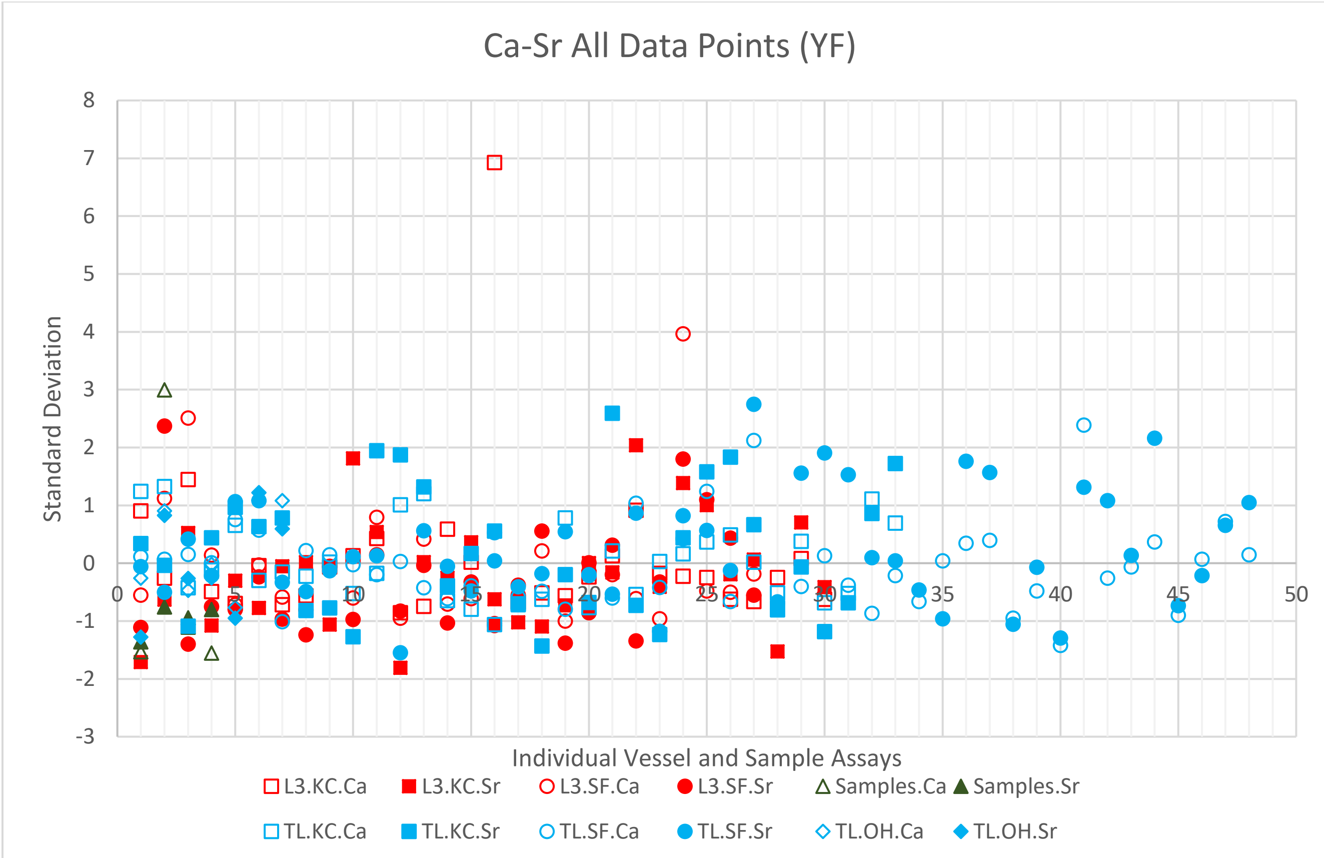


Figure 19. Ca-Sr ratio of all sites and samples, YF run.

Al-K ratios show a high degree of similarity in the sherds, with few values presenting outside of three standard deviations (Figure 20). Thomas/Luckey has more sherds of both Kelso Corded and Shenks Ferry that are above +2. The sites are relatively similar, though this scatterplot shows the largest separation between the two because of the high similarity and little deviation from the mean. There is no clear separation between Kelso Corded, Oak Hill Corded, and Shenks Ferry vessels, with minor separation between Losey 3 and Thomas/Luckey sites. Clay values are like other graphs.

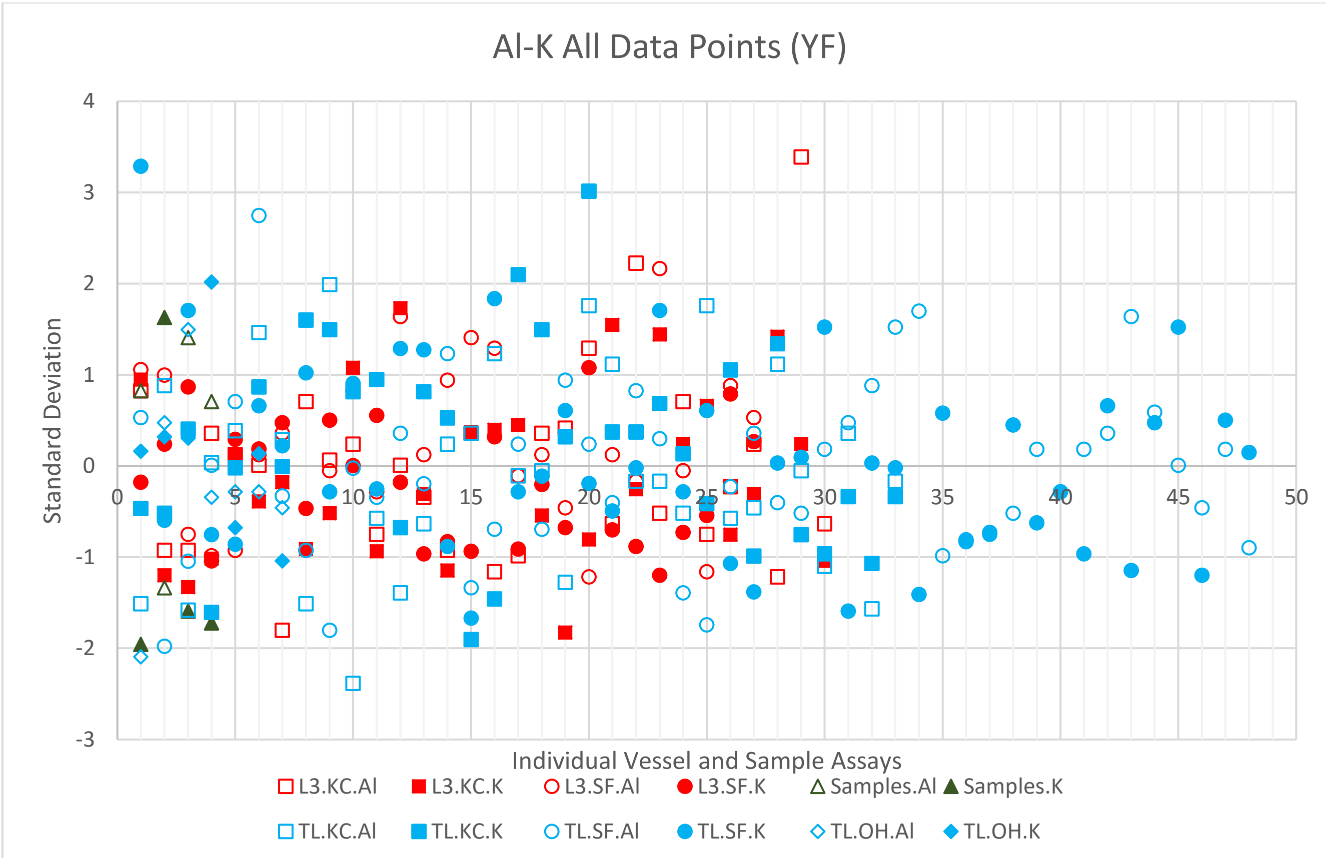


Figure 20. Al-K ratio of all sites and samples, YF run.

Titanium is only able to be detected with the use of the yellow filter, and this ratio is only seen in Figure 21. Types are still very related, though some of the Oak Hill Corded values stand alone and are less related than Shenks Ferry and Kelso Corded. Both the Al and Ti values reflect some separation between Losey 3 and Thomas/Luckey assemblages, though not to a large extent. Clay values, while continuing the trend of two clusters, are closest in value here in this ratio. Titanium and aluminum together illustrate relatedness of the assemblages within sites and between sites, though they are not as tight as other ratios.

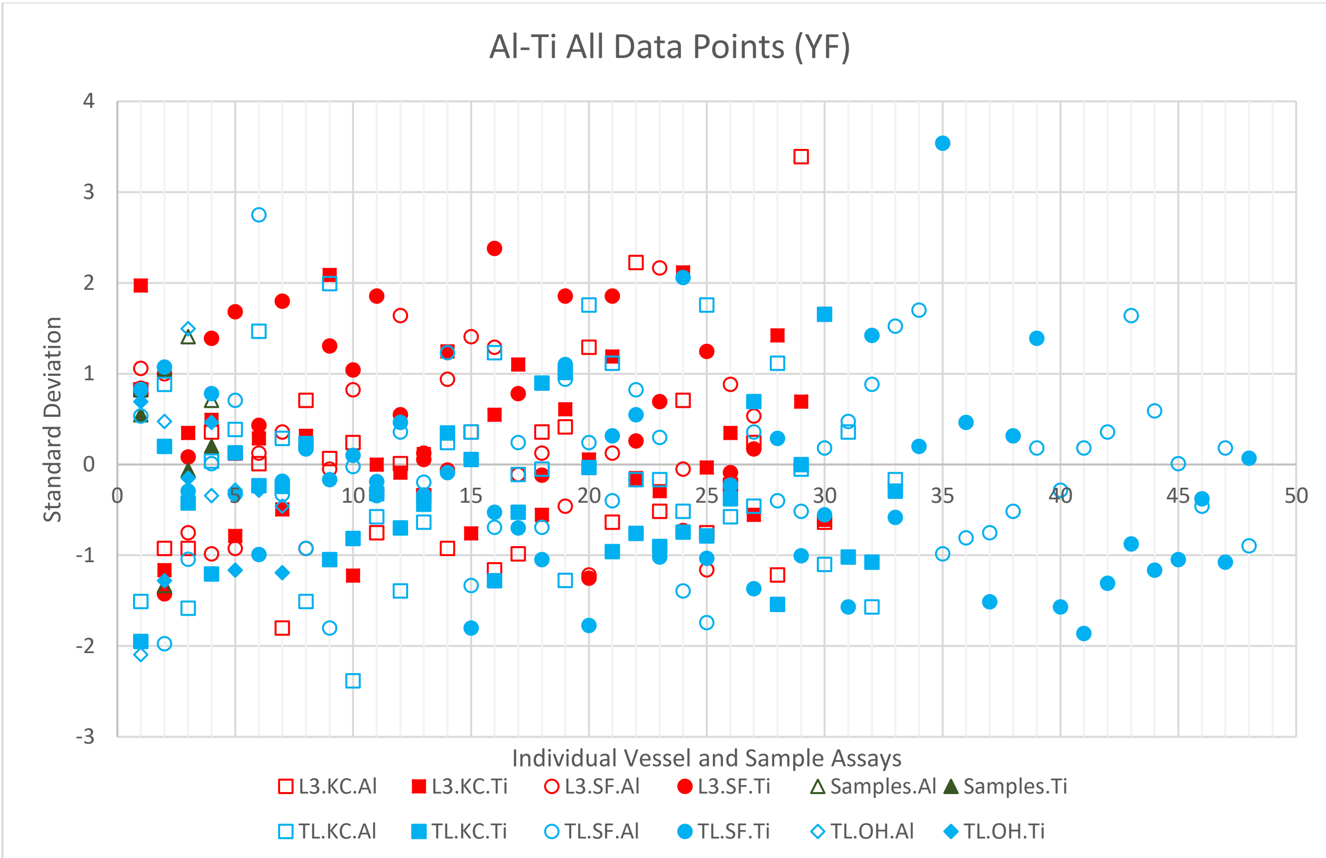


Figure 21. Al-Ti ratio of all sites and samples, YF run.

The scatterplots support the null hypothesis meaning that both the Thomas/Luckey and Losey 3 potters made both Shenks Ferry and Kelso Corded vessels from clay collected from elementally similar quarries in the region. There is some separation of the dataset by site, but not in every ratio as would be expected by differing outcrop usage. This disproves the second hypothesis. Additionally, there is little separation of types within the sites, disproving the third and fourth hypotheses. While the null hypothesis is supported by the scatterplots, the visual and subjective nature of the results encourages further analysis and validation of these results.

***K*-means Cluster Analysis**

The standardized datasets of element ratios shown in the scatterplots depict a pure comparison of values. In contrast, *k*-means analysis provides an evaluation of whether the range of datapoints cluster into groups based on similarities in the datasets. The *k*-means test offers the option to select the number of clusters based on what you might expect to find in the data. Alternatively, you can use a statistical solution (the "elbow" graphing method) for the optimal number of clusters based on plots of the variation in the data against a range of clustering levels. I began with my research questions and the hypotheses discussed previously to select clustering levels in a more interpretive fashion, followed by analysis using the statistically derived clusters. Due to the size of the tables, the statistically derived clusters are separated with NF runs presented first and YF presented second. To test the null hypothesis that there is no difference in the clays used by potters resident at the two sites (i.e., vessels were made from regional clays with characteristics similar to the raw clay samples), I first selected two clusters (Table 12). In other words, this hypothesis should yield no difference in the elemental signatures of the clays at Thomas/Luckey and Losey, and therefore the vessels from the two sites will not divide into two clusters. The *k*-means analysis did, in fact, reveal that there is no elemental differentiation between the pottery from the Thomas/Luckey and the Losey 3 assemblages. This indicates that the clay used to form all vessels, regardless of whether typed as Shenks Ferry, Kelso Corded, or Oak Hill Corded at each site is similar. This could be related to use of the same clay sources, or the possibility that clays found near the two sites, both on the Alleghany Plateau do not differ greatly in their elemental composition. Additionally, the three types (Shenks Ferry, Kelso Corded, and Oak Hill

Corded) do not separate into one or the other cluster for either site. The exception is the Oak Hill Corded vessels, which appear to more heavily cluster than the other types. This may be due to an actual distinction between vessels' creation or it is the product of the limited sample. The sampled clay is impacted by the presence of the yellow filter; Sample 2 is separate from the other three samples when subjected to assays with the filter. This indicates that Ti makes up some part of the difference between samples. To address the alternative hypotheses about the local and assumed non-local nature of pottery types at each site, intra-site cluster analysis was conducted.

Table 12. NF (Left) and YF (Right), Thomas/Luckey (Blue) and Losey 3 (Red).

Cluster 1	Cluster 2
L3.HY.V153.10300.1	L3.KC.V115.NA
L3.KC.V1.897.1	L3.KC.V12.8929.7
L3.KC.V106.7057.1	L3.KC.V123.3475.338
L3.KC.V11.1026.1	L3.KC.V124.8915.4
L3.KC.V125.9231.1	L3.KC.V128.10325.1
L3.KC.V14.669.173	L3.KC.V129.10261.1
L3.KC.V16.9244.238	L3.KC.V15.665.309
L3.KC.V4.1063.1	L3.KC.V2.1027.1
L3.KC.V61.1820.1	L3.KC.V59.3804.1
L3.KC.V8.903.9	L3.KC.V6.669.125
L3.KC.V83.4722.1	L3.KC.V5.967.1
L3.KC.V85.4963.4	L3.KC.V60.1406.1
L3.KC.V88.7034.1	L3.KC.V65.1396.1
L3.SF.V105.8932.1	L3.KC.V7.669.123
L3.SF.V119.9565.8	L3.KC.V84.4216.1
L3.SF.V140.10538.1	L3.KC.V9.918.1
L3.SF.V154.10340.1	L3.KC.V97.8014.1
L3.SF.V27.9594.1	L3.SF.V101.9675.1
L3.SF.V29.9833.1	L3.SF.V102.8893.1
L3.SF.V66.1346.1	L3.SF.V25.1079.1
L3.SF.V68.1539.1	L3.SF.V26.1078.1
TL.KC.8N4WI1	L3.SF.V28.1029.1
TL.KC.F21.E.V9	L3.SF.V31.1170.2
TL.KC.F57	L3.SF.V33.1310.4
TL.KC.TL97.370.1479	L3.SF.V35.8100.2
TL.KC.TL96.120.494	L3.SF.V36.693.71
TL.KC.TL96.174.719.A	L3.SF.V37.668.274
TL.KC.TL96.21.77	L3.SF.V38.668.273
TL.KC.TL96.22.83	L3.SF.V39.2165.7
TL.KC.TL96.50.203	L3.SF.V40.669.176
TL.KC.TL96.81.330.V30	L3.SF.V69.3642.1
TL.KC.TL96.92.378	L3.SF.V70.1838.1
TL.KC.TL97.190.873	L3.SF.V72.733.3
TL.KC.TL97.252.1053	L3.SF.V82.1692.8
TL.KC.TL97.268.1134	L3.SF.V86.NA
TL.OH.F75Zone1	L3.SF.V91.3982.7
TL.OH.TL96.22.83	Sample 1
TL.OH.TL96.48.193	Sample 2
TL.OH.TL97.150.681	Sample 3
TL.OH.TL97.438.1664	Sample 4
TL.SF.14N38EL3	TL.KC.F12
TL.SF.F12.V5	TL.KC.F21.V8
TL.SF.F12A.V7	TL.KC.F3.C.V11
TL.SF.F21.C.V49	TL.KC.F3.J.V12
TL.SF.F21.V48	TL.KC.F3.V10
TL.SF.F22	TL.KC.F81
TL.SF.F28.V51	TL.KC.TL95.88.4
TL.SF.F3	TL.KC.TL96.103.410
TL.SF.F30	TL.KC.TL96.129.531
TL.SF.F33.V55	TL.KC.TL96.160.670
TL.SF.F4.V57	TL.KC.TL96.17.58
TL.SF.F57.A	TL.KC.TL96.17.58.A
TL.SF.F57	TL.KC.TL96.174.719
TL.SF.F58.A.V62	TL.KC.TL96.35.131
TL.SF.F58.V63	TL.KC.TL96.59.235
TL.SF.F67	TL.KC.TL96.88.361
TL.SF.F81.A	TL.KC.TL96.96.387
TL.SF.N10E46L2.AC.V2	TL.KC.TL96.97.390
TL.SF.N10E46L2.B	TL.KC.TL97.112.516
TL.SF.N10E46L2	TL.OH.TL95.88.4
TL.SF.TL96.158.662	TL.OH.TL96.172.713.V41
TL.SF.TL97.120.545	TL.SF.16N26EL3
TL.SF.TL97.350.1404	TL.SF.F12.UN
TL.SF.TL98.11.57	TL.SF.F21.F.V47
TL.SF.TL98.217.786	TL.SF.F3.A
TL.SF.Trench 18 NE Quad	TL.SF.F33.B
TL.SF.West Surface.V87	TL.SF.F4.B
	TL.SF.F57.B
	TL.SF.F74
	TL.SF.F81.V66
	TL.SF.TL95.88.4
	TL.SF.TL95.94.15
	TL.SF.TL96.146.600
	TL.SF.TL96.146.600.A
	TL.SF.TL96.149.615
	TL.SF.TL96.172.713
	TL.SF.TL96.197.768
	TL.SF.TL96.24.93
	TL.SF.TL96.44.173
	TL.SF.TL97.329.1329
	TL.SF.TL97.357.1435
	TL.SF.West Surface.A

Cluster 1	Cluster 2
L3.HY.V153.10300.1	L3.KC.V1.897.1
L3.KC.V106.7057.1	L3.KC.V11.1026.1
L3.KC.V125.9231.1	L3.KC.V115.NA
L3.KC.V14.669.173	L3.KC.V12.8929.7
L3.KC.V16.9244.238	L3.KC.V123.3475.338
L3.KC.V4.1063.1	L3.KC.V124.8915.4
L3.KC.V5.967.1	L3.KC.V128.10325.1
L3.KC.V61.1820.1	L3.KC.V129.10261.1
L3.KC.V83.4722.1	L3.KC.V15.665.309
L3.KC.V85.4963.4	L3.KC.V2.1027.1
L3.KC.V88.7034.1	L3.KC.V59.3804.1
L3.SF.V101.9675.1	L3.KC.V6.669.125
L3.SF.V105.8932.1	L3.KC.V60.1406.1
L3.SF.V119.9565.8	L3.KC.V65.1396.1
L3.SF.V140.10538.1	L3.KC.V7.669.123
L3.SF.V154.10340.1	L3.KC.V8.903.9
L3.SF.V27.9594.1	L3.KC.V84.4216.1
L3.SF.V29.9833.1	L3.KC.V9.918.1
L3.SF.V38.668.273	L3.KC.V97.8014.1
L3.SF.V40.669.176	L3.SF.V102.8893.1
L3.SF.V66.1346.1	L3.SF.V25.1079.1
Sample 2	L3.SF.V26.1078.1
TL.KC.8N4WI1	L3.SF.V28.1029.1
TL.KC.F21.E.V9	L3.SF.V31.1170.2
TL.KC.F3.V10	L3.SF.V33.1310.4
TL.KC.F57	L3.SF.V35.8100.2
TL.KC.TL95.88.4	L3.SF.V36.693.71
TL.KC.TL96.103.410	L3.SF.V37.668.274
TL.KC.TL96.174.719.A	L3.SF.V39.2165.7
TL.KC.TL96.21.77	L3.SF.V68.1539.1
TL.KC.TL96.22.83	L3.SF.V69.3642.1
TL.KC.TL96.50.203	L3.SF.V70.1838.1
TL.KC.TL96.59.235	L3.SF.V72.733.3
TL.KC.TL96.81.330.V30	L3.SF.V82.1692.8
TL.KC.TL96.92.378	L3.SF.V86.NA
TL.KC.TL96.96.387	L3.SF.V91.3982.7
TL.KC.TL97.190.873	Sample 1
TL.KC.TL97.252.1053	Sample 3
TL.KC.TL97.268.1134	Sample 4
TL.OH.F75Zone1	TL.KC.F12
TL.OH.TL95.88.4	TL.KC.F21.V8
TL.OH.TL96.22.83	TL.KC.F3.C.V11
TL.OH.TL96.48.193	TL.KC.F3.J.V12
TL.OH.TL97.150.681	TL.KC.F81
TL.OH.TL97.438.1664	TL.KC.TL96.120.494
TL.SF.N10E46L2.AC.V2	TL.KC.TL96.129.531
TL.SF.N10E46L2.B	TL.KC.TL96.160.670
TL.SF.N10E46L2	TL.KC.TL96.17.58
TL.SF.14N38EL3	TL.KC.TL96.17.58.A
TL.SF.F12A.V7	TL.KC.TL96.174.719
TL.SF.F21.C.V49	TL.KC.TL96.35.131
TL.SF.F21.F.V47	TL.KC.TL96.88.361
TL.SF.F21.V48	TL.KC.TL96.97.390
TL.SF.F22	TL.KC.TL97.112.516
TL.SF.F28.V51	TL.KC.TL97.370.1479
TL.SF.F3.A	TL.OH.TL96.172.713.V41
TL.SF.F30	TL.SF.16N26EL3
TL.SF.F4.V57	TL.SF.F12.UN
TL.SF.F57.A	TL.SF.F12.V5
TL.SF.F57.B	TL.SF.F3
TL.SF.F57	TL.SF.F33.B
TL.SF.F58.A.V62	TL.SF.F33.V55
TL.SF.F58.V63	TL.SF.F4.B
TL.SF.F67	TL.SF.F74
TL.SF.F81.A	TL.SF.F81.V66
TL.SF.TL95.88.4	TL.SF.TL95.94.15
TL.SF.TL96.158.662	TL.SF.TL96.146.600.A
TL.SF.TL97.120.545	TL.SF.TL96.146.600
TL.SF.TL98.217.786	TL.SF.TL96.149.615
TL.SF.Trench 18 NE Quad	TL.SF.TL96.172.713
TL.SF.West Surface.V87	TL.SF.TL96.197.768
	TL.SF.TL96.24.93
	TL.SF.TL96.44.173
	TL.SF.TL97.329.1329
	TL.SF.TL97.350.1404
	TL.SF.TL97.357.1435
	TL.SF.TL98.11.57
	TL.SF.West Surface.A

Losey 3 only has two types and, therefore, two clusters were selected for the analysis (Table 13); since Thomas/Luckey has three types, three clusters were selected (Table 14). In the following table, Shenks Ferry vessels are green, Kelso Corded, yellow, and Oak Hill purple. The Shenks Ferry/Kelso Corded Hybrid is shaded lime green. Clay samples are uncolored. If each of these types are indicative of separate origins, they should cluster independently of one another. The *k*-means analysis showed that this is not the case at either site.

