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During the Late Pre-Hispanic period, settlements in Northern Highland Ecuador were organized under a number of chiefdoms. While a basic hierarchical political system is described in the ethnohistoric literature, the nature of the interactions between specific settlements has remained unknown. This study utilizes two methods for describing the degree and scale of interactions between these settlements based on archaeological data.

In the first part of this study, comparisons of site size and complexity were used to describe the variation in chiefly sites at the regional scale. A Geographic Information System (GIS) was also used to model the distributional pattern of significant chiefly archaeological sites in northern Ecuador in order to determine spacing and examine evidence of hierarchy and possible clustering. In the second part of the study, the results of Instrumental Neutron Activation Analysis (INAA) of ceramic samples from chiefly sites were used to determine whether ceramic vessels moved among communities. The composition groups identified in ceramic assemblages were compared to field-collected clay samples to identify probable clay "sources". The locations of these sources were then compared to locations of

significant archaeological sites as a way of tracking the production and movement of ceramics made from local and non-local clay resources.

The results of these analyses demonstrate that the chiefdoms of the Late Period were associated through a regional political system that lacked a nested hierarchy. The trace-element analyses in the northern part of the study area revealed that a limited number of ceramics were moving between larger settlements, while smaller settlements consumed ceramics almost exclusively of local production. These new models of interaction provide valuable information for the study of political organization prior to Inca and Spanish influence. Identification of interaction patterns in chiefdom societies also directly influences our understanding of economic and political systems in the context of chiefdoms.

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DEGREE AND SCALE OF INTERACTIONS AMONG CHIEFDOMS DURING THE PRE-HISPANIC LATE PERIOD IN NORTHERN HIGHLAND ECUADOR (AD 1250-1525)

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Kaitlin C. Yanchar, Author

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Chapter 1: Introduction

According to Spanish accounts, Northern Highland Ecuador was divided and managed by multiple chiefs during the Late Period, the time period before the Inca invasion of the region (AD 1250-1525). Less than a century later, Spanish *conquistadores* seized control of the Inca Empire, initiating the Colonial Period and the first written descriptions of prehistoric lifeways during the Late Period. While these accounts provide the names of chiefs of interest to the Spanish Empire, little is known about the relationships among chiefs at the time, which settlements were the most politically important, or, most obviously, why they built *tolas*, or artificial earthen mounds, throughout the region.

Archaeological investigations have helped to fill in some of these details, providing information about the different types of *tola* sites observed in the region, their general distribution, and their various functions through time. Evidence of large and recurring feasting events at *tola* sites is an important clue to the methods used by chiefs to manage communities. However, many questions remain about the political climate during this period, including the nature of interaction among chiefly polities prior to the Inca incursion.

1.1. The Chiefdom Model

The most basic criteria of a chiefdom is the political and managerial office of a chief whom maintains control over communities within a territory (Carneiro 1981). There are many ways in which his roles may be carried out, with examples of loosely associated communities with limited interaction with their chief, to highly organized regional systems with complex systems of tribute (Earle 1987; Cobb 2003). The development of social inequality is of particular interest to archaeologists. How do we explain the transition from egalitarian hunter-gatherer groups to highly stratified states? Within this continuum, chiefdoms have received considerable attention as they occupy the

intermediate level of political organization between egalitarian and highly stratified societies (Earle 1987; 1993).

As a categorical type, chiefdoms can take many different forms; including theocratic, militaristic, and "tropical forest" chiefdoms; group-oriented and individualistic chiefdoms; and simple and complex chiefdoms (Earle 1987:280). Our understanding of how chiefdoms function and their possible purposes has changed over time as study has expanded to include examples from multiple geographic areas and time periods. Elman Service first described chiefdoms as redistributive systems in which the chief has the primary responsibility of organizing exchange relationships with other chiefdoms, and organizing labor for large construction projects (1962). He explored the idea that groups occupying different ecological niches produce diverse goods that are more desirable to other groups that do not have the same resources. The creation of a competitive environment focused on access to resources motivates the formation of a leadership office that has the authority to gather, distribute, and exchange goods for the benefit of the entire community (Service 1962).

Carneiro (1998) also recognized a direct relationship between differential access to resources in the natural environment and the formation of chiefdoms. His concept of environmental circumscription focuses on the effect of increased population on the availability of productive and desirable land. Based on his observations of modern Amazonian populations, he concluded that warfare is endemic to all groups, and as populations become more densely concentrated, the demand for land increases. He argues that political organization became more complex as warfare becomes vital to the success of a group; he called this increase in population pressure social circumscription (Carneiro 1998).

Non-functionalist descriptions of chiefdoms recognize that individuals pursue higher social status for a number of different reasons. Many discussions of the development of chiefdom-level societies operate under the assumption that within any given group of people, some individuals will possess the skill and desire to accumulate goods and political power. Thus, the act of provisioning one's community with

consumable resources has both altruistic and selfish motivations. "Aggrandizers" is a term given to individuals who seek to manipulate the social system in a way that generates political and economic benefits that are only enjoyed by the elite (Clark and Blake 1994). Wealthier members of the community may then lend products or capital to those without these benefits, thereby generating debt. Aggrandizers then use this debt as leverage to extract labor and other products from the population (Flannery 1972; Hayden 1996).

1.2. Key Components and Archaeological Correlates

In light of the multiple forms a chiefdom may take, Earle outlined three defining organizational characteristics of chiefdoms: scale of integration, centrality of decision-making authority, and social stratification. Chiefdoms are "regionally organized societies with a centralized decision-making hierarchy coordinating activities among several village communities" (Earle 1987:288). Scale of integration refers to a recognized trend in which increasing polity size is positively correlated with increasing political complexity. The simplest and smallest chiefdoms have a population of a few thousand, while a more complex chiefdom has a population in the tens of thousands (Earle 1987). As the size of the chiefdom increases, so do the number of executive decisions the chief is responsible for, creating a system of centralized leadership. Earle notes centrality as "the clearest indicator of chiefdoms" (1987:289), and that centrality is manifested in a regional hierarchy based on site size. The creation of different social ranks, with the chief and his kin occupying the highest rank, is an expression of social stratification. The benefits associated with the higher social class can be identified from several forms of archaeological evidence, allowing for the interpretation of political and social institutions based on those material remains (Peebles and Kus 1977).

1.2.1. Settlement Hierarchy

One of the most significant correlates of a chiefdom is the presence of a basic settlement hierarchy, in which specific settlements are distinguishable from others based on their larger relative size (Peebles and Kus 1977). These settlements and their associated architectural features can also be distinguished based on construction methods, elaborateness, use of uncommon or labor-intensive materials, and limited physical proximity to settlements of lower-ranking members of society. Elevated locations or ones nearest to agriculturally productive areas were the most desirable locations and encouraged the influx of population and political power to sites with these attributes. Elaborate monuments are also indicative of large labor investments, which would have been arranged by individuals with high political and social authority (Peebles and Kus 1977).

1.2.2. Burial Practices

Another manifestation of social hierarchy in chiefdom-level societies is differences in burial practices between elites and commoners, and among members of different age and sex classes. Elite burials are likely to display greater investments of labor and ritual. They are also expected to contain prized goods featuring special symbols or materials (Peebles and Kus 1977). For the elite, their "high culture" is likely to include esoteric representations of their worldview that are not shared with lower ranking members of society (Baines and Yoffee 2000). Restricting the use of particular symbols to elite burial goods highlights the differences between social ranks (Cobb 2003). In contrast, members of the general population are typically accompanied with fewer goods at their death, and those goods tend to be less elaborate. Group burial is indicative of the lowest level of social status as individuals are rarely interred with grave goods and there is no distinction between individuals. Social stratification expresses itself in other ways, but mortuary analysis can provide the most convincing evidence of social hierarchy because it is a direct reflection of the social status of an individual. Comparison of

multiple burials illustrates the range of social categories recognized by society and how these roles may fit within the context of society.

1.2.3. Political Instability

Chiefdoms are inherently unstable. The development of centralized leadership also encourages the development of factions which compete for seats of power (Spencer 2003). This situation is complicated by the complex kinship ties between the chief, his family members, and the rest of society (Earle 1997). Research on chiefdoms has shown that the elite have developed diverse strategies for maintaining social ties while still competing for political and economic control, including feasting, gift exchange, intermarriage and child exchange (Earle 1997; Oberem 1978).

1.2.4. Feasting

Feasting is a common cultural event described among chiefdoms, and its prevalence owes to its success in meeting a number of goals. Both ethnographic and historical evidence demonstrate that work feasts are a virtually universal feature among agrarian societies, and were one of the few ways of organizing and executing large labor projects when the populace is under no obligation to participate (Dietler and Herbich 2001:240). In a chiefdom where political power is more pronounced, competitive feasts were also hosted by chiefs as a way to impress neighboring chiefs and commoners.

Hayden (1996) describes four main motivations for hosting a competitive feast. The first is economic, whereby the chief demonstrates his financial means by providing the food and drink to be consumed. His ability to amass these products is also an indication of his superior social standing and privileged access to large stores of goods. Second, a feasting event offers an opportunity for the chief to self-aggrandize by means of speeches and gregarious behavior. Third, he is able to compete with other members of high social standing by offering unique foods or especially large quantities of food. Hayden makes the point that food appeals to all levels of society, and so the offer of "free" food encourages people to congregate and potentially pledge their allegiance to the

local chief. Fourth, beyond self-aggrandizement, feasts enable the chief to take material gains in rare and exotic goods from other chiefs and forge loose alliances with other leaders (Hayden 1996).

Feasting augments the political power of the chief because he decides when feasts will be held, who is permitted to attend, and what will be served. The activity of hosting a feast and offering food as gifts to the members of a community is not a selfless gesture; gift-giving obligates the receiver to fulfill the exchange with an item of equivalent value, plus interest, at some point in the future (Mauss 1990). Large concentrations of ceramic cooking pots, serving bowls, and butchered faunal remains, are possible indicators of such activities.

1.2.5. Exchange of Prestige Goods

The production and exchange of prestige goods is another strategy for the accumulation of power by chiefs. Prestige goods are used as special payments to other elites or outstanding members of society (D'Altroy and Earle 1985). By definition, prestige or sumptuary goods hold value because they are difficult to produce, are made from rare materials, or are transported long distances. Supplies of these goods are intentionally limited to increase their value. Limiting the production of prestige goods by attached specialists, who are sponsored by local leaders, further limits the supply of goods (Brumfiel and Earle 1987). Curation of prestige goods over multiple generations also increases their value by creating a physical and cultural link between the current ruler and his forbearers, legitimizing leadership positions in chiefdom-level societies (Salomon 1986; Anderson 1994; Baines and Yoffee 2000).

1.2.6. Warfare and Hostility

As best described by Carneiro, warfare and inter-societal competition often play a role in the development of chiefdom society. As population increases, so does the demand for land, especially agriculturally productive land. If the extent of such areas is limited, or there are political controls over access to these areas, other groups will be

motivated to find ways to forcibly gain control over these resources (Carneiro 1998).

Chiefdoms are particularly prone to violent conflict not only between chiefs but also between members of the same kin group. The Mississippian chiefdoms of the southeastern United States, dated to AD 900 - 1600, are a case in point. Both archaeological and ethnohistoric descriptions depict them as sedentary communities practicing intensive *maize* agriculture. Subsidiary towns and polities had a tributary relationship with their chief who resided in the political center. Many of these centers have large platform mounds where ritually significant structures were constructed. A number of prestige goods have also been identified, with evidence that they were readily exchanged between elites (Anderson 1994). Competition for important resources may be one of the best explanations for the formation and breakdown of political ties between chiefs as they continuously renegotiate their rank within the regional hierarchy.

Both direct and indirect evidence for warfare amongst these groups reveals that conflict played a central role in the establishment and enforcement of tributary relationships, as well as leading to social fission and eventual collapse of the organizational system, a phenomenon Anderson refers to as factional competition (1994:66). Palisades and defensive walls are some of the most obvious archaeologically visible indicators of violent conflict during this period. A more subversive tactic employed by elites involved desecrating the ancestral remains curated by enemy groups as a way of demonstrating their power (Anderson 1994). Within the kin group of the chief, male siblings could be perceived as threats to his power, and were often sent off to establish settlements in other areas, effectively separating them from their power base and the possibility of inciting a rebellion. Anderson also considers food distribution through feasting events as a form of factional competition, as chiefs were effectively competing against each other to be the most conspicuous consumer.

The literature on chiefdom-level societies suggests that there are a number of archaeological correlates that allow us to interpret the internal dynamics of these societies and monitor their development and organization. The evidence available for any one

component of chiefdom-level society, but when these components are combined, the presence of a chiefly political structure can become clear.

1.3. Northern Highland Ecuador as a Case Study

Ethnohistoric documents from the Spanish period in Northern Ecuador have offered the greatest amount of information about the nature of pre-Incaic society, although it should be noted that this information was recorded at the end of the reign of the chiefs in the highland area. Groups inhabiting this area during the Late Period are collectively referred to as the Cara, and they were organized into a series of small polities or chiefdoms (Athens 1980) **(Fig. 1.1)**. Previous archaeological investigations have identified similarities in architectural features and ceramic types at sites throughout the region, indicating that these peoples were culturally related (Bray 2008). Based on extensive research of documents from the Spanish era, Salomon argued that *cacicazgos*, or chiefdoms, were small in scale, but were simultaneously highly centralized and stratified (1986).

Based on the archaeological surveys of Gondard y López and J. Stephen Athens' in the Guayllabamba Basin, the primary archaeological marker of chiefly sites are *tolas*, artificial earthen mounds that appear to have served, at least in the late pre-Hispanic period, as the foundation of chiefly residences. Chiefly sites vary in size and in *tola* abundance (Athens 2003) and their distribution on the landscape ranges from a dispersed to a clustered pattern **(Fig. 1.2)** suggesting differing levels of political power throughout the region.

The Late Period is marked by the construction of ramped *tola* mounds, secured by radiocarbon dates and relative dating based on changes in ceramic vessel morphology and surface decoration compared with earlier periods (Athens 1980; Goff 1980). The limited range of dates for the Late Period (AD 1250-1525) based on these parameters enables direct comparison of ramped *tola* sites and their associated ceramic assemblages as indicators of contemporaneous political institutions.

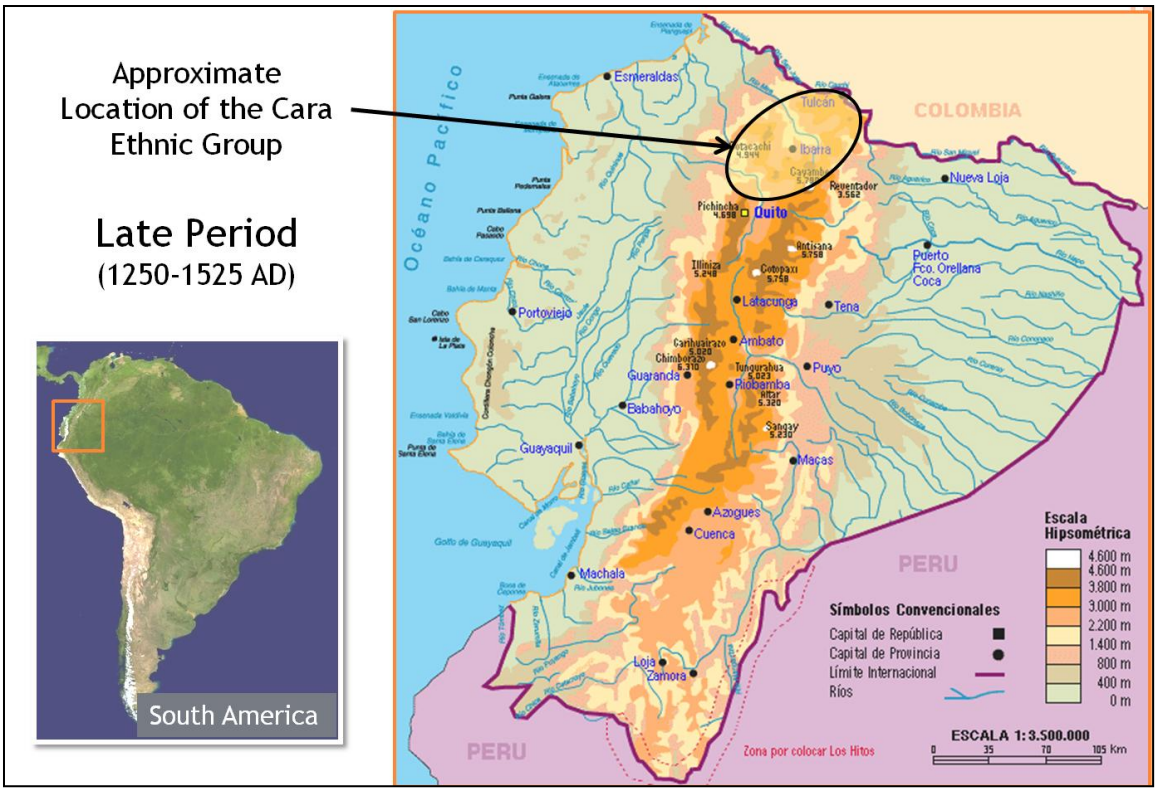

Figure 1.1: Map of Ecuador indicating the approximate location of the Cara ethnic group in the northern Highland region.

Athens (1980) argues that burial data from the northern highlands indicates differences in social class as early as AD 1000. To the contrary, Bray notes that the small burial assemblages found with some individuals at *tola* sites suggest that these individuals did not possess significantly more wealth than other members of society; nor have the prestige goods described by the Spanish been recovered from burial contexts (Bray 2008), although the prevalence of looters' pits at *tola* sites may be partly to blame. In short, it remains unclear to what extent burials reflect social hierarchy in northern Ecuador.

Ethnographic observations of *chicha*, or corn beer, production as an important aspect of feasting demonstrate that although it requires high labor and time investment, it is consumed on a fairly regular basis at various religious and social events. There are also specific types of ceramic vessels that are used to mill, cook, and ferment the product,

many of which bear striking resemblance to archaeological remains (Bray 1991; Hayashida 2008). Both serving and food preparation vessels were found at the main ramped *tola* at Puntiachil, as well as ramped *tolas* at Socapamba, Cochasquí, and others, providing strong evidence of feasting at ramped *tola* mounds and the continuation of the feasting practice through time (Athens 1976; Bray 1991; Cordero Ramos 1998).

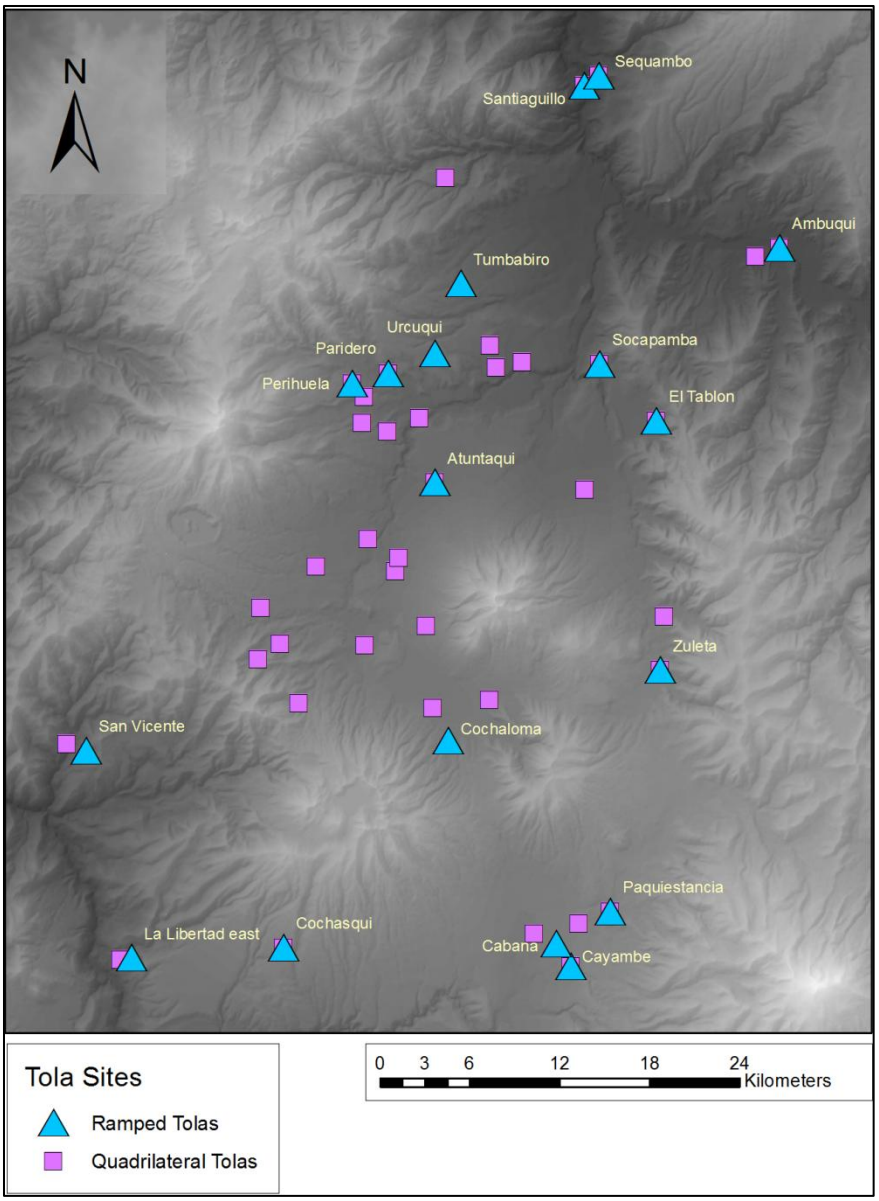

Figure 1.2: Distribution of *tola* sites in northern Highland Ecuador.

Trading behavior during the Late Period is strongly evidenced by the presence of multiple ceramic ware types that have extra-local origins (Bray 1991). Tuza ceramics, produced in the northern Carchi province, have a distinctively different decorative style than the local Caranqui ware and tend to be found at *tola* sites located in the northernmost portion of the study area. Another exotic ceramic type is Panzaleo/Cosanga. This ware has a much larger range than Tuza and tends to occur in small quantities at any one location (Bray 1991). The source location for these ceramics has been debated, but mineralogical evidence strongly points to an origin in the Cordillera Oriental and south of the northern highlands (Bray 1991), a conclusion supported by the trace-element analyses conducted as part of this study.

Based on Anderson's characterization of Mississippian chiefdoms, it is reasonable to expect conflict to arise between competing chiefdoms when both legitimacy and wealth are at stake. While *pucarás*, or hilltop fortresses, were used by the Caranqui, they were not constructed until the end of the Late Period, when the Inca became a threat (Bray 2008).

Relationships among the various villages are unclear. On one hand, the distribution of *tola* sites in the highland region shows maximum spacing based on the nearest neighbor statistic (Athens 1980). This pattern supports ethnohistoric descriptions of incessant warfare between neighboring groups. Yet these groups shared a common language, and artistic tradition, as well as the practice of *tola* construction, and Cieza de León (1553) mentions that the chiefdoms of Otavalo, Cayambe, Cochasquí, and Pifo came together to fight off the Inca (Athens 1980). Several different integrating mechanisms may have forged the bonds that linked these groups.

Ethnohistorical and archaeological data from this area supports the designation of a chiefdom-level organization during the Late Period (Athens 1980; Bray 1991; Salomon 1986). Analysis described in this study augments this information to refine the picture of political and economic organization during this period. Specifically, the study seeks to answer questions concerning (a) the degree to which the political schemes of individual chiefs were integrated at the local and regional level, and (b) the extent to which ceramics

were exchanged between neighboring settlements, and between distant settlements within the region.

1.4. Purpose of Study

Bray (1991) notes that "the socioeconomic configuration in the northern sierra seems particularly enigmatic." Some scholars believe the chiefdoms of the period interacted at a regional scale, while others believe that these settlements were more politically isolated from one another (Bray 2008). Most of the information about exchange of people and goods in the highlands is based on ethnographic records from the Spanish colonial period.

This study is aimed at providing a more detailed understanding of the geographic relationships between settlements associated with *tola* sites and how they related to the exchange of ceramics within the northern highlands. What was the degree and scale of political interactions between these groups based on the spatial distribution of sites? What sorts of exchange interactions did they have and how can they be tracked using ceramics?

1.5. Methods

This study used a two-prong approach to investigate the structure and organization of the political system in Late Period northern highland Ecuador. Geographic relationships are investigated using theories developed by settlement pattern analysis. The first task was to compare the relative sizes of *tola* sites to determine if a regional hierarchy exists; size is the most commonly used attribute for determining site hierarchy (Wason 2004:128). Next, the degree of clustering between sites and least-cost paths were interpreted to show that most ramped *tola* sites are equally spaced from one another, as one would expect in a chiefdom system. The locations of Late Period ramped *tolas* were then compared to the locations of quadrilateral *tolas*, which have a more ambiguous position in the regional chronology. Signs of a simple chiefdom would

include a weak clustering pattern between *tola* sites and unequal distances between sites of similar size and complexity in terms of the number of *tolas* present. These patterns are more indicative of a complex chiefdom organization in which a single regional center dictates and manages the construction of monumental architecture, maximizing access to these sites by outlying communities (King 1986).

The second portion of this study investigates the exchange of ceramics based on the identification of groups of clays and ceramics with similar elemental composition. Instrumental neutron activation analysis (INAA), a well-established method for the chemical characterization of ceramics (Bishop and Blackman 2002; Arnold *et al.* 1991; Neff 2000), was the primary method used for identifying elemental concentrations in archaeological ceramics and modern clay samples. The composition groups represented at sampled archaeological sites were then compared to the clay samples to identify probable sources for each ceramic, based on analysis of geologic regions. Finally, the locations of sampled clays were compared to the sampled archaeological sites to determine which ceramics were produced locally and which were likely produced at another site and then transported. In this context, the movement of ceramics is considered as a function of the movement of people for feasting, trade, or other social customs.

1.6. Preview of Results and Significance

1.6.1. Geospatial Analysis

Basic differences in the sizes of *tola* sites, as well as the abundance and size of *tolas* indicate variation in chiefly sites. A dispersed clustering pattern for the more politically powerful ramped *tola* sites indicates maximum spacing between sites and the delineation of territorial areas, impacting access to resources. Nuanced differences between the locations of sites and topography reveal that the definition of local and non-local resources varies noticeably. The spatial extents of territorial areas fit within the parameters proposed by Spencer (1982:6-7), specifically distances that could be covered within a half-day's walk.

1.6.2. Exchange Interactions

Five separate composition groups were identified for the highlands based on the analysis of ceramics, with statistical tests matching these groups to multiple clay samples collected in the field. By using the results of Tobler's Hiking Function as a guide, these clay sources were identified as local, possibly local, and non-local for sampled archaeological sites. These analyses demonstrate that ceramics were exchanged between the larger northern territories of the study area. Based on the range of the Atuntaqui ceramic and clay composition group, limited exchange occurred among sites in the north and likely did not occur between the north and the south.

1.6.3. Significance of Study

This study contributes to the general study of chiefdoms, including both the spatial patterning of sites within a chiefdom with a predominately local organization scheme and the how ceramics moved within such a system. This study is also significant to the understanding of social organization during the pre-Hispanic period in northern Ecuador. The combination of ethnohistoric and archaeological information paints a clearer picture of interactions between chiefs and the communities they resided over. The techniques used to identify interactions in this study can be applied to other prehistoric societies.

1.7. Chapter Outline

Chapter 2 discusses the current interpretations of political organization during the Late Period in the northern highland region. Ethnohistoric data from this period has remained an important starting point for archaeological investigations in the area. As archaeological investigation of the area has intensified, more detailed questions about the political organization of the time have been evaluated. Ethnohistoric data concerning the regional organization of settlements during this period is also presented. Archaeological investigations in the region have included regional scale studies as well as investigations

of individual sites with features indicative of chiefs with greater political power than their neighbors.

Chapter 3 details a regional scale analysis of settlement patterns during the Late Period, with a focus on archaeological sites with ramped *tola* features. A majority of the analysis was carried out using ESRI's ArcGIS 10.0© software package. A database was developed for this project and includes information from multiple archaeological and geologic maps of the region.

Chapter 4 provides the results of instrumental neutron activation analysis conducted for a large collection of ceramic sherds from the study area. These samples were prepared and irradiated at the Oregon State University Radiation Center Archaeometry Laboratory. Statistical analysis of the samples was used to identify composition groups of interest and then compared to clay samples collected in the study area. The distances between sites and these clay sources were then compared to interpret patterns of ceramic production and exchange.

Chapter 5 provides a summary of the results presented in this study, as well as concluding remarks on the degree and scale of interactions between chiefdoms during the Late Period.

Chapter 2: Late Prehistoric Period Northern Highland Ecuador

2.1. Previous Ethnohistoric Research

After the conquest of Cuzco, the Inca capital city in central Perú, agents of the Spanish crown were sent throughout the empire to conduct an inventory of their new acquisitions, as well as make observations of the practices of the local populations. These inventories covered a large portion of Perú and the interior portions of Ecuador, but not quite reaching Colombia. Many of these notes are general observations about the state of society at the time, documenting such important details as place-names, general counts of population, locations of particular settlements, and social organization. This information has provided the foundation for archaeological investigations of the region, including interpretations of social and political organization.

Among the most useful Spanish-era records for the understanding of Late Period culture include *La Crónica del Perú* (Cieza de León 1553); *Relaciones Geográficas de Indias* (Borja 1562; Anónimo 1573, 1582; Paz Ponce de León 1582); *Compendio historial del estado de los indios del Perú* (Lope de Atienza 1575?); *Visita de la encomienda de Francisco Ruiz* (Mosquera y San Martín 1559); and *Audiencia de Quito* (Archivo General de Indias, Sevilla 1578-1612). These records, among others, were the primary sources used by multiple chroniclers of the late Prehistoric period, most notably Salomon (1986), Larraín-Barros (1980), Caillavet (1981, 1985) and Oberem and Moreno (1981).

2.1.1. Social Stratification and Hierarchy

Ethnohistoric sources are clear about the presence of chiefs in the highland area before the arrival of the Inca. Paz Ponce de León described house sizes as the distinction between the chiefs and the lower, subservient class (cited in Athens 1980). Juan de Salinas Loyola describes the social hierarchy observable in the chiefdoms around Quito that persisted into the colonial period:

> "The government, which in antiquity was controlled by the chiefs, each in his own territory, was feared for his harshness, and could do whatever he wanted without thought otherwise, and if he wanted, he could order the execution of a subject. The chiefs had their *capitanes*, which obey the chief of their *parcialidad*, and the *capitanes* and Indians obeyed their chief" (Paz Ponce de León [1573] in Ponce1991:217-8).

Little is known about the way chiefs acquired power within this political system; however, it is clear that an administrative system with at least two levels of control was in place. According to Anónimo:

> "The natives live in sectors [*parcialidades*] one separate from another…the chiefs have their captains [*capitanes*], whom the Indians of each sector obeyed; both the Indians and the *capitanes* obeyed their *cacique*" ([1573] (1965):224-7).

According to the *Visita* conducted by San Martín and Mosquera, each *cacique*, or chief, resided with multiple wives and servitors at the largest settlement in each territory ([1559] in Salomon 1986). Each sub-chief, or *capitán*, carried out the will of his *cacique* in his own sector, or *principalidad*, within the larger territory of the *cacicazgo*. The basic unit within the *parcialidad* was the *llakta*, or village, which was, at minimum, a center where a major maize field was cultivated in the name of the political leader and where the lord had his household (Salomon 1986:122-3). *Parcialidades* varied in size from 20-100 households with a total of 70-400 individuals. The rest of the population resided in a dispersed pattern in neighboring maize fields. In each *cacicazgo*, or chiefly territory, the *cacique* and his *capitanes* constituted an elite social class; but the majority of the population was found in the dispersed hamlets that supported the *llakta* (Oberem 1981).

While a single *parcialidad* constituted an autonomous community headed by a *cacique* in northern Ecuador, in southern Ecuador it was more common for several *parcialidades* to be aggregated as a single political unit, with one *parcialidad* designated as the hub of political power (Salomon 1986). This description is somewhat confusing, as many Spanish accounts mention several different terms for political leaders, including

caciques, *principales*, and *capitanes*. To clarify, the term *cacique* is best used as a blanket term for the main chief in charge of a particular *parcialidad*. In the case of a single *llakta* that is not under the jurisdiction of another larger *parcialidad*, it is appropriate to call the political leader of that *llakta* a *cacique*. However, in cases where several *llakta* are under the jurisdiction of another more powerful *llakta*, the leader with control over the largest territory would be termed the *cacique*, and the local political leaders for each smaller *llakta* would be termed his *capitanes* or *principales*. These two terms appear interchangeable and are likely the result of different divisions of the Spanish government recording the same information.

Because *tolas* were used as building platforms for chiefly residences during the late Prehistoric period, they are considered one of the main markers of chiefly status, as well as the location of the chiefly center of power. Adding to the status of these features was their use as venues for community feasts:

> "The residential structures of the *caciques* and *senores* were large like a church, and these places were where they made their presence and where people came together to drink" (Anónimo de Quito [1573]1965:123).

The differences in sizes of *tolas* observed at the larger sites in the region may relate to accounts that *principales* followed a dual residence pattern, with one household in his *parcialidad*, and a second in the *cacique's* settlement:

> "The *capitanes*, who ordinarily had their houses close to those of the chief, and dwelt there or else kept persons there to advise them on whatever happened, on understanding, would send their *cachas*, which means messengers, who then gathered the people to carry out the will of their land" (Anónimo de Quito [1573]1965:224-7).

A dual residence pattern could have been one strategy for maintaining political ties between the leaders of dispersed settlements.

2.1.2. Interactions among Chiefly Communities

The amount of power exercised by chiefs over their community was also controlled by the social rules connected with kinship ties. Marriages between elites of different communities were fairly common, and helped to strengthen the connections between social groups (Atienza [1575]1931:81). Oberem also describes the practice of "child-lending". Gerónimo Puento, the *cacique* of Cayambe, was raised by the *cacique* of Otavalo for several years while he was a child (Oberem 1978:53 *in* Bray 1991). This practice served to strengthen social ties between different *cacicazgos* while still maintaining political divisions. Exogamy and child exchange were recorded as practices "facilitating the movement of people between different villages" (Oberem 1978 in Bray 2008). Sources also indicate institutionalized trade and the importation of exotic goods from lowland and jungle regions (Salomon 1986; Oberem 1978).

Maize was probably the most significant and most voluminous crop produced in Pre-Incaic times in the highland region (Salomon 1986). Part of this is based on the climate and productivity of the region, but the consumption of this crop, in various forms, touches almost every aspect of ritual and everyday life according to the Spanish accounts of the time (Atienza[1575?] 1931). Raw maize was exchanged as a type of currency, but it did not initiate a social tie *sensu* Mauss the way that cooked maize did (Salomon 1986). One expression of this social tie was the act of laborers being paid in cooked maize by their sponsor (Anónimo [1573] 1965:226). The exchange of *chicha*, or corn beer, signaled the existence of a stronger and more substantial social tie. Under no circumstances could one reject the offer of *chicha* from an ally; this highlights the political sway of this exchange, as well as the setup for the return gift (Mauss 1967). In exchange for *chicha*, commoners were expected to offer their labor as well as a tribute of raw maize to the *cacique*. In addition to cooked maize, *chicha*, herbs, tubers, beans, red pepper, and salt were commonly consumed (Anónimo [1573]1965:226).

Chicha has a complex significance in Pre-Incaic life because it was used for a number of different purposes, including drinking parties, curing, rites of passage, and as a daily beverage (Anónimo [1573]1965). Brewing of *chicha* was not restricted to the

chief's compound and was produced on a frequent basis by individual households. "The chief's claim to mobilize all village members to produce his maize, and to offer all of them processed maize in return, was a signal of rank only in the sense that his social network was (locally) all-encompassing" (Salomon 1986:81). It appears as though the production and consumption of *chicha* was always a local affair, in that the members of the outlying community would congregate at the chief's compound on various occasions to consume *chicha* produced by his secondary wives (Tovar Pinzon 1970).

The raw maize used in the production of the higher status *chicha* originated in the fields of the commoners and utilized by the chief's specialized workers. As Salomon points out, the political power gleaned by the chief through this production process rests in the immediate community. The community members also retain most of the control over the chief's access to raw maize; their only obligation to contribute was the threat of bodily or political harm by not paying tribute (Anónimo [1573]1965:227). However, the exchange of *chicha* created a system of "institutionalized generosity" that took advantage of the link between the native lord and his access to abundant resources (Murra 1964:433-4). Family members would have felt moral, ethical, and social obligation to participate in this exchange system, or face some type of social consequence. Murra mentions that this same pattern of providing raw materials, food, and drink to community members in exchange for labor was observed during the subsequent Inca period (Bray 2008).

Tolas served as the link between the social obligations of the feast and the political aspirations of a local leader. There are also significant from the standpoint of settlement patterns, as they indicate the concentration of wealth, labor, and ceremonial activity. The development of larger structures over time is indicative of an increase in population density. Burned cane stalks preserved in a trough features at the site of Socapamba support ethnohistoric descriptions of house features observed by the Spanish. One such description by Juan de Salinas Loyola described the commoners' role in the construction of house structures for the elite, as well as their function as feasting locations:

> "The houses constructed by the men and chiefs are large like a church, and this is where [the chiefs] made their presence and came to drink together…For the other important houses, and those of the chiefs and captains, the Indians brought the necessary wood, and if they were the main joists, each captain divided them up [to complete the work]" (Paz Ponce de León [1573]1991:216).

This evidence supports Athens' description of *tolas* functioning as house mounds for the elite (1980), which is the perspective also taken by Bray (1991), Cordero Ramos (1998), and Salomon (1978).

2.1.3. Exchange

The Spanish described a number of items of wealth that were traded into the highlands from highland groups further north and from the tropical lowlands. They included tobacco, coca, necklaces made of insect wing covers, silver bracelets, seed-like gold beads, mantles, *Spondylous* shell beads, and hatchets (Salomon 1986:90-92). Yumbo peoples from the western montaña provided a steady supply of parrots, monkeys, medicinal plants, and children to the highlands (Oberem 1974). The uncommon pondo or amphora vessel type found at mound sites throughout the region (as described by Athens 1980) may have also been a prestige good, based on the more complex surface treatment of these vessels in comparison to most pottery from the area, and because of their probable use in ritual *chicha* consumption. Panzaleo pottery, from the south, is another likely prestige good, indicated by its limited representation at individual sites, but widespread distribution at sites across the region (Bray 1995).

Prestige goods from the lowlands made their way into the hands of elites through a special group of traders known as *mindalaes* (Salomon 1986). These individuals had a unique and privileged status within society and were often sponsored by individual chiefs to conduct trade excursions (Salomon 1986; Bray 1991). During Inca times, these individuals had their own private district in Quito and were given different tribute rules by the Spanish. The activities of the *mindalaes* give the impression that they were attached specialists (Costin 1991), but sources indicate that only some of their excursions

were financed by elites. Their political independence enabled them to own special facilities where they stored goods that were not required to be given up as tribute, and were then able to exchange them independently in the markets of Quito (Salomon 1986). This arrangement enabled certain individuals to acquire large stockpiles of goods that they could distribute in exchange for political and social favors. *Mindalaes* did not wield the same amount of power as local chiefs, but their access to prestige goods, and their ability to exchange them, certainly undermined the redistributive authority of elites.

Salt, cotton, and *ají*, a type of hot pepper, were also important trade goods linking the highlands and the lowlands in northern Ecuador. Ethnohistoric records describe the ubiquity of these products in the households of both the elite and the general community. As Anónimo (1573) describes, "a pint of toasted or boiled maize and three or four red peppers with a fistful of salt" was the minimally acceptable ration for a person traveling (Salomon 1986:73). Bray suggests that because these goods were available to everyone, it is unlikely that the elite controlled their importation (1991). Salmon supports this interpretation, pointing out that elites would not be able to create a political monopoly if these goods were distributed evenly and with disregard for social position or allegiance to the chief. Additionally, the ability of a kinship or household unit to provide these products to its members would have signified their economic self-sufficiency (Salomon 1986).

2.2. Previous Archaeological Research

Jijón y Caamaño (1914, 1920, 1952) was the first to describe archaeological horizons in the *País Caranqui*. Focusing on burial types and pottery styles, he designated three main periods based on relative dates: Periodo de las Tolas Habitaciones (habitation mounds, AD 1250-1525); Periodo de las Tolas con Pozos (mounds with pit burials; positive painting on ceramics; AD 1000-1250), and Periodo de los Pozos Sepulcrales (pit burials, negative painting on ceramics; 600-100 BC). He was also the first to suggest that large quadrilateral *tolas* used for habitation were constructed during the late Prehistoric

period. Finally, he identified the differences between Caranqui pottery, found in the Imbabura and Pichincha provinces of Ecuador, and Carchi pottery, found further north in modern-day Carchi province, bordering Colombia, indicating that they represented separate cultural traditions despite their close geographic proximity.

J. Stephen Athens and Alan Osborn were the first to produce a stratigraphically controlled ceramic sequence for the region following their excavations at the sites of Socapamba, La Chimba, and Im-11 (1974, 1978). At Socapamba, they encountered both Regional Developmental (500 BC- AD 500) and Integration Period (AD 500-1500) deposits. Among their most significant finds were burials attributed to the Regional Developmental period that demonstrated differential status based on age and sex (1980). Im-11 represented a densely populated settlement, possibly a village, representing the earliest period of occupation associated with ceramic manufacture. Linda Goff (1980) further refined the Regional Developmental ceramic sequence, providing important evidence for the simultaneous occupation of La Chimba and Socapamba. Her work demonstrated an observable contrast between ceramics from the Regional Developmental and Late Periods that supports change in cultural and political organization over time **(Table 2.1)**.

Excavation of the large, multiple-*tola* site of Cochasquí was conducted by Udo Oberem, Albert Meyers and Wolfgang Wurster from 1969-1981. This site contains multiple styles of *tola*, including at least one large ramped quadrilateral *tola* constructed using *cangahua* (indurated volcanic tuff) blocks. Their excavations identified what are now considered the representative ceramic styles for the Late Period, including red-on-white painting and Panzaleo exotic ware. They also identified trough-like features, burials, and house floor surfaces. Carbon-14 dates for mound E, the largest *tola* at the site, dated the feature to AD 1450-1530, securing its age to the Late Period. Excavations of smaller *tolas*, dated to about AD 900, revealed more burials and refuse related to domestic activities, suggesting that the function of *tolas* changed over time. In contrast to Athens, Oberem came to conclusion that *tolas* were important ceremonial centers and not just used for the constructions of chiefly residences (1989).

Period	Estimated dates	Diagnostic element	Other features
Inca	AD 1534-1525	Architecture & ceramics	-
Late	AD 1525-1250	Ramp mounds, red painted amphoras	Quadrilateral and hemispherical mounds, Tuza ware
6	AD 1250-1000	Shoe-shaped vessels, rust slip, painted Panzaleo ware	Burial and house mounds
5	AD 1000-700	Interior red slip and burnishing	Burial and house mounds, Panzaleo
4	AD 700-200	Initiation of mound building	First use of red paint
3	AD 200-BC 200	Exterior diagonal incision	Carinated bowls
2	BC 200-600	Exterior indented design	-
1	BC 600-1000	"flat bottom" ollas	-

Table 2.1: Simplified chronology for Imbabura and Pichincha provinces, adapted from Athens (1980).

Athens was the first to conduct a systematic survey of *tola* sites in the highlands in the 1970s (Athens 1980; 1992). Sites were identified using aerial photographs and an effort was made to visit each site. A second regional survey was conducted in 1983 by Pierre Gondard and Freddy López of the Ministerio de Agricultura y Ganadería, Programa Nacional de Regionalización (MAG/PRONAREG, Ecuador) and the Office de la Recherche Scientifique et Technique outre Mer (ORSTROM, Francia) for el Banco Central de Ecuador. They identified additional archaeological sites using aerial photography, including small burial mounds (*bohíos*), *tolas* (mounds), *pucarás* (fortified stone structures), and *camellones* (raised agricultural fields). This information was compiled in a large-scale map of the region (Gondard y López 1983).

An additional survey was conducted by Athens (2003) to confirm the sites first identified by Gondard y López and to record the dimensions of each site, as well as calculate the sizes of the largest *tolas* at each site **(Fig. 2.1)**. A number of previously unidentified sites were documented, and more precise quantification of site size and number of tolas provides a valuable resource for looking at relationships between sites. In addition, several sites identified by the Gondard y López survey were shown to not be archaeological in nature. Athens was greatly concerned by the pace at which *tolas* were

being destroyed to accommodate urban sprawl and for the manufacture of bricks; some *tolas* mentioned in the report have since been destroyed.

Athens' dissertation (1980) provided a regional analysis of social complexity in the Late Period based on energy subsidies and network analysis. He suggested that given a system in which agricultural production is equitable, or relatively unaffected by seasonality or other environmental constraints, one would expect to find a dispersed settlement pattern with populations of similarly limited size, a lack of specialist producers, and multiple power centers distributed throughout the territory. Myers (1974) was one of the first to describe evidence of irrigation agriculture in the region, specifically at the site of Cayambe. Similar features are described for other *tola* sites in the region, suggesting that they were a common component of *tola* sites (Pierre 1983). These hypotheses have found support through archaeological evidence, though information on actual agricultural practices has been limited primarily to identification of raised fields.

Maria Auxiliadora Cordero Ramos (1998) conducted more focused research at the site of Puntiachil, modern-day Cayambe, dated to the Late Period. Ethnohistoric sources suggest that this site may have been the political center for the Cayambi *cacicazgo* (chiefdom). Her investigations focused on whether evidence for feasting existed at different *tola* sites; the presence or absence of Panzaleo at Puntiachil and its proportion to local Caranqui ware; and how these two sets of evidence may be correlated. Data concerning the proportion of serving vessels to other types of vessels recovered from multiple *tolas* at the site suggest that feasting was a common activity, and this practice may indicate competition between different factions within the Cayambi chiefdom. The lack of burials at this site is also an indication that the function of the ramped *tola* did not change over time.

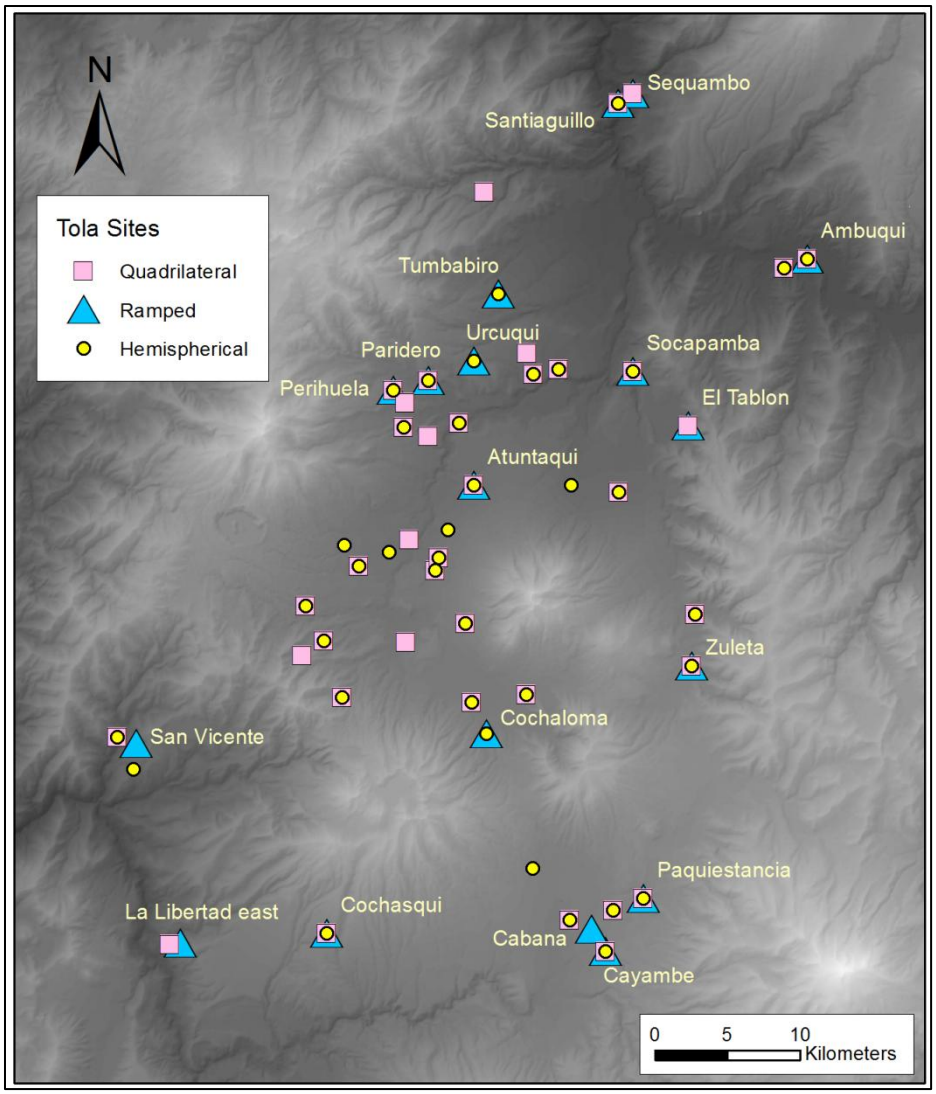

Figure 2.1: Locations of *tola* sites in the highland region of Northern Ecuador.

2.3. Archaeological Record

2.3.1. Tolas

Tolas - the most prominent examples of pre-Inca and pre-Hispanic structures in the region- show many similarities to the man-made earthen mounds found in the Southeast United States (Gondard and López 1983) **(Fig. 2.2).** The earliest style of *tola* is hemispherical in shape, an average of 6 m in diameter and 1-2 m in height. Excavations

show that they functioned as burial mounds (Athens and Osborn 1974). The earliest date for this style of *tola* is AD 680, obtained from a charcoal lens from mound #18 at the site of Socapamba (Athens 1980:133). Other hemispherical mounds are at least 30 m in diameter and greater than 5 m in height and also served as burial mounds. The two styles of hemispherical *tola* were constructed until about AD 1250-1300 based on radiocarbon dates from later quadrilateral mounds at Socapamba, Cochasquí, and Pinsaquí (Athens 1980:125), as well as Atuntaqui (Athens 2003:137) **(Table 2.2)**. This change in *tola* shape and function marks the boundary between the Regional Developmental and Late Period. Some of the largest quadrilateral mounds have long ramp features that would have enabled access to the top surface of the mound (Athens 1980).

Context	***Tola* style**	**Conv. C14 age**	**Calib. C14 date**	**Sample ID**	**Year**
Socapamba, mound #18	hemispherical	1270 BP ± 75	AD 680	DIC 386	1974
Socapamba, mound #21	quadrilateral	600 BP ± 60	AD 1350	DIC 754	1976
Cochasquí, mound "E"	quadrilateral	n/a	AD 1450-1500s	DIC 755	1976
Pinsaquí	quadrilateral	360 BP ± 65	AD 1590	DIC 756	1976
Atuntaqui, mound 30	quadrilateral	519 BP ± 46	AD 1406-1438	Wk-12153	1993
Puntiachil, PP-04, 70-75 cm depth	ramped	430 BP ± 60	AD 1400-1640	Beta-90597	1996
La Libertad, upper ramp feature	ramped	389 BP ± 45	AD 1433-1642	Wk-12154	1993

Table 2.2: Radiocarbon ages for *tola* features in Northern Highland Ecuador.

Athens found that a majority of *tola* features occur in the temperate inter-Andean valleys between the elevations of 2,000 and 3,000 meters, and tend to exist in clusters of at least three, usually representing more than one style of *tola*. Some of the largest examples exist at the site of Cochasquí, located approximately 2 hours north of modern-day Quito (Oberem 1989); the largest ramped *tola* at this site is 144,000 m^3 in volume.

The number of *tolas* at a site can vary significantly. The site of Atuntaqui in Imbabura province contained 33 mounds in 2000, while Hacienda Zuleta has close to 150 mounds, making it the largest concentration known in northern Ecuador. Significantly, sites with ramped *tolas* show similarities in the types of mounds and artifacts present. Athens argues that these larger sites were buffered by equally sized territories (1980).

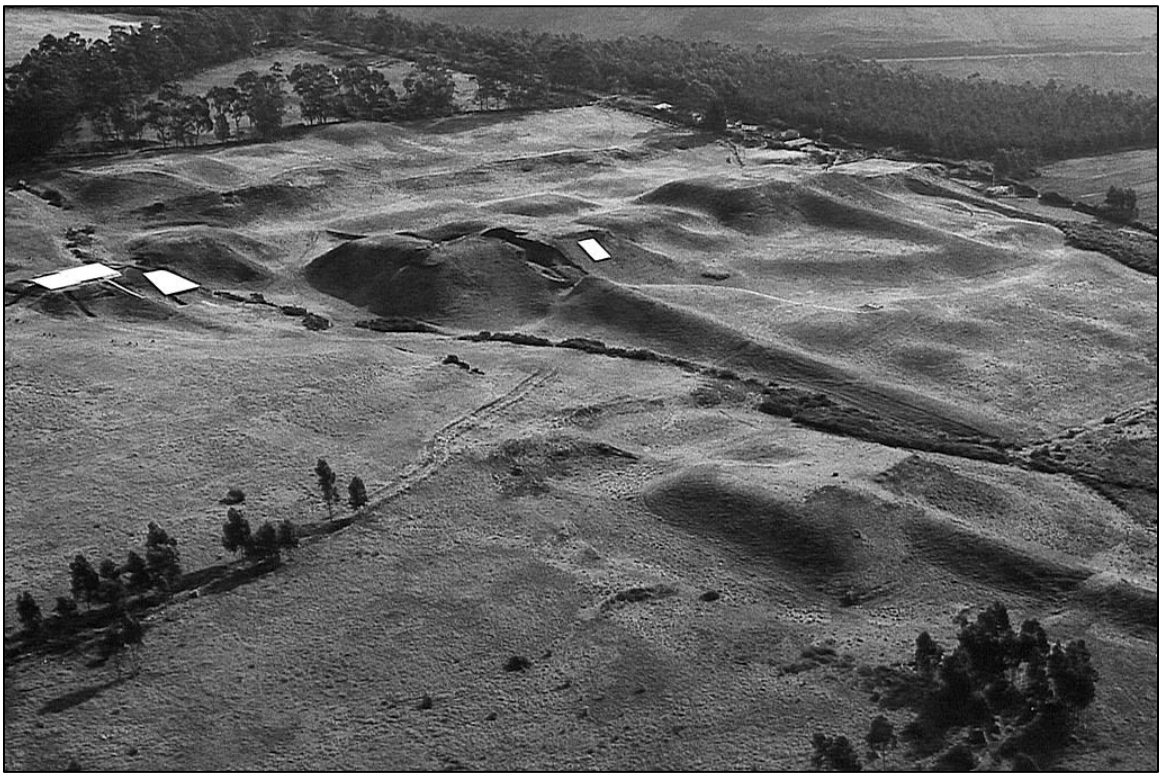

Figure 2.2: Ramped and non-ramped *tolas* at Cochasquí (source: procultur-ecuador.blogspot.com 2011).

Habitation surfaces are discernible from the fill based on higher concentrations of ceramics and other artifacts. Post holes and outlines of house floors uncovered on the surfaces of *tolas* show that round structures sat on top of these features. They also contain canal-like hearth features used for cooking (Athens 2003). With only one known exception at Cochasquí, ramped *tolas* hosted only one house structure, which most likely belonged to an elite member of the community. This assertion is further supported by the residential character of the ceramic assemblages recovered from these sites, as along with *manos* and *metates* used for food processing (Athens 1980).

The distribution of ramped quadrilateral *tolas* indicates that sites with these features were the loci of political authority during the Late Period. If this is the case, they would have hosted the greatest diversity of activities, and, in turn, would have represented the highest levels of population concentration in order to complete those

activities (Athens 1980). The central planning of the ramped *tolas* at sites, their similar techniques of construction and the similarity between the ceramic assemblages at different *tolas* stand as proof that *tolas* of this style were built during the same period. Radiocarbon dates also support this theory (Athens 1976).

2.3.2. Camellones

Ridge-and-furrow fields, or *camellones*, are another significant archaeological feature of the highlands, and are often found in association with the ramped quadrilateral mounds of the Late Period (Athens 1980; Bray 1991). Modern agricultural practices do not utilize these features because the more productive marshy conditions that once characterized the area were converted to pastureland by Spaniards (Bray 1991; Wilson *et al* 2002). The width of the raised portion of the *camellones* is between 2.5 and 3.5 meters, with a length of several meters. Based on analysis of stratigraphy within these features, they were created by digging ditches and then using the excavated material to create the raised agricultural beds (Wilson *et al*. 2002).

Redoximorphic features such as clay and Fe depletions, as well as gleyed soil prove that the *camellones* were used to facilitate the movement of water (Wilson *et al*. 2002:269). They functioned by draining water from swampy regions and redistributing it in order to regulate the surface temperature of the raised beds. Knapp and Ryder (1983) conducted a series of planting experiments in ancient *camellones* near Quito, and found that the system effectively prevented frost formation on important crops such as *maize* and potatoes. This advantage would have enabled double-cropping as well, producing a food base they propose could have supported 700 individuals per km^2 (Knapp and Ryder 1983; Knapp 1991). The site of Puntiachil, east of present-day Quito, has approximately 1200 hectares of visible *camellones*, which likely would have been necessary to support this important population center (Bray 1991).

The scale of these features would have also required a large labor investment for their construction and maintenance. Micromorphological analysis of several *camellones* at the site of Zuleta shows that ash from the eruption of Quilotoa in AD 1280 was cleared

from the features before it became incorporated into the soil (Wilson *et al* 2002: 277). A profile of site 4 at Zuleta shows that the original trough of the *camellón* had filled with material and experienced three phases of clearing (Wilson *et al.* 2002:277). Similar maintenance activities were observed on *camellón* features at Puntiachil (Myers 1974), supporting the interpretation that they played an important role in agricultural production.

2.3.3. Pucarás

Pucarás, or fortified hilltop sites, have been described in both the highland and coastal regions of Ecuador and Peru and are attributed to the Cayambe people who attempted to hold off the Inca advance around AD 1500 (Bray 2008). They were successful for about 9 years, but were eventually defeated by the Inca. Sites of this type are concentrated in the Pambamarca complex in northern Ecuador. They are all similar in size and lack evidence of residential structures, indicating that they were intended as short-duration defensive locations. The uniformity of their construction may reflect standardized construction (Bray 1990). More recent investigations by Samuel Connell and Chad Gifford on *pucarás* (2002-present) have investigated the possibility that that these locations were used by both the local population and the Inca. These structures and their associated bola throwing stones and obsidian weapons are the only archaeological indications of armed conflict in the region (Ogburn *et al* 2009).

2.3.4. The Built Environment and Social Status

Structures and earthworks, such as *tolas*, *camellones,* and *pucarás,* are important subjects of archaeological investigation because they modify the landscape in ways that influence the development of social institutions. Earle describes three attributes of the built landscape that makes these structures significant to the population: scale, exposure, and permanence (2001). By building an architectural feature larger than the typical household or communal structure, a chief makes an overt statement about his social standing and economic wealth. Earle refers to this strategy as the scale aspect of the built environment. Construction not only confers prestige, but it also allows the social,

political, and economic power of the elite to be experienced by a large group of people simultaneously. Individuals' daily experience of working around structures and their general visibility explains the concept of exposure. Finally, structures built from stone, earth, and clay have a physical permanence that suggests that the power of the elite transcends time, with the same structures, the physical representations of the power of the chiefly office, remaining part of the landscape for multiple generations (Earle 2001). The prominence of these structures within the landscape helps legitimize the social hierarchy and encourage its maintenance over time.

While the built environment works to increase the prominence of the elite, it can also enforce cultural norms and expected behaviors (Earle 2001). Ritual and sacred behavior performed on elevated platforms and earthworks physically situate these activities above the mundane tasks of everyday life, bringing attention and prestige to those behaviors. Individuals who are not directly involved with the ritual activities that take place at these sites remain witnesses to feasting and other socially persuasive acts intentionally put on display to encourage involvement by the community.

In summary, archaeological investigation of the northern highlands has revealed several important elements of the political system in place during the Late Period. *Tolas* are evidence of concentrated political and communal power. Ceramic assemblages that include forms used for food preparation, as well as ornamental service forms, indicate that feasting activities took place at *tola* mounds. Not only did *tolas* require the labor input of many individuals, but they served as venues utilized by all members of society, acting to socially unify the immediate area. The implication of local leaders mobilizing labor, coupled with burial data pointing to social stratification, strongly supports the ethnohistoric description of chiefdoms in the area.

Interpretations of the nature of political authority, as practiced by chiefs during the Late Period, are tied to questions about the amount of contact and exchange occurring between these groups. On the one hand, similarity in style of the local Caranqui ceramic ware supports the cultural unity of settlements within the highland region (Bray 1991). However, it is unknown whether local ceramics or other goods were exchanged within

the highlands between chiefdoms and their associated villages. Similarly, circulation of exotic goods from regions outside of the highlands shows that trading relationships existed between distance settlements. At the same time, it is not clear that similar relationships existed within the highlands, and whether they operated at the local or regional scale.

2.4. Interpretations of Regional Organization

As described by Bray (2008), scholars of Ecuadorian prehistory have differed in their interpretations of regional political organization during the Pre-Inca period. Espinosa (1983), Larraín-Barros (1980) and Caillavet (1981) have argued for the preeminence of the Caranqui, Otavalo, Cayambe, or Cochasquí chiefdoms (Bray 2008), suggesting the beginning of a regional hierarchy, perhaps along the line of a paramount chieftaincy. An alternative model describes each of the chiefdoms as semi-autonomous (Bray 2008), with the largest sites reflecting population size rather than higher levels of political authority. A review of the arguments for each side of the debate provides a useful framework for interpreting the results of settlement pattern analysis, presented in the next chapter.

2.4.1. Nested Regional Hierarchy

Some ethnohistoric records refer to four major polities present at the time of Spanish conquest: Cochasquí, Caranqui, Otavalo, and Cayambe (Athens 1980:148). The recognition of these sites as separate political entities is suggestive of a factional system. Caranqui and Otavalo are in fact only a few kilometers apart, while Cochasquí and Cayambe both occur in separate parts of the southern region. Interestingly, Socapamba is absent from this list despite its strategic position at the northernmost edge of the Guayllabamba Basin. Based on the ethnographic information, hostilities existed between these different polities, but the fact that there are few references to actual warfare suggests that the hostilities may have been more political.