Losey 3 presents a relatively even distribution of Shenks Ferry and Kelso Corded, with little variation between the NF and YF assays. If the Shenks Ferry vessels were brought into the village from their natal territory they should cluster separately from the Kelso Corded vessels. Since this is not the case, they are made from similar clays.

Table 13. NF (Left) and YF (Right), Losey 3 Type Clusters.

Cluster 1	Cluster 2
L3.HY.V153.10300.1	L3.KC.V115.NA
L3.KC.V1.897.1	L3.KC.V12.8929.7
L3.KC.V106.7057.1	L3.KC.V123.3475.338
L3.KC.V11.1026.1	L3.KC.V124.8915.4
L3.KC.V125.9231.1	L3.KC.V128.10325.1
L3.KC.V14.669.173	L3.KC.V129.10261.1
L3.KC.V16.9244.238	L3.KC.V15.665.309
L3.KC.V4.1063.1	L3.KC.V2.1027.1
L3.KC.V61.1820.1	L3.KC.V59.3804.1
L3.KC.V8.903.9	L3.KC.V6.669.125
L3.KC.V83.4722.1	L3.KC.V5.967.1
L3.KC.V85.4963.4	L3.KC.V60.1406.1
L3.KC.V88.7034.1	L3.KC.V65.1396.1
L3.SF.V105.8932.1	L3.KC.V7.669.123
L3.SF.V119.9565.8	L3.KC.V84.4216.1
L3.SF.V140.10538.1	L3.KC.V9.918.1
L3.SF.V154.10340.1	L3.KC.V97.8014.1
L3.SF.V27.9594.1	L3.SF.V101.9675.1
L3.SF.V29.9833.1	L3.SF.V102.8893.1
L3.SF.V66.1346.1	L3.SF.V25.1079.1
L3.SF.V68.1539.1	L3.SF.V26.1078.1
	L3.SF.V28.1029.1
	L3.SF.V31.1170.2
	L3.SF.V33.1310.4
	L3.SF.V35.8100.2
	L3.SF.V36.693.71
	L3.SF.V37.668.274
	L3.SF.V38.668.273
	L3.SF.V39.2165.7
	L3.SF.V40.669.176
	L3.SF.V69.3642.1
	L3.SF.V70.1838.1
	L3.SF.V72.733.3
	L3.SF.V82.1692.8
	L3.SF.V86.NA
	L3.SF.V91.3982.7
	Sample 1
	Sample 2
	Sample 3
	Sample 4

Cluster 1	Cluster 2
L3.HY.V153.10300.1	L3.KC.V1.897.1
L3.KC.V106.7057.1	L3.KC.V11.1026.1
L3.KC.V125.9231.1	L3.KC.V115.NA
L3.KC.V14.669.173	L3.KC.V12.8929.7
L3.KC.V16.9244.238	L3.KC.V123.3475.338
L3.KC.V4.1063.1	L3.KC.V124.8915.4
L3.KC.V5.967.1	L3.KC.V128.10325.1
L3.KC.V61.1820.1	L3.KC.V129.10261.1
L3.KC.V7.669.123	L3.KC.V15.665.309
L3.KC.V83.4722.1	L3.KC.V2.1027.1
L3.KC.V85.4963.4	L3.KC.V59.3804.1
L3.KC.V88.7034.1	L3.KC.V6.669.125
L3.SF.V101.9675.1	L3.KC.V60.1406.1
L3.SF.V105.8932.1	L3.KC.V65.1396.1
L3.SF.V119.9565.8	L3.KC.V8.903.9
L3.SF.V140.10538.1	L3.KC.V84.4216.1
L3.SF.V154.10340.1	L3.KC.V9.918.1
L3.SF.V27.9594.1	L3.KC.V97.8014.1
L3.SF.V29.9833.1	L3.SF.V102.8893.1
L3.SF.V38.668.273	L3.SF.V25.1079.1
L3.SF.V40.669.176	L3.SF.V26.1078.1
L3.SF.V66.1346.1	L3.SF.V28.1029.1
L3.SF.V72.733.3	L3.SF.V31.1170.2
L3.SF.V82.1692.8	L3.SF.V33.1310.4
Sample 2	L3.SF.V35.8100.2
	L3.SF.V36.693.71
	L3.SF.V37.668.274
	L3.SF.V39.2165.7
	L3.SF.V68.1539.1
	L3.SF.V69.3642.1
	L3.SF.V70.1838.1
	L3.SF.V86.NA
	L3.SF.V91.3982.7
	Sample 1
	Sample 3
	Sample 4

Thomas/Luckey presents a relatively even distribution of Shenks Ferry and Kelso Corded, with only moderate variation between the NF and YF assays. Oak Hill Corded again is separated by the YF assay, with the type's presence in three clusters dropped down to two clusters in the NF assay. If the Shenks Ferry pots were not made locally they should cluster separately from the Kelso Corded vessels. While a perfect separation of types was unlikely, it was expected that one type would be in the majority in each cluster. illustrating an elemental similarity between all of the types at the site.

Table 14. NF (Left) and YF (Right), Thomas/Luckey Type Clusters.

Cluster 1	Cluster 2	Cluster 3
Sample 1	Sample 2	TL.KC.8N4Wl1
Sample 3	TL.KC.F12	TL.KC.F21.E.V9
Sample 4	TL.KC.F21.V8	TL.KC.F57
TL.KC.TL96.129.531	TL.KC.F3.C.V11	TL.KC.TL97.370.1479
TL.KC.TL96.17.58	TL.KC.F3.J.V12	TL.KC.TL96.174.719.A
TL.KC.TL96.17.58.A	TL.KC.F3.V10	TL.KC.TL96.21.77
TL.KC.TL96.35.131	TL.KC.F81	TL.KC.TL96.50.203
TL.KC.TL96.88.361	TL.KC.TL95.88.4	TL.KC.TL96.81.330.V30
TL.KC.TL97.112.516	TL.KC.TL96.103.410	TL.KC.TL97.190.873
TL.SF.F33.B	TL.KC.TL96.120.494	TL.KC.TL97.252.1053
TL.SF.F74	TL.KC.TL96.160.670	TL.KC.TL97.268.1134
TL.SF.TL95.94.15	TL.KC.TL96.174.719	TL.OH.F75Zone1
TL.SF.TL96.172.713	TL.KC.TL96.22.83	TL.OH.TL97.150.681
TL.SF.TL96.197.768	TL.KC.TL96.59.235	TL.OH.TL97.438.1664
	TL.KC.TL96.92.378	TL.SF.14N38EL3
	TL.KC.TL96.96.387	TL.SF.F12.V5
	TL.KC.TL96.97.390	TL.SF.F12A.V7
	TL.OH.TL95.88.4	TL.SF.F21.C.V49
	TL.OH.TL96.172.713.V41	TL.SF.F21.V48
	TL.OH.TL96.22.83	TL.SF.F22
	TL.OH.TL96.48.193	TL.SF.F3
	TL.SF.16N26EL3	TL.SF.F30
	TL.SF.F12.UN	TL.SF.F33.V55
	TL.SF.F21.F.V47	TL.SF.F4.V57
	TL.SF.F28.V51	TL.SF.F57.A
	TL.SF.F3.A	TL.SF.F57
	TL.SF.F4.B	TL.SF.F58.A.V62
	TL.SF.F57.B	TL.SF.F58.V63
	TL.SF.F81.V66	TL.SF.F67
	TL.SF.TL95.88.4	TL.SF.F81.A
	TL.SF.TL96.146.600	TL.SF.N10E46L2.AC.V2
	TL.SF.TL96.146.600.A	TL.SF.N10E46L2.B
	TL.SF.TL96.149.615	TL.SF.N10E46L2
	TL.SF.TL96.24.93	TL.SF.TL96.158.662
	TL.SF.TL96.44.173	TL.SF.TL97.120.545
	TL.SF.TL97.329.1329	TL.SF.TL98.217.786
	TL.SF.TL97.350.1404	TL.SF.Trench 18 NE Quad
	TL.SF.TL97.357.1435	TL.SF.West Surface.V87
	TL.SF.TL98.11.57	
	TL.SF.West Surface.A	

Cluster 1	Cluster 2	Cluster 3
Sample 1	Sample 2	TL.KC.8N4Wl1
Sample 3	TL.KC.F21.E.V9	TL.KC.F3.V10
Sample 4	TL.KC.F57	TL.KC.TL96.103.410
TL.KC.F12	TL.KC.TL95.88.4	TL.KC.TL96.120.494
TL.KC.F21.V8	TL.KC.TL96.174.719.A	TL.KC.TL96.129.531
TL.KC.F3.C.V11	TL.KC.TL96.22.83	TL.KC.TL96.21.77
TL.KC.F3.J.V12	TL.KC.TL96.50.203	TL.KC.TL96.81.330.V30
TL.KC.F81	TL.KC.TL96.59.235	TL.KC.TL96.96.387
TL.KC.TL96.160.670	TL.KC.TL96.92.378	TL.KC.TL97.252.1053
TL.KC.TL96.17.58	TL.KC.TL97.190.873	TL.KC.TL97.268.1134
TL.KC.TL96.17.58.A	TL.OH.F75Zone1	TL.KC.TL97.370.1479
TL.KC.TL96.174.719	TL.OH.TL96.22.83	TL.OH.TL95.88.4
TL.KC.TL96.35.131	TL.OH.TL96.48.193	TL.OH.TL97.150.681
TL.KC.TL96.88.361	TL.SF.N10E46L2.AC.V2	TL.OH.TL97.438.1664
TL.KC.TL96.97.390	TL.SF.N10E46L2	TL.SF.N10E46L2.B
TL.KC.TL97.112.516	TL.SF.F12A.V7	TL.SF.14N38EL3
TL.OH.TL96.172.713.V41	TL.SF.F21.F.V47	TL.SF.F21.C.V49
TL.SF.16N26EL3	TL.SF.F22	TL.SF.F21.V48
TL.SF.F12.UN	TL.SF.F28.V51	TL.SF.F3.A
TL.SF.F12.V5	TL.SF.F30	TL.SF.F33.B
TL.SF.F3	TL.SF.F57.A	TL.SF.F4.V57
TL.SF.F33.V55	TL.SF.F57	TL.SF.F57.B
TL.SF.F4.B	TL.SF.F58.V63	TL.SF.F58.A.V62
TL.SF.F74	TL.SF.TL96.158.662	TL.SF.F67
TL.SF.F81.V66	TL.SF.TL97.120.545	TL.SF.F81.A
TL.SF.TL95.94.15	TL.SF.TL98.217.786	TL.SF.TL95.88.4
TL.SF.TL96.146.600.A		TL.SF.TL96.172.713
TL.SF.TL96.146.600		TL.SF.TL97.329.1329
TL.SF.TL96.149.615		TL.SF.TL98.11.57
TL.SF.TL96.197.768		TL.SF.Trench 18 NE Quad
TL.SF.TL96.24.93		TL.SF.West Surface.V87
TL.SF.TL96.44.173		
TL.SF.TL97.350.1404		
TL.SF.TL97.357.1435		
TL.SF.West Surface.A		

To further examine potential clustering among the vessel types at the two sites, I used the elbow method to derive a statistically optimal number of clusters. For Thomas/Luckey, the plot of variance suggested that eight clusters would be optimal. For Losey, the plot showed six clusters.

Under the given parameters outlined in Table 11 above, I selected 20 classes (clusters) to begin the evaluation of best fit for clustering in the dataset (Figure 22). Larger datasets would require more clusters to evaluate the best groupings, while smaller datasets, such as this one, require fewer. As more points are added, the variation between clusters increases, and with each new clustering point there is less variation at each cluster. More clusters, in turn, have higher degrees of similarity around each point. I plotted the variance within the whole dataset against the number of classes.

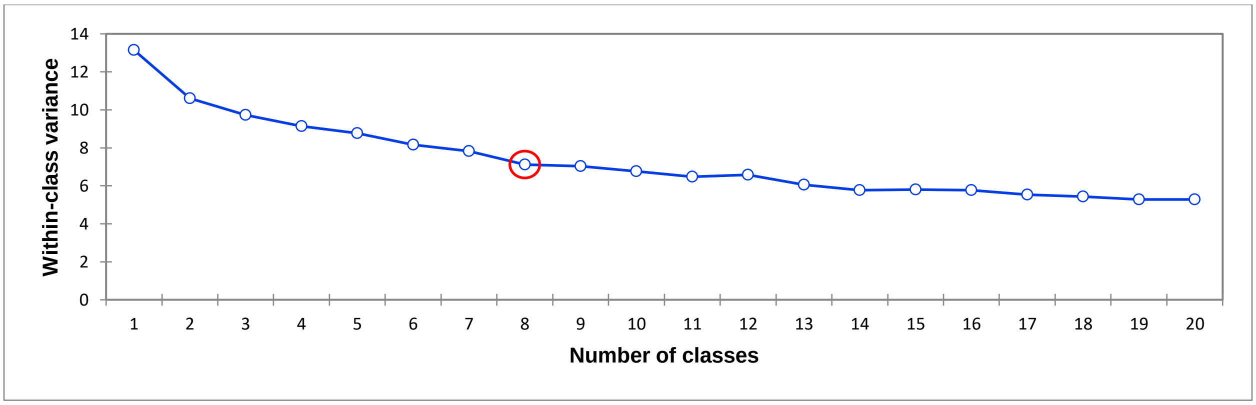


Figure 22. Variance of dataset over number of clusters for all NF runs.

No Filter Results

Each line in the below tables represents a unique vessel. Each column represents the vessels that cluster at each point, due to similarities of elemental signatures. Thomas/Luckey artifacts are marked with blue text, and Losey 3 artifacts with red text. Shenks Ferry vessels are filled with green, Kelso Corded with yellow and Oak Hill with purple. The Shenks Ferry/Kelso Corded Hybrid is marked with lime green. Clay samples are left uncolored with black text.

Table 15. No Filter All Data Points, 8 Clusters.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8
L3.HY.V153.10300.1	L3.KC.V1.897.1	L3.KC.V115.NA	L3.KC.V12.8929.7	L3.KC.V128.10325.1	L3.KC.V4.1063.1	L3.KC.V5.967.1	TL.SF.F33.B
L3.KC.V106.7057.1	L3.KC.V11.1026.1	L3.KC.V123.3475.338	L3.KC.V6.669.125	L3.KC.V129.10261.1	L3.SF.V105.8932.1	L3.KC.V8.903.9	
L3.KC.V125.9231.1	L3.KC.V124.8915.4	L3.KC.V15.665.309	L3.KC.V97.8014.1	L3.KC.V65.1396.1	L3.SF.V72.733.3	L3.KC.V85.4963.4	
L3.KC.V14.669.173	L3.KC.V2.1027.1	L3.KC.V59.3804.1	L3.SF.V25.1079.1	L3.SF.V102.8893.1	Sample 2	L3.SF.V140.10538.1	
L3.KC.V16.9244.238	L3.KC.V60.1406.1	L3.KC.V7.669.123	L3.SF.V26.1078.1	L3.SF.V33.1310.4		L3.SF.V27.9594.1	
L3.SF.V119.9565.8	L3.KC.V61.1820.1	L3.KC.V84.4216.1	L3.SF.V31.1170.2	L3.SF.V35.8100.2		L3.SF.V66.1346.1	
L3.SF.V154.10340.1	L3.KC.V83.4722.1	L3.KC.V9.918.1	Sample 1	L3.SF.V36.693.71		L3.SF.V69.3642.1	
L3.SF.V68.1539.1	L3.KC.V88.7034.1	L3.SF.V101.9675.1	Sample 3	TL.KC.F12		TL.KC.8N4WI1	
TL.KC.F21.E.V9	L3.SF.V28.1029.1	L3.SF.V38.668.273	Sample 4	TL.KC.F3.J.V12		TL.KC.F3.C.V11	
TL.KC.F57	L3.SF.V29.9833.1	L3.SF.V39.2165.7	TL.KC.TL96.17.58	TL.KC.F3.V10		TL.KC.TL96.120.494	
TL.KC.TL97.370.1479	L3.SF.V37.668.274	L3.SF.V40.669.176		TL.KC.TL96.129.531		TL.KC.TL96.50.203	
TL.KC.TL96.174.719.A	TL.KC.F21.V8	L3.SF.V70.1838.1		TL.KC.TL96.160.670		TL.KC.TL96.59.235	
TL.KC.TL96.21.77	TL.KC.TL96.22.83	L3.SF.V82.1692.8		TL.KC.TL96.17.58.A		TL.KC.TL96.81.330.V30	
TL.KC.TL97.190.873	TL.KC.TL97.252.1053	L3.SF.V86.NA		TL.KC.TL96.35.131		TL.KC.TL96.92.378	
TL.KC.TL97.268.1134	TL.OH.F75Zone1	L3.SF.V91.3982.7		TL.KC.TL96.88.361		TL.OH.TL96.22.83	
TL.OH.TL97.150.681	TL.SF.F3.A	TL.KC.F81		TL.KC.TL97.112.516		TL.OH.TL96.48.193	
TL.OH.TL97.438.1664	TL.SF.F3	TL.KC.TL95.88.4		TL.OH.TL95.88.4		TL.SF.F12.V5	
TL.SF.14N38EL3	TL.SF.F30	TL.KC.TL96.103.410		TL.OH.TL96.172.713.V41		TL.SF.F12A.V7	
TL.SF.F21.C.V49	TL.SF.F57	TL.KC.TL96.174.719		TL.SF.16N26EL3		TL.SF.F21.V48	
TL.SF.F22	TL.SF.TL96.44.173	TL.KC.TL96.96.387		TL.SF.F12.UN		TL.SF.F28.V51	
TL.SF.F4.V57	TL.SF.Trench 18 NE Quad	TL.KC.TL96.97.390		TL.SF.F74		TL.SF.F33.V55	
TL.SF.F58.A.V62		TL.SF.F21.F.V47		TL.SF.F81.V66		TL.SF.F57.A	
TL.SF.F67		TL.SF.F4.B		TL.SF.TL95.94.15		TL.SF.F57.B	
TL.SF.F81.A		TL.SF.TL95.88.4		TL.SF.TL96.172.713		TL.SF.F58.V63	
TL.SF.N10E46L2.B		TL.SF.TL96.146.600		TL.SF.TL96.197.768		TL.SF.N10E46L2.AC.V2	
TL.SF.N10E46L2		TL.SF.TL96.149.615		TL.SF.TL97.329.1329		TL.SF.TL96.146.600.A	
		TL.SF.TL96.158.662		TL.SF.TL97.357.1435		TL.SF.TL96.24.93	
				TL.SF.West Surface.A		TL.SF.TL97.120.545	
						TL.SF.TL97.350.1404	
						TL.SF.TL98.11.57	
						TL.SF.TL98.217.786	
						TL.SF.West Surface.V87	

It is clear from the distribution in Table 15 that the two sites do not separate into homogeneous clusters, even when analyzed as a complete dataset with multiple optimal clusters derived from the statistical method. This supports the hypothesis that these communities used clay from elementally similar outcrops. It also may indicate a higher degree of relation between the sites, and there could have been more interaction movement of people between these communities. All clusters except for Clusters 6 and 8 have a mix of both sites and pottery types. It is interesting to note that raw clay Samples 1, 3, and 4 all are clustered together, while Sample 2 is in a different cluster. This correlates to the differing material properties of the clay, and demonstrates the regional similarity of clays, but also indicates the variation inherent in the region, allowing for finer-grained sourcing studies. This patterning also matches the scatterplot representations.

Within the Thomas/Luckey site assemblage, the Kelso Corded and Shenks Ferry vessels do not separate out into homogenous clusters (Table 16). Additionally, the Oak Hill Corded vessels are not all clustering together, which indicates that they are also made from clay that is similar to the other types at this site. The Oak Hill Corded vessels do not seem to group with either Shenks Ferry or Kelso Corded varieties, and instead seem relatively evenly distributed amongst clusters.

Cluster 8 represents a single Shenks Ferry vessel (F33.B) that is dissimilar to all other vessels and clay sampled. When the raw values of F33.B are examined, they do not vary greatly from the overall assemblage; there is no obvious reason for this outlier.