Conversely, the Caranqui and Cayambi were the dominant chiefdoms in the region based on several lines of evidence, as outlined by Probanza de Puento (1974). First, Otavalo and Cochisqui (presumably Cochasquí) were ancient subjects of Cayambe during the Inca wars. Second, many other smaller *llaktas* were subjects of Cayambe. Third, Caranqui was not a subject of Cayambe, making it more powerful than other *llaktas*, but weaker than Cayambe, because it had no subjects of its own. Finally, the two chiefdoms were linked by a shared kin network (Puente 1974:28-48). Larraín-Barros also described the Caranqui and the Cayambi as the two prominent *cacicazgos* of the region (1980). The Cayambi *cacique* Nasacoto Puento was responsible for organizing a local resistance force against the Inca invasion in the early 1520s, which has led some to believe that this chiefdom was regionally dominant. The Caranqui pueblo is an example of the Inca of strategy of conquering areas around the most powerful settlement in the area as a way to undermine the local power structure (Bray 2008), suggesting that Caranqui had local political significance.

Bray describes the territory occupied by both the Caranqui and Cayambi chiefdoms as the Caranqui polity, which she describes as a non-state entity. This term is somewhat confusing as it has alternately been called the *País Caranqui* and the Cara region. Nevertheless, archaeological and toponymic evidence supports a model of a territory extending from the Chota-Mira River in the north to the Guayllabamba River in the south (Bray 2008).

Using information from various chroniclers working for the Spanish crown, Larrain-Barros created a map separating the Caranquis from the Cayambis **(Fig. 2.3)**. In his division, the Caranquis inhabited the northern section of the *País Caranqui*, with Atuntaqui, Cotacache, and Laguna San Pablo on the southwestern border. The Cayambis inhabited the southern section of the territory, with the southern boundary near modern-day Pifo, extending a few kilometers west of the Guayllabamba River (Larraín-Barros 1980:99). Cordero Ramos also describes the *cacicazgo* Cayambi as a separate entity from the *cacicazgo* Caranqui, with the modern town of Cayambe (ancient pueblo of Puntiachil) as its capital.

Bray (1991) and Athens (1980) discount the ethnic differences between the inhabitants of these two territories based on archaeological data. This does not preclude the possibility of a politically separate Cayambi chiefdom. In fact, the inherent instability of chiefdoms is often attributed to battles for power within the same kin network. If there was a significant political division between these groups, what were the consequences, and can they be tested using archaeological data?

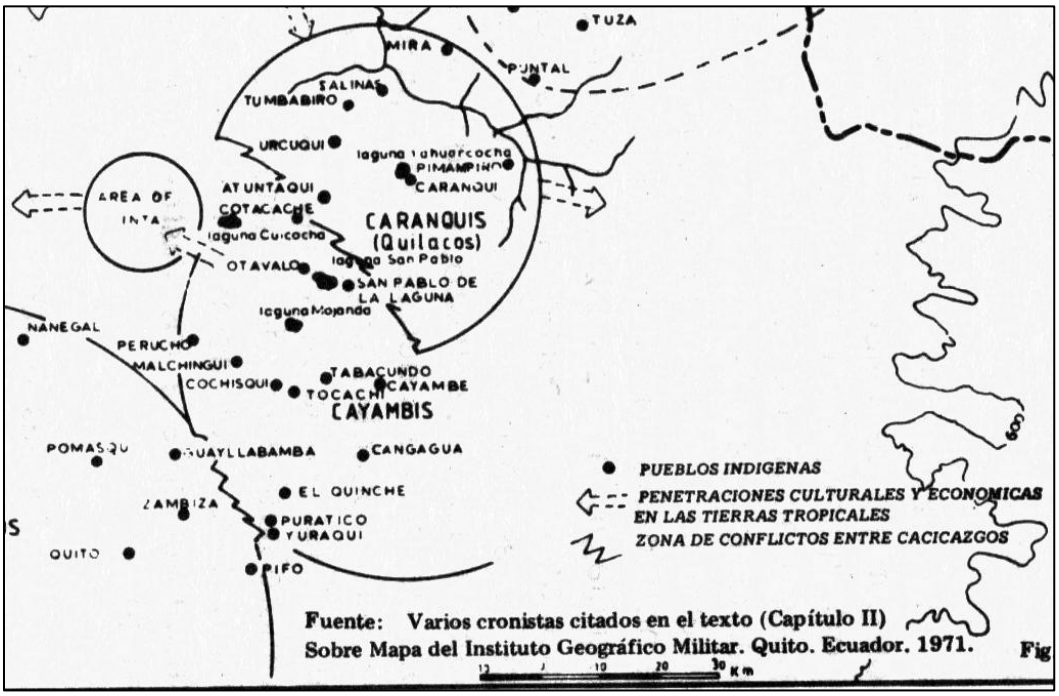

Figure 2.3: Larraín-Barros' map showing the locations of the Caranqui and Cayambi chiefdoms (subset).

Several ethnohistorical accounts mention that the Cayambe people were joined by other local groups to fight the Inca (Salomon 1986). This suggests that the groups involved in the conflict either felt little animosity between each other, or they all recognized that the Inca was a powerful threat to their way of life. More recent excavations on the Pambamarca complex of *pucarás* has shown that while Inca materials are found at a number of these sites, in several cases, Caranqui style ceramics are found at deeper stratigraphic levels (Connell, personal communication 2011). This suggests that

the features were utilized by both the Inca and Cara peoples during different periods, with the possibility that some of the structures were constructed by the local population and then used by the conquering Inca.

2.4.2. Isolated Chiefdoms

Ethnohistoric records of the interactions between the chiefdoms around the Quito area also make references to warfare between settlements. Athens provides a translation of one such description:

> "They brought war upon one another about the land they possessed, and the more powerful Indian displaced the other of all he possessed; and these controversies they always had with their neighbors, of a manner that all was anarchy" (Paz Ponce de León [1582] *in* Athens 1980:198).

Conflict between neighboring groups is indicative of a lack of regional-scale political organization. However, because the degree and scale of conflict is not clear, only limited interpretations about political organization can be made from this information.

2.5. Linking Arguments and Expectations

In spite of the emerging picture of Northern Highland chiefdoms, several basic questions remain unanswered concerning the political and economic organization of these pre-Inca chiefly societies. Specifically, what was the degree and scale of interaction between these groups?

To understand the relationships between settlements within a chiefdom political organization, it is necessary to characterize the scale at which the system operated. The most effective way to make this determination is to evaluate the amount of interaction occurring between settlements in close proximity to each other, and to contrast that with the interactions observed for settlements the greatest distance apart within the same system.

A geographic comparison of relative site sizes and locations is an effective means of determining if all settlements are of a similar size and contain similar numbers, sizes, and types of *tola* features. Obvious differences in the sizes of sites and their components are suggestive of a regional political organization, as opposed to a more localized and isolated political system in the first scenario. Larger, more complex sites may occur in geographically strategic locations or enjoy better access to significant natural, cultural, or labor resources (King 1986).

Information about the movement of ceramic products between neighboring sites also clarifies the degree of hostility between political units, as successful trade depends on relatively stable relationships between groups. A generalized pattern of exchange between ramped *tola* sites would suggest amicable relationships, while a general preference for the local production of ceramic vessels would suggest that interactions were restricted to the local level, and political organization at the regional scale was limited.

Based on the ethnohistoric data, there is little reason to believe that the entire Guayllabamba Basin was controlled by the same regional political system. Factional competition existed between several settlements and descriptions of the Cayambi and Caranqui chiefdoms identify a regional division between the north and the south. The expectation is that there will be any area between clusters of more northern and more southern clusters of sites in which no sites are recorded. This would express a political buffer zone between the two chiefdoms as a reflection of hostile relations.

There is also an expectation for settlement hierarchy within the northern or southern zones. In other words, at least one site in the north and one in the south will stand out as being the largest or having the greatest number of *tolas* (or both). If a subregional hierarchy does not exist, it would suggest that sites were highly isolated politically, and the term "chiefdom" was not meant to refer to a unified political system in the literature.

The expectation is that the chemical data for ceramics from the study area will follow a similar pattern of separation between the more northern and more southern

settlements. One would expect to see a limited number of ceramic composition groups that occur in both the north and the south. If specific sites in either region stand out as larger, one would expect more ceramic composition groups to be represented at these sites because larger territories had greater access to resources and political power (Earle 1987).

Chapter 3 discusses the concepts of settlement pattern analysis and how they were applied to Late Period ramped *tola* sites as a way to determine the distribution of chiefly political power. This chapter also explores the evidence for an against an integrated political system organized at the regional scale, including settlements from Imbabura and Pichincha provinces.

Chapter 3: Settlement Pattern Analysis

3.1. Background

Analysis of regional settlement patterns is useful in the interpretation of social and economic activities. Geographic information related to site locations and distribution is assumed to be reliable and can offer generalized information about the nature of social, economic, and political relationships between settlements (Parsons 1972). The extent of social and political territories has also been evaluated using a combination of settlement data and ceramic assemblages to track exchange patterns through time [Parkinson (2006) in Kowaleski (2008)]. Several models in particular have proven useful in the interpretation of settlement distribution and continue to be adapted to explain more detailed geographic information.

Systems theory is a model for complex societies that describes society as a collection of parts, or institutions, that interact in both independent and dependent ways. The processes of segregation and centralization act to create internal differentiation within the system, while simultaneously developing linkages between the different processes, with the goal of maintaining homeostasis (Flannery 1972). Settlement pattern analysis builds on the idea that a regional social system is similarly composed of parts, in this case settlements of different size, composition, and function. Each of the settlement types plays a particular role in the functioning of the system as a whole, creating flows of political and social power, individuals, and commodities.

3.1.1. Components of Regional Settlement Systems

Regional systems can be described in terms of their vertical, or hierarchical components, as well as their lateral, or spatial components. First-order sites, which occupy the top of the hierarchy, are characterized by their larger size, more concentrated population, and their unique aspects, such as temple complexes or urban layout (Johnson 1977). In addition, urban centers are characterized as hosting a greater range of activities,

including economic, administrative, and ceremonial services that might not otherwise be carried out at the same scale in rural or otherwise dispersed communities (Flannery 1972; Johnson 1977).

Investigation of the lateral components of regional settlement systems, in terms of spatial distribution of settlements in relationship to one another, is useful in evaluating site hierarchy as well as determining clustering behavior. Among archaeological phases with highly developed market economies, first-order towns acted as centers for the distribution of goods. According to central place theory, by being centrally located, these sites were able to provide goods to the maximum number of surrounding settlements while maintaining an equivalent travel distance between sites (King 1986). The locations of lower order sites are influenced by resource distribution, while regional centers are influenced by their access to these outlying communities where the bulk of agricultural production needed to sustain larger settlements takes place (Flannery 1972; Smith 1976).

Direct application of central place theory is not particularly useful in regions with less organized market systems because it assumes that the locations of first-order sites are governed by "competitive features of the market economy" (Smith 1976:10). Non-market systems like chiefdoms have more strongly defined territories, which prevent community members from choosing which distributional locations are closest to them and prevents the development of competition within the same territory (Steponaitis 1978).

Point pattern analysis has been the most widely-used technique for quantifying these relationships. By computing the average distance between sites and comparing those values to the expected distance between randomly generated sites, it is possible to identify the degree of clustering exhibited by the sites of interest (Hodder and Orton 1976).

3.1.2. Methods for Identifying Hierarchy and Interaction

The concept of interrelatedness between settlements of different rank developed expressed through central place theory is significant for regional scale analysis of settlement patterns. One empirical approach to identifying the true nature of settlement

scale is the rank-size rule. It is far more common to observe a rank-order distribution in which each center is slightly smaller than the last, as opposed to a system in which site sizes fall within a narrow range for each category (Smith 1976). Regional settlement systems typically have a distribution of population sizes, and in an ideal system, a settlement of rank r has a population equal to 1/r of the largest settlement in the system. For example, a rank 2 settlement will have 1/2 the population of a rank 1 settlement in the same system. A logarithmic transformation of such a dataset shows a linear relationship between site rank and population size (Blanton 1976; Johnson 1977). A more common distribution is the "primate" distribution, in which the relative differences between large and small settlements are amplified, and a few settlements will stand out as larger than the general trend would suggest (Johnson 1977; Drennan and Peterson 2004). Graphically, this distribution is represented by a large peak for the highest ranked site, followed by a steep drop-off that includes the rest of the sites in the region. An alternative scenario presents a convex distribution, in which sites of similarly large size all fall into the same rank and there is a gradual drop-off in site size as site rank decreases (Drennan and Peterson 2004).

The primary assumption of this model is site population is correlated with site size. Because site population estimates are notoriously difficult to determine, variability in other archaeologically measurable components such as public architecture have been employed to differentiate site function, and therefore rank (Parsons 1972:142). Hodder argues that site size can simply be substituted for site population in the rank-size rule because of the high correlation between these variables (1979:118). The inherent difficultly of determining site population has made site size a more pragmatic measure for site rank.

In addition to accurately representing regional site rank, a theoretical basis is needed to interpret the results of this model, as inputting any dataset will produce a curve. The primate pattern suggests a hierarchy in which most of the political and economic power is concentrated at a few select sites, with the most extreme case being a highly stratified state society. Alternatively, a convex curve indicates several large settlements

with populations of similar size, where political power is interpreted to be more dispersed and diluted as more than one settlement occupies the highest rank (Berry 1961; Hodder 1979).

Gravity models provide a more generalized characterization of the relationships between settlements of different size rank within the same regional hierarchy. Interaction tends to decrease with distance and increase with population growth. Larger sites, with presumably larger populations, therefore exert more "gravitational pull" on smaller settlements, drawing more individuals to them for any number of activities (Johnson 1977). Site size and the abundance of *tolas* present at a site are the main measures of site rank in this study. Little information is available on the density of the population during the Late Period, so site size was used as a proxy measure for this variable.

3.1.3. Chiefdom Settlement Patterns

Graphical representations of settlement size distribution are useful in the interpretation of political and economic structure in a variety of archaeological contexts. Steponaitis (1981) identified three dimensions of political complexity that are particularly relevant to archaeologists studying chiefdoms. They include: (a) the number of levels in the political hierarchy; (b) the degree of decision-making ability at the uppermost level; and (c) the relative amount of surplus food mobilized to support the political establishment. In contrast to more politically and economically diverse states, chiefdoms exert the greatest political control over the settlements adjacent to the political center. Support for elites at these political centers, in the form of agricultural products, labor, and other services, is provided by these local communities (Peebles and Kus 1977; Steponaitis 1981; Earle 1987). A chief is able to secure these goods based on his political power, meaning that the relationship between settlement productivity and chiefly access to goods translates to larger site size and public architecture with greater political power (Steponaitis 1981). Understanding the link between the size of a site and the degree of political centralization is vital to an interpretation of regional settlement patterns.

Along with site size, the number of levels in the regional hierarchy is indicative of the size of a chiefdom and its spatial distribution (Earle 1987). One common explanation for the development of regional hierarchies is the need to organize larger amounts of information related to the managerial responsibilities of elites (Flannery 1972; Earle 1987). At the scale of the chiefdom, a smaller population and less complex market arrangements reduce the demand for a large group of managers. As a result, one would expect fewer levels in the hierarchy compared to a state-level society. Wright and Johnson (1975) and Flannery (1998) were more explicit in this regard, stating that above the local level, a two-tier hierarchy is suggestive of a chiefdom, while a three-tier or more is indicative of a state. This distinction is a helpful framework for interpreting patterns in regional settlement systems.

Several case studies for regional settlement patterns for chiefdoms can help to illustrate the utility of central place theory, point pattern analysis, and other techniques. During the early 'Ubaid period (ca. 5500-3800 BC) in south and central Mesopotamia, a two-level settlement hierarchy emerged, with a majority of sites smaller than 4 hectares in size. Settlements that would later become politically significant centers, specifically Eridu, Ur, and Uquair, were twice as large, composing a distinctly different rank. Stein (1994) has argued that the emergent two-level hierarchy represented an early chiefdom.

Mississippian polities in the American southeast (AD 1000-1500) demonstrate a much stronger hierarchy based on site size and the volume of fill used to construct burial and ritual mounds. The largest chiefdoms, namely Cahokia and Moundville, display a primate pattern, with a multi-mound center surrounded by a series of sites with one or a few mound features. Topological features such as floodplain regions appear to have had a strong influence on the extent of the territories controlled by these chiefdoms (Cobb 2003). Both of the preceding cases illustrate the utility of the rank-size rule for measuring levels of hierarchy based on site size relative to other sites within the same area. While the Cahokia sites stand out, a direct comparison of the preceding examples would disguise the hierarchy present during the early 'Ubaid period. For this reason, the rank-

size rule has utility for measuring hierarchy during the Late Period in northern Ecuador as well.

3.2. Driving Questions

After reviewing the literature related to archaeological and ethnohistoric investigations of northern highland Ecuador, several significant questions remain unanswered. The most general question concerns the political and economic organization of the pre-Inca chiefly societies; specifically, what was the degree and scale of interaction between these groups? Were settlements actively interacting with each other to exchange ceramics and hold communal feasts? Or were settlements isolated from one another, acting independently to produce ceramic goods for local consumption and feasting only with local neighbors? To help answer these questions, it is necessary to evaluate the spatial distribution of *tola* sites within the highland area and determine whether a hierarchical relationship exists at the regional level. What types of patterns emerge, and what might these patterns reveal about the relationships between individual *tola* sites?

Gondard y López (1983), Athens (1980; 2003), and Bray (1991; 1992) have discussed the distribution of *tola* and other archaeological sites in the highlands at the regional scale. The current study builds on data collected in previous investigations, comparing the size and distribution of sites as a finer scale. Previous research has not discussed the presence of a hierarchical relationship between *tola* sites, making it the focus of attention in this study.

3.3. Expectations

The gravity model implies that sites that host the greatest diversity of activities attract the most individuals, creating a positive correlation between population size and site complexity. Chiefs that exert power over sites with a large population also receive a boost in political power, as they preside over a larger group of people, and from a

functionalist perspective, access to a greater labor pool. When larger sites have political and economic control over smaller sites, the system is described as a nested regional hierarchy. When there is no obvious subordinate/dominate political or economic relationship between sites, the system lacks a nested hierarchy (Smith 1976). In a typical nested hierarchy, smaller sites are found in clusters, and those clusters are centered on a single, larger settlement (Smith 1976).

Whereas a state political organization appears as a single, nested hierarchy that links settlements of all sizes in a region, chiefdoms are constantly renegotiating political boundaries, resulting in a loose conglomeration of settlements with various levels of control and access to smaller neighboring settlements (Earle 1987). Evaluation of the political and economic links between these settlements will be conducted using spatial analyses of site distribution and the delineation of hypothetical territories around these sites. A pattern in which larger territory sizes correlate with larger site sizes suggests that larger *tola* sites had more political power, and therefore greater access to land, resources, and labor. A pattern that shows no correlation between site size and territory size would suggest that political power was not expressed through site area, but perhaps through the abundance of *tolas* present at a site.

The most useful measures for a nested regional site hierarchy are the relative sizes of individual sites, and functions that describe whether or not sites cluster geographically in a statistically significant way. On a regional scale, a lack of clustering between ramped *tola* sites would suggest the absence of a regional hierarchical system; rather, a widely-spaced distribution of ramped *tolas* would indicate limited political and economic contact between neighboring settlements. At the more local level, a tightly clustered pattern centered on ramped *tola* sites would suggest that a hierarchical relationship exists among these sites. In contrast, if sites without ramped *tolas* occur in a random pattern, it would suggest that each site was managed independent of any political influence wielded by elites at ramped *tola* sites. If hypothetical boundaries between ramped *tola* sites coincide with the ethnohistorically described boundaries between the chiefdoms of the area, it

suggests that localized site hierarchies developed in response to animosity between neighboring chiefdoms

3.4. Data Acquisition

Several different forms of data were utilized to address the questions of settlement patterning. First, information such as location, site name, and site size was digitized. This was accomplished by "georeferencing" scanned paper maps produced by Gondard y López (1983) and manually adding a point for each *tola* site. Information regarding site size, dimensions of individual tolas, and the names of sites from Athens (2003) was entered into Microsoft Excel and then imported into ArcMap 10.0. Site names and IDs were used to join the information into one table. To make analysis more efficient, a new shapefile was created for each type of *tola*; ramped *tolas* were grouped together, then all of the sites with only quadrilateral *tolas* with no ramps, then *bohios*, or hemispherical burial mounds were grouped together. Ramped *tolas* are the only type of mound specific to the Late Period, while the other two types have a less certain chronology.

A 30 meter resolution Digital Elevation Model (DEM) was used to evaluate the relationship between site locations and topography. This data was available as multiple files from <http://www.rsgis.ait.ac.th/~souris/ecuador.htm>. Multiple DEM tiles were combined to create a single DEM representing the study area. This information was then manipulated using tools available within ArcMap to generate slope and aspect of individual pixels within the raster file. Finally, the site data was combined with the DEM to create a digital representation of the study area and its associated archaeological features. The datum used for this study is the PSAD56 (Provisional South American Datum 1956), and all units were converted to UTM Zone 17N.

3.5. Methods

3.5.1. Histograms

The first step to evaluating hierarchical relationships between sites in the region was to produce histograms of site size to identify the number of levels in the regional site hierarchy. This technique uses multimodality in site size to create differentiable classes, or "levels" in the hierarchy. A "primate" distribution with most sites occupying the lower ranks will suggest that a strong regional hierarchy is present; alternatively, a convex distribution with a relatively equal distribution of sites between the different ranks will suggest a weak regional hierarchy (Hodder 1979).The total number of *tolas* present is then compared to the areal extent of each site in a bivariate plot to determine whether a relationship between site size and amount of features exists.

3.5.2. Point Pattern Analysis

The degree of clustering between sites was evaluated using the nearest neighbor statistic and Ripley's K function. Nearest neighbor distance refers to the distance from each point to the next closest point, in this case, the distance between each set of *tola* sites. The mean is taken of these distances and compared to the mean distance of a set of random points within the same area. A ratio “R” of observed mean distance to the "random" mean distance expresses the randomness of the distribution, with $R = 1$ representing a completely random distribution, $R > 1$ representing a dispersed distribution of points, and $R < 1$ representing a clustered distribution. A *p* value is also generated, which describes the statistical significance of the R-value, specifically the probability of the observed pattern being a result of random chance; values below 0.10 indicate a significant result (Hodder and Orton 1976).

Ripley's K Function is a statistical test that determines the degree of clustering at multiple distance intervals, or in other words, how features are distributed within a predetermined area (Boots and Getis 1988:56-7). The function works by calculating the average number of neighboring features at set distance intervals. As the distance from a

site increase, the number of neighbors will also increase. If the average number of neighbors at one of these distance intervals is greater than the average number of neighbors, the test indicates a clustered pattern at that distance. In ArcGIS, this analysis is called multi-distance spatial cluster analysis, and the results of the analysis are presented as a bivariate plot with distance intervals on the x-axis and average distances between sites on the y-axis. The program compares the K values for a random pattern and those for the values in the dataset to determine at what distances clustering or dispersion occur (ArcGIS Resource Center: Ripley's K Function).

ArcGIS displays a line with slope of one and a y-intercept of zero as the expectation for a completely random clustering pattern. If the data produces a line that falls above the random line, the data shows a pattern towards clustering. The further the observed line is from the random line, the more pronounced the clustering. If the data produces a line that falls below the random line, then the data shows a tendency towards a more evenly distributed pattern. Points at which the two lines cross indicate distances as which a transition between clustering and dispersion occurs. The Ripley's K tool within ArcGIS 10.0 also allows the user to input how many times the function would have calculated. In this case, the calculation was repeated the maximum 99 times to prevent misidentification of clustering.

3.5.3. Isotropic Distance

A more visual method for investigating clustering behavior is with the centripetal buffer zone. Buffers are "expressions of a function in which the magnitude at any point of the map is the measured proximity to a particular geographic entity or entities" (Wheatley and Gillings 2002:148). In other words, they are a visual representation of all the area within a specified distance from a site in all directions. They appear as circles in their most basic form because the distance from the source is equal in all directions (isotropic).

Thiessen polygons (Voronoi diagrams, Voronoi tessellation) is another method of spatial allocation that divides up the specified study area into territories, such that each

territory contains only one feature (Hodder and Orton 1976); in this case, ramped *tola* sites were the features used. To delineate the territorial boundaries, first a line is drawn to connect a set of two sites. The weighted distance, or half-way point, is then calculated for the two sites. Finally, a perpendicular line is drawn at that point, creating the boundary between the neighboring sites (Wheatley and Gillings 2002:150). This test operates under the assumption that all land surfaces are controlled by an entity, and that there is no overlap between territories. It also assumes straight-line, flat-land travel, which is clearly unrealistic for this region.

Spencer argues that the size of a chiefdom is limited by the distance an individual can walk in half a day. Therefore, the distance traveled within 4-6 hours defines the radius of the chief's domain (Spencer 1982:6-7). Hostility between neighboring groups in a regional chiefdom system will produce the same sort of pattern seen with Thiessen polygons, and the boundaries of each polygon should approximate a half-day's walk from each site. If the territories created using the Thiessen polygon tool do not mimic the boundaries present between *tola* sites, it suggests that ramped *tolas* were not evenly distributed throughout the region.

3.5.4. Anisotropic Distance

Calculation of anisotropic distances is particularly useful in archaeological settlement pattern analysis because it can take slope, aspect, land type, and other factors into account. Tobler’s Hiking Function is one such anisotropic distance calculation. The slope angles of the terrain are used to either increase or decrease the “cost” of walking through pixel, with a slope of 0 having the lowest cost, and any angle greater than 80 degrees having the greatest cost (Tobler 1993). In this study, 4km/hr was used as the flat-land velocity, based on comparisons between predicted and actual walking velocity for local individuals traveling in the south-central Andes (Aldenderfer 1998:12-5) The slope represented by each pixel was derived from the DEM using a tool available in the software package. These values were then converted into isochronic lines representing the maximum distance traveled from a site every two hours, up to 10 hours. These values

were generated using a vertical factor table and tutorial provided by Dr. Nico Tripcevich at <http://mapaspects.org>. An abridged version of this tutorial can be found in Appendix E.

An estimate of the areal extent of territory sizes was produced using a combination of the boundaries produced through the Thiessen polygon tool and Tobler's Hiking Function. Contours representing the distance traveled after 8 hours proved to be the best representation of the effect of rapid elevation change on travel distance. Most individuals would also be unlikely to travel further for more than 16 hours in a day, especially if terrain greatly reduced walking speed. For each of the five sites used to calculate Tobler's Hiking Function, the contour line at the 8-hour distance was converted into a closed polygon. These polygons were then merged together to form a single polygon that represented the most reasonably traversable portions of the Guayllabamba Basin based on slope. Areas like the flanks of volcanoes have a large slope angle, were unlikely choices for travel and excluded by following the 8-hour contour. This polygon was then clipped using the Thiessen polygon boundaries generated for the ramped *tola* sites. The area was then calculated for each new polygon, representing the area of each hypothetical territory.

The final application of anisotropic distance and travel cost mapping was the generation of least-cost paths between five sites. One of the main applications of this analysis is the identification of probable travel routes (Conolly and Lake 2006:255). Long-term exchange interactions between settlements rely on the knowledge and use of trail networks with predictable travel times. Assuming that individuals preferred shorter trails with few changes in slope, least-cost path analysis can predict the locations of these ideal trails when no information is available on locations of actual trails (Conolly and Lake 2006).

The calculation of least-cost paths uses the results of a cost surface algorithm, typically based on elevation derived from a DEM, and a "backlink" raster, representing slope and aspect, to determine a path between two points that represents the least effort. As with Tobler’s Hiking Function, the cost of traveling through each cell in the DEM

raster is a function of slope. The result is analogous to the path taken by a drop of water traveling through a landscape until it reaches the lowest point, represented by the destination (Wheatly and Gillings 2002).

In this study, a subset of *tola* sites was used as the sources and destinations for the individual paths. These sites were chosen based on their geographic locations and the results of the histograms for site size and *tola* abundance. Puntiachil/Cayambe was included based on its significance as the capital of the Cayambi chiefdom (Cordero Ramos 1998). Combined with the isochrones produced using Tobler's Hiking Function, it is clear that travel within the highlands was significantly restricted. Sites at strategic locations along the least-cost paths would have had the opportunity to regulate the movement of people and goods between settlements, thus increasing the economic and political power of chiefs controlling those locations.

3.5.5. Methodological Issues

The tools included with the Spatial Analysis extension of ArcMap 10.0 are designed for a rectangular study area with minor topographic features. These assumptions are violated in most cases, especially regions like the Andes, where rapid changes in elevation strongly influence on-the-ground distances between locations. That being said, the data generated using geographic information systems is extremely useful for gaining a general understanding of geographic relationships.

Another significant issue surrounding the use of GIS data is that much of the data is obtained via download from the internet. The data must be screened for accuracy regardless of its source to prevent the introduction of error. It is often difficult to obtain information related to the conditions under which the data was transferred and stored. The DEM used in this analysis was cross-validated with topographic maps of the study area and another DEM provided by United State Geologic Survey (USGS). Based on the large scale of the analysis, minor inconsistencies in elevation were left as-is.

3.6. Results

3.6.1. Nested Regional Settlement Hierarchy

The first step in evaluating whether there is a hierarchical relationship between sites in the study area is to compare the spatial extent of individual sites. A total of 66 sites were included in this analysis using information documented in Athens (2003). Producing a histogram of site size revealed that one site, Atuntaqui, is by far the largest site identified in the area at 850 hectares **(Fig. 3.1)**. The next largest site is Zuleta, which is less than half the size of Atuntaqui at 340 hectares. The majority of sites (85%) fall within the 1 to 200 hectare range, demonstrating that Atuntaqui and Zuleta constitute at least one, if not two separate levels within the regional hierarchy above the local level.

The abundance of *tolas* at each site was also investigated as a measure of site importance. Most sites have fewer than 20 *tolas*, while several sites stand out as having 45 or more **(Fig. 3.2)**. That is, both overall site size and mound construction provide evidence of at least a two-level regional hierarchy.

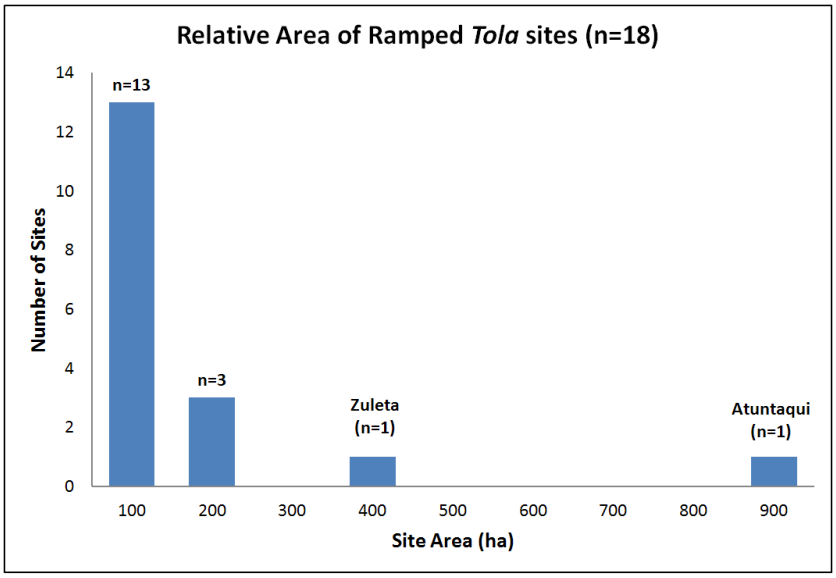

Figure 3.1: Histogram of site area (n=18) showing at least a two-tiered hierarchy for ramped *tola* sites.

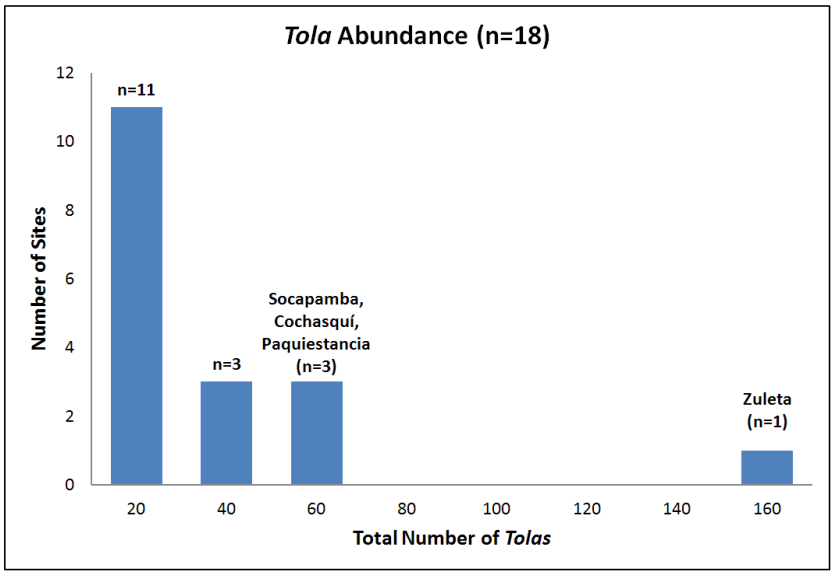

Figure 3.2: Histogram of *tola* abundance (n=18) also showing a two or three-tiered hierarchy for ramped *tola* sites.

3.6.2. Point Pattern Analysis

The overall distribution of sites in the dataset shows several patterns, based on an interpretation of **Fig. 3.3**. Most sites are found in valley bottoms where the terrain is relatively flat and the elevation is below 2900 meters. The few sites that do sit at higher elevations tend to be smaller in spatial extent. Ramped *tolas* appear to be distributed evenly throughout the study area, while quadrilateral and hemispherical *tola* sites are more concentrated in the northwest section. The highest overall concentration of sites occurs in this same section, north of the Imbabura volcanic edifice and northeast of Cotacachi. Most sites are located in close proximity to rivers, though there are notable exceptions. Based on the map of site locations alone, it is not clear whether there is a consistent clustered or dispersed distribution of sites in the study region. In this scenario, statistical measures of point distribution are the most effective for identifying the underlying pattern in the data.

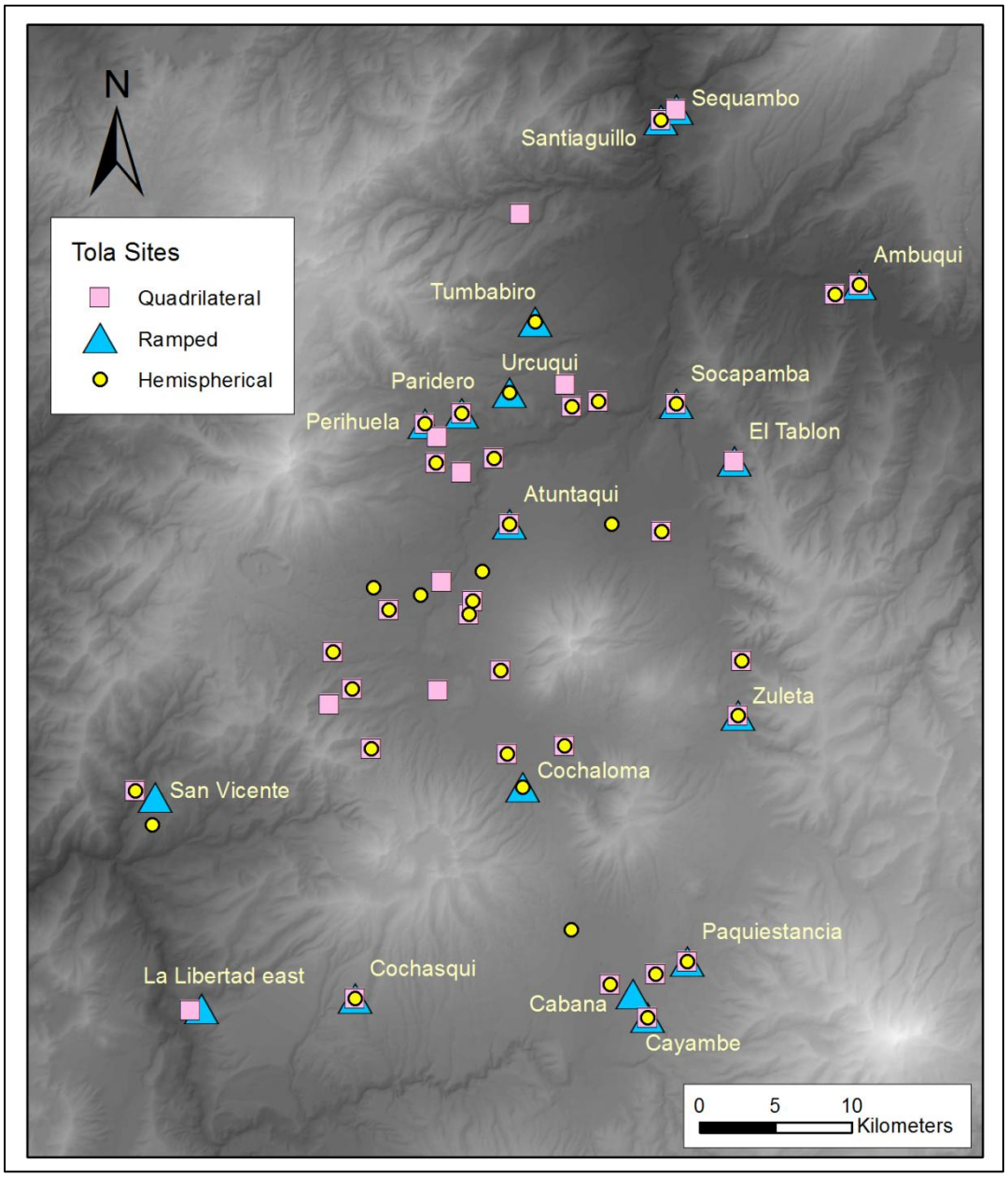

Fig. 3.3: Elevation map showing ramped, quadrilateral, and hemispherical *tola* sites recorded by Gondard y López (1983) and confirmed by Athens (2003).

Calculation of the nearest neighbor statistic for ramped *tola* sites using straight line Euclidean distance produced a mean distance of 6609.6 meters, with a *p* value of 0.084 and an R value of 1.2 **(Table 3.2)**.With an R value greater than 1, these features show a tendency towards a dispersed pattern but do not deviate far from random. The

same calculation for quadrilateral mounds produced a mean distance of 3625.1 meters, with a *p* value of 0.34 and an R-value 0.92, also making this pattern not significantly different from an expected random pattern. A dispersed pattern in ramped *tola* distribution suggests maximization of territorial areas and the possibility of hostile political relations. The near random distribution of quadrilateral sites indicates that in general, they are not closely associated with ramped *tola* sites, and would were probably not under tight political control by the political centers.

Features	Mean Distance	*p* value	R value	Interpretation
Ramped tolas only	6609.6 m	0.084	1.2	dispersed
Quadrilateral only	3625.1 m	0.34	0.92	random
All *tola* types	2560.3 m	0.0006	0.75	clustered

Table 3.1: Results of the nearest neighbor statistic for ramped *tola* sites, non-ramped quadrilateral *tola* sites, and all sites.

In contrast, for all of the sites, the nearest neighbor distance was smaller, at 2560.3 meters, a *p* value of 0.0006 and an R-value 0.75, indicating a clustering pattern **(Table 3.1)**. This pattern demonstrates that while there is no strong clustering pattern between sites of similar type, there is a general pattern of sites occurring together. Locations of *bohíos* in close proximity to both later types of *tola* points to a gradual accumulation of political power over time; some settlements associated with the earliest mound types grow in size and influence, bringing the necessary labor to produce quadrilateral *tolas*. Later political changes, perhaps associated with increases in population, lead to an even greater concentration of labor, leading to the construction of ramped *tolas*.

Athens (2003) believed that Gondard y López overestimated the number of hemispherical mounds (*bohios*) in the study area, but they were included on the preceding map. Thirty-six sites are recorded as having *bohios* present. There are six instances (17%) where *bohios* are the only style of tola present. Quadrilateral tolas are found at 39 sites, with 9 instances of this style occurring alone (23%). Ramped *tolas* occur at 18 sites

within the study area. There are three instances (also 17%) of this style occurring alone. One particularly significant pattern is the co-occurrence of all three *tola* types at the same location. Of 18 ramped *tola* sites, 10 also contain quadrilateral and hemispherical *tolas.* The greater number of quadrilateral *tolas* than any other type is also significant. Assuming that ramped *tolas* were the latest style to be built, it would suggest that political power was more dispersed during the period of quadrilateral *tola* construction, and then became more concentrated during the period of ramped *tola* construction.

Based on Euclidean distance, sites are densely packed, with distances of less than 3 km separating them in most cases. The longest distance separating sites, not including hemispherical mounds, is about 10 km, and occurs between the sites of Cochaloma and Cabana. Neither of these sites are discussed in the ethnohistoric literature. Cabana, however, is situated near the site of Cayambe, also known as Puntichil, which was referred to as the capital of the Cayambe *cacicazgo*. Cochaloma is the southern-most site on the western side of the Guayllabamba Basin, south of the cluster of quadrilateral mounds. This site is also one of the few sites that is not in close (< 3 km) proximity to a water source. Between Cochaloma and Cayambe, there is a distance of about 18 km.

3.6.3. Ripley's K Function

Ripley's K function was used to evaluate the clustering of sites based on type. Ninety-nine iterations of the function revealed that ramped *tola* sites tend to have a dispersed distribution **(Fig. 3.4)**. At the regional scale, a dispersed distribution of sites indicates the absence of hierarchical relationships among sites. The greatest amount of dispersion occurs at the largest distance from a feature, translating to maximum spacing between sites, perhaps in competition for resources. At the local level (smaller distances), sites are slightly clustered, indicating shared access to territory and resources.

Sites with quadrilateral *tolas* show a pattern in which the sites form clusters at distances between 2000 and 8000 meters, and exhibit a dispersed pattern at distances greater than 10 km. The clustering behavior of these sites is not strong as the observed K values do not stray far from the expected K values **(Fig. 3.5)**. When all of the sites in the

study area were evaluated using Ripley's K, the result was a distribution that was very similar to that of a random distribution **(Fig. 3.6)**, with a slight tendency towards a dispersed distribution.

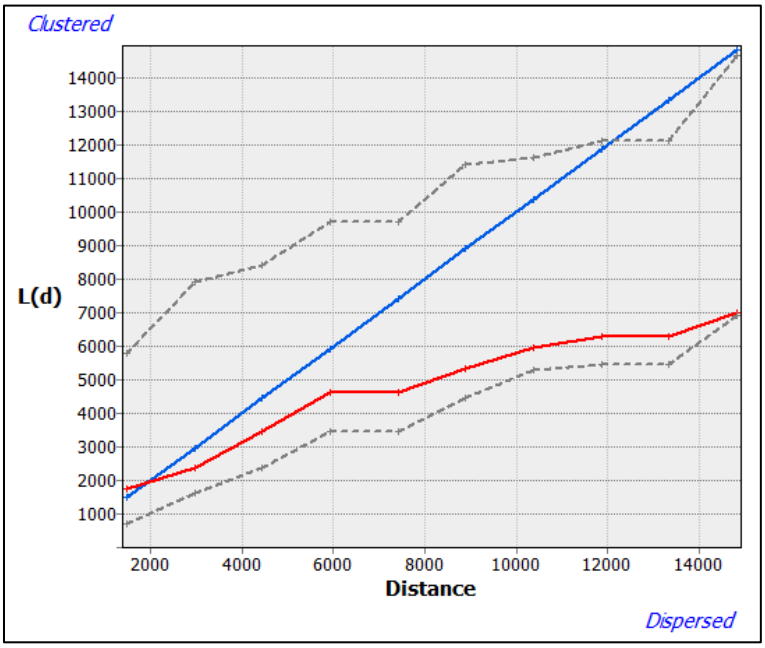

Fig. 3.4: Ripley's K function for ramped *tola* sites (n=18); The x-axis represents distance from a feature, and the y-axis is the average distance between a feature and its neighbors. The blue line indicates a random distribution; the red line represents the pattern observed in the data, and dashed lines show the confidence interval after 99 iterations.

Both the nearest neighbor statistic and the results of Ripley's K Function support the interpretation of maximum spacing between sites. Another motivation for establishing sites in a dispersed pattern, other than maximizing access to resource, can be a result of violent conflict between settlements. During the Late Toltec period in the Valley of Mexico, communities decreased in size and nucleation in response to hostilities between the Tula and Cholula (Alden 1979). The result was a more dispersed distribution of settlements in comparison to earlier, more peaceful periods.

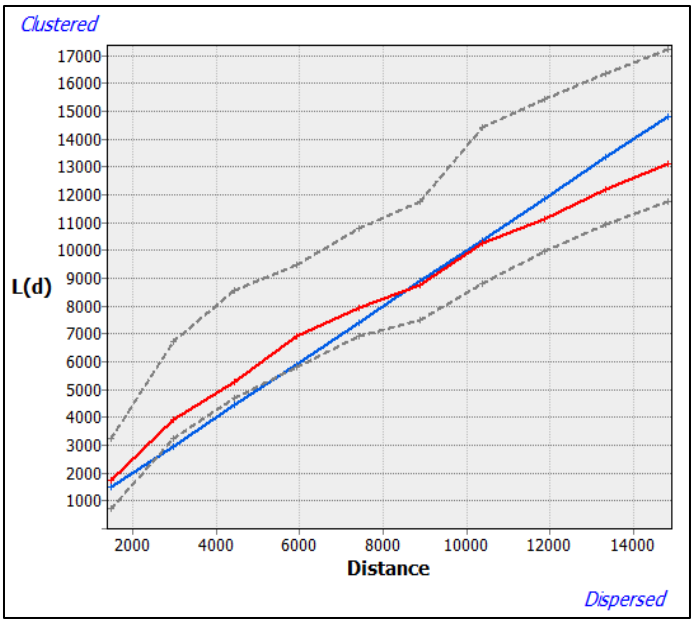

Fig. 3.5: Ripley's K function for quadrilateral *tola* sites (n=39); Blue line indicates a random distribution; the red line represents the pattern observed in the data, and dashed lines show the confidence interval after 99 iterations.

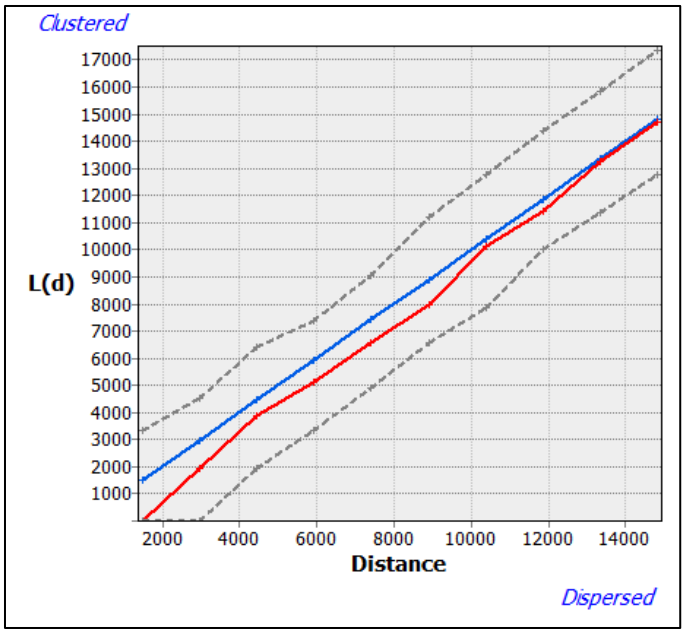

Fig. 3.6: Ripley's K function for all sites in study area (n=52); Blue line indicates a random distribution; the red line represents the pattern observed in the data, and dashed lines show the confidence interval after 99 iterations.

3.6.4. Buffers

The results of Ripley's K Function for ramped and quadrilateral *tolas* indicates that there is a switch from a clustered to a dispersed pattern at 2 km, then back to clustered at 8 km. Placing isotropic buffers at 2.0, 5.0 (the midpoint of these distances), and 8 km from the center of each ramped *tola* site clearly shows the spatial relationship between ramped and non-ramped *tola* sites **(Fig. 3.7)**. Most quadrilateral *tola* sites are either within the same site extent as a ramped site, or are found within 8 km of a ramped *tola* site. Only six sites, or 15%, are beyond the buffers of any neighboring ramped *tola* site. Two of these sites, Perugache and Gualsaqui, are greater than 100 hectares in area and have examples of some of the largest quadrilateral *tolas* recorded. It is also significant that almost all of the ramped *tola* sites have overlapping buffers at 8 km distance because this was the distance at which quadrilateral *tola* sites transition from a clustered to a dispersed pattern. This suggests that ramped *tolas* were constructed within a set proximity to quadrilateral sites, lending further evidence that quadrilateral *tolas* were constructed at an earlier date. The interpretation of this pattern is that instead of ramped *tolas* being the first feature built in a community, they were built after quadrilateral mounds in response to greater access to labor and an increase in political power.

The buffers also show the range of distances between ramped *tola* sites. Some buffers do not touch at the 8 km distances, while others overlap almost completely. There is no clear pattern of dispersion or clustering that describes the entire region. Instead, there seem to be different distribution patterns in the interior of the region versus the periphery. Those sites that stand out as possibly more politically powerful based on the histograms of site size and abundance of *tolas*, namely Atuntaqui and Zuleta, appear to have the least overlap in their buffers. As will be discussed later, the influence of topography on actual travel distance between sites changes the way these straight-line distances are interpreted. However, these values are useful for generalizing the distribution of sites within the study area.

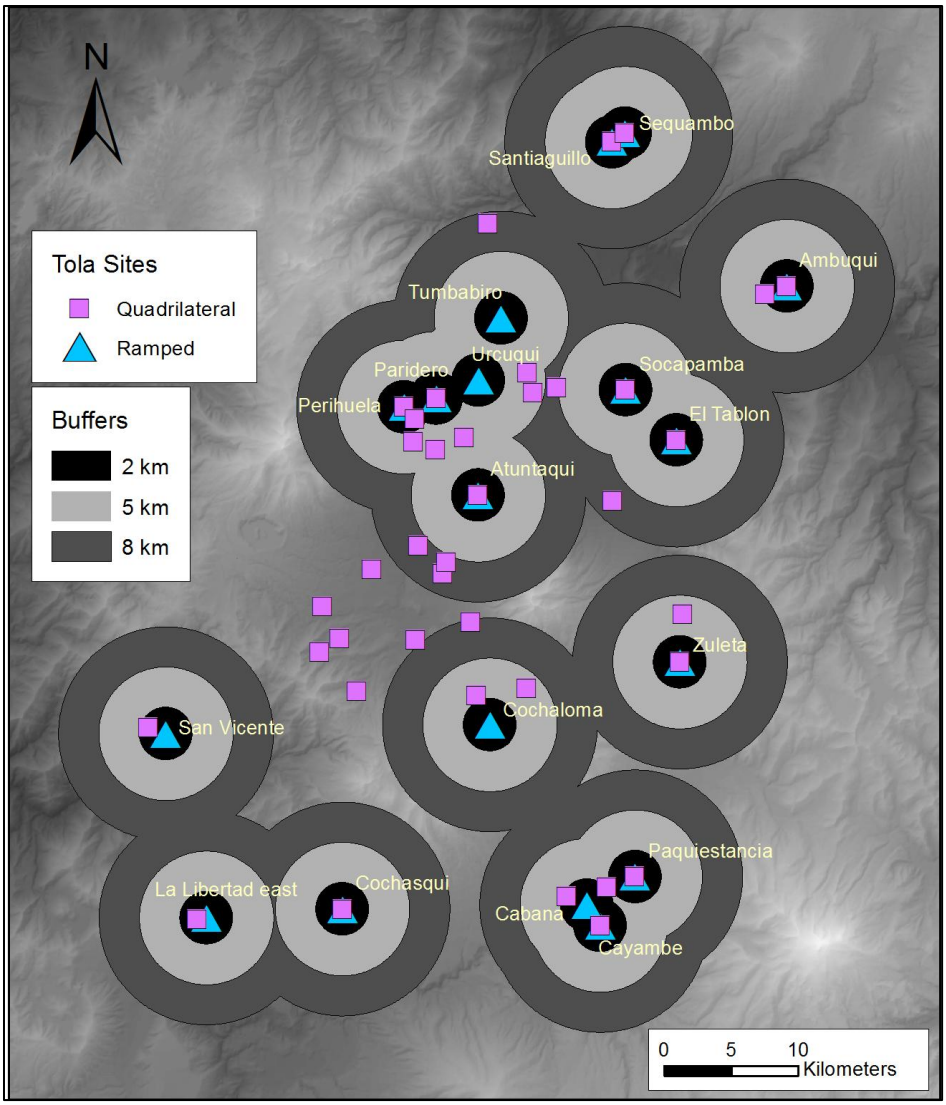

Fig. 3.7: Buffers at 2, 5, and 8 km from ramped *tola* sites showing the close association between ramped and quadrilateral *tola* sites.

3.6.5. Thiessen Polygons

Thiessen polygons are useful in evaluating clustering patterns because they demarcate hypothetical political boundaries in a scenario where political centers are antagonistic to their neighbors and maximum spacing occurs between each center. Overlaying these hypothetical boundaries (based on ramped *tola* sites) over the map of sites for the study area shows that while some ramped sites are buffered by a consistent distance from their neighboring ramped sites, some are actually in close proximity to one

another **(Fig. 3.8)**. The Thiessen polygon map also demonstrates that quadrilateral *tolas* commonly occur at the same sites as ramped *tolas*. It is clear that these different styles of *tola* are not mutually exclusive in terms of their locations. However, there are clear exceptions to this pattern, with quadrilateral *tolas* occurring at sites without ramped *tolas*, and vice versa **(Fig. 3.8)**. In addition to outlining the territorial boundaries of ramped *tola* sites, Thiessen polygons show other sites that may have been under the control of a chief residing at a ramped *tola* site.

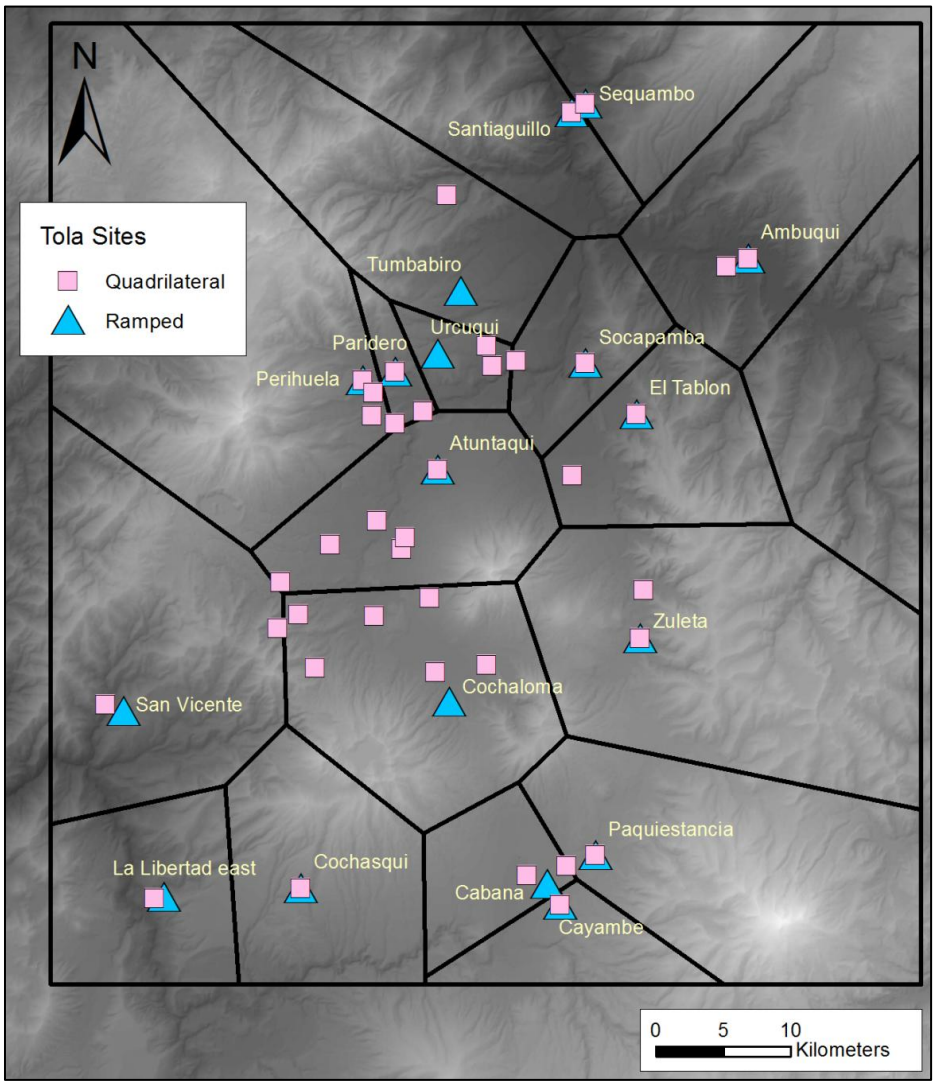

Fig. 3.8: Ramped and Quadrilateral *Tola* sites with overlay of Thiessen Polygons produced using ramped *tola* sites as features.

3.6.6. Tobler's Hiking Function

The hiking function indicates that El Tablón and Socapamba were the most impacted by topography, in that only a relatively small area is within a half-day's walk (4-6 hours) from the site **(Figs 3.9)**. These two sites are a few kilometers' distance from each other. Steep terrain west of Socapamba likely precluded travel in that direction, funneling traffic south and east towards Atuntaqui. The steepness of the terrain also would have discouraged travel east from El Tablón. The path with the least travel cost is to the south and west, suggesting a close relationship between these two sites.

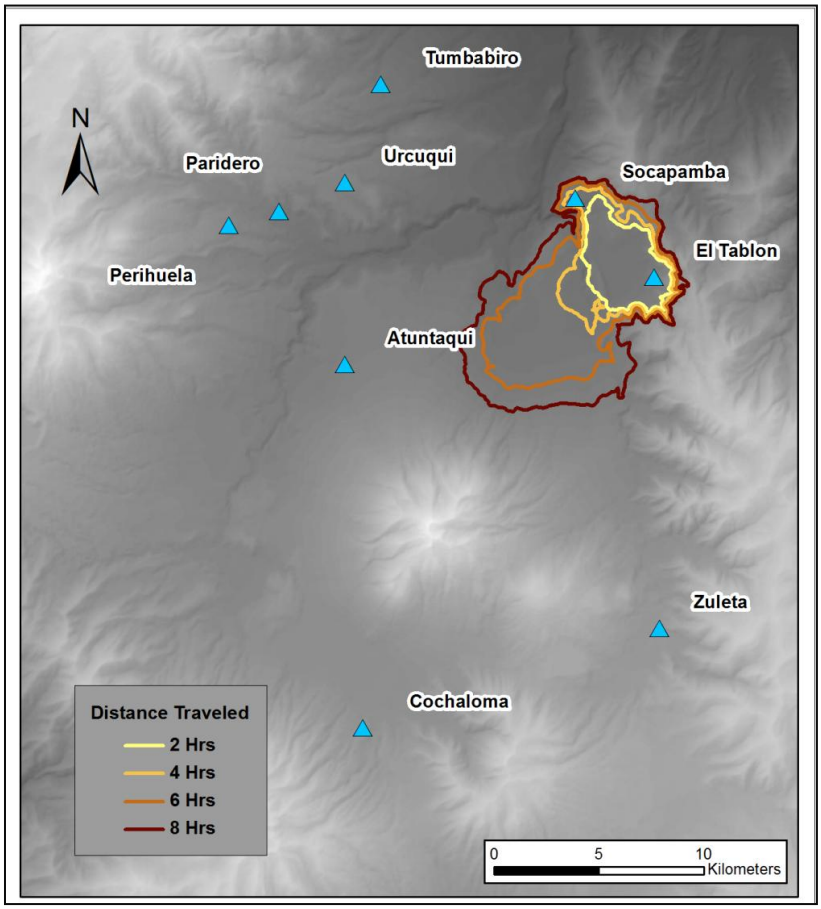

Figure 3.9: Anisochrones representing distance traveled every 2 hours from El Tablón; travel distances from Socapamba, to the northwest, are also greatly reduced by topographic features.

Travel to or from Atuntaqui is the least impacted by topography (**Fig. 3.10**). Compared to the other sites analyzed, travel distance per hour is more consistent in every direction for this site than any other. Cayambe produced a similar result, with the volcanic cones to the north creating the largest obstacle to foot traffic. These same cones restricted travel south from Atuntaqui and Zuleta.

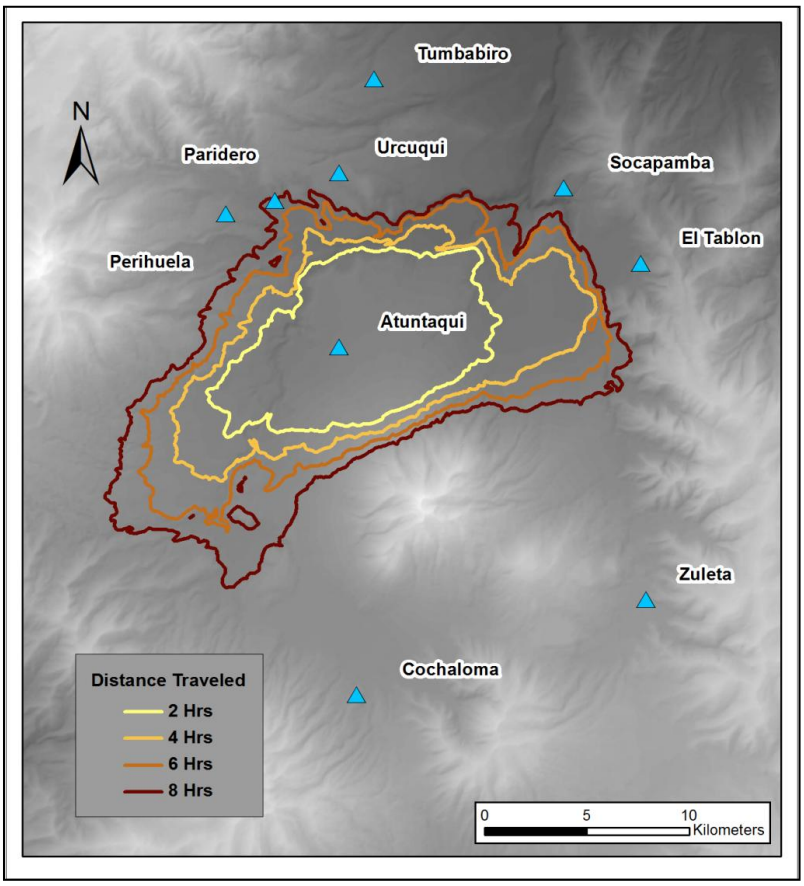

Figure 3.10: Anisochrones representing distance traveled every 2 hours from Atuntaqui, demonstrating the few topographic limits to travel.

Distances between the sites at each corner of the study area were great enough that it was unlikely that a political representative would have been able to travel to a neighboring ramped *tola* site and back in one day **(Fig. 3.11)**. Exceptions include Socapamba and El Tablón; as well as Cayambe, Paquiestancia, and Cabana. This is highly suggestive of a chiefdom system in which territories were independently managed without the oversight of a regional authority.

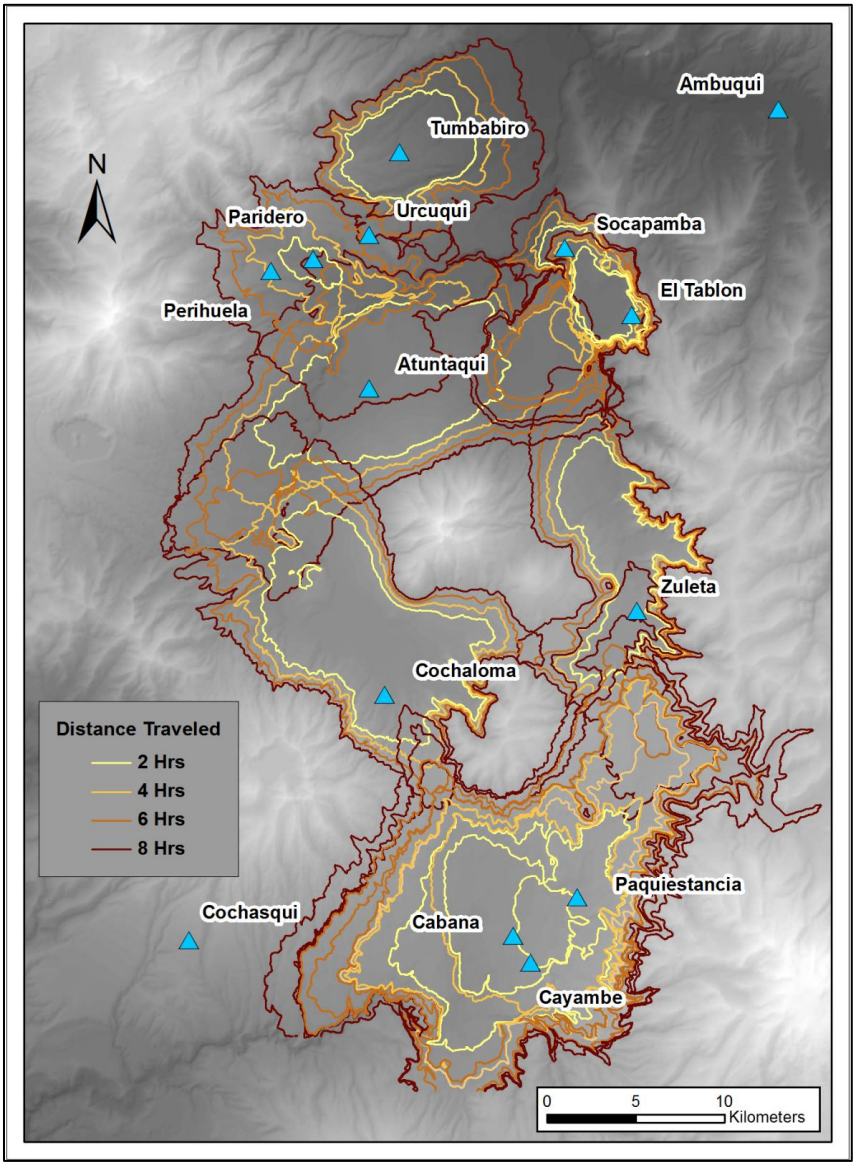

Figure 3.11: Anisochrones of distances traveled in 2-hour time intervals from 10 ramped *tola* sites produced using Tobler's Hiking Function.

Thiessen polygons indicate the maximum boundaries between hostile neighbors; the boundaries for each territory are established at the midpoint between each pair of sites. Tobler's hiking function calculates a more precise boundary for each territory by using measures of travel speed through an environment with varying topography. By combining the two tests, it is possible to determine how well the idealized hostile

neighbor model, with maximum spacing between sites, matches with the actual travel distances from each site **(Fig. 3.12)**. In this study, sites distributed in a clustered pattern, such as those in the southern portion of the study area, have a considerable amount of overlap in their territories that is not expressed by the results of Thiessen polygon calculations. Sites with a more dispersed pattern, such as Atuntaqui, Cochaloma, and Cochasquí, have little or no overlap in their territories and match fairly well with the Thiessen polygons.

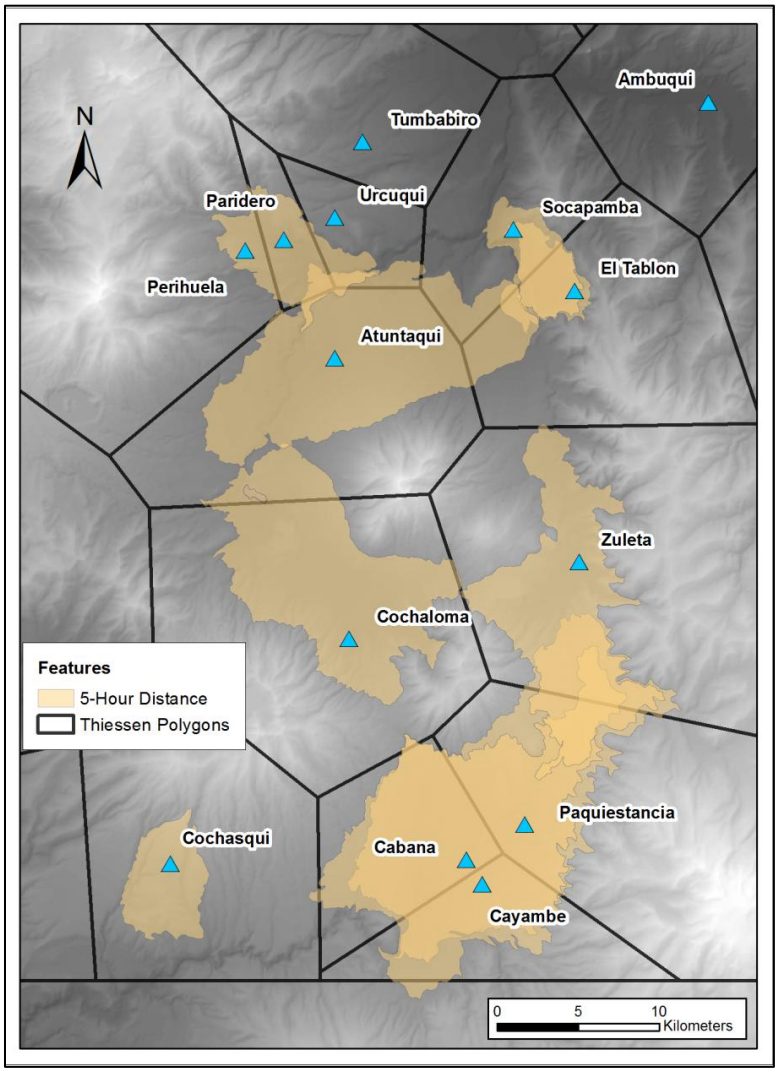

Figure 3.12: Comparison of hypothetical territorial boundaries produced using Tobler's Hiking Function and Thiessen polygons based on ramped *tola* sites.

To further demonstrate the differences in overlap between chiefly territories, the area of each territory, as determined by Tobler's hiking function set to five hours, was calculated. Next, this territory was divided along the Thiessen polygon boundaries and the area within each polygon was calculated. Finally, the percent of the total territory in each Thiessen polygon was calculated. Some Tobler's territorial areas are completed bounded within the single matching Thiessen polygon, while others cut across several **(Table 3.2)**.

Site/Territory	Tobler's Territory Area (ha)	% match with Thiessen polygon
Cochasquí	2986	100.0%
Cochaloma	11924	86.8%
Zuleta	10317	84.9%
Atuntaqui	14457	75.8%
El Tablón	2272	71.4%
Paridero	3918	52.4%
Paquistancia	19839	40.0%
Cabana	17012	35.2%
Cayambe	17986	25.7%

Table 3.2: Percent of territory generated using Tobler's Hiking Function that falls within the Thiessen polygon for the same site.

3.6.7. Least-Cost Paths

The calculation of least cost paths between the five chosen sites further demonstrates the constraints that the local geography would have put on the possibility of travel by foot. The shortest distance was between Socapamba and El Tablón, at a little over 7 km. All of the other sites were at least 20 km apart, with the greatest distance between Puntiachil and Atuntaqui **(Table 3.3)**. Most travel would have been restricted to the margins of Imbabura and Mojanda volcanoes. The site of Zuleta, which has the greatest abundance of *tolas* in the region, is equidistant from the largest sites in the north and Puntiachil/Cayambe in the south, making it a logical half-way point for any travel between the northern and southern subregions. Though the least cost distance was not calculated for Cochaloma, it sits in an equally strategic position is terms of distance to the

largest, and potentially most significant, Late Period sites in the west. Stopping at this site would have split the distance between Puntiachil and Atuntaqui into two 20km sections.

Site Path	**Total length (km)**
Socapamba-Atuntaqui	20.62
Socapamba- El Tablón	7.29
Zuleta-El Tablón	24.49
Zuleta-Socapamba	26.08
Zuleta-Atuntaqui	29.23
Zuleta-Puntiachil	28.20
Puntiachil-Atuntaqui	43.33

Table 3.3: Least-cost path distances for five ramped *tola* sites; on-the-ground distances are greater than the predicted nearest neighbor distance (6.61km).

3.7. Discussion

Analysis of the distribution of multiple Late Period sites in northern Ecuador does not provide evidence of a nested hierarchy that exists at the regional scale. In fact, the degree of clustering among sites varies depending on the scale of analysis. At short distance intervals, ramped *tola* sites are slightly clustered, whereas at the regional scale, the distribution of sites is strongly dispersed. Based on their larger sizes, the abundance of *tolas* present, and the sizes of their territories, Atuntaqui and Zuleta were likely more politically powerful settlements than their neighbors. However, in no case do we see the development of a clear regional hierarchy.

Ramped *tola* sites in the central portion of the study area also show a strongly dispersed pattern, suggesting limited contact between chiefs at these sites, and perhaps limited contact between the populations of their corresponding territories. Athens calculated the nearest neighbor statistic for 12 ramped mounds and found almost an identical result to that generated in this analysis: 6.56 km (1980:192), compared to 6.61 km. The determination of the Ripley's K value for ramped *tola* sites strongly supports his

interpretation that, in general, sites were established at maximum distances from each other. Least-cost path lengths further demonstrate a dispersed pattern, with values greater than those predicted for an area lacking topographic features. The approximate match between half-day walking distances from central sites and Thiessen polygons is further evidence that maximum spacing among certain sites was deliberate.

In terms of political complexity and organization, maximum spacing between sites suggests that each site acted independently to exert power over the population within the territory controlled by that chief. Any resources available within the territory would have been controlled by the chief, restricting access to individuals from other territories. In addition, the chiefs of each area would compete directly with one another to increase their domain. As a result, the boundaries between each site would ebb and flow with changes in the exertion of power (Earle 1997; Cobb 2003).

The relationship between ramped and quadrilateral *tola* sites, on the other hand, shows that quadrilateral *tolas*, which were likely built earlier than ramped *tolas*, tend to occur within 8 km on ramped *tolas*, based on both buffers and the results of Ripley's K Function. The nearest neighbor calculation of 6.61 km spacing between ramped *tola* sites suggests that while ramped sites are dispersed from one another, quadrilateral *tolas* are most concentrated around other quadrilateral *tolas* and ramped *tolas*, and not evenly distributed around the landscape. This result supports a scenario in which quadrilateral *tolas* were constructed prior to ramped ones. As the concentration of power grew at these sites, ramped *tolas* began to appear to accommodate larger populations and a greater concentration of political power. New types of ceramics began to appear around this same time, supporting a rather sudden increase in the accumulation of economic wealth and power at ramped *tola* sites (Athens 1980).

There are noticeably differences in the distribution of sites in the northern versus the southern portions of the study area. In the north, there are more sites and they tend to occur in clusters, while in the south, there are far fewer sites and they tend to be spaced further apart. In looking at the locations of both ramped and quadrilateral *tola* sites in the study region, there is a strip of land between Cochaloma in the north and Paquiestancia in

the south where no sites were found. This stretch is similar to the "no-man's land" seen in the Valley of Mexico during the Early Toltec Period. Like the situation in highland Ecuador, the northern region showed more clustering of sites in comparison to the south. The distance between these subregions was about 20 km (Alden 1979); in highland Ecuador, the distance is closer to 10 km. Several interpretations of these patterns were debated, but Alden (1979:193) suggests that: (a) the more dispersed southern region was controlled by semiautonomous members of a few lineages; and (b) the more densely clustered northern region was controlled by political leaders attempting to integrate the entire area under one regional hierarchy.

In Northern Highland Ecuador, the degree of dispersion between ramped *tola* sites increases with distance, mainly because there are fewer ramped *tola* sites as one moves outward from the north-central portion of the valley. The closer proximity of sites in the northern region, where the Caranqui *cacicazgo* would have existed, may have enabled political integration. In contrast, the Cayambi *cacicazgo* in the southern region has fewer sites that are, in general, more dispersed. The hypothetical boundaries produced using Thiessen polygons and Tobler's Hiking Function approximate the boundary discussed in the ethnohistoric literature. It also demonstrates that ramped *tola* sites within the Caranqui and Cayambi regions have different clustering patterns.

Application of Tobler's hiking function to the dataset brings attention to the large time investments required for travel in this region. Travel from the site of Atuntaqui, located in one of the flatter parts of the valley, proceeds at a pace close to 1.5 km/hr, considerably slower than the hypothetical 4 km/hr used in the function. The difficulty of moving through the terrain must have impacted the movement of people and goods around the region, impacting the development of economic and political institutions that spanned the entire region.

The next chapter will discuss the utilization of clay resources for the production of ceramics in the highlands as another approach to the analysis of interactions between settlements during the Late Period. Interpretations of the relationship between site location and clay resource location build upon the results of settlement pattern analysis.

Chapter 4: Exchange Interactions during the Late Period

4.1. Introduction

Geospatial analysis of the distribution of ramped *tola* sites within the northern highlands suggests that in general, maximum spacing was maintained between individual sites. This suggests that (a) ramped *tola* sites functioned as the center for each chiefly territory and (b) chiefs were conscious of the locations of their neighboring rivals and built accordingly to maximize distance from competitors. An additional technique for evaluating the relationships between neighboring settlements is the analysis of ceramics recovered from these sites. Instrumental neutron activation analysis was used to determine whether the patterns seen in the exchange of ceramics during the Late Period correlate with the proposed regional settlement pattern. Ceramics were chosen as the artifact of interest because they were readily available for analysis and there is extensive literature on this method of analysis (i.e. Arnold *et al.* 1991; Glascock 1992; Bishop and Blackman 2002; Neff 2002; Minc 2008). A complete list of samples included in the analysis can be found in Appendix A.

Compared to the geologic or pedogenic definition of clay materials, the anthropological definition of clay is less rigorous. Potters in traditional and non-industrialized contexts use materials that "are highly impure and contain a variety of substances besides clay minerals or clay-sized particles" (Rice 1987:52). Anthropogenic factors in clay resource exploitation and use have important influences on the final elemental composition of a ceramic artifact and how confidently that artifact can be linked with a specific clay source (Arnold *et al.* 1991).

The main factors affecting the final composition of a ceramic paste include: natural, cultural, and post-depositional. The mineralogy of the parent material from which the ceramic paste is derived, the types of clay formation processes involved in the formation of that clay, and the weathering of clay deposits are all considered natural factors in final composition (Rice 1987). Cultural factors include the mixing of different

clays, techniques used to prepare the ceramic paste, and firing conditions. Finally, post-depositional factors describe how finished ceramic vessels, recovered in the archaeological record, are affected by various forms of contamination and weathering (Rice 1987).

In spite of the challenge in linking compositional studies to clay sources and artifacts, these studies provide invaluable information about ceramic production and use. Since the mid-1970s, INAA "has been the preferred analytical technique for addressing archaeological questions pertaining to the procurement and use of raw materials and trade or exchange of finished goods" (Bishop and Blackman 2002; see also Arnold *et al.* 1991; Neff 2000, 2002; Glascock 1992, 2006). Adding various materials to “temper” the clay can also affect the final mineralogy of the ceramic paste, but clay sources can still be differentiated using trace-element characterization (Neff *et al.* 1998).

The majority of ceramic artifacts recovered from ramped *tola* sites can be assigned to the Late Period based on their decorative style and association with *tola* surfaces radiocarbon dated to the Late Period. Based on the assumption that these ceramic vessels were utilized during the same time frame, differences in chemical composition can be used to track exchange interactions between political units. The presence or absence of established trading networks between neighboring groups provides additional insight into the active political and economic relationships of the time.

4.1.1. Tola Ceramics

The majority of ceramic assemblages recovered from *tola* sites throughout northern Ecuador include a thick-walled, red-slipped variety termed Caranqui ware, lacking the addition of temper (Bray 1991). Some of these ceramics include burnishing and painted geometric designs, differing noticeably from unfinished utilitarian wares that were probably used on a more daily basis by highland society (Bray 1991; Goff 1980). Bray's functional analysis of these different vessel forms led her to the conclusion that the more finished pieces were used for temporary storage and service of specialty food and

drink (1991). The frequency of these vessel types in both surface and excavated contexts of *tola* sites suggests that the consumption of *chicha* and other high status foods like deer, partridge, camelid, and guinea pig played a vital role in various aspects of ritual and political life during the Late Period (Athens 1980; Salomon 1986; Bray 1991).

Another ceramic ware type encountered in the highlands at *tola* sites is Panzaleo/Cosanga ware; a thin-walled, un-slipped, orange-colored paste type, often with fragments of mica visible on the surface due to burnishing. It occurs in multiple Late Period assemblages across the region, though only in small quantities at any one location. Research suggests that Panzaleo was produced as a prestige good that was imported from the eastern lowlands (Bray 1995). The geology of the Cordillera Oriental is differentiated from the Cordillera Occidental by the presence of metamorphic formations. Petrographic analysis of several Panzaleo sherds indicated metamorphic components, excluding the possibility that the clay sources for this ware are located on the western side of the valley (Bray, 1991). This finding is significant, as both the ethnohistorical evidence for colonial Quito and archaeological evidence from the highland site of Pimampiro, northern Ecuador, indicate strong exchange relationships between the highlands and lowlands (Oberem 1986; Bray 2005).

An additional ceramic ware of interest is Tuza/Capulí. Both of these wares are associated with the Pasto ethnic group in far northern Ecuador and southern Colombia (Francisco 1969). Tuza ceramics are thin-walled, have a light cream-colored paste, and often have painted anthropomorphic and zoomorphic designs in black, brown, and red. Capulí pottery has resist painting with black geometric designs layered on red designs (Francisco 1969). Similar to Panzaleo/Cosanga, these exotic ceramics do not appear at *tola* sites with high frequency. This suggests that they were also exchanged as prestige goods.

The question of exchange centers on the analysis of both utilitarian, Caranqui-ware vessels (the local ware type), as well as more elaborately finished exotic wares, such as Panzaleo/Cosanga from the south and Tuza from the north **(Fig. 4.1)**. These exotic wares have been recovered at many *tola* sites, pointing to an exchange network that

extended beyond the highlands. Within the highlands, the stylistic homogeneity of Caranqui ware has made it difficult to evaluate local trade patterns. Information about the movement of ceramic products between neighboring sites may clarify the degree of hostility between political units, as successful trade depends on relatively stable relationships between groups.

Based on the analysis of the interactions between individual political units, it is possible to increase the scale of the analysis to the entire region. A generalized pattern of exchange between ramped *tola* sites would suggest amicable relationships, while a general preference for the local production of ceramic vessels would suggest that interactions were restricted to the local level, and political organization at the regional scale was limited.

4.2. Linking Arguments

Trace-element data are appropriate for evaluating the level of chiefly organization in northern Ecuador because they reveal patterns in clay utilization and exchange based on differences in elemental concentrations. The exchange of ceramics, which were used for both mundane and ritually - charged feasting events, can be used as a proxy indicator for the degree of interaction between chiefs of different *caciques*, as well as suggest the type of activity or context of that interaction.

Various attributes of ceramics can be used to evaluate their production and exchange. These attributes include vessel shape, decorative motifs, characteristics of the clay used to produce ceramics, and instrumental measures of elemental concentrations, to name a few. In addition to the physical components of ceramic artifacts, social rules surrounding the production and use of ceramics can inform our understanding of how ceramics function within society. Large feasting events have been an important aspect of Andean culture since the Inca period and probably earlier (Salomon 1986). Chiefs holding such events to gain supporters and laborers would have required a large number of ceramic vessels to prepare and serve food to guests. Utilitarian, serving, and storage

ceramics recovered from *tola* sites are the remnants of these events. Analyzing these particular ceramics allows for the interpretation of whether it was the local population or visiting populations that furnished the pots, bowls, and jars used for these events.

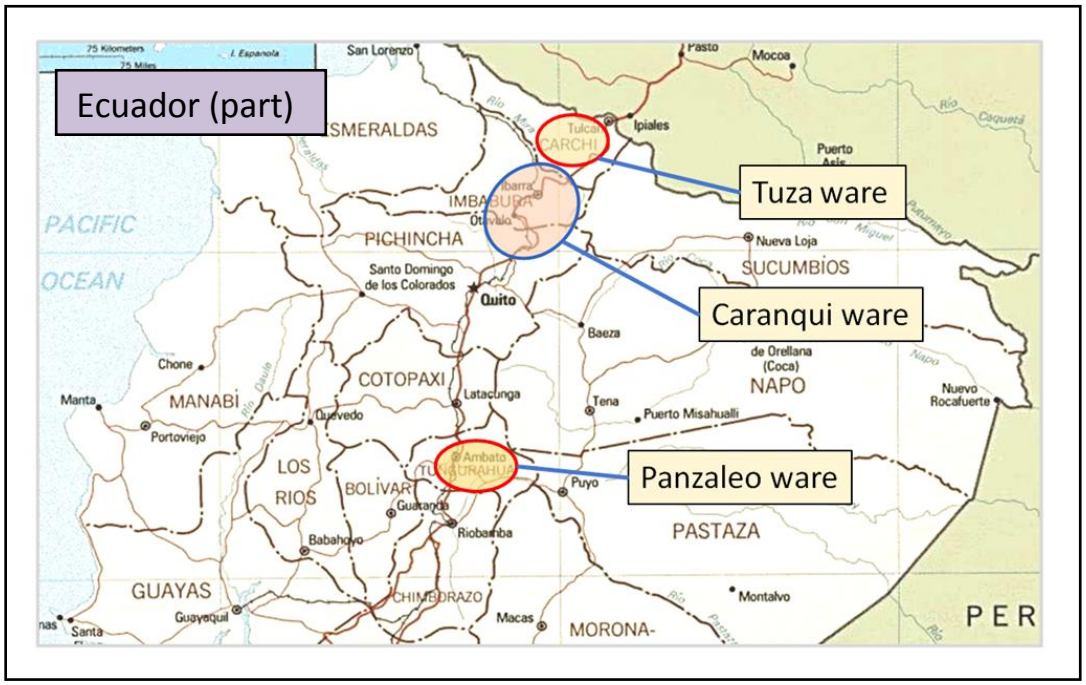

Figure 4.1: Map of northern and central Ecuador showing source localities of Caranqui, Tuza, and Panzaleo wares.

The measurement of element concentrations is a reliable technique for characterizing ceramic artifacts and clay resources (Glascock 1992). The composition of volcanic flows, ash deposits and other geologic components influence the concentration of various elements within the raw material used for ceramic production. General descriptions of the volcanic cones in northern highland Ecuador have suggested that it is possible to differentiate deposits based on differences in elemental concentrations (i.e. Le Pennec *et al.* 2006). The compositions of finished vessels should bear a resemblance to the approximate source of a particular type of clay. This enables the connection between

the approximate source of a particular type of clay and the ceramics recovered from archaeological sites (Bishop and Blackman 2002).

4.3. Hypotheses and Expectations

The primary assumption involved in this analysis, based on previous archaeological interpretations of that region, is that utilitarian wares, which would be used to prepare and cook food, were produced on-site. More finely finished ceramic wares, which are assumed to have been used exclusively for serving food and beverages, were not necessarily produced on-site. In the case of exotic wares like Tuza and Panzaleo/Cosanga, they are more likely to be produced at one location and then exchanged as a prestige good. Ceramics produced locally should be made with clays that match the geologic deposits adjacent to the site.

Based on the ethnographic information concerning political organization in the region, the expectation for ceramic assemblages is that their composition will reflect exploitation of local clay resources. Arnold described a 1-7 km typical walking range for individuals collecting clay resources (1985). The results of Tobler's Hiking Function and Thiessen Polygons, as discussed in the previous chapter, would allow such distances within a half-day's travel from the majority of sites in the study area. For the purposes of this study, local clay resources are those that could be reached within a maximum of eight hours from a settlement.

4.4. Sample

A total of 17 archaeological sites are represented in this study, including both *tola* and non-*tola* sites **(Table 4.1)**. The sample of archaeological ceramics was primarily surface collected from *tola* sites and excavated materials were borrowed on loan from La Reserva del INPC in Quito. In addition, modern ceramics and clay samples were collected from modern potters and field locations producing a total dataset of 561

samples. Archaeological ceramics and modern ceramics were collected by the author, Dr. Leah Minc and Dr. Tamara Bray. Samples of clays and modern ceramics were analyzed to provide a comparison to archaeological finds **(Fig. 4.2)**.

Site Name	**Site Code**	**Sample Count**	***Tola* or non-*tola***	**Context**
Angochagua	ANG	16	*Tola*	Surface
Atuntaqui	ATU	40	*Tola*	Surface
Cantón Montufar	MON	11	Non-*tola*	Surface
Caranqui	CAR	26	*Tola*	Surface
El Carmelo	CRM	9	Non-*tola*	Surface
El Tablón	TBL	60	*Tola*	Surface
Hacienda La Violeta	HLV	7	Non-*tola*	Surface
Huataviro	HUA	57	*Tola*	Excavated
La Portada	POR	15	Non-*tola*	Surface
Loma Sandoval	SDV	58	Non-*tola*	Excavated
Los Soles	SOL	14	*Tola*	Surface
Mascarilla	MAS	9	Non-*tola*	Surface
Puntiachil/Cayambe	PUN	60	*Tola*	Excavated
San Roque	ROQ	13	*Tola*	Surface
Socapamba	SOC	64	*Tola*	Surface
Tajamar	TAJ	30	Non-*tola*	Excavated
Tulipe	TUL	11	Non-*tola*	Excavated

Table 4.1: Archaeological sample sites, counts, and context.

Clay samples collected in the field provided some insight into the differences in clay raw materials available in the region. Because little was previously known, the goal was to sample as many different sources as possible for comparison with archaeological samples. Most of the archaeological ceramic samples collected in 2010 were from Late Period sites, while samples collected in 2011 came from a variety of sites.

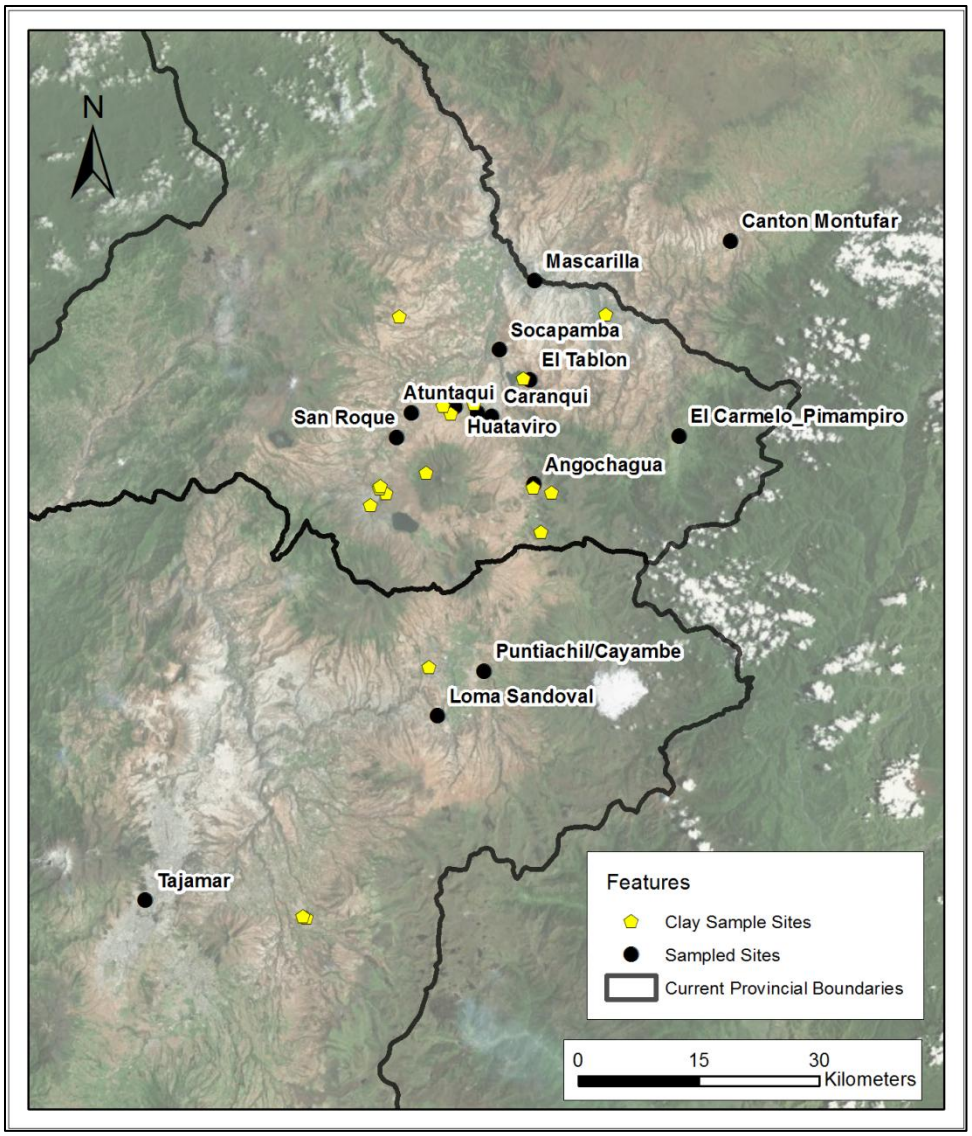

Figure 4.2: Map of Northern Ecuador indicating sites where both archaeological ceramics and clay samples were collected during 2010 and 2011.

4.5. Methods

4.5.1. Sample Processing

Instrumental neutron activation is a highly precise, highly controlled technique that enables calculation of the concentrations of multiple major, minor, and trace

elements in archaeological ceramics, as well as a variety of other artifacts and objects of unknown composition (Minc 2008).

The process works by bombarding a sample with neutrons within a nuclear facility creating unstable isotopes of elements present within the sample. To regain stability in the nucleus, the isotopes release gamma radiation at characteristic and measureable energy levels and at rates dictated by the half life of each isotope. Each gamma ray creates an electrical signal within the detector system that is then recorded as the energy level for that ray. The number of gamma rays at each energy level are recorded by a gamma detector and represented by a spectrum which can be displayed by a computer system (Minc 2008; Glascock 1992). Spectra allow for the visual identification of characteristic energy peaks, such as the twin peaks associated with Co-60, as a quick way of comparing the concentrations of elements of interest to reference materials and other samples (Minc 2008).

Included within each batch of unknown samples are several reference materials that have known elemental concentrations which have been reviewed by multiple INAA facilities and certified. Reference materials and unknown samples are activated and measured under identical conditions. Once the spectra for all of the unknowns and standards are collected for a batch, element concentrations are determined using the direct comparison method. By comparing the number of gamma rays emitted by a sample of known elemental concentrations to that of a sample with unknown concentrations on a weight ratio basis, it is fairly straightforward to calculate the concentration values for the unknown sample.

Once the concentrations of the various elements of interest have been determined, the data is imported into a statistics software package that enables univariate and multivariate comparison of the elemental concentrations for every sample. Assuming that different clay sources are composed of statistically different concentrations of particular elements, it is possible to identify groups of samples based on these differences that presumably represent different source materials. Variations in composition are then compared to geologic, archaeological, and other relevant data to identify the geographic

source(s) of these distinct component groups. Ultimately, the goal is to determine the approximate "source" of each sample as a way to compare the production and use-life of samples included in the analysis (Arnold *et al.* 1991; Neff 2002).

The protocols used to conduct INAA at Oregon State University are as follows: Artifacts collected in the field, borrowed from the INPC, and borrowed from Jose Echeverria were individually bagged and labeled with a unique three-letter code for the site of origin and a two digit sample number. Each sherd was sampled by breaking off a small (0.5 cm^2) piece using a steel tile cutter. All exposed (and potentially contaminated) surfaces of the fragment were removed using a tungsten-carbide burr, and then gently rinsed using deionized water. The sample was then set on a piece of glassine weighing paper and placed in a drying oven at 100° C for 24 hours.

Once the fragment was properly dried, it was ground to a fine powder using a mortar and pestle. The resulting powder was placed in a glass scintillation vial and labeled with the appropriate site and sample code. Approximately 250 ± 5mg of each powder was encapsulated in a high purity 400 μL polyethylene vial and heat-sealed. Finally, each 400 μL vial was placed inside a 2.0 dram vial (secondary containment) in preparation for irradiation.

Each batch consisted of 30 vials: 24 ceramic samples, three NIST-certified standards, and three check standards. Three replicates of NIST 1633a, Coal Fly Ash, were used as standards. In the rabbit irradiations, NIST 688, Basalt Rock, was also used as a standard for Ca. The consensus values for these standards were used in the final data reductions, which employed the direct comparison method (Glascock 2006). A total of 16 batches were irradiated at the Oregon State University Radiation Center over the course of approximately one year.

Two separate irradiations and four separate counts of gamma activity were performed on each batch. First the PT and H2 counts were performed after a "rabbit" (pneumatic tube) irradiation of seven seconds at decay intervals of 15 minutes and 2 hours, respectively. Week 1 and Week 4 counts were performed after one week and four weeks, respectively, after a 14 hour irradiation in the reactor core. Samples are set aside

to decay over these intervals because it allows for the shorter half-life elements to decay away, leaving only the isotopes with longer half-lives that are more difficult to measure with the noise of short half-life elements present shortly after irradiation. After the spectrum for each sample and the standards were gathered for each count, elemental concentrations were determined using the direct comparison method. Finally, the results were transferred to Microsoft Excel and then imported into the program JMP (SAS©) for statistical analysis (Neff 2002).

4.5.2. Data Reduction and Quality Assurance

Quality assurance was assessed for each batch of samples to ensure the accuracy of the results. Two check standards, including NIST1633b and New Ohio Red Clay, were irradiated with each batch and treated as unknowns (NIST 688 was used as a check standard for counts other than the PT count). To evaluate the consistency of the results, the elemental concentrations for the NIST-certified standards and the check standards in each batch were compared to the consensus values listed in Glascock (2006). Then, these values were compared within and between batches to ensure consistent neutron flux and proper lead shielding during counting.

In addition to comparisons between NIST and check standards, the results of each count are screened for zero and negative values, indicating concentrations that fell below detection limits. Several elements were excluded from the final analysis on this basis, including Ni and Zr, leaving 26 elements in the data set: Mn, Al, Ca, Ti, V, Ba, La, Lu, Sm, Na (Week 1), U, Yb, Ce, Cs, Cr, Co, Eu, Hf, Fe, Nd, Rb, Sc, Sr, Ta, Th, Zn. Manganese values are typically gathered from the H2 count, but calibration issues led the author to extract these values from the PT count. Sodium values were only used from the W1 count. Although many authors recommend log-transformations for ceramic data, final values were used without transformation for subsequent univariate and multivariate statistical analyses, following Reimann and Filzmoser 1999; Neff 2002; and under the guidance of Dr. Leah Minc.

4.6. Caveats

This study is centered on ceramic sherds that were obtained primarily through surface collection. There is some debate over the validity of obtaining samples this way, but many of those issues are put to rest by the fact that (a) the sites under investigation are approx. 500-1000 years in age; (b) we know that at least some of the samples were in their primary context when they were recovered; (c) limited access to excavated collections; and d) time constraints on the project.

Samples that were field collected were chosen based on a stratified random sample. Preference was given to sherds that contained some portion of a rim and/or contained some other diagnostic property such as surface treatment or thickness of piece in profile. The majority of Caranqui sherds encountered could not be assigned to a particular vessel form. However, a large portion of rim sherds could be assigned to general categories of bowl, jar, large storage container, and amphora. The main purpose of this project is to determine the major clay types that were used in the region during the Late Period, and so for these purposes, it was not vital that sherds could be unambiguously assigned to a specific vessel form.

While the concept that archaeological ceramics match geologic sources does hold to a certain degree, it is important to take into account both the natural and cultural/behavioral influences on ceramic production. Ethnographic information for both the Andes, in general, and Ecuador, in particular, shows that potters typically mix at least two types of clay to produce vessels with desirable attributes (Druc 1996; Minc *et al.* n.d.). These behaviors and others modify the final concentrations of elements present in archaeological ceramics, complicating the task of linking artifacts with geologic clay sources. That being said, general patterns in element concentrations are discernible in the highland region, lending support to the interpretation that certain ceramic artifacts are more reflective than the immediately local clay resources than others.

4.7. Results

4.7.1. Quantitative Analysis

The final sample set consisted of 330 ceramics from *tola* sites, 179 samples from non-*tola* sites, and 56 clay samples. First, a histogram was produced for each element to identify extreme outliers and to determine if any of the element distributions displayed bi- or multi-modality. Chromium was clearly bimodal and possibly trimodal, with several samples showing up as high outliers for the element, assigning them to the very high Cr group. La, Lu, Yb, as well as Fe displayed clear bimodality. The Panzaleo/Cosanga ceramic group was enriched in all three of these rare earth elements, as well as several others. Because this group was so well defined across multiple elements, it was temporarily excluded from the analysis to enable other groupings to be identified.

Iron provided the next measure of differentiation within the ceramic samples, defining an outlying high Fe group and low Fe group. The low Fe group was tightly clustered, and after looking at the typological information for these samples, it was determined that they were exotic Tuza ceramics, associated with the northern province of Carchi. In contrast, the high Fe group was found primarily at the sites of Loma Sandoval, southwest of Cayambe, in the southern portion of the study area. This group was tentatively labeled as the High Fe group, as it showed some overlap with both the High and Low Cr groups. After excluding these clear groupings, the dataset was pared down to a fairly dispersed high Cr group and a more tightly clustered low Cr group.

Discriminant analysis, with stepwise variable selection, revealed that the main variables of differentiation for this subset of the data were Cr, Sc, Th, and Fe. Based on a bivariate plot of Cr and Sc, there was a portion of the Low Cr group that was also high in Sc. This group was tentatively identified as the Atuntaqui group, based on the provenance of the some of the samples included in the group. Using the nonparametric density function for the bivariate plot of Sc and Cr, it was possible to identify a tentative boundary between the High Cr and Low Cr groups. The High Cr group had Cr concentrations $\geq$ 55.7 ppm, while the Low Cr group ranged from 27 - 51 ppm.

Principal components analysis was useful in defining the two groups that were originally identified as the High Cr group. Initially, the high Cr group was quite dispersed in distribution. Eight principal components were generated on the correlation matrix with eigenvalues greater than 1, accounting for a total of 84.8% of the variance **(Table 4.2)**. The first principal component loaded on both the Light and Heavy rare earth elements (LREE and HREE) and several metals, including Fe, and several major elements (Al and Ti). The second principal component loads on Sc, Ca, Co, Fe, Na, and V, and differentiates the Atuntaqui composition group from the rest of the dataset, which is high in Sc and low in Cr. The third principal component loads primarily on Cr. Principal components four through eight load on the alkali earth metals, including Ba and Sr. The final principal component loads positively on Zn and negatively on Sr, which are both captured by principal component six.

Bivariate plots of the first three principal components support the divisions between the groups that were already identified. In addition, these bivariate plots revealed a bimodal distribution of samples in the High Cr group. The new group had a higher average Cr concentration, a lower Na concentration, and a lower Eu concentration. Bivariate plots of other REE with this new grouping showed that it was also low in La, Sm, and Yb. The final designation for this group was the “Low REE” group, based on these analyses. The very high Cr group, which was initially labeled a group of interest, was mostly absorbed by the new Low REE group. Box plots were produced for each of the principal components, and the associated outliers were excluded from subsequent multivariate analysis.

Eigenvalue	9.2	5.3	3.6	2.6	2.3	2.1	2	1.7
Cumul. %	27.1	42.7	53.3	60.8	67.6	73.8	79.7	84.8
Element	**Prin1**	**Prin2**	**Prin3**	**Prin4**	**Prin5**	**Prin6**	**Prin7**	**Prin8**
Zn	0.1553	0.1708	0.0383	0.3488	-0.2954	**0.4298**	0.1048	**0.448**
Lu	**0.6201**	0.3484	-0.1053	***-0.4311***	-0.0759	-0.0445	0.2633	0.3193
U_Mean	0.2001	-0.426	-0.2302	-0.0901	0.139	-0.1039	0.4245	0.2731
Yb	**0.655**	0.3709	-0.1	-0.3882	-0.1221	-0.0869	0.1337	0.2656
Rb	0.1536	-0.3369	-0.0083	**0.5347**	-0.1831	0.223	-0.3025	0.183
Sc	0.3896	**0.7103**	0.4592	-0.2511	-0.0659	0.0538	0.2255	0.1637
Cs	0.0135	***-0.6325***	-0.0559	0.2843	0.0294	-0.257	-0.0207	0.1259
Mn	0.4219	0.4511	-0.0177	0.2827	**0.5633**	-0.2868	0.1289	0.1065
Ba_Mean	0.0306	-0.3601	-0.0019	-0.2748	0.4337	**0.6866**	-0.1068	0.0953
Sm	**0.9036**	0.199	-0.2697	-0.092	-0.1402	0.1135	-0.186	0.0083
La	**0.8866**	-0.056	-0.2685	-0.1043	-0.0357	0.1215	-0.226	-0.0229
Ca	0.1861	**0.6747**	***-0.4543***	0.0907	-0.1023	0.0118	0.1486	-0.0247
Eu	**0.911**	0.2415	-0.2865	-0.0284	-0.1422	0.0919	-0.153	-0.0335
Co	**0.5638**	**0.5789**	0.2117	0.3086	0.3887	-0.1058	0.0767	-0.0445
Cr	0.1241	0.0521	**0.8389**	-0.0781	0.075	0.2825	-0.1435	-0.0754
Nd	**0.7563**	0.1099	-0.2387	0.0362	-0.1934	-0.059	-0.2069	-0.1161
Fe	**0.7524**	**0.5564**	0.2599	0.1872	-0.1322	0.1644	-0.0501	-0.1273
Ce	**0.8256**	-0.18	-0.0312	0.1116	0.1793	0.0537	-0.177	-0.1274
Th	**0.5688**	***-0.6214***	-0.0743	0.0693	0.0184	-0.0171	-0.1553	-0.148
Al	**0.6965**	0.0598	0.3815	-0.0344	-0.3241	0.0463	-0.0387	-0.1606
Na_W1	0.1708	**0.5045**	***-0.6374***	0.2261	-0.2252	-0.2747	0.2879	-0.1624
Ti	**0.6402**	0.138	0.1696	0.2564	-0.229	0.2394	-0.1724	-0.1791
Ta	**0.5756**	***-0.5321***	0.0423	0.1066	0.0188	0.0694	-0.2551	-0.2702
Hf	**0.6317**	-0.3293	0.2514	0.0883	-0.0785	-0.0002	-0.143	-0.2865
V	**0.5171**	**0.5346**	0.2434	0.107	-0.1416	-0.1098	0.411	-0.3544
Sr	0.1237	0.1337	-0.4511	0.1839	0.0896	**0.3687**	**0.509**	***-0.4812***

Table 4.2: Eigenvalues, cumulative percentages, and element loadings for the first eight principal components; bolded values indicate strong positive loading and italicized values indicate strong negative loadings.

Using these new preliminary groupings, discriminate analysis was run again, this time showing that fewer than 10% of the samples had been misidentified in terms of their group membership. Samples with greater than 80% probability of group membership in a different group were reassigned, and the analysis was run a second time. The number of misidentified samples was again reduced, and those with an equal probability of belonging to two or more groups were labeled "unknown." Finally, cluster analysis was

applied to the final groupings, including a total of 439 samples, excluding unassigned samples, to determine the statistical strength of the preliminary groups. All elements were included in the analysis, and both the Ward and Average algorithms were used, producing a fairly consistent result in group membership **(Figs. 4.3, 4.4)**. It is clear from these dendrograms and previous bivariate plots that the High Cr (green) and Low Cr (dark blue) groups are more dispersed in comparison to the Atuntaqui (red), Low REE (magenta) and High Fe (orange) groups.

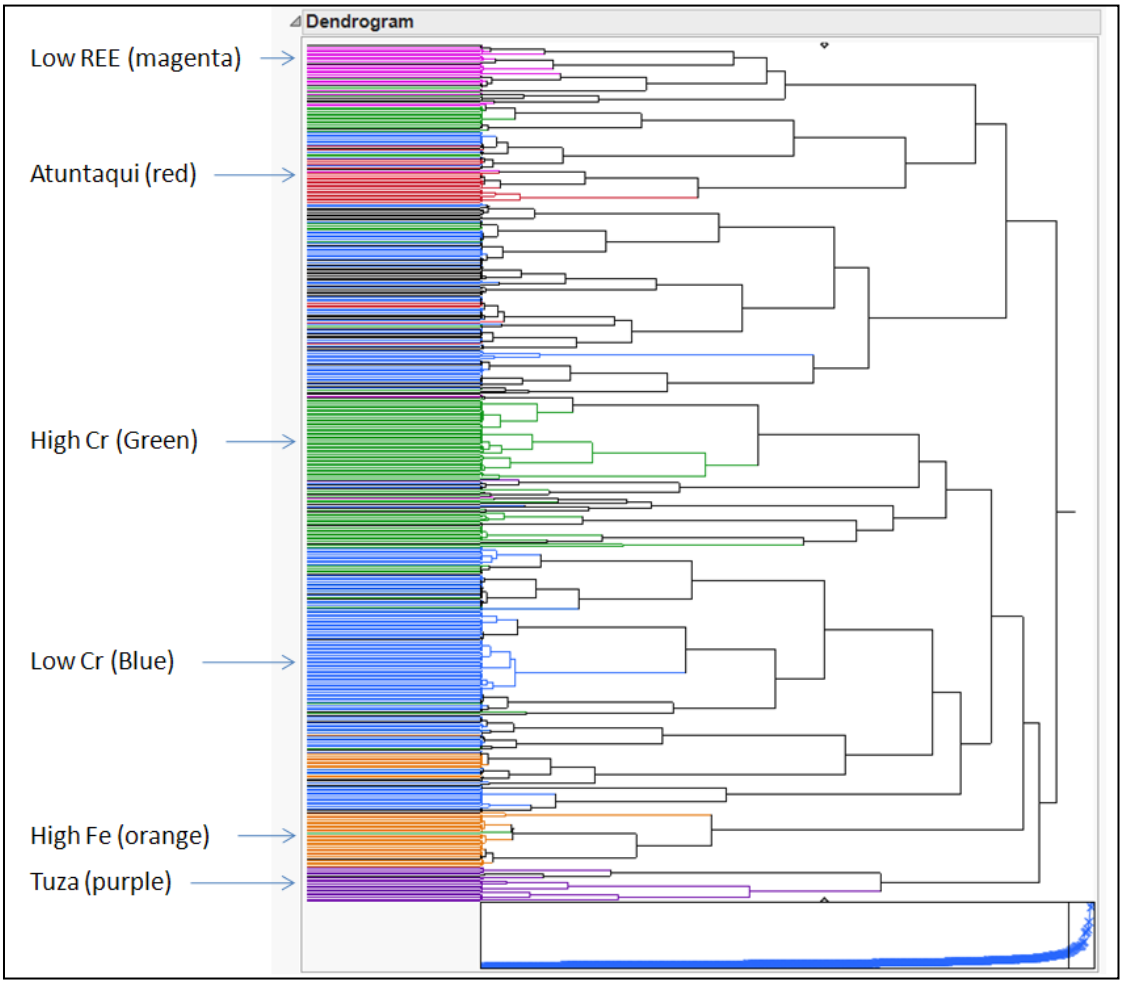

Figure 4.3: Cluster analysis using the Ward algorithm, demonstrating that most preliminary composition groups remain associated when compared on all of the elements, with some exceptions in the High and Low Cr groups.

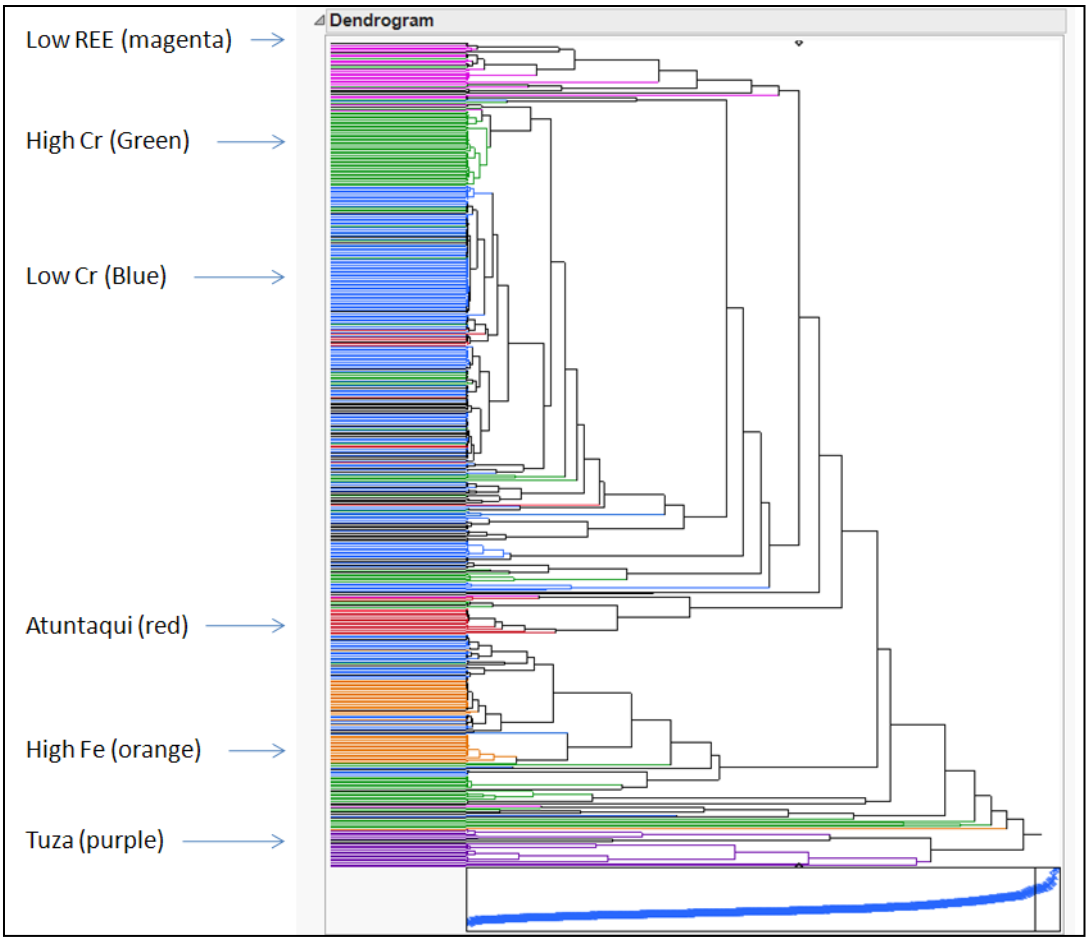

Figure 4.4: Cluster analysis using the Average algorithm, demonstrating that most preliminary composition groups remain associated when compared on all of the elements, with some exceptions in the High and Low Cr groups.

To improve the resolution for each of the preliminary groups, including those temporarily excluded from the analysis, the groups were refined using the Mahalanobis distance statistic, in which each sample was tested against the group using a jackknifed distance measure. This process identified samples with high probabilities of group membership, or core members of each composition group. The first seven principal components were used for Jackknifing and the Mahalanobis distance test in order to represent as many chemical groups as possible.

Six ceramic composition groups were evaluated using jackknifing and the Mahalanobis distance test. The Low Fe/Tuza group lost 6% of the original members, and

none were added. In contrast, the Low Cr group lost 29% of the original members, bringing the size of the group down to 139. The High Cr group also lost more than 25% of its members. Prior analyses conducted without the Low REE group, which is a subset of the High Cr group, resulted in an even higher percentage of excluded samples, indicating that the Low REE group accounts for some of the diversity within the High Cr group. The Atuntaqui, High Fe, and Low REE groups lost 19, 20 and 13%, of their original members, respectively (**Table 4.3)**. These values suggest most component groups are rather diffuse, and internally variable.

Group name	**# of samples for Jackknifing**	**# excluded**	**% loss**	**Count**
Atuntaqui	21	4	19%	17
High Cr	104	28	27%	76
Low Cr	195	56	29%	139
High Fe	36	7	20%	29
Low REE	30	4	13%	26
Panzaleo	Not enough data	-	-	
Low Fe/Tuza	18	1	6%	17

Table 4.3: Results of Jackknifing on preliminary composition groups.

After the core members for each group were identified, they were compared to every other sample in the dataset using the Mahalanobis distance test. Samples with high probabilities of belonging to each group, determined by comparison of principal component values, were assigned the tag "probable group X" and included in the final count for each composition group at the sampled sites. Field-collected clay samples and "unknown" ceramic samples labeled during preliminary group evaluation were also compared to the composition groups. The final groups, with probability of group membership, are shown in **Figs. 4.5 & 4.6**.

4.7.2. Compositional Groups

The final grouping suggests that in northern highland Ecuador, there are at least five clay compositional groups used in vessel construction. The chemical characteristics, as well as the sites associated with each composition group, are discussed below.

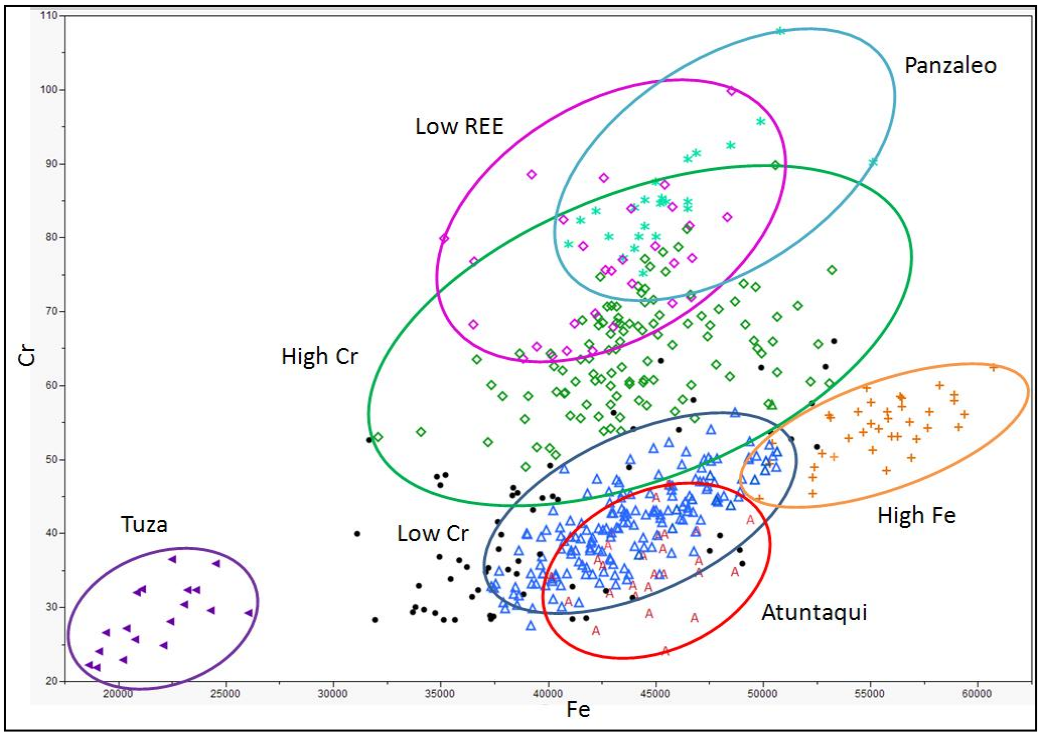

Figure 4.5: Bivariate plot of Cr and Fe concentrations showing composition groups identified in the dataset; black points are samples that did not match any group.

Low Cr Group (n=134)

The two largest groups, Low Cr and High Cr, vary based on Cr concentrations (ppm). The centroid of the Low Cr group is composed of samples from Tajamar, Loma Sandoval, and Puntiachil**.** The greatest number of Low Cr ceramics was identified at Puntiachil, followed by Loma Sandoval, both of which occur in the southern part of the study area. However, there are also high percentages of Low Cr ceramics in assemblages at the northern sites of San Roque, Caranqui, Atuntaqui, and Socapamba. Samples from Puntiachil and Socapamba were predominately thick-walled bowls. Triangularly-rimmed jar fragments similar to amphora, but less decorated, were also recovered from Puntiachil and Loma Sandoval.

The Mahalanobis distance test added two clay samples to the Low Cr group (ECU_20B, 21A) following the exclusion of mixed clay samples. Given the ubiquity of Low Cr ceramics in the study area, as well as the broad match between Low Cr ceramics

and sampled clays on bivariate plots, it appears as though Low Cr clays are present throughout the region. While this does not help to narrow down the source of Low Cr ceramics, it reveals that clays similar in composition may be found at multiple locations. This seems to relate to the distribution of andesitic and dacitic volcanic deposits, to be discussed later.

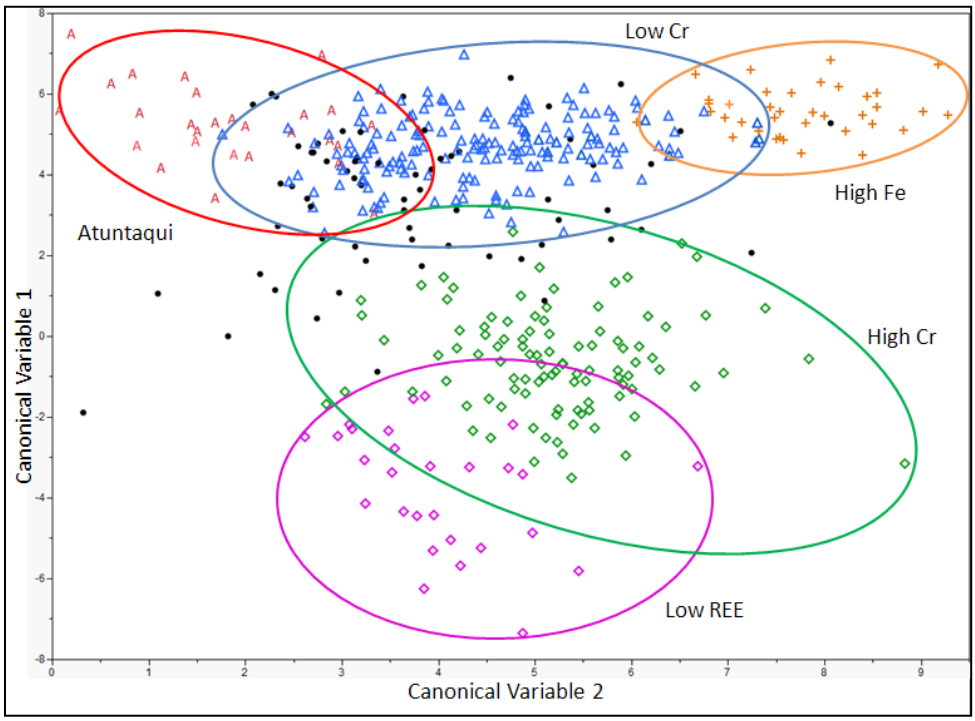

Figure 4.6: Bivariate plot of canonical variables 1 and 2 for highland compositional groups, derived from discriminate analysis.

High Cr Group (n=83)

The High Cr group is differentiated from other groups in the study based on a higher than average Cr content (≥ 55.7 ppm) and Fe content (0.437%) less than that of the High Fe group (0.552%). A majority of this group is composed of samples from the sites of Socapamba and El Tablón, located in the northeast-east portion of the study area. Similar to the Low Cr composition group, the High Cr group is represented at a variety of sites in varying concentrations. This group is represented by one sample at the southern

site of Puntiachil. This suggests that High Cr clays were not present in the southern region and few ceramics identifiable to the High Cr group were transported to these sites.

This group experienced a considerable loss of core members through Jackknifing (27%). Compared to the other identified groups, this group is the most dispersed in terms of elemental concentrations. The Mahalanobis distance test added back the previously excluded ceramic samples to the group, as well as samples with similar composition. They included ECU_16C and 2 ECU_17 clay samples (TBL_27, 28). The TBL clay samples strongly link the High Cr group to the eastern edge of the valley, where the site of El Tablón is located.

Low Rare Earth Element Group (Low REE; n=26)

This group was created as a subset of the High Cr group. Compared to this original group, the Low REE group it has a higher average Cr concentration, a lower Na concentration, and a lower Eu concentration. Bivariate plots of other rare earth elements show that it is also low in La, Sm, and Yb. This group is composed primarily of samples in the central portion of the study area adjacent to Imbabura volcano. Other sites with ceramic samples from this group include Mascarilla and Socapamba in the northern section of the study area.

The Mahalanobis distance test only added one additional sample to the group. No clay samples had a high probability of group membership; however, ECU_03A had a 4.2% probability of belonging to this group. These clay samples were taken further south, but their low probability of group membership suggests that they are not the best representation of the source area for these ceramics. More than half of the ceramics within this group likely had a serving function, based on chi-square analysis.