Table 16. No Filter Thomas/Luckey and Clay Samples, 8 Clusters.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8
Sample 1	Sample 2	TL.KC.8N4WI1	TL.KC.F12	TL.KC.F57	TL.KC.TL96.103.410	TL.KC.TL97.252.1053	TL.SF.F33.B
Sample 3	TL.KC.F3.J.V12	TL.KC.F21.E.V9	TL.KC.F21.V8	TL.KC.TL97.370.1479	TL.KC.TL96.174.719.A	TL.KC.TL97.268.1134	
Sample 4	TL.KC.F3.V10	TL.KC.TL96.120.494	TL.KC.F3.C.V11	TL.KC.TL96.21.77	TL.KC.TL96.50.203	TL.OH.F75Zone1	
TL.KC.TL96.129.531	TL.KC.F81	TL.OH.TL96.22.83	TL.KC.TL96.22.83	TL.KC.TL97.190.873	TL.KC.TL96.81.330.V30	TL.SF.14N38EL3	
TL.KC.TL96.17.58	TL.KC.TL95.88.4	TL.OH.TL96.48.193	TL.KC.TL96.96.387	TL.OH.TL97.150.681	TL.KC.TL96.92.378	TL.SF.F22	
TL.KC.TL96.17.58.A	TL.KC.TL96.160.670	TL.SF.F12.V5	TL.SF.16N26EL3	TL.OH.TL97.438.1664	TL.SF.F21.F.V47	TL.SF.F3	
TL.KC.TL96.35.131	TL.KC.TL96.174.719	TL.SF.F12A.V7	TL.SF.F3.A	TL.SF.F21.C.V49	TL.SF.F57.B	TL.SF.F30	
TL.KC.TL96.88.361	TL.KC.TL96.59.235	TL.SF.F21.V48	TL.SF.TL96.146.600	TL.SF.F57.A	TL.SF.N10E46L2.AC.V2	TL.SF.F57	
TL.KC.TL97.112.516	TL.KC.TL96.97.390	TL.SF.F33.V55	TL.SF.TL96.146.600.A	TL.SF.F67	TL.SF.N10E46L2		
TL.SF.F74	TL.OH.TL95.88.4	TL.SF.F4.V57	TL.SF.TL96.149.615	TL.SF.F81.A	TL.SF.TL95.88.4		
TL.SF.TL95.94.15	TL.OH.TL96.172.713.V41	TL.SF.F58.A.V62	TL.SF.TL96.44.173	TL.SF.N10E46L2.B	TL.SF.TL96.158.662		
TL.SF.TL96.172.713	TL.SF.F12.UN	TL.SF.F58.V63		TL.SF.Trench 18 NE Quad	TL.SF.TL97.120.545		
TL.SF.TL96.197.768	TL.SF.F28.V51	TL.SF.TL97.350.1404			TL.SF.West Surface.V87		
	TL.SF.F4.B	TL.SF.TL98.11.57					
	TL.SF.F81.V66	TL.SF.TL98.217.786					
	TL.SF.TL96.24.93						
	TL.SF.TL97.329.1329						
	TL.SF.TL97.357.1435						
	TL.SF.West Surface.A						

As with the Thomas/Luckey assemblage, Kelso Corded and Shenks Ferry do not separate out into distinct clusters at Losey 3 except for Cluster 2 (Table 17). The Shenks Ferry vessels do not exist in a cluster that is completely independent of Kelso Corded. V153 is the Shenks Ferry/Kelso Hybrid vessel and it appears in Cluster 1. It is related to both Shenks Ferry and Kelso Corded pots in that cluster and is not as elementally distinct as its decorations. Cluster 7 is the most homogeneous Shenks Ferry grouping although only two Shenks Ferry vessels. This is not a strong or convincing cluster. The next *k*-means run uses the yellow filter results from the pXRF.

Table 17. No filter Losey 3 and Clay samples, 8 Clusters.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8
L3.HY.V153.10300.1	L3.KC.V1.897.1	L3.KC.V115.NA	L3.KC.V12.8929.7	L3.KC.V123.3475.338	L3.KC.V128.10325.1	L3.KC.V4.1063.1	Sample 1
L3.KC.V106.7057.1	L3.KC.V11.1026.1	L3.KC.V5.967.1	L3.KC.V6.669.125	L3.KC.V15.665.309	L3.KC.V129.10261.1	L3.SF.V105.8932.1	Sample 3
L3.KC.V125.9231.1	L3.KC.V124.8915.4	L3.KC.V85.4963.4	L3.KC.V97.8014.1	L3.KC.V59.3804.1	L3.KC.V65.1396.1	L3.SF.V72.733.3	Sample 4
L3.KC.V14.669.173	L3.KC.V2.1027.1	L3.KC.V9.918.1	L3.SF.V25.1079.1	L3.KC.V7.669.123	L3.SF.V102.8893.1		
L3.KC.V16.9244.238	L3.KC.V60.1406.1	L3.SF.V101.9675.1	L3.SF.V26.1078.1	L3.KC.V84.4216.1	Sample 2		
L3.KC.V8.903.9	L3.KC.V61.1820.1	L3.SF.V28.1029.1	L3.SF.V35.8100.2	L3.SF.V38.668.273			
L3.SF.V119.9565.8	L3.KC.V83.4722.1	L3.SF.V31.1170.2	L3.SF.V36.693.71	L3.SF.V40.669.176			
L3.SF.V140.10538.1	L3.KC.V88.7034.1	L3.SF.V33.1310.4		L3.SF.V70.1838.1			
L3.SF.V154.10340.1	L3.SF.V29.9833.1	L3.SF.V37.668.274		L3.SF.V82.1692.8			
L3.SF.V27.9594.1		L3.SF.V39.2165.7		L3.SF.V91.3982.7			
L3.SF.V66.1346.1		L3.SF.V69.3642.1					
L3.SF.V68.1539.1		L3.SF.V86.NA					

Yellow Filter Results

The same initial steps were repeated for YF assays as for the NF assays, with 20 classes initially selected (Figure 23) to determine the point of diminishing returns where the variance began to stabilize. Six classes were selected.

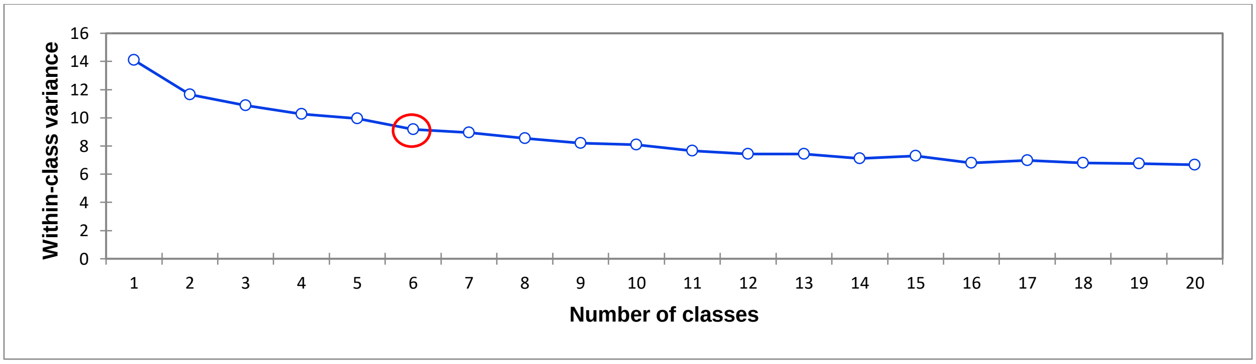


Figure 23. Variance of dataset over number of clusters for all YF runs.

The distribution depicted in Table 18 suggests that the two sites separate into mostly distinct groupings at Cluster 4 (predominated by Losey 3) and Cluster 7 (mostly Thomas/Luckey). Clay Samples 1, 3, and 4 are also in Cluster 4 suggesting a possible connection of these vessels to clay sources with the characteristics of these samples. F33.B from Thomas/Luckey is again clustered on its own showing that it is elementally dissimilar to the clay samples, other Thomas/Luckey vessels, and Losey 3 (Table 18). Kelso Corded, Shenks Ferry, and Oak Hill Corded are intermixed within all clusters, except Cluster 8. Both sites are approximately evenly mixed in the other clusters, except for Clusters 4 and 7 which are dominated by Losey 3 and Thomas/Luckey, respectively.

Table 18. Yellow Filter All Data Points, 6 Clusters.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
L3.HY.V153.10300.1	L3.KC.V1.897.1	L3.KC.V11.1026.1	L3.KC.V128.10325.1	L3.KC.V14.669.173	TL.SF.F33.B
L3.KC.V106.7057.1	L3.KC.V123.3475.338	L3.KC.V115.NA	L3.KC.V2.1027.1	L3.KC.V5.967.1	
L3.KC.V125.9231.1	L3.KC.V83.4722.1	L3.KC.V12.8929.7	L3.KC.V65.1396.1	L3.KC.V61.1820.1	
L3.KC.V16.9244.238	L3.KC.V85.4963.4	L3.KC.V124.8915.4	L3.KC.V8.903.9	L3.KC.V7.669.123	
L3.KC.V4.1063.1	L3.SF.V72.733.3	L3.KC.V129.10261.1	L3.KC.V9.918.1	L3.KC.V88.7034.1	
L3.SF.V119.9565.8	L3.SF.V82.1692.8	L3.KC.V15.665.309	L3.SF.V102.8893.1	L3.SF.V101.9675.1	
L3.SF.V38.668.273	TL.KC.8N4WI1	L3.KC.V59.3804.1	L3.SF.V86.NA	L3.SF.V105.8932.1	
L3.SF.V40.669.176	TL.KC.F3.V10	L3.KC.V6.669.125	TL.KC.F12	L3.SF.V140.10538.1	
TL.KC.F21.E.V9	TL.KC.TL96.103.410	L3.KC.V60.1406.1	TL.KC.F3.C.V11	L3.SF.V154.10340.1	
TL.KC.F57	TL.KC.TL96.120.494	L3.KC.V84.4216.1	TL.KC.F3.J.V12	L3.SF.V27.9594.1	
TL.KC.TL96.21.77	TL.KC.TL96.81.330.V30	L3.KC.V97.8014.1	TL.KC.F81	L3.SF.V29.9833.1	
TL.KC.TL96.96.387	TL.KC.TL96.88.361	L3.SF.V25.1079.1	TL.KC.TL96.129.531	L3.SF.V66.1346.1	
TL.KC.TL97.190.873	TL.KC.TL96.92.378	L3.SF.V26.1078.1	TL.KC.TL96.35.131	Sample 2	
TL.KC.TL97.268.1134	TL.KC.TL97.112.516	L3.SF.V28.1029.1	TL.KC.TL96.97.390	TL.KC.TL95.88.4	
TL.OH.F75Zone1	TL.KC.TL97.252.1053	L3.SF.V31.1170.2	TL.OH.TL96.172.713.V41	TL.KC.TL96.174.719	
TL.OH.TL97.438.1664	TL.KC.TL97.370.1479	L3.SF.V33.1310.4	TL.SF.16N26EL3	TL.KC.TL96.174.719.A	
TL.SF.N10E46L2.B	TL.OH.TL95.88.4	L3.SF.V35.8100.2	TL.SF.F12.UN	TL.KC.TL96.22.83	
TL.SF.N10E46L2	TL.OH.TL97.150.681	L3.SF.V36.693.71	TL.SF.F4.B	TL.KC.TL96.50.203	
TL.SF.14N38EL3	TL.SF.F57.B	L3.SF.V37.668.274	TL.SF.F74	TL.KC.TL96.59.235	
TL.SF.F21.C.V49	TL.SF.F81.V66	L3.SF.V39.2165.7	TL.SF.TL97.350.1404	TL.OH.TL96.22.83	
TL.SF.F21.V48	TL.SF.TL95.88.4	L3.SF.V68.1539.1	TL.SF.TL97.357.1435	TL.OH.TL96.48.193	
TL.SF.F3.A	TL.SF.TL95.94.15	L3.SF.V69.3642.1	TL.SF.West Surface.A	TL.SF.N10E46L2.AC.V2	
TL.SF.F4.V57	TL.SF.TL96.146.600	L3.SF.V70.1838.1		TL.SF.F12.V5	
TL.SF.F57.A	TL.SF.TL96.172.713	L3.SF.V91.3982.7		TL.SF.F12A.V7	
TL.SF.F58.A.V62	TL.SF.TL96.197.768	Sample 1		TL.SF.F21.F.V47	
TL.SF.F58.V63	TL.SF.TL97.329.1329	Sample 3		TL.SF.F22	
TL.SF.F67	TL.SF.TL98.11.57	Sample 4		TL.SF.F28.V51	
TL.SF.TL96.158.662	TL.SF.Trench 18 NE Quad	TL.KC.F21.V8		TL.SF.F30	
	TL.SF.West Surface.V87	TL.KC.TL96.160.670		TL.SF.F33.V55	
		TL.KC.TL96.17.58		TL.SF.F57	
		TL.KC.TL96.17.58.A		TL.SF.F81.A	
		TL.SF.F3		TL.SF.TL97.120.545	
		TL.SF.TL96.146.600.A		TL.SF.TL98.217.786	
		TL.SF.TL96.149.615			
		TL.SF.TL96.24.93			
		TL.SF.TL96.44.173			

Cluster 1 groups the three elementally similar clay outcrops with several Kelso Corded vessels, and no other types. Apart from this first cluster, and Cluster 8, all other clusters show a mixture of all three types. Thomas/Luckey's F33.B is again isolated in its own separate cluster (Table 19), illustrating that it is radically dissimilar to the overall assemblage. The presence of titanium and different energy signatures of the returned elements from the YF assays does not significantly alter the overall similarity of pottery types within each site or the overall similarity of the assemblages themselves.

Table 19. Yellow Filter Thomas/Luckey and Clay, 6 Clusters.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Sample 1	Sample 2	TL.KC.8N4WI1	TL.KC.F12	TL.KC.F81	TL.SF.F33.B
Sample 3	TL.KC.F21.E.V9	TL.KC.TL97.252.1053	TL.KC.F3.V10	TL.KC.TL95.88.4	
Sample 4	TL.KC.F57	TL.OH.TL97.438.1664	TL.KC.TL96.120.494	TL.KC.TL96.174.719	
TL.KC.F21.V8	TL.KC.TL96.103.410	TL.SF.14N38EL3	TL.KC.TL96.129.531	TL.KC.TL96.22.83	
TL.KC.F3.C.V11	TL.KC.TL96.174.719.A	TL.SF.F3.A	TL.KC.TL96.35.131	TL.KC.TL96.50.203	
TL.KC.F3.J.V12	TL.KC.TL96.21.77	TL.SF.F4.V57	TL.KC.TL96.88.361	TL.KC.TL96.59.235	
TL.KC.TL96.160.670	TL.KC.TL96.81.330.V30	TL.SF.F67	TL.KC.TL97.370.1479	TL.KC.TL96.97.390	
TL.KC.TL96.17.58	TL.KC.TL96.92.378		TL.OH.TL95.88.4	TL.KC.TL97.112.516	
TL.KC.TL96.17.58.A	TL.KC.TL96.96.387		TL.OH.TL97.150.681	TL.OH.TL96.172.713.V41	
TL.SF.F3	TL.KC.TL97.190.873		TL.SF.16N26EL3	TL.SF.F12.UN	
TL.SF.F4.B	TL.KC.TL97.268.1134		TL.SF.F57.B	TL.SF.F12.V5	
TL.SF.TL96.146.600.A	TL.OH.F75Zone1		TL.SF.F74	TL.SF.F21.F.V47	
TL.SF.TL96.149.615	TL.OH.TL96.22.83		TL.SF.TL95.88.4	TL.SF.F28.V51	
TL.SF.TL96.24.93	TL.OH.TL96.48.193		TL.SF.TL95.94.15	TL.SF.F33.V55	
TL.SF.TL96.44.173	TL.SF.N10E46L2.AC.V2		TL.SF.TL96.172.713	TL.SF.F57	
	TL.SF.N10E46L2.B		TL.SF.TL96.197.768	TL.SF.F81.V66	
	TL.SF.N10E46L2		TL.SF.TL97.329.1329	TL.SF.TL96.146.600	
	TL.SF.F12A.V7		TL.SF.TL98.11.57	TL.SF.TL97.120.545	
	TL.SF.F21.C.V49		TL.SF.Trench 18 NE Quad	TL.SF.TL97.350.1404	
	TL.SF.F21.V48			TL.SF.TL97.357.1435	
	TL.SF.F22			TL.SF.TL98.217.786	
	TL.SF.F30			TL.SF.West Surface.A	
	TL.SF.F57.A				
	TL.SF.F58.A.V62				
	TL.SF.F58.V63				
	TL.SF.F81.A				
	TL.SF.TL96.158.662				
	TL.SF.West Surface.V87				

Except for Cluster 1, there is mostly admixture of the two types. The three clay samples seem to align more with Shenks Ferry at Losey 3 but more with Kelso Corded at Thomas/Luckey. The Shenks Ferry/Kelso Corded Hybrid is elementally closer to Shenks Ferry than Kelso Corded in terms of paste composition, though it is difficult to quantify this closeness. The Hybrid Shenks Ferry/Kelso Corded vessel values do not typically stand apart from the Losey 3 assemblage or favor either Kelso Corded or Shenks Ferry. With the addition of titanium values, the Hybrid clusters with the Shenks Ferry vessels more than the Kelso Corded vessels, though this cluster (Cluster 1) is the only homogeneous cluster (Table 20). All other groupings consistently present a mix of types and the clay samples fall into their now expected pattern.

Table 20. Yellow Filter Losey 3 and Clay, 6 Clusters.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
L3.HY.V153.10300.1	L3.KC.V1.897.1	L3.KC.V106.7057.1	L3.KC.V11.1026.1	L3.KC.V128.10325.1	L3.KC.V4.1063.1
L3.KC.V14.669.173	L3.KC.V115.NA	L3.KC.V123.3475.338	L3.KC.V12.8929.7	L3.KC.V129.10261.1	L3.SF.V105.8932.1
L3.KC.V61.1820.1	L3.KC.V124.8915.4	L3.KC.V125.9231.1	L3.KC.V8.903.9	L3.KC.V2.1027.1	L3.SF.V72.733.3
L3.KC.V7.669.123	L3.KC.V15.665.309	L3.KC.V16.9244.238	L3.KC.V97.8014.1	L3.KC.V65.1396.1	Sample 2
L3.KC.V88.7034.1	L3.KC.V5.967.1	L3.KC.V83.4722.1	L3.SF.V31.1170.2	L3.SF.V102.8893.1	
L3.SF.V101.9675.1	L3.KC.V59.3804.1	L3.KC.V85.4963.4	L3.SF.V33.1310.4	L3.SF.V39.2165.7	
L3.SF.V140.10538.1	L3.KC.V6.669.125	L3.SF.V119.9565.8	L3.SF.V37.668.274	L3.SF.V86.NA	
L3.SF.V154.10340.1	L3.KC.V60.1406.1	L3.SF.V38.668.273	L3.SF.V68.1539.1		
L3.SF.V25.1079.1	L3.KC.V84.4216.1	L3.SF.V40.669.176	Sample 1		
L3.SF.V27.9594.1	L3.KC.V9.918.1	L3.SF.V82.1692.8	Sample 3		
L3.SF.V28.1029.1	L3.SF.V26.1078.1		Sample 4		
L3.SF.V29.9833.1	L3.SF.V35.8100.2				
	L3.SF.V36.693.71				
	L3.SF.V66.1346.1				
	L3.SF.V69.3642.1				
	L3.SF.V70.1838.1				
	L3.SF.V91.3982.7				

Summary

Collectively both sets of results show no clear elemental distinction between either the Thomas/Luckey site or the Losey 3 site. This illustrates that the clay used to make vessels at the sites is either the same clay or similar clay. Additionally, the raw clay samples that were collected share similar elemental signatures to the vessel in both assemblages. This indicates that the potters at both sites used clay that was available locally. Within each site, vessels typed as Shenks Ferry, Kelso Corded, and Oak Hill Corded vessels did not separate into distinct clusters based on their elemental composition. If these vessels were traded into the local communities or if potters showed a preference for clay outcrops outside the local region, a separation based on paste would be evident. Instead, potters making different styles shared a community of practice, and possibly expressed identity, in regard to acquiring clay. Additionally, these vessels are alike, but not identical to clay samples from the region. Collectively this supports the reproduction of natal designs and a community of practice after arrival to the area and does not support trade of vessels. The next chapter addresses the interpretation and discussion of these results in relation to the hypotheses being tested and the data, and how the results address the broader anthropological questions posed for this thesis

CHAPTER 7. DISCUSSION

In this chapter I will discuss how the results of the analyses presented in Chapter 6 can be interpreted within the larger anthropological research questions outlined in Chapter 1. I will address how the communities of practice concept and our archaeological understandings of identity play into the understanding of the Late Woodland past in the Northeast. Additionally, I will examine the results from this study in relation to some previous ideas about the site

Overview

My initial research question focused on how vessels categorized as Shenks Ferry, with origins in central Pennsylvania, came to be present on sites outside the core area for these decorated vessels. Explanations proposed in advance of analysis included trade of finished vessels, movements of people carrying the style of decoration taught in their natal communities of practice to new communities, or copying these designs by residents of the two northerly communities, Thomas/Luckey and Losey 3. After pXRF analysis of the elemental composition of vessels from each site, I examined the raw data using scatterplots and *k*-means cluster analysis. As discussed in the previous chapter, the analysis did not clearly differentiate between the two communities of Thomas/Luckey and Losey 3 nor did analysis show a serration of the three pottery types (Shenks Ferry, Kelso Corded, and Oak Hill Corded) based on the paste used in creating the pots. This supports the hypothesis that all vessels, regardless of design, are made from clay from regions surrounding the two sites and not from distant clay sources. It is therefore more likely that this is the result of the movement of people who carried with them the knowledge of decoration styles, not actual pots, and the transference of this knowledge onto the creation of new pots made of local clay. The scatter plots of elemental ratios derived from pXRF mostly showed wide variation of some elemental ratios around the mean of the composite assemblages, and some clustering close to the mean. The Shenks Ferry, Kelso Corded, and Oak Hill Corded vessels at each site did not cluster into separate areas of the plots indicating that the clay used was similar both within sites and between sites.

The *k*-means cluster analysis further explored the hypotheses being tested in this thesis. This non-hierarchical method of determining similarities in the datasets starts with a preferred number of clusters, here based on the two or three pottery types and their elemental signatures, and determines if the separation expected is actually present. If the vessels were made from drastically different parent material, they would be more apt to cluster independently in both the scatterplots and *k*-means.