Atuntaqui Group (n=27)

The Atuntaqui group is characteristically high in Sc and low in Cr and contains samples primarily from Atuntaqui and Huataviro. Samples from this group also show up in smaller amounts in several other sites. Two samples were added to this group following the Mahalanobis distance test, along with three clays: ECU_01, 8B, 9A). These

clays cluster around the western flank of Imbabura volcano. Chi-square analysis revealed that the majority of samples assigned to this group had a probable serving function.

High Fe Group (n=30)

The other group of significance is the High Fe group, which has a Cr concentration intermediate between the Low and High Cr groups. As the name suggests, this group includes samples with the highest Fe concentrations in the dataset. This group only occurs at Puntiachil and Loma Sandoval and the Mahalanobis distance test added only samples from Puntiachil. Two clays in the far southern portion of the study area were also added to this group, both with less than 1% probability of group membership: ECU_12, 13A. Because these values are so low, it is unlikely that the clays used to produce High Fe ceramics were available within a half- day's walking distance to either site.

Other Groups of Interest

Several other possible composition groups were identified, but because their sample sizes were less than ten, it was not possible to evaluate them using the Mahalanobis distance test. They include a High Th group and a Very High Cr group, both containing samples from a variety of sites. Comparing the actual ceramic samples of the High Th group to the others in dataset revealed that they tended to be more finished, i.e. more likely to be slipped on both the interior and exterior surfaces, and more likely to have one or both surfaces burnished. No such patterns were detected for the Very High Cr samples, nor were these samples bounded geographically. High Th samples, on the other hand, tend to occur in the northernmost part of the valley, with the most southern site with an example being Huataviro Several samples originally included in the Very High Cr group were later added to the Low REE group and withstood Jackknifing, suggesting that the Very High Cr group may be a subset of the Low REE group.

Panzaleo/Cosanga and Tuza ceramics, which are exotic to the highlands, can be readily identified based on decorative style. INAA of several of these ware types reveal

that their chemical compositions are also markedly different from those within the northern highlands. Bivariate plots of the elements of interest, as well as the results of discriminate analysis, show that their compositions are also tightly clustered. Compared to other groups, the Panzaleo/Cosanga group displays the highest concentration of Yb, and elevated concentrations of Ce, Cs, Rb, and Th. The Tuza group is characteristically low in Fe, Cr, and Co compared to the ceramic groups local to the highlands. Two exotic samples were obtained from the two southern sites of Loma Sandoval and Puntiachil, while more than 10 were recovered from the most northern *tola* sites.

4.8. Geologic Constraints

4.8.1. Ecuadorian Volcanoes

Subduction of the Nazca oceanic plate off the western coast of South America has created a very volcanically active region, leading to the formation of dozens of volcanic centers along the cordilleras, showing a range of compositions (Le Pennec *et al.* 2011). Of these, five occur within the study area: Cayambe, Cotacachi, Cusín, Imbabura, and Mojanda - Fuya Fuya. They are primarily andesitic (SiO_2: 57-63 wt. %) or dacitic (SiO_2: 64-77 wt. %) in composition (Klein *et al.* 2008), but multiple eruption events have diversified the composition of some of these formations **(Fig. 4.7)**.

The volcanic arc of Ecuador consists of three zones. The volcanic front, or Cordillera Occidental (western range), is comprised of two terranes. The older terrane is an oceanic plateau suite derived from a basaltic to andesitic source. The younger terrane shows similarities in source rock, but is partially sedimentary, suggesting an island arc sequence (Hughes and Pilatasig 2002). In contrast, the main arc, or Cordillera Oriental (eastern range) consists of metamorphic rocks that occur on the surface of the continental crust (Zeil 1979:80; Spikings and Crowhurst 2004). The third zone is the back-arc in the upper Amazonian regions (Robin *et al.* 2010). The mineralogical differences observable between the two cordilleras, which border the study area, enabled Bray to determine that

Panzaleo/Cosanga ceramics, with obvious metamorphic components, originated from a location adjacent to the Cordillera Oriental (1991; 1995).

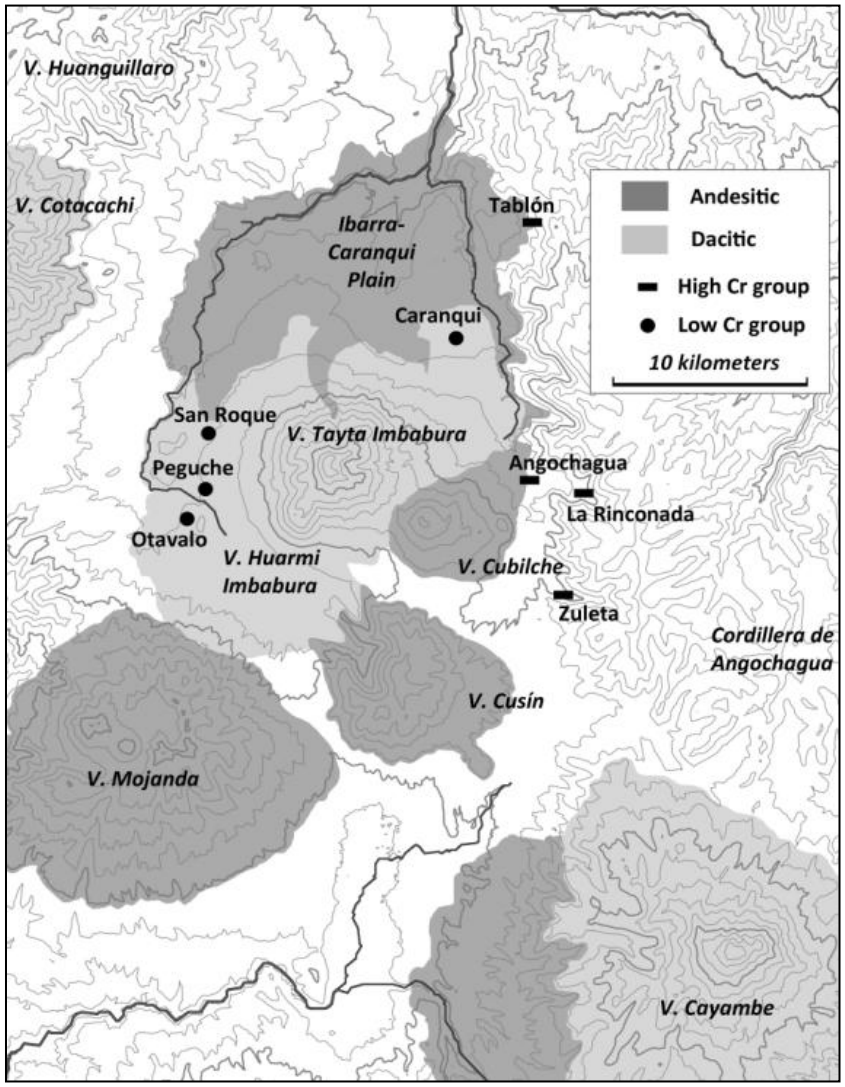

Figure 4.7: Distribution of andesitic and dacitic volcanic products within the study area, from Minc *et al.* (N.d.), adapted from Le Pennec (2006; 2011); High Cr and Low Cr group symbols indicate clay sample locations with the corresponding composition.

Many of the large volcanic edifices of Ecuador, including Cayambe, Mojanda-Fuya Fuya, and Pichincha, are characterized by a shift to adakitic magmatism over time (Chiaradia *et al.* 2009). Adakites possess a SiO^2 > 56 wt%, high Al, Na, and Sr, and low

Y and HREE contents, resulting in high La/Yb and Sr/Y ratios. In addition, Th/La ratios are noticeably higher in the eastern cordillera volcanoes (Hidalgo et al 2012: 182). In a bivariate plot of Th/La, the ratio of ceramics belonging to the Panzaleo group demonstrate this higher ratio in comparison to the other ceramics sampled, lending additional evidence to Bray's theory that Panzaleo ceramics originated in the Cordillera Oriental (1991; 1995).

4.8.2. Mineralogy and Geochemistry of Northern Volcanoes

Located in the southeastern corner of the study area, nearest to the *tola* sites of Loma Sandoval and Puntiachil, Volcán Cayambe consists of an older, andesitic component on its western flank ("Viejo Cayambe") and a younger, explosive, dacitic series on its eastern flank ("Nevado Cayambe") **(Fig. 4.7)**. This eastern flank is described as being enriched in Cr and Ni in comparison to the andesitic component (Samaniego *et al*. 2002). The main mineralogical difference between the two suites is the presence of amphibole in Nevado Cayambe rocks, which is absent in Viejo Cayambe rocks (Samaniego *et al*. 2002).

To the northeast of Cayambe is the Mojanda-Fuya Fuya volcanic complex, which also exhibits multiple individual volcanic flows with differentiable components **(Fig. 4.7)**. The older Mojanda volcano was constructed through the extrusion of Si-rich andesitic lavas and dacitic domes, which was capped by an andesitic cone. Fuya Fuya is more silica-rich (61-75 wt% SiO2), categorizing it as dacitic. The Fuya Fuya suite can also be characterized by its high Sr/Y and La/Yb ratios. Both suites show similar Sr content, but Yb for the Fuya Fuya suite ranges between 0.5 and 1.2 ppm, while Yb content in the Mojanda suites are > 1.3 ppm (Robin *et al.* 2009: 240-2). Mojanda samples taken further from the summit consist of plagioclase, orthopyroxene, clinopyroxene, magnetite, and possibly olivine in the mafic samples, and amphibole, and biotite in the more silicic ones. The Fuya Fuya samples contain plagioclase, amphibole, and magnetite, and may contain clinopyroxene, orthopyroxene, biotite, or quartz (Robin *et al.* 2009).

To the north of Mojanda- Fuya Fuya are three additional volcanic edifices: Cusín, Imbabura, and Cotacachi (**Fig. 4.7)**. Cusín is described as predominately andesitic, while Cotacachi is dacitic (Le Pennec *et al*. 2006). Imbabura consists of a series of andesitic lava successions, ranging from low silica andesites to dacites, with the large Huarmi flow field extending to the SW identified as dacitic, and Cubilche, the SE flow, andesitic. Plagioclase, ortho- and clinopyroxene, amphibole, oxides and accessory olivine are the common minerals present (Le Pennec *et al.* 2006; 2011).

4.8.3. Other Ecuadorian Volcanoes

Pichincha volcano, located west of the city of Quito, has experienced several phases of cone building, and continues to be geologically active. The most recent activity has included pyroclastic flow deposits of both ash and lava, and it is primarily dacitic in composition. Rubidium concentrations are higher in the younger Guagua cone on the western flank (34-53 ppm), compared to the older Rucu terminal cone (11-30 ppm) (Robin *et al.* 2010).

Cotopaxi volcano stands out in this region because its eruptions have alternated between rhyolitic and andesitic for the past 0.5 Ma; the most recent Holocene episode being andesitic in composition. It is located within the Cordillera Oriental (eastern range), about 60 km south of Quito (Hall and Mothes 2008). Like other subduction zone related volcanic rocks, samples from this location show depletion in Ta/Nb rations and enrichment in the light rare earth elements (U, Sr, Ba, Th, Pb, La). There is also a decrease in FeO^3 and MgO with increasing silica content (Garrison *et al.* 2011).

4.8.4. Clay Resources in Ecuadorian Volcanic Environments

As a result of the ubiquity of volcanoes in the region, soils in this area are derived primarily from thick layers of volcanic ash, which includes sedimentary clay deposits which are known to be exploited by modern ceramic producers (Minc *et al.* N.d.). The solubility of volcanic ash as well as its general lack of a crystalline structure encourages the precipitation of amorphous materials such as allophane and imogolite in

the clay size fraction. In moist regimes like northern Ecuador, these amorphous materials persist, whereas in the more marked dry season of southern Ecuador, these materials are more likely to form crystalline clays (Zehetner *et al.* 2003). The lack of a dry season also prohibits the formation of clays that have the plasticity desired by modern potters. Instead, a hardpan material, known locally as *cangahua,* accumulates where one would expect to find a clay-rich horizon (Creutzberg *et al.* 1990; Quantin and Zebrowski 1997). This material is suitable for such things as the large blocks used to create the mound features at Cochasquí, but it lacks the plasticity and workability that make it well suited to ceramic manufacture. Because quality raw clay resources are relatively uncommon, the mixing of different clays and transporting powdered clays of higher quality from other parts of the region occur in the modern production of ceramics, and may have also occurred in antiquity (Minc *et al*. N.d.; see also Druc 1996).

4.8.5. Cr source

Cr proved to be the best discriminating element for this analysis, and the geology of the region provides some insight as to why the concentrations of this element vary. The Low Cr group was detected at multiple clay sample site throughout the study area, and these sites are consistently associated with dacitic volcanic deposits. A similar trend occurs for the High Cr group and andesitic deposits. Electron Microprobe (EMPA) analysis of ceramic samples for Cr, Fe, and Sc concentrations by the author suggest a spatial correlation between points with higher Cr and Fe concentrations. EMPA of several Fe-Ti oxides from the Cayambe Volcanic Complex, located south of the study area, also showed a positive correlation between Fe and Cr content (Samaniego *et al*. 2005). Fe-Ti oxides were found to occur in all of the samples as microphenocrysts, microlites, and inclusions in other phases. Cr was also found in amphiboles, pyroxenes, olivine, and biotite, but none of these phases show the same visual correlation with Fe as the oxides (Samaniego *et al.* 2005). Compared to dacites, andesites are more mafic, producing higher concentrations of elements such as Mg and Fe. This may account for

the High Fe group, which is restricted to the southern portion of the study area, adjacent to the andesitic flow of Cayambe Volcano.

The average concentration of Cr for each of the composition groups recorded by is 34.4 ppm for the Atuntaqui group, 41.6 ppm for the Low Cr group, 65.1 ppm for the High Cr group, 54.4 ppm for the High Fe group, and 63.7 ppm for the Low REE group. These values show that Cr content varies for all of the composition groups identified, not just the High and Low Cr groups. ICP-AES analysis of whole rock samples from Imbabura volcano, which sits north of Cayambe, showed that the highest level of Cr occurs on the andesitic southwest flank (64 ppm), while much lower concentrations were found on the dacitic northern slope (average 11.5 ppm). In terms of mineralogy, oxides are a common feature of these rocks as well (Le Pennec *et al.* 2011). EMPA of two High Cr group ceramics by the author indicated they the highest concentrations of Cr compared to the other samples identified to the Low Cr and Atuntaqui groups. There is also a positive correlation between Fe and Ti content in the highland composition groups based on bivariate plots for these two elements **(Fig. 4.8)**.

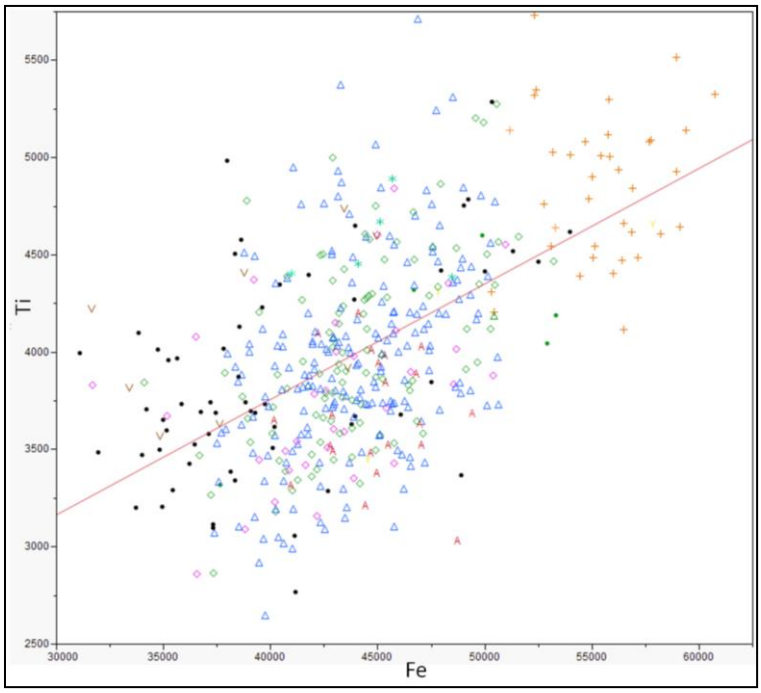

Figure 4.8: Bivariate plot of Fe and Ti concentrations in highland composition groups; red line represents the linear regression trend line.

Together this evidence suggests that samples with higher Fe content have higher numbers of Fe-Ti oxides present. Comparing Fe and Cr content demonstrates that there is a linear trend between low and intermediate Cr samples (Low Cr, Atuntaqui, High Fe groups) and increasing amounts of Fe.

4.9. Comparison of Clay Samples and Ceramic Composition Groups

Based on the geologic maps covering the study region, much of the valley is blanketed in volcanic deposits from Imbabura (P_{Im}- dark pink) and Angochagua (Pl_{An}- medium yellow) **(Fig. 4.9)**. The majority of the Imbabura cone is dacitic, but includes andesitic pyroxenes (MRNE 1980b; Le Pennec *et al.* 2006; 2011). Several sites are situated on this deposit, including: Atuntaqui, Caranqui, Socapamba, and San Roque. Clay samples from this deposit include ECU_006-San Roque, ECU_007-Bellavista (adjacent to Caranqui), ECU_002-Otavalo, ECU_020-Caranqui, and ECU_021-Caranqui. Volcanic deposits from "Angochagua" volcano are actually from Cubilche volcano and the northern edifice of Imbabura. Compositionally, they are eroded andesitic lavas. Within this deposit **(Fig. 4.9)** are several clay samples, including two ECU_017 clay samples taken at the site of El Tablón; ECU_010-Angochagua; ECU_004-La Rinconada; and ECU_016-Zuleta.

Low Cr Clays (n=2)

After reviewing the clays matching the Low Cr group, two were retained based on their percent matches and provenience information: ECU_20B (8.5%) and ECU_21A (7.1%). These samples fall within the primary flow of Imbabura volcano, which is primarily dacitic in composition **(Fig. 4.9)**. While Low Cr samples are found at almost all sampled sites within the study area, the highest occurrences are found at sites adjacent to dacitic volcanic deposits.

High Cr Clays (n=3)

Two separate clay sample locales were found to be associated with the High Cr composition group: ECU_16C and ECU_17 (2 samples). The geographic extent of these clays is less expansive compared to the Low Cr clays, restricted to the central-eastern portion of the study area **(Fig. 4.9)**. These clays are strongly associated with andesitic volcanics from Imbabura, Cubilche, and Cusín, all of which are separate flows of the Imbabura Volcanic Complex (Le Pennec 2006). Over 75% of the ceramics analyzed from El Tablón are associated with the High Cr group. This site was also the location where the ECU_017 samples were collected.

The total ceramic assemblages for the High and Low Cr group show several interesting attributes. Most significantly, a similar diversity of vessel shapes and investment in surface decoration are represented in both assemblages. There are also noticeable differences in the morphology of vessels of the same general form but from different sites. For example, thick-walled bowls from El Tablón are similar to those from Socapamba, except the ones from El Tablón have a more concave rim. There is a similar pattern in the bowl rims recovered from Puntiachil/Cayambe. While the general form of the vessel is the same, side-by-side comparison of rims from the two sites reveals small, but noticeable differences in shape. The similarity of vessels at Socapamba and El Tablón likely relates to their close proximity to one another, compared to the distances between other ramped *tola* sites.

Low REE Clays (n=1)

One clay samples had a weak probability of belonging to the Low REE group: ECU_03A, at 4.2%. This sample was taken in close proximity to ECU_01, 08, and 09, bordering the southern part of the Atuntaqui territory and moving into Cochaloma. Similar to the Atuntaqui group, the Low REE group shows up in ceramic assemblages at sites within the northern flow of Imbabura volcano, except for the site of Mascarilla, which is located on "Angochagua" volcanic materials.

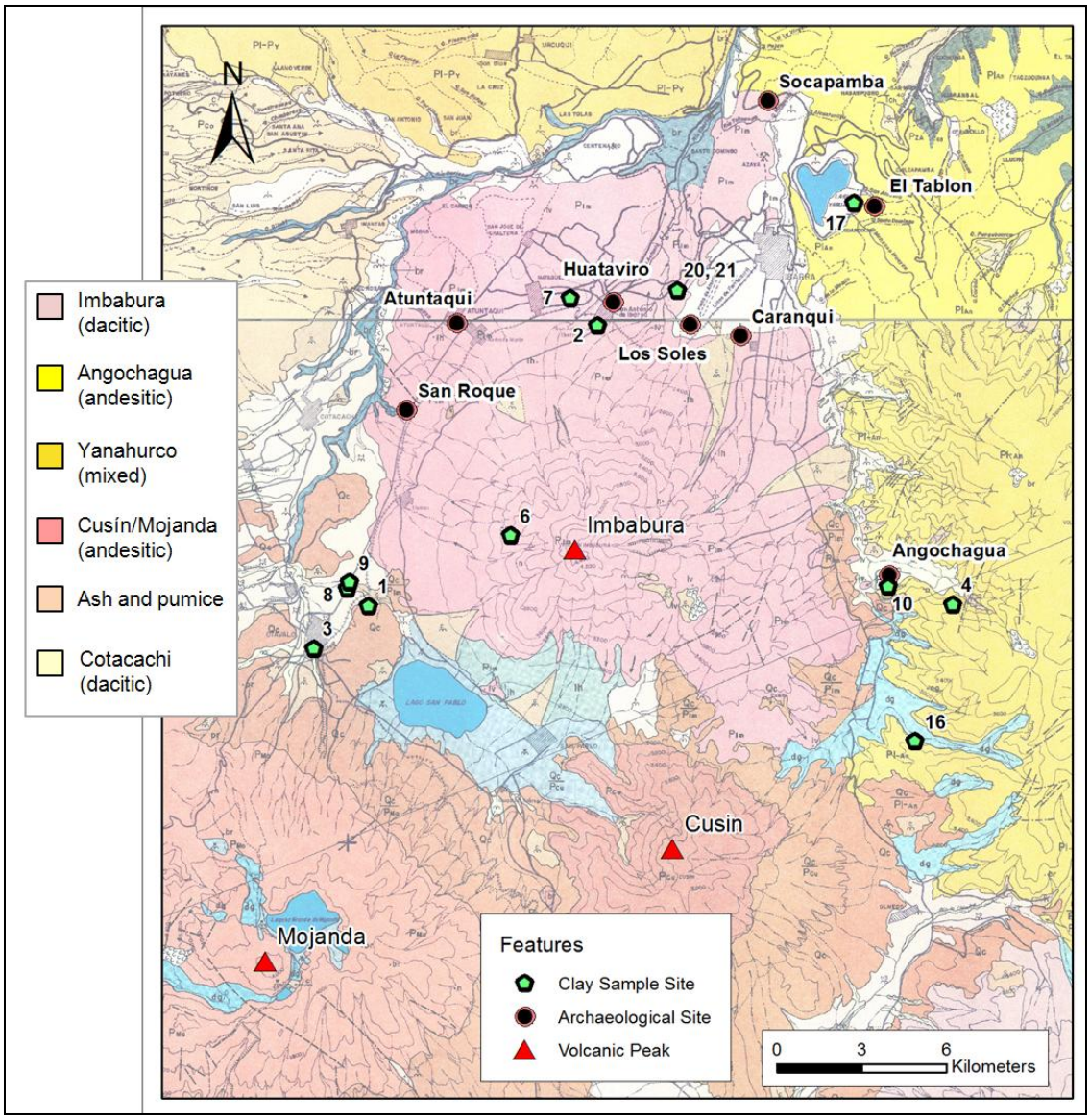

Figure 4.9: Map of geologic units in Imbabura Province indicating locations of sampled archaeological sites and clay sources.

Atuntaqui Clays (n=3)

Three clay samples assigned to the Atuntaqui composition group based on the Mahalanobis distance test and provenience information: ECU_01, 8B, and 9A. They occur in a tight cluster on the southern boundaries of the hypothetical Atuntaqui territory. According to the geologic map for the area, they were recovered in an area covered by volcanic products from both Imbabura and Mojanda, which are primarily dacitic and

andesitic, respectively (Le Pennec 2006; **Fig. 4.9)**. The bounding of the Atuntaqui clay samples to the area immediately surrounding the Imbabura cone supports the hypothesis that dacitic volcanics have a lower Cr content than andesitic ones in this region. In addition, the low occurrence of the Atuntaqui composition group outside of the Atuntaqui territory suggests that ceramics of this composition were not moving far from their source.

The matching Atuntaqui and Low rare earth element clays are both located in andesitic ash and pumice deposits, which we would expect to produce a composition matching the High Cr group. Large areas may be broadly similar in composition, as in the case of the matching High Cr clay samples, but individual flows may differ significantly enough to account for smaller composition groups like Atuntaqui and the Low rare earth element group.

High Fe Clays (n=0)

Two clay samples were identified for the High Fe group, neither of which had a greater than 1% match with the core ceramic samples for that group. However, ECU_012 and 13A are both located in the southern portion of the study area, which is the only area where High Fe ceramic samples were found, suggesting an association with volcanic complexes in the central part of the country.

According to the geologic map for northern Pichincha province, these two sites sit within a region of metamorphic rock overlain with volcanic products from Cusin, an andesitic cone **(Fig. 4.10)**. The major phenocrysts identified by the map include plagioclase, clinopyroxene, and orthopyroxene. The latter two phases often contain proportions of Fe and Mg (Klein *et al.* 2008), and could therefore explain the strong presence of Fe in clays from this area. Interestingly, the same map shows that Puntiachil/Cayambe is overlain by a lahar deposit that includes materials from Imbabura volcano, a dacitic volcano, and the western flank of Cayambe volcano, an andesitic deposit **(Fig. 4.10)**. The overlap between the High Fe group and the High and Low Cr groups based may be an expression of mixture of these clay parent materials.

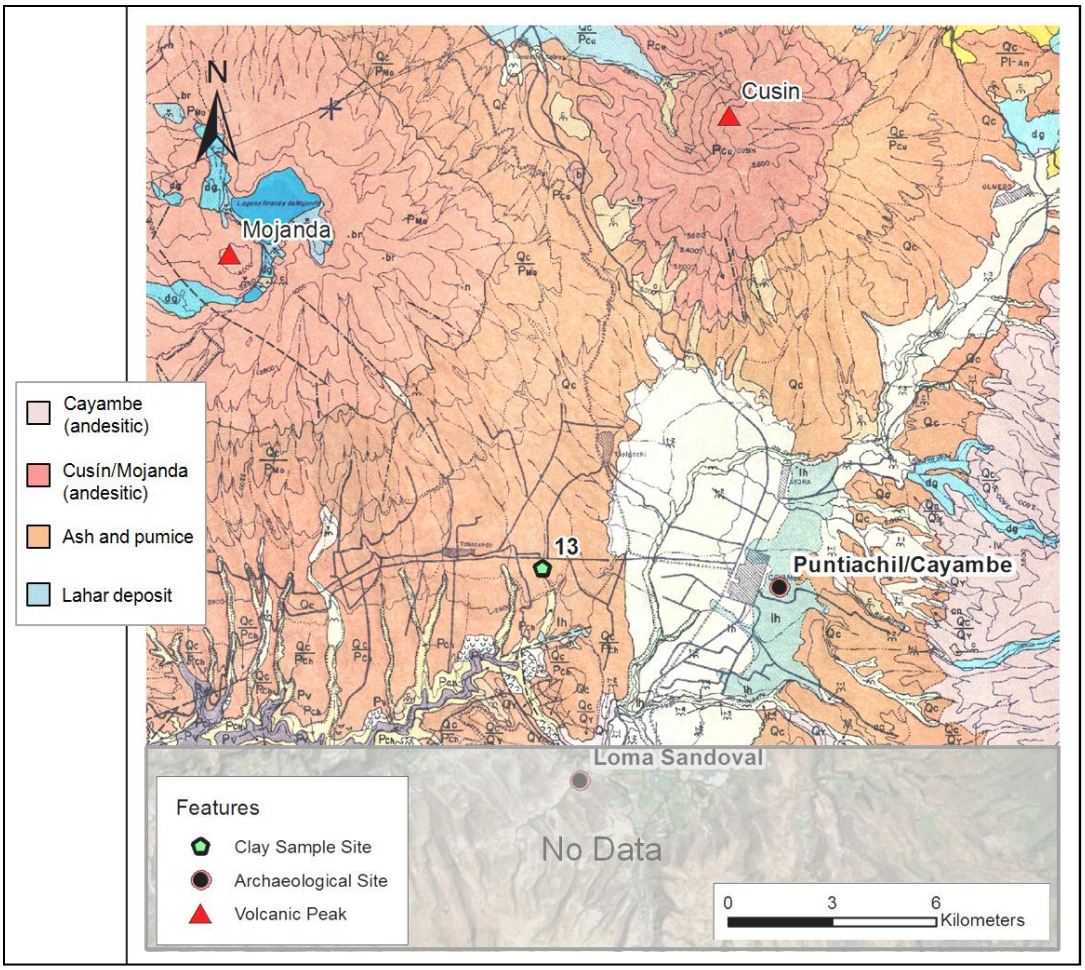

Figure 4.10: Map of geologic units in Pichincha Province indicating locations of sampled archaeological sites and clay sources.

4.10. Discussion

Sampled ceramic assemblages demonstrate clear patterning in composition group distributions at the regional scale **(Fig. 4.11)**. The High Cr and Low Cr composition groups appear the most often in ceramic assemblages, with Low Cr ceramics occurring at almost all sites. High Cr, Atuntaqui, Low REE and High Th ceramics only occur in the northern section of the region, and High Fe ceramics are restricted to the south. The High Cr, Low Cr, Low REE, and Atuntaqui composition groups match compositionally with clay samples, allowing the identification of local clay sources.

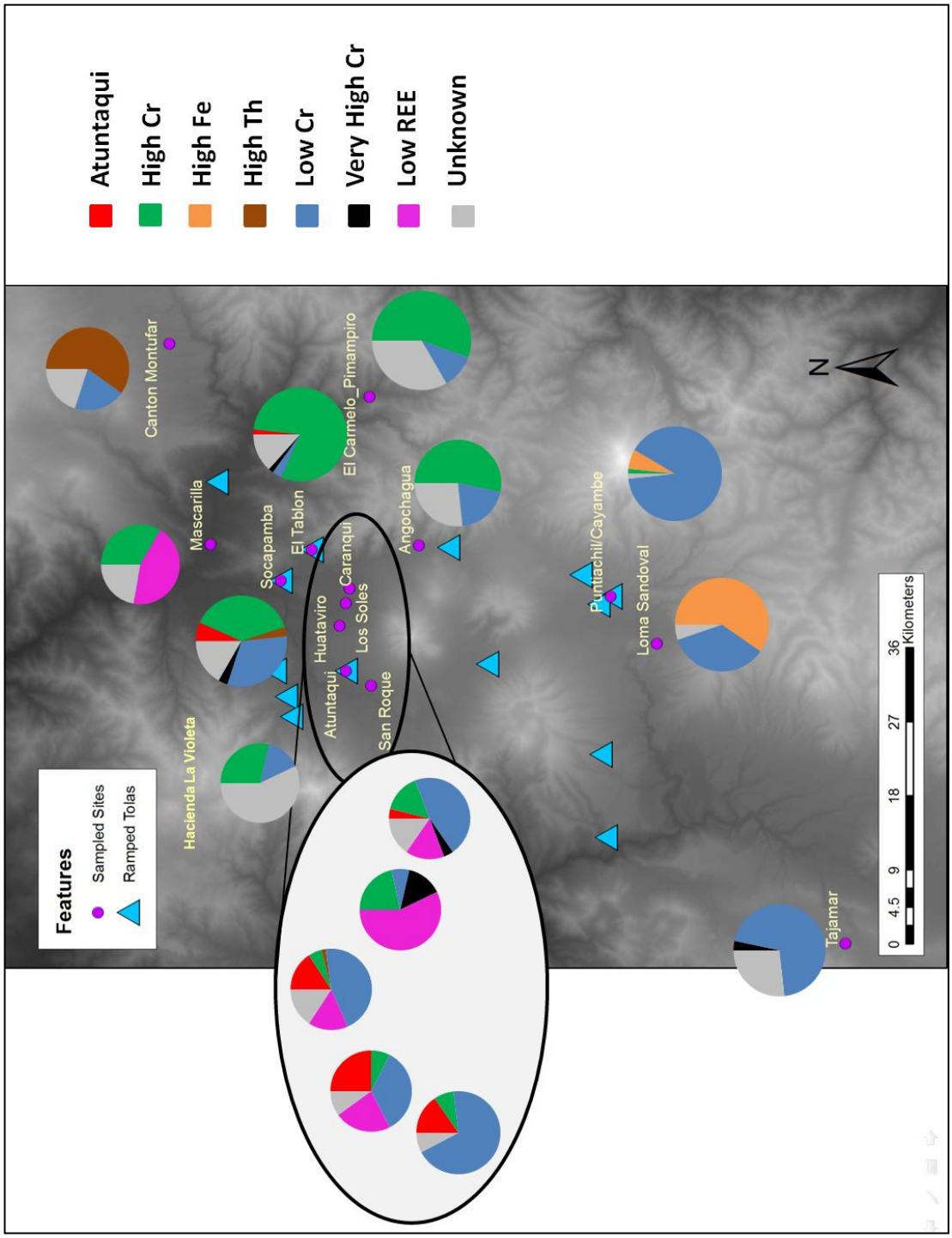

Figure 4.11: Pie charts indicating composition group representation, as a percentage, at sampled sites.

4.10.1. Local and Non-Local Clay Sources

Spencer postulated that chiefs would not travel more than a half-day's walking distance to settlements within their territory, defining the maximum size of territories (1982). Potters likely followed a similar limit to travel time. This is a somewhat different approach than that taken by Arnold (1985), who set the distance limit to 7 km based on observations of modern potters. This metric does not work here because walking distances vary so greatly between sites.

To determine which clays were actually local to each site, a maximum 8-hour walking distance from each site was used to determine territory sizes. Once a contour line representing the maximum extent of each territory was created, it was used as a guide to determined which clay samples fell within or close to that boundary. Those within the boundary were considered local clay sources, and those on the periphery were identified as possibly local clay sources. Clay samples that did not match the ceramic groups were disregarded **(Table 4.4)**.

Given people had access to multiple types of clay, it was challenging to determine whether ceramics were locally made or imported. As an example, the site of Caranqui is only a few kilometers from the Low Cr clay source to the west, and a few more kilometers from the High Cr clay source to the northeast. However, there are ceramics from all four matching composition groups found at the site. This suggests that both local and non-local ceramics were used at this site.

Comparison of the composition groups represented at each site and the determination of local clay resources produced significant results. The expectation for access to Low Cr clays, which occur at almost every sampled site, was that most sites would have local access; this was in fact the case. The only sites that had Low Cr ceramics in significant percentages but did not have local access to the identified clay source were the southern sites. These samples may match dacitic deposits from Cayambe volcano that were not sampled. High Cr clay samples are local to sites in the northeastern portion of the study area, and possibly local to Atuntaqui and San Roque in the north, and Puntiachil/Cayambe and Loma Sandoval in the south. Only one High Cr ceramic sample

occurred in the southern region, suggesting that although they may have had access to High Cr clays, they were not utilized at these two sites or transported into these sites.

Polity/Ramped Tola	**High Cr**	**Low Cr**	**Atuntaqui**	**Low REE**
Atuntaqui	local	local	local	local
Cayambe	*possibly local*			
El Tablón	local	local	*import*	
Socapampa	local	local	*import*	
Non-tola site (polity)				
Los Soles (El Tablon)	local	local	*possibly local*	*possibly local*
Angochagua (Zuleta)	local	*possibly local*		
Huataviro (Atuntaqui)	local	local	local	local
Caranqui (El Tablon)	local	local		*import*
Loma Sandoval (Cayambe)	*possibly local*			
San Roque (Atuntaqui)	*possibly local*	local	local	local

Table 4.4: Identification of local, possibly local, and non-local clay sources.

The Atuntaqui and Low REE composition groups are local to sites within the Atuntaqui territory, and Los Soles, which sits on the border between the Atuntaqui and El Tablón territories. Of these sites, Los Soles is the only one without Atuntaqui ceramics. In fact, the occurrence of Atuntaqui ceramics steadily drops off as one moves east and away from the known sources of Atuntaqui clays (ECU_01, 08B, 09A). Non-local Atuntaqui ceramics at Socapamba and El Tablón suggest exchange relationships between these three territories. This interpretation is further supported by the occurrence of possibly non-local High Cr ceramics at Atuntaqui and San Roque. Non-local Low REE ceramics are notably absent at Socapamba and El Tablón. Neither of these composition groups appears at Puntiachil or Loma Sandoval in the south.

Differential access to compositionally distinct clay resources is an indicator of the movement of ceramics between sites. Atuntaqui and High Cr ceramics were likely exchanged between the Atuntaqui territory in the west and the Socapamba and El Tablón

territories in the east. Typological analysis of the ceramics in this dataset indicates High Cr, Low Cr, and High Fe clays were used to produce the full range of vessel types, from serving vessels to utilitarian and storage vessels. Atuntaqui and Low REE clays, on the other hand, seem to have been preferred for the production of serving vessels. That being said, the Atuntaqui ceramics that appear in Socapamba and El Tablón assemblages are both utilitarian and serving vessels. The same is true of High Cr ceramic samples at sites within the Atuntaqui territory. The significance of this finding is that there is no discernible preference for the exchange of serving vessels. As a result, there is no reason to believe that serving vessels were transported between sites specifically for feasting events.

Ten amphora sherds recovered from Socapamba and El Tablón were also included in this analysis. As special-use vessels that were more decorated than other utilitarian and serving wares, they have the greatest potential of moving between settlements for feasting events. The results of trace-element analysis, however, show that these vessels were also produced using locally-available clays. At Socapamba, two of the amphora were Low Cr ceramics, and the two others were High Cr. The equal distribution of amphora between the two composition groups is indicative of the distribution of all of the ceramics at the site. Amphora from El Tablón were produced using High Cr clay, which was available on-site.

These results indicate limited exchange in ceramics occurring between neighboring sites. The identification of ceramic composition groups and the determination of their approximate sources show that some ceramics were moving between sites, but exchange was not occurring on a regional scale. Most sites have ceramic assemblages that reflect locally- available clays, indicating that few ceramics were actually moving beyond their source locations.

In contrast with local ceramics, the acquisition of exotic ceramics from areas outside of the region substantiated elite status. Exotic ceramics move by means of extended trade networks that supersede chiefly territorial boundaries. On the other hand, local ceramics likely moved with individuals traveling to attend feasts at other locations.

In general, the distribution of both exotic wares is patchy, reflecting differential access to these goods by individual chiefs **(Fig. 4.12)**.

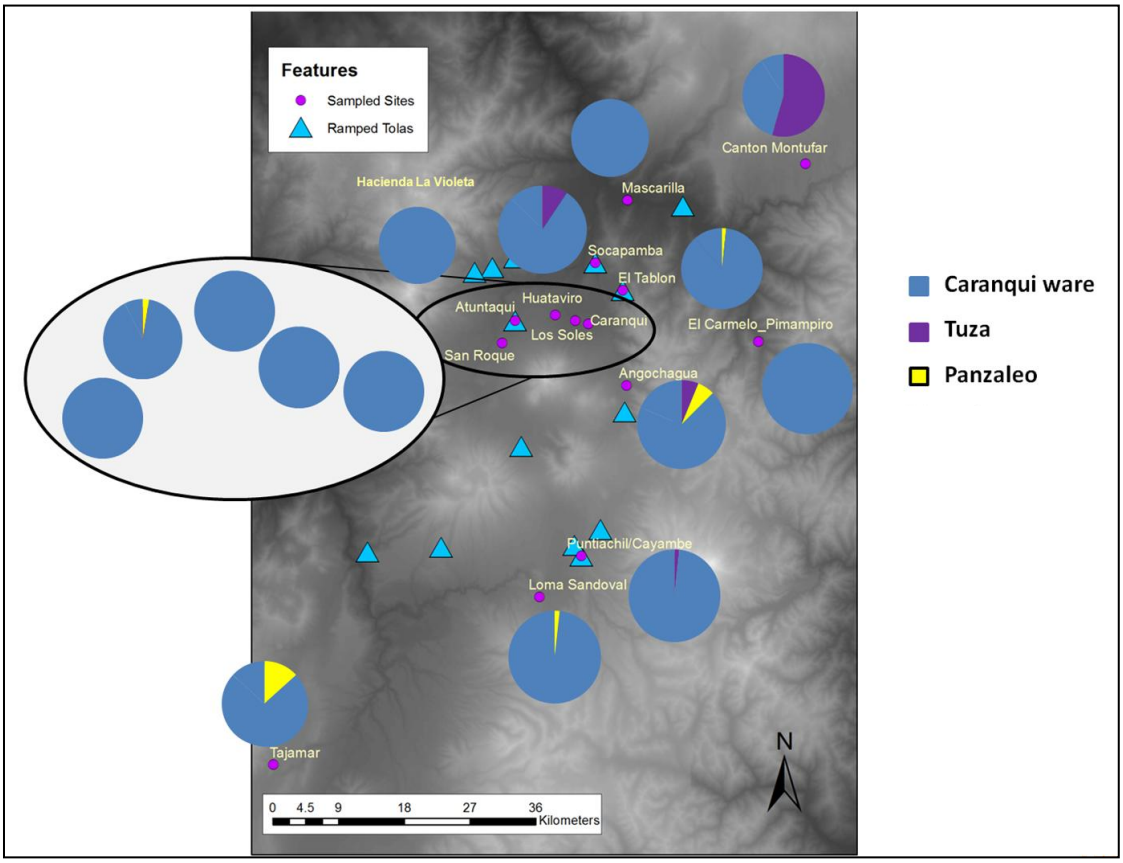

Figure 4.12: Distribution of exotic ceramics at sampled sites shown as percentages of the total assemblage

Similarities in the decorative style of Caranqui ware suggest that vessels were produced by the same dispersed, but related, culture group. Vessels produced at different sites show very similar patterns in shape and surface treatment, making it almost impossible to determine source locations. The results of instrumental neutron activation analysis demonstrate that of the five main highland ceramic composition groups identified, Low Cr and High Cr ceramics occur at most sites. These groups included a large portion of the samples in the study and were internally variable in their composition. On the other hand, High Fe, Atuntaqui, and Low REE ceramics have

limited geographic range. These ceramics are found within close proximity to matching clays. Comparison of the distributions of ceramic samples from all five composition groups reveals virtually no evidence of exchange between the north and the south.

The Atuntaqui territory had access to all of the northern composition groups. As a result, there is almost an equal proportion of these composition groups represented at the site. Socapamba, which also ranks high in site area and abundance of *tolas* at the regional scale, and its immediate neighbor El Tablón, had access to fewer clay resources but also have ceramics that were produced using non-local clays. All of the other sites sampled show a predominately localized pattern of clay resource exploitation. This pattern suggests that the degree and scale of exchange at the local level was directly related to the size and political power of chiefly site. Some exchange between the most politically significant sites in the region, along with the importation of exotic Tuza and Panzaleo/Cosanga ceramics, suggest an exchange network of limited degree and scale.

Chapter 5: Summary and Conclusions

While ethnohistoric information has helped to create a framework for interpreting Pre-Incaic political and economic organization in Northern Highland Ecuador, several important components of the regional political system remained unknown. First, what was the degree and scale of interaction between these groups? There has been no consensus answer as to whether a regional hierarchy existed, or if groups were politically semi-autonomous (Bray 2008). The political and economic interactions between settlements at the local scale have also remained ambiguous. Archaeological evidence of feasting at *tola* sites first prompted the investigation of local interaction patterns, while the importation of exotic ceramics from groups north and south of the Guayllabamba Basin raised the possibility of regional-scale exchange system linking political units.

Two methods were used to model political and economic interactions occurring during the Late Period. Settlement pattern analysis was performed using the ArcGIS 10.0 software package, focusing on the spatial distribution of individual archaeological sites, the boundaries of territories that may have been administered by political centers, and finally, the distances between political centers and clay sources used to produce ceramics. Instrumental neutron activation analysis was used for trace element detection in archaeological and modern ceramics, as well as field-collected clay samples. The concentrations of the detected elements were then compared against one another to identify groups of samples of similar composition. These results were then used to track the movement of ceramics within the highland region, using the movement of ceramics as a way to measure the movement of individuals.

5.1. Summary of Results

5.1.1. Settlement Pattern Analysis

Several methods were used to interpret the distribution of settlements within the study area. Histograms of site size, *tola* abundance, and individual *tola* size provided a

basic picture of the variation between sites, showing that larger sites tend to have more *tolas* present. At the regional scale, the two sites of Atuntaqui and Zuleta are several times larger than the other sites in the region, suggesting the possibility of a nested hierarchical system. Other methods were applied to the dataset to determine whether this was actually the case.

Analysis of the clustering behavior of ramped, quadrilateral, and hemispherical *tolas* revealed that ramped *tola* sites, the centers of political power in the region, have both a clustered and dispersed settlement pattern. Along the periphery, sites tend to be more clustered, while in the center of the region, they are strongly dispersed. Smaller non-ramped *tola* sites tend to cluster around ramped *tola* sites at distances of 8 km, demonstrating a hierarchical relationship at the local level, but there is no indication of a nested hierarchical relationship between ramped *tola* sites.

Application of Tobler's Hiking Function was critical to the understanding of territorial boundaries and access to clay resources in the highlands. Travel from some sites, such as Socapamba and El Tablón, was greatly restricted by the steepness of the terrain. In contrast, an individual traveling from Atuntaqui, located in an area with less severe topography, could make their way twice as far than from Socapamba in the same amount of time. Comparing the possible distances traveled within a half-day's walk with hypothetical territorial boundaries created using Thiessen polygons further demonstrated the contrast between clustered, peripheral sites and dispersed, centrally located sites. Least-cost path calculations for sites at each corner of the study area produced a consistent result of approximately 20 km, indicating that although straight line distances between sites can vary, the difficulty of the terrain works to equalize the walking times between sites.

Thiessen polygons also showed the unequal distribution of non-ramped *tola* sites within the territorial boundaries of ramped *tola* sites. As an example, there are only two sites within the Zuleta territory, while there are six sites within the Atuntaqui territory. There is only one site within the Cayambi territory, assuming that the neighboring ramped *tola* sites were independent. If a strong regional hierarchy were present, one

would expect to see a consistent pattern of clusters of smaller *tola* sites associated with the more politically powerful ramped sites.

A weakly integrated regional hierarchy of *tola* sites exists in the study area, lacking an obvious nested hierarchy, and is based on relative site area, territorial control, and *tola* size. Atuntaqui is the largest site, followed by Zuleta, then Angochagua, Socapamba, and Cochasquí. In terms of *tola* density, Zuleta ranks first, followed by Socapamba, Cochasquí, Paquistancia, Atuntaqui, and Angochagua. In addition, Atuntaqui and Zuleta have the largest territorial areas based on Thiessen polygons. Other ramped *tola* sites in the region are much smaller in size, and have a similarly small territorial area. The number of *tolas* present at a site is the most variable measure of hierarchy among these smaller sites.

The results of settlement pattern analysis also indicated a region between Cayambe and Cochaloma where no sites exist, supporting the ethnohistorically described boundary between the Caranqui and Cayambi chiefdoms. There also appears to be an economic boundary between the two areas based on where ceramics of different composition groups appear. Based on this analysis, there was no site that had political power over the entire region; rather, the region was divided between two factions, with several sites in the northern faction standing out as considerably larger and with more political influence, but apparently not to the degree needed to create a regionally integrated political system.

5.1.2. Exchange Interactions based on Ceramic Chemical Composition

Trace-element analysis of ceramic samples representing both *tola* and non-*tola* sites were analyzed as a way to identify exchange relationships between the territories identified through geospatial analysis. The local Caranqui ceramic ware is stylistically and morphologically consistent throughout the culture area, making the identification of distinctive source locations particularly difficult. Instrumental neutron activation analysis was used in this study for its ability to identify the chemical composition of ceramics, and provide a basis for tying artifacts to clay sources.

Five composition groups were identified for the highland region: High Cr, Low Cr, High Fe, Low Rare Earth Element (Low REE) and Atuntaqui. Low Cr ceramic samples were recovered from all of the sampled sites but one non-*tola* site. The High Cr group was also represented at a large portion of sites, but was absent in the southern portion of the region except for one sample, indicating a generally inverse correlation between this group and High Fe ceramic samples. The Atuntaqui and Low REE composition groups are best represented at sites within the Atuntaqui territory, with few samples appearing at sites outside of the area. The strength of these groups was tested and confirmed using several multivariate and univariate statistical techniques to provide the most accurate characterization of the groups as possible.

Statistical comparison of ceramic composition groups and field-collected clay samples revealed multiple matches, indicating that individual ceramic samples could be tied to specific clay sources. Using the boundaries of chiefly territories generated using Tobler's Hiking Function (territories could be no larger than the distance traveled in a half-day), clay samples with matches to ceramic composition groups were compared to the territorial boundaries to identify local and non-local clay sources for each sampled archaeological site. The ceramic composition groups represented by each sampled assemblage were then compared to the local and non-local clay sources to identify which ceramics may have been traded into the site rather than produced locally. Ceramic samples that did not match local clays were identified as non-local ceramics. The results of these comparisons were then interpreted at the local and regional level as a way of describing exchange interactions between different settlements.

Low Cr clays occurred in the northern portion of the Eastern Cordillera, east of the cluster of archaeological sites in the center of the valley. A majority of sites had local access to these clays, and as one would expect, Low Cr ceramics are found throughout the region. High Cr clays were local to a higher percentage of sites, including the southern sites of Puntiachil/Cayambe and Loma Sandoval. Only one High Cr ceramic was found in the south, while almost all northern sites contain High Cr ceramics. Atuntaqui and Low REE clays occur along the western flank of Imbabura volcano and

were local to all sites within the Atuntaqui territory. Some Atuntaqui and Low REE ceramics occur outside of this area, pointing to the possibility of limited trade between the Atuntaqui and El Tablón territories. No clay samples matched the High Fe ceramic group, although it is highly unlikely that such sources were non-local to Loma Sandoval and Puntiachil, where all of these samples are concentrated. The results of INAA clearly show that exchange of Caranqui ware was only occurring on the local scale. Exotic Panzaleo and Tuza ceramics seemed to have been traded a much greater distance, but the mechanisms governing the exchange of these two classes of ceramic vessels differed significantly; elites would have been the most interested in obtained ceramics from exotic locales as a strategy for demonstrating power, while the exchange of local ceramics was governed by the movement of individuals among neighboring settlements in response to invitations to feasting events.

5.2. Conclusions

Interpretation of settlement patterns and clay resource exploitation for Northern Highland Ecuador during the Late Period suggest that there was limited political and economic interaction among chiefdoms. Ramped *tola* sites occur in both dispersed and clustered patterns, and some territorial boundaries coincide with half-day walking distances, suggesting that sites were semi-autonomous. Some sites stand out as considerably larger, with a greater number of *tolas* present, suggesting that differences in political influence and power did vary between sites, but these differences are not reflective of a nested hierarchical political system during the Late Period.

At the local scale, exchange occurred at limited distances. Several settlements in the northern section of the study area could have only acquired some of their ceramics from other neighboring territories via trade. Virtually no ceramics appear to have been exchanged between the northern Caranqui and southern Cayambi areas based on the limited distribution of High Fe ceramics and the absence of Atuntaqui and Low REE ceramics in the south. As a result, exchange of Caranqui ware at the regional scale was

limited. In conclusion, the political system employed by chiefdoms of Northern Highland Ecuador during the Late Period had some attributes of a regionally integrated system, but most evidence points to a system organized at the local level, i.e. between neighboring territories. These findings support the ethnohistoric evidence of a more fragmented political system.

The chiefdom model is an effective tool for describing societies with a political organization intermediate between tribes and states (Earle 1987). This study provides a more detailed analysis of the nature of political and economic interactions during the Pre-Hispanic period in northern highland Ecuador. It also provides valuable information to the theoretical analysis of chiefdoms, especially how these models can be applied to the analysis of archaeological information. Study of the prehistory of northern highland Ecuador also promotes protection of archaeological resources as the area faces rapid urbanization and population growth.

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APPENDIX A:

Ceramic Sample Descriptions

Table A.1: Ceramic Sample Descriptions, Part 1

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
ANG_001		Angochagua	Panzaleo	rim	bowl	ext. thickened
ANG_002	?	Angochagua	Tuza	body	bowl	-
ANG_003	serving	Angochagua	Caranqui	rim	compotera	everted, flared
ANG_004	serving	Angochagua	Caranqui	rim	bowl	ext. thickened
ANG_005	utilitarian	Angochagua	Caranqui	other	other	-
ANG_006	serving	Angochagua	Caranqui	rim	compotera	horiz. everted
ANG_007	?	Angochagua	Caranqui	body	jar?	-
ANG_008	utilitarian	Angochagua	Caranqui	rim	bowl	bevelled
ANG_009	?	Angochagua	Caranqui	rim	other	-
ANG_010	?	Angochagua	Caranqui	other	other	-
ANG_011	serving	Angochagua	Caranqui	rim	bowl	rounded, inverted
ANG_012	serving	Angochagua	Caranqui	rim	bowl	bevelled
ANG_013	serving	Angochagua	Caranqui	body	jar	-
ANG_014	serving	Angochagua	Caranqui	other	other	-
ANG_015	serving	Angochagua	Caranqui	rim	compotera	thickened, everted
ANG_016	serving	Angochagua	Caranqui	rim	bowl	rounded, inverted
ATU-01	serving	Atuntaqui	Caranqui	rim	bowl	flattened
ATU-02	serving	Atuntaqui	Caranqui	rim	bowl	thickened, flattened
ATU-03	storage	Atuntaqui	Caranqui	body	large container	
ATU-04	storage	Atuntaqui	Caranqui	body	large storage container	
ATU-05	utilitarian	Atuntaqui	Caranqui	body	large container	-
ATU-06	utilitarian	Atuntaqui	Caranqui	body	-	-
ATU-07	serving	Atuntaqui	Caranqui	rim	bowl	rounded
ATU-08	utilitarian	Atuntaqui	Caranqui	rim	bowl	rounded, slightly concave
ATU-09	serving	Atuntaqui	Caranqui	rim	jar	rounded, pinched
ATU-10	serving	Atuntaqui	Caranqui	rim	bowl	rounded, flattened
ATU-11	serving	Atuntaqui	Caranqui	rim	bowl	rounded, slightly pointed
ATU-12	serving	Atuntaqui	Caranqui	rim	jar*	rounded, slightly pointed
ATU-13	serving	Atuntaqui	Caranqui	rim	jar	rounded, slightly pointed
ATU-14	serving	Atuntaqui	Caranqui	body	-	-
ATU-15	serving	Atuntaqui	Caranqui	rim	bowl	rounded
ATU-16	serving	Atuntaqui	Caranqui	rim	bowl	slightly thickened, flattened
ATU-17	serving	Atuntaqui	Caranqui	rim	jar	rounded, slightly bulstered

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
ATU-18	serving	Atuntaqui	Caranqui	rim	carinated bowl	flattened
ATU-19	utilitarian	Atuntaqui	Caranqui	body	jar	-
ATU-20	serving	Atuntaqui	Caranqui	rim	bowl	flattened, slightly everted
ATU-21	serving	Atuntaqui	Caranqui	rim	jar	rounded, everted
ATU-22	serving	Atuntaqui	Caranqui	rim	jar	rounded, everted
ATU-23	serving	Atuntaqui	Caranqui	rim	jar	flattened, everted
ATU-24	serving	Atuntaqui	Caranqui	rim	jar	everted, rounded
ATU-25	?	Atuntaqui	Caranqui	rim	cup	angular eversion
ATU-26	utilitarian	Atuntaqui	Caranqui	rim	jar	rounded, everted
ATU-27	utilitarian	Atuntaqui	Caranqui	body	jar or bowl	-
ATU-28	utilitarian	Atuntaqui	Caranqui	rim	bowl	rounded
ATU-29	storage	Atuntaqui	Caranqui	body	large storage container	-
ATU-30	serving	Atuntaqui	Caranqui	rim	jar	rounded, slightly flattened
ATU-31	storage	Atuntaqui	Caranqui	body	large storage container	-
ATU-32	utilitarian	Atuntaqui	Caranqui	body	-	-
ATU-33	serving	Atuntaqui	Caranqui	rim	bowl	rounded, inverted
ATU-34	storage	Atuntaqui	Caranqui	body	large storage container	-
ATU-35	storage	Atuntaqui	Panzaleo	body	storage container	-
ATU-36	storage	Atuntaqui	Caranqui	body	large storage container	-
ATU-37	utilitarian	Atuntaqui	Caranqui	rim	jar	everted, squared
ATU-38	serving	Atuntaqui	Caranqui	rim	jar	slightly squared, everted
ATU-39	utilitarian	Atuntaqui	Caranqui	rim	jar	everted, squared
ATU-40	serving	Atuntaqui	Caranqui	rim	amphora	bolstered, triangular
CAR_001	-	Caranqui	Inca	body	aribalo	-
CAR_002	-	Caranqui	Inca	handle	jar	flattened
CAR_003	-	Caranqui	Inca	handle	Aribalo	-
CAR_004	-	Caranqui	Inca	handle	Pedestal Pot	-
CAR_005	-	Caranqui	Inca	rim	Aribalo	-
CAR_006	-	Caranqui	Inca	body	Aribalo	-
CAR_007	-	Caranqui	Inca	body	-	-
CAR_008	-	Caranqui	Inca	rim	plate	-
CAR_009	-	Caranqui	Caranqui	rim	bowl	horiz. Flattened
CAR_010	-	Caranqui	Caranqui	rim	jar	flattened, ext. thickened

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
CAR_011	-	Caranqui	Caranqui	rim	jar	thickened on underside
CAR_012	-	Caranqui	Caranqui	rim	jar	ext. thickened
CAR_013	-	Caranqui	Caranqui	rim	bowl	everted, ext. thickened
CAR_014	-	Caranqui	Caranqui	rim	jar	flared, ext. thickened
CAR_015	-	Caranqui	Caranqui	rim	jar	thickened, horiz. Everted
CAR_016	-	Caranqui	Caranqui	rim	olla	horizontally flattened
CAR_017	-	Caranqui	Caranqui	rim	bowl or jar	everted, horiz. Flattened
CAR_018	-	Caranqui	Caranqui	rim	bowl	bevelled
CAR_019	-	Caranqui	Caranqui	rim	jar	bolstered
CAR_020	-	Caranqui	Caranqui	rim	bowl	flattened
CAR_021	-	Caranqui	Caranqui	rim	compotera	horizontally everted
CAR_022	-	Caranqui	Inca	other	Aribalo	-
CAR_023	-	Caranqui	Inca	handle	Aribalo	-
CAR_024	-	Caranqui	Inca	handle	Aribalo	-
CAR_025	-	Caranqui	Inca	handle	Aribalo	-
CAR_026	-	Caranqui	Inca	body	-	-
CRM-01	-	El Carmelo, Pimampiro	-	rim?	-	flattened
CRM-02	-	El Carmelo, Pimampiro	-	rim	jar	rounded, everted
CRM-03	-	El Carmelo, Pimampiro	-	rim	open vessel	flattened
CRM-04	-	El Carmelo, Pimampiro	-	rim	bowl	tapered
CRM-05	-	El Carmelo, Pimampiro	-	rim	bowl	rounded, slightly bolstered
CRM-06	-	El Carmelo, Pimampiro	-	rim	restricted vessel	rounded, everted
CRM-07	-	El Carmelo, Pimampiro	-	rim	concave bowl	slightly tapered, strongly inverted
CRM-08	-	El Carmelo, Pimampiro	-	rim	jar	rounded, slightly tapered, everted
CRM-09	-	El Carmelo, Pimampiro	-	rim	large round jar	rounded, strongly everted, prominent shoulder
HLV-01	-	Hacienda La Violeta	Caranqui	rim	-	flattened
HLV-02	other	Hacienda La Violeta	Caranqui	other	figurine	-
HLV-03	-	Hacienda La Violeta	Caranqui	rim	-	rounded, slightly tapered
HLV-04	-	Hacienda La Violeta	Caranqui	rim	jar	bolstered, triangular
HLV-05	utilitarian	Hacienda La Violeta	Caranqui	rim	jar	rounded, slightly everted
HLV-06	utilitarian	Hacienda La Violeta	Caranqui	rim	jar	rounded, slightly bolstered, everted
HLV-07	-	Hacienda La Violeta	Caranqui	body	-	-
HUA-01	utilitarian	Huataviro	-	rim	jar	tapered, everted

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
HUA-02	serving	Huataviro	-	rim	bowl	tapered, straight/slightly everted
HUA-03	serving	Huataviro	Pasto?	rim	bowl	rounded, tapered, slightly everted
HUA-04	serving	Huataviro	-	rim	jar or bowl	tapered, slightly everted
HUA-05	serving	Huataviro	-	rim	jar	rounded, everted
HUA-06	serving	Huataviro	-	rim	jar	rounded, everted
HUA-07	serving	Huataviro	-	rim	jar	rounded, straight on interior
HUA-08	utilitarian	Huataviro	-	rim	large storage jar	rounded, slightly everted
HUA-09	utilitarian	Huataviro	-	rim	jar	rounded, everted
HUA-10	serving	Huataviro	-	rim	bowl	rounded, tapered
HUA-11	serving	Huataviro	-	rim	globular bowl	rounded, everted
HUA-12	serving	Huataviro	-	rim	bowl	tapered
HUA-13	serving	Huataviro	Pasto?	rim	bowl	rounded
HUA-14	serving	Huataviro	-	body	-	-
HUA-15	serving	Huataviro	Caranqui	rim	bowl	rounded
HUA-16	utilitarian	Huataviro	-	rim	large storage container	rounded, strongly everted; straight below rim
HUA-17	serving	Huataviro	-	rim	bowl	rounded, slightly inverted
HUA-18	serving	Huataviro	Caranqui	rim	bowl	rounded, slightly flattened
HUA-19	utilitarian	Huataviro	-	rim	bowl	flattened, angled toward interior
HUA-20	storage	Huataviro	Caranqui	rim	large storage container	heavily bolstered, somewhat triangular
HUA-21	serving	Huataviro	Caranqui	rim	compotera	bolstered, flattened, everted
HUA-22	utilitarian	Huataviro	-	rim	bowl	rounded
HUA-23	-	Huataviro	-	rim	cylindrical form	tapered
HUA-24	utilitarian	Huataviro	Caranqui	rim	jar	rounded, slightly everted
HUA-25	-	Huataviro	Caranqui	rim	jar	rounded, everted
HUA-26	-	Huataviro	-	other	base?	flattened
HUA-27	serving	Huataviro	-	rim	cylindrical form	rounded, slightly bolstered
HUA-28	serving	Huataviro	Caranqui	rim	jar or compotera	rounded, strongly everted
HUA-29	serving	Huataviro	-	rim	cylindrical form?	beveled, slightly everted
HUA-30	serving	Huataviro	-	rim	cylindrical form?	rounded, slightly everted
HUA-31	serving	Huataviro	-	rim	bowl or compotera	flattened, slightly bolstered
HUA-32	serving	Huataviro	-	rim	cylindrical form	beveled, slightly everted
HUA-33	serving	Huataviro	-	rim	restricted vessel	pinched, strongly everted
HUA-34	serving	Huataviro	-	rim	conical shaped bowl	pinched, rounded