Vessels from both the Thomas/Luckey site and the Losey 3 site fall into clusters independent of their design types within each site. They do not cluster by site or pottery type. The raw clay Sample 2 is an outlier in most analyses, and this could be the result of other treatments to the clay used in the vessels during processing by the potters The outlier of the Shenks Ferry vessel F33.B is anomalous, and it is unknown what it represents. Additionally, there is no clear separation of vessels based on the raw clay samples analyzed; the pottery at each site is made of clays similar to these samples. Clay sample values are similar to the vessel types in the assemblages, but not conclusively identical, showing local similarity but not exact provenience. Clay Sample 2 is typically found near the median values in the scatterplots, however Samples 1, 3, and 4 are usually less related to the overall data. This could be from contaminants in the sample (non-clay sediment, organics, or other waterborne contaminants), or that these exact clay sources were not used by the communities to make pots; Sample 2 most resembles the clays used in pot construction at the sites. Alternatively, other aspects of the processing of the clay into paste (mixing clay sources, adding temper, etc.) may have altered the elemental signature sufficiently to obscure this exact relationship, though this is a small chance. Sample 2 demonstrated that it is more likely that I have located an outcrop or part of a larger clay body that was used by potters from these sites. As demonstrated by Rieth (1997) there is a distinction between clay sources in the Upper Susquehanna River Valley, but it is more likely that there some similarities between outcrops at a more local level.

While some groups may have closely guarded and kept their clay sources restricted to members of their community, this does not appear to the case here. This could indicate that there were no clear preferences among potters in the region, which is contrary to any assumption that those who made the pots had a community tradition tied to a specific source of clay.

Clay outcrops in this local area are relatively homogenous based on my sampling and are not as distinct as would be preferable for fine-grained sourcing. A river subbasin may be the finest grain resolution for sourcing in this area with these tools. This does not indicate that sourcing is useless in this area, as the different quarries being utilized in the same village would be comparable and not radically distinct. Clay Sample 2 clustered independently of Samples 1, 3, and 4 illustrating that there is at least some distinction between clay sources. It is likely that vessels at each site represent pots made from local clay, but maybe not the sources identified for this study. If pots were brought in from a Shenks Ferry home territory they would be expected to be compositionally distinct from local Kelso Corded vessels. The clays of the Southern Tier and northern Pennsylvania are glacially deposited, secondary sources, with those of central and south-central Pennsylvania being primary clay sources. Additionally, the Shenks Ferry type site is in Lancaster County, far below the Last Glacial Maximum. This would provide sources of primarily *in situ* clays and not the secondarily deposited clays that dominate the landscape along the present Pennsylvania/New York border.

The elemental composition of Shenks Ferry vessels at both the Thomas/Luckey and Losey 3 sites supports the null hypothesis of the movement of people or the replication of decoration styles, and not trade. If any or all Shenks Ferry sherds had a chemical composition significantly different from the clay used on Kelso Corded vessels that would indicate that some vessels were brought into the site and some were reproduced at the site. That is not the case at either site. Instead, the better fit interpretation is the movement of people with the knowledge of how to decorate pots in a Shenks Ferry style, using local clays in their new communities based on the chemical composition of the pottery paste. This interpretation has implications for understanding these patterns within the concepts of identity, communities of practice, type, and place.

Identity

At the beginning of this study, one expectation was that the Thomas/Luckey and Losey 3 sites might show some degree of separation in the clay paste of vessels due to their location in different drainages of the Southern Tier of New York. Analysis showed that the two sites did not show a clear separation. Another expectation was that pottery decorated with designs considered "foreign" to this region, namely Shenks Ferry vessels, would display differences in clay composition due to the use of distinct regional sources of clay tied to traditional practices in these communities. Analysis indicated that there is no strong differentiation among the three vessel types – Kelso Corded, Shenks Ferry, and Oak Hill Corded - based on the elemental composition of the clay used to make these vessels. This shows that the personal or group identity being encapsulated in local versus non-local vessel types was not reflected in their selection of clay sources. This pan-regional clay composition pattern neutralizes this component of vessel construction in relation to understanding identity at the sites.

The reproduction of identity is a complex process and has both active and passive components. The Shenks Ferry potters, or more likely the potters who decorated vessels in a Shenks Ferry fashion, may have done so as an active process linked to the ingrained traditions they were taught and continued to execute. They also may have recreated an identity through vessel decoration that linked themselves to a larger or distant community using these traditional practices.

The intention behind the decoration is admittedly hard to determine. By not excluding members who exhibit a different identity or participate in a different community of practice, the host community accepted new people or groups into their village either as temporary or permanent members. The reproduction of their designs signaled ties and connections and possibly even obligations, to their natal community.

These ties could then be relied upon to support themselves or those to which they were tied in times of adversity, like resource scarcity.

The identities expressed in vessel decorations partially reinforce the notion that while people or their ancestors may have moved to a new community, they retained and expressed traditional knowledge by creating pots with the designs of their natal community. Dating this decorative survivance is difficult, as many factors can play into why or why not a design may persist. Ethnographically and through both oral tradition and historical records, women assumed the role of potters. Elders trained novices, probably members of their lineage or a larger community of practice. If your daughter is taught how to make pottery the way you were taught, but is being raised in a new group that has differing community of practice as evidenced by different decorative styles, how likely is it to continue?

If the newer group is tolerant of multivocality, then a design would be less likely to be suppressed. Present-day non-pottery examples can be drawn from to inform our thoughts of this in the past. Some variation of the conflict of “traditional” and “modern” identities in certain lived groups and communities of practice echoes that of the difference between “heritage” and “adaption” for many migrants. Modern examples are, the Amish/Mennonite communities, Americanized German practices vs German practices, and reverberations of Orthodox and reformed faiths These traditions of practice often did persist for generations, and survived changes experienced by these communities.

The Late Woodland period was a time when dispersed households coalesced into larger villages. It follows that part of this coalescence involved people moving from region to region, and in the process affirming or redefining their identities. Visual representations of identity are part of this process. Thomas/Luckey and Losey 3 are both situated at the periphery of several archaeologically defined cultures. As discussed by Knapp (2009) and Miroff (2002, 2009) Thomas/Luckey exhibits a lack of expected boundaries internal to the site. They are north of the Shenks Ferry heartland, they are southwest of the Mohawk Valley and the Oak Hill tradition and are located at the southern edge of Owasco. Maintaining identities that tie a group, of which you are a member, to larger alliances or communities allows for many benefits, some of which are practical such as conflict reduction, resource sharing, trade, and options to fall back on relationships in times of stress. Other less tangible benefits may include remembrance or commemoration of ancestors or places of heritage as well as maintaining ties to deeply held beliefs or worldviews. These individual manifestations of identity have connections to larger communities of practice at each site. It appears from this study that if identity is expressed through decorations on pots, it takes precedence over selecting traditional sources of clay as an expression of identity. If this were not the case, I would expect the types to be more elementally distinct indicating separate and mutually exclusive sources. We cannot discount some group separation in the past, though; perhaps potters were permitted to go to the same source, but at different times. The first influx of people may have maintained a separation, but not successive generations. This would not appear in the archaeological record.

Communities of Practice

Applying Lave and Wenger's (1991) concept of communities of practice to pottery production illustrates the networks of individuals who worked together, mentored novices, and passed along traditional knowledge about pottery creation and decoration to their descendants. While pottery decoration is only a part of a person's identity, and pots do not translate entirely to people, the pan-regional consistency of certain types of pottery decoration has some relationship with widespread communities of practice. In the absence of being able to directly interview the creators of the pottery at either site, assessing the communities of practice through the designs is the only option. The patterns seen in the finished pots allow for the interpretation of regional relationships, movement of people, and the maintenance of shared identities. A study of communities of practice and identity using compositional analysis allows a glimpse into how a potter was creating and finishing vessels and whether this process had local and/or regional implications.

As suggested by Knapp (2009) and Miroff (2002, 2009), among others, a multi-scalar approach involving both regional and the local levels of analysis will provide a broad an understanding of past processes and their interconnections. The absence of defensive structures at Thomas/Luckey and only a small portion of a palisade at Losey 3 suggests a lack of regional conflict and an open border situation that may have allowed for regional cooperation and free movement of individuals within regional communities. This may have fostered an allowance for the continuation of decorative styles within distant communities. The persistence of the Shenks Ferry style in regions outside its core area illustrates this scenario where amicable groups moved throughout adjacent regions without pressure to abandon their traditional signaling measures, such as pottery decoration. If these Shenks Ferry potters were brought into these villages under duress, we would likely see the forced abandonment of natal traditions, practices, and language. This could occur if there was raiding of villages, and the taking of captives, but this does not appear to be the case at either Losey 3 or Thomas/Luckey. The cordial scenario suggested by the data also implies an absence of conflict. Neither site is particularly well suited to defense (both were on floodplains rather than elevated landforms) and while there is evidence for a partial palisade at Losey 3, palisades were likely more than just purely defensive structures. Vessels with different decorations cooccurring in features suggests cooperation, freedom of expression, and communal storage/refuse practices among subgroups within a community.

The exact reason or reasons for why people moved and continued to reproduce their traditional designs is unknown, but the possible pathways for movement can be derived from existing information.

Routes

The presence of different traditions of pottery decoration speaks to the potential linkages of people and communities across the landscape. While the core of this thesis did not center on pathways linking communities, the physical routes of travel in a region facilitated not only physical movement but also communication.

Losey 3 lies on the Tioga Path (Figure 9). Thomas/Luckey lies along the Forbidden Path and lies just north of the intersection of the Forbidden Path and the Great Warriors Path (Figure 9). Neither path directly ends at either site, however these paths do run by several other larger sites. More importantly, they connect to a network of paths that ran across Pennsylvania and into the greater Northeast. These paths extended southward to central Pennsylvania into what is considered the Shenks Ferry heartland and were possibly some of the routes taken by the people who lived in the Losey 3 and Thomas/Luckey villages. These were probably well-established paths that facilitated not only the movements of people and ideas, but also trade, and eventually warfare. The dates that these paths were established is unknown to archaeologists, and the paths were likely flexible, shifting through time within a changing landscape.

These links allowed for comparatively easy movement of resources and people. Computer modelled Least Cost Paths (LCPs) do not always match up with the existing paths; this encourages archaeologists to further refine models and offer possible explanations for why LCPs deviate from the historically recorded routes. It is likely that many minor trails existed, and these did not rise to the level of a named "path" in recorded history. Many archaeological sites are located along named paths and lesser trails, indicating the potential that people carrying the objects and knowledge of their cultures traveled these routes. The potential that artifacts of multiple cultures became intermixed on sites is undeniable as evidenced by the presence of different pottery styles. The clay outcrops themselves could have been the place of encounters between groups as they were a commonly sought resource.

Typologies

While the validity of decorated pots as expressions of identity signaling markers is the subject of debate, the process of creating these pots represents some degree of knowledge obtained from experts and communities of practice. Archaeologists place these types of decoration and their temporal associations into types to standardize and facilitate discussion. The pervasiveness of typologies as put forth by archaeologists and professors illustrates the way students are trained in a modern community of practice and our conceptions of how we identify the manufacture of identity in the material culture. Typologies arose with the best use of technology and understandings of the time, and with further analysis of non-local vessels we should continue to reassess them with the best available techniques, technology, and current conceptual contexts. These foundational works, like all research, periodically need to be reassessed with newer information and input from descendant communities when applicable (Heisey 1971; Kinsey and Graybill 1971; Lenig 1965; Lucy 1959; MacNeish 1952, 1980; Niemczycki 1984; Ritchie and MacNeish 1949; Weber 1971). A typology is never finished; they are only in varying stages of completion. I believe that the distinct Shenks Ferry decorations were deliberate and meaningful and therefore should be kept separate from the Kelso Corded type despite their elemental similarity at these sites. I also believe we cannot assume the origins of a vessel but should verify with testing. Testing assumptions will allow us to rethink our interpretations of local and non-local production.

CHAPTER 8. CONCLUSIONS

While the exact decision-making processes involved in the production and decoration of pottery vessels at the Thomas/Luckey and Losey 3 sites cannot be precisely determined through archaeology and analysis, this thesis attempted to understand some of the possibilities.

At the start of this research I followed a series of steps that first sought to determine if the clay paste used to create pottery vessels showed enough distinctive elemental composition to suggest that Thomas/Luckey and Losey 3 were two separate communities each accessing their own sources of clay. The results of the p-XRF analysis determined no significant distinctions in the elemental composition of vessels. The next step focused on determining if the Shenks Ferry vessels intermixed in the assemblages at each site were the result of trade or the movements of people carrying decorated pots with them. Based on the results of pXRF analysis of the clay paste of vessels from both sites, no discernable distinctions emerged between the assumed local pottery (Kelso Corded and Oak Hill Corded) and the non-local pottery (Shenks Ferry). They are made from similar clay, and that clay likely derived from the locale around the sites. This indicates that the Shenks Ferry vessels present at the sites are not an example of trade, but of movement. This movement was either of people or movement of ideas on decoration style, such as what archaeologists call Shenks Ferry. Manufacturing vessels from the same clay but with different decorative patterns ties the producer into a larger network of practice and they may have sought to maintain these natal relations through pottery designs. The Shenks Ferry vessels at each site were found to have been made from pastes similar to the Kelso Corded vessels. Additionally, analysis determined that pastes were similar to both the Oak Hill Corded and the raw clay samples collected for this study. If the Shenks Ferry vessels were made closer to their heartland and carried into new communities, the elemental signatures would have been different. The analysis of paste composition of ceramics gives a more accurate view of a vessel's place of creation than inferring point of origin from the visual characteristics of the pottery type. I concluded that the similarity in paste and the differences in design needed to be addressed within contexts other than trade or the movements of people with finished pots.

The second part of my research examined the possible reasons why different designs were applied to pots at sites where the dominant design was a different style. Using the concepts of communities of practice and identity signaling, I addressed the expression of traditional pottery designs as a vehicle for reproduction of linkages to past communities or commemoration of the traditional knowledge.

The Late Woodland period in the Northeastern United States encapsulates a trend towards population coalescence and identity formation. Dispersed small communities joined larger villages in other regions, and territorial boundaries were dynamic and fluid. This concept of open borders is further cemented by the absence of signs of conflict or warfare as both sites are located on less defensible floodplains rather than more defensible rises. Fluid boundaries suggest that people may have been able to freely move among multiple communities, and host villages accepted or tolerated other group's designs. Why or how this acceptance came to be is unknown but accepting outsiders could allow the replenishment of dwindling group members or aid distant kin in times of stress. Accepting groups is also a wise policy when situated between larger cultural territories. An analysis of least-cost pathways and historical trails concluded that travel between places, such as the Shenks Ferry heartland and communities within the Southern Tier of what is now New York, would have been facilitated by well-established paths overland and along waterways. There was probably a deep history to the movements of people and trade items along these paths, culminating in some of the processes of coalescence during the Late Woodland.

If potters from distant regions were reproducing their traditional forms of decoration in new communities, this indicates that they did so with acceptance and not in defiance. This could indicate acceptance and an amicable social environment where they were free to reaffirm their identity and roots in other communities.

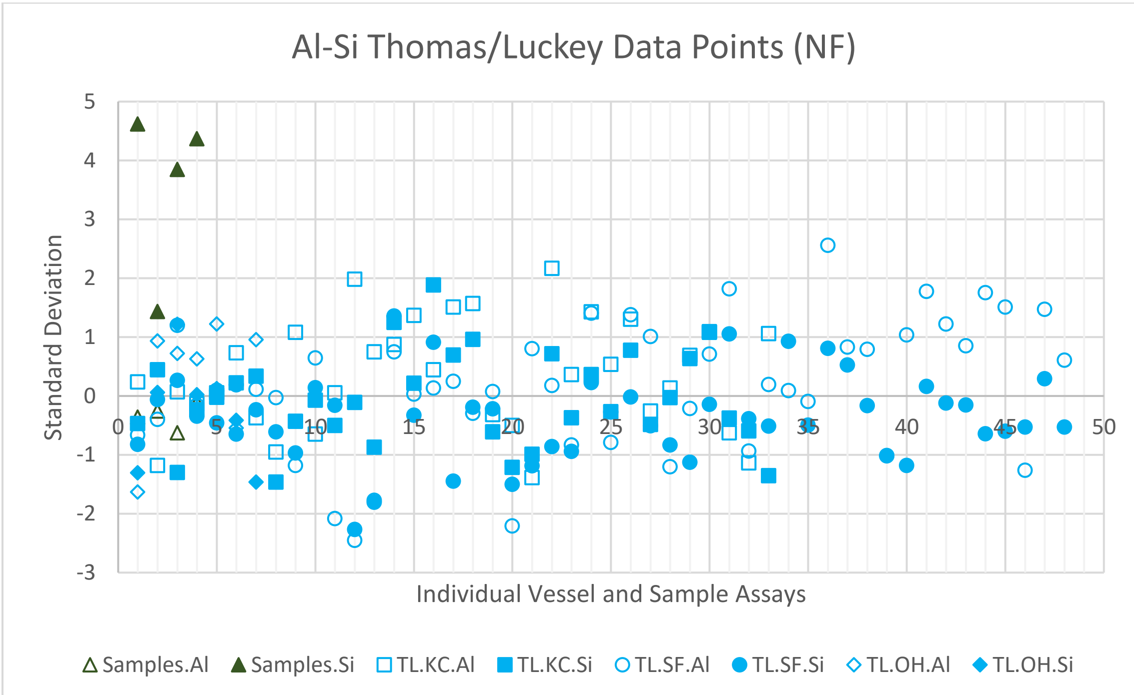
Finally, my work relates to a question about the assumptions of trade archaeologists make when “foreign” or exotic items are found on a site. Often, the movement of people or persistence of traditional techniques are a better explanation. Modern technology provides us with the tools to test these assumptions and introduce new knowledge into older arguments.

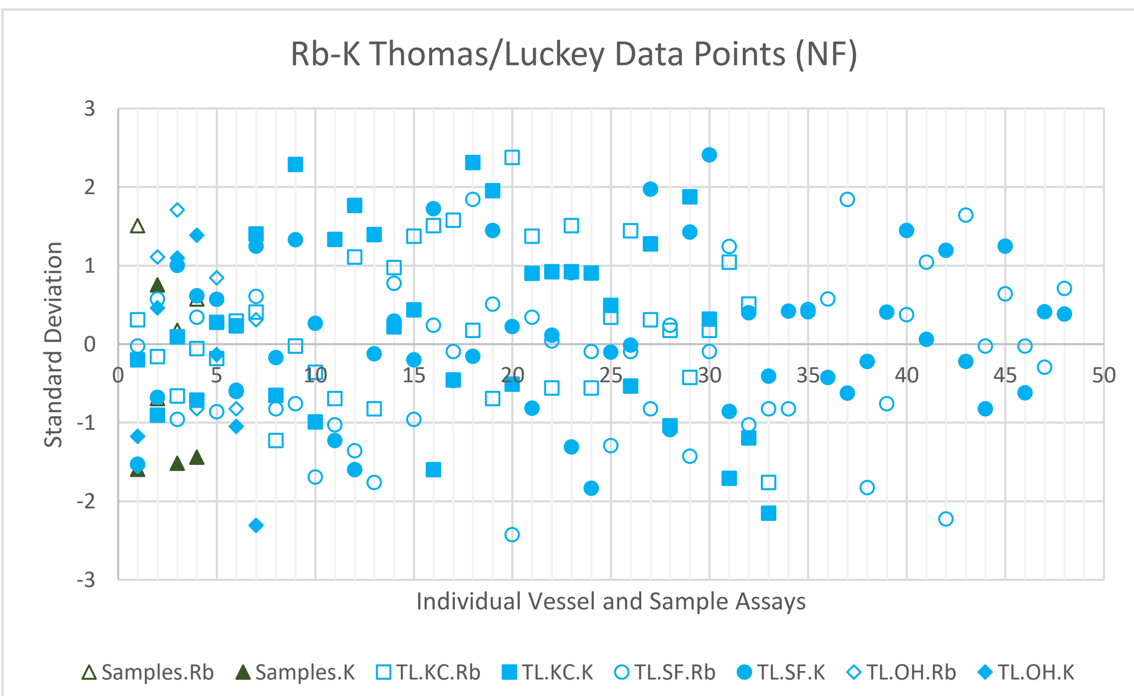
Significance and Further Work

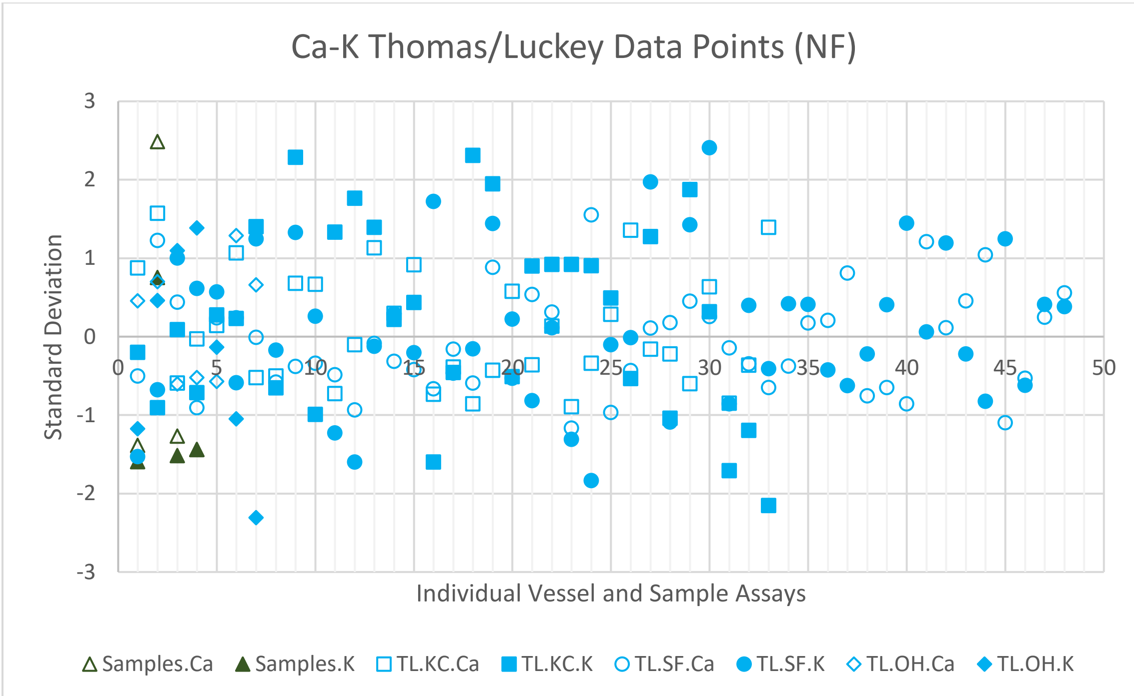
The significance for New York and Pennsylvania archaeology lies with the raw data resulting from the analysis, as well as the implications the results have for understanding the fluidity of movement of people and their traditional knowledge into or out of the valleys of New York and northern Pennsylvania. Precontact groups did not exist in isolation, including during the Late Woodland – they interacted, visited, cohabitated, and traded throughout the Americas. Within the Chemung River Valley and the Tioga River Valley, the results of this thesis contribute a more local level interpretation of how pots and/or their decorations moved within and among the Thomas/Luckey and Losey 3 communities. These results encourage further research to add new depth to these interpretations of how identity may be expressed through pottery decorations within Late Woodland villages. For instance, examining the vessel formation techniques, through noninvasive means such as radiographic imagery, to understand the method of pot construction, may provide additional knowledge of communities of practice and whether or not the decoration was what migrated or the people who created it. Further research with higher resolution techniques such as LA ICP MS, will provide an even more detailed examination of the pottery in the region. Although this analysis was intended as part of the current study, it not conducted due to time and equipment constraints; a future study is planned. A broader approach and studying more clay and combinations of clay sources, can release new and exciting developments about how identity was encoded into pottery and what that meant for the producers and the communities. Thomas/Luckey has since been mined for its topsoil ending the archaeological history of the site, though other research has continued on its artifacts. Gilligan (2008) compares the communities of practice in cordage twist, and both sites contribute to our archaeological understanding of the region, and continue to be used in broader studies. Continued analysis of existing collections using new research questions and new analytical techniques will advance our understanding of the people who lived in communities no longer visible.