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
HUA-35	serving	Huataviro	-	rim	globular jar	rounded, beveled, strongly everted
HUA-36	serving	Huataviro	-	rim	lipped bowl/container	beveled, rounded, everted
HUA-37	serving	Huataviro	-	rim	conical shaped bowl	rounded, slightly pinched
HUA-38	utilitarian	Huataviro	-	rim	conical shaped bowl	rounded
HUA-39	utilitarian	Huataviro	-	rim	bowl	rounded, slightly everted
HUA-40	serving	Huataviro	-	rim	bowl	rounded
HUA-41	utilitarian	Huataviro	-	rim	bowl?	rounded, slightly flattened
HUA-42	serving	Huataviro	-	rim	conical shaped bowl	rounded, pinched
HUA-43	utilitarian	Huataviro	-	rim	bowl?	flattened, everted
HUA-44	serving	Huataviro	-	rim	bowl/tray	rounded, slightly flattened
HUA-45	serving	Huataviro	-	rim	bowl	rounded, slightly flattened
HUA-46	storage	Huataviro	-	rim	large storage container?	flattened, bolstered
HUA-47	serving	Huataviro	-	rim	bowl	rounded, slightly inverted
HUA-48	utilitarian	Huataviro	-	rim	conical shaped bowl	pinched
HUA-49	serving	Huataviro	-	rim	bowl (unique)	flattened, inverted
HUA-50	storage	Huataviro	-	rim	large storage jar	rounded, strongly everted
HUA-51	?	Huataviro	-	body	?	-
HUA-52	serving	Huataviro	-	body	globular bowl	-
HUA-53	utilitarian	Huataviro	-	rim	jar?	rounded, everted
HUA-54	serving	Huataviro	-	body	-	-
HUA-55	serving	Huataviro	-	body	-	-
HUA-56	serving	Huataviro	-	rim	conical shaped bowl	pinched, rounded
HUA-57	serving	Huataviro	-	rim	conical shaped bowl	pinched
MAS-01	-	Mascarilla	Caranqui	rim	-	bolstered, button appliques
MAS-02	-	Mascarilla	Caranqui	rim	-	tiered, bolstered, button appliques
MAS-03	-	Mascarilla	Caranqui	rim	-	rounded, flattened
MAS-04	-	Mascarilla	Caranqui	rim	-	bolstered, triangular
MAS-05	-	Mascarilla	Caranqui	rim	bowl	rounded
MAS-06	-	Mascarilla	Caranqui	rim	jar	convex, button appliques
MAS-07	-	Mascarilla	Caranqui	rim	bowl	rounded, flattened
MAS-08	-	Mascarilla	Caranqui	rim	bowl	flattened
MAS-09	-	Mascarilla	Caranqui	rim	bowl	flattened
MON-01	-	Cantón Montúfar	Caranqui	rim	jar	pinched, rounded

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
MON-02	-	Cantón Montúfar	Caranqui	rim	jar	rounded
MON-03	-	Cantón Montúfar	Caranqui	rim	bowl	rounded
MON-04	-	Cantón Montúfar	Tuza	rim	bowl	rounded
MON-05	-	Cantón Montúfar	Tuza?	rim	bowl	rounded
MON-06	-	Cantón Montúfar	Tuza	rim	bowl	rounded
MON-07	-	Cantón Montúfar	Caranqui	rim	jar	rounded, bolstered
MON-08	-	Cantón Montúfar	Caranqui	rim	bowl/cup	rounded
MON-09	-	Cantón Montúfar	Caranqui	rim	bowl	pinched, rounded
MON-10	-	Cantón Montúfar	Tuza	rim	bowl	rounded
MON-11	-	Cantón Montúfar	Tuza	rim	bowl	rounded
POR_001	-	La Portada	Caranqui	rim	bowl	rounded
POR_002	-	La Portada	Caranqui	rim	olla	rounded
POR_003	-	La Portada	Tuza	rim	bowl	rounded
POR_004	-	La Portada	Caranqui	-	-	-
POR_005	-	La Portada	Tuza	body	compotera	-
POR_006	-	La Portada	Tuza	body	compotera	-
POR_007	-	La Portada	Tuza	rim	compotera	rounded
POR_008	-	La Portada	Piartal	body	jar	-
POR_009	-	La Portada	Piartal	rim	olla	flattened
POR_010	-	La Portada	Tuza	rim	bowl	slightly flared
POR_011	-	La Portada	Tuza	rim	bowl	slightly flared
POR_012	-	La Portada	Piartal	rim	bowl	rounded
POR_013	-	La Portada	Piartal	-	-	-
POR_014	-	La Portada	Tuza	rim	bowl	tapered
POR_015	-	La Portada	Panzaleo	body	compotera	-
PUN-01	utilitarian	Puntiachil	Caranqui	rim	jar	everted, thickened
PUN-02	serving	Puntiachil	Caranqui	rim	jar	rounded, thickened
PUN-03	utilitarian	Puntiachil	Caranqui	rim	bowl	pointed
PUN-04	serving	Puntiachil	Caranqui	rim	bowl	flattened
PUN-05	utilitarian	Puntiachil	Caranqui	rim	olla or jar	rounded, everted
PUN-06	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded
PUN-07	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded, slightly flattened
PUN-08	serving	Puntiachil	Caranqui	rim	bowl/cup	flattened

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
PUN-09	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded, pointed
PUN-10	serving	Puntiachil	Caranqui	rim	bowl	rounded
PUN-11	storage	Puntiachil	Caranqui	rim	jar	triangular
PUN-12	serving	Puntiachil	Caranqui	rim	bowl/cup	flattened
PUN-13	storage	Puntiachil	Caranqui	rim	large storage jar	triangular
PUN-14	serving	Puntiachil	Caranqui	rim	bowl	rounded, pointed
PUN-15	utilitarian	Puntiachil	Caranqui	rim	bowl	flattened
PUN-16	serving	Puntiachil	Caranqui	rim	bowl	flattened, thickened interiorly
PUN-17	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded
PUN-18	serving	Puntiachil	Caranqui	rim	bowl	rounded
PUN-19	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded
PUN-20	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded, slightly thickened
PUN-21	?	Puntiachil	Caranqui	rim	bowl or jar	flattened
PUN-22	utilitarian	Puntiachil	Caranqui	rim	bowl or jar	flattened
PUN-23	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded, concave
PUN-24	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded, thickened, concave
PUN-25	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded
PUN-26	serving	Puntiachil	Caranqui	rim	bowl	rounded
PUN-27	storage	Puntiachil	Caranqui	rim	large storage jar	rounded, everted
PUN-28	serving	Puntiachil	Caranqui	rim	bowl	rounded, flattened
PUN-29	serving	Puntiachil	Caranqui	rim	jar	everted
PUN-30	serving	Puntiachil	Caranqui	rim	bowl	rounded
PUN-31	serving	Puntiachil	Caranqui	rim	bowl	rounded
PUN-32	utilitarian	Puntiachil	Caranqui	rim	jar	rounded, everted
PUN-33	storage	Puntiachil	Caranqui	rim	jar	triangular
PUN-34	serving	Puntiachil	Caranqui	rim	globular bowl	rounded, everted
PUN-35	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded, slightly inverted
PUN-36	utilitarian	Puntiachil	Caranqui	rim	large storage jar	triangular
PUN-37	?	Puntiachil	Caranqui	rim	bowl?	pinched, inverted
PUN-38	utilitarian	Puntiachil	Caranqui	rim	bowl?	flattened
PUN-39	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded
PUN-40	serving	Puntiachil	Caranqui	rim	jar	rounded
PUN-41	serving	Puntiachil	Caranqui	rim	unusual jar	flattened

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
PUN-42	serving	Puntiachil	Caranqui	rim	jar	thickened, rounded, everted
PUN-43	serving	Puntiachil	Caranqui	rim	bowl	rounded, slightly flattened
PUN-44	serving	Puntiachil	Caranqui	rim	jar	thickened, rounded, everted
PUN-45	utilitarian	Puntiachil	Caranqui	rim	jar	bolstered, straight walled
PUN-46	utilitarian	Puntiachil	Caranqui	rim	large jar	bolstered, straight walled
PUN-47	serving	Puntiachil	Caranqui	rim	bowl	rounded, straight on interior
PUN-48	serving	Puntiachil	Caranqui	rim	jar	triangular, everted
PUN-49	serving	Puntiachil	Tuza	rim	bowl or cup	tapered, straight
PUN-50	serving	Puntiachil	Caranqui	rim	bowl	rounded
PUN-51	storage	Puntiachil	Caranqui	rim	large jar	triangular, straight on interior
PUN-52	utilitarian	Puntiachil	Caranqui	rim	jar?	flattened, everted
PUN-53	serving	Puntiachil	Caranqui	rim	bowl	rounded, inverted
PUN-54	utilitarian	Puntiachil	Caranqui	rim	bowl	rounded, inverted
PUN-55	serving	Puntiachil	Caranqui	rim	bowl	flattened, slightly thickened
PUN-56	serving	Puntiachil	Caranqui	rim	bowl	flattened
PUN-57	serving	Puntiachil	Caranqui	rim	bowl?	rounded, flattened
PUN-58	utilitarian	Puntiachil	Caranqui	rim	bowl	inverted, rounded
PUN-59	utilitarian	Puntiachil	Caranqui	rim	jar	everted, flattened edge
PUN-60	utilitarian	Puntiachil	Caranqui	rim	jar	thickened, flattened, everted
ROQ_001	serving	San Roque	Caranqui	rim	bowl	tapered
ROQ_002	utilitarian	San Roque	Caranqui	body	jar	-
ROQ_003	serving	San Roque	Caranqui	rim	compotera	thickened, rounded
ROQ_004	serving	San Roque	Caranqui	body	compotera	-
ROQ_005	serving	San Roque	Caranqui	body	jar	-
ROQ_006	serving	San Roque	Caranqui	body	olla	-
ROQ_007	serving	San Roque	Caranqui	body	olla	-
ROQ_008	serving	San Roque	Caranqui	body	bowl	-
ROQ_009	serving	San Roque	Caranqui	-	-	-
ROQ_010	utilitarian	San Roque	Caranqui	body	jar	-
ROQ_011	serving	San Roque	Caranqui	body	jar	-
ROQ_012	utilitarian	San Roque	Caranqui	body	jar	-
ROQ_013	serving	San Roque	Caranqui	body	olla	-
SDV-01	serving	Loma Sandoval	Caranqui	rim	large jar	triangular, everted

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
SDV-02	utilitarian	Loma Sandoval	Caranqui	rim	large jar	triangular, everted
SDV-03	serving	Loma Sandoval	Caranqui	rim	bowl	flattened
SDV-04	utilitarian	Loma Sandoval	Caranqui	rim	jar	rounded, everted
SDV-05	utilitarian	Loma Sandoval	Caranqui	rim	bowl	rounded, straight
SDV-06	storage	Loma Sandoval	Caranqui	rim	jar	triangular, straight on interior
SDV-07	utilitarian	Loma Sandoval	Caranqui	rim	jar	thickened, everted
SDV-08	serving	Loma Sandoval	Caranqui	rim	jar	rounded, everted
SDV-09	serving	Loma Sandoval	Caranqui	rim	carinated bowl	flattened, angled, slightly everted
SDV-10	utilitarian	Loma Sandoval	Caranqui	rim	jar?	rounded, everted
SDV-11	utilitarian	Loma Sandoval	Caranqui	rim	jar or bowl	rounded
SDV-12	storage	Loma Sandoval	Caranqui	rim	jar	triangular, straight on interior
SDV-13	utilitarian	Loma Sandoval	Caranqui	rim	jar	rounded, grooved
SDV-14	serving	Loma Sandoval	Caranqui	rim	bowl	rounded
SDV-15	serving	Loma Sandoval	Caranqui	rim	bowl	bolstered, flattened
SDV-16	serving	Loma Sandoval	Caranqui	rim	bowl	rounded
SDV-17	utilitarian	Loma Sandoval	Caranqui	rim	bowl	tapered on interior, straight on exterior
SDV-18	serving	Loma Sandoval	Caranqui	rim	jar	rounded, everted
SDV-19	serving	Loma Sandoval	Caranqui	rim	bowl	everted, rounded
SDV-20	serving	Loma Sandoval	Caranqui	rim	bowl	slightly tapered, straight on exterior
SDV-21	serving	Loma Sandoval	Caranqui	rim	bowl	tapered
SDV-22	serving	Loma Sandoval	Caranqui	rim	bowl	rounded
SDV-23	utilitarian	Loma Sandoval	Caranqui	rim	jar	rounded, strongly everted
SDV-24	serving	Loma Sandoval	Caranqui	rim	bowl	rounded
SDV-25	serving	Loma Sandoval	Caranqui	rim	bowl	flattened, slightly thickened (burnished red slip)
SDV-26	serving	Loma Sandoval	Caranqui	rim	bowl	flattened, inverted
SDV-27	utilitarian	Loma Sandoval	Caranqui	rim	bowl/basin	rounded, inverted
SDV-28	utilitarian	Loma Sandoval	Caranqui	rim	jar	beveled, strongly everted
SDV-29	utilitarian	Loma Sandoval	Caranqui	rim	jar	rounded, everted
SDV-30	serving	Loma Sandoval	Caranqui	rim	carinated bowl	flattened, inverted
SDV-31	serving	Loma Sandoval	Caranqui	rim	bowl/cup	tapered, inverted
SDV-32	storage	Loma Sandoval	Caranqui	rim	jar	triangular, everted
SDV-33	utilitarian	Loma Sandoval	Caranqui	rim	jar	flattened, squared-off, everted
SDV-34	serving	Loma Sandoval	Caranqui	rim	bowl/cup	beveled, straight outer edge

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
SDV-35	serving	Loma Sandoval	Caranqui	rim	carinated bowl	beveled, slightly everted
SDV-36	serving	Loma Sandoval	Caranqui	rim	?	rounded, thickened on interior
SDV-37	serving	Loma Sandoval	Caranqui	rim	bowl	beveled toward interior
SDV-38	serving	Loma Sandoval	Caranqui	rim	large jar	thickened, rounded, everted
SDV-39	serving	Loma Sandoval	Caranqui	rim	bowl	rounded, slightly inverted
SDV-40	utilitarian	Loma Sandoval	Caranqui	rim	jar	thickened, strongly everted
SDV-41	utilitarian	Loma Sandoval	Caranqui	rim	large jar	triangular, everted
SDV-42	utilitarian	Loma Sandoval	Caranqui	rim	bowl	rounded
SDV-43	utilitarian	Loma Sandoval	Caranqui	rim	jar	rounded, everted
SDV-44	serving	Loma Sandoval	Tuza?	rim	bowl	rounded
SDV-45	utilitarian	Loma Sandoval	Caranqui	rim	cup	rounded
SDV-46	utilitarian	Loma Sandoval	Caranqui	rim	bowl/cup	rounded, slightly pointed
SDV-47	utilitarian	Loma Sandoval	Caranqui	rim	jar	rounded, everted
SDV-48	serving	Loma Sandoval	Caranqui	rim	bowl	flattened, everted
SDV-49	utilitarian	Loma Sandoval	Caranqui	rim	bowl	rounded, straight on interior
SDV-50	utilitarian	Loma Sandoval	Caranqui	rim	jar	squared, everted
SDV-51	utilitarian	Loma Sandoval	Caranqui	rim	jar	triangular, everted
SDV-52	serving	Loma Sandoval	Caranqui	rim	jar	rounded, slightly tapered
SDV-53	utilitarian	Loma Sandoval	Caranqui	rim	bowl	rounded, slightly flattened
SDV-54	?	Loma Sandoval	Cosanga	body	bowl	-
SDV-55	utilitarian	Loma Sandoval	Caranqui	rim	jar	squared, everted
SDV-56	utilitarian	Loma Sandoval	Caranqui	rim	jar	rounded, everted
SDV-57	utilitarian	Loma Sandoval	Caranqui	rim	jar	flattened, everted
SDV-58	utilitarian	Loma Sandoval	Caranqui	rim	jar	tapered
SOC-01	serving	Socapamba	Caranqui	body	amphora	-
SOC-02	serving	Socapamba	Caranqui	body	amphora	-
SOC-03	serving	Socapamba	Caranqui	body	amphora	-
SOC-04	?	Socapamba	Panzaleo	body	bowl	-
SOC-05	serving	Socapamba	Caranqui	body	amphora	-
SOC-06	utilitarian	Socapamba	Caranqui	body	jar	-
SOC-07	serving	Socapamba	Caranqui	rim	bowl	straight
SOC-08	serving	Socapamba	Caranqui	body	jar	-
SOC-09	serving	Socapamba	Caranqui	body	bowl	-

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
SOC-10	serving	Socapamba	Caranqui	rim	bowl	everted
SOC-11	utilitarian	Socapamba	Caranqui	rim	jar	folded
SOC-12	serving	Socapamba	Caranqui	body	jar	-
SOC-13	serving	Socapamba	Caranqui	rim	jar	flared
SOC-14	serving	Socapamba	Caranqui	rim	jar	flared
SOC-15	serving	Socapamba	Caranqui	rim	bowl	-
SOC-16	serving	Socapamba	Caranqui	rim	compotera	flared
SOC-17	utilitarian	Socapamba	Caranqui	rim	jar	-
SOC-18	serving	Socapamba	Caranqui	rim	plate	rounded
SOC-19	?	Socapamba	Caranqui	other	-	-
SOC-20	serving	Socapamba	Caranqui	rim	compotera	flared
SOC-21	utilitarian	Socapamba	Caranqui	rim	bowl	thickened, triangular
SOC-22	utilitarian	Socapamba	Caranqui	rim	container	flattened
SOC-23	utilitarian	Socapamba	Caranqui	rim	bowl	channeled
SOC-24	utilitarian	Socapamba	Caranqui	rim	other	-
SOC-25	utilitarian	Socapamba	Caranqui	body	bowl	-
SOC-26	utilitarian	Socapamba	Caranqui	body	bowl	-
SOC-27	utilitarian	Socapamba	Caranqui	body	other	-
SOC-28	utilitarian	Socapamba	Caranqui	rim	other	-
SOC-29	serving	Socapamba	Tuza	body	bowl	-
SOC-30	serving	Socapamba	Tuza	rim	bowl	-
SOC-31	?	Socapamba	Piartal	rim	bowl	-
SOC-32	?	Socapamba		body	-	-
SOC-33	serving	Socapamba		body	bowl	-
SOC-34	utilitarian	Socapamba	Caranqui	rim	bowl	rounded
SOC-35	utilitarian	Socapamba	Caranqui	rim	bowl	bolstered
SOC-36	utilitarian	Socapamba	Caranqui	rim	bowl	rounded
SOC-37	utilitarian	Socapamba	Caranqui	rim	jar	flattened
SOC-38	utilitarian	Socapamba	Caranqui	rim	jar	pinched
SOC-39	utilitarian	Socapamba	Caranqui	rim	jar	rounded
SOC-40	utilitarian	Socapamba	Caranqui	rim	bowl	rounded
SOC-41	serving	Socapamba	Caranqui	rim	compotera	flattened, bolstered
SOC-42	serving	Socapamba	Caranqui	rim	jar	pinched, flattened

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
SOC-43	utilitarian	Socapamba	Caranqui	rim	jar	flattened, rounded
SOC-44	serving	Socapamba	Caranqui	rim	jar	rounded
SOC-45	utilitarian	Socapamba	Caranqui	rim	-	pinched, rounded
SOC-46	serving	Socapamba	Caranqui	rim	bowl	rounded
SOC-47	utilitarian	Socapamba	Caranqui	rim	bowl	pinched, rounded
SOC-48	utilitarian	Socapamba	Caranqui	rim	bowl	flattened
SOC-49	utilitarian	Socapamba	Caranqui	rim	jar	rounded
SOC-50	utilitarian	Socapamba	Caranqui	rim	jar	rounded
SOC-51	serving	Socapamba	Caranqui	rim	compotera	flattened, extended
SOC-52	serving	Socapamba	Caranqui	rim	jar	pinched, rounded, flattened
SOC-53	serving	Socapamba	Cosanga	body	-	-
SOC-54	?	Socapamba	Caranqui	rim	small jar?	rounded
SOC-55	?	Socapamba	Caranqui	rim	bowl?	rounded
SOC-56	serving	Socapamba	Caranqui	rim	jar	pinched, rounded
SOC-57	utilitarian	Socapamba	Caranqui	rim	bowl	rounded, straight on interior
SOC-58	serving	Socapamba	Caranqui	rim	compotera	pinched, flattened
SOC-59	serving	Socapamba	Caranqui	rim	jar	rounded, flattened
SOC-60	utilitarian	Socapamba	Caranqui	rim	bowl/compotera	flattened
SOC-61	utilitarian	Socapamba	Caranqui	rim	bowl	concave rounded
SOC-62	serving	Socapamba	Caranqui	rim	large jar	rounded
SOC-63	utilitarian	Socapamba	Caranqui	rim	bowl	rounded, bolstered
SOC-64	serving	Socapamba	Caranqui	rim	bowl?	rounded, bolstered
SOL-01	-	Los Soles	Caranqui	rim	carinated bowl	pointed, flattened
SOL-02	-	Los Soles	Caranqui	rim	jar	bolstered, triangular
SOL-03	-	Los Soles	Caranqui	rim	bowl	pointed, flattened
SOL-04	-	Los Soles	Cosanga?	rim	jar	thinned, concave
SOL-05	-	Los Soles	Caranqui	rim	carinated bowl	flattened
SOL-06	-	Los Soles	Caranqui	rim	carinated bowl	pointed, flattened
SOL-07	-	Los Soles	Caranqui	rim	bowl	flattened
SOL-08	-	Los Soles	Caranqui	other	stand?	-
SOL-09	-	Los Soles	Caranqui	rim	carinated bowl	pointed, flattened
SOL-10	-	Los Soles	Pasto	rim	bowl/compotera	flattened, slightly thickened
SOL-11	-	Los Soles	Caranqui	rim	decorative jar	complex; strip of clay with button appliques

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
SOL-12	-	Los Soles	Caranqui	rim	jar	convex, bent
SOL-13	-	Los Soles	Caranqui	rim	decorative jar	complex; strip of clay with button appliques
SOL-14	-	Los Soles	Caranqui	rim	jar	modeled scallop
TAJ-01	-	Tajamar	Cosanga	body	-	-
TAJ-02	-	Tajamar	Cosanga	body	-	-
TAJ-03	-	Tajamar	Cosanga	body	-	-
TAJ-04	-	Tajamar	Quito	body	bowl?	-
TAJ-05	-	Tajamar	Quito	body	jar?	-
TAJ-06	-	Tajamar	Quito	rim	unrestricted	rounded
TAJ-07	-	Tajamar	Quito	body	-	-
TAJ-08	-	Tajamar	Quito	rim	unrestricted	rounded
TAJ-09	-	Tajamar	Quito	body	-	-
TAJ-10	-	Tajamar	Quito	rim	bowl	flattened
TAJ-11	-	Tajamar	Quito	body	large jar	-
TAJ-12	-	Tajamar	Quito	body	jar?	-
TAJ-13	-	Tajamar	Quito	rim	jar	rounded, slightly everted
TAJ-14	-	Tajamar	Quito	body	-	-
TAJ-15	-	Tajamar	Quito	body	-	-
TAJ-16	-	Tajamar	Quito	body	jar	-
TAJ-17	-	Tajamar	Quito	body	-	-
TAJ-18	-	Tajamar	Quito	body	-	-
TAJ-19	-	Tajamar	Quito	body	-	-
TAJ-20	-	Tajamar	Quito	body	-	-
TAJ-21	-	Tajamar	Quito	body	-	-
TAJ-22	-	Tajamar	Quito	rim	jar	beveled (oriented vertically with exterior wall)
TAJ-23	-	Tajamar	Quito	body	large container	-
TAJ-24	-	Tajamar	Quito	body	-	-
TAJ-25	-	Tajamar	Quito	body	-	-
TAJ-26	-	Tajamar	Quito	rim	large jar	rounded, everted
TAJ-27	-	Tajamar	Quito	body	large container	-
TAJ-28	-	Tajamar	Quito	body	-	-
TAJ-29	-	Tajamar	Quito	rim	jar	rounded, slightly flattened
TAJ-30	-	Tajamar	Quito	body	-	-

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
TBE007	-	-	Panzaleo	-	-	-
TBE00X/254	-	-	Panzaleo	-	-	-
TBE015	-	-	Panzaleo	-	-	-
TBE016	-	-	Panzaleo	-	-	-
TBE027	-	-	Panzaleo	-	-	-
TBE028	-	-	Panzaleo	-	-	-
TBE032	-	-	Panzaleo	-	-	-
TBE043	-	-	Panzaleo	-	-	-
TBE047	-	-	Panzaleo	-	-	-
TBE071	-	-	Panzaleo	-	-	-
TBE119	-	-	Panzaleo	-	-	-
TBE136	-	-	Panzaleo	-	-	-
TBE144	-	-	Panzaleo	-	-	-
TBE149	-	-	Panzaleo	-	-	-
TBE153	-	-	Panzaleo	-	-	-
TBE189	-	-	Panzaleo	-	-	-
TBE194	-	-	Panzaleo	-	-	-
TBE256	-	-	Panzaleo	-	-	-
TBE38A	-	-	Panzaleo	-	-	-
TBE38B	-	-	Panzaleo	-	-	-
TBE39A	-	-	Panzaleo	-	-	-
TBE39B	-	-	Panzaleo	-	-	-
TBE443	-	-	Panzaleo	-	-	-
TBL-01	serving	El Tablón	Caranqui	body	amphora	-
TBL-02	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-03	serving	El Tablón	Caranqui	body	amphora	-
TBL-04	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-05	serving	El Tablón	Caranqui	body	bowl	-
TBL-06	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-07	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-08	serving	El Tablón	Caranqui	rim	bowl	tapered
TBL-09	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-10	serving	El Tablón	Caranqui	rim	bowl	bevelled, rounded

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

INAA ID	Function	Site	Ware	Sherd Type	Vessel Form	Rim/lip Form
TBL-11	serving	El Tablón	Caranqui	body	jar	-
TBL-12	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-13	utilitarian	El Tablón	Caranqui	body	container	-
TBL-14	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-15	utilitarian	El Tablón	Caranqui	body	bowl	-
TBL-16	serving	El Tablón	Caranqui	rim	jar	exteriorly thickened
TBL-17	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-18	serving	El Tablón	Caranqui	body	jar	-
TBL-19	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-20	serving	El Tablón	Caranqui	other	other	-
TBL-21	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-22	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-23	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-24	utilitarian	El Tablón	Caranqui	body	jar	-
TBL-31	utilitarian	El Tablón	Caranqui	rim	bowl	rounded, flattened on interior
TBL-32	utilitarian	El Tablón	Caranqui	rim	bowl	rounded, slightly inverted
TBL-33	serving	El Tablón	-	other	tripod leg	-
TBL-34	serving	El Tablón	-	body	cup?	-
TBL-35	?	El Tablón	-	body	-	-
TBL-36	utilitarian	El Tablón	Caranqui	rim	olla or jar	everted, slightly bolstered
TBL-37	serving	El Tablón	Caranqui	body	amphora	-
TBL-38	serving	El Tablón	-	body		-
TBL-39	utilitarian	El Tablón	Panzaleo?	body		-
TBL-40	storage	El Tablón	Caranqui	rim	large storage jar/amphora?	triangular
TBL-41	serving	El Tablón	-	body		-
TBL-42	serving	El Tablón	Caranqui	other	tripod leg	-
TBL-43	utilitarian	El Tablón	Caranqui	rim	conical shaped bowl	rounded
TBL-44	serving	El Tablón	-	rim	olla or jar	rounded, strongly everted
TBL-45	utilitarian	El Tablón	Caranqui	rim	bowl	rounded, slightly flattened
TBL-46	utilitarian	El Tablón	-	rim	olla	rounded, strongly everted
TBL-47	utilitarian	El Tablón	Caranqui	rim	Simple or conical bowl	rounded, slightly flattened on top
TBL-48	serving	El Tablón	Caranqui	body	-	-
TBL-49	utilitarian	El Tablón	Caranqui	rim	bowl	rounded, slightly inverted

Table A.1: Ceramic Sample Descriptions, Part 1 (continued)

TBL-50	?	El Tablón	-	body	-	-
TBL-51	utilitarian	El Tablón	Caranqui	rim	conical shaped bowl	rounded, slightly flattened on top
TBL-52	utilitarian	El Tablón	Caranqui	rim	conical shaped bowl	rounded
TBL-53	utilitarian	El Tablón	Caranqui	rim	bowl	rounded, slightly thickened
TBL-54	serving	El Tablón	Caranqui	body	amphora	-
TBL-55	serving	El Tablón	-	body	cup	-
TBL-56	serving	El Tablón	Caranqui	rim	amphora	triangular with strip added to thicken rim
TBL-57	storage	El Tablón	-	rim	large storage jar	triangular, heavily bolstered
TBL-58	utilitarian	El Tablón	Caranqui	rim	very large storage jar	triangular
TBL-59	serving	El Tablón	Caranqui	rim	amphora	triangular
TBL-60	utilitarian	El Tablón	Caranqui	rim	very large bowl	slightly bulbous
TUN_001	-	Tungipamba	Panzaleo	body	bowl or jar	-
TUN_002	-	Tungipamba	Panzaleo	body	jar	-
TUN_003	-	Tungipamba	Panzaleo	body	jar	-
TUN_004	-	Tungipamba	Panzaleo	body	jar	-
TUN_005	-	Tungipamba	Panzaleo	body	jar	-
TUL-01	-	Tulipe	Yumbo	rim	tall jar	rounded
TUL-02	-	Tulipe	Yumbo	rim	?	rounded, slightly everted
TUL-03	-	Tulipe	Yumbo	rim	jar	rounded, slightly everted
TUL-04	-	Tulipe	Yumbo	rim	?	rounded, slightly everted
TUL-05	-	Tulipe	Yumbo	rim	jar	rounded, everted
TUL-06	-	Tulipe	Yumbo	rim	tall jar	rounded, everted
TUL-07	-	Tulipe	Yumbo	rim	storage jar	bolstered, triangular, everted
TUL-08	-	Tulipe	Yumbo	rim	jar	bolstered, everted
TUL-09	-	Tulipe	Yumbo	rim	tall bowl or cup	tapered
TUL-10	-	Tulipe	Yumbo	rim	jar	flattened, bolstered, everted
TUL-11	-	Tulipe	Yumbo	rim	bowl	flattened, slighlty inverted

Table A.2: Ceramic Sample Descriptions, Part 2

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
ANG_001	wiped	wiped	Surface
ANG_002	slipped (white)	slipped, painted (red on white)	Surface
ANG_003	slipped, burnished	slipped, burnished	Surface
ANG_004	wiped	slipped	Surface
ANG_005	none	none	Surface
ANG_006	heavily worn	slipped	Surface
ANG_007	heavily worn	smoothed	Surface
ANG_008	slipped, wiped	slipped, burnished	Surface
ANG_009	slipped	none	Surface
ANG_010	slipped	slipped	Surface
ANG_011	slipped	slipped, burnished	Surface
ANG_012	slipped, wiped	slipped, burnished	Surface
ANG_013	slipped, burnished	slipped	Surface
ANG_014	slipped	slipped	Surface
ANG_015	slipped	slipped	Surface
ANG_016	slipped	slipped, burnished	Surface
ATU-01	red slip	red slip	Surface
ATU-02	red slip	red slip, burnished	Surface
ATU-03	maroon/dark red slip	wiped	Surface
ATU-04	orangy brown slip, polished	orangy-brown and red slip; zonal design	Surface
ATU-05	carbonized	reddish-brown slip	Surface
ATU-06	carbonized	carbonized	Surface
ATU-07	red slip	red slip	Surface
ATU-08	carbonized	red slip	Surface
ATU-09	reddish- brown slip	red slip	Surface
ATU-10	reddish- brown slip	red slip	Surface
ATU-11	smoothed; faint red vertical strip running down from rim	red slip	Surface
ATU-12	red slip	red slip, burnished	Surface
ATU-13	smoothed	red slip	Surface
ATU-14	reddish- brown slip (highly worn)	red slip	Surface
ATU-15	red slip (worn)	reddish-brown slip	Surface
ATU-16	smoothed	red slip	Surface
ATU-17	burnished red slip on bolstered edge; carbonized rim	smoothed	Surface

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
ATU-18	red slip, burnished	red slip, burnished	Surface
ATU-19	red slip	faint red slip	Surface
ATU-20	red slip	red slip, burnished	Surface
ATU-21	smoothed, red slip rim; uneven strip	red slip	Surface
ATU-22	red slip	red slip	Surface
ATU-23	smoothed, burnished	red slip, burnished	Surface
ATU-24	maroon/dark red slip	red slip with possible painted design	Surface
ATU-25	red slip, burnished	red slip, burnished	Surface
ATU-26	red slip	smoothed	Surface
ATU-27	smoothed	smoothed	Surface
ATU-28	smoothed	smoothed	Surface
ATU-29	smoothed	unfinished, rough	Surface
ATU-30	red slip	red slip	Surface
ATU-31	red slip	red slip (highly worn)	Surface
ATU-32	smoothed, carbonized	unfinished, rough	Surface
ATU-33	carbonized	maroon slip, burnished	Surface
ATU-34	smoothed	smoothed, some carbonization	Surface
ATU-35	smoothed	wiped in orientations perpendicular to one another	Surface
ATU-36	smoothed	smoothed	Surface
ATU-37	red slip (highly worn)	red slip along rim, smoothed below shoulder	Surface
ATU-38	red slip	red slip, horizontal burnishing	Surface
ATU-39	red slip	red slip along rim, smoothed below shoulder	Surface
ATU-40	red slip rim, red slip vertical geometric design below rim	smoothed, top of rim, red slipped	Surface
CAR_001	n/a	n/a	Surface
CAR_002	none	wiped	Surface
CAR_003	wiped	slipped	Surface
CAR_004	slipped	wiped	Surface
CAR_005	n/a	n/a	Surface
CAR_006	n/a	n/a	Surface
CAR_007	slipped (buff), painted (black, red)	unknown	Surface
CAR_008	n/a	n/a	Surface
CAR_009	n/a	slipped	Surface
CAR_010	wiped	slipped	Surface

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
CAR_011	n/a	n/a	Surface
CAR_012	n/a	n/a	Surface
CAR_013	-	slipped	Surface
CAR_014	slipped	n/a	Surface
CAR_015	slipped	wiped	Surface
CAR_016	slipped, burnished	slipped, burnished	Surface
CAR_017	slipped	slipped	Surface
CAR_018	slipped	slipped	Surface
CAR_019	slipped	slipped	Surface
CAR_020	wiped	slipped	Surface
CAR_021	wiped	slipped	Surface
CAR_022	slipped	none	Surface
CAR_023	slipped	none	Surface
CAR_024	slipped	none	Surface
CAR_025	slipped (black)	slipped	Surface
CAR_026	slipped (buff), painted (black, red, gray)	slipped (buff)	Surface
CRM-01	applique globules, making piece resemble bunch of grapes	smoothed, but rough	Surface
CRM-02	red and orange slip, burnished	red and orange slip, burnished	Surface
CRM-03	red slip, burnished	red slip, slightly burnished	Surface
CRM-04	smoothed, mica visible on surface	smoothed, mica visible on surface	Surface
CRM-05	red slip, burnished	red slip, burnished	Surface
CRM-06	red and orange slip, mica visible on surface	smoothed above shoulder, wiped below shoulder, mica	Surface
CRM-07	black slip, burnished (fine, smooth surface)	black slip, burnished (not quite as smooth as exterior)	Surface
CRM-08	red slip, burnished	red slip, burnished	Surface
CRM-09	red slip, burnished, carbonized along neck	red slip, burnished rim, unburnished below rim	Surface
HLV-01	highly worn	highly worn	Surface
HLV-02	smoothed	-	Surface
HLV-03	red slip (highly worn)	red slip (highly worn)	Surface
HLV-04	red slip (highly worn)	smoothed	Surface
HLV-05	smoothed (highly worn)	highly worn	Surface
HLV-06	highly worn	remnants of red slip (highly worn)	Surface
HLV-07	red slip (highly worn)	highly worn	Surface
HUA-01	carbonized	red slip	Trench

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
HUA-02	red slip, slightly burnished	red slip, burnished	Trench
HUA-03	black slip, burnished, vertical striations, striations 0.5 cm below rim	black slip, burnished	Trench
HUA-04	red slip, burnished in some areas	black slip, burnished, horizontal indentations	Trench
HUA-05	burnished, geometric designs in red slip	red slip rim, wiped below rim	Trench
HUA-06	red slip, some burnishing	red slip, burnished	Trench
HUA-07	smoothed	red slip, burnished	Trench
HUA-08	wiped (horizontal striations visible)	smoothed, some horizontal striations visible	Trench
HUA-09	carbonized	smoothed	Trench
HUA-10	wiped, carbonized on top 1cm of rim	black slip(?) burnished	Trench
HUA-11	red slip, burnished	red slip, burnished on rim, not burnished below rim	Trench
HUA-12	orangy brown slip, burnished	orangy red slip, burnished	Trench
HUA-13	orangy-brown slip, some carbonization, vertical striations	some carbonization and burnishing	Trench
HUA-14	red slip, burnished horizontal lines	carbonized, wiped	Trench
HUA-15	smoothed, some carbonization	red slip, burnished	Trench
HUA-16	red slip, carbonized	signs of red slip, carbonized	Trench
HUA-17	smoothed	brownish-red slip, burnished horizontal lines	Trench
HUA-18	wiped	red slip, burnished	Trench
HUA-19	smoothed	smoothed	Trench
HUA-20	red slip	smoothed, blotchy red slip	Trench
HUA-21	red slip rim, wiped below rim	red slip, burnished	Trench
HUA-22	red slip, but worn	red slip, but worn	Trench
HUA-23	smoothed, ribbed	heavily worn	Trench
HUA-24	heavily worn red slip	smoothed, faint red slip	Trench
HUA-25	red slip rim, red slip 3 cm below rim, pale brown slip inbetween	red slip	Trench
HUA-26	smoothed	red slip	Trench
HUA-27	wiped (horizontal striations visible)	smoothed, red slip	Trench
HUA-28	red slip	red slip (smoother than exterior)	Trench
HUA-29	wiped	dark brown/black slip, burnished	Trench
HUA-30	red slip, worn	red slip, worn	Trench
HUA-31	red slip, worn	red slip, burnished	Trench
HUA-32	red slip	red slip, slightly burnished	Trench
HUA-33	slipped, burnished, mica clearly visible	smoothed, mica visible; slipped, burnished rim	Trench
HUA-34	wiped	slipped, burnished	Trench

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
HUA-35	slipped, burnished	smoothed below rim; slipped, burnished on rim	Trench
HUA-36	slipped (orange-cream), burnished, horizontal striations	slipped (dark orange-red), burnished, horizontal striations	Trench
HUA-37	smoothed (wear or carbonization along rim)	slipped, burnished	Trench
HUA-38	wiped	unslipped, burnished	Trench
HUA-39	smoothed, unslipped	unslipped, burnished	Trench
HUA-40	smoothed, carbonized along rim	slipped, burnished (dark brown)	Trench
HUA-41	slipped	smoothed	Trench
HUA-42	smoothed, carbonized	slipped, burnished	Trench
HUA-43	smoothed	smoothed, slipped (worn)	Excavated
HUA-44	slipped, burnished	smoothed, slipped	Excavated
HUA-45	wiped, carbonized	slipped, burnished	Excavated
HUA-46	smoothed	smoothed	Excavated
HUA-47	wiped, carbonized	slipped, burnished	Excavated
HUA-48	wiped, carbonized	smoothed	Excavated
HUA-49	slipped, well-burnished	wiped with small weave cloth	Excavated
HUA-50	smoothed (worn)	slipped (highly worn)	Excavated
HUA-51	slipped	smoothed, slipped	Excavated
HUA-52	slipped (worn)	slipped (worn)	Excavated
HUA-53	smoothed	slipped (worn)	Excavated
HUA-54	slipped, patterned burnish	smoothed	Excavated
HUA-55	smoothed, partially carbonized	slipped, burnished	Excavated
HUA-56	wiped (stepped; see drawing)	slipped, burnished	Excavated
HUA-57	smoothed	slipped, burnished	Excavated
MAS-01	wiped	wiped	Surface
MAS-02	wiped	wiped	Surface
MAS-03	red slip, "punctate" design	wiped	Surface
MAS-04	red slip	red slip	Surface
MAS-05	smoothed	smoothed	Surface
MAS-06	wiped	wiped	Surface
MAS-07	wiped, red slip rim	red slip	Surface
MAS-08	wiped, red slip rim	red slip	Surface
MAS-09	wiped, red slip rim	red slip	Surface
MON-01	cream slip	white/cream slip, red slip rim	Surface

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
MON-02	wiped	red slip rim	Surface
MON-03	wiped	smoothed, red slip rim	Surface
MON-04	white/cream slip	red painted rim and geometric design	Surface
MON-05	wiped	smoothed, red slip rim	Surface
MON-06	smoothed, red slip rim	white/cream slip, red paint rim and geom. design	Surface
MON-07	wiped	smoothed, red slip rim	Surface
MON-08	wiped	smoothed, red slip rim	Surface
MON-09	wiped, red slip rim	red slip, burnished	Surface
MON-10	white/cream slip, red slip rim	white/cream slip, red paint rim and geom. design	Surface
MON-11	white/cream slip, red slip rim; orange tint	white/cream slip, red paint rim and geom. design	Surface
POR_001	slipped, burnished	slipped, burnished	Surface
POR_002	slipped, burnished	wiped	Surface
POR_003	slipped	slipped (buff)	Surface
POR_004	-	-	Surface
POR_005	slipped, burnished	slipped, burnished	Surface
POR_006	slipped	burnished	Surface
POR_007	slipped	slipped	Surface
POR_008	slipped, burnished	slipped (buff)	Surface
POR_009	slipped	slipped (buff), painted (red stripe below rim)	Surface
POR_010	slipped	slipped (buff), painted (dark, anthropomorphic)	Surface
POR_011	slipped	slipped (buff), painted (dark, anthropomorphic)	Surface
POR_012	slipped (black), painted (red rim)	slipped?	Surface
POR_013			Surface
POR_014	slipped, burnished	slipped, painted (red geometric)	Surface
POR_015	slipped (buff)	none	Surface
PUN-01	smoothed	red slip	Excavated
PUN-02	red slip	red slip	Excavated
PUN-03	smoothed	smoothed, possible red slip	Excavated
PUN-04	red slip	red slip	Excavated
PUN-05	red slip	red slip along rim, smoothed below rim	Excavated
PUN-06	cannot determine (carbonized)	red slip	Excavated
PUN-07	cannot determine (carbonized)	red slip	Excavated
PUN-08	red geometric paint	red slip	Excavated

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
PUN-09	cannot determine (carbonized)	red slip	Excavated
PUN-10	cannot determine (carbonized)	red slip	Excavated
PUN-11	red slip	smoothed	Excavated
PUN-12	wiped	red slip, burnished below rim	Excavated
PUN-13	red slip	orangy slip	Excavated
PUN-14	red slip	red slip	Excavated
PUN-15	cannot determine (carbonized)	maroon slip	Excavated
PUN-16	wiped	red slip, burnished	Excavated
PUN-17	wiped, red slip rim	maroon slip	Excavated
PUN-18	smoothed	red slip, burnished	Excavated
PUN-19	cannot determine (carbonized)	red slip	Excavated
PUN-20	smoothed, red paint 2 cm down from rim	smoothed	Excavated
PUN-21	red slip	smoothed, red slip rim	Excavated
PUN-22	wiped	smoothed, red slip rim	Excavated
PUN-23	cannot determine (carbonized)	red slip	Excavated
PUN-24	cannot determine (carbonized)	maroon slip	Excavated
PUN-25	red slip, carbonized	red slip	Excavated
PUN-26	smoothed	red slip, burnished	Excavated
PUN-27	smoothed, red slip rim, some carbonization	wiped	Excavated
PUN-28	maroon slip	maroon slip	Excavated
PUN-29	wiped	red slip, burnished	Excavated
PUN-30	wiped	red slip, burnished	Excavated
PUN-31	red slip	red slip	Excavated
PUN-32	red slip	red slip	Excavated
PUN-33	red slip on rim, orangey slip below shoulder	wiped, red slip rim	Excavated
PUN-34	smoothed, red slip rim	red slip rim, orangey-brown slip below rim	Excavated
PUN-35	cannot determine (carbonized)	red slip along top 0.5 cm, brownish slip strip ~2 cm	Excavated
PUN-36	reddish-red slip, carbonized	carbonized	Excavated
PUN-37	cannot determine (highly worn)	cannot determine (highly worn)	Surface
PUN-38	carbonized	maroon slip	Surface
PUN-39	cannot determine (carbonized)	cannot determine (highly worn)	Surface
PUN-40	red slip	red slip	Surface
PUN-41	red slip	distinct red slip rim, cream slip below rim	Surface

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
PUN-42	some red slip (highly worn)	red slip	Surface
PUN-43	red slip	red slip	Surface
PUN-44	red slip	red slip (more subtle red below shoulder)	Surface
PUN-45	smoothed, red slip rim	wiped	Surface
PUN-46	red slip	wiped	Surface
PUN-47	red slip	red slip	Surface
PUN-48	wiped	red slip and dark slip, stripes	Surface
PUN-49	smoothed (very fine)	cream slip, red rim	Surface
PUN-50	red slip, partially carbonized	red slip	Surface
PUN-51	red slip	red slip	Surface
PUN-52	wiped	wiped	Surface
PUN-53	red slip	red slip	Surface
PUN-54	carbonized	red slip	Surface
PUN-55	red slip, burnished	red slip, cream slip, both burnished	Surface
PUN-56	carbonized, possible plastic decoration	red slip	Surface
PUN-57	dark-colored slip	red slip	Surface
PUN-58	carbonized	red slip	Surface
PUN-59	smoothed	evidence of red slip, but highly worn	Surface
PUN-60	wiped	smoothed	Surface
ROQ_001	wiped	slipped, painted (parallel stripes)	Surface
ROQ_002	slipped	wiped	Surface
ROQ_003	slipped	unknown	Surface
ROQ_004	wiped	slipped, painted (parallel red stripes)	Surface
ROQ_005	slipped	slipped	Surface
ROQ_006	burnished	wiped	Surface
ROQ_007	slipped, burnished	wiped	Surface
ROQ_008	slipped	slipped	Surface
ROQ_009	-	-	Surface
ROQ_010	wiped	wiped	Surface
ROQ_011	slipped	slipped	Surface
ROQ_012	wiped	wiped	Surface
ROQ_013	slipped	slipped	Surface
SDV-01	red slip	red slip, burnishing (from use?)	Excavated

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
SDV-02	red slip	smoothed	Excavated
SDV-03	wiped, red slip rim	wiped, red slip rim	Excavated
SDV-04	smoothed, red paint along rim, just below rim	smoothed	Excavated
SDV-05	smoothed, evidence of red slip	smoothed, red rim	Excavated
SDV-06	red slip	smoothed	Excavated
SDV-07	wiped	smoothed	Excavated
SDV-08	red slip, burnished	red slip, burnished	Excavated
SDV-09	wiped	red slip	Excavated
SDV-10	smoothed	smoothed	Excavated
SDV-11	red slipped rim	red slipped rim	Excavated
SDV-12	red slipped rim; no slip below rim	smoothed	Excavated
SDV-13	wiped	smoothed	Excavated
SDV-14	red slip	highly worn; red slipped rim	Excavated
SDV-15	wiped	red slip, burnished	Excavated
SDV-16	dark red slip, possible plastic decoration below rim	red slip	Excavated
SDV-17	brown slip, red slip rim	red slip rim	Excavated
SDV-18	red slip	red slip (rough surface)	Excavated
SDV-19	wiped, red slip rim	red slip rim, burnished	Excavated
SDV-20	red slip rim, entire surface burnished	red slip design, red slipped rim	Excavated
SDV-21	wiped, red slipped rim	red slipped rim, burnished	Excavated
SDV-22	wiped	red slip	Excavated
SDV-23	smoothed	smoothed on rim, wiped below rim	Excavated
SDV-24	wiped	red slip, burnished	Excavated
SDV-25	wiped	smoothed, red slip stripes	Excavated
SDV-26	wiped	red slip	Excavated
SDV-27	unfinished	smoothed	Excavated
SDV-28	red slip	red slip rim, wiped below rim, with one stripe of pale red slip	Excavated
SDV-29	smoothed	smoothed, red slip rim	Excavated
SDV-30	black slip, red slip rim	slightly lighter dark slip, red slip rim	Excavated
SDV-31	smoothed, red slip along top 1.5cm	burnished orange slip with black stripes	Excavated
SDV-32	red slip, burnished on rim	smoothed below rim, red slip on rim	Excavated
SDV-33	smoothed	smoothed	Excavated
SDV-34	smoothed	red slip, burnished	Excavated

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
SDV-35	wiped	red slip	Excavated
SDV-36	carbonized	evidence of red slip, burnished, but highly worn	Excavated
SDV-37	burnished	burnished	Excavated
SDV-38	red slip with carbon spots	red slip rim, smoothed below rim, stripe of pale red slip	Excavated
SDV-39	wiped	burnished, very smooth	Excavated
SDV-40	smoothed	wiped, possible slip on rim	Excavated
SDV-41	extremely rough below rim, rim smoothed	smoothed	Excavated
SDV-42	wiped, red slip rim	wiped, red slip rim	Excavated
SDV-43	carbonized	wiped	Excavated
SDV-44	cream slip, burnished; red slipped rim	smoothed	Excavated
SDV-45	wiped	smoothed	Excavated
SDV-46	highly worn	wiped	Excavated
SDV-47	highly worn	smoothed	Excavated
SDV-48	wiped/worn	smoothed, burnished	Excavated
SDV-49	wiped	smoothed	Excavated
SDV-50	wiped	smoothed	Excavated
SDV-51	red slip on rim, red slip on shoulder	smoothed, red slip on rim	Excavated
SDV-52	smoothed, red slip rim	red slip	Excavated
SDV-53	highly worn	smoothed	Excavated
SDV-54	black slip stripes over slipped gray background; mica visible on surface	wiped	Excavated
SDV-55	smoothed below rim, red slip on rim	red slip rim, smoothed below rim	Excavated
SDV-56	wiped	smoothed, possible slip matching clay	Excavated
SDV-57	wiped, red slip rim	red slip rim	Excavated
SDV-58	red slip	wiped	Excavated
SOC-01	slipped, painted (geometric)	wiped	Surface
SOC-02	slipped, painted (geometric)	wiped	Surface
SOC-03	slipped, painted (geometric)	slipped?	Surface
SOC-04	slipped, painted (wash)	slipped, well-burnished	Surface
SOC-05	slipped, painted (geometric)	wiped	Surface
SOC-06	slipped, painted (band)	wiped	Surface
SOC-07	slipped, burnished	slipped, burnished	Surface
SOC-08	slipped, burnished	wiped	Surface
SOC-09	slipped, burnished, painted (band)	slipped, burnished	Surface

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
SOC-10	unslipped, painted (band)	slipped	Surface
SOC-11	slipped (rim only)	wiped	Surface
SOC-12	slipped, burnished	wiped	Surface
SOC-13	slipped, burnished	slipped rim	Surface
SOC-14	slipped	slipped	Surface
SOC-15	unslipped	slipped, burnished	Surface
SOC-16	wiped	slipped, burnished	Surface
SOC-17	slipped	wiped (rim slipped)	Surface
SOC-18	wiped	slipped, burnished	Surface
SOC-19	slipped, well-burnished	none	Surface
SOC-20	wiped (slipped rim)	slipped	Surface
SOC-21	slipped	wiped	Surface
SOC-22	wiped	wiped	Surface
SOC-23	wiped	wiped	Surface
SOC-24	wiped	none	Surface
SOC-25	slipped, painted band	wiped	Surface
SOC-26	wiped	wiped	Surface
SOC-27	slipped	wiped	Surface
SOC-28	slipped	wiped	Surface
SOC-29	painted: white, black, red	paint: white, black, red	Surface
SOC-30	white slip, red rim	white slip, red rim	Surface
SOC-31	wiped, black slipped rim	black, maroon, and white resist pattern	Surface
SOC-32	orange/yellow gradient slip	white slip, red paint	Surface
SOC-33	white slip, geometric red paint	white slip, geo. red painted cross	Surface
SOC-34	carbonized	red slip	Surface
SOC-35	carbonized	red slip	Surface
SOC-36	carbonized	red slip	Surface
SOC-37	unfinished, red slipped rim	red slip	Surface
SOC-38	unfinished, red slipped rim	red slip	Surface
SOC-39	unfinished, rough	unfinished, smoothed	Surface
SOC-40	unfinished, rough	possible red slip	Surface
SOC-41	orange slip, red slipped rim	orange slip	Surface
SOC-42	red slip	red slip	Surface

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
SOC-43	orange slip, burnished	red slip	Surface
SOC-44	orange slip	red slip	Surface
SOC-45	carbonized	red slip	Surface
SOC-46	red slip	red slip	Surface
SOC-47	carbonized	red slip	Surface
SOC-48	unfinished, wiped	red slip	Surface
SOC-49	unfinished, smoothed	smoothed, red slipped rim	Surface
SOC-50	carbonized	red slip	Surface
SOC-51	smoothed	red slip	Surface
SOC-52	red slip	red slip	Surface
SOC-53	black slip	black slip, burnished	Surface
SOC-54	smoothed, red slip rim	red slip	Surface
SOC-55	cream slip	cream slip	Surface
SOC-56	red slip, exposed unslipped portion near rim	red slip	Surface
SOC-57	carbonized	red slip	Surface
SOC-58	thin red slip	red slip	Surface
SOC-59	cream slip	red slip	Surface
SOC-60	thin red slip	thin red slip	Surface
SOC-61	carbonized	red slip	Surface
SOC-62	red slip, burnished below shoulder	red slip	Surface
SOC-63	carbonized	red slip	Surface
SOC-64	carbonized	dark red slip, burnished	Surface
SOL-01	red slip	red slip	Surface
SOL-02	red slip rim	red slip rim	Surface
SOL-03	smoothed	smoothed, red slip rim	Surface
SOL-04	black slip	black slip	Surface
SOL-05	red slip	red slip	Surface
SOL-06	excised geometric design on smoothed surface; red slip below design	red slip	Surface
SOL-07	red slip, burnished	red slip, burnished	Surface
SOL-08	smoothed	smoothed	Surface
SOL-09	red slip, cross-hachted burnish	red slip	Surface
SOL-10	wiped	red slip, maroon negative "wave" design and maroon rim	Surface
SOL-11	red slip	red slip	Surface

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
SOL-12	red slip, small incised marks	wiped, red slip rim w/carbon	Surface
SOL-13	smoothed, red slip below rim	red slip	Surface
SOL-14	red slip, burnished; small incised marks	red slip	Surface
TAJ-01	smoothed, mica visible on surface, carbonized	smoothed, mica visible on surface	Excavated
TAJ-02	smoothed, mica visible on surface	smoothed, mica visible on surface	Excavated
TAJ-03	smoothed, carbonized	smoothed	Excavated
TAJ-04	signs of burnishing, but carbonized	red slip	Excavated
TAJ-05	burnished, but carbonized	wiped	Excavated
TAJ-06	red slip, burnished, carbonized	smoothed	Excavated
TAJ-07	brown slip, burnished	smoothed	Excavated
TAJ-08	burnished, carbonized	red slip, horizontal burnishing	Excavated
TAJ-09	brown/dark red slip, burnished	smoothed, horizontal striations	Excavated
TAJ-10	horizontal translucent decoration (paint?)	wiped	Excavated
TAJ-11	black slip, burnished	smoothed	Excavated
TAJ-12	red slip, burnished	smoothed	Excavated
TAJ-13	smoothed	dark brown slip, burnished	Excavated
TAJ-14	dark red/maroon slip, burnished	wiped (highly worn)	Excavated
TAJ-15	burnished, carbonized	smoothed	Excavated
TAJ-16	burnished, carbonized	wiped	Excavated
TAJ-17	remnants of red slip, burnished, carbonized	wiped	Excavated
TAJ-18	smoothed, burnished, some carbonization	smoothed	Excavated
TAJ-19	dark red/brown slip, burnished	smoothed	Excavated
TAJ-20	dark red/brown slip, may be burnished	smoothed	Excavated
TAJ-21	carbonized	smoothed	Excavated
TAJ-22	red slip, burnished	red slip, burnished	Excavated
TAJ-23	carbonized	smoothed	Excavated
TAJ-24	red slip, burnished, carbonized	smoothed	Excavated
TAJ-25	burnished, carbonized	smoothed	Excavated
TAJ-26	red slip, burnished	smoothed, red slip along top edge of rim	Excavated
TAJ-27	dark red slip, burnished	wiped	Excavated
TAJ-28	light brown slip, burnished, carbonized	smoothed	Excavated
TAJ-29	remnants of red slip, carbonized	smoothed	Excavated
TAJ-30	burnished, carbonized	smoothed	Excavated

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
TBE007	-	-	Surface
TBE00X/254	-	-	Surface
TBE015	-	-	Surface
TBE016	-	-	Surface
TBE027	-	-	Surface
TBE028	-	-	Surface
TBE032	-	-	Surface
TBE043	-	-	Surface
TBE047	-	-	Surface
TBE071	-	-	Surface
TBE119	-	-	Surface
TBE136	-	-	Surface
TBE144	-	-	Surface
TBE149	-	-	Surface
TBE153	-	-	Surface
TBE189	-	-	Surface
TBE194	-	-	Surface
TBE256	-	-	Surface
TBE38A	-	-	Surface
TBE38B	-	-	Surface
TBE39A	-	-	Surface
TBE39B	-	-	Surface
TBE443	-	-	Surface
TBL-01	slipped, painted (red geometric)	wiped	Surface
TBL-02	slipped	wiped	Surface
TBL-03	slipped, painted (red geometric)	wiped	Surface
TBL-04	wiped	none	Surface
TBL-05	slipped	slipped	Surface
TBL-06	slipped	wiped	Surface
TBL-07	slipped	wiped	Surface
TBL-08	slipped	slipped	Surface
TBL-09	slipped	wiped	Surface
TBL-10	painted (rim)	slipped	Surface

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
TBL-11	slipped, burnished	wiped	Surface
TBL-12	slipped	wiped	Surface
TBL-13	wiped	wiped	Surface
TBL-14	wiped	wiped	Surface
TBL-15	wiped	wiped	Surface
TBL-16	slipped (buff), painted (red geometric, rim)	wiped	Surface
TBL-17	slipped	wiped	Surface
TBL-18	slipped	slipped	Surface
TBL-19	wiped	none	Surface
TBL-20	slipped	slipped	Surface
TBL-21	wiped	wiped	Surface
TBL-22	wiped	wiped	Surface
TBL-23	slipped	none	Surface
TBL-24	slipped (dark red)	wiped	Surface
TBL-31	carbonized	smoothed	Surface
TBL-32	carbonized	carbonized, evidence of red slip	Surface
TBL-33	red slip, carbonized	smoothed	Surface
TBL-34	red painted stripes (highly worn)	highly worn	Surface
TBL-35	granular (high worn?)	smoothed	Surface
TBL-36	thin red slip	wiped below rim, smoothed (or worn) on interior of rim	Surface
TBL-37	vertical stripes on neck, solid red slip where curve begins	smoothed	Surface
TBL-38	very smooth brown slip (or paste), dark brown painted lines (5YR4/4)	smoothed	Surface
TBL-39	unslipped, red parallel lines	smoothed	Surface
TBL-40	thin slip (worn)	thin slip (worn)	Surface
TBL-41	smoothed, red painted stripes	wiped	Surface
TBL-42	slipped	-	Surface
TBL-43	carbonized, some evidence of red slip	smoothed	Surface
TBL-44	wiped, red slip	red slip	Surface
TBL-45	carbonized	smoothed	Surface
TBL-46	dark red/brown slip	dark red/brown slip (5YR4/3)	Surface
TBL-47	carbonized	wiped	Surface
TBL-48	smoothed with red painted stripes	highly worn	Surface
TBL-49	wiped, red slip along rim	red slip, carbonized	Surface

Table A.2: Ceramic Sample Descriptions, Part 2 (continued)

INAA ID	Exterior Surface Finish	Interior Surface Finish	Context
TBL-50	dark red/brown slip, parallel stripes of burnishing	smoothed	Surface
TBL-51	wiped, red slip rim	wiped, red slip rim	Surface
TBL-52	red slip, worn, carbonized	smoothed	Surface
TBL-53	red slip, carbonized	dark red slip	Surface
TBL-54	orange slip, red painted geometric design	wiped	Surface
TBL-55	red slip	wiped	Surface
TBL-56	red slip on rim, vertical stripes below rim	smoothed below inclined part of rim, red slip on incline	Surface
TBL-57	red slip rim, smoothed below rim	red slip along top edge of rim, wiped below	Surface
TBL-58	smoothed, red slip	heavily worn	Surface
TBL-59	red slip rim, vertical red painted stripes	smoothed, red slip along top edge of rim	Surface
TBL-60	smoothed	smoothed	Surface
TUN_001	painted (white, red parallel stripes)	slipped	Surface
TUN_002	slipped, painted (white, red parallel stripes)	wiped	Surface
TUN_003	wiped	wiped	Surface
TUN_004	wiped	wiped	Surface
TUN_005	slipped (white/red), burnished, painted (red parallel stripes)	none	Surface
TUL-01	dark red slip, well burnished (fine, smooth finish)	smoothed	Excavated
TUL-02	red slip, vertical burnishing	smoothed	Excavated
TUL-03	dark brown/maroon slip, vertical burnishing	smoothed	Excavated
TUL-04	red slip, slightly burnished	smoothed	Excavated
TUL-05	red slip, burnished	smoothed	Excavated
TUL-06	red slip, well-burnished (fine, smooth finish), striations or incisions vertical	smoothed	Excavated
TUL-07	remnants of red slip or paint, smoothed; red slip on flat surface of rim	highly worn	Excavated
TUL-08	smoothed	smoothed	Excavated
TUL-09	red slip, signs of burnishing	smoothed, no slip	Excavated
TUL-10	red slip, diagonal painted lines below rim	smoothed	Excavated
TUL-11	carbonized, signs of burnishing	burnished, carbonized	Excavated

APPENDIX B:

Ceramic Chemical Data and Mahalanobis Distance Results

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Atuntaqui	Core Member	HUA-07	RC1950-23	RC1950-24	808.9524	96382.93	34823.8	4009.283	119.2375	862.52435
Atuntaqui	Core Member	HUA-11	RC1950-23	RC1950-24	636.3589	96345.53	33637.44	3842.611	159.0843	789.7883
Atuntaqui	Added	HUA-15	RC1950-23	RC1950-24	949.5666	88034.46	35783.72	3206.581	153.3438	1001.0136
Atuntaqui	Core Member	HUA-17	RC1950-23	RC1950-24	852.003	92449.31	33766.69	3310.801	128.9265	958.8806
Atuntaqui	Added	HUA-18	RC1950-23	RC1950-24	690.5126	92346.59	35774.26	3486.703	159.0427	649.3269
Atuntaqui	Core Member	HUA-19	RC1950-23	RC1950-24	922.2056	97913	35623	3027.693	126.995	739.7218
Atuntaqui	Added	HUA-31	RC1950-25	RC1950-26	912.8953	92848.52	34855.86	3886.767	170.9555	699.35855
Atuntaqui	Core Member	HUA-40	RC1950-25	RC1950-26	926.1298	91914.75	35266.41	3672.214	140.4717	922.52575
Atuntaqui	Core Member	HUA-51	RC1950-25	RC1950-26	778.5546	91274.99	33192.45	3942.14	134.2887	707.72235
Atuntaqui	Added	ATU-03	RC1950-3	RC1950-4	665.7725	96999.24	32307.08	3373.856	137.3091	1225.274
Atuntaqui	Added	ATU-13	RC1950-5	RC1950-6	231.0854	96819.52	39246.97	3515.78	122.4587	1160.7275
Atuntaqui	Core Member	ATU-14	RC1950-5	RC1950-6	890.8978	95157.59	39219.75	3520.361	111.8085	871.785
Atuntaqui	Core Member	ATU-21	RC1950-5	RC1950-6	890.0335	95200.69	37861.75	4025.06	124.747	1141.0765
Atuntaqui	Core Member	ATU-24	RC1950-5	RC1950-6	744.0126	89633.99	39120.31	4199.142	117.6479	1155.1655
Atuntaqui	Added	ATU-27	RC1950-5	RC1950-6	662.8499	87241.76	41458.68	4094.065	108.798	1011.2752
Atuntaqui	Core Member	ATU-28	RC1950-5	RC1950-6	671.7332	95020.45	38947.04	3481.657	118.752	974.0585
Atuntaqui	Core Member	ATU-29	RC1950-5	RC1950-6	810.2786	93151.66	39809.51	3521.428	114.6373	973.1573
Atuntaqui	Core Member	ATU-31	RC1950-5	RC1950-6	722.9721	92613.72	39388.95	3982.73	128.6702	779.91565
Atuntaqui	Core Member	ATU-32	RC1950-5	RC1950-6	700.7039	91420	39137.45	3645.134	116.7481	1086.3975
Atuntaqui	Added	ECU_001	RC1904-5	RC1904-8	882.0875	97264.52	33554.81	3326.226	136.3255	777.9143
Atuntaqui	Core Member	ROQ_003	RC1904-3	RC1904-4	846.8976	91887.8	35510.9	3681.282	126.7767	973.5228
Atuntaqui	Added	ROQ_006	RC1904-3	RC1904-4	594.4807	90208.66	34358.91	3993.194	104.4403	1557.1453
Atuntaqui	Added	SOC-43	RC1950-1	RC1950-2	761.2681	91324.52	33437.96	3842.962	110.8885	901.2769
Atuntaqui	Added	SOC-48	RC1950-1	RC1950-2	820.8106	92734.26	36396.87	4350.003	144.2333	1139.724
Atuntaqui	Core Member	SOC-59	RC1950-3	RC1950-4	911.4477	91335.05	33939.15	3630.328	119.412	944.7461
High Cr	Added	CRM-02	RC1950-27	RC1950-28	671.8884	84000.98	29736.27	3843.926	86.13806	2507.7185
High Cr	Added	CRM-04	RC1950-29	RC1950-30	873.0732	97254.14	9665.822	4865.714	144.2291	820.31455
High Cr	Added	CRM-05	RC1950-29	RC1950-30	588.1214	98064.98	26437.22	4609.145	134.9222	1799.007
High Cr	Added	CRM-06	RC1950-29	RC1950-30	706.9958	91263.45	17771.66	4777.593	122.032	767.7882
High Cr	Added	CRM-09	RC1950-29	RC1950-30	958.5952	104269.5	24502.75	4335.728	129.9297	1522.682
High Cr	Added	HLV-05	RC1950-27	RC1950-28	1181.097	85739.37	29619.71	3648.222	125.0359	1278.477
High Cr	Added	HLV-06	RC1950-27	RC1950-28	1074.576	95996.6	35420.43	3581.698	141.8435	688.25225
High Cr	Added	HUA-08	RC1950-23	RC1950-24	730.4427	89416.53	20250.44	5275.002	206.9044	1461.3265

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
High Cr	Added	HUA-12	RC1950-23	RC1950-24	719.9691	96617.34	32643.86	4120.225	155.681	1034.8461
High Cr	Added	HUA-54	RC1950-27	RC1950-28	617.09	95033.53	31423.4	4238.838	135.9959	760.44885
High Cr	Added	MAS-04	RC1950-17	RC1950-18	451.5894	96085.04	15535.44	3267.869	102.542	736.51235
High Cr	Added	MAS-07	RC1950-17	RC1950-18	736.1655	94231.52	31795.76	3461.104	137.2053	1049.8979
High Cr	Added	MAS-08	RC1950-17	RC1950-18	618.0897	88536.06	28166.6	3427.01	107.6919	1408.1075
High Cr	Added	SOL-04	RC1950-19	RC1950-20	419.1562	102940.9	20545.73	4719.084	125.9278	769.53525
High Cr	Added	SOL-08	RC1950-19	RC1950-20	790.4393	102037.8	6086.597	3612.013	152.1227	1042.997
High Cr	Added	SOL-12	RC1950-19	RC1950-20	725.2557	101263.6	18393.26	3720.584	100.9719	629.2309
High Cr	Added	TBL-31	RC1950-19	RC1950-20	917.8623	96717.55	26007.52	3535.183	122.5979	1056.903
High Cr	Core Member	TBL-32	RC1950-19	RC1950-20	676.7199	94583.73	25733.48	3873.86	118.7395	1605.1475
High Cr	Core Member	TBL-36	RC1950-19	RC1950-20	742.6019	88505.16	26635.11	3345.274	109.1316	1290.499
High Cr	Added	TBL-37	RC1950-19	RC1950-20	686.1092	97539.67	27424.42	3901.764	109.5378	2371.0175
High Cr	Added	TBL-38	RC1950-19	RC1950-20	700.415	99262.49	29806.06	3496.035	120.683	2354.7165
High Cr	Core Member	TBL-39	RC1950-19	RC1950-20	577.6608	92546.88	26827.82	3663.516	107.2348	1874.874
High Cr	Core Member	TBL-40	RC1950-19	RC1950-20	663.3241	90917.64	27055.12	3180.447	92.02888	2191.904
High Cr	Core Member	TBL-41	RC1950-19	RC1950-20	555.3781	89818.55	25838.2	3679.803	116.6289	2007.287
High Cr	Core Member	TBL-42	RC1950-21	RC1950-22	739.3241	101409.1	28114.08	3852.844	135.5454	1210.214
High Cr	Core Member	TBL-43	RC1950-21	RC1950-22	842.4814	98384.28	25277.72	3939.203	126.4565	1008.8363
High Cr	Core Member	TBL-45	RC1950-21	RC1950-22	709.9731	96754.05	25043.24	3474.963	123.7424	1130.539
High Cr	Core Member	TBL-46	RC1950-21	RC1950-22	747.2441	96712.7	26609.97	3362.795	116.663	1860.9655
High Cr	Core Member	TBL-47	RC1950-21	RC1950-22	752.9582	94892.48	25693.19	3582.661	114.8473	1019.7346
High Cr	Core Member	TBL-49	RC1950-21	RC1950-22	753.2691	100036.8	28724.58	4369.563	122.8564	1655.9775
High Cr	Core Member	TBL-51	RC1950-21	RC1950-22	548.1099	89205.3	26564.05	2865.78	111.052	1592.195
High Cr	Core Member	TBL-52	RC1950-21	RC1950-22	750.759	95252.45	24847.25	3888.193	125.9024	1012.4306
High Cr	Core Member	TBL-53	RC1950-21	RC1950-22	796.0805	94008.26	28191.92	4389.619	111.7673	1379.862
High Cr	Core Member	TBL-54	RC1950-21	RC1950-22	822.9243	89819.89	26022.06	3536.796	109.1283	1361.137
High Cr	Core Member	TBL-55	RC1950-21	RC1950-22	689.9498	98903.78	28174.71	4277.178	121.0965	2008.224
High Cr	Core Member	TBL-57	RC1950-21	RC1950-22	675.2414	97692.95	23449.63	4025.379	103.835	1695.753
High Cr	Added	TBL-58	RC1950-21	RC1950-22	616.3275	93921.3	28974.4	3506.478	112.2881	1524.0585
High Cr	Core Member	TBL-59	RC1950-21	RC1950-22	715.7439	94301.5	27104.2	3953.566	106.335	2113.542
High Cr	Core Member	ANG_003	RC1904-1	RC1904-2	761.3345	97383.69	24836.04	4282.896	88.54873	1986.525
High Cr	Added	ANG_004	RC1904-1	RC1904-2	855.2802	108854.7	23023.64	4565.711	150.2095	1129.3543
High Cr	Core Member	ANG_009	RC1904-1	RC1904-2	699.3561	94716.7	24218.18	3733.078	118.7805	1676.6663
High Cr	Added	ANG_011	RC1904-1	RC1904-2	667.9159	93297.29	23582.12	4497.869	99.78716	1259.3947

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
High Cr	Added	ANG_013	RC1904-1	RC1904-2	878.64	90802.86	26742.37	3645.982	98.61704	2265.9057
High Cr	Added	ANG_014	RC1904-1	RC1904-2	781.9164	94561.81	26122.35	4753.726	99.6376	2800.2303
High Cr	Core Member	ANG_016	RC1904-1	RC1904-2	753.4024	95232.81	26180.12	4269.125	98.07304	1541.438
High Cr	Core Member	ATU-01	RC1950-3	RC1950-4	592.8152	95879.09	21462.61	4503.469	116.489	1974.3665
High Cr	Added	ATU-17	RC1950-5	RC1950-6	854.4058	105661.3	22003.53	5202.356	124.6222	1774.3275
High Cr	Added	ATU-26	RC1950-5	RC1950-6	1066.112	98888.72	26560.44	5180.622	117.0887	1199.378
High Cr	Core Member	CAR_009	RC1882-2	RC1882-1	698.8183	84775.34	28386.33	3843.212	125.9142	1990.245
High Cr	Added	CAR_020	RC1882-2	RC1882-1	695.9019	91211.8	37986.01	4271.382	110.7774	3621.157
High Cr	Added	POR_010	RC1904-7	RC1904-9	1107.481	114600.8	19574.85	4904.434	151.3057	883.18677
High Cr	Added	POR_011	RC1904-7	RC1904-9	1050.893	116426.6	16395.12	4742.645	159.1202	895.2989
High Cr	Added	PUN-24	RC1950-9	RC1950-10	824.132	98519.34	26518.27	3733.644	145.1117	735.37465
High Cr	Added	ROQ_010	RC1904-3	RC1904-4	619.8772	112086.4	21781.87	4539.428	128.0652	770.403
High Cr	Core Member	SOC-01	RC1904-11	RC1904-13	791.6508	98793.82	31453.54	4200.38	117.0207	1231.6703
High Cr	Core Member	SOC-02	RC1904-11	RC1904-13	694.4603	96476.23	30251.18	3789.482	106.8286	1428.261
High Cr	Core Member	SOC-07	RC1904-11	RC1904-13	782.5869	93952.89	28846.83	4291.252	110.4561	1061.0927
High Cr	Core Member	SOC-15	RC1904-11	RC1904-13	804.0963	92848.03	26967.54	5000.942	107.3636	857.63783
High Cr	Core Member	SOC-16	RC1904-11	RC1904-13	749.2651	96731.53	25060.52	3572.406	125.6132	1268.9467
High Cr	Core Member	SOC-18	RC1904-12	RC1904-14	699.9026	88492.2	21410.66	3471.792	111.4144	1127.2523
High Cr	Core Member	SOC-21	RC1904-12	RC1904-14	924.6489	95710.02	24057.47	4476.511	121.796	860.2943
High Cr	Core Member	SOC-22	RC1904-12	RC1904-14	741.8999	88793.34	32377.73	3896.584	106.394	1214.778
High Cr	Core Member	SOC-25	RC1904-12	RC1904-14	584.9653	95170.04	17962.12	3388.072	104.2289	783.79717
High Cr	Core Member	SOC-26	RC1904-12	RC1904-14	856.6348	90877.05	39883.78	4149.547	124.1367	821.24007
High Cr	Core Member	SOC-27	RC1904-12	RC1904-14	760.6891	89982.59	29259.46	3400.195	105.8948	1482.1673
High Cr	Core Member	SOC-28	RC1904-12	RC1904-14	727.3224	93284.95	26995.85	3290.751	114.3193	1473.5353
High Cr	Core Member	SOC-34	RC1950-1	RC1950-2	776.5294	95050.16	32886.39	4300.973	131.1079	829.4569
High Cr	Added	SOC-35	RC1950-1	RC1950-2	805.8567	108325.2	32621.96	4467.272	150.4413	868.9749
High Cr	Core Member	SOC-38	RC1950-1	RC1950-2	747.0807	99704.73	32840.85	4345.716	119.6342	967.84205
High Cr	Added	SOC-39	RC1950-1	RC1950-2	996.9036	98145.09	27270.98	4122.135	136.3203	1381.824
High Cr	Core Member	SOC-40	RC1950-1	RC1950-2	683.4504	92145.49	30610.48	3327.908	106.6285	971.1766
High Cr	Core Member	SOC-42	RC1950-1	RC1950-2	705.3879	96657.49	29970.17	3831.902	115.8802	1110.3125
High Cr	Core Member	SOC-50	RC1950-1	RC1950-2	817.7126	93505.21	32435.24	3636.871	120.3677	1227.873
High Cr	Core Member	SOC-52	RC1950-1	RC1950-2	751.9161	93253.98	31418.51	4427.962	103.7801	975.2287
High Cr	Core Member	SOC-53	RC1950-3	RC1950-4	670.6152	89523.36	28563.71	4100.211	120.9127	1188.47
High Cr	Added	SOC-57	RC1950-3	RC1950-4	716.8525	92154.75	29529.28	4648.659	118.1204	916.25935

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
High Cr	Core Member	SOC-63	RC1950-3	RC1950-4	820.7979	92987.28	32102.98	3998.724	115.548	997.08525
High Cr	Core Member	SOC-64	RC1950-3	RC1950-4	719.5605	92565.66	33183.27	4199.185	119.002	1568.2275
High Cr	Added	TBL-01	RC1904-3	RC1904-4	882.1454	107674.3	27167.05	4122.671	145.4187	776.89813
High Cr	Core Member	TBL-03	RC1904-5	RC1904-8	804.1925	99821.59	26106.49	3893.256	127.5011	828.0759
High Cr	Core Member	TBL-04	RC1904-5	RC1904-8	875.2811	100887.1	24175.69	4568.086	121.6187	743.47697
High Cr	Core Member	TBL-05	RC1904-5	RC1904-8	874.6739	99250.61	30922.41	3769.75	125.5122	1287.7013
High Cr	Core Member	TBL-06	RC1904-5	RC1904-8	688.9406	105194.5	24440.1	3862.367	110.6356	751.1196
High Cr	Core Member	TBL-08	RC1904-5	RC1904-8	531.003	93699.48	25472.72	3815.032	115.5867	1702.6437
High Cr	Core Member	TBL-09	RC1904-5	RC1904-8	650.9089	101091.4	27026.05	3448.219	157.9928	776.07197
High Cr	Core Member	TBL-10	RC1904-5	RC1904-8	670.7664	90276.77	27901.26	3902.201	107.9069	1120.4707
High Cr	Core Member	TBL-11	RC1904-5	RC1904-8	478.4715	91172.12	26745.32	3536.918	105.8842	1325.1213
High Cr	Core Member	TBL-12	RC1904-5	RC1904-8	837.1683	104746.3	26345.25	3947.023	137.0979	705.7183
High Cr	Core Member	TBL-13	RC1904-5	RC1904-8	817.9229	106014.7	29044.67	3913.764	127.5858	685.76227
High Cr	Core Member	TBL-14	RC1904-5	RC1904-8	850.2173	102280.1	27681.89	4293.761	123.0582	723.32307
High Cr	Core Member	TBL-15	RC1904-5	RC1904-8	813.7514	105205.7	24993.5	4533.625	131.7049	759.01383
High Cr	Core Member	TBL-16	RC1904-5	RC1904-8	819.2783	93761.28	30375.36	4012.87	125.037	1792.688
High Cr	Added	TBL-18	RC1904-5	RC1904-8	1120.598	103261.5	25451.28	4595.7	178.4457	1933.2703
High Cr	Core Member	TBL-19	RC1904-5	RC1904-8	775.3888	91857.18	28056.57	3764.89	115.3744	1090.1117
High Cr	Core Member	TBL-20	RC1904-5	RC1904-8	644.389	92833.02	28419.91	3820.75	111.4268	1598.7783
High Cr	Core Member	TBL-21	RC1904-5	RC1904-8	576.2158	93159.28	22754.26	3754.851	124.3783	1047.8813
High Cr	Core Member	TBL-22	RC1904-5	RC1904-8	632.8563	95124.48	25214.36	3790.515	112.1248	825.72903
High Cr	Core Member	TBL-23	RC1904-5	RC1904-8	888.5242	99223.54	28835.94	3803.919	137.5723	1042.676
Unknown	-	TBL-25	RC1904-11	RC1904-13	884.645	89952.42	30530.77	3581.333	108.1389	765.71373
Unknown	-	TBL-26	RC1904-11	RC1904-13	895.118	87529.01	29975.6	3888.006	125.3329	743.39177
High Cr	Added	TBL-27	RC1904-11	RC1904-13	916.7502	95693.97	30098.22	4067.448	119.3084	1252.2587
High Cr	Added	TBL-28	RC1904-11	RC1904-13	891.3716	86509	28605.33	3659.536	118.2684	1086.4457
Unknown	Added	TBL-29	RC1904-11	RC1904-13	874.3647	88754.32	31744.56	4206.509	108.5929	1038.4108
Unknown	-	TBL-30	RC1904-11	RC1904-13	812.3874	89178.1	31479.31	3441.172	103.2588	1054.3297
High Fe	Added	SDV-33	RC1950-15	RC1950-16	1058.545	105452.2	34111.11	5092.254	159.3826	728.70135
High Fe	Core Member	SDV-36	RC1950-15	RC1950-16	865.2577	99904.5	37331.89	5347.494	138.5104	1202.1955
High Fe	Core Member	SDV-38	RC1950-15	RC1950-16	855.9382	101275.1	30661.98	4473.291	148.6322	628.2618
High Fe	Core Member	SDV-39	RC1950-15	RC1950-16	860.9686	98037.84	34628.59	4842.86	155.5434	1156.0105
High Fe	Core Member	SDV-40	RC1950-15	RC1950-16	936.7931	103423.9	34281.42	4926.313	168.9375	730.09615
High Fe	Core Member	SDV-41	RC1950-15	RC1950-16	812.8762	99548.8	33083.41	4939.219	156.3054	848.8152

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
High Fe	Core Member	SDV-42	RC1950-15	RC1950-16	901.1272	98508.23	39809.04	4406.1	149.754	1114.306
High Fe	Core Member	SDV-43	RC1950-15	RC1950-16	964.046	102212.9	36130.55	5517.188	175.245	1041.2855
High Fe	Core Member	SDV-45	RC1950-15	RC1950-16	922.6888	102775.3	35713.35	5326.446	171.9829	966.2052
High Fe	Core Member	SDV-46	RC1950-15	RC1950-16	836.514	97959.98	32852.18	4759.217	162.9779	1107.2395
High Fe	Added	SDV-47	RC1950-15	RC1950-16	1041.931	101809.9	38221.32	4644.87	183.497	904.37945
High Fe	Core Member	SDV-48	RC1950-15	RC1950-16	713.2295	97263.58	32577.29	4901.156	142.1963	1416.2385
High Fe	Core Member	SDV-49	RC1950-15	RC1950-16	943.3421	100798	35423.73	4486.458	154.9533	1047.76
High Fe	Core Member	SDV-50	RC1950-15	RC1950-16	981.3209	104552.8	35065.9	4605.938	166.1636	922.2827
High Fe	Added	SDV-55	RC1950-15	RC1950-16	898.7695	100461.3	30798.6	4543.63	151.2508	1240.5765
High Fe	Core Member	SDV-57	RC1950-17	RC1950-18	848.9148	99235.03	34064.4	5732.734	145.2734	1290.9205
High Fe	Core Member	SDV-58	RC1950-17	RC1950-18	771.8176	97864.82	34779.7	5026.844	153.9515	1331.4435
High Fe	Added	PUN-11	RC1950-7	RC1950-8	805.6871	97437.65	26502.41	4389.9	130.4491	1135.0955
High Fe	Added	PUN-31	RC1950-9	RC1950-10	808.2137	95223.33	31907.39	4639.792	120.7227	1050.602
High Fe	Added	PUN-41	RC1950-9	RC1950-10	1361.07	93602.38	29211.39	5142.63	132.1222	1432.2265
High Fe	Core Member	PUN-52	RC1950-11	RC1950-12	892.5396	103103.6	31950.79	4660.379	143.1121	790.41125
High Fe	Core Member	SDV-01	RC1950-11	RC1950-12	806.9651	99410.9	34583.9	5321.799	145.7531	1207.169
High Fe	Core Member	SDV-02	RC1950-11	RC1950-12	833.0803	102096.8	33110.95	5116.286	151.3544	818.2246
High Fe	Core Member	SDV-05	RC1950-11	RC1950-12	918.5212	101683	36994.89	4115.972	164.4502	1173.644
High Fe	Core Member	SDV-07	RC1950-11	RC1950-12	896.0341	101546.7	35988.61	4786.935	154.2429	908.9042
High Fe	Core Member	SDV-08	RC1950-11	RC1950-12	835.4949	97412.47	33877.09	5005.397	141.3784	1089.71
High Fe	Core Member	SDV-09	RC1950-13	RC1950-14	738.9593	94687.55	35066.9	5007.675	148.6779	1264.809
High Fe	Core Member	SDV-11	RC1950-13	RC1950-14	747.5491	97219.09	34365.84	4206.377	147.7568	1378.1365
High Fe	Core Member	SDV-14	RC1950-13	RC1950-14	775.9727	94907.91	33653.66	4392.872	158.4099	1101.9485
High Fe	Added	SDV-20	RC1950-13	RC1950-14	902.6251	106735	31970.55	4615.199	168.7966	1126.064
High Fe	Core Member	SDV-21	RC1950-13	RC1950-14	775.3782	97353.16	34329.18	5298.614	147.4055	1173.785
High Fe	Core Member	SDV-22	RC1950-13	RC1950-14	893.6151	101348.7	34879.25	5015.792	151.9575	1095.589
High Fe	Added	SDV-23	RC1950-13	RC1950-14	988.5942	98654.98	29935.01	4309.286	141.472	1301.748
High Fe	Core Member	SDV-26	RC1950-13	RC1950-14	899.8406	101000.5	37992.96	4486.229	161.0997	991.07625
High Fe	Core Member	SDV-28	RC1950-13	RC1950-14	819.1979	99152.45	34768.14	4543.817	154.6777	1317.121
High Fe	Core Member	SDV-29	RC1950-13	RC1950-14	1008.775	102967.6	36246.93	5140.568	170.4324	908.35565
High Fe	Core Member	SDV-30	RC1950-13	RC1950-14	719.3676	95415.76	33096.41	5083.062	143.6325	1294.4895
High Fe	Added	SDV-31	RC1950-13	RC1950-14	998.4302	106169.2	29666.65	5082.393	145.0132	950.41505
High Th	Not Tested	HUA-33	RC1950-25	RC1950-26	316.0114	83672.32	17086.66	4224.898	168.6857	965.4024
High Th	Not Tested	MON-01	RC1950-17	RC1950-18	730.5893	91482.21	20633.71	3817.181	106.179	2572.6495

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
High Th	Not Tested	MON-08	RC1950-17	RC1950-18	528.0546	100982.7	17742.98	4738.19	142.7858	3017.052
High Th	Not Tested	MON-09	RC1950-17	RC1950-18	906.6347	96601.57	21112.79	4409.934	131.4772	3428.239
High Th	Not Tested	TAJ-24	RC1950-31	RC1950-32	785.704	100375.1	29713.71	3919.764	123.4908	1525.4585
High Th	Not Tested	POR_005	RC1904-7	RC1904-9	571.8061	92396.13	22027.97	3630.931	115.5634	1937.34
High Th	Not Tested	SOC-29	RC1950-1	RC1950-2	306.5507	117443.1	19449.43	4600.105	113.9275	979.39545
High Th	Not Tested	SOC-33	RC1950-1	RC1950-2	416.2411	93930.17	20676.8	3570.002	98.2533	1191.3895
Low Cr	Added	CRM-07	RC1950-29	RC1950-30	866.15	94572.52	27333.69	3943.366	152.3937	2193.4035
Low Cr	Added	HLV-01	RC1950-27	RC1950-28	579.3981	95539.99	24589.83	4044.136	117.2234	997.8613
Low Cr	Added	HUA-01	RC1950-21	RC1950-22	698.0151	85243.68	33252.16	3336.312	127.5966	845.6908
Low Cr	Added	HUA-04	RC1950-21	RC1950-22	788.3444	96565.21	31778.21	4015.901	135.0445	1023.5847
Low Cr	Added	HUA-10	RC1950-23	RC1950-24	725.739	86856.99	32253.24	3484.215	173.3548	1134.032
Low Cr	Core Member	HUA-21	RC1950-23	RC1950-24	710.9348	87857.95	35804.55	3312.793	142.3552	880.32205
Low Cr	Core Member	HUA-22	RC1950-23	RC1950-24	843.3123	90285.31	32527.08	3154.124	124.4992	1088.8415
Low Cr	Added	HUA-23	RC1950-23	RC1950-24	600.348	90189.85	29377.77	3104.797	127.1786	723.5691
Low Cr	Core Member	HUA-24	RC1950-23	RC1950-24	844.2126	87459.77	29183.05	3195.882	107.0985	906.04905
Low Cr	Added	HUA-25	RC1950-23	RC1950-24	972.2307	88205.27	33380.34	3286.628	113.4994	839.6399
Low Cr	Core Member	HUA-27	RC1950-23	RC1950-24	655.9841	87593.41	32484.57	4033.329	127.0233	795.58925
Low Cr	Core Member	HUA-29	RC1950-23	RC1950-24	653.7264	97656.83	25888.55	3041.867	122.8052	1199.2895
Low Cr	Core Member	HUA-30	RC1950-25	RC1950-26	824.4128	86657.99	31126.21	3850.214	139.9028	721.4204
Low Cr	Added	HUA-32	RC1950-25	RC1950-26	787.2313	93984.65	19244.36	3057.143	129.0898	894.3065
Low Cr	Added	HUA-34	RC1950-25	RC1950-26	834.2093	95279.5	25383.43	3021.062	168.5594	909.9916
Low Cr	Core Member	HUA-37	RC1950-25	RC1950-26	883.9946	92504.03	31374.04	3930.67	108.6695	811.0455
Low Cr	Added	HUA-38	RC1950-25	RC1950-26	885.4323	93268.97	30201.36	4027.395	142.0572	968.03635
Low Cr	Core Member	HUA-41	RC1950-25	RC1950-26	688.3056	84553.07	27916.64	3531.868	125.6515	921.0524
Low Cr	Core Member	HUA-42	RC1950-25	RC1950-26	942.7667	89785.8	29099.67	3949.618	146.5371	1014.1327
Low Cr	Added	HUA-43	RC1950-25	RC1950-26	716.1912	99768.02	27987.93	3492.677	129.6455	925.0453
Low Cr	Core Member	HUA-45	RC1950-25	RC1950-26	991.4799	89988.8	32229.7	3580.471	119.7337	1174.201
Low Cr	Core Member	HUA-47	RC1950-25	RC1950-26	878.4488	87879.13	30984.29	3604.548	123.3405	1128.7918
Low Cr	Added	HUA-50	RC1950-25	RC1950-26	665.9891	103171.3	31595.14	4099.271	161.1604	1063.695
Low Cr	Added	HUA-52	RC1950-25	RC1950-26	657.1832	93448.05	21414.5	4055.71	141.3717	828.4067
Low Cr	Added	HUA-53	RC1950-25	RC1950-26	683.5572	90339.95	28168.12	3339.504	107.7304	797.3038
Low Cr	Added	HUA-55	RC1950-27	RC1950-28	939.2303	90365.65	38309.68	3928.5	108.3354	782.8677
Low Cr	Core Member	HUA-56	RC1950-27	RC1950-28	643.0449	96022.07	33923.21	4360.199	150.1641	868.7074
Low Cr	Added	HUA-57	RC1950-27	RC1950-28	616.0468	93426.31	35706.64	3436.596	162.353	760.1884

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Low Cr	Core Member	SDV-34	RC1950-15	RC1950-16	696.0213	96565.7	30050.93	4170.185	101.9675	1089.715
Low Cr	Core Member	SDV-35	RC1950-15	RC1950-16	679.4991	95879.67	29939.68	4200.242	130.9261	1257.255
Low Cr	Core Member	SDV-37	RC1950-15	RC1950-16	776.874	91622.26	27514.72	3850.126	134.0112	1019.9505
Low Cr	Core Member	SDV-51	RC1950-15	RC1950-16	734.1437	94926.79	30834.56	3732.309	121.4196	1054.5635
Low Cr	Core Member	SDV-52	RC1950-15	RC1950-16	694.522	96482.82	31446.6	3749.638	123.2866	1345.721
Low Cr	Core Member	SDV-53	RC1950-15	RC1950-16	496.6237	92984.42	30071.79	4106.42	91.6635	1087.517
Low Cr	Core Member	SDV-56	RC1950-15	RC1950-16	601.0352	94590.51	32686.68	3735.096	94.15557	1232.508
Low Cr	Core Member	SOL-10	RC1950-19	RC1950-20	653.9076	93779.65	28902.79	3573.234	100.4414	1159.064
Low Cr	Core Member	TAJ-05	RC1950-29	RC1950-30	702.8558	96219.05	36126.77	3433.179	127.6098	1055.648
Low Cr	Core Member	TAJ-06	RC1950-29	RC1950-30	693.5388	93910.71	37158.41	3742.855	128.9235	1195.474
Low Cr	Core Member	TAJ-08	RC1950-29	RC1950-30	743.6221	92859.29	32759.79	3148.972	127.4117	1182.352
Low Cr	Core Member	TAJ-11	RC1950-29	RC1950-30	636.0332	92340.27	37517.7	4147.677	125.7182	897.4561
Low Cr	Core Member	TAJ-12	RC1950-29	RC1950-30	548.0043	90748.4	34559.42	2990.588	105.2273	919.87405
Low Cr	Core Member	TAJ-13	RC1950-29	RC1950-30	725.19	94363.77	33887.28	3415.249	132.0929	1338.907
Low Cr	Added	TAJ-14	RC1950-29	RC1950-30	821.8836	88581.95	31852.93	3205.917	118.8406	1655.6505
Low Cr	Added	TAJ-15	RC1950-29	RC1950-30	1306.324	91442.33	34955.5	4036.289	127.5479	940.86505
Low Cr	Core Member	TAJ-16	RC1950-29	RC1950-30	706.971	95129.73	37209.98	3462.878	120.1752	1550.1705
Low Cr	Core Member	TAJ-17	RC1950-29	RC1950-30	678.754	101963.3	36567.11	3720.901	142.344	1298.3075
Low Cr	Core Member	TAJ-18	RC1950-31	RC1950-32	682.0364	90049.27	29067.28	3297.098	111.177	1061.5215
Low Cr	Core Member	TAJ-19	RC1950-31	RC1950-32	573.5374	91323.16	35292.16	3711.783	116.1813	1006.5963
Low Cr	Added	TAJ-20	RC1950-31	RC1950-32	859.6043	100647.7	31843.94	4563.244	132.3811	829.78025
Low Cr	Added	TAJ-21	RC1950-31	RC1950-32	676.2285	93830.13	34649.43	3776.188	124.5688	951.0246
Low Cr	Added	TAJ-22	RC1950-31	RC1950-32	523.3429	94380.48	38506.82	4073.156	107.7172	1456.3935
Low Cr	Added	TAJ-23	RC1950-31	RC1950-32	804.3237	101098.5	28849.08	4774.076	142.6765	835.8083
Low Cr	Added	TAJ-26	RC1950-31	RC1950-32	677.184	96652.55	38783.3	5066.98	115.1069	1418.6755
Low Cr	Added	TAJ-27	RC1950-31	RC1950-32	662.5091	94143.69	36499.68	4118.902	138.2708	1645.6635
Low Cr	Core Member	TAJ-28	RC1950-31	RC1950-32	662.0394	90665.02	34331.96	4342.347	131.9672	1492.0575
Low Cr	Added	TAJ-29	RC1950-31	RC1950-32	583.0018	92210.86	35323.96	4490.234	97.3177	1519.923
Low Cr	Core Member	TAJ-30	RC1950-31	RC1950-32	717.8574	94297.93	34454.47	3646.79	120.9007	1048.4665
Low Cr	Added	TBL-33	RC1950-19	RC1950-20	752.2542	94238.09	31331.15	3699.767	114.0609	1584.774
Low Cr	Added	TBL-35	RC1950-19	RC1950-20	511.6863	94414.57	29055.83	4227.874	90.59444	1189.819
Low Cr	Core Member	TBL-44	RC1950-21	RC1950-22	671.095	92184.34	28640.81	3587.739	96.51466	1481.968
Low Cr	Core Member	TUL-01	RC1950-27	RC1950-28	587.9676	94654.84	35216.95	3907.07	128.3855	881.7995
Low Cr	Added	TUL-02	RC1950-27	RC1950-28	536.2658	94591.21	35961.08	3751.878	93.95689	1104.4845

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Low Cr	Added	TUL-03	RC1950-27	RC1950-28	469.1836	95397.66	34527.11	3669.804	90.87476	1223.5
Low Cr	Added	TUL-04	RC1950-27	RC1950-28	1505.198	91620.35	36940.91	3496.265	125.0297	1177.4275
Low Cr	Added	TUL-06	RC1950-27	RC1950-28	873.3375	95852.11	33965.99	4359.447	122.7518	1103.7785
Low Cr	Core Member	TUL-07	RC1950-27	RC1950-28	572.6399	92578.63	33039.81	3579.454	107.7045	1391.0215
Low Cr	Added	TUL-08	RC1950-27	RC1950-28	608.3466	94129.65	34631.25	3488.738	122.3922	1871.923
Low Cr	Added	TUL-09	RC1950-27	RC1950-28	474.8673	93109.27	31728.11	4438.491	107.0546	1834.899
Low Cr	Added	TUL-10	RC1950-27	RC1950-28	581.7446	90407.83	31488.75	4209.313	119.4631	1491.554
Low Cr	Added	ANG_005	RC1901-2	RC1901-5	685.4578	90343.45	26615.8	3832.622	103.916	1020.7453
Low Cr	Added	ANG_006	RC1904-1	RC1904-2	627.2642	84669.86	31814.95	3386.816	81.21899	1557.0593
Low Cr	Added	ANG_012	RC1904-1	RC1904-2	631.1163	95504.91	21908.27	4355.135	102.5234	2242.2973
Low Cr	Added	ATU-04	RC1950-3	RC1950-4	577.3143	88744.95	27802.79	4011.868	101.5587	903.1382
Low Cr	Core Member	ATU-05	RC1950-3	RC1950-4	651.7219	86575.26	29008.81	2648.417	107.7808	968.02065
Low Cr	Added	ATU-06	RC1950-3	RC1950-4	599.6351	92607.38	30722.37	3671.177	121.4697	1525.4995
Low Cr	Core Member	ATU-07	RC1950-3	RC1950-4	837.5358	91141.37	38259.7	3713.974	124.935	882.9306
Low Cr	Core Member	ATU-08	RC1950-3	RC1950-4	643.4578	95119.43	28002.38	4042.169	122.1722	1438.221
Low Cr	Core Member	ATU-09	RC1950-3	RC1950-4	870.0599	82753.66	38475	2921.854	104.664	1011.1562
Low Cr	Added	ATU-10	RC1950-3	RC1950-4	631.8431	97083.63	38235.89	3820.983	123.3722	1384.43
Low Cr	Core Member	ATU-11	RC1950-3	RC1950-4	790.6768	91584.03	36207.98	3093.311	134.7136	1223.564
Low Cr	Core Member	ATU-15	RC1950-5	RC1950-6	885.8637	86332.89	31875.81	3471.472	111.3549	946.6105
Low Cr	Core Member	ATU-16	RC1950-5	RC1950-6	765.458	89277.79	37920.7	4042.962	114.9495	1030.9855
Low Cr	Core Member	ATU-30	RC1950-5	RC1950-6	758.8205	99510.59	35510.61	4032.478	129.9913	1219.1165
Low Cr	Core Member	ATU-33	RC1950-5	RC1950-6	770.0521	90816.38	35911.68	3773.288	122.3711	1003.7786
Low Cr	Added	ATU-34	RC1950-5	RC1950-6	613.6809	96123.61	25048.11	3912.073	110.8338	1955.0385
Low Cr	Core Member	ATU-36	RC1950-5	RC1950-6	713.0242	93612.38	38833.84	3806.481	143.4804	1169.5895
Low Cr	Core Member	ATU-37	RC1950-7	RC1950-8	678.381	96378.02	30169.41	3670.412	100.814	1097.8598
Low Cr	Added	ATU-39	RC1950-7	RC1950-8	720.8425	94028.63	28754.24	3731.612	92.01582	987.9268
Low Cr	Added	CAR_013	RC1882-2	RC1882-1	634.1373	90316.51	33118.38	3339.24	114.6805	1786.7527
Low Cr	Added	CAR_017	RC1882-2	RC1882-1	865.2242	107974.3	33549.88	4103.454	131.9187	1093.2767
Low Cr	Added	CAR_018	RC1882-2	RC1882-1	517.6044	94853.7	13778.41	3723.521	110.9489	2664.0847
Low Cr	Core Member	CAR_019	RC1882-2	RC1882-1	747.4333	89076.23	28680.56	3341.54	93.16913	1469.2283
Low Cr	Added	PUN-01	RC1950-7	RC1950-8	565.0166	96811.58	30325.4	4521.147	100.5648	1228.2195
Low Cr	Added	PUN-02	RC1950-7	RC1950-8	594.7908	94619.09	32731.1	3733.01	105.3848	1282.1615
Low Cr	Core Member	PUN-03	RC1950-7	RC1950-8	607.7355	95200.32	23459.32	3859.069	110.6029	1304.7035
Low Cr	Core Member	PUN-04	RC1950-7	RC1950-8	635.3195	95134.59	31084.13	4764.236	114.5463	1033.1486

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Low Cr	Core Member	PUN-05	RC1950-7	RC1950-8	536.9025	94600.81	29655.21	3808.632	103.6354	1260.0105
Low Cr	Core Member	PUN-06	RC1950-7	RC1950-8	685.9381	100506.6	32325.45	4832.031	108.4695	1113.4785
Low Cr	Added	PUN-07	RC1950-7	RC1950-8	782.6127	98158.1	28668.03	4171.833	131.295	1181.1385
Low Cr	Core Member	PUN-08	RC1950-7	RC1950-8	539.9944	98742.56	30827.08	3867.896	99.49229	1257.338
Low Cr	Added	PUN-09	RC1950-7	RC1950-8	415.2014	97548.97	28902.28	4544.393	109.6271	1271.52
Low Cr	Added	PUN-10	RC1950-7	RC1950-8	1270.404	90520.07	30641.72	4414.574	134.4176	1150.4905
Low Cr	Core Member	PUN-12	RC1950-7	RC1950-8	560.8052	95200.89	30688.39	3813.678	100.3965	1352.454
Low Cr	Added	PUN-13	RC1950-7	RC1950-8	789.239	97945.26	32749	4805.782	139.0011	1451.2725
Low Cr	Core Member	PUN-14	RC1950-7	RC1950-8	675.8918	96814.24	30120.66	4196.029	109.6842	1146.486
Low Cr	Core Member	PUN-15	RC1950-7	RC1950-8	774.9999	96830.28	31600.24	3703.872	130.7733	1229.1585
Low Cr	Core Member	PUN-16	RC1950-7	RC1950-8	603.1143	88908.51	28131.68	3997.75	120.7593	1103.417
Low Cr	Core Member	PUN-17	RC1950-7	RC1950-8	627.86	98362.7	30495.46	4709.611	129.5677	1092.2455
Low Cr	Core Member	PUN-18	RC1950-7	RC1950-8	455.8935	100760	30528.25	5374.057	123.601	1095.4615
Low Cr	Core Member	PUN-19	RC1950-7	RC1950-8	602.9832	97615.34	30741.91	4298.519	128.8256	1120.8995
Low Cr	Core Member	PUN-20	RC1950-7	RC1950-8	728.5551	90795.69	28315.19	3937.063	120.9524	802.1403
Low Cr	Core Member	PUN-21	RC1950-9	RC1950-10	595.7665	97192.29	28853.29	4206.004	104.6164	1144.935
Low Cr	Core Member	PUN-22	RC1950-9	RC1950-10	720.2924	97644.46	31291.34	4097.002	122.8761	1011.8421
Low Cr	Core Member	PUN-23	RC1950-9	RC1950-10	569.7798	100868.8	32164.94	4442.146	137.1556	955.0806
Low Cr	Core Member	PUN-25	RC1950-9	RC1950-10	659.6061	102045.8	31991.83	4199.507	122.9418	960.1914
Low Cr	Core Member	PUN-26	RC1950-9	RC1950-10	556.1297	90593.55	29267.57	3827.579	111.8284	1049.1077
Low Cr	Added	PUN-27	RC1950-9	RC1950-10	978.5707	93203.07	31625.58	3809.835	115.1122	1128.359
Low Cr	Core Member	PUN-28	RC1950-9	RC1950-10	561.8041	95104.53	31442.25	3798.491	111.698	945.85175
Low Cr	Core Member	PUN-29	RC1950-9	RC1950-10	578.6356	95892.29	31710.49	4931.448	113.1115	840.74135
Low Cr	Core Member	PUN-30	RC1950-9	RC1950-10	560.8519	93273.45	32992.62	3106.025	111.9768	1027.7439
Low Cr	Added	PUN-32	RC1950-9	RC1950-10	661.9603	97965.77	30190.26	4786.192	131.8677	1323.5795
Low Cr	Core Member	PUN-33	RC1950-9	RC1950-10	618.739	94757.54	31973.43	4149.052	116.2548	1032.9075
Low Cr	Core Member	PUN-34	RC1950-9	RC1950-10	632.7666	92988.58	32727.37	3577.288	110.7971	979.70165
Low Cr	Core Member	PUN-35	RC1950-9	RC1950-10	714.1878	95783.21	33484.37	4467.115	125.3682	1008.6852
Low Cr	Core Member	PUN-36	RC1950-9	RC1950-10	589.0806	93695.42	30229.5	3572.052	110.8887	1023.3002
Low Cr	Added	PUN-37	RC1950-9	RC1950-10	1002.583	97642.33	32951.23	3726.203	128.6519	1688.42
Low Cr	Core Member	PUN-38	RC1950-9	RC1950-10	732.6185	95440.36	30969.33	4344.958	121.5018	1094.1715
Low Cr	Core Member	PUN-39	RC1950-9	RC1950-10	638.9458	93568.61	29080.18	4651.708	117.4831	1583.411
Low Cr	Core Member	PUN-40	RC1950-9	RC1950-10	779.7863	94095.52	32824.93	3973.829	131.748	1420.583
Low Cr	Added	PUN-42	RC1950-9	RC1950-10	607.6199	99101.97	29389.67	4197.88	118.0694	1591.4965

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Low Cr	Core Member	PUN-43	RC1950-9	RC1950-10	637.6969	98815.84	30052.42	3739.548	120.7944	1341.618
Low Cr	Core Member	PUN-44	RC1950-9	RC1950-10	544.561	94527.33	31418.16	4075.069	104.2262	1395.854
Low Cr	Core Member	PUN-45	RC1950-11	RC1950-12	571.1025	97668.92	30229.53	4013.879	127.2086	1594.672
Low Cr	Core Member	PUN-46	RC1950-11	RC1950-12	716.3466	96865.19	34249.07	4845.308	117.3209	1224.445
Low Cr	Core Member	PUN-47	RC1950-11	RC1950-12	696.8187	97460.94	33517.58	4600.117	124.2388	1567.5755
Low Cr	Core Member	PUN-48	RC1950-11	RC1950-12	558.6461	96935.67	27194.08	4704.629	100.4357	1532.787
Low Cr	Core Member	PUN-50	RC1950-11	RC1950-12	692.9384	97019.73	28998.14	4003.668	120.3855	1370.972
Low Cr	Core Member	PUN-51	RC1950-11	RC1950-12	570.4069	99149.98	32143.51	4036.524	130.2121	1223.9375
Low Cr	Added	PUN-53	RC1950-11	RC1950-12	1211.249	95611.05	28910.43	4614.985	129.5134	1996.5235
Low Cr	Core Member	PUN-54	RC1950-11	RC1950-12	659.7349	98113.58	32025.92	4760.749	127.8435	1096.1705
Low Cr	Core Member	PUN-55	RC1950-11	RC1950-12	697.1783	95635.53	28609.54	3742.125	117.5641	1260.4315
Low Cr	Added	PUN-57	RC1950-11	RC1950-12	909.1678	97077.54	30681.31	5314.081	121.148	1332.445
Low Cr	Core Member	PUN-58	RC1950-11	RC1950-12	617.7805	99400.52	27542.7	4847.814	128.0986	1145.2585
Low Cr	Core Member	PUN-59	RC1950-11	RC1950-12	713.1221	97143.28	28925.26	3805.564	116.8543	1345.9425
Low Cr	Core Member	PUN-60	RC1950-11	RC1950-12	794.1648	95794.16	28875.32	5714.956	129.7575	1549.032
Low Cr	Core Member	ROQ_001	RC1904-3	RC1904-4	693.277	94707.16	33701.85	4086.483	119.1454	1204.6877
Low Cr	Core Member	ROQ_004	RC1904-3	RC1904-4	793.5731	94653.41	33514.36	4119.843	100.108	1339.8803
Low Cr	Core Member	ROQ_005	RC1904-3	RC1904-4	726.4908	95373.55	35229.54	3435.71	142.624	1224.2863
Low Cr	Core Member	ROQ_007	RC1904-3	RC1904-4	697.2496	90179.49	35072	3820.931	124.4032	900.64213
Low Cr	Core Member	ROQ_008	RC1904-3	RC1904-4	603.1049	89387.17	37662.46	4380.613	115.6826	1195.4113
Low Cr	Core Member	ROQ_009	RC1904-3	RC1904-4	659.6256	91602.38	35191.7	3530.936	111.9975	1186.7867
Low Cr	Core Member	ROQ_011	RC1904-3	RC1904-4	781.7057	99770.26	34959.39	4804.338	127.1851	1259.0957
Low Cr	Added	ROQ_012	RC1904-3	RC1904-4	575.7274	104963.1	28885.13	3993.684	146.5708	1248.6487
Low Cr	Added	ROQ_013	RC1904-3	RC1904-4	687.5229	91638.2	26394.74	3629.402	102.4345	1138.3713
Low Cr	Added	SDV-04	RC1950-11	RC1950-12	787.9685	93246.43	32896.29	4593.938	114.8314	849.9627
Low Cr	Core Member	SDV-06	RC1950-11	RC1950-12	785.8396	98048.64	33890.3	4481.299	133.385	795.76785
Low Cr	Core Member	SDV-12	RC1950-13	RC1950-14	825.298	99339.53	30260.68	5244.745	132.0074	1202.529
Low Cr	Added	SDV-13	RC1950-13	RC1950-14	1121.2	95718.67	31001.96	4552.226	123.6737	1161.6265
Low Cr	Core Member	SDV-15	RC1950-13	RC1950-14	734.0645	95746.06	29919.04	4205.763	119.1496	1394.9245
Low Cr	Core Member	SDV-16	RC1950-13	RC1950-14	679.5324	90461.23	31510.47	3717.689	112.1536	1117.96
Low Cr	Added	SDV-17	RC1950-13	RC1950-14	1486.037	93032.3	29561.98	4274.345	130.484	1444.582
Low Cr	Core Member	SDV-18	RC1950-13	RC1950-14	736.0208	93646.27	34428.79	3475.255	123.4801	1119.893
Low Cr	Core Member	SDV-19	RC1950-13	RC1950-14	688.96	93237.22	30773.48	4236.779	114.5694	1083.0225

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Low Cr	Core Member	SDV-24	RC1950-13	RC1950-14	672.5499	92690.79	34463.59	4002.623	115.5856	1346.024
Low Cr	Core Member	SDV-25	RC1950-13	RC1950-14	762.6885	94094.3	30343.52	3792.56	137.666	1120.786
Low Cr	Core Member	SDV-27	RC1950-13	RC1950-14	599.1243	95297.45	28596.01	3736.55	125.8855	1492.0255
Low Cr	Core Member	SDV-32	RC1950-13	RC1950-14	655.1432	92755.95	28673.38	3756.439	115.3652	1453.4485
Low Cr	Core Member	SOC-03	RC1904-11	RC1904-13	617.1941	93175.91	28561.65	3125.581	92.25749	1311.5037
Low Cr	Core Member	SOC-05	RC1904-11	RC1904-13	821.92	92191.3	28816.29	4030.66	102.5973	1250.687
Low Cr	Core Member	SOC-06	RC1904-11	RC1904-13	682.8385	95471.95	29504.65	4078.583	101.5981	1322.2097
Low Cr	Core Member	SOC-09	RC1904-11	RC1904-13	770.1681	96137.48	32866.62	4875.008	120.1445	1151.5127
Low Cr	Core Member	SOC-10	RC1904-11	RC1904-13	847.6512	91749.98	30049.54	3743.862	114.3538	1079.7517
Low Cr	Added	SOC-12	RC1904-11	RC1904-13	689.1207	96666.29	27720.4	4005.123	98.39562	1268.1633
Low Cr	Added	SOC-13	RC1904-11	RC1904-13	841.6224	94279.75	32581.05	3678.061	119.8149	1095.22
Low Cr	Core Member	SOC-14	RC1904-11	RC1904-13	830.4741	90616.59	31332.69	3052.109	102.536	1385.689
Low Cr	Core Member	SOC-17	RC1904-12	RC1904-14	681.0331	94248.36	31721.2	3880.911	109.4811	1188.3903
Low Cr	Core Member	SOC-20	RC1904-12	RC1904-14	748.8151	93590.52	32066.89	3700.26	85.50297	1171.9397
Low Cr	Added	SOC-37	RC1950-1	RC1950-2	630.2593	97757.5	31237.89	3614.733	110.8521	1084.142
Low Cr	Added	SOC-41	RC1950-1	RC1950-2	875.0033	98945.93	29152.91	3628.205	123.325	1154.818
Low Cr	Core Member	SOC-44	RC1950-1	RC1950-2	630.8401	95500.65	33110.15	4062.146	118.8049	1034.329
Low Cr	Added	SOC-46	RC1950-1	RC1950-2	921.6721	89052.35	28934.28	4759.618	121.6823	913.5282
Low Cr	Core Member	SOC-47	RC1950-1	RC1950-2	635.5328	87836.52	24649.62	4497.208	100.0942	1037.844
Low Cr	Core Member	SOC-56	RC1950-3	RC1950-4	636.7341	84757.6	32317.93	3075.454	104.0357	1005.9187
Low Cr	Added	SOC-60	RC1950-3	RC1950-4	817.5205	91956.5	27916.76	4094.12	100.7417	782.9912
Low Cr	Core Member	SOC-61	RC1950-3	RC1950-4	710.1569	89436.62	30044.53	4506.016	104.4674	813.55635
Low Cr	Added	SOC-62	RC1950-3	RC1950-4	649.4154	89156.95	34339.93	4398.008	109.13	1037.5034
Low Cr	Core Member	TBL-07	RC1904-5	RC1904-8	846.0604	101586.2	33004.71	4200.888	120.6312	862.12153
Low Cr	Core Member	TBL-17	RC1904-5	RC1904-8	899.3787	96356.03	30692.33	4950.704	107.352	811.73967
Low Cr	Core Member	TBL-24	RC1904-5	RC1904-8	844.5948	95588.75	26270.24	4053.588	117.3515	958.70307
Low Fe/Tuza	Core Member	MON-03	RC1950-17	RC1950-18	504.1254	98604.12	19208.16	4464.435	71.84815	1208.939
Low Fe/Tuza	Core Member	MON-04	RC1950-17	RC1950-18	316.9268	90068.15	22570.92	3558.294	56.20862	2070.7905
Low Fe/Tuza	Core Member	MON-05	RC1950-17	RC1950-18	336.4041	100143.7	19635.39	3659.753	58.68517	2354.468
Low Fe/Tuza	Core Member	MON-06	RC1950-17	RC1950-18	278.3539	92789.03	22815.6	4671.711	74.63332	3659.015
Low Fe/Tuza	Core Member	MON-10	RC1950-17	RC1950-18	358.6638	90453.12	20890.3	3444.385	55.81356	1909.2975
Low Fe/Tuza	Core Member	MON-11	RC1950-17	RC1950-18	405.3335	89270.3	21684.43	3807.148	50.7898	2308.733
Low Fe/Tuza	Core Member	ANG_002	RC1904-1	RC1904-2	629.1431	88218.55	13783.53	3107.539	67.99511	1124.1338
Low Fe/Tuza	Core Member	POR_001	RC1904-7	RC1904-9	388.2396	90002.63	21011.76	4183.075	62.39172	1924.651

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Low Fe/Tuza	Core Member	POR_003	RC1904-7	RC1904-9	370.6214	88344.25	20379.61	3922.221	60.27815	1832.276
Low Fe/Tuza	Core Member	POR_004	RC1904-7	RC1904-9	389.8914	89728.13	21045.08	3579.796	61.90158	1933.3397
Low Fe/Tuza	Core Member	POR_006	RC1904-7	RC1904-9	403.7627	96103.73	23013.45	4050.527	63.79829	1872.5693
Low Fe/Tuza	Core Member	POR_009	RC1904-7	RC1904-9	287.7351	93840.75	23936.71	3603.52	71.61851	1452.652
Low Fe/Tuza	Added	PUN-49	RC1950-11	RC1950-12	397.5167	91726.22	17108.93	4372.693	79.86442	3113.48
Low Fe/Tuza	Core Member	SOC-04	RC1904-11	RC1904-13	298.3644	92407.72	22720.96	3406.913	55.53173	1146.1023
Low Fe/Tuza	Core Member	SOC-31	RC1950-1	RC1950-2	362.812	93497.15	20872.71	4227.566	56.01253	1314.25
Low Fe/Tuza	Core Member	SOC-32	RC1950-1	RC1950-2	352.8053	94121.84	28916.91	4704.018	59.5249	1218.072
Low Fe/Tuza	Core Member	SOC-55	RC1950-3	RC1950-4	308.3974	87770.55	17900.03	3492.6	61.67388	1343.6165
Low REE	Added	HUA-05	RC1950-21	RC1950-22	487.2755	86508.59	21533.75	3497.497	97.06194	1239.9505
Low REE	Core Member	HUA-06	RC1950-23	RC1950-24	718.9161	89988.21	29609.01	2859.205	106.9732	635.18685
Low REE	Core Member	HUA-14	RC1950-23	RC1950-24	312.0001	99725.98	23621.09	3832.491	145.0383	722.3044
Low REE	Added	HUA-16	RC1950-23	RC1950-24	506.9029	91718.68	31557.77	3434.611	128.8072	727.9112
Low REE	Added	HUA-26	RC1950-23	RC1950-24	617.0368	94785.92	20407.31	3770.767	147.2032	1324.0825
Low REE	Added	HUA-28	RC1950-23	RC1950-24	359.8974	98916.23	20101.89	3651.182	140.0657	686.1721
Low REE	Core Member	HUA-44	RC1950-25	RC1950-26	450.1175	101538.3	23251.51	3157.937	167.2801	935.02185
Low REE	Core Member	HUA-46	RC1950-25	RC1950-26	441.741	95506.47	29545.04	4374.151	222.3543	697.4124
Low REE	Core Member	HUA-49	RC1950-25	RC1950-26	585.774	85591.3	24312.43	3673.149	135.9513	718.29175
Low REE	Core Member	MAS-01	RC1950-17	RC1950-18	730.8444	99072.01	21621.5	3899.313	142.2883	731.32195
Low REE	Core Member	MAS-02	RC1950-17	RC1950-18	542.3298	102740.7	7401.938	3431.159	159.0255	646.48685
Low REE	Added	MAS-03	RC1950-17	RC1950-18	948.5389	92340.99	23153.4	3786.313	81.85753	2639.207
Low REE	Added	MAS-06	RC1950-17	RC1950-18	356.276	80821.7	42023.63	4079.247	126.9036	1193.994
Low REE	Core Member	SOL-01	RC1950-17	RC1950-18	504.9791	100215.3	11849.95	4005.312	152.5512	765.29145
Low REE	Core Member	SOL-02	RC1950-19	RC1950-20	654.3435	92789.13	23726.15	3447.314	110.1664	1218.757
Low REE	Added	SOL-03	RC1950-19	RC1950-20	719.6224	91376.7	30824.58	3802.716	116.8231	965.47235
Low REE	Core Member	SOL-05	RC1950-19	RC1950-20	736.0179	95381.21	19140.46	4150.466	125.5246	862.2158
Low REE	Core Member	SOL-06	RC1950-19	RC1950-20	601.6071	88501.22	28374.11	3543.153	126.2997	743.70675
Low REE	Core Member	SOL-09	RC1950-19	RC1950-20	562.0523	91795.32	23605.4	3391.771	104.177	788.23695
Low REE	Core Member	SOL-11	RC1950-19	RC1950-20	580.3773	87308.97	22873.34	3092.331	136.2215	668.3636
Low REE	Core Member	SOL-14	RC1950-19	RC1950-20	449.7624	94257.85	22992.18	3712.251	138.1628	665.86695
Low REE	Core Member	ATU-02	RC1950-3	RC1950-4	477.0153	85417.16	24937.3	3492.972	115.624	1050.143
Low REE	Core Member	ATU-12	RC1950-3	RC1950-4	614.2674	96703.9	20060.52	4841.185	132.7154	1560.605
Low REE	Core Member	ATU-18	RC1950-5	RC1950-6	539.2236	96184	24204.03	3352.575	111.9758	1350.9515
Low REE	Core Member	ATU-19	RC1950-5	RC1950-6	485.1378	93966.41	25545.93	3419.094	129.1901	1069.079

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Low REE	Core Member	ATU-20	RC1950-5	RC1950-6	728.2461	92210.84	16281.49	4110.469	157.2195	1216.6025
Low REE	Core Member	ATU-22	RC1950-5	RC1950-6	697.3782	86846.48	30566.79	3604.278	136.6812	1045.7064
Low REE	Added	ATU-23	RC1950-5	RC1950-6	463.1606	98636.27	23092.95	3979.172	116.3386	1063.103
Low REE	Core Member	ATU-25	RC1950-5	RC1950-6	500.2411	99303.43	27782.43	3837.328	117.5926	1510.4515
Low REE	Core Member	ATU-38	RC1950-7	RC1950-8	639.539	95743.34	22469.35	3229.904	138.0247	1160.718
Low REE	Core Member	CAR_011	RC1882-2	RC1882-1	578.9068	88338.41	28742.6	3591.642	124.4124	1901.8357
Low REE	Added	CAR_012	RC1882-2	RC1882-1	549.557	97030.2	33784.87	4476.12	128.3358	2567.6417
Low REE	Core Member	CAR_014	RC1882-2	RC1882-1	535.6551	89150.69	26188.54	3513.042	107.4057	2023.4937
Low REE	Added	CAR_015	RC1882-2	RC1882-1	843.7177	85950.36	25671.37	4605.594	120.2762	1645.6113
Low REE	Core Member	CAR_016	RC1882-2	RC1882-1	672.2769	96987.77	22705.92	4357.164	124.7488	1399.73
Panzaleo	Added	SDV-54	RC1950-15	RC1950-16	470.317	88966.93	12262.18	4403.285	170.7218	749.6403
Panzaleo	Added	TAJ-01	RC1950-29	RC1950-30	634.0349	87359.41	8061.356	4891.141	155.1669	442.09895
Panzaleo	Added	TAJ-02	RC1950-29	RC1950-30	601.7687	84234.7	13573.5	4453.878	151.4638	1274.6025
Panzaleo	Added	TAJ-03	RC1950-29	RC1950-30	439.1642	99529.86	6747.818	4388.015	217.7993	702.2601
Panzaleo	Added	TAJ-10	RC1950-29	RC1950-30	527.8557	90136.9	11510.07	4669.788	164.8117	477.90895
Panzaleo	Core Member	TBE007		NIST						
Panzaleo	Core Member	TBE00X/254		NIST						
Panzaleo	Core Member	TBE015		NIST						
Panzaleo	Core Member	TBE016		NIST						
Panzaleo	Core Member	TBE027		NIST						
Panzaleo	Core Member	TBE028		NIST						
Panzaleo	Core Member	TBE032		NIST						
Panzaleo	Core Member	TBE043		NIST						
Panzaleo	Core Member	TBE047		NIST						
Panzaleo	Core Member	TBE071		NIST						
Panzaleo	Core Member	TBE119		NIST						
Panzaleo	Core Member	TBE136		NIST						
Panzaleo	Core Member	TBE144		NIST						
Panzaleo	Core Member	TBE149		NIST						
Panzaleo	Core Member	TBE153		NIST						
Panzaleo	Core Member	TBE189		NIST						
Panzaleo	Core Member	TBE194		NIST						
Panzaleo	Core Member	TBE256		NIST						
Panzaleo	Core Member	TBE38A		NIST						