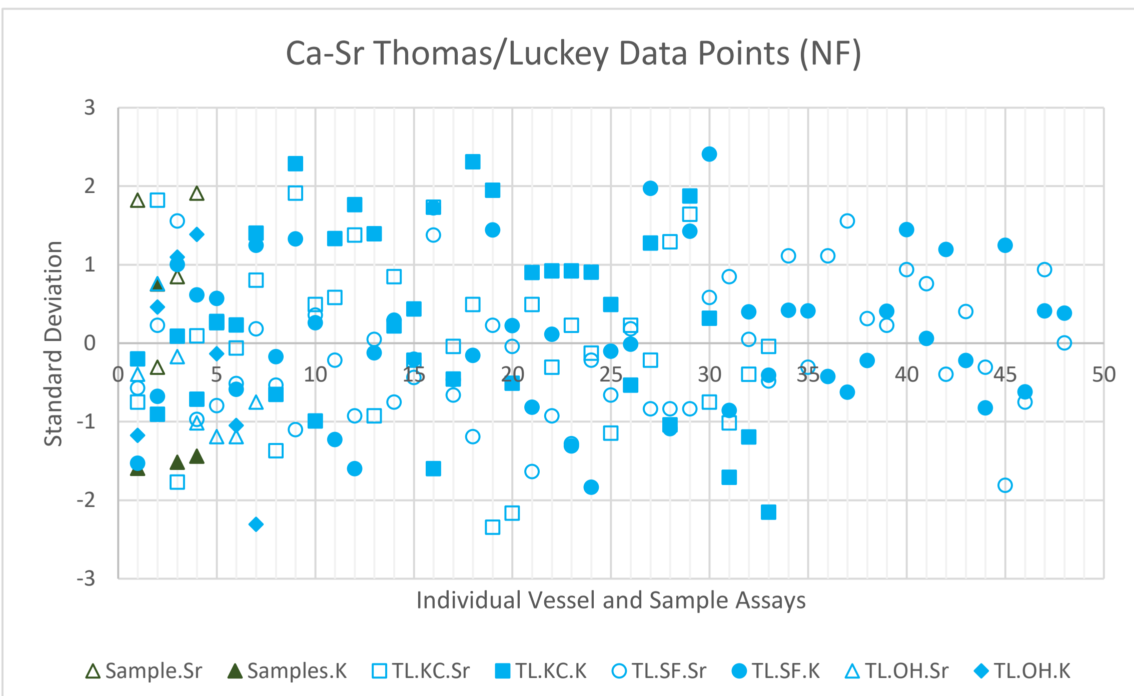
Appendix A: Intra-Site Scatterplots

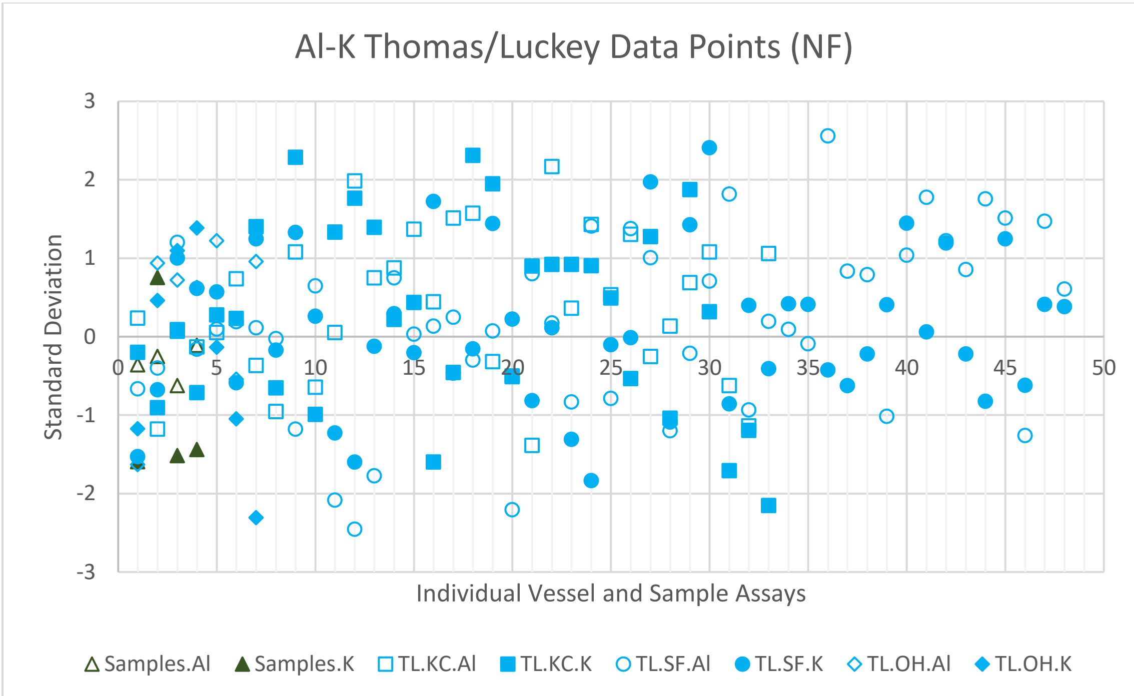
No Filter (NF)Thomas/Luckey



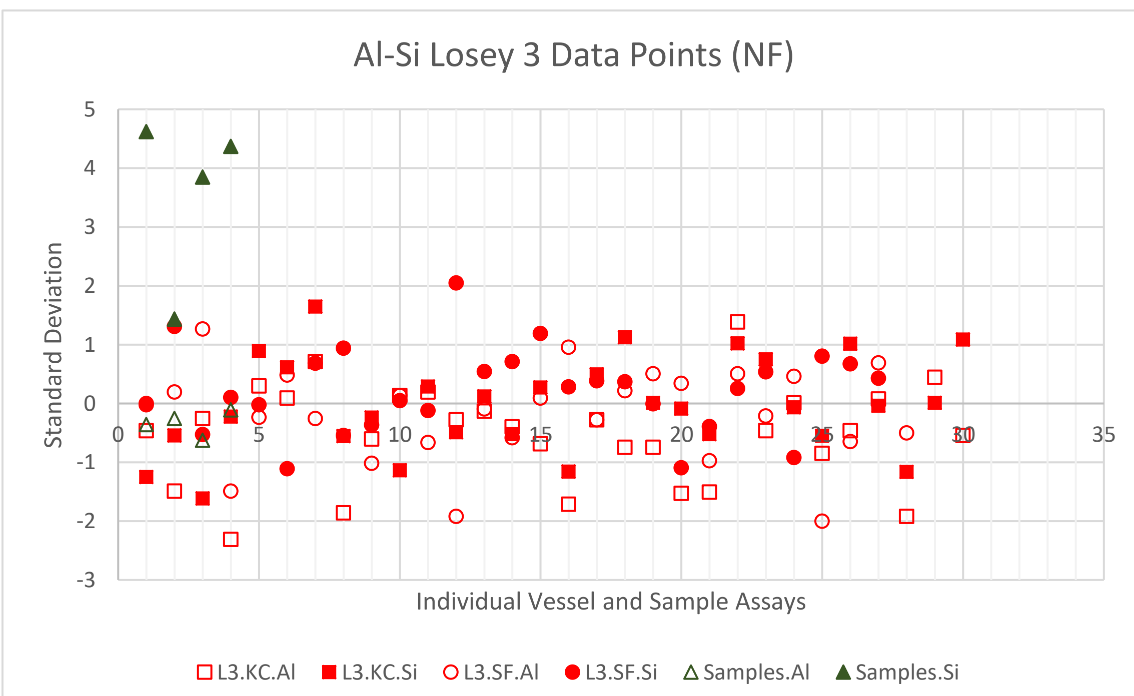


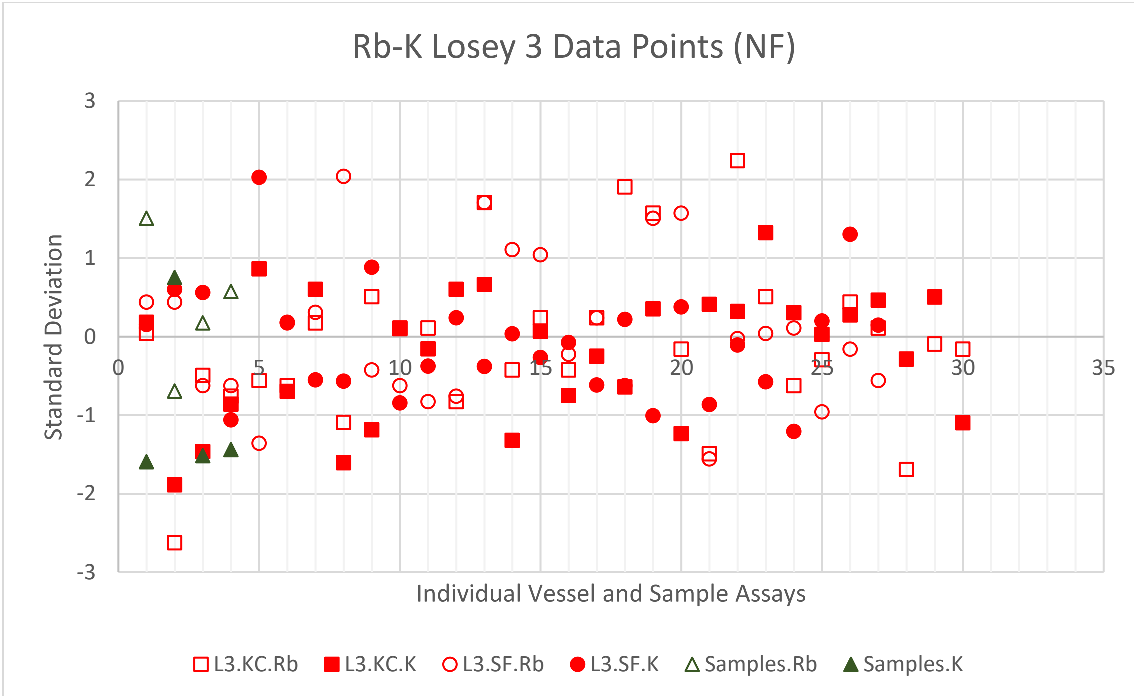

Ca-K Thomas/Luckey Data Points (NF)
Standard Deviation
Individual Vessel and Sample Assays
3
2
1
0
-1
-2
-3
0
5
10
15
20
25
30
35
40
45
50
Samples.Ca
Samples.K
TL.KC.Ca
TL.KC.K
TL.SF.Ca
TL.SF.K
TL.OH.Ca
TL.OH.K

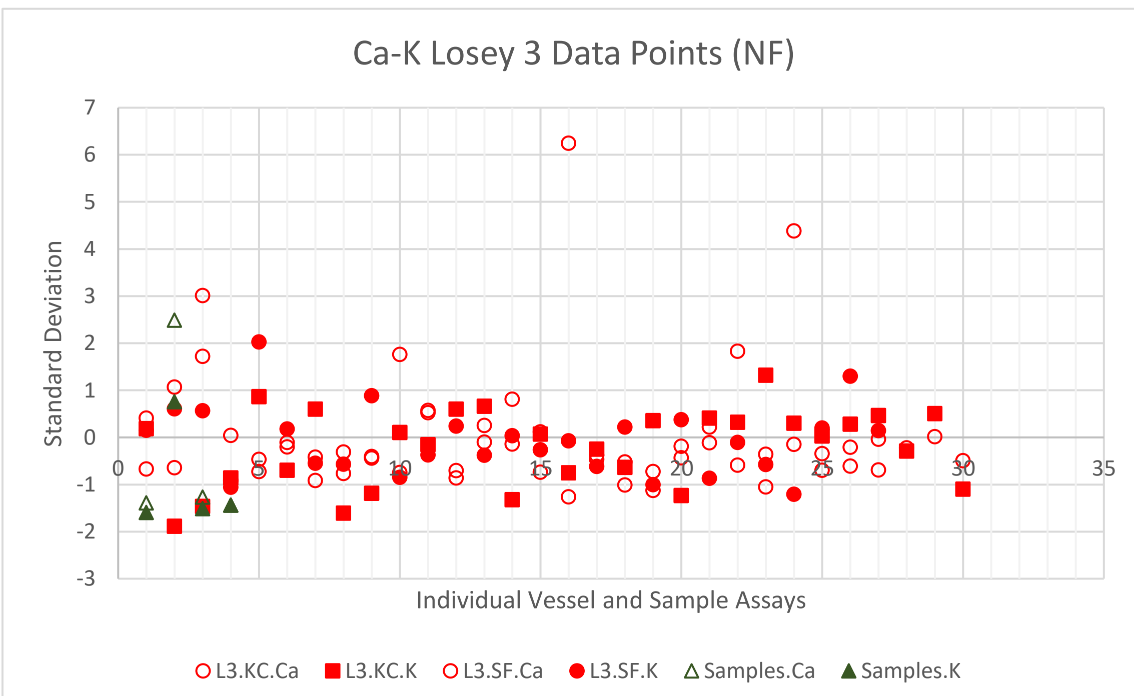

Ca-Sr Thomas/Luckey Data Points (NF)
Standard Deviation
Individual Vessel and Sample Assays
3
2
1
0
-1
-2
-3
0
5
10
15
20
25
30
35
40
45
50
Sample.Sr
Samples.K
TL.KC.Sr
TL.KC.K
TL.SF.Sr
TL.SF.K
TL.OH.Sr
TL.OH.K

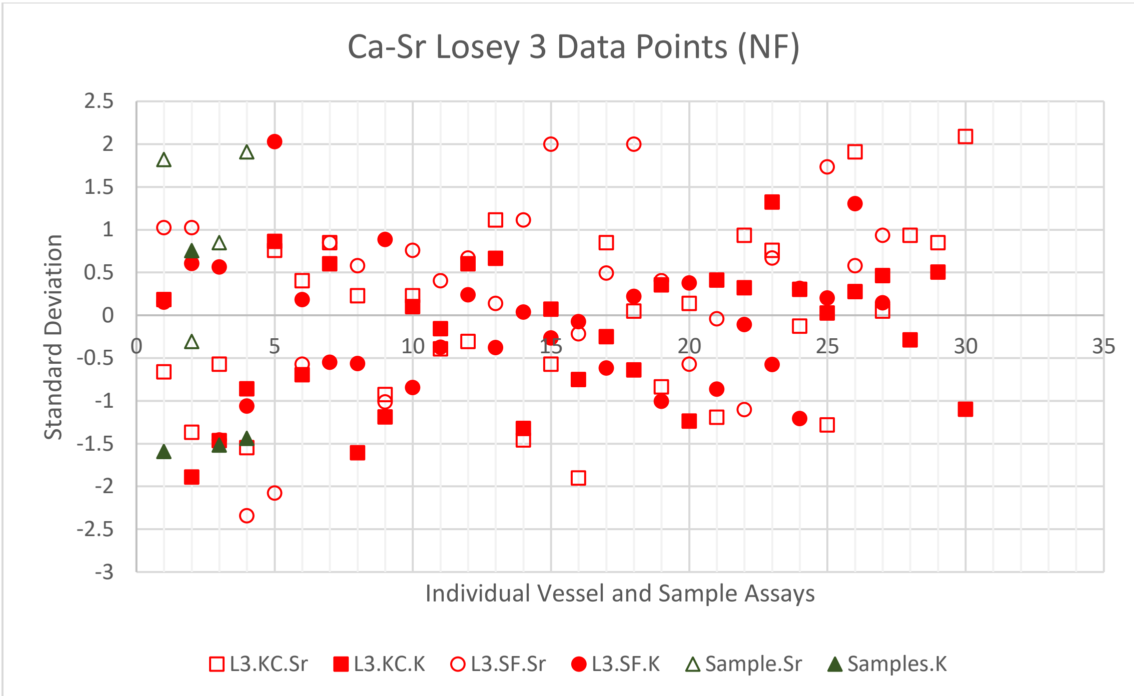


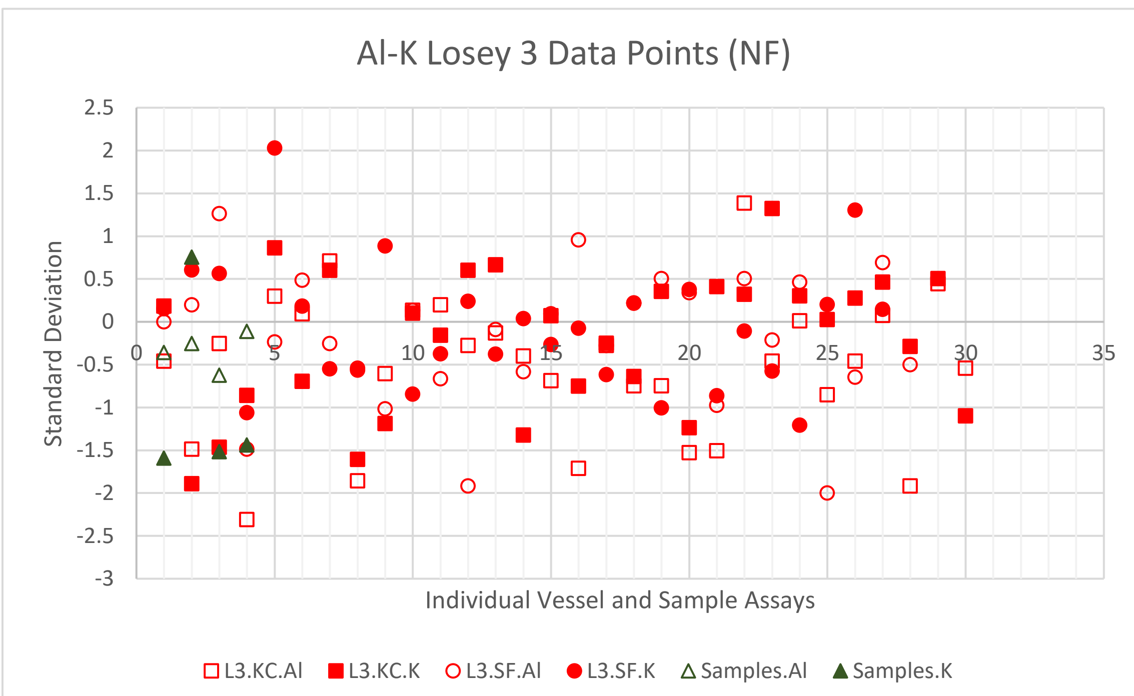
No Filter (NF) Losey 3



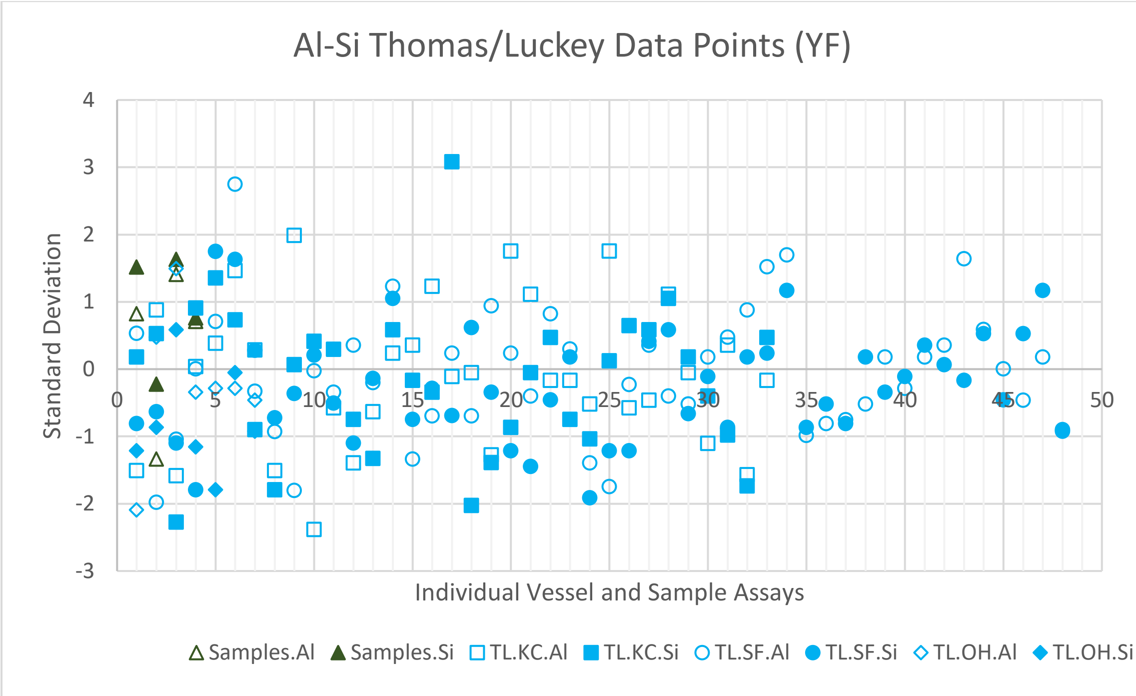

Rb-K Losey 3 Data Points (NF)
Standard Deviation
Individual Vessel and Sample Assays
L3.KC.Rb
L3.KC.K
L3.SF.Rb
L3.SF.K
Samples.Rb
Samples.K

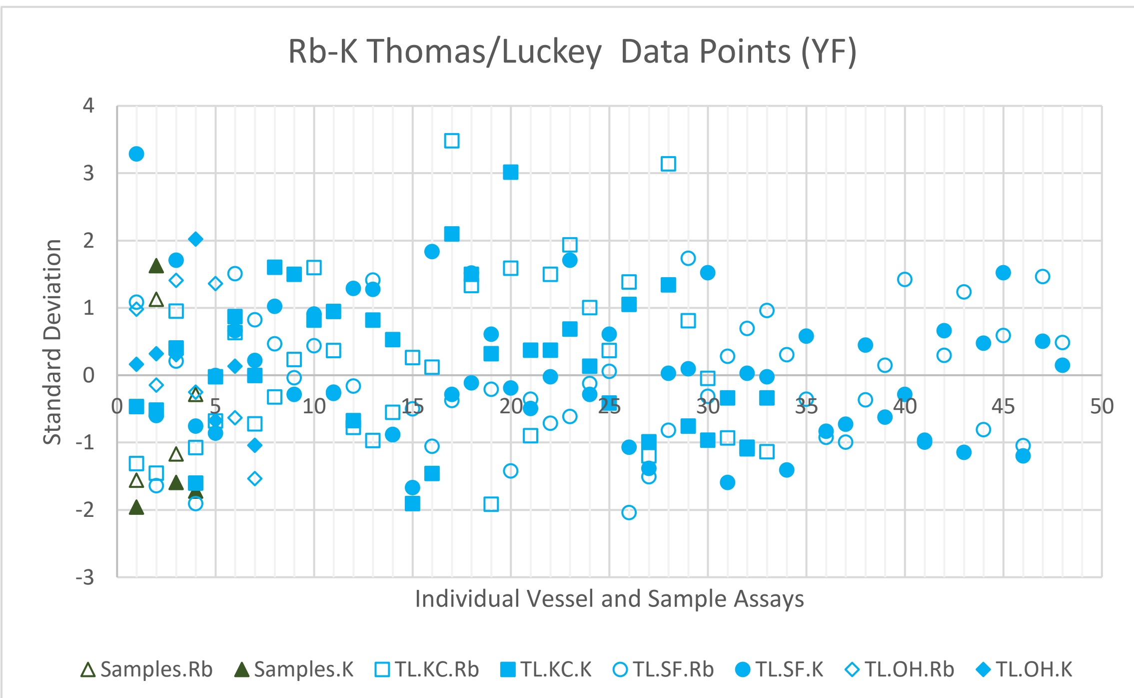

Ca-K Losey 3 Data Points (NF)
Standard Deviation
Individual Vessel and Sample Assays
L3.KC.Ca
L3.KC.K
L3.SF.Ca
L3.SF.K
Samples.Ca
Samples.K

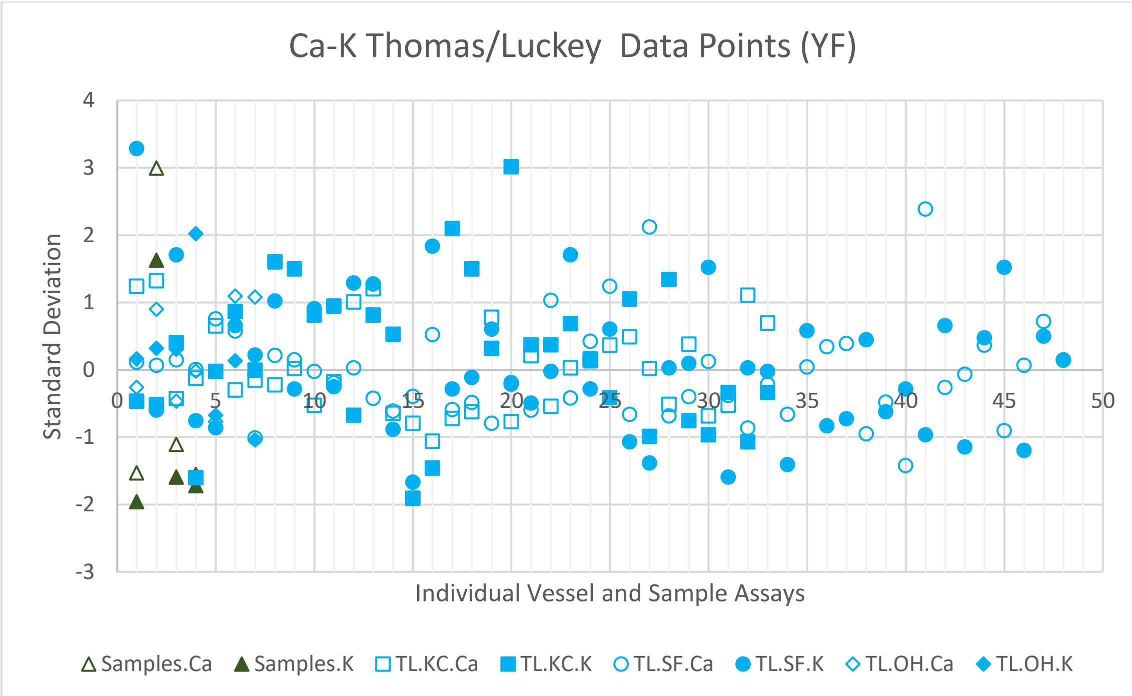

Ca-Sr Losey 3 Data Points (NF)
Standard Deviation
Individual Vessel and Sample Assays
L3.KC.Sr
L3.KC.K
L3.SF.Sr
L3.SF.K
Sample.Sr
Samples.K

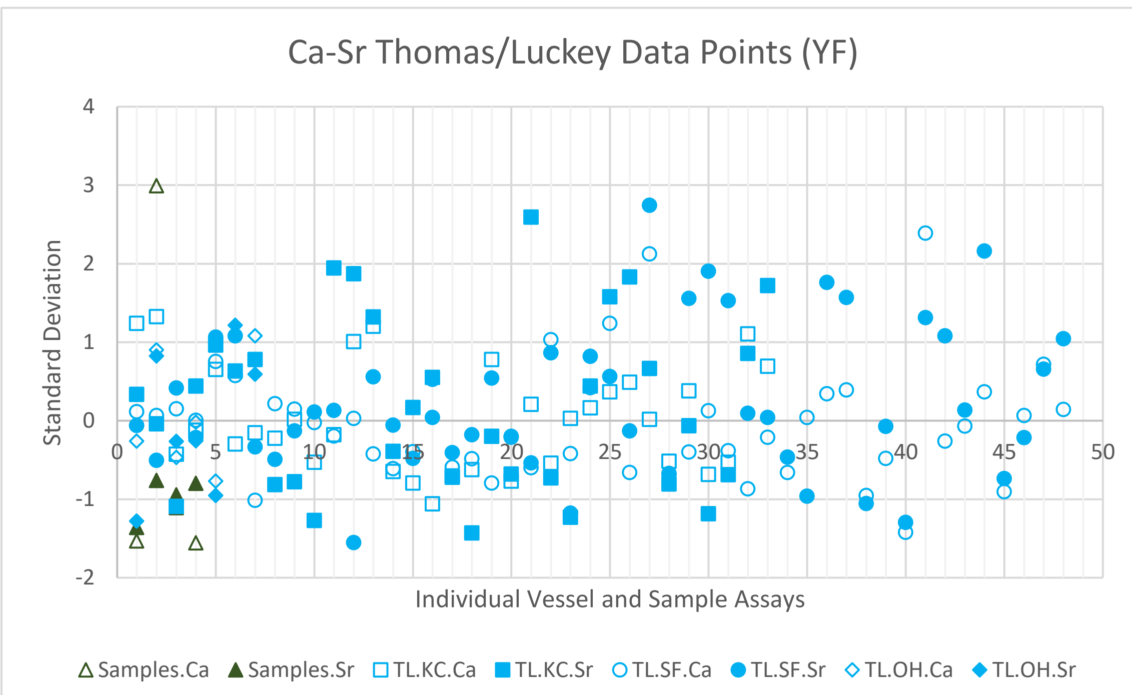

Al-K Losey 3 Data Points (NF)
Standard Deviation
Individual Vessel and Sample Assays
L3.KC.Al
L3.KC.K
L3.SF.Al
L3.SF.K
Samples.Al
Samples.K

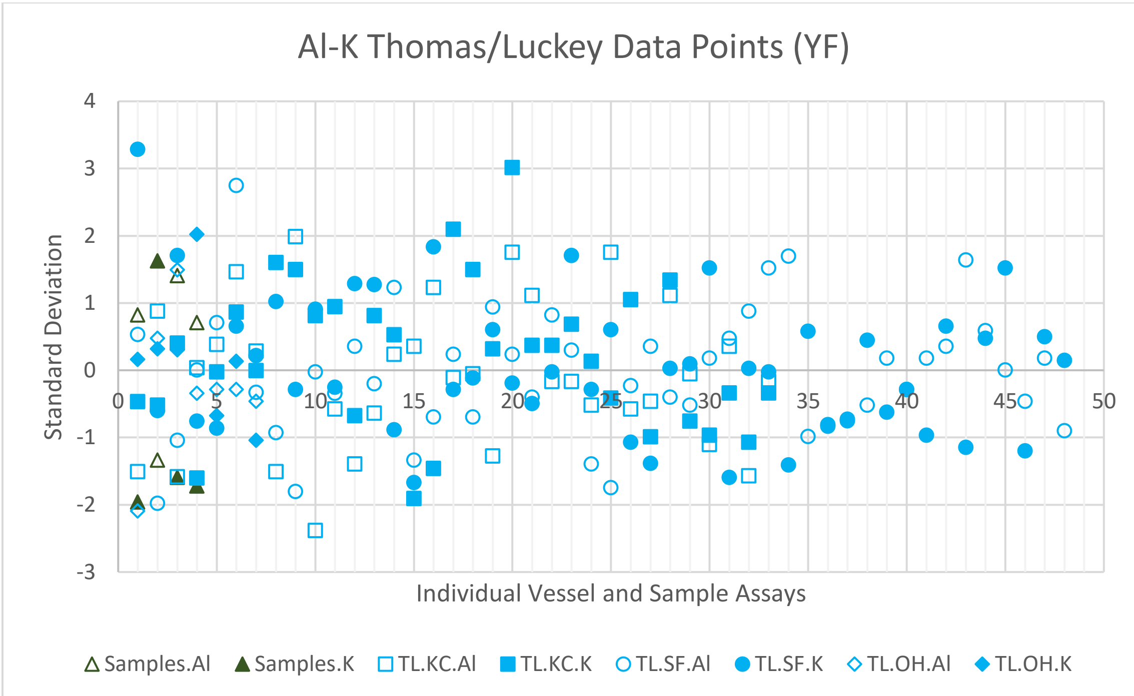
Yellow Filter (YF) Thomas/Luckey

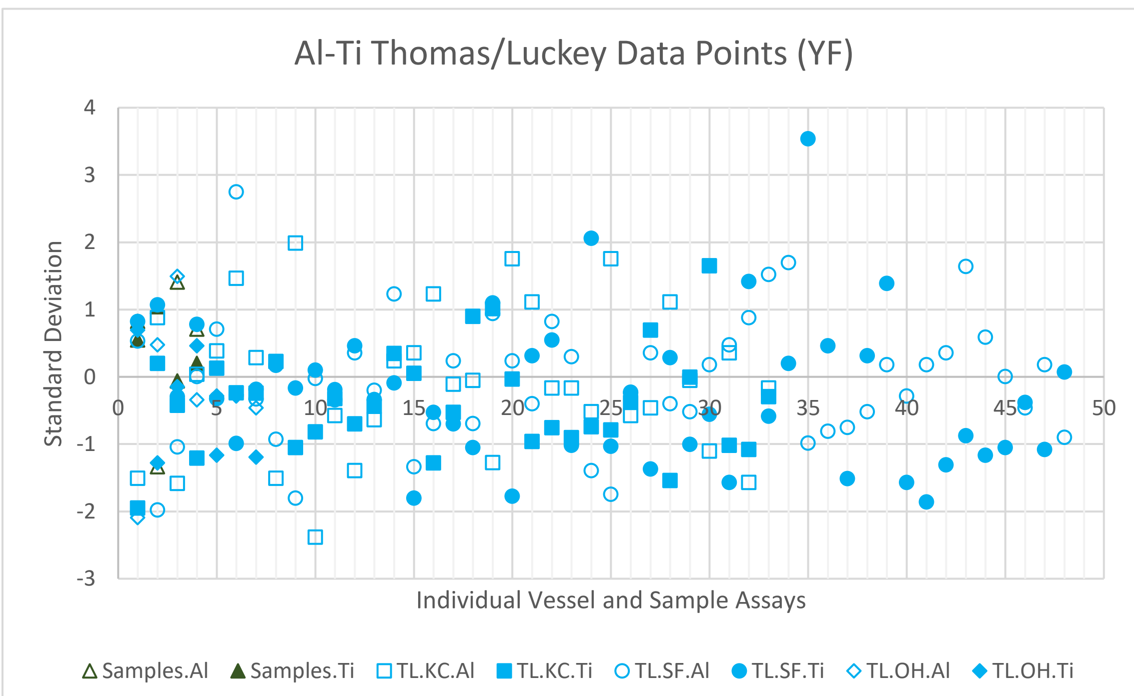




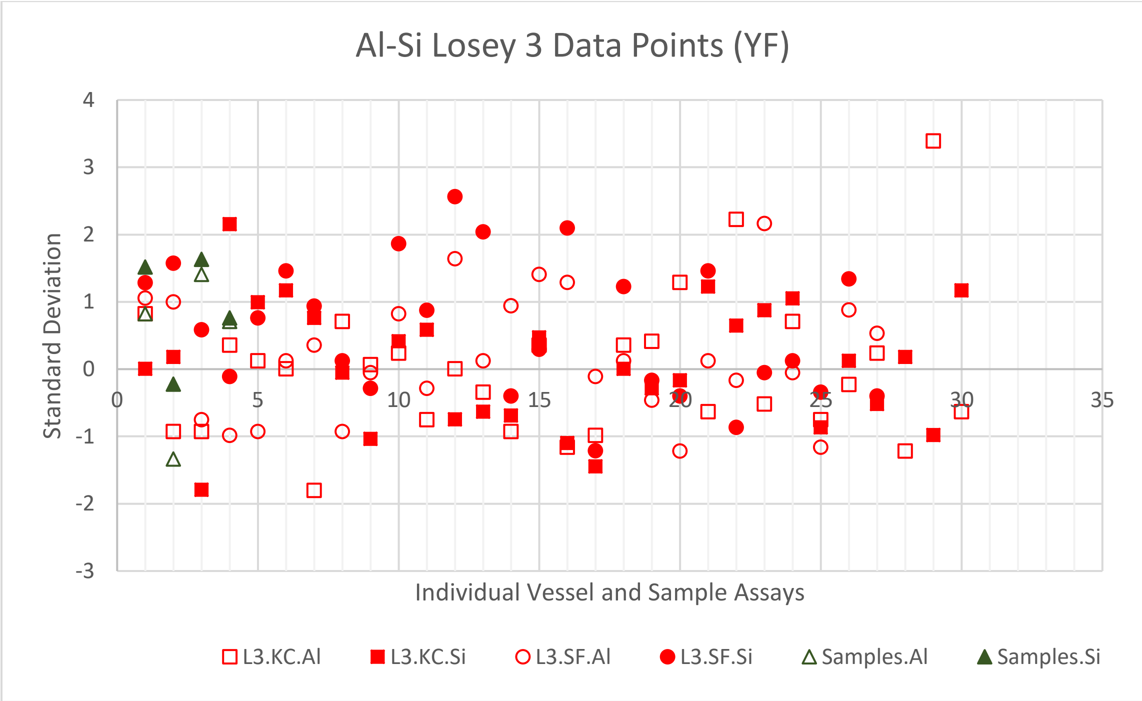

Ca-K Thomas/Luckey Data Points (YF)
Standard Deviation
Individual Vessel and Sample Assays
Samples.Ca
Samples.K
TL.KC.Ca
TL.KC.K
TL.SF.Ca
TL.SF.K
TL.OH.Ca
TL.OH.K

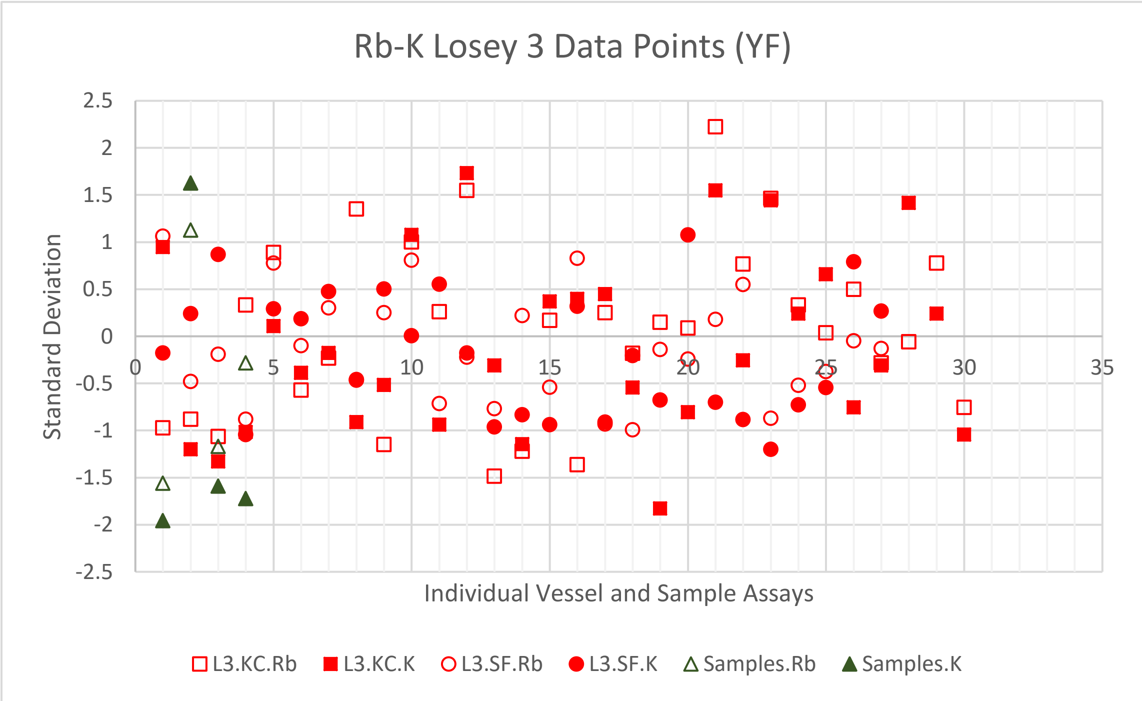

Ca-Sr Thomas/Luckey Data Points (YF)
Standard Deviation
Individual Vessel and Sample Assays
Samples.Ca
Samples.Sr
TL.KC.Ca
TL.KC.Sr
TL.SF.Ca
TL.SF.Sr
TL.OH.Ca
TL.OH.Sr

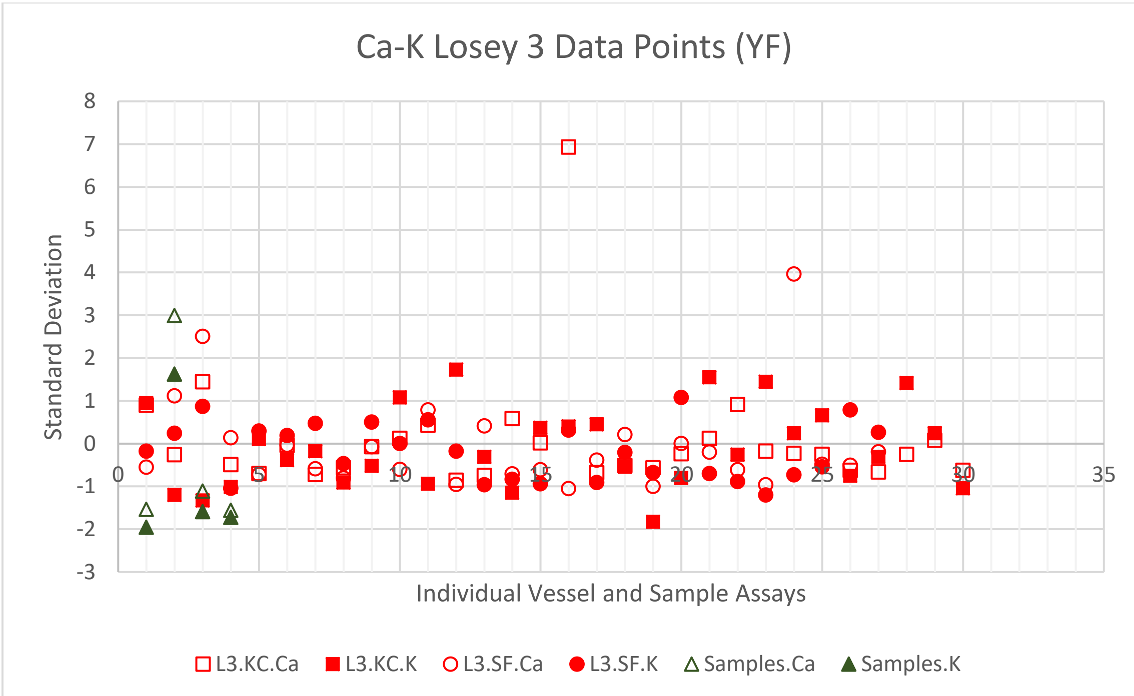

Al-K Thomas/Luckey Data Points (YF)
Standard Deviation
Individual Vessel and Sample Assays
Samples.Al
Samples.K
TL.KC.Al
TL.KC.K
TL.SF.Al
TL.SF.K
TL.OH.Al
TL.OH.K

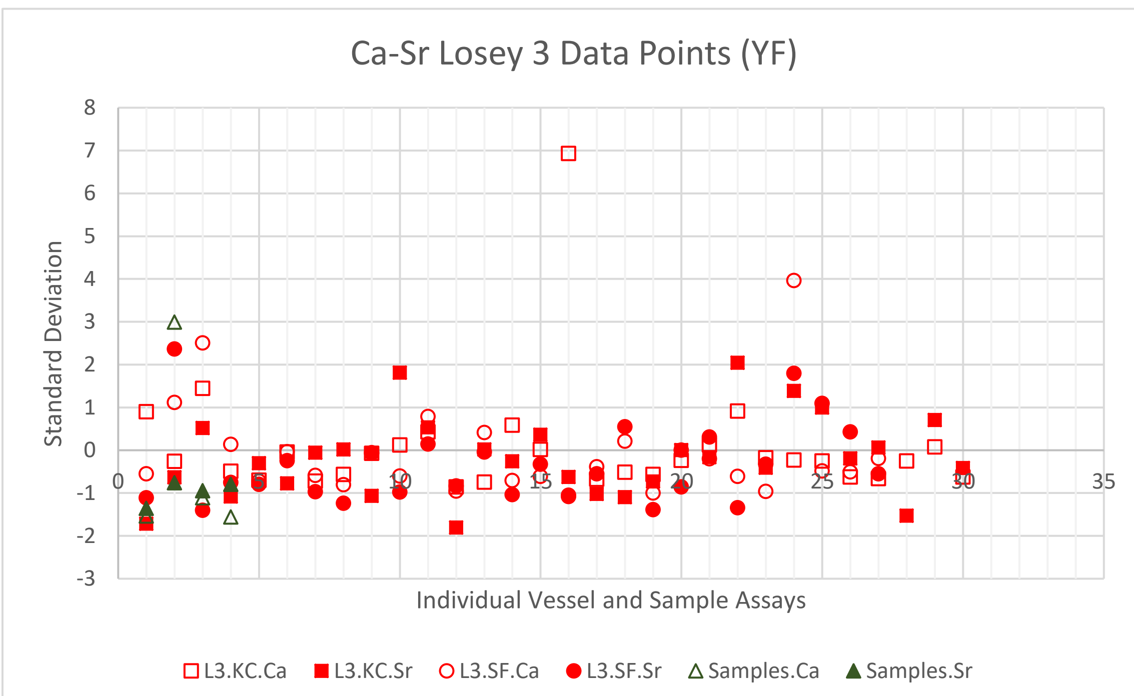

Al-Ti Thomas/Luckey Data Points (YF)
Standard Deviation
Individual Vessel and Sample Assays
Samples.Al
Samples.Ti
TL.KC.Al
TL.KC.Ti
TL.SF.Al
TL.SF.Ti
TL.OH.Al
TL.OH.Ti