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Panzaleo	Core Member	TBE38B		NIST						
Panzaleo	Core Member	TBE39A		NIST						
Panzaleo	Core Member	TBE39B		NIST						
Panzaleo	Core Member	TBE443		NIST						
Panzaleo	Added	TUN_005	RC1904-7	RC1904-9	589.3998	93258.52	12478.85	4551.294	128.0065	848.18493
Unknown	-	CRM-01	RC1950-27	RC1950-28	663.7387	89665.27	26817.63	4317.065	141.5552	1803.253
Unknown	-	CRM-03	RC1950-29	RC1950-30	622.358	106839.4	17620	4566.906	151.258	3454.329
Unknown	-	TAJ-09	RC1950-29	RC1950-30	436.1517	93003.63	30744.71	3664.67	91.58913	1718.1175
Unknown	-	TBL-60	RC1950-21	RC1950-22	693.1075	97713.86	27681.64	3668.997	107.6762	835.19335
Unknown	-	POR_002	RC1904-7	RC1904-9	536.5755	95879.82	22255.33	3976.051	101.9099	1805.715
Unknown	-	POR_015	RC1904-11	RC1904-13	469.8412	125838.4	17181.33	5518.921	135.4437	994.2197
Unknown	-	CRM-08	RC1950-29	RC1950-30	608.9194	97275.23	25255.05	3695.337	106.1788	1388.228
Unknown	-	DBS-01	RC1950-17	RC1950-18	728.7787	93908.03	34494.4	3375.447	117.3119	719.7614
Unknown	-	HLV-02	RC1950-27	RC1950-28	1820.967	92777.25	15935.13	3713.661	117.0264	1255.305
Unknown	-	HLV-03	RC1950-27	RC1950-28	2039.396	83164.83	21159.12	3308.948	121.8599	1242.5085
Unknown	-	HLV-04	RC1950-27	RC1950-28	1348.941	93642.17	28180.9	4908.561	130.6162	1030.693
Unknown	-	HLV-07	RC1950-27	RC1950-28	1308.597	88356.44	19233.06	4463.223	166.3947	1284.8995
Unknown	-	HUA-02	RC1950-21	RC1950-22	317.5746	84909.46	23119.59	2617.991	222.8369	921.11045
Unknown	-	HUA-03	RC1950-21	RC1950-22	647.6391	84682.02	28412.89	3483.451	95.44095	978.5268
Unknown	-	HUA-09	RC1950-23	RC1950-24	713.2756	84202.55	30916.64	3576.757	110.1312	1127.002
Unknown	-	HUA-13	RC1950-23	RC1950-24	680.9666	87950.7	31099.6	3967.886	104.7906	868.28105
Unknown	-	HUA-20	RC1950-23	RC1950-24	497.715	97847.34	25926.64	4504.734	166.1712	1485.4045
Unknown	-	HUA-35	RC1950-25	RC1950-26	405.7358	111663.5	16098.15	4982.039	180.7943	1072.964
Unknown	-	HUA-36	RC1950-25	RC1950-26	612.6699	90313.07	25888.18	3291.024	98.05624	986.3954
Unknown	-	HUA-39	RC1950-25	RC1950-26	568.4308	86738.91	26833.39	3199.991	103.3405	915.06275
Unknown	-	HUA-48	RC1950-25	RC1950-26	724.4933	99301.43	29636.72	4271.091	133.7212	929.04825
Unknown	-	MAS-05	RC1950-17	RC1950-18	683.0511	87915.52	28760.62	3094.739	98.86741	1390.5315
Unknown	-	MAS-09	RC1950-17	RC1950-18	772.3721	108751.2	18174.33	4751.657	117.497	1281.2935
Unknown	-	MON-02	RC1950-17	RC1950-18	645.7557	98910.83	11213.82	4575.219	93.47733	2253.473
Unknown	-	MON-07	RC1950-17	RC1950-18	493.8543	96694.73	18079.02	4514.392	101.6912	1340.932
Unknown	-	PJL-01	RC1950-31	RC1950-32	996.0772	100765.5	30718.42	4014.62	138.6651	823.07655
Unknown	-	SDV-44	RC1950-15	RC1950-16	789.1331	103569.4	32504.19	4516.527	152.2354	1277.653
Unknown	-	TAJ-04	RC1950-29	RC1950-30	635.7023	91978.63	30345.55	3204.147	96.1579	1415.2045
Unknown	-	TAJ-07	RC1950-29	RC1950-30	688.0997	99603.86	37791.6	4465.198	131.1398	1348.443

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Unknown	-	TAJ-25	RC1950-31	RC1950-32	680.3842	97639.13	33982.63	4598.901	142.6491	1333.1005
Unknown	-	TBL-34	RC1950-19	RC1950-20	1260.154	86050.12	25769.36	2764.563	93.74094	1979.193
Unknown	-	TBL-48	RC1950-21	RC1950-22	444.1908	84398.3	27990.39	3733.259	76.34238	1792.6105
Unknown	-	TBL-56	RC1950-21	RC1950-22	777.1958	87195.61	28014.46	3742.645	88.74352	1544.478
Unknown	-	TUL-05	RC1950-27	RC1950-28	685.607	95644.7	34584.93	4301.47	103.6648	1616.7575
Unknown	-	TUL-11	RC1950-27	RC1950-28	592.7947	88571.1	33102.78	3538.106	102.9704	1912.5325
Unknown	-	ANG_001	RC1904-1	RC1904-2	501.5382	91950.05	14105.03	4959.927	157.0229	609.3292
Unknown	-	ANG_007	RC1904-1	RC1904-2	881.7827	89994.05	24507.79	4606.174	152.8089	1266.988
Unknown	-	ANG_008	RC1904-1	RC1904-2	656.9943	97652.87	20879.94	4016.98	89.38802	2615.04
Unknown	-	ANG_010	RC1904-1	RC1904-2	717.3317	99492.05	27224.88	4346.398	128.3524	2608.1597
Unknown	-	ANG_015	RC1904-1	RC1904-2	529.1751	94858.65	17876.39	4128.167	96.39473	1563.886
Unknown	-	ATU-35	RC1950-5	RC1950-6	681.6824	91953.9	32474.83	4099.215	79.55362	2096.761
Unknown	-	ATU-40	RC1950-7	RC1950-8	472.0072	88220.3	28532.81	3703.628	86.51804	1699.049
Unknown	-	CAR_021	RC1882-2	RC1882-1	554.2478	93956.03	25991.8	3869.985	89.87728	1575.2713
Unknown	-	POR_007	RC1904-7	RC1904-9	392.9254	93916.61	25422.6	4010.24	98.82001	1589.4873
Unknown	-	POR_008	RC1904-7	RC1904-9	461.0987	93507.77	22412.71	4224.101	92.70049	1464.076
Unknown	-	POR_012	RC1904-7	RC1904-9	278.3012	90107.05	15719.03	4150.219	95.03473	655.05817
Unknown	-	POR_013	RC1904-7	RC1904-9	256.116	98189.18	14150.85	3826.278	95.28779	605.42263
Unknown	-	POR_014	RC1904-11	RC1904-13	292.2733	98486.29	14102.89	4591.654	93.2922	747.14377
Unknown	-	PUN-56	RC1950-11	RC1950-12	566.7244	99201.33	27540.07	5282.858	119.6587	1422.095
Unknown	-	ROQ_002	RC1904-3	RC1904-4	889.966	88681.95	30652.14	3113.836	99.56631	1383.395
Unknown	-	SDV-03	RC1950-11	RC1950-12	866.2499	93580.22	33204.19	4419.415	122.9199	880.09225
Unknown	-	SDV-10	RC1950-13	RC1950-14	658.71	97766.73	30924.11	3739.768	104.7616	1035.621
Unknown	-	SOC-08	RC1904-11	RC1904-13	425.8298	103030.8	18432.02	3315.25	90.90249	1219.589
Unknown	-	SOC-11	RC1904-11	RC1904-13	484.1232	89783.55	27401.63	3526.607	90.04878	1129.2797
Unknown	-	SOC-23	RC1904-12	RC1904-14	804.6746	97243.81	34912.75	4188.395	133.8976	1620.9077
Unknown	-	SOC-24	RC1904-12	RC1904-14	541.4108	89951.27	31183.46	3595.08	104.1817	1000.6653
Unknown	-	SOC-30	RC1950-1	RC1950-2	519.3402	96776.44	22205.43	3955.985	107.3782	1098.505
Unknown	-	SOC-36	RC1950-1	RC1950-2	1458.035	85641.51	29384.93	3368.123	142.2987	956.8715
Unknown	-	SOC-49	RC1950-1	RC1950-2	745.8317	94523.55	21834.8	3991.96	80.74318	1770.706
Unknown	-	SOC-51	RC1950-1	RC1950-2	704.4103	100308.9	30956.2	4045.197	130.6792	1240.0705
Unknown	-	SOC-54	RC1950-3	RC1950-4	436.136	84357.52	29920.69	3468.342	69.13729	999.4493
Unknown	-	SOC-58	RC1950-3	RC1950-4	498.7778	82299.47	30248.45	3692.834	98.52734	718.1815
Unknown	-	TBL-02	RC1904-5	RC1904-8	894.7553	85299.44	29543.81	3689.286	91.56024	1431.8863

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Unknown	-	TUN_001	RC1904-7	RC1904-9	568.19	87759.99	14561.07	5221.581	170.5726	575.72193
Unknown	-	TUN_002	RC1904-7	RC1904-9	471.2595	92885.69	11130.19	4859.564	204.4367	798.56293
Unknown	-	TUN_003	RC1904-7	RC1904-9	458.0571	93082.16	14625.03	5123.295	187.3707	549.29263
Unknown	-	TUN_004	RC1904-7	RC1904-9	707.7559	90392.02	17822.39	4459.736	179.0754	719.19537
Very High Cr	Not tested	SOL-07	RC1950-19	RC1950-20	669.2981	105086.4	17078.97	4016.741	145.4866	911.11285
Very High Cr	Not tested	SOL-13	RC1950-19	RC1950-20	638.2539	94430.22	31736.78	3450.961	141.3317	756.80785
Very High Cr	Not tested	TBL-50	RC1950-21	RC1950-22	828.0569	97857.91	28217.28	4315.789	127.323	2837.5215
Very High Cr	Not tested	CAR_010	RC1882-2	RC1882-1	750.1711	117285.9	26638.89	4663.132	161.6489	1222.1657
Very High Cr	Not tested	SOC-19	RC1904-12	RC1904-14	674.4054	108840.4	32792.89	3879.577	129.8982	735.76777
Very High Cr	Not tested	SOC-45	RC1950-1	RC1950-2	817.6714	102703.1	38525.05	4505.497	143.4363	911.69005
Unknown	-	ECU_002	RC1904-1	RC1904-2	1123.95	114935	24161.04	4787.232	206.0394	681.23997
Low REE	Added	ECU_003A	RC1904-6	RC1904-10	1027.019	107305.4	22828.43	3942.466	157.3249	861.8983
Unknown	-	ECU_003B	RC1904-1	RC1904-2	1116.212	105967.1	21922.83	4361.71	145.4561	901.3668
Unknown	-	ECU_003C	RC1904-1	RC1904-2	892.6519	98719.09	32390.17	3605.481	126.5582	764.04157
Unknown	-	ECU_004A	RC1904-1	RC1904-2	894.1379	122543.9	19321.46	4634.725	167.2944	1017.2707
Unknown	-	ECU_004B	RC1904-6	RC1904-10	864.3424	119513	17334.16	5018.495	159.8363	958.48543
Unknown	-	ECU_005A	RC1904-1	RC1904-2	1261.773	114128.6	6562.337	5136.214	229.8475	1205.221
Unknown	-	ECU_005B	RC1904-1	RC1904-2	639.0928	93178.23	9026.426	4274.773	138.4246	910.70097
Unknown	-	ECU_005C	RC1904-1	RC1904-2	586.092	92589.35	14021.86	4897.077	145.0081	1097.3287
Unknown	-	ECU_005D	RC1904-7	RC1904-9	607.0427	82478.81	35499.08	2459.891	81.80589	581.6935
Unknown	-	ECU_005E	RC1904-6	RC1904-10	702.6924	92979.2	16511.83	3833.292	146.7731	862.3582
Unknown	-	ECU_006A	RC1904-1	RC1904-2	870.7705	92960.33	27239.15	3455.885	108.8901	813.0296
Unknown	-	ECU_006B	RC1904-1	RC1904-2	1038.328	105433.5	23279.77	4796.808	138.7657	1024.484
Unknown	-	ECU_006C	RC1904-3	RC1904-4	661.4257	92330.15	27056.23	4020.01	170.3331	597.0893
Unknown	-	ECU_006D	RC1904-3	RC1904-4	659.0978	120342.3	19117.74	4742.61	153.6239	665.79023
Unknown	-	ECU_006E	RC1904-3	RC1904-4	861.2125	104353.6	29440.24	4534.845	146.2229	882.22873
Unknown	-	ECU_008A	RC1904-3	RC1904-4	1137.647	89269.43	28564.36	3268.816	122.0065	835.17387
Atuntaqui	Added	ECU_008B	RC1904-3	RC1904-4	758.8922	88993.55	32303.3	3384.272	127.202	859.4946
Atuntaqui	Added	ECU_009A	RC1904-3	RC1904-4	834.3336	100187.8	33210.44	3461.963	126.1667	691.5762
Unknown	-	ECU_009B	RC1904-3	RC1904-4	735.6687	102406.6	28962.55	3723.498	133.8248	918.01607
Unknown	-	ECU_010B	RC1904-3	RC1904-4	969.6147	98954.99	34129.19	3342.488	135.2519	742.75107
Unknown	-	ECU_011	RC1904-3	RC1904-4	882.3953	100907.3	34424.31	4401.653	144.6791	834.5737
Unknown	-	ECU_012	RC1904-3	RC1904-4	1216.34	101928.4	37813.12	4737.171	163.7489	756.98267

Table B.1: INAA Values and Mahalanobis Distance Results, Part 1 (continued)

Final Group	Mahalanobis Result	INAA ID	Batch PT	Batch IC	Mn *846.8 keV*	Al *1779 keV*	Ca *3084.5 keV*	Ti *320.1 keV*	V *1434.1 keV*	Ba_Mean
Unknown	-	ECU_013A	RC1904-6	RC1904-10	916.3597	106460.1	33633.82	4571.438	161.6373	809.7032
Unknown	-	ECU_013B	RC1904-6	RC1904-10	904.4428	99254.83	37755.97	4570.398	163.6354	768.93903
Unknown	-	ECU_014A	RC1904-6	RC1904-10	824.7358	95874.09	25561.56	3420.515	98.46578	787.95103
Unknown	-	ECU_014B	RC1904-6	RC1904-10	721.9188	98317.07	25171.71	3649.196	118.1728	816.72087
Unknown	-	ECU_014C	RC1904-7	RC1904-10	809.682	92512.1	29760.41	3453.212	109.3566	795.8487
Unknown	-	ECU_016B	RC1904-7	RC1904-10	599.333	96272.18	33539.97	4961.956	134.0109	849.13047
High Cr	Added	ECU_016C	RC1904-6	RC1904-10	809.9993	92640.52	31715.85	4388.421	128.4226	820.66037
Unknown	-	ECU_018A	RC1904-6	RC1904-10	865.1845	104103.5	34155.71	4012.597	126.5421	780.24633
Unknown	-	ECU_018B	RC1904-6	RC1904-10	846.6085	100824.7	30583.21	4067.435	130.0974	722.95717
Unknown	-	ECU_018C	RC1904-6	RC1904-10	862.4815	101790.3	35347.12	4243.094	126.7404	757.4579
Unknown	-	ECU_018D	RC1904-6	RC1904-10	869.2178	100651.5	32646.29	4716.09	127.9481	755.98727
Unknown	-	ECU_018E	RC1904-6	RC1904-10	838.8759	100412.4	29673.84	4057.007	136.0674	734.06183
Unknown	-	ECU_018F	RC1904-6	RC1904-10	903.8978	103826.5	30500.14	4504.489	132.8718	732.66843
Unknown	-	ECU_018G	RC1904-6	RC1904-10	815.4354	102424.2	30324.8	4029.506	126.8909	726.6178
Unknown	-	ECU_018H	RC1904-6	RC1904-10	866.174	98793.4	32238.48	4651.056	131.0363	739.96473
Unknown	-	ECU_018I	RC1904-6	RC1904-10	655.3564	102279.2	40460.09	4376.473	129.1862	748.82827
Unknown	-	ECU_019A	RC1904-6	RC1904-10	81.96066	117545.5	1247.039	6577.334	93.64864	273.23117
Unknown	-	ECU_019B	RC1904-6	RC1904-10	85.6665	119398.2	863.9479	7247.584	92.45779	258.13487
Unknown	-	ECU_019C	RC1904-6	RC1904-10	79.70134	119873	1362.279	6721.416	95.05563	290.65877
Unknown	-	ECU_020A	RC1882-3	RC1882-4	1026.727	158311	7238.358	7485.803	317.0722	428.4283
Low Cr	Added	ECU_020B	RC1882-3	RC1882-4	578.326	92667.09	29581.76	3366.996	102.878	789.2342
Unknown	-	ECU_020C	RC1882-3	RC1882-4	831.0219	90347.69	40405.37	3611.156	125.4844	702.51
Low Cr	Added	ECU_021A	RC1904-6	RC1904-10	820.2025	89050.15	30237.13	2618.527	114.9315	861.31867
Unknown	-	ECU_021B	RC1904-6	RC1904-10	832.1279	95498.87	36941.48	3459.261	106.6608	662.09347
Unknown	-	ECU_022A	RC1904-7	RC1904-9	1173.971	115232.4	20415.85	4654.866	200.1881	618.79667
Unknown	-	ECU_022B	RC1904-7	RC1904-9	1243.861	115760.5	20594.02	4615.618	194.4132	674.04293

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
HUA-07	16.12913	0.159953	3.277952	23713.41	1.1312305	1.211472	32.54816	1.212002	29.19782	17.67527	0.971921
HUA-11	19.18723	0.154146	3.374524	25075	1.5237035	1.120257	40.46904	1.073262	34.48384	15.0181	1.059609
HUA-15	17.99412	0.205123	3.132308	24069.19	2.685761	1.205031	33.9672	1.0865	37.06861	18.52267	0.966091
HUA-17	18.61714	0.207652	3.512665	23016.57	2.342363	1.233182	36.30521	1.223613	30.80449	16.0579	0.995527
HUA-18	9.7092	0.142842	2.059583	23599.13	2.1305275	0.782616	22.15666	1.023781	39.96411	16.06807	0.76571
HUA-19	15.81706	0.162378	3.290699	22762.63	1.679042	1.387027	34.65405	1.115793	34.85123	20.01326	1.005806
HUA-31	15.6432	0.168545	3.118659	20835.18	0.400434	1.376225	32.70847	0.929831	28.65329	19.80399	0.974631
HUA-40	17.2021	0.229629	3.255962	22138.02	1.9326605	1.180196	34.90699	1.392239	32.04135	18.90762	0.997054
HUA-51	12.43053	0.132582	2.706801	22154.64	0.339571	1.025622	26.6786	1.041564	44.85485	17.50882	0.843103
ATU-03	22.43071	0.1789134	3.845775	18718.45	1.8119475	1.061044	44.83849	1.47677	34.474	16.41517	1.085958
ATU-13	21.03127	0.1455206	3.122911	18361.65	1.689524	0.9315532	44.47134	1.85336	38.4382	17.47818	0.9634987
ATU-14	18.9292	0.1502101	2.981214	20470.95	1.817991	0.9998461	41.88157	2.090317	34.77365	20.05814	1.013571
ATU-21	16.60405	0.1747823	2.94452	21183.98	1.0688125	1.060288	36.19511	1.510943	36.38594	19.98187	0.9642565
ATU-24	20.25076	0.224134	3.760088	20126.91	1.0998247	1.49465	39.02482	1.062242	31.52588	16.68743	1.067907
ATU-27	17.28374	0.2099943	3.440986	20583.3	1.9993475	1.173951	34.07125	1.240907	26.86214	14.60431	0.9784901
ATU-28	16.25451	0.2297357	3.370209	22024.99	1.7823425	1.205068	32.65683	1.32368	32.79467	16.49061	0.9699414
ATU-29	17.95253	0.2702309	3.961174	23045.34	1.555736	1.614362	34.88672	0.9753659	24.18738	17.77449	1.046927
ATU-31	15.79223	0.1872058	3.192442	23445.47	1.67551	0.9281638	33.85438	1.507356	37.97029	17.86947	0.9443752
ATU-32	21.19745	0.1612698	3.685992	20407.46	1.825401	1.353266	40.46539	1.422746	34.16075	14.53273	0.9758818
ECU_001	22.81331	0.1667682	3.647039	20933.35	2.1065665	1.080447	44.83793	1.899192	41.16252	17.74236	1.072415
ROQ_003	12.45946	0.1492673	2.712861	21993.74	1.760111	1.005457	27.29423	1.296394	41.92826	19.01282	0.8337491
ROQ_006	25.90269	0.1608878	3.776346	20932.65	2.557487	0.9430532	49.7305	1.995782	29.9501	12.48108	1.023567
SOC-43	20.30708	0.1737239	3.512824	20133.76	2.1762355	1.023002	37.61003	1.429148	37.63386	14.6765	1.058548
SOC-48	16.91627	0.1858237	3.495215	23409.11	0.3196062	1.212086	30.85162	1.283566	65.0118	20.01893	1.02419
SOC-59	14.65406	0.1600581	3.011079	21712.06	1.1771415	1.05403	32.87728	1.092505	40.37708	19.76682	0.9708251
CRM-02	24.88361	0.142758	3.364663	18912.15	2.199564	0.945972	42.30028	1.804362	53.74645	12.46829	0.93591
CRM-04	23.13972	0.201623	3.870848	14953.69	2.5057935	1.609036	66.99453	3.770342	70.32642	19.6348	0.981543
CRM-05	17.05555	0.128973	2.377455	15130.63	1.671557	0.689866	51.63317	2.018348	60.48223	17.84637	0.808345
CRM-06	13.53392	0.151324	2.270278	14416.77	1.6154405	0.854138	43.05222	3.068277	55.4655	16.29019	0.6531
CRM-09	18.4814	0.113547	2.696508	16392.43	1.955926	0.790358	62.34139	2.172961	62.90535	20.85591	0.848537
HLV-05	19.89795	0.125454	3.147209	19599.34	1.879835	0.734232	44.68627	1.627922	64.79718	18.30733	0.895108
HLV-06	20.13902	0.162422	3.710074	21684.26	1.534793	1.035593	38.66593	1.115756	69.46014	21.26117	0.989359
HUA-08	24.49401	0.246123	4.412612	17098.53	2.62088	1.524699	56.71499	2.812101	89.79787	21.41388	1.139471
HUA-12	34.28812	0.190977	4.859975	21304.07	2.3931635	1.096685	75.52892	1.746187	73.17859	17.93116	1.326923

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
HUA-54	23.38687	0.167733	3.862171	22202.82	1.8020085	0.851962	50.50056	1.795897	53.92964	15.69665	1.080297
MAS-04	21.68303	0.179218	3.448618	14295.72	2.1945375	0.855343	39.60402	1.906279	52.3267	9.859776	0.979113
MAS-07	20.08891	0.122118	3.165656	17875.32	2.2788935	0.805359	39.20969	1.503183	60.57839	16.62317	0.969651
MAS-08	26.05114	0.130571	3.817544	14601.21	1.142693	0.865539	49.05421	1.45275	35.38627	12.832	1.011027
SOL-04	19.54208	0.148315	3.005352	15560.87	2.1467075	0.898511	54.62735	2.161775	71.97817	11.23286	0.877662
SOL-08	37.4238	0.163937	5.720601	16931.55	2.8819605	1.321945	65.17804	2.271197	60.25694	16.38642	1.452765
SOL-12	22.77784	0.175002	3.333619	12898.88	2.9373995	1.202275	46.54035	2.891404	64.41547	14.45172	0.998939
TBL-31	21.5749	0.135118	3.410488	15985.6	1.68651	1.08865	48.97306	2.19123	65.50685	19.49857	0.982831
TBL-32	22.03497	0.162146	3.427038	17892.89	2.4387125	0.904941	49.00614	1.889782	68.4081	16.41361	1.033644
TBL-36	21.6251	0.142511	3.454074	17300.87	1.806557	0.840516	49.6797	1.830885	60.53559	19.0648	1.007897
TBL-37	28.46148	0.215919	4.289624	16500.93	2.845558	1.587662	61.07212	1.527934	67.38725	15.83696	1.218405
TBL-38	25.85303	0.183488	4.002666	15983.57	2.6177035	1.023685	53.18261	1.791436	71.59338	16.22148	1.066808
TBL-39	22.10464	0.126254	3.597552	16214.98	1.935178	0.892081	49.31001	2.205069	60.92466	14.05466	1.005594
TBL-40	22.58232	0.102276	3.365304	16589.8	1.3081895	0.712152	48.74807	1.994522	62.62482	14.9608	1.003865
TBL-41	22.34527	0.158685	3.548382	16773.86	2.16154	0.916934	53.08168	1.972686	61.5663	16.32769	1.039685
TBL-42	26.48687	0.18923	4.198471	16832.52	2.005899	0.968541	53.29804	1.973421	72.35522	17.25952	1.192476
TBL-43	22.48566	0.140646	3.595492	16240.77	1.9135695	0.968723	47.97547	1.655089	70.69001	16.94205	0.97837
TBL-45	21.79832	0.132122	3.518291	17179.54	1.355736	0.86782	44.57322	1.773326	65.63338	15.83954	0.967229
TBL-46	25.67102	0.152378	3.789253	17374.29	1.653015	0.8587	51.72781	1.586351	63.6443	15.97638	1.024026
TBL-47	22.61361	0.186794	3.565	16297.98	1.919124	0.989173	51.219	1.711417	69.15305	17.14269	1.040213
TBL-49	27.7287	0.1635	4.1825	17485.83	1.812826	1.362028	52.53785	1.831157	67.0288	16.29706	1.122307
TBL-51	18.6002	0.142342	3.206963	16453.74	1.0951945	0.922668	35.02512	1.492752	60.12658	14.23263	0.905751
TBL-52	23.25441	0.152737	3.55622	16370.51	2.127158	0.896153	48.17029	1.425634	69.32523	15.91645	1.028176
TBL-53	24.81333	0.144164	3.663628	17120.96	2.0002205	0.806948	52.64565	1.705328	58.94594	17.23623	1.009035
TBL-54	22.12155	0.156373	3.510994	17873.01	1.7683075	0.950648	47.01556	1.621546	58.54719	17.67362	0.982851
TBL-55	21.50886	0.138758	3.548026	16854.23	1.520116	1.262412	41.85514	1.516523	77.13116	15.40923	0.961964
TBL-57	28.37167	0.175684	4.291473	14996.99	1.527146	1.081165	52.113	1.822876	60.02645	15.01109	1.155933
TBL-58	21.49923	0.130858	3.42698	18294.53	1.5908795	1.09209	48.02754	1.644577	49.12443	15.84187	0.974564
TBL-59	23.61999	0.200006	3.719524	17019.7	2.045456	1.005892	47.51833	1.600501	63.60448	16.00611	1.026706
ANG_003	23.66813	0.1642218	3.660701	15068.24	3.096088	1.157074	51.65948	1.517355	75.45909	18.80936	0.9978161
ANG_004	27.44062	0.1673621	4.280354	15065.96	3.6367555	1.239302	58.05915	2.390563	69.35726	20.69382	1.136168
ANG_009	24.15343	0.1620648	3.817147	15683.32	2.3869695	0.9758898	47.04164	2.187537	58.07137	14.34584	1.074561
ANG_011	23.30736	0.1573929	3.775399	14645.36	2.3526905	1.064978	49.77387	1.902642	55.83096	14.99236	1.014617
ANG_013	25.13528	0.1456841	3.784368	16284.98	3.411995	0.7599607	53.39029	1.838213	55.55353	19.22065	1.11409

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
ANG_014	32.17642	0.2214538	5.188805	16160.06	3.234767	1.289018	60.44841	1.797123	60.84338	15.25863	1.309235
ANG_016	23.51554	0.1854827	3.608405	14413.26	2.3023195	0.8612734	48.87281	1.830747	55.60144	17.63663	1.048781
ATU-01	23.85213	0.169664	3.803263	12481.33	1.7572015	0.9735642	44.81157	1.48092	74.7722	14.40636	1.030318
ATU-17	21.61402	0.0932231	3.134254	14700.26	2.0416135	0.7238659	56.62134	1.90901	66.1193	19.92694	0.973148
ATU-26	21.54344	0.1302889	3.500036	17749.55	2.220602	0.6195557	58.70811	2.301353	64.34023	21.41005	1.062741
CAR_009	19.67264	0.1422111	3.120315	17367.58	1.511144	0.8367956	42.21856	1.351555	68.42879	18.26433	0.9186803
CAR_020	31.62753	0.2245938	4.084259	19933.67	4.481333	1.05823	53.96146	1.433496	67.45739	14.21914	1.156651
POR_010	23.02506	0.2301045	4.357048	14830.05	2.0024185	1.455161	52.33593	2.397411	60.61339	21.26616	1.269888
POR_011	23.65614	0.1868155	4.340813	14461.3	2.3173875	1.22673	53.81278	2.427957	60.36938	20.09203	1.224001
PUN-24	25.43608	0.1071953	4.336137	19980.69	1.4147775	1.039387	58.173	1.597669	51.07587	23.75663	1.148097
ROQ_010	19.6717	0.1620999	3.336201	15081.64	1.676807	1.226648	51.49852	1.677477	68.17101	15.03301	1.003791
SOC-01	24.91939	0.1760183	3.773379	18859.12	1.6239355	0.9996403	53.42854	1.573306	58.64899	16.90579	1.053123
SOC-02	19.36683	0.1783426	3.303682	18398.39	2.167194	0.8974836	42.48162	2.017229	53.83673	15.87578	0.9012765
SOC-07	23.84636	0.1458712	3.473157	18101.83	1.659416	0.7825807	54.49215	1.688807	57.30042	19.74047	1.072907
SOC-15	26.02897	0.1632239	3.692958	21036.74	1.8823875	0.7740565	54.47128	1.891907	57.42739	16.22666	1.137733
SOC-16	26.7593	0.2042549	3.894625	16479.01	2.0587	1.051789	54.79598	1.786187	66.89039	16.76439	1.065504
SOC-18	20.95006	0.1829327	3.292874	20331.89	1.7907145	1.285069	41.0984	1.492683	63.58929	16.98113	0.9684815
SOC-21	19.7472	0.1395926	3.051692	23694.45	2.040652	0.6472147	46.70369	1.857327	78.10613	19.37239	0.9557765
SOC-22	23.05719	0.1315191	3.62814	19692.86	2.272802	0.8228826	45.35806	1.908049	58.64585	16.05373	1.058452
SOC-25	21.24402	0.1179797	3.252675	22024.24	1.1869656	0.7671425	59.42587	1.574739	62.04594	12.67043	0.9255824
SOC-26	21.03686	0.118025	3.323351	21435.7	2.004092	0.8638368	40.56144	1.261929	68.54147	17.9656	1.061943
SOC-27	27.94861	0.1667397	4.080728	16428.69	1.1742468	1.153637	56.49537	1.474346	60.72731	16.44823	1.104195
SOC-28	25.70068	0.1587267	3.662348	16620.34	1.429388	0.709864	51.81019	1.329356	55.94189	15.23247	1.042222
SOC-34	20.01047	0.1364503	3.245155	20832.35	1.242135	1.207666	47.61817	1.606914	76.1599	19.81043	0.9972543
SOC-35	29.74011	0.2340177	4.577401	21100.68	1.6769655	1.580208	54.45459	1.430227	75.69904	18.31455	1.302907
SOC-38	19.83227	0.1539681	3.486315	20150.49	0.7057136	1.084233	36.76622	1.57781	66.00384	16.81764	0.9252628
SOC-39	21.26979	0.1264362	3.232527	18959.68	2.329633	0.7032727	51.36833	2.189497	57.54739	21.1828	0.9933345
SOC-40	18.42436	0.1447065	3.077081	20313.03	0.8483734	0.9185109	37.61784	1.322486	73.43692	16.26987	0.9560079
SOC-42	24.57573	0.189349	3.620531	17736.23	1.1297884	1.184638	47.80114	1.439441	81.15026	17.40503	1.079983
SOC-50	24.91321	0.1400346	3.875141	19356.28	1.6399375	1.091072	47.97808	1.779626	68.05247	18.09776	1.111429
SOC-52	22.92429	0.1607814	3.482108	21185.76	1.2975605	1.190364	45.58418	1.613249	62.47131	16.4175	1.030731
SOC-53	22.02547	0.1517307	3.609872	15343.64	1.1127941	1.06508	39.29873	1.279381	70.73255	15.47651	0.931637
SOC-57	20.63583	0.1553581	3.343985	19151.08	1.506108	0.781488	52.77282	1.645213	54.11276	18.10965	1.019276
SOC-63	25.94385	0.1605196	3.901412	20071.48	1.683194	1.088103	50.42688	1.625011	66.0123	17.13139	1.051111

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
SOC-64	23.62849	0.1571414	3.761044	18376.49	0.9909948	0.9237007	45.5372	1.377595	72.49748	16.62651	1.031577
TBL-01	30.11165	0.2038905	4.220436	16259.08	2.7844695	1.351879	64.8735	2.244231	68.31946	19.9571	1.255371
TBL-03	26.71804	0.1600242	3.966147	16658.67	1.619317	1.017668	54.62091	1.54396	60.73982	17.21456	1.118986
TBL-04	25.95137	0.1644115	3.998064	17983.61	1.719747	1.087727	52.37232	2.425771	56.50354	18.48013	1.111915
TBL-05	24.49521	0.1562566	3.660462	17901.11	1.6823635	0.916712	51.84932	1.789841	55.73923	17.07607	1.07304
TBL-06	22.81093	0.1734063	3.718245	15824.46	1.4314315	1.068986	42.25214	1.646429	63.28635	14.68327	0.9144118
TBL-08	22.93972	0.1871001	3.419446	15140.83	2.0868745	0.9655291	45.44742	1.653018	59.05633	13.77927	0.942988
TBL-09	25.09974	0.1727139	3.715596	15787.27	2.1897065	0.8615692	50.41141	1.702356	61.65841	14.68865	1.019389
TBL-10	22.926	0.1433934	3.459103	16983.79	1.9165165	1.142118	45.88987	1.786657	64.95192	15.94087	0.9921112
TBL-11	21.93755	0.1335236	3.460885	17373.98	1.3857615	0.966973	43.16111	1.70263	68.1323	13.15305	1.038713
TBL-12	26.67815	0.1600502	4.079983	18299.62	2.071593	1.044296	61.1361	2.219992	73.37677	19.45501	1.137569
TBL-13	29.26225	0.161889	4.343716	17581.35	2.43412	1.207566	62.98749	2.555592	73.82236	19.85513	1.195979
TBL-14	28.27783	0.1821844	4.238612	17441.17	1.835402	1.012396	55.78838	1.984842	66.61933	17.83253	1.155144
TBL-15	29.40354	0.1650813	4.423198	17413.21	2.2622095	1.340732	60.28781	2.345195	71.44706	18.77892	1.207057
TBL-16	20.35051	0.1263276	3.320851	18072.82	1.6849645	0.9040388	41.86746	1.660112	71.30904	18.77304	0.9891962
TBL-18	21.92818	0.1400249	2.918942	16588.8	2.996969	0.919988	59.53418	1.771936	70.78857	21.60383	0.9107246
TBL-19	23.5769	0.1690016	3.720253	17664.03	1.595313	1.126688	45.32578	1.581434	68.5379	17.1745	1.051578
TBL-20	23.85342	0.1737402	3.526945	17452.26	1.7861035	0.9265782	44.25231	1.499395	57.43331	14.63944	1.002132
TBL-21	20.84394	0.1420445	3.347072	16321.9	1.6351345	0.9370587	41.47672	1.806937	68.41768	15.13313	0.9491623
TBL-22	27.44699	0.1429674	3.985398	18193.71	2.813849	1.141162	53.01491	2.216485	54.21225	14.5098	1.122921
TBL-23	24.30588	0.1717855	3.724725	17627.92	2.312844	0.988647	50.14164	1.882985	68.35101	18.80493	1.057668
TBL-25	18.8123	0.1346485	3.315095	21464.33	1.7923695	1.020347	36.71587	1.685777	51.616	16.69681	0.978918
TBL-26	19.18701	0.1537759	3.393873	21751.98	1.4577885	1.105528	38.16721	1.547554	50.64521	17.44187	0.9703336
TBL-27	28.18058	0.1599904	4.071198	19307.85	1.881616	1.228376	53.16999	1.771058	70.83119	18.11104	1.117577
TBL-28	20.66064	0.1246862	3.41172	17887.69	1.9578565	1.114198	42.14693	1.672523	49.07964	16.54044	1.036275
TBL-29	20.14466	0.1629514	3.295943	20682.49	1.5662695	1.071626	39.45906	1.655339	51.6592	16.47559	0.9581335
TBL-30	18.62194	0.1407437	3.278918	20288.34	1.4034235	0.9179082	37.87063	1.503862	59.15719	15.94207	1.003522
SDV-33	30.40355	0.167657	4.962716	20564.7	1.105597	0.983503	65.28158	1.794742	56.42739	23.40895	1.453422
SDV-36	28.90454	0.146635	4.539578	20183.04	1.0839325	1.068456	53.72228	1.692343	48.8992	19.4027	1.334574
SDV-38	30.77375	0.157633	5.269386	20553.74	1.708932	1.199623	61.85762	1.5304	58.43953	20.33147	1.435957
SDV-39	33.79651	0.186445	5.632246	20124.79	1.0782725	1.746777	63.62683	1.428714	50.17561	20.63936	1.525967
SDV-40	32.73426	0.21211	5.632252	20845.14	1.8794475	1.164557	63.4957	1.902042	57.9431	21.91171	1.495151
SDV-41	32.0755	0.181651	5.195358	20985.69	1.618425	1.348343	61.90123	1.86616	53.04873	19.65732	1.365385
SDV-42	27.83413	0.161899	4.858303	21784.4	0.95254	1.301417	55.39227	1.328299	53.10305	21.51492	1.372167

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
SDV-43	30.68802	0.190005	5.365865	21262.98	1.3408495	1.202502	57.56348	1.590116	58.71164	22.37556	1.460002
SDV-45	33.08868	0.21575	5.585082	21615.05	1.8439765	1.246935	60.78397	1.822727	62.45865	22.09173	1.52756
SDV-46	32.61867	0.160688	5.58602	20322.04	1.5646805	1.172163	54.12494	1.503746	50.72326	19.35859	1.404017
SDV-47	35.49409	0.246549	6.503766	22309.06	2.2665235	1.743357	62.68496	1.420591	54.36841	22.79237	1.676662
SDV-48	29.34695	0.130019	4.625214	20070.59	1.0514475	1.170082	48.39788	1.197933	54.79107	18.5331	1.208948
SDV-49	31.88158	0.216706	5.3552	21507.33	1.5268985	1.282277	60.50212	1.45999	52.72847	20.64108	1.441986
SDV-50	38.00828	0.248332	6.470809	22191.57	1.7973835	1.425327	64.02754	1.614628	59.97037	22.2252	1.575356
SDV-55	28.82508	0.173335	4.679034	21009.96	1.584035	0.955339	59.9914	1.426552	51.17699	21.05024	1.312224
SDV-57	31.12621	0.236402	5.406214	21602.01	1.3852165	1.168497	52.58334	1.413313	45.39637	18.76125	1.369477
SDV-58	31.3982	0.152555	5.371259	20627.2	1.3849925	1.121508	56.07175	1.613778	55.5654	18.27563	1.320914
PUN-11	26.95644	0.1435327	4.536918	18797.03	2.03008	0.9917433	57.09369	1.543734	49.82498	20.09339	1.29948
PUN-31	28.42899	0.1896639	4.699296	20206.52	2.021469	0.8895512	57.0028	1.488332	50.27225	22.87212	1.255029
PUN-41	27.16692	0.1845817	4.340296	19464.15	2.6254835	1.12737	76.0238	1.512726	47.33713	28.7105	1.151158
PUN-52	29.0221	0.1876272	4.923783	21082.23	2.037937	1.412498	55.22315	2.166162	57.09499	20.65098	1.460269
SDV-01	33.26023	0.1931146	5.297599	19257.51	1.205835	1.341003	61.55931	1.380269	47.52857	18.06685	1.334838
SDV-02	31.57877	0.1795908	5.092546	20152.57	1.693056	1.237	64.27126	1.892352	48.45445	19.49137	1.411711
SDV-05	32.51883	0.1914741	5.541776	20313.2	1.4338965	1.504589	60.66291	1.469418	58.25097	20.76432	1.524806
SDV-07	32.39606	0.1723398	5.236865	21109.57	1.5955755	1.513188	62.12689	1.409888	59.60751	20.06668	1.421836
SDV-08	28.95351	0.1541287	4.704417	20621.9	1.44723	0.9875249	56.01691	1.526497	55.48766	20.00353	1.344718
SDV-09	27.35093	0.1614343	4.689551	21746.66	1.0213214	0.9353955	50.48452	1.077623	54.15868	18.86768	1.184436
SDV-11	31.05563	0.1783149	5.062799	21150.38	1.728782	1.03146	54.52809	1.105856	52.18666	18.20115	1.359136
SDV-14	27.85939	0.1495894	4.905858	21171.25	1.399124	1.252577	52.56161	1.115076	56.38309	19.60192	1.315982
SDV-20	33.74095	0.2071798	5.438558	20557.65	1.982881	1.412156	61.65704	1.712283	54.97865	21.22295	1.450343
SDV-21	27.93627	0.1528211	4.812871	20727.78	1.2031697	0.8289975	53.54325	1.32872	56.35839	19.61477	1.278151
SDV-22	31.39204	0.1758542	5.517687	20442.22	1.776337	1.334542	56.72419	1.296545	52.89738	20.05589	1.466947
SDV-23	33.96012	0.1948329	5.184024	18492.78	2.3595445	1.466311	65.55962	1.415273	49.41338	20.29475	1.39215
SDV-26	27.67251	0.1720156	4.735331	22400.98	1.61228	1.272277	54.1361	1.551401	57.62599	21.07062	1.291899
SDV-28	30.46281	0.1520564	5.158916	22047.78	1.522375	1.188967	54.12303	1.320179	55.96364	19.08998	1.355007
SDV-29	31.25557	0.1912594	5.379904	20819.9	1.4287515	1.288282	56.85114	1.550787	56.07207	24.07521	1.475285
SDV-30	28.39076	0.1339883	4.610408	20306.42	1.4688905	0.8817844	50.61812	1.372912	53.67008	19.63977	1.265185
SDV-31	38.07082	0.2449934	6.360039	20432.86	2.5642145	1.596382	55.7697	1.03068	54.20008	23.50918	1.720722
HUA-33	17.26087	0.094686	2.572486	15692.23	7.4462175	0.777016	41.42957	4.011988	52.62315	9.053648	0.767016
MON-01	35.85322	0.169864	4.682663	17209.9	3.606491	1.20576	49.72647	2.279617	46.47529	12.56483	1.238133
MON-08	33.72746	0.184234	3.788528	16335.68	4.472848	1.372476	69.6586	2.208474	46.63323	11.53387	1.07949

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
MON-09	46.51345	0.227796	4.844098	17712.15	3.991223	1.382168	88.54493	2.764596	41.58403	16.97831	1.327407
TAJ-24	37.72764	0.226572	5.161016	21229.98	3.6019305	1.429712	77.54171	2.760026	42.53859	16.38424	1.454654
POR_005	44.47287	0.1972768	4.48783	14937.82	3.4770345	1.263344	87.24249	1.848408	38.12868	10.11623	1.226293
SOC-29	30.56024	0.1369015	4.557282	13923.78	4.699508	1.324745	65.52059	2.194081	46.01097	11.20718	1.259293
SOC-33	30.84946	0.1891682	3.997458	19920.95	2.986428	1.254683	65.95271	2.517369	45.90057	10.88987	1.187449
CRM-07	16.35361	0.096833	2.509464	16820.95	1.8123115	0.541661	55.43115	2.146448	47.36262	22.69192	0.814042
HLV-01	14.98111	0.094173	2.41946	18352.25	2.497125	0.779589	45.46255	2.133532	39.9216	14.16137	0.838928
HUA-01	27.36588	0.179609	4.103134	20764.33	4.8154805	1.048137	54.0227	1.889295	33.28775	13.26671	1.12764
HUA-04	27.31107	0.203987	4.118887	22811.18	4.443976	0.975546	56.13271	1.951546	34.80836	17.32691	1.120055
HUA-10	23.70988	0.157282	3.670715	21170.67	4.113113	1.040682	41.58969	1.675789	27.60304	14.27312	1.032594
HUA-21	20.6624	0.204928	3.751421	21157.27	1.6209585	1.116264	41.51026	1.847498	36.52723	17.0639	0.989937
HUA-22	18.34373	0.141806	2.940883	22626.61	2.0235135	0.81385	43.11314	1.861482	29.95441	15.97668	0.859049
HUA-23	15.72537	0.109733	2.643601	21131.02	2.07131	0.673405	40.63636	2.54901	30.36929	13.33283	0.789363
HUA-24	22.76708	0.172961	3.707045	21708.38	2.3076675	0.923015	45.35083	1.787613	31.22839	16.44481	1.015727
HUA-25	17.42413	0.158497	2.874497	20418.59	1.8212005	1.231351	48.51104	1.84981	32.23986	19.4281	0.866303
HUA-27	23.09521	0.177323	3.846058	23211.22	2.249066	0.979035	44.50931	1.871265	34.22975	15.17373	1.08761
HUA-29	24.33147	0.117725	3.741935	23517.31	2.9301365	1.109651	49.2007	1.763227	39.59844	14.37905	0.99851
HUA-30	17.8955	0.166557	2.816942	19433.31	2.9032315	0.69476	44.11085	1.868899	32.7532	14.11829	0.993616
HUA-32	19.03693	0.127604	3.090238	21426.02	1.407552	0.686429	43.34894	2.009163	28.44425	15.08106	0.930288
HUA-34	20.02964	0.123751	3.134291	20335.57	2.450346	0.876413	45.74011	1.934011	30.16312	15.80931	0.983218
HUA-37	19.40974	0.123571	3.092804	19417.59	2.269393	0.84121	41.92546	1.750371	33.91911	16.43577	0.979891
HUA-38	22.74911	0.186965	3.595357	21253.16	2.9777515	0.966583	48.16039	2.299327	33.82832	17.75073	1.08123
HUA-41	18.52815	0.12357	3.095729	19820.43	1.1516075	1.02038	41.16043	1.949057	32.6187	13.80457	0.947128
HUA-42	22.00333	0.158422	3.619673	21981.96	2.786457	1.340166	43.12435	2.023893	34.49694	17.35204	1.072457
HUA-43	28.40059	0.222303	4.951054	20249.84	1.6753045	1.419311	53.23141	1.563184	41.74058	14.44725	1.240562
HUA-45	23.27395	0.150469	3.616884	20271.21	2.434918	0.827067	50.16267	1.862038	30.76898	18.15111	1.03085
HUA-47	24.57382	0.156824	3.961035	22145.87	2.1727255	0.927175	48.47573	1.893309	30.74076	15.00849	1.061739
HUA-50	28.8277	0.175337	4.693106	23311.24	1.906725	1.388591	56.46476	1.699088	37.34578	15.48908	1.248264
HUA-52	18.87387	0.170478	3.063466	23490.83	4.8334335	0.827034	41.99632	1.363904	38.11911	14.49031	0.938025
HUA-53	16.43286	0.094191	2.849377	20167.79	1.456822	0.636208	36.67898	1.796956	46.21498	14.7283	0.803873
HUA-55	23.91845	0.156048	3.777638	19706.83	2.311465	0.833882	47.14666	1.93971	31.92322	15.61342	1.02211
HUA-56	21.10449	0.170022	3.555403	22466.84	1.8152285	0.935571	44.50598	1.834464	50.08154	16.21653	1.094143
HUA-57	19.36082	0.166049	3.215869	22228.53	1.881344	0.864489	42.26388	1.977427	47.47097	15.10366	0.994515
SDV-34	21.84924	0.093579	3.287494	19213.97	1.4627115	0.610125	44.90257	1.697617	43.14727	15.54234	1.109445

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
SDV-35	24.92115	0.12202	3.736871	18987	1.0041375	0.94386	51.70447	1.535223	50.48951	16.62257	1.185305
SDV-37	26.81292	0.173008	4.021985	22514.66	1.9637975	0.918286	50.49218	1.548614	38.16945	16.98984	1.247904
SDV-51	23.93334	0.152695	4.101781	21913.2	1.847471	0.917692	58.61582	1.535257	42.60968	18.02125	1.096356
SDV-52	25.20486	0.144059	4.337235	21489.19	1.5697065	0.946486	45.97046	1.826337	43.75654	15.61485	1.151082
SDV-53	19.67257	0.089521	3.149407	21408.8	1.5548415	0.978759	35.35104	1.864429	39.48043	11.18871	0.933309
SDV-56	21.82172	0.122658	3.524971	21525.7	1.56513	1.027222	42.22691	2.113242	39.48967	13.91607	1.042336
SOL-10	22.66043	0.144678	3.605326	15721.52	1.8169385	0.825088	46.64076	1.9092	33.59616	13.55153	1.003507
TAJ-05	20.24975	0.118988	3.719043	22244.33	1.3664835	0.943391	41.18748	1.596344	47.06305	16.6043	1.05972
TAJ-06	22.63537	0.147959	4.060585	21963.25	1.23265	1.102568	42.8389	1.416336	45.47804	15.84115	1.065134
TAJ-08	21.63406	0.162701	3.701396	21512.87	1.4909465	0.814753	47.61125	1.467873	41.54689	17.73639	1.056792
TAJ-11	20.65817	0.140761	3.708368	22321.23	0.857232	1.173272	37.88442	1.389272	52.33527	15.6358	1.054753
TAJ-12	18.1867	0.124508	3.118461	21600.48	1.8898825	1.015856	30.27545	1.545038	39.6333	12.31352	0.942632
TAJ-13	24.6227	0.160958	4.135949	20637.67	1.1104625	1.053926	48.75721	1.850758	45.13624	16.30212	1.055836
TAJ-14	21.19589	0.117056	3.51384	21311.41	1.718694	0.699258	44.79784	1.614246	42.36132	17.55939	0.993028
TAJ-15	20.0722	0.132471	3.641834	21608.7	1.279399	0.759676	56.49666	1.520481	45.27328	28.37409	1.013241
TAJ-16	21.73422	0.143669	3.619229	21979.13	2.002464	0.838808	48.78864	1.691858	43.05081	16.78201	1.063895
TAJ-17	24.25851	0.1745	3.891495	21694.56	2.1040475	1.294504	47.52836	1.662205	51.10404	16.98964	1.161348
TAJ-18	18.89671	0.098657	3.341313	20160.6	1.7267065	1.11067	38.55236	1.367841	44.88812	15.5618	1.007376
TAJ-19	19.41014	0.140251	3.434552	21708.63	1.8163435	0.914834	35.51845	1.410195	45.5799	13.27192	0.977509
TAJ-20	26.77456	0.172881	4.406116	19640.49	2.340494	1.06105	57.15538	2.336735	51.98532	18.94043	1.21595
TAJ-21	19.34695	0.158238	3.455204	21263.12	1.7009405	0.949445	37.61806	1.577293	42.89513	14.45305	1.067708
TAJ-22	25.31625	0.148603	4.18923	21459.31	1.428132	1.082303	45.2836	1.651485	43.16656	12.14387	1.12573
TAJ-23	27.83358	0.19588	4.591594	19692.44	2.4349415	1.220464	58.20601	1.977717	50.54065	18.77999	1.263855
TAJ-26	21.72526	0.112471	3.770764	23160.8	1.686871	0.869335	41.94941	1.274908	51.53721	15.01588	1.10419
TAJ-27	25.96935	0.163153	4.265473	21592.52	1.646887	0.914262	51.33858	1.712677	48.92676	15.2969	1.123742
TAJ-28	25.64903	0.158799	4.299341	20832.5	1.1157635	1.394283	50.30818	1.802721	41.52771	15.62825	1.138245
TAJ-29	23.64004	0.112476	3.893111	21929.36	1.1579575	1.084257	47.0296	1.525999	45.36222	14.33837	1.044498
TAJ-30	21.29563	0.142915	3.693455	23136.62	1.5873555	0.811846	40.50806	1.462978	47.05077	16.90352	1.074492
TBL-33	19.72012	0.120557	3.320581	18266.76	2.1442165	0.870002	39.72793	1.874085	46.57348	16.31397	0.939255
TBL-35	20.89112	0.116046	3.24123	16970.82	1.780846	0.856715	39.29049	1.86762	37.18053	12.64083	0.921878
TBL-44	21.16378	0.13032	3.400055	18932.38	1.8376	0.90527	39.64495	2.014585	34.9893	12.7054	0.974329
TUL-01	21.70985	0.146667	3.855705	21050.92	1.52033	0.952099	38.77493	1.397644	52.36115	13.88646	1.033668
TUL-02	18.33841	0.118506	3.295228	20072.74	1.0275465	0.637019	34.37717	1.252128	44.14088	13.91778	0.971995
TUL-03	16.72176	0.093941	2.796806	22225.36	1.1451765	0.713867	39.37227	1.371689	46.60029	12.11237	0.90451

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
TUL-04	20.63068	0.151921	3.665426	22227.32	1.777549	0.960414	70.28749	1.076179	48.89152	30.99876	1.021086
TUL-06	26.28492	0.165692	4.13761	19191.36	1.799098	1.061841	66.457	2.020764	51.66524	22.44144	1.115531
TUL-07	23.65602	0.128317	3.975627	20405.35	1.3390785	0.868514	47.43301	1.424433	42.31197	15.24736	1.041897
TUL-08	23.46197	0.17671	4.06439	20892.14	1.779812	1.283125	45.80707	1.458335	45.2048	15.04448	1.054388
TUL-09	22.35487	0.137166	3.593227	20310.29	1.374008	1.096406	44.94045	1.722799	51.64403	13.42174	0.993777
TUL-10	23.28965	0.161429	3.909215	19469.39	1.79967	1.00387	44.22278	1.803538	50.8672	17.02748	1.049033
ANG_005	20.76292	0.1279813	3.341789	17012.29	1.5636165	0.7199329	41.85862	1.961108	35.46706	15.14536	0.8900907
ANG_006	20.52623	0.1352318	3.446708	17766.48	1.6345	0.8251347	35.83473	1.716601	35.14615	11.91401	0.9393147
ANG_012	26.75869	0.145966	3.918489	15998.49	2.872113	0.8699018	52.26324	1.80156	43.20297	11.69706	1.083117
ATU-04	22.78537	0.1414893	3.551768	18001.26	1.805581	1.199982	49.244	1.790844	29.24101	12.32269	0.9736551
ATU-05	20.41899	0.1887742	3.398388	19368.02	1.932675	0.8440129	39.89736	1.734785	34.68141	14.22741	0.9837969
ATU-06	20.95728	0.1514128	3.481323	17646.78	2.4411565	1.05997	44.77911	2.30947	33.0111	15.06571	0.9928611
ATU-07	21.93289	0.194464	3.751071	20958.67	2.3398765	1.162892	43.81777	1.975583	35.63306	17.11766	1.029592
ATU-08	26.15866	0.1560231	4.081038	17314.24	1.6928045	1.127736	53.21631	1.639032	33.31456	13.80686	1.169939
ATU-09	18.81329	0.1505743	3.305873	19149.74	1.7722085	1.217729	40.20906	1.78388	33.23024	16.01543	0.9197214
ATU-10	21.72739	0.1662928	3.73787	20612.46	1.809707	1.169266	44.04931	1.444303	42.93349	16.21175	1.11048
ATU-11	17.51579	0.1304659	3.101555	20228.58	1.603938	0.8921305	35.84595	1.631798	40.48246	15.54451	0.8630756
ATU-15	19.95829	0.1375743	3.111207	19459.29	1.7533355	0.9690541	41.06144	1.562393	33.03518	15.66503	0.9287933
ATU-16	20.43622	0.1182504	3.273326	21017.9	1.2074655	1.044289	40.59822	1.449025	37.72387	15.74615	1.051811
ATU-30	28.46758	0.2049167	4.63994	20372	2.154516	1.235485	58.42363	1.504502	34.37049	16.01525	1.249298
ATU-33	21.29867	0.1500878	3.533024	19540.47	1.5009495	1.083264	41.91847	1.930537	34.66778	15.40893	0.9743038
ATU-34	28.56606	0.1692535	4.69387	15535.2	3.1201795	1.321161	57.91265	1.928417	38.99588	14.22011	1.112974
ATU-36	24.9663	0.165022	4.018967	21482.72	1.8343095	1.194572	45.71612	1.745402	35.85145	15.83737	1.099428
ATU-37	19.15549	0.088539	3.131212	18441.73	1.892633	0.6646158	39.14714	1.862541	34.64798	14.33637	0.9206874
ATU-39	19.75524	0.0852788	3.19021	19335.44	1.4586635	0.7924127	39.53135	1.796525	44.81464	16.96445	0.9342175
CAR_013	22.51074	0.1396052	3.461154	19661.92	1.6373305	0.9487638	45.60553	1.378017	37.9402	13.62172	1.02062
CAR_017	33.6541	0.2493114	4.991673	20490.64	2.4393425	1.314555	58.43627	1.57399	37.66953	15.97278	1.330832
CAR_018	22.62678	0.1560819	3.335457	17439.23	1.6378955	0.937055	40.73548	1.631539	40.55346	12.23757	0.980894
CAR_019	20.46129	0.1075983	3.216528	18570.74	1.8357055	1.116118	43.12033	1.889437	36.97639	18.38251	0.9138885
PUN-01	26.57876	0.1138643	4.202177	21152.51	1.4403075	0.6144214	49.29951	1.582524	44.2285	13.36642	1.188316
PUN-02	25.38173	0.0971385	4.104187	21363.1	1.9240575	0.8626701	45.56606	1.534199	42.81302	13.76882	1.121615
PUN-03	26.03523	0.151099	4.141955	20360.49	1.452921	0.8354266	46.90416	1.960953	41.88727	13.75489	1.16203
PUN-04	22.58275	0.1597534	3.95873	21514.77	1.4355415	0.8898628	37.44287	1.522951	37.61071	13.27013	1.0648
PUN-05	24.10296	0.1461562	3.898096	21565.66	1.6449845	0.6864656	45.20424	1.585691	40.8175	13.22141	1.144197

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
PUN-06	29.7085	0.2054625	4.735717	20725.47	2.3577685	1.222988	47.70058	1.987543	50.08177	15.14362	1.31056
PUN-07	30.03457	0.1451219	4.790676	18962.17	1.85437	0.9266607	64.22775	1.68585	47.34776	21.42327	1.343012
PUN-08	26.51676	0.2003171	4.177272	20332.31	1.3174975	0.7069932	50.89691	1.567383	45.70261	13.00766	1.273925
PUN-09	27.17614	0.1346276	4.646724	18713.22	1.5235945	1.013716	50.67064	1.675174	49.85787	12.52332	1.275221
PUN-10	24.52969	0.1568348	4.070435	20261.74	2.070506	0.7499089	58.21332	1.648432	37.64867	28.83024	1.166476
PUN-12	22.27116	0.1476694	3.798753	19685.49	1.4987645	0.8117892	41.96077	1.677361	40.77695	12.02054	1.083399
PUN-13	26.63499	0.1923942	4.586844	18116.74	2.326075	1.197536	50.19499	1.759881	44.61899	21.25169	1.29319
PUN-14	26.33275	0.1269261	4.371817	19267.74	1.784001	0.9695054	49.45972	1.759717	47.41654	16.4284	1.188753
PUN-15	27.86745	0.1810425	4.628643	18740.5	1.772917	0.9019321	56.42488	1.532811	44.88718	18.21655	1.2546
PUN-16	21.74349	0.1442838	3.786731	19781.23	1.894697	0.8666642	40.70626	1.839583	34.46306	14.0938	1.06245
PUN-17	25.27428	0.1683362	4.381725	19458.64	1.934914	1.045947	46.79408	1.221443	42.65387	14.95663	1.252485
PUN-18	24.12276	0.1693202	4.056203	18514.74	1.948243	0.9524269	42.91678	1.666991	40.76178	11.12405	1.15751
PUN-19	24.77726	0.1680513	4.27306	18566.09	2.163241	0.9714542	52.1697	1.293092	50.31717	15.28693	1.179263
PUN-20	22.64758	0.1492569	3.915481	19250.23	2.503194	0.8727497	41.51506	1.685961	41.22646	15.58123	1.054882
PUN-21	24.94062	0.1452559	4.128712	20118.24	1.9863165	0.8375022	49.40463	1.736714	45.87624	15.462	1.160244
PUN-22	22.88424	0.1412096	3.689151	19959.83	2.163504	0.7710406	47.41615	1.668695	43.16639	15.37119	1.117721
PUN-23	26.98232	0.1809668	4.647466	19996.41	1.9780145	1.011452	41.86403	1.507074	52.50592	13.90266	1.208845
PUN-25	28.31078	0.1660302	4.646216	18550.13	1.844395	1.182459	55.29937	1.546383	50.19211	15.99781	1.272847
PUN-26	25.05711	0.1276691	3.942111	20786.72	2.0057115	0.8505061	46.65838	1.642224	38.83889	13.89592	1.121155
PUN-27	23.66234	0.1259738	3.874339	19078.9	1.716379	0.7557951	74.24473	1.758196	37.12186	25.48224	1.032258
PUN-28	26.80912	0.1679536	4.375766	20263.39	2.057628	0.881229	44.06358	1.641633	43.36472	13.52628	1.174101
PUN-29	20.79504	0.1615721	3.90205	22044.38	1.42426	0.780849	37.1146	1.669203	40.83706	13.52266	1.050662
PUN-30	25.0306	0.1783148	4.335162	21267.62	1.934341	0.991688	43.58266	1.700777	45.14094	14.34001	1.203969
PUN-32	29.39281	0.1811049	4.942062	19894.55	2.435674	1.117902	51.09646	1.1923	54.31331	15.92248	1.295246
PUN-33	26.47164	0.1490833	4.375435	21104.15	2.1093935	1.011829	46.76311	1.685644	46.03144	14.13351	1.257227
PUN-34	23.29991	0.1175397	3.908443	21650.21	1.877734	0.7091163	43.58726	1.672698	34.50904	14.19927	1.120277
PUN-35	25.79424	0.1438547	4.359261	20135.95	2.0584935	0.9845482	54.47049	1.26365	44.52461	20.9077	1.144866
PUN-36	27.47158	0.1656339	4.567859	19486.17	2.1214745	1.139027	50.95852	1.915477	39.79647	14.64105	1.147257
PUN-37	32.56453	0.1850206	5.038701	20947.19	2.486485	1.573404	66.8324	1.893741	48.62714	24.03838	1.334524
PUN-38	25.55822	0.1398764	4.125762	20397.47	2.3332835	0.9444441	52.98787	1.703939	44.70448	19.50624	1.198802
PUN-39	27.97291	0.1669928	4.546429	19759.8	1.9898345	1.205878	54.37566	1.615231	44.3591	17.27569	1.23929
PUN-40	30.00418	0.1957549	4.972723	21646.99	2.2362275	1.297995	51.18119	1.408189	49.06601	18.6034	1.287876
PUN-42	32.46346	0.1853803	4.769234	20636.69	3.10389	1.333858	56.05445	1.514466	45.11513	13.85711	1.328085
PUN-43	25.07555	0.1563212	4.244883	20394.81	2.0761235	0.9660584	47.10104	1.221006	46.55235	15.46931	1.192221