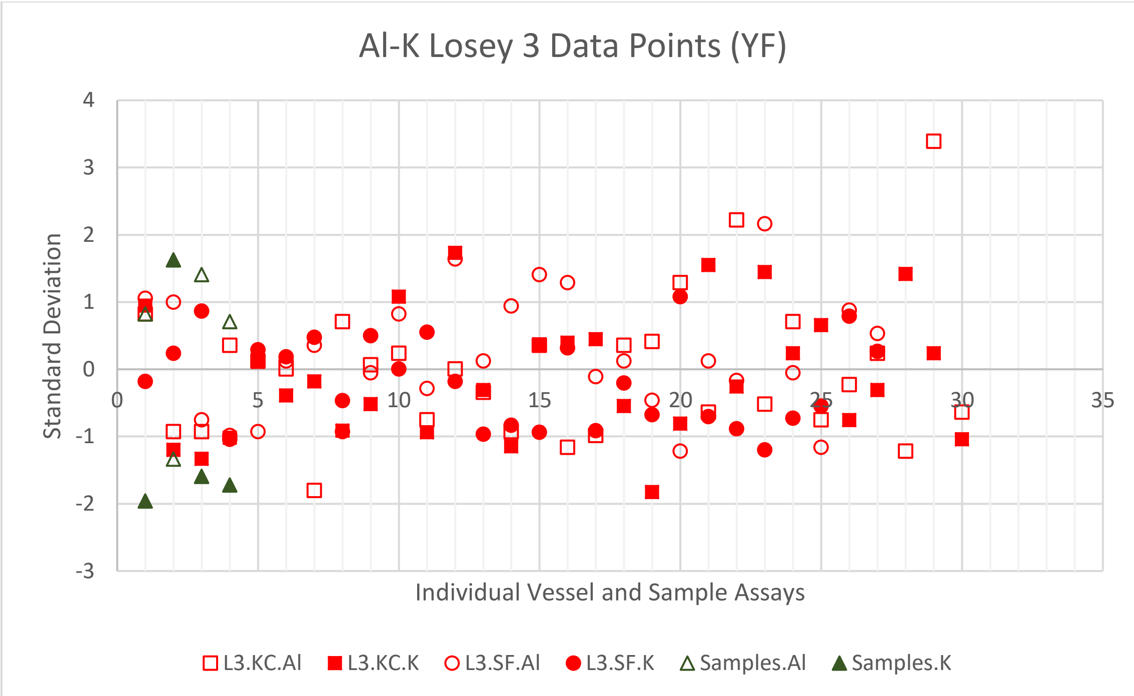
Yellow Filter (YF) Losey 3

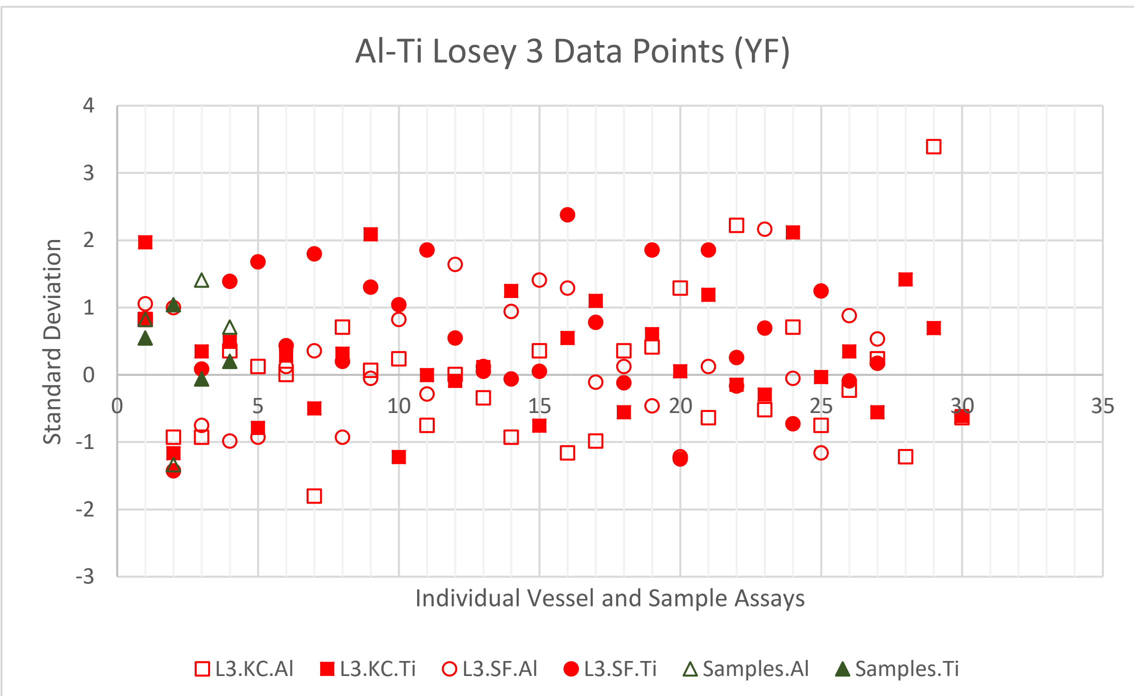





Ca-K Losey 3 Data Points (YF)
Standard Deviation
8
7
6
5
4
3
2
1
0
-1
-2
-3
0
5
10
15
20
25
30
35
Individual Vessel and Sample Assays
L3.KC.Ca
L3.KC.K
L3.SF.Ca
L3.SF.K
Samples.Ca
Samples.K


Ca-Sr Losey 3 Data Points (YF)
Standard Deviation
8
7
6
5
4
3
2
1
0
-1
-2
-3
0
5
10
15
20
25
30
35
Individual Vessel and Sample Assays
L3.KC.Ca
L3.KC.Sr
L3.SF.Ca
L3.SF.Sr
Samples.Ca
Samples.Sr


Al-K Losey 3 Data Points (YF)
Standard Deviation
Individual Vessel and Sample Assays
L3.KC.Al
L3.KC.K
L3.SF.Al
L3.SF.K
Samples.Al
Samples.K


Al-Ti Losey 3 Data Points (YF)
Standard Deviation
Individual Vessel and Sample Assays
L3.KC.Al
L3.KC.Ti
L3.SF.Al
L3.SF.Ti
Samples.Al
Samples.Ti

Appendix B: Sherd Provenience Data

Scatterplot Order	Sherd/Sample Identifier	Site	Type	Vessel/FS#'s
1	L3.HY.V153.10300.1	Losey 3 (36TI0028)	SF/KC Hybrid	V153.10300.1
2	L3.KC.V1.897.1	Losey 3 (36TI0028)	Kelso Corded	V1.897.1
3	L3.KC.V106.7057.1	Losey 3 (36TI0028)	Kelso Corded	V106.7057.1
4	L3.KC.V11.1026.1	Losey 3 (36TI0028)	Kelso Corded	V11.1026.1
5	L3.KC.V115.NA	Losey 3 (36TI0028)	Kelso Corded	V115.NA
6	L3.KC.V12.8929.7	Losey 3 (36TI0028)	Kelso Corded	V12.8929.7
7	L3.KC.V123.3475.338	Losey 3 (36TI0028)	Kelso Corded	V123.3475.338
8	L3.KC.V124.8915.4	Losey 3 (36TI0028)	Kelso Corded	V124.8915.4
9	L3.KC.V125.9231.1	Losey 3 (36TI0028)	Kelso Corded	V125.9231.1
10	L3.KC.V128.10325.1	Losey 3 (36TI0028)	Kelso Corded	V128.10325.1
11	L3.KC.V129.10261.1	Losey 3 (36TI0028)	Kelso Corded	V129.10261.1
12	L3.KC.V14.669.173	Losey 3 (36TI0028)	Kelso Corded	V14.669.173
13	L3.KC.V15.665.309	Losey 3 (36TI0028)	Kelso Corded	V15.665.309
14	L3.KC.V16.9244.238	Losey 3 (36TI0028)	Kelso Corded	V16.9244.238
15	L3.KC.V2.1027.1	Losey 3 (36TI0028)	Kelso Corded	V2.1027.1
16	L3.KC.V4.1063.1	Losey 3 (36TI0028)	Kelso Corded	V4.1063.1
17	L3.KC.V5.967.1	Losey 3 (36TI0028)	Kelso Corded	V5.967.1
18	L3.KC.V59.3804.1	Losey 3 (36TI0028)	Kelso Corded	V59.3804.1
19	L3.KC.V6.669.125	Losey 3 (36TI0028)	Kelso Corded	V6.669.125
20	L3.KC.V60.1406.1	Losey 3 (36TI0028)	Kelso Corded	V60.1406.1
21	L3.KC.V61.1820.1	Losey 3 (36TI0028)	Kelso Corded	V61.1820.1
22	L3.KC.V65.1396.1	Losey 3 (36TI0028)	Kelso Corded	V65.1396.1
23	L3.KC.V7.669.123	Losey 3 (36TI0028)	Kelso Corded	V7.669.123
24	L3.KC.V8.903.9	Losey 3 (36TI0028)	Kelso Corded	V8.903.9
25	L3.KC.V83.4722.1	Losey 3 (36TI0028)	Kelso Corded	V83.4722.1
26	L3.KC.V84.4216.1	Losey 3 (36TI0028)	Kelso Corded	V84.4216.1
27	L3.KC.V85.4963.4	Losey 3 (36TI0028)	Kelso Corded	V85.4963.4
28	L3.KC.V88.7034.1	Losey 3 (36TI0028)	Kelso Corded	V88.7034.1
29	L3.KC.V9.918.1	Losey 3 (36TI0028)	Kelso Corded	V9.918.1
30	L3.KC.V97.8014.1	Losey 3 (36TI0028)	Kelso Corded	V97.8014.1

1	L3.SF.V101.9675.1	Losey 3 (36TI0028)	Shenks Ferry	V101.9675.1
2	L3.SF.V102.8893.1	Losey 3 (36TI0028)	Shenks Ferry	V102.8893.1
3	L3.SF.V105.8932.1	Losey 3 (36TI0028)	Shenks Ferry	V105.8932.1
4	L3.SF.V119.9565.8	Losey 3 (36TI0028)	Shenks Ferry	V119.9565.8
5	L3.SF.V140.10538.1	Losey 3 (36TI0028)	Shenks Ferry	V140.10538.1
6	L3.SF.V154.10340.1	Losey 3 (36TI0028)	Shenks Ferry	V154.10340.1
7	L3.SF.V25.1079.1	Losey 3 (36TI0028)	Shenks Ferry	V25.1079.1
8	L3.SF.V26.1078.1	Losey 3 (36TI0028)	Shenks Ferry	V26.1078.1
9	L3.SF.V27.9594.1	Losey 3 (36TI0028)	Shenks Ferry	V27.9594.1
10	L3.SF.V28.1029.1	Losey 3 (36TI0028)	Shenks Ferry	V28.1029.1
11	L3.SF.V29.9833.1	Losey 3 (36TI0028)	Shenks Ferry	V29.9833.1
12	L3.SF.V31.1170.2	Losey 3 (36TI0028)	Shenks Ferry	V31.1170.2
13	L3.SF.V33.1310.4	Losey 3 (36TI0028)	Shenks Ferry	V33.1310.4
14	L3.SF.V35.8100.2	Losey 3 (36TI0028)	Shenks Ferry	V35.8100.2
15	L3.SF.V36.693.71	Losey 3 (36TI0028)	Shenks Ferry	V36.693.71
16	L3.SF.V37.668.274	Losey 3 (36TI0028)	Shenks Ferry	V37.668.274
17	L3.SF.V38.668.273	Losey 3 (36TI0028)	Shenks Ferry	V38.668.273
18	L3.SF.V39.2165.7	Losey 3 (36TI0028)	Shenks Ferry	V39.2165.7
19	L3.SF.V40.669.176	Losey 3 (36TI0028)	Shenks Ferry	V40.669.176
20	L3.SF.V66.1346.1	Losey 3 (36TI0028)	Shenks Ferry	V66.1346.1
21	L3.SF.V68.1539.1	Losey 3 (36TI0028)	Shenks Ferry	V68.1539.1
22	L3.SF.V69.3642.1	Losey 3 (36TI0028)	Shenks Ferry	V69.3642.1
23	L3.SF.V70.1838.1	Losey 3 (36TI0028)	Shenks Ferry	V70.1838.1
24	L3.SF.V72.733.3	Losey 3 (36TI0028)	Shenks Ferry	V72.733.3
25	L3.SF.V82.1692.8	Losey 3 (36TI0028)	Shenks Ferry	V82.1692.8
26	L3.SF.V86.NA	Losey 3 (36TI0028)	Shenks Ferry	V86.NA
27	L3.SF.V91.3982.7	Losey 3 (36TI0028)	Shenks Ferry	V91.3982.7
1	Sample 1	Pennsylvania		Sample 1
2	Sample 2	Pennsylvania		Sample 2
3	Sample 3	Pennsylvania		Sample 3
4	Sample 4	New York		Sample 4
1	TL.KC.8N4Wl1	Thomas/Luckey (SUBi-888)	Kelso Corded	8N4Wl1
2	TL.KC.F12	Thomas/Luckey (SUBi-888)	Kelso Corded	F12
3	TL.KC.F21.E.V9	Thomas/Luckey (SUBi-888)	Kelso Corded	F21.E.V9
4	TL.KC.F21.V8	Thomas/Luckey (SUBi-888)	Kelso Corded	F21.V8
5	TL.KC.F3.C.V11	Thomas/Luckey (SUBi-888)	Kelso Corded	F3.C.V11
6	TL.KC.F3.J.V12	Thomas/Luckey (SUBi-888)	Kelso Corded	F3.J.V12
7	TL.KC.F3.V10	Thomas/Luckey (SUBi-888)	Kelso Corded	F3.V10
8	TL.KC.F57	Thomas/Luckey (SUBi-888)	Kelso Corded	F57
9	TL.KC.F81	Thomas/Luckey (SUBi-888)	Kelso Corded	F81

10	TL.KC.TL95.88.4	Thomas/Luckey (SUBi-888)	Kelso Corded	TL95.88.4
11	TL.KC.TL96.103.410	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.103.410
12	TL.KC.TL96.120.494	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.120.494
13	TL.KC.TL96.129.531	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.129.531
14	TL.KC.TL96.160.670	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.160.670
15	TL.KC.TL96.17.58	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.17.58
16	TL.KC.TL96.17.58.A	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.17.58.A
17	TL.KC.TL96.174.719	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.174.719
18	TL.KC.TL96.174.719.A	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.174.719.A
19	TL.KC.TL96.21.77	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.21.77
20	TL.KC.TL96.22.83	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.22.83
21	TL.KC.TL96.35.131	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.35.131
22	TL.KC.TL96.50.203	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.50.203
23	TL.KC.TL96.59.235	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.59.235
24	TL.KC.TL96.81.330.V30	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.81.330.V30
25	TL.KC.TL96.88.361	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.88.361
26	TL.KC.TL96.92.378	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.92.378
27	TL.KC.TL96.96.387	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.96.387
28	TL.KC.TL96.97.390	Thomas/Luckey (SUBi-888)	Kelso Corded	TL96.97.390
29	TL.KC.TL97.112.516	Thomas/Luckey (SUBi-888)	Kelso Corded	TL97.112.516
30	TL.KC.TL97.190.873	Thomas/Luckey (SUBi-888)	Kelso Corded	TL97.190.873
31	TL.KC.TL97.252.1053	Thomas/Luckey (SUBi-888)	Kelso Corded	TL97.252.1053
32	TL.KC.TL97.268.1134	Thomas/Luckey (SUBi-888)	Kelso Corded	TL97.268.1134
33	TL.KC.TL97.370.1479	Thomas/Luckey (SUBi-888)	Kelso Corded	TL97.370.1479
1	TL.OH.F75Zone1	Thomas/Luckey (SUBi-888)	Oak Hill Corded	OH.F75Zone1
2	TL.OH.TL95.88.4	Thomas/Luckey (SUBi-888)	Oak Hill Corded	OH.TL95.88.4
3	TL.OH.TL96.172.713.V41	Thomas/Luckey (SUBi-888)	Oak Hill Corded	OH.TL96.172.713.V41
4	TL.OH.TL96.22.83	Thomas/Luckey (SUBi-888)	Oak Hill Corded	OH.TL96.22.83
5	TL.OH.TL96.48.193	Thomas/Luckey (SUBi-888)	Oak Hill Corded	OH.TL96.48.193
6	TL.OH.TL97.150.681	Thomas/Luckey (SUBi-888)	Oak Hill Corded	OH.TL97.150.681
7	TL.OH.TL97.438.1664	Thomas/Luckey (SUBi-888)	Oak Hill Corded	OH.TL97.438.1664
1	TL.SF.N10E46L2.AC.V2	Thomas/Luckey (SUBi-888)	Shenks Ferry	N10E46L2.AC.V2
2	TL.SF.N10E46L2.B	Thomas/Luckey (SUBi-888)	Shenks Ferry	N10E46L2.B
3	TL.SF.N10E46L2	Thomas/Luckey (SUBi-888)	Shenks Ferry	N10E46L2
4	TL.SF.14N38EL3	Thomas/Luckey (SUBi-888)	Shenks Ferry	14N38EL3
5	TL.SF.16N26EL3	Thomas/Luckey (SUBi-888)	Shenks Ferry	16N26EL3
6	TL.SF.F12.UN	Thomas/Luckey (SUBi-888)	Shenks Ferry	F12.UN
7	TL.SF.F12.V5	Thomas/Luckey (SUBi-888)	Shenks Ferry	F12.V5
8	TL.SF.F12A.V7	Thomas/Luckey (SUBi-888)	Shenks Ferry	F12A.V7
9	TL.SF.F21.C.V49	Thomas/Luckey (SUBi-888)	Shenks Ferry	F21.C.V49

Appendix B: Sherd Provenience Data (continued)

10	TL.SF.F21.F.V47	Thomas/Luckey (SUBi-888)	Shenks Ferry	F21.F.V47
11	TL.SF.F21.V48	Thomas/Luckey (SUBi-888)	Shenks Ferry	F21.V48
12	TL.SF.F22	Thomas/Luckey (SUBi-888)	Shenks Ferry	F22
13	TL.SF.F28.V51	Thomas/Luckey (SUBi-888)	Shenks Ferry	F28.V51
14	TL.SF.F3	Thomas/Luckey (SUBi-888)	Shenks Ferry	F3
15	TL.SF.F3.A	Thomas/Luckey (SUBi-888)	Shenks Ferry	F3.A
16	TL.SF.F30	Thomas/Luckey (SUBi-888)	Shenks Ferry	F30
17	TL.SF.F33.B	Thomas/Luckey (SUBi-888)	Shenks Ferry	F33.B
18	TL.SF.F33.V55	Thomas/Luckey (SUBi-888)	Shenks Ferry	F33.V55
19	TL.SF.F4.B	Thomas/Luckey (SUBi-888)	Shenks Ferry	F4.B
20	TL.SF.F4.V57	Thomas/Luckey (SUBi-888)	Shenks Ferry	F4.V57
21	TL.SF.F57.A	Thomas/Luckey (SUBi-888)	Shenks Ferry	F57.A
22	TL.SF.F57.B	Thomas/Luckey (SUBi-888)	Shenks Ferry	F57.B
23	TL.SF.F57	Thomas/Luckey (SUBi-888)	Shenks Ferry	F57
24	TL.SF.F58.A.V62	Thomas/Luckey (SUBi-888)	Shenks Ferry	F58.A.V62
25	TL.SF.F58.V63	Thomas/Luckey (SUBi-888)	Shenks Ferry	F58.V63
26	TL.SF.F67	Thomas/Luckey (SUBi-888)	Shenks Ferry	F67
27	TL.SF.F74	Thomas/Luckey (SUBi-888)	Shenks Ferry	F74
28	TL.SF.F81.A	Thomas/Luckey (SUBi-888)	Shenks Ferry	F81.A
29	TL.SF.F81.V66	Thomas/Luckey (SUBi-888)	Shenks Ferry	F81.V66
30	TL.SF.TL95.88.4	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL95.88.4
31	TL.SF.TL95.94.15	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL95.94.15
32	TL.SF.TL96.146.600.A	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL96.146.600.A
33	TL.SF.TL96.146.600	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL96.146.600
34	TL.SF.TL96.149.615	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL96.149.615
35	TL.SF.TL96.158.662	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL96.158.662
36	TL.SF.TL96.172.713	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL96.172.713
37	TL.SF.TL96.197.768	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL96.197.768
38	TL.SF.TL96.24.93	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL96.24.93
39	TL.SF.TL96.44.173	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL96.44.173
40	TL.SF.TL97.120.545	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL97.120.545
41	TL.SF.TL97.329.1329	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL97.329.1329
42	TL.SF.TL97.350.1404	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL97.350.1404
43	TL.SF.TL97.357.1435	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL97.357.1435
44	TL.SF.TL98.11.57	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL98.11.57
45	TL.SF.TL98.217.786	Thomas/Luckey (SUBi-888)	Shenks Ferry	TL98.217.786
46	TL.SF.Trench 18 NE Quad	Thomas/Luckey (SUBi-888)	Shenks Ferry	Trench 18 NE Quad
47	TL.SF.West Surface.A	Thomas/Luckey (SUBi-888)	Shenks Ferry	West Surface.A
48	TL.SF.West Surface.V87	Thomas/Luckey (SUBi-888)	Shenks Ferry	West Surface.V87

Bibliography

Adler, Michael A., Todd Van Pool, and Robert D. Leonard
1996 Ancestral Pueblo population aggregation and abandonment in the North American Southwest. *Journal of World Prehistory* 10(3):375-438.

Arnold, Dean E.
1985 *Ceramic theory and cultural process*. Cambridge University Press, Cambridge

Berg, T.M., W.E. Edmunds, A.R. Geyer, A.D. Glover, D.M. Hoskins, D.B. MacLachlan, S.I. Root, W.D. Sevon, and A.A. Socolow
1980 *Geologic map of Pennsylvania (2nd ed.)*. Pennsylvania Geological Survey. Middletown, Pennsylvania.

Bourdieu, Pierre
1972 Structures and the Habitus. In *Outline of a Theory of Practice*. Cambridge University Press, Cambridge.

Bowser, Brenda J.
2000 From Pottery to Politics: An Ethnoarchaeological study of Political Factionalism, Ethnicity, and Domestic Pottery style in the Ecuadorian Amazon. *Journal of Archaeological Method and Theory* 7(3):219-248.

Bowser, Brenda J., and John Q. Patton
2008 Women's Life Histories and Communities of Practice in the Ecuadorian Amazon. In *Cultural Transmission and Material Culture: Breaking Down Boundaries*, Vol 2, edited by Miriam T. Stark, Brenda J. Bowser, and Lee Horne, pp. 105-129. University of Arizona Press, Tucson.

Braun, David P.
1991 Why decorate a pot? Midwestern household pottery, 200 BC-AD 600. *Journal of Anthropological Archaeology* 10(4):360-397.

Cadwell, Donald H., Ernest H. Muller, and P Jay. Fleisher
2003 Geomorphic History of New York state. In *Geoarchaeology of Landscapes in the Glaciated Northeast*, Vol 497, edited by David L. Cremeens, and John P. Hart, pp. 7-14. New York State Museum Albany, New York.

Cameron, Catherine M.
1991 Structure Abandonment in Villages. *Archaeological Method and Theory* 3:155-194.

Carr, Christopher
1995 Building a Unified Middle-Range Theory of Artifact Design. In *Style, Society, and Person: Archaeological and Ethnological Perspectives*, edited by Christopher Carr, and Jill E. Neitzel, pp. 151-170. Springer US, Boston, Massachusetts.

Carr, Kurt W., and Roger W. Moeller
2015 *First Pennsylvanians: The Archaeology of Native Americans in Pennsylvania*. Pennsylvania Historical and Museum Commission, Harrisburg, Pennsylvania.

Chilton, Elizabeth S.
1996 Embodiments of choice: Native American Ceramic Diversity in the New England interior. Ph.D., Department of Anthropology, UnNiversity of Massachusets, Amherst, Amherst.

Chilton, Elizabeth S.
1999 Mobile Farmers of Pre-Contact Southern New England: The Archaeological and Ethnohistorical Evidence. . In *Current Northeast Paleoethnobotany*, edited by John P Hart. University of the State of New York, State Education Dept., Albany.

Colwell-Chanthaphonh, Chip, T. J. Ferguson, Dorothy Lippert, Randall H. McGuire, George P. Nicholas, Joe E. Watkins, and Larry J. Zimmerman
2010 The Premise and Promise of Indigenous Archaeology. *American Antiquity* 75:228-238.

Conolly, James, and Mark Lake
2006 *Geographical Information Systems in Archaeology*. Cambridge University Press, Cambridge.

Cresswell, Robert
1976 Techniques et culture: les bases d’un programme de travail. *Techniques & Culture. Revue semestrielle d’anthropologie des techniques* (54-55):20-45.

Custer, Jay F.
1987 Problems and prospects in Northeastern Prehistoric Ceramic studies. *North American Archaeologist* 8(2):97-123.

David, Nicholas, Judy Sterner, and Kodzo Gavua
1988 Why Pots are Decorated. *Current Anthropology* 29(3):365-389.

Deloria, Vine
1969 *Custer died for your sins: An Indian manifesto*. University of Oklahoma Press, Norman, OK.

Denny, Charles Storrow, Walter Henry Lyford, and John Campbell Goodlett
1963 *Surficial geology and soils of the Elmira-Williamsport region, New York and Pennsylvania*. US Government Printing Office.

Dorland, Steven G.H.
2018 Maintaining traditions: A study of southern Ontario Late Woodland ceramics through a Communities-of-Practice approach. *Journal of Archaeological Method and Theory* 25(3):892-910.

East, Thomas C., Christopher T. Espenshade, Matthew G. Hyland, and Kenneth W. Mohney
2006a *Tioga County, Pennsylvania: S.R. 6015, sections G20 and G22, U.S. Route 15 improvements project: Phase I/II/III archaeological investigations: Volume VI: Conclusions and Recommendations.* . Submitted to Federal Highway Administration and Pennsylvania Department of Transportation Engineering District 3-0 Copies available from Inc Skelly and Loy, Monroeville, Pennsylvania.

East, Thomas C., Christopher T. Espenshade, Kenneth W. Mohney, Margaret G. Sams, and Bryan C. Henderson
2006b *Tioga County, Pennsylvania: S.R. 6015, sections G20 and G22, U.S. Route 15 improvements project: Phase I/II/III archaeological investigations: Volume V: Figures, Tables, and Photographs*. Submitted to Federal Highway Administration and Pennsylvania Department of Transportation Engineering District 3-0 Copies available from Inc Skelly and Loy, Monroeville, Pennsylvania.

East, Thomas C., Christopher T. Espenshade, Margaret G. Sams, Jessica Smoker, Matthew G. Hyland, Patricia H. Baker, and Bryan C. Henderson
2006c *Tioga County, Pennsylvania: S.R. 6015, sections G20 and G22, U.S. Route 15 improvements project: Phase I/II/III archaeological investigations: Volume I: Introduction*. Submitted to Federal Highway Administration and Pennsylvania Department of Transportation Engineering District 3-0 Copies available from Inc Skelly and Loy, Monroeville, Pennsylvania.

Engelbrecht, William
1971 A Stylistic Analysis of New York Iroquois Pottery. Ph.D. Dissertation, University of Michigan, Ann Arbor, Michigan.

Engelbrecht, William
2003 *Iroquoia: The development of a native world*. Syracuse University Press.

Ericksen, Annette Gabrielle
1995 Shenks Ferry Subsistence and Settlement: The Archaeobotanical Record. Ph.D. Dissertation, Anthropology, The Ohio State University, Ann Arbor, Michigan.

Espenshade, Christopher T.
2001 Two Native Potters" Speak" About Punctates: Harding Flats Data and the Clemsons Island Concept. *Journal of Middle Atlantic Archaeology* 17:59-84.

Espenshade, Christopher T.
2006 *Tioga County, Pennsylvania: S.R. 6015, sections G20 and G22, U.S. Route 15 improvements project: Phase I/II/III archaeological investigations: Volume II: Ceramics*. Submitted to Federal Highway Administration and Pennsylvania Department of Transportation Engineering District 3-0 Copies available from Inc Skelly and Loy, Monroeville, Pennsylvania.

Espenshade, Christopher T.
2014 Peri-Susquehannock Pottery of the Tioga River area, Pennsylvania and New York. *Pennsylvania Archaeologist* 84(1):15.

Espenshade, Christopher T., and Linda Kennedy
2002 Recognizing individual potters in Nineteenth-century Colonoware. *North American Archaeologist* 23(3):209-240.

Feuer, Bryan
2016 *Boundaries, borders and frontiers in archaeology: a study of spatial relationships*. McFarland.

Gilboa, Ayelet, Avshalom Karasik, Ilan Sharon, and Uzy Smilansky
2004 Towards Computerized Typology and Classification of ceramics. *Journal of Archaeological Science* 31(6):681-694.

Gilligan, Shane Patrick
2008 Identifying communities of practice through cord impressed ceramics at the early Late Prehistoric sites of Thomas/Luckey and Chenango Point in central New York. M.A. Thesis, SUNY Binghamton, Ann Arbor, Michigan.

Gosselain, Olivier P., and Alexandre Livingstone Smith
2005 The source: Clay selection and processing practices in sub-Saharan Africa. *Pottery manufacturing processes: Reconstruction and interpretation*:33-47.

Graybill, Jeffery R., and James T. Herbstritt
2014 Shenks Ferry Traditional Ceramic Seriation. *Pennsylvania Archaeologist* 84(1):27-45.

Hart, John P.
1999 Dating Roundtop's domesticates: implications for northeastern late prehistory. In *Current Northeast Paleoethnobotany*, Vol New York State Museum Bulletin No. 494 edited by John P. Hart, pp. 47-68. The University of the State of New York The State Education Department Albany, New York.

Hart, John P.
2011 The Death of Owasco - Redux. In *Current Research in New York Archaeology: AD 700-1300*, edited by Christina B. Rieth, and John P. Hart. New York State Museum, New York State Education Department, Albany, New York.

Hart, John P.
2012 Pottery wall thinning as a consequence of increased maize processing: a case study from central New York. *Journal of Archaeological Science* 39(11):3470-3474.

Hart, John P., and Hetty Jo Brumbach
2003 The Death of Owasco. *American Antiquity* 68(4):737-752.

Hawkins, Alicia L., Joseph A. Petrus, Lisa Marie. Anselmi, and Gary. Crawford
2016 Laser ablation-inductively coupled plasma-mass spectrometry analysis of copper-based artifacts from Southern Ontario and the chronology of the indirect contact period. *Journal of Archaeological Science: Reports* 6:332-341.

Heisey, Henry
1971 An interpretation of Shenks Ferry ceramics. *Pennsylvania Archaeologist* 41(4):44-70.

Herbstritt, James T.
2019a Becoming Susquehannock. In *The Susquehannocks: New Perspectives on Settlement and Cultural Identity*, edited by Paul A Raber. Pennsylvania State University Press, University Park, Pennsylvania.

Herbstritt, James T.
2019b Becoming Susquehannock: the West Branch and North Branch Traditions. In *The Susquehannocks: New Perspectives on Settlement and Cultural Identity*, edited by Paul A. Raber. Pennsylvania State University Press, University Park, Pennsylvania.

Herbstritt, James T.
2020 The Late Woodland Period in the Susquehanna and Northern Potomac Drainage Basins, Circa AD1100-1575. In *The Archaeology of Native Americans in Pennsylvania* Vol 2, edited by Kurt W. Carr, Christopher A. Bergman, Christina B. Rieth, Bernard K . Means, and Roger W. Moeller, pp. 573-624. University of Pennsylvania Press, Philadelphia, Pennsylvania.

Herbstritt, James T., and Barry C. Kent
1989 Shenks Ferry Revisited: A New Look at an Old Culture. *Pennsylvania Heritage* 26:12-17.

Hunt, Alice M.W.
2017 *The Oxford handbook of archaeological ceramic analysis*. Oxford University Press, Oxford.

Kinsey, W. Fred, and Jeffrey R. Graybill
1971 Murry site and its role in Lancaster and Funk phases of Shenks Ferry culture. *Pennsylvania Archaeologist* 41(4):7-44.

Kirkland, James T.
1993 Fluvial Geomorphology of the Upper Susquehanna Study Area. In *Archaeological Investigations in the Upper Susquehanna Valley, New York State*, Vol I, edited by Robert E Funk. Persimmon Press, Buffalo, New York.

Knapp, Timothy D.
1996 *Stage 3 Data Recovery, Thomas/Luckey Site (SUBi-888), Town of Ashland, Chemung County, New York*. Public Archaeology Facility, Department of Anthropology, SUNY Binghamton.

Knapp, Timothy D.
2009 An unbounded future? Ceramic types,"cultures," and scale in late prehistoric research. In *Iroquoian Archaeology & Analytic Scale*, edited by Laurie E. Miroff, and Timothy D. Knapp, pp. 101-129. Univeristy of Tennessee Press, Knoxville, Tennessee.

Kuhn, Robert D.
1986 Interaction patterns in Eastern New York: a trace element analysis of Iroquoian and Algonkian ceramics. *The Bulletin and Journal of the New York State Archaeological Association* 92:9-21.

Kylander, Malin E., Linda Ampel, Barbara Wohlfarth, and Daniel Veres
2011 High-resolution X-ray fluorescence core scanning analysis of Les Echets (France) sedimentary sequence: new insights from chemical proxies. *Journal of Quaternary Science* 26(1):109-117.

Lathrap, Donald W.
1973 The antiquity and importance of long-distance trade relationships in the moist tropics of pre-Columbian South America. *World Archaeology* 5(2):170-186.

Lave, Jean, and Etienne Wenger
1991 *Situated learning: Legitimate peripheral participation*. Cambridge University Press, Cambridge.

Lenig, Donald
1965 *The Oak Hill Horizon and its relation to the development of Five Nations Iroquois culture*. Kraus Reprint Company, Buffalo, New York.

Lucy, Charles
1959 Pottery types of the upper Susquehanna. *Pennsylvania Archaeologist* 29(1):28-37.

MacDonald, Douglas H.
2008 The age, function, and distribution of keyhole structures in the upper Susquehanna River valley. *Journal of Middle Atlantic Archaeology* 28:99-112.

MacNeish, Richard S.
1952 *Iroquois pottery types: a technique for the study of Iroquois prehistory*. Minister of Resources and Development.

MacNeish, Richard S.
1980 *Iroquois pottery types 32 years later*. Proceedings of the 1979 Iroquois Pottery Conference. Rochester Museum and Science Center, Rochester, New York.

Masucci, Maria A.
2000 Defining Ceramic Change and Cultural Interaction: Results of Typological, Chronological, and Technological Analysis of Guangala Phase Ceramics. *Andean Past* 6(1):10.

Miroff, Laurie E.
1997 *Thomas/Luckey site (SUBi-888) 1996 SUNY Binghamton Field School Report Town of Ashland Chemung County, New York (MCD 01501)*. Submitted to SUNY Binghamton. Copies available from Public Archaeology Facility, Ann Arbor, Michigan.

Miroff, Laurie E.
2002 Building a village one household at a time: Patterning at the Thomas/Luckey site, New York. Ph.D. Dissertation, Anthropology, Binghamton University, Ann Arbor, Michigan.

Miroff, Laurie E.
2009 *A Local-level Analysis of Social Reproduction and Transformation in the Chemung Valley*. Iroquoian Archaeology and Analytic Scale. University of Tennessee Press, Knoxville, Tennessee.

Mt. Pleasant, Jane
2016 Food yields and nutrient analyses of the Three Sisters: A Haudenosaunee cropping system. *Ethnobiology Letters* 7(1):87-98.

Mullins, Henry T., William P. Patterson, Mark A. Teece, and Adam W. Burnett
2011 Holocene climate and environmental change in central New York (USA). *Journal of Paleolimnology* 45(2):243-256.

Niemczycki, Mary Ann Palmer
1984 *The origin and development of the Seneca and Cayuga tribes of New York State*. Research Records, Vol. 17. Rochester Museum and Science Center, Rochester, New York.

Nieuwenhuyse, Olivier
2017 Pots to be seen. In *Painting Pots–Painting People*, edited by Olivier Nieuwenhuyse, Walter Cruells, and Inna Mateiciucová. Oxbow Books, Philadelphia.

NRCS, and USDA
2009 Web soil survey. In *URL* *http://www.websoilsurvey.ncsc.usda.gov/app/[verifiedOctobe29,2009*.

Parker, Arthur Caswell
1907 *Excavations in an Erie Indian Village and Burial Site at Ripley, Chautauqua Co., NY: Being the Record of the State Museum Archeological Expedition of 1906*, Vol. 418. New York State Education Department, Albany, New York.

Pietras, Jeffrey T., and Ethan B. Spiegel
2018 XRF-based Chemostratigraphy Between and Across Two Disconformities in the Ordovician Trenton Group and Utica Shale of Central New York, USA. *Journal of Sedimentary Research* 88(3):365-384.

Prezzano, Susan C.
1992 Longhouse, village, and palisade: community patterns at the Iroquois southern door. Ph.D., Anthropology, State University of New York at Binghamton, Ann Arbor, Michigan.

Rice, Prudence M.
2015 *Pottery Analysis: A Sourcebook*. University of Chicago Press, Chicago.

Rickard, L.V., Y.W Isachsen, and Fisher D.W.
1970 *Geologic map of New York*. New York State Museum and Science Service. Albany, New York.

Ries, Heinrich
1903 *The clays of the United States east of the Mississippi River*. US Government Printing Office.

Rieth, Christina B.
1997 Culture contact during the Carpenter Brook phase: A tripartite approach to the study of the spatial and temporal movement of early Iroquoian groups throughout the upper Susquehanna River Valley. Ph.D Dissertation, Anthropology, SUNY Albany, Ann Arbor, Michigan.

Rieth, Christina B.
2002 Trace Element Analysis and Its Role in Analyzing Ceramics in the Eastern Woodlands. In *Archaeological Chemistry*, Vol 831, pp. 199-213. ACS Symposium Series, Vol. 831. 0 vols. American Chemical Society.

Rieth, Christina B.
2004 Cordage, fabrics, and their use in the manufacture of early late prehistoric ceramic vessels in New York. *Perishable material culture in the Northeast*:129-142.

Rieth, Christina B., Sean M. Rafferty, and Derek Saputo
2007 A trace element analysis of ceramics from the Pethick site, Schoharie county, New York. *North American Archaeologist* 28(1):59.

Ritchie, William A.
1965 *The Archaeology of New York State*. Harbor Hill Books, Harrison, New York.

Ritchie, William A., and Robert E Funk
1973 *Aboriginal settlement patterns in the Northeast*. University of the State of New York, State Education Department, Alany, New York.

Ritchie, William A., and Richard S. MacNeish
1949 The Pre-Iroquoian Pottery of New York State. *American Antiquity* 15(2):97-124.

Roddick, Andrew P., and Ann B. Stahl
2016 *Knowledge in motion: constellations of learning across time and place*. University of Arizona Press, Tucson, Arizona.

Rouse, Irving
1960 The classification of artifacts in archaeology. *American Antiquity*:313-323.

Roux, Valentine
2016 Ceramic manufacture: the chaîne opératoire approach. *The Oxford handbook of archaeological ceramic analysis*:101-113.

Sanger, Matthew C.
2017 Coils, slabs, and molds: examining community affiliation between Late Archaic shell ring communities using radiographic imagery of pottery. *Southeastern Archaeology* 36(2):95-109.

Sassaman, Kenneth E.
2016 A constellation of practice in the experience of sea-level rise. *Knowledge in Motion: Constellations of learning across time and place*:271-298.

Scarcella, Simona
2011 *Archaeological ceramics: A review of current research*. Archaeopress.

Schulenberg, Janet K.
2002 New dates for Owasco pots. In *Northeast Subsistence-Settlement Change: AD*, edited by John P Hart, and Christina B Rieth.

Shackley, M. Steven
2012 Portable X-ray Fluorescence Spectrometry (pXRF): The Good, the Bad, and the Ugly. *Archaeology Southwest Magazine* 26:1-8.

Skibo, James M.
2013 Understanding pottery function. In *Understanding Pottery Function*, pp. 1-25. Springer.

Skibo, James M., Michael B. Schiffer, and Nancy Kowalski
1989 Ceramic style analysis in archaeology and ethnoarchaeology: Bridging the analytical gap. *Journal of Anthropological Archaeology* 8(4):388-409.

Snow, Dean R.
1995 Migration in prehistory: the northern Iroquoian case. *American Antiquity*:59-79.

Snow, Dean R.
1996 *The Iroquois*. Wiley-Blackwell, Malden, Massachusets.

Snow, Kristin
2007 Walking in Two Worlds: Native Americans, Archaeology & Dialogue along the Cowanesque, Joanne Alexis, general editor. Commonwealth Media Services, United States.

Speakman, Scott A.
2011 Using the Bruker Tracer III-SD Handheld X-Ray Fluorescence Spectrometer using PC Software for Data Collection, edited by Massachusets Institute of Technology. Center for Materials Science and Engineering at MIT, Cambridge, Massachusetts.

Spence, Michael W.
1999 Comments: The Social Foundations of Archaeological Taxonomy. In *Taming the Taxonomy: Toward a New Understanding of Great Lakes Archaeology*, edited by Ronald F Williamson, and Christopher M Watts. Eastendbooks, Toronto, Canada.

SRBC
2006 *Upper Susquehanna Subbasin*. Susquehanna River Basin Commission. Harrisburg, PA.

Stark, Miriam T., Ronald L. Bishop, and Elizabeth Miksa
2000 Ceramic technology and social boundaries: cultural practices in Kalinga clay selection and use. *Journal of Archaeological Method and Theory* 7(4):295-331.

Suluvan III, Alan P., James M. Skibo, and Mary Van Buren
1992 Sherds as tools: The roles of vessel fragments in prehistoric succulent plant processing. *North American Archaeologist* 12(3):243-255.

Tuck, James A.
1971 *Onondaga Iroquois prehistory: a study in settlement archaeology*. Syracuse University Press, Syracuse, New York.

Vaughn, Kevin J., Jelmer W. Eerkens, Carl Lipo, Sachiko Sakai, and Katharina Schreiber
2014 It's about time? Testing the Dawson ceramic seriation using luminescence dating, southern Nasca Region, Peru. *Latin American Antiquity* 25(4):449-461.

Velasco, Matthew C.
2018 Ethnogenesis and social difference in the Andean Late Intermediate Period (AD 1100–1450): A bioarchaeological study of cranial modification in the Colca Valley, Peru. *Current Anthropology* 59(1):98-106.

Versaggi, Nina, and Robert Ewing
1979 *Cultural Resource Management Survey, 1989 Highway Program: PINs 6750.07 and 6006.08, Chemung County, New York. Prepared for the New York State Museum and NYSDOT* Public Archaeology Facility, State University of New York at Binghamton.

Watkins, Joe
2000 *Indigenous Archaeology: American Indian Values and Scientific Practice*. AltaMira, Walnut Creek, CA.

Weber, Cynthia J.
1971 Types and Attributes in Iroquois pipes. *Man in the Northeast* 2:51-65.

Wenger, Etienne
1998 *Communities of practice: Learning, meaning, and identity*. Cambridge University Press, Cambridge.

Wenger, Etienne
2010 Communities of practice and social learning systems: the career of a concept. In *Social learning systems and communities of practice*, pp. 179-198. Springer.

Witthoft, John, and Samuel S. Farver
1971 Two Shenk's Ferry Sites in Lebanon County, Pennsylvania. In *Foundations of Pennsylvania Prehistory*, edited by Barry C. Kent, Ira F. Smith III, and Catherine McCann. Pennsylvania Historical and Museum Commission, Harrisburg, Pennsylvania.

Wobst, H. Martin
1977 Stylistic behavior and information exchange. *For the director: Research essays in honor of James B. Griffin* 61:317-342.

Wright, Kevin Pierce
2019 Hidden In the Matrix: Using Compositional Analyses to Examine Social Boundaries at the Chickasawhay Creek Sites. . Master Of Arts, Anthropology, The University of Alabama, Tuscaloosa, Alabama.