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
PUN-44	24.53223	0.1495941	4.041278	19993.61	1.7699975	0.9746894	44.47078	1.654097	39.56499	12.901	1.117467
PUN-45	26.57059	0.1441398	4.297788	19662.84	1.7037245	0.9857992	45.50605	1.490381	46.39254	13.27897	1.223909
PUN-46	26.76148	0.1607558	4.25736	20254.07	1.4756615	1.014132	51.99447	1.405865	48.0014	16.89604	1.16777
PUN-47	27.80642	0.1588932	4.351041	19991.01	2.0748645	0.8993903	49.17203	1.583704	43.12152	15.21942	1.255729
PUN-48	27.45174	0.1361838	4.299472	19990.05	2.2051935	1.101474	50.03255	2.003975	42.91922	13.7274	1.255758
PUN-50	25.95931	0.159393	4.205858	19982.3	1.9721425	1.043285	51.4091	2.075941	43.31512	19.50922	1.187516
PUN-51	21.48857	0.1774581	3.741762	20469.61	1.9203705	0.8897365	44.70448	1.721633	50.2951	14.2729	1.172318
PUN-53	30.69398	0.183538	4.853592	19776.83	2.2353225	1.143832	80.00659	1.954805	48.654	30.74554	1.339828
PUN-54	23.52956	0.1455262	3.924582	20462.5	1.8089765	1.184647	58.03666	1.476404	47.86357	18.90733	1.164964
PUN-55	26.47463	0.1486119	4.27165	20516.66	2.1936305	1.150113	46.3285	1.684034	42.56902	14.91276	1.20138
PUN-57	28.17084	0.1746278	4.528723	20803.74	1.8402815	1.049113	59.16069	1.585286	43.85424	20.98824	1.24242
PUN-58	29.84237	0.1380115	4.656241	18596.99	2.1855545	1.408532	51.03791	1.951005	47.46583	14.32717	1.194188
PUN-59	28.21458	0.1851804	4.452168	19884.26	2.300278	1.073137	52.61232	1.559268	50.11441	16.70092	1.274121
PUN-60	28.74101	0.1471378	4.602183	19459.03	2.517958	1.162654	54.6382	1.903536	40.28506	17.12356	1.162591
ROQ_001	22.66306	0.1946105	3.728154	21215.21	1.754048	0.9975345	45.4128	1.718156	35.36982	15.92753	1.093342
ROQ_004	21.34479	0.1412124	3.497703	19319.13	1.593795	0.7915804	42.6147	1.723232	35.74437	15.80611	0.9623175
ROQ_005	26.01716	0.1917627	3.89887	22672.24	2.1852255	1.072218	52.4761	1.809514	41.5417	16.80248	1.183239
ROQ_007	20.69296	0.1294973	3.216263	22582.38	1.530861	0.6779789	41.56594	1.990663	39.36659	15.62111	1.006911
ROQ_008	18.69197	0.110921	2.928312	22840.12	1.5107335	0.7932639	41.0117	1.866242	38.99242	14.49272	0.952007
ROQ_009	17.78032	0.1349951	2.829101	23153.58	1.7665715	0.7458277	39.97947	1.642596	39.5525	14.74296	0.9263538
ROQ_011	27.16875	0.2033325	4.240418	21511.03	2.315193	1.102788	51.84522	1.525311	33.11051	15.89455	1.153956
ROQ_012	33.96124	0.2131204	5.243472	22321.69	1.669872	1.440309	63.92372	1.750271	34.47497	14.40155	1.356485
ROQ_013	29.30713	0.1689149	4.030818	20555.19	5.0929015	1.133998	57.71352	2.084853	31.67791	13.1336	1.095982
SDV-04	22.33699	0.1317259	3.830494	23718.57	2.168741	0.9163867	44.04074	2.021178	38.24443	16.0926	1.068174
SDV-06	26.22746	0.1476061	4.265187	22611.85	2.271239	1.246554	52.65804	1.871653	45.70318	18.72258	1.237383
SDV-12	27.14421	0.1720372	4.457901	21056.26	1.883762	0.9926746	52.49408	1.727111	47.00909	17.9935	1.244542
SDV-13	23.16424	0.1409586	3.974338	21074.85	1.6298365	1.003819	66.87574	1.425439	40.77247	24.06025	1.109583
SDV-15	30.8001	0.1858079	4.90804	20238.84	2.0107455	1.43393	54.30642	1.587919	43.46445	16.3671	1.349988
SDV-16	19.64252	0.109616	3.344243	22815.7	1.4796755	0.7938111	38.19918	1.516559	36.43657	15.30902	0.9657897
SDV-17	26.73838	0.154122	4.43408	20993.54	1.5615705	0.9679131	85.79434	1.449918	40.43535	34.14067	1.156172
SDV-18	24.29691	0.1492493	4.182476	21003.11	1.381424	0.9345229	46.45501	1.50329	42.00788	18.72053	1.157721
SDV-19	23.8121	0.1622791	4.14144	21213.53	1.5916915	1.133274	42.91996	1.594509	41.87526	15.92352	1.150617
SDV-24	25.60303	0.1058604	3.876567	20770.75	1.6490025	0.7235878	51.24757	1.684016	40.79701	14.74212	1.121968
SDV-25	27.15139	0.1618944	4.599446	21224.89	2.0149835	1.067406	49.19469	1.667089	45.0411	18.30743	1.238284

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
SDV-27	25.52307	0.145193	4.361714	20517.76	1.8083465	0.8150355	44.53335	1.413187	46.66101	15.0447	1.192084
SDV-32	24.06812	0.130304	3.874605	20406.86	1.746958	0.9862921	46.46751	1.640301	38.28722	16.93472	1.064272
SOC-03	21.99328	0.139458	3.601701	18206.62	1.401093	0.6102541	45.75652	1.938693	37.86248	14.20843	1.023857
SOC-05	23.62074	0.1319196	3.601955	18023.72	2.3777805	0.6938168	50.03152	1.806399	33.05231	15.84472	1.023542
SOC-06	22.21601	0.1071629	3.499292	18212.11	1.792935	0.8900149	38.78392	2.044969	40.12496	14.6015	1.016606
SOC-09	24.94532	0.177336	3.798615	20464.76	1.413692	0.8181446	50.82286	1.600635	46.95171	16.88941	1.128547
SOC-10	18.92941	0.143499	3.378866	19420.3	1.5674935	0.7998923	36.01424	1.585289	42.80431	17.12518	0.919799
SOC-12	18.90255	0.0890039	2.592654	19366.19	2.585782	0.7642528	43.34064	1.985872	40.05159	15.36451	0.953962
SOC-13	24.42933	0.1557704	4.005304	18899.67	2.087303	0.9621636	47.97095	1.399928	53.97772	18.66062	1.11845
SOC-14	23.31226	0.1130994	3.759979	17747.54	1.3934335	0.8879758	46.83314	1.751598	34.48647	16.7968	1.092829
SOC-17	26.95813	0.1322325	4.179975	18601.42	2.162713	0.9795964	53.40508	1.634394	45.47156	14.6197	1.088399
SOC-20	21.71611	0.1553278	3.353356	18322.12	2.047846	0.8286198	43.77988	2.084434	41.44757	15.46095	0.9791832
SOC-37	21.40781	0.1174281	3.509994	21625.97	1.6536375	1.136261	46.25259	1.843489	44.98949	14.27613	1.020761
SOC-41	29.11516	0.1803813	4.359057	21046.93	2.490513	1.317199	58.30711	1.586954	48.96306	17.48419	1.236519
SOC-44	17.88067	0.1327862	3.217718	20854.54	1.75082	0.8372755	33.77224	1.808658	39.93737	14.98453	0.9917881
SOC-46	23.25525	0.1278902	3.795222	22087.21	2.325803	0.8981922	45.57972	1.840987	36.25152	19.05808	1.093116
SOC-47	23.22823	0.1259247	3.480724	19711.44	2.168433	0.9520803	40.53549	1.992261	33.19987	12.26969	1.038683
SOC-56	21.12384	0.1444783	3.390304	19004.04	2.011551	0.7739472	39.20801	1.473751	32.92094	12.55683	0.9950907
SOC-60	22.17876	0.1098739	3.558404	19963.1	1.6626385	0.8013915	50.35252	1.802143	39.7503	18.41482	1.008044
SOC-61	20.24994	0.1235929	3.405282	20585.84	2.054504	1.011587	42.50687	2.475426	36.73493	17.23114	0.9716739
SOC-62	16.54378	0.1027317	2.728183	19215.76	1.3902515	0.7753609	33.97459	1.7353	28.52781	12.79112	0.8462973
TBL-07	20.20348	0.173376	3.283129	19960.64	2.1080615	0.7805883	41.77076	2.15178	40.48401	15.72176	0.9983748
TBL-17	19.32748	0.1346225	3.010002	20836.32	2.3756165	1.296654	42.18279	1.817243	37.74392	17.62493	1.0019
TBL-24	22.00673	0.1092467	3.328324	17668.24	2.447505	0.968771	46.22844	1.515371	47.28705	18.11642	1.042297
MON-03	23.53621	0.098663	2.795424	20894.3	4.4140295	0.628918	39.68525	2.100597	29.22106	6.912802	0.842974
MON-04	44.87373	0.142879	5.428931	20598.43	3.109043	1.035743	63.49335	1.791383	22.17672	6.73484	1.429113
MON-05	22.61486	0.096161	3.099198	19955.05	4.720855	0.656328	35.02006	2.030976	32.37997	5.443092	0.977929
MON-06	34.29166	0.142429	3.87063	18852.83	3.0694665	0.810791	53.25985	1.887224	24.05898	4.476231	1.037985
MON-10	54.14075	0.179844	5.676474	23174.28	3.4806955	1.279793	71.05647	1.758515	22.87064	6.514829	1.583629
MON-11	44.86827	0.133377	5.022604	20763.19	3.9310565	1.071581	55.58468	1.824078	21.82808	6.17484	1.427051
ANG_002	20.50632	0.0788003	2.615552	18042.17	2.553485	0.6963403	38.0913	1.870598	28.03652	6.230614	0.7948107
POR_001	32.8575	0.1463557	3.574853	17277.42	3.0972175	1.036969	52.57166	1.973215	32.49201	8.346859	1.030715
POR_003	34.55321	0.1511397	4.006453	18471.83	2.5455215	1.029213	59.86007	2.088214	36.51662	7.141812	1.152571
POR_004	31.85955	0.1055013	3.189026	16608.82	3.300474	0.7977617	52.92453	1.951052	27.10505	8.391876	0.9854825

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
POR_006	47.74123	0.1373072	3.929141	15320.42	2.423128	0.6331181	76.66164	2.174545	32.29756	9.526164	1.049847
POR_009	34.43527	0.1668301	4.12007	19599.28	4.0425145	0.8193697	58.55985	1.931876	25.62362	5.937073	1.254018
PUN-49	33.52509	0.1491291	4.875383	14291.25	2.666512	1.007891	53.67748	1.66863	35.88177	8.333558	1.317204
SOC-04	43.30687	0.1314703	4.798271	20931.28	3.6461395	0.9787092	63.95899	2.022476	26.61498	7.163497	1.358175
SOC-31	31.74008	0.105294	3.662906	19619.95	2.9287815	0.920888	45.58498	2.328053	32.01331	7.191545	1.01666
SOC-32	40.90928	0.143956	4.943421	22518.52	3.811838	1.253265	56.75245	1.696834	29.52508	7.88191	1.448489
SOC-55	20.60266	0.096114	2.62712	21577.69	2.556034	0.5693809	39.18026	2.058866	24.88753	5.387571	0.8375812
HUA-05	16.33457	0.088037	2.55904	20920.63	1.8232025	0.506258	33.05194	1.679328	47.64921	11.8731	0.715731
HUA-06	13.33622	0.110709	2.575197	22873.37	1.1220095	0.806077	31.06708	1.392669	76.81937	15.58777	0.757919
HUA-14	14.46485	0.10514	2.47274	16663.21	1.637638	0.664515	40.95002	1.85513	52.58187	9.899348	0.684765
HUA-16	14.26189	0.154909	2.75635	21839.33	1.485141	0.755847	33.26441	1.72973	48.85574	14.34991	0.848862
HUA-26	17.92888	0.118433	2.840073	15230.93	1.5933535	0.779334	34.55362	1.892333	64.33188	14.0704	0.83277
HUA-28	10.30238	0.076485	1.818505	20585.63	1.7352855	0.499345	31.05	1.614118	46.53649	9.048687	0.556916
HUA-44	13.18208	0.172654	2.523967	16688.32	1.80488	0.857618	36.46323	1.084164	69.7661	13.72968	0.743759
HUA-46	15.19187	0.122016	2.728235	18794.11	1.787791	0.750178	43.03727	1.231357	88.52988	14.88938	0.857271
HUA-49	15.85126	0.101692	2.806181	17860.37	1.502284	0.84212	37.30243	1.047302	79.97511	15.02458	0.801971
MAS-01	14.68638	0.143404	2.67852	17854.9	1.653867	0.730192	47.12281	1.379671	81.6781	17.97729	0.73771
MAS-02	19.05415	0.148541	3.30631	17442.61	2.350964	1.057855	33.93787	1.192013	71.13132	17.21697	0.862967
MAS-03	12.96766	0.117245	2.156358	12374.85	0.911682	0.706261	30.99162	1.601619	64.6918	19.49396	0.579112
MAS-06	11.08871	0.09492	2.118563	15528.31	3.5010865	0.550585	30.84867	1.335119	68.247	11.14456	0.603513
SOL-01	14.61519	0.133924	2.426642	16051.21	1.850781	0.661346	39.24315	1.644735	56.27596	14.58104	0.700236
SOL-02	16.95269	0.122957	2.951925	16626.04	0.9496015	0.816272	42.89812	1.616252	65.28535	14.22373	0.804916
SOL-03	21.0618	0.101354	3.217555	16578.1	0.918898	0.791159	48.60654	1.629889	88.1577	15.121	0.849855
SOL-05	15.53129	0.135431	2.493773	13332.79	2.0132275	0.766247	41.75771	1.842234	67.9749	17.05935	0.745881
SOL-06	12.21227	0.093827	2.494392	17758.95	1.2296005	0.663389	36.39458	1.880588	68.425	15.95551	0.680653
SOL-09	12.90344	0.121082	2.182914	14235.2	1.3374415	0.60715	37.55053	1.341162	64.73588	13.89712	0.686588
SOL-11	13.34023	0.079711	2.213155	15030.55	1.0660485	0.640774	36.85934	1.331059	63.71181	12.6078	0.635385
SOL-14	13.84904	0.103837	2.330225	14648.97	1.456552	0.617069	37.31408	1.606317	87.17515	14.48861	0.717682
ATU-02	14.57281	0.1368528	2.344128	14142.46	1.263535	0.6873685	34.02028	1.195862	82.4805	12.61725	0.7168253
ATU-12	17.74928	0.1472502	2.888532	11837.76	1.8026715	0.7748774	43.03228	1.574783	84.22624	18.93151	0.8141233
ATU-18	15.13282	0.1305872	2.732742	13087.51	1.255375	0.8443049	39.75628	1.220163	73.82803	14.56253	0.7924341
ATU-19	11.12192	0.0666783	2.097714	14955.84	1.0785095	0.5538101	32.3123	1.791359	78.9416	13.04583	0.6823788
ATU-20	16.43853	0.1701041	2.895612	13716.48	1.297664	0.881466	38.6708	1.236726	76.55585	19.48664	0.8789182
ATU-22	15.67406	0.1015882	2.817976	16422.78	1.0261112	0.9871285	39.72569	1.146797	75.51175	16.45354	0.8750445

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
ATU-23	20.81499	0.1378869	3.579024	12415.81	1.417686	1.054314	46.20058	1.803342	83.91094	11.93619	1.010414
ATU-25	11.74025	0.1036678	2.322727	11887.61	1.6281545	0.7493846	39.61175	1.560468	99.88204	14.34745	0.6810338
ATU-38	15.15374	0.1107205	2.691922	13202.98	1.0953857	0.6808501	34.02264	1.40269	64.03013	13.92325	0.7498315
CAR_011	15.44924	0.1225137	2.632841	16337.96	1.703088	0.7470657	40.80889	1.16996	77.0127	16.83253	0.8446612
CAR_012	18.57555	0.1511322	3.066477	16180.17	2.511956	0.9016513	35.11167	1.300733	77.27399	13.44289	0.9214887
CAR_014	15.66593	0.1061629	2.438208	16295.01	1.7613015	0.6742364	37.69955	1.535859	75.69786	13.37539	0.7137196
CAR_015	11.01347	0.1213687	1.993066	16825.58	1.0246397	0.6160341	45.18674	1.811525	78.83706	20.87794	0.7069011
CAR_016	18.96792	0.1712868	2.953326	13037.76	2.3420645	0.9536819	44.26056	1.551065	82.81489	18.44575	0.7503523
SDV-54	43.9923	0.386967	6.968325	13639.88	3.79734	2.571521	78.91005	5.627198	79.08714	13.65781	1.31011
TAJ-01	40.0116	0.410333	6.863157	10944.14	3.1981125	2.769508	83.72118	5.292931	81.04092	15.51023	1.333091
TAJ-02	36.73116	0.432883	6.615407	7920.985	3.1429045	3.147721	76.56341	4.937717	77.13111	14.57086	1.359542
TAJ-03	47.95565	0.408096	7.654986	9485.144	3.8730665	2.893378	99.47459	7.087085	86.76634	14.71144	1.553015
TAJ-10	40.8963	0.403503	7.009235	9608.314	3.4516565	2.825212	87.30318	5.882936	79.84576	18.7197	1.384898
TBE007	50.8	0.453	7.08	9700	-	3.33	92	6.03	84.9	-	1.36
TBE00X/254	50.4	0.512	6.84	10200	-	3.21	90.6	5.89	84.7	-	1.32
TBE015	45.4	0.547	7.19	12100	-	3.35	82.2	4.85	78.5	-	1.36
TBE016	50.6	0.451	6.79	10900	-	3.18	88.7	6.78	92.5	-	1.34
TBE027	49	0.467	6.87	7700	-	3.38	89.9	5.53	90.2	-	1.37
TBE028	50.6	0.434	6.32	10100	-	3.04	88.3	6.25	77.3	-	1.28
TBE032	46.7	0.486	6.43	9700	-	3.88	82	5.31	83.9	-	1.29
TBE043	51.5	0.385	7.03	11500	-	2.72	88.9	5.12	95.7	-	1.41
TBE047	42.7	0.423	5.82	10800	-	3.07	74.3	5.07	80.2	-	1.12
TBE071	47.9	0.53	7.01	10500	-	3.25	85.3	6.38	75.2	-	1.36
TBE119	48.1	0.452	6.25	10400	-	2.94	84.1	5.24	82.4	-	1.18
TBE136	41.9	0.372	5.87	10700	-	2.89	74.3	4.22	80.2	-	1.16
TBE144	47.6	0.446	6.04	10700	-	2.92	85.3	5.62	83.6	-	1.15
TBE149	47.4	0.468	6.3	12000	-	2.79	83.6	5.45	85.3	-	1.23
TBE153	54.6	0.477	7.36	11500	-	3.37	96.2	8.51	90.6	-	1.38
TBE189	46.1	0.5	6.4	12100	-	3.27	82.4	5.2	80.2	-	1.32
TBE194	48.2	0.398	7.18	11200	-	3.08	86.5	4.97	84.9	-	1.3
TBE256	48.8	0.54	7	11800	-	3.19	87.9	6.25	84.1	-	1.36
TBE38A	49.4	0.488	6.65	10600	-	2.95	86.9	5.01	81.5	-	1.32
TBE38B	49.3	0.478	6.34	8600	-	3.52	83.9	5.27	91.4	-	1.09
TBE39A	51.5	0.519	7.01	9700	-	3.68	91	5.2	85.1	-	1.37

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
TBE39B	47.5	0.344	6.15	11900	-	2.92	86.3	5.53	87.5	-	1.25
TBE443	56.5	0.411	7.29	12600	-	2.88	99.5	6.31	107.9	-	1.4
TUN_005	52.4556	0.4785364	8.822645	8081.536	3.8654935	3.300872	108.015	12.46103	67.74257	13.62582	1.603974
CRM-01	16.03519	0.112028	2.25319	14333.33	2.2488375	0.47322	51.12574	2.167104	58.31557	14.93979	0.758474
CRM-03	15.01409	0.092911	2.261938	12460.6	2.4278915	0.638173	64.27408	1.552017	66.43849	17.73592	0.677407
TAJ-09	36.2326	0.15861	4.548456	20455.04	1.838147	1.021457	68.71174	2.411554	32.07679	9.425374	1.285572
TBL-60	29.7718	0.139083	4.217154	19285.12	2.4464135	1.214667	55.90286	2.588079	35.03112	13.41624	1.20667
POR_002	23.45297	0.1357721	3.026851	17214.85	2.5219195	0.7247745	57.93809	2.603455	43.08736	14.03604	0.9856309
POR_015	39.80696	0.2919068	5.864114	12997.02	5.222565	1.729818	90.01755	3.266043	55.48743	19.28937	1.556446
CRM-08	18.4826	0.129942	2.94487	19204.66	1.7374655	0.973043	39.7865	1.829476	43.74529	12.37951	0.940782
DBS-01	22.51249	0.162106	3.919606	24152.83	1.9891185	1.078767	41.63004	1.858392	48.7097	15.90337	1.096729
HLV-02	17.60112	0.097558	2.620997	16476.04	4.243031	0.541971	43.07883	1.793991	40.6767	21.98624	0.865517
HLV-03	15.63834	0.098438	2.511472	17665.56	1.4460105	0.759243	35.97234	1.947918	36.25182	27.4184	0.832035
HLV-04	14.50529	0.091405	2.412194	18011.55	1.6657065	0.367957	41.51659	2.215512	34.30284	19.46396	0.80002
HLV-07	15.07703	0.08363	2.549429	13596.58	1.287694	0.978319	46.80367	1.252627	87.10369	23.65868	0.736802
HUA-02	11.37401	0.088468	2.136145	18135.51	0.959509	0.573988	25.73006	1.082478	75.8606	11.40213	0.64162
HUA-03	21.94483	0.113245	3.225289	20161.46	2.3366995	0.688307	48.04648	2.182095	28.26805	11.67895	0.890914
HUA-09	25.66522	0.152517	4.027533	19646.52	2.972777	1.081861	48.30943	1.665157	34.69904	13.16226	1.047081
HUA-13	20.42939	0.116852	3.199314	20378.47	1.992254	0.518887	48.50306	2.436981	28.2471	13.57834	0.857656
HUA-20	27.00087	0.102613	3.415835	24009.27	2.2446825	0.977331	58.36831	1.530035	45.15357	16.1758	1.026546
HUA-35	36.15327	0.137663	3.846972	16116.78	4.7386945	0.706739	70.89635	8.337616	68.68967	18.39599	1.062057
HUA-36	18.10402	0.08868	2.587286	18529.79	2.0866555	0.495897	41.08999	1.863893	33.86206	12.6036	0.833282
HUA-39	16.40386	0.113524	2.395203	21156.68	1.6686375	0.553281	39.62658	2.414609	29.31825	11.25154	0.828952
HUA-48	21.64584	0.186326	3.509324	20931.66	2.6442255	1.346396	47.61468	2.298941	31.2629	17.6851	1.006877
MAS-05	35.46075	0.144982	4.555087	18525.18	1.655048	0.907671	52.3317	1.517811	28.8604	13.08042	1.206496
MAS-09	29.68193	0.186373	4.045969	17997.78	2.8669165	1.195613	63.39005	1.610413	35.86032	16.23343	1.195517
MON-02	22.67403	0.163383	3.292342	22233.03	2.156552	0.867229	51.99317	3.04732	36.30278	13.11869	0.98816
MON-07	23.52582	0.135706	3.469263	22446.29	2.8983745	0.77766	47.65639	2.615675	37.7603	12.65535	1.058565
PJL-01	31.82298	0.186348	4.833039	23073.11	2.6988065	1.446833	66.43583	1.877915	41.79319	23.14633	1.202179
SDV-44	33.69184	0.176079	5.589351	21338.39	2.3883845	1.012668	65.46325	1.677073	52.67478	19.37094	1.485031
TAJ-04	23.48637	0.125292	3.533987	21706.63	2.045822	0.871668	52.3606	2.109336	36.769	12.27935	1.038579
TAJ-07	23.18723	0.125506	3.81589	19805.25	1.287162	1.027544	45.24648	1.583164	51.6338	16.53321	1.12436
TAJ-25	22.35731	0.131083	3.826602	21455.97	1.675951	0.891983	45.25959	1.38597	62.37259	17.83907	1.132928
TBL-34	23.4633	0.149225	3.660678	17605.35	1.953619	1.028841	52.769	1.955059	32.84013	20.61012	1.048862

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
TBL-48	16.38654	0.106697	2.514613	16367.83	1.9447165	0.495741	33.32673	1.769363	36.34697	10.24418	0.839078
TBL-56	23.93602	0.119026	3.632127	16692	2.345937	0.986438	48.79303	2.037117	31.71903	14.58094	0.939936
TUL-05	28.33715	0.175436	4.507016	18631.9	1.69505	1.218156	55.32353	1.465539	57.61816	16.54899	1.078034
TUL-11	21.95621	0.177457	3.698389	20374.81	2.2531255	1.060741	46.18903	1.843807	37.85364	12.6085	1.064889
ANG_001	43.71122	0.4463925	7.410723	11618.78	3.57037	3.058183	85.63174	5.600181	82.01459	14.26449	1.461584
ANG_007	19.66893	0.0652458	2.981513	16943.49	1.674574	0.6087801	43.7939	2.154716	54.78944	16.19346	0.9239492
ANG_008	32.8734	0.1594077	4.499145	14989.32	2.4145175	0.7257879	58.19087	1.603197	39.79881	11.026	1.194304
ANG_010	35.74615	0.1858566	4.90966	15211.81	3.594692	1.123984	67.14202	1.645151	44.57301	13.37513	1.297385
ANG_015	31.19265	0.2136078	4.526183	16756.99	2.599681	0.9933978	53.51553	1.934269	45.46423	10.74121	1.221555
ATU-35	25.79714	0.1451467	4.014098	18143.54	3.3888595	0.9034813	49.79294	2.161813	30.06833	12.70601	1.023977
ATU-40	24.36834	0.1506246	3.708273	17776.77	2.2297275	0.9026999	45.53895	2.461861	29.69486	11.92099	1.004809
CAR_021	22.81197	0.1164735	3.372599	17544.11	2.9739185	1.216733	39.74737	1.702304	34.56717	10.78171	0.9836764
POR_007	28.86595	0.1499541	3.608898	18238.49	2.8724705	1.168895	55.24467	2.088992	38.59858	9.201702	1.019935
POR_008	37.56932	0.1610626	3.903376	18309.85	3.370955	1.083846	63.10732	2.834375	35.06858	9.444121	1.142151
POR_012	14.53092	0.1270463	2.214254	13802.85	3.182613	0.7001469	36.04101	2.681699	46.28652	8.679376	0.663426
POR_013	14.15567	0.1715195	2.234974	12484.25	3.301296	0.6847993	33.73657	2.387335	42.08553	7.393721	0.6606174
POR_014	25.23315	0.2250368	3.72201	15518.66	4.048302	0.9274349	47.44276	2.94245	45.96604	7.454034	1.034001
PUN-56	25.21502	0.1620608	4.127154	19050.51	2.1891955	1.012449	38.85923	1.739356	53.63641	13.01998	1.231815
ROQ_002	20.12362	0.1170439	3.18397	20931.88	2.090912	0.7474099	46.50237	2.260949	28.36189	15.70186	0.988273
SDV-03	25.00771	0.1372116	4.166432	21315.57	1.687672	0.8792986	47.1983	1.630037	39.69626	16.98442	1.198093
SDV-10	34.68579	0.2034907	5.636749	21469.15	3.4257365	1.476831	60.47801	2.133086	35.27999	15.56089	1.434367
SOC-08	20.93468	0.1343223	3.006164	12866.54	1.8864785	1.096064	53.04818	1.783418	41.55117	9.117409	0.828909
SOC-11	20.73026	0.1273365	3.231104	18373.23	1.4284395	0.7665614	36.25415	2.032956	31.43557	10.25076	0.9326172
SOC-23	28.83579	0.1359099	4.358536	17906.59	1.202777	1.038278	56.52385	1.665182	65.97617	20.43626	1.205851
SOC-24	25.70694	0.153452	3.708481	19871.27	1.7722715	1.033943	48.29274	1.827634	28.3485	11.51067	0.9400963
SOC-30	19.86256	0.1383508	2.880865	17570.92	1.824498	1.20227	36.79372	2.689905	47.83542	10.68031	0.9221634
SOC-36	18.60326	0.1633133	3.179767	19798.82	1.6446225	0.8604957	37.6442	1.296764	37.75856	20.10398	0.9760323
SOC-49	23.14567	0.1140572	3.074571	20106.38	3.0808535	0.9333155	48.89382	2.184418	39.9311	12.02559	0.9271899
SOC-51	22.45099	0.19239	4.275457	21084.4	1.0138203	1.348189	36.87249	1.435647	62.51132	17.40069	1.12693
SOC-54	20.86961	0.1404676	3.466078	18218.39	1.588407	0.8852913	39.25138	1.906702	32.88727	9.539335	0.9834934
SOC-58	14.12965	0.1462486	2.870054	19482.94	1.663597	0.929611	29.17701	1.260443	32.27943	12.4496	0.8651088
TBL-02	21.21027	0.1492221	3.230771	17139.74	2.096892	0.7691144	44.28395	1.868933	28.7977	16.91121	0.9303489
TUN_001	42.23902	0.4536094	7.432917	9666.125	3.7856275	2.891744	91.23122	5.504844	88.27168	17.51785	1.480293
TUN_002	44.25562	0.4263624	7.299087	10583.51	3.749403	2.680248	89.74731	5.651588	76.30437	13.80801	1.516303

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
TUN_003	43.95345	0.4566797	7.610567	9474.517	3.480471	3.108125	91.15282	6.059227	87.0421	16.35711	1.533122
TUN_004	43.75248	0.4343033	7.299648	10277.56	3.589346	2.673803	84.55544	4.736	84.06136	15.73922	1.371187
SOL-07	20.59109	0.134016	3.392312	15114.58	1.9894995	0.961309	45.6576	1.426155	92.09155	16.39191	0.938036
SOL-13	18.45752	0.145638	3.206306	17946.11	1.2134715	1.161672	43.56683	1.789159	93.21514	17.90146	0.935685
TBL-50	30.22929	0.204489	4.057055	18012.33	2.3282005	1.108883	56.55424	1.80145	90.34972	18.1615	1.188629
CAR_010	23.34498	0.2171705	4.009573	15210.94	2.941632	1.194218	44.52552	1.753463	102.5248	20.29133	1.196934
SOC-19	15.97435	0.1184712	2.691397	18261.82	1.0534118	0.7999102	38.03585	1.095396	102.4706	16.76332	0.7826571
SOC-45	25.52624	0.1725345	4.059558	22658.96	1.286451	1.318258	49.94135	1.388104	87.02937	19.34543	1.223841
ECU_002	20.58211	0.199578	4.247018	15666.54	1.672973	1.712799	37.28757	1.808594	55.49488	22.23974	1.150505
ECU_003A	22.50757	0.1771684	3.223161	19016.63	2.519062	1.063425	46.40286	1.700022	95.72489	22.54008	1.011697
ECU_003B	21.64958	0.2116289	3.508339	18927.8	3.1413245	1.249105	45.47108	1.874436	86.42476	23.88119	0.9583295
ECU_003C	18.96576	0.1928045	3.563259	20235.74	2.155421	0.9220511	37.99656	1.730655	32.88968	18.54916	1.001743
ECU_004A	21.46615	0.1973374	3.426653	14000.79	2.6359535	1.121409	58.99528	2.489946	77.9415	20.5567	0.999968
ECU_004B	19.47293	0.1889043	3.048862	14669.51	2.43954	1.083677	57.12733	2.672179	76.86683	20.63808	0.977404
ECU_005A	41.89979	0.482747	8.057306	17139.57	8.6822365	3.363261	88.46113	7.127878	144.019	22.57777	1.710829
ECU_005B	43.97434	0.3958706	8.289985	15987.25	4.1318805	2.474125	91.80831	6.127867	103.9399	18.15585	1.582197
ECU_005C	34.48252	0.3711696	6.805723	18254.85	6.3696255	2.377429	73.82308	8.281529	111.371	15.9993	1.37975
ECU_005D	9.569303	0.1179032	2.383374	30577.11	0.4891352	0.8366882	19.98944	1.347085	28.37101	12.11378	0.6616068
ECU_005E	39.59387	0.337828	6.719604	15638.07	4.508084	1.983549	82.88464	5.480402	99.65105	21.84376	1.481187
ECU_006A	24.32872	0.1380188	3.804173	20516.95	2.5892065	1.169001	48.67211	2.184022	36.36955	15.61316	1.07931
ECU_006B	31.09114	0.1651621	4.499328	17548.22	3.081641	1.351087	63.90725	2.172332	38.85448	19.79891	1.256653
ECU_006C	14.6154	0.1878811	3.248309	21434.37	1.1698687	1.27741	29.83455	2.099795	135.8163	25.80479	0.9604113
ECU_006D	18.61762	0.1435188	3.2503	16815.87	1.6422325	0.9344141	31.23336	1.37624	111.1458	15.39173	0.9765558
ECU_006E	25.27424	0.185448	3.992502	19790.9	2.7480395	1.258789	50.08398	2.105051	58.11627	18.98064	1.082429
ECU_008A	23.98112	0.2125796	3.685699	20183.72	2.994612	1.03299	47.16788	1.933272	25.05655	18.38842	0.9907838
ECU_008B	15.63868	0.1770848	2.945547	21312.81	1.142921	1.085075	30.06397	1.459586	20.39406	13.13392	0.932538
ECU_009A	19.635	0.2250581	3.842961	19810.67	2.392389	1.214636	41.10741	1.564958	31.076	19.87698	1.032117
ECU_009B	23.60453	0.1750344	3.697251	21265.22	2.477323	1.180486	46.34146	2.567058	31.39788	17.08307	1.006707
ECU_010B	19.65482	0.1523666	3.522247	25020.86	2.021517	0.8523232	39.93099	1.475943	56.16869	21.37936	1.106294
ECU_011	36.79068	0.2426781	5.375222	21332.09	2.6292995	1.291786	68.74174	2.146726	48.28013	19.02161	1.448326
ECU_012	32.83359	0.2161448	5.085145	21062.42	1.6654975	1.455417	63.08279	1.582889	54.52556	23.71061	1.422538
ECU_013A	28.39982	0.153982	4.185256	21938.93	1.865798	0.7545442	60.73833	2.286318	52.25024	21.11564	1.33519
ECU_013B	26.56294	0.1980883	4.02827	23654.33	1.2320839	1.14767	48.38559	1.427248	50.53885	20.12995	1.25073
ECU_014A	25.40524	0.1650426	3.269956	19101.08	2.6044215	0.6796197	52.66224	2.443334	38.82172	17.05146	1.070892

Table B.2: INAA Values and Mahalanobis Distance Results, Part 2 (continued)

INAA ID	La *1596.5 keV*	Lu *208.4 keV*	Sm *103.2 keV*	Na_W1 *1368.6 keV*	U_Mean	Yb *396.3 keV*	Ce *145.5 keV*	Cs *795.9 keV*	Cr *320.1 keV*	Co *1332.5 keV*	Eu *1408 keV*
ECU_014B	28.1067	0.1507823	3.776534	18956.91	2.2878885	0.986611	54.89398	2.218792	44.50634	17.95184	1.173554
ECU_014C	17.71721	0.1766217	3.060396	22534.98	1.83531	0.8212386	33.62946	1.72877	49.92715	15.49596	0.9262661
ECU_016B	22.59033	0.1704011	3.59235	24638.67	2.014034	1.083759	42.84256	2.014482	86.08002	15.22401	1.16665
ECU_016C	20.74753	0.1858784	3.231318	24747.13	2.331619	0.9494039	40.84942	2.055887	78.82065	19.71335	1.033553
ECU_018A	33.92153	0.2202317	4.217917	23111.25	1.912594	1.269728	62.78725	2.465182	42.42598	17.42912	1.266301
ECU_018B	32.8731	0.186956	4.134645	23112.6	2.4682175	1.270547	59.42739	2.007911	42.8162	17.2524	1.225899
ECU_018C	32.80763	0.2085664	4.271319	23355.19	2.0830145	1.207415	60.23613	1.96268	40.41892	16.80054	1.194854
ECU_018D	32.29424	0.2079705	4.153299	22623.23	2.282239	1.202597	61.66015	2.08824	43.35349	17.2952	1.226213
ECU_018E	32.84662	0.2163196	4.233213	23043.46	2.0419635	1.17377	59.4817	2.17823	42.42877	16.56665	1.198206
ECU_018F	33.6694	0.1671955	4.304672	23417.08	2.0370495	1.150175	60.27502	2.200291	49.38853	17.14627	1.253851
ECU_018G	32.58702	0.2260898	4.071388	22662.82	2.4391705	1.435255	58.98549	2.386172	39.15282	16.22803	1.123329
ECU_018H	33.52527	0.224212	4.256465	23672.75	2.357815	1.073749	60.76521	2.438467	41.96584	17.26593	1.245294
ECU_018I	24.75656	0.143907	3.54647	24235.04	2.5753115	0.9660748	43.5103	1.71876	50.77512	14.69212	1.175922
ECU_019A	80.26153	0.7898903	10.69116	1989.468	6.599176	5.353847	168.4634	6.388774	75.95055	6.048628	1.971968
ECU_019B	79.30863	0.7863727	10.78333	1872.422	6.0264775	5.375759	163.0106	6.057965	72.94296	5.325197	1.956279
ECU_019C	81.41705	0.7726348	10.84734	1951.547	6.3743855	5.353993	166.5526	6.460207	72.63869	5.855898	2.065698
ECU_020A	25.41288	0.198524	3.429481	3179.214	3.0995865	1.339001	42.94349	1.967984	150.5136	27.76758	0.9364395
ECU_020B	20.07469	0.1540921	3.255264	19780.98	2.023617	0.958676	39.25025	2.284549	33.60387	11.65799	0.9047051
ECU_020C	15.59728	0.1311905	2.907155	22911.44	1.6435825	0.9369315	31.8457	1.811634	38.47203	15.92877	0.9085026
ECU_021A	22.11184	0.1411605	3.236107	21864.74	2.2443285	1.226416	42.39223	2.352823	30.2256	14.04986	0.999912
ECU_021B	16.79773	0.1723244	2.854929	23740.63	1.406259	1.055	35.21271	1.741549	36.17181	17.31449	0.966399
ECU_022A	17.52912	0.1747871	3.470081	14079.98	1.8046075	1.344922	37.92824	1.4547	63.86279	30.74256	1.001606
ECU_022B	19.77684	0.2575197	4.045187	13835.29	2.009375	1.378229	43.1586	1.673549	69.57996	31.86623	1.154725

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
HUA-07	2.817729	44729.45	15.17317	36.39381	14.34991	819.1986	0.417214	4.424409	66.86779
HUA-11	3.577729	45391.86	14.10434	35.89202	12.43609	851.4855	0.485848	5.786058	58.48497
HUA-15	2.789539	44450.2	14.8024	24.67509	14.16274	1050.985	0.280149	3.803971	64.24814
HUA-17	2.703381	40988.01	20.54584	33.10526	13.37499	775.2947	0.358037	4.58951	70.9799
HUA-18	2.749338	42953.66	10.44769	31.49526	12.9632	880.3212	0.340203	3.713052	53.34163
HUA-19	2.94577	48737.81	11.27118	33.47155	15.6703	745.2772	0.276225	4.470412	67.98519
HUA-31	2.774793	46831.11	21.18137	10.97689	15.70993	661.2946	0.234115	4.172331	73.91024
HUA-40	3.261111	42895.79	17.74576	30.89453	13.97974	819.3875	0.264331	4.266207	80.394
HUA-51	2.72823	45051.41	12.21562	35.54191	14.15781	753.4496	0.245238	3.74299	55.0919
ATU-03	3.715504	44973.5	20.68222	32.37946	13.43274	531.1378	0.44049	6.957166	70.00935
ATU-13	3.751647	42796.75	10.66446	50.94736	12.80086	811.2772	0.4757626	7.309462	77.75831
ATU-14	3.674698	47053.55	14.66317	32.20943	14.70348	609.4484	0.3707706	6.209403	71.12885
ATU-21	3.038383	47063.27	14.80727	29.86079	15.19042	835.6057	0.3400897	4.493538	76.60852
ATU-24	3.0583	44112	17.68148	38.57974	16.10527	715.4346	0.3570459	5.019238	69.52751
ATU-27	3.160416	42258.25	12.47472	43.41076	14.3989	975.9169	0.2692567	4.965985	122.4669
ATU-28	3.064694	44698.52	10.57991	41.12583	15.61628	690.7368	0.2621776	4.812198	71.20018
ATU-29	3.055817	45510.02	15.32625	25.18094	16.1236	777.5564	0.282541	5.003617	77.83348
ATU-31	3.279747	45362.71	11.38038	28.10405	14.15977	694.2427	0.3430577	4.38817	72.52921
ATU-32	3.39235	40185.91	10.95798	37.88616	12.3749	693.4564	0.3872198	5.597038	83.96426
ECU_001	3.724471	44960.42	14.69035	25.27286	13.28838	641.0262	0.4964271	6.068949	73.96092
ROQ_003	3.004395	49450.21	13.27704	28.0516	15.02621	603.3994	0.3294353	3.985012	65.6998
ROQ_006	3.773174	37996.15	20.24532	34.50174	9.034611	862.9935	0.6366617	7.996708	71.14935
SOC-43	3.754062	47526.79	13.59795	32.84253	12.7329	708.6097	0.4135039	4.902825	73.9543
SOC-48	3.974065	49733.29	14.89414	41.94067	15.66158	711.8671	0.3073663	4.180335	73.77393
SOC-59	2.592058	46971.62	13.63377	32.6123	15.47662	524.9689	0.3443406	4.130076	68.38116
CRM-02	3.560812	34073.51	16.3701	54.89622	9.270122	921.3028	0.502268	6.220126	72.09006
CRM-04	6.062686	47930.57	20.64137	97.25097	13.03737	542.7714	0.989458	9.033208	81.31889
CRM-05	4.860336	44393.24	19.37366	39.54738	9.420408	809.0243	0.778205	8.546953	78.72391
CRM-06	5.483981	38893.89	12.68665	90.59795	9.925009	422.4349	0.838647	6.905509	74.55257
CRM-09	4.513829	47795.09	29.67211	45.61023	10.79639	632.0167	0.721936	8.687469	67.31947
HLV-05	3.384618	42795.99	14.33829	57.02551	10.71081	899.1781	0.472614	6.529897	61.41795
HLV-06	3.960467	47120.12	20.60242	45.46624	13.58415	754.7955	0.34799	5.504908	68.70154
HUA-08	4.349122	50552.74	22.32563	54.74028	12.67568	718.9774	0.902045	8.508542	70.96191
HUA-12	4.521585	44481.3	32.35755	38.71597	11.71355	1144.83	0.748175	8.750889	62.30364

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
HUA-54	4.088686	43383.96	19.2965	39.75352	11.09816	769.0103	0.613284	7.263153	61.3651
MAS-04	3.605887	37191.68	13.20632	62.03463	10.573	489.1826	0.533876	6.905272	63.72124
MAS-07	3.29135	43781.24	14.11152	26.52787	12.47064	826.9637	0.500857	6.274135	98.29533
MAS-08	3.554495	36241.2	17.88045	32.94895	9.178943	788.6403	0.608215	7.504943	61.83342
SOL-04	4.341133	46658.85	8.864274	73.5165	12.2103	482.7299	0.781524	9.303402	75.5606
SOL-08	4.52047	43789.54	26.15963	56.70712	12.41918	730.2039	0.718357	8.505951	61.48912
SOL-12	4.337278	40100.61	17.81742	72.73792	10.61783	387.3096	0.717924	9.175886	65.93517
TBL-31	3.690482	45762.24	13.1449	25.21632	12.4991	494.3184	0.551317	7.646001	57.31929
TBL-32	3.929206	44886.72	18.18369	43.25632	12.3822	654.8458	0.601798	6.869356	62.91818
TBL-36	3.963527	41260	12.12795	39.1155	11.73905	722.4541	0.613931	6.593901	53.92772
TBL-37	3.714899	43487.35	20.4284	38.56758	12.66417	768.9303	0.659747	7.815166	50.33737
TBL-38	4.132978	44896.03	14.44343	39.06378	12.67955	772.9043	0.646027	7.665099	63.08434
TBL-39	4.13865	42438.97	13.11287	39.78946	12.15204	773.1827	0.557554	7.420895	61.89017
TBL-40	3.45133	40245.33	13.64939	49.40313	10.7727	772.8585	0.621106	6.408024	57.15106
TBL-41	3.912817	42114.69	12.15869	39.24942	11.65678	762.9343	0.638579	7.045849	66.08302
TBL-42	4.208898	46613.1	24.38661	50.11327	13.75791	562.9454	0.477966	7.29262	64.84894
TBL-43	3.636353	43171.07	20.72981	34.12316	12.50749	516.6452	0.587377	6.626334	46.00217
TBL-45	3.5686	41905.18	13.57493	37.77943	12.07808	502.3808	0.46229	6.539049	65.19833
TBL-46	3.914396	41898.59	17.82047	40.12294	11.51401	646.7402	0.635121	6.84645	55.41288
TBL-47	3.984714	43239.05	18.1012	37.49722	12.72529	675.9106	0.572039	6.740372	42.55718
TBL-49	4.213091	42885.86	22.94555	59.75188	11.65677	598.6362	0.584413	7.279932	52.01872
TBL-51	3.54488	37325.42	9.285711	32.82095	11.14294	461.5171	0.50489	5.662707	62.23249
TBL-52	4.037938	42284.39	20.93563	41.9475	12.9836	372.2339	0.558801	6.450887	50.93372
TBL-53	4.201949	40751.89	17.31832	45.67019	11.24148	686.4332	0.486981	6.62429	50.66611
TBL-54	4.019078	39043.21	22.70165	37.92231	10.87203	622.7727	0.547277	6.595211	52.92006
TBL-55	3.733785	44500.12	13.46215	46.61491	12.86155	535.3803	0.449828	5.920994	55.16902
TBL-57	4.351777	42913.74	22.31039	38.26738	12.84316	746.0015	0.538632	7.299212	51.04759
TBL-58	4.050038	40107.06	18.37064	39.68625	10.69884	760.5233	0.419476	6.629099	56.07781
TBL-59	4.534271	41507.11	12.62431	43.28799	11.86776	697.6566	0.561332	6.721232	56.76949
ANG_003	4.328119	45440.3	13.52082	66.53764	13.03736	619.7999	0.5758907	6.661064	82.42809
ANG_004	4.334334	50647.26	21.18189	52.0451	13.58233	521.3497	0.6630449	7.833163	77.77202
ANG_009	4.072959	44220.8	14.69277	54.27864	11.13312	556.1628	0.5924516	6.880173	79.95487
ANG_011	3.940035	42328.53	11.61123	55.59795	11.37812	792.5711	0.6203478	6.900591	147.9635
ANG_013	4.011091	46821.1	18.33962	58.94572	11.03482	731.4824	0.6090901	7.507165	84.35564

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
ANG_014	3.949035	44881.34	21.11363	64.22036	13.34319	862.406	0.6804817	7.57007	88.61259
ANG_016	4.015466	41479.87	19.41192	59.92041	11.09211	789.7193	0.5472589	6.75634	93.64265
ATU-01	4.192459	42432.21	18.27245	30.7318	12.62938	631.8732	0.5968491	6.84653	64.72353
ATU-17	4.938898	49570.54	9.844273	56.77254	11.70749	608.8967	0.7829992	9.370354	93.92958
ATU-26	4.74852	49931.55	16.4406	52.23231	11.97614	826.8099	0.7598636	8.97302	82.30695
CAR_009	3.412106	43342.16	10.13919	32.44159	12.62451	865.6688	0.449087	5.555193	69.07306
CAR_020	3.670906	44363.3	20.52627	34.71364	12.55101	973.0046	0.5788839	6.875221	59.65543
POR_010	5.098341	52211.07	22.69831	30.21278	14.77043	374.6047	0.7724613	7.69946	84.44466
POR_011	4.73154	53067.93	20.5478	38.31583	15.15284	276.2898	0.6800327	7.784635	70.01028
PUN-24	3.998578	50630.23	23.85392	52.60418	11.42041	716.493	0.6183877	7.137918	73.22514
ROQ_010	4.733983	47545.33	16.71724	25.48191	13.29273	541.6692	0.5916463	7.085928	70.54929
SOC-01	4.171544	43183.8	24.40386	41.45098	11.64489	539.106	0.5120531	7.118628	57.96368
SOC-02	3.702976	42581.19	13.60521	32.10544	11.89703	532.8243	0.4449735	6.450311	54.99915
SOC-07	4.387137	44578.82	17.96498	40.8195	10.99832	654.4543	0.6076958	7.474352	44.7337
SOC-15	4.496388	42912.88	21.35794	44.58089	10.83513	582.9205	0.6586406	7.868379	59.94677
SOC-16	4.027483	45090.98	21.12319	31.14022	12.69038	561.7693	0.6012839	7.387105	64.28241
SOC-18	3.607661	36656.61	17.53333	42.57202	11.35184	598.8005	0.4614007	6.146718	51.53841
SOC-21	3.687885	45325.39	17.25721	42.2625	12.36134	697.4941	0.5954106	6.554523	74.7255
SOC-22	3.924927	37848.29	16.64899	47.50891	10.65822	763.9	0.5995058	6.905	65.92618
SOC-25	3.970499	40677.34	15.83537	38.24057	10.29357	649.3744	0.6723868	7.360325	62.66605
SOC-26	3.330117	43179.89	12.95891	29.95979	13.50754	691.4278	0.4224969	5.03121	83.34779
SOC-27	4.494796	42172.24	18.98187	28.75777	12.03514	694.6428	0.6889402	7.275551	64.909
SOC-28	3.677586	41022.38	13.74909	37.34356	11.16657	635.0113	0.6233646	7.067743	49.20459
SOC-34	4.570031	44716.9	13.91641	34.66718	12.77828	809.1528	0.5825118	6.049895	64.50345
SOC-35	5.306552	53216.35	33.52456	40.32135	15.33454	803.2416	0.7051888	7.580225	59.87345
SOC-38	4.33787	50449.07	13.66142	39.80678	15.03487	576.4552	0.4686324	5.079809	67.41589
SOC-39	4.805824	50261.32	13.25936	45.35213	10.87281	875.3806	0.6813008	8.186889	73.06705
SOC-40	4.124295	44180.85	11.61563	25.71731	12.8321	611.6572	0.4260729	5.183954	65.07359
SOC-42	3.89927	46429.22	13.25601	50.16496	13.46846	695.4954	0.546267	6.564752	66.25545
SOC-50	4.338366	44178.18	15.79973	36.30725	12.54564	810.6904	0.5785008	7.052017	55.73957
SOC-52	3.70346	43419.64	15.25643	50.54672	12.50943	779.3127	0.5351579	6.173991	71.11408
SOC-53	3.567788	42727.96	10.63872	35.01537	13.17353	491.043	0.5067223	5.453634	60.13588
SOC-57	3.818484	43960.03	19.05672	46.78339	11.35544	711.4838	0.7114676	7.034676	55.78514
SOC-63	3.746037	43338.07	20.63382	30.91292	12.39895	636.0963	0.5440544	6.40115	62.06879

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
SOC-64	3.544579	44324.49	12.76298	32.73594	13.11006	589.9079	0.5157934	6.084646	85.0211
TBL-01	4.220568	49152.44	24.11287	37.15706	14.1556	589.6704	0.732355	8.249692	73.82204
TBL-03	4.01121	44439.41	21.71231	31.6222	12.12877	527.9136	0.7354912	7.195578	67.69713
TBL-04	4.201775	45901.19	26.06971	46.08587	12.35041	466.4461	0.6243494	7.281066	73.13171
TBL-05	4.040019	43346.5	16.22262	46.47663	11.87283	546.5003	0.6808741	6.939019	77.66236
TBL-06	3.980237	45233.88	23.25624	38.10927	13.06953	711.3484	0.5797613	6.434235	80.66025
TBL-08	3.807663	40770.01	25.68496	31.44438	11.40857	394.0853	0.507951	6.778764	55.47036
TBL-09	4.335887	42942.2	14.98212	32.13002	12.22808	453.8676	0.6267285	6.892995	66.14159
TBL-10	4.126457	43115.96	26.48796	37.43018	11.46527	532.1579	0.6086023	7.006551	58.08752
TBL-11	3.804333	42318	24.51336	39.8605	11.96617	512.4766	0.6157019	6.329983	71.78368
TBL-12	4.604554	49632.88	25.14552	45.53581	13.83012	497.3947	0.7201615	7.862682	66.24129
TBL-13	4.288729	49099.81	18.43366	47.13939	13.83562	736.3271	0.7277509	8.008964	78.16469
TBL-14	4.551795	47411.79	21.15257	39.0839	12.76887	557.7867	0.7166672	7.715836	96.65826
TBL-15	4.420935	48665.56	17.82147	42.37347	13.34183	420.3741	0.6904924	7.84379	67.59908
TBL-16	3.789916	44483.93	13.20699	34.51281	12.4292	641.098	0.4250157	5.825557	83.18095
TBL-18	4.326613	51584.07	19.46877	39.20927	12.11626	516.9342	0.6678432	7.818366	100.2485
TBL-19	3.974455	42541.33	12.21811	36.61769	12.30652	554.5601	0.6069534	6.274612	74.69875
TBL-20	3.855631	41766.62	23.2935	53.16371	11.40805	523.9851	0.5377551	6.760056	75.46359
TBL-21	4.054769	43776.67	26.62164	34.81985	11.96244	503.7265	0.500444	7.041765	52.7494
TBL-22	4.35764	42888.81	29.23501	39.57691	11.17883	424.1577	0.6412899	8.096112	63.22898
TBL-23	4.066874	46490.51	26.48871	32.9309	13.26927	535.8975	0.6406658	6.832632	77.08781
TBL-25	3.332614	40059.51	15.62641	39.24528	11.49303	618.1893	0.5032179	5.045559	68.94707
TBL-26	3.632234	40328.36	15.08509	34.2655	11.96869	502.7478	0.3430648	5.229743	79.88564
TBL-27	3.876508	42943.04	19.07893	54.36637	12.63298	569.7545	0.5381133	6.609619	67.3353
TBL-28	3.521371	38935.95	15.7319	56.25677	11.37275	563.978	0.4484229	5.6676	81.49429
TBL-29	3.481531	39471.72	11.28107	34.108	11.43728	550.1255	0.4110089	5.540728	68.05328
TBL-30	3.499517	40381.08	14.3457	37.29137	11.68441	503.4251	0.4024979	5.368901	68.22558
SDV-33	4.536175	57758.62	27.14244	46.32713	13.6564	883.0632	0.651196	7.557106	78.17303
SDV-36	4.126547	52397.76	31.97595	50.55676	11.69103	999.7943	0.621899	7.390265	66.21666
SDV-38	4.496002	56386.54	32.12346	44.84946	13.27372	841.7906	0.605212	7.207827	78.33292
SDV-39	4.371206	56907.05	36.17301	54.46139	14.10913	979.8029	0.666846	7.38586	72.30425
SDV-40	4.397938	58922.91	26.92771	50.72289	14.08174	695.7516	0.704615	7.666327	74.25589
SDV-41	4.577763	56252.11	32.91991	70.88198	13.14013	787.9636	0.708847	7.447186	77.01762
SDV-42	4.234193	55979.48	27.2787	45.62281	13.20301	939.2351	0.574261	6.823794	72.6288

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
SDV-43	4.51414	58921.5	26.763	49.58672	14.38909	777.9188	0.626963	6.614704	77.03851
SDV-45	4.607968	60746.16	29.55756	56.0142	14.4538	700.2003	0.691019	7.432163	75.28329
SDV-46	4.301699	52762.91	32.98591	41.942	12.89023	835.4714	0.597802	6.814353	66.00687
SDV-47	4.415167	59089.94	35.57195	41.94361	15.30188	815.5887	0.574761	7.235674	75.6619
SDV-48	4.216827	55019.45	22.94505	38.80521	12.0864	906.4709	0.631081	6.672798	76.55712
SDV-49	4.47372	57137.14	28.62245	58.83621	13.67223	873.8052	0.579186	7.234212	70.72652
SDV-50	4.475159	58216.19	30.87596	40.95276	13.79147	700.2472	0.775511	7.954281	73.82894
SDV-55	4.755291	55126.42	23.60273	44.31869	11.35345	782.9994	0.798023	7.994303	79.52718
SDV-57	3.875442	52322.54	31.22573	45.76949	12.86409	966.3127	0.548985	6.930732	68.47137
SDV-58	4.109979	53150.59	28.23746	48.08783	12.23337	985.0225	0.601343	7.613042	64.04874
PUN-11	4.341562	50122.08	27.7213	45.48245	11.29598	603.8571	0.6087705	7.344609	145.5233
PUN-31	4.205333	53302.36	30.16735	47.43552	11.85468	799.9978	0.5515839	7.132293	80.12807
PUN-41	3.757202	51179.98	23.04532	44.82761	11.45445	653.0256	0.6411079	7.193534	72.6993
PUN-52	4.338146	56479.76	31.90654	50.44679	14.93791	541.997	0.6764461	7.006505	75.13728
SDV-01	4.531985	52328.05	35.92859	42.57158	12.64253	635.7915	0.6270765	7.944882	66.3451
SDV-02	4.636843	55734.37	33.42038	61.77108	13.19878	606.0733	0.6869667	7.977555	78.34521
SDV-05	4.424064	56486.34	29.13588	48.32242	13.71115	644.2911	0.6083314	7.412442	83.27701
SDV-07	4.389556	54841.07	36.16824	63.17789	12.86516	699.0668	0.6666289	7.329192	67.74427
SDV-08	4.628415	55813.86	24.82461	41.28281	13.20766	667.4799	0.5829891	7.168445	71.47068
SDV-09	3.750769	55398.8	15.34865	49.9865	12.3166	782.8224	0.6558107	6.179881	78.61375
SDV-11	4.163947	50427.88	27.31809	38.59837	11.9836	881.647	0.6305535	6.66081	68.99867
SDV-14	4.342954	54419.45	23.75655	48.77409	12.43277	778.4615	0.6157902	6.788875	78.00141
SDV-20	4.797081	56846.61	25.24985	46.17292	13.63665	721.678	0.7171802	8.346863	72.87237
SDV-21	4.101129	55794.72	21.5325	42.5696	13.03019	715.1807	0.6103802	6.500125	71.93607
SDV-22	4.157173	54002.5	22.97581	39.24631	13.16161	765.2608	0.5732374	6.925125	64.71555
SDV-23	4.449844	50309.64	25.9484	34.24097	12.38615	585.4468	0.7877593	7.67064	59.40872
SDV-26	4.391103	55037.88	29.89071	44.07883	12.59459	758.4526	0.6329515	6.762168	76.87968
SDV-28	4.157405	53070.61	21.65156	44.50449	12.57547	718.6212	0.6459992	7.550897	68.69774
SDV-29	4.820408	59371.28	27.66402	41.76373	14.40854	755.3885	0.6834543	7.028598	73.03112
SDV-30	3.933712	54685.69	30.72254	40.61724	12.80837	849.0757	0.6552046	6.210231	68.96322
SDV-31	4.176259	57678.14	28.72486	11.8929	15.81734	614.01	0.5332664	6.372489	97.65647
HUA-33	5.26048	31631.21	19.76275	80.73859	9.662462	730.0719	0.787739	7.698857	72.97807
MON-01	4.767434	33394.23	23.48445	36.59703	10.04172	815.8448	0.903905	10.76374	49.86946
MON-08	6.190302	43439.99	15.06701	32.25805	11.02974	860.5991	1.040158	12.8388	60.43033

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
MON-09	5.47338	38741.3	23.34812	47.93449	9.296862	873.1272	1.059583	12.01304	60.64388
TAJ-24	5.80114	43575.84	22.69164	47.45791	10.85357	637.671	1.045131	12.5743	172.1305
POR_005	7.142587	37620.11	24.51964	43.47641	8.743041	650.4429	1.229854	15.69655	72.30447
SOC-29	6.222587	44926.5	32.25805	36.93671	11.62346	685.5687	1.1916	13.67352	72.1189
SOC-33	5.814699	34829.51	18.29421	46.56948	9.832408	637.7204	0.9444819	11.09402	60.60435
CRM-07	4.57491	44088.3	10.59182	46.17989	9.758741	896.1168	0.685205	8.465187	70.82153
HLV-01	4.431563	39022.65	11.0608	48.4694	8.515444	793.4684	0.630531	7.879686	58.96245
HUA-01	3.729376	37564.32	21.09717	40.20306	10.02437	847.806	0.51275	8.078558	59.63918
HUA-04	3.870415	42593.51	19.85028	46.168	11.23431	688.2595	0.669916	7.866706	50.24535
HUA-10	4.283152	39165.26	25.19912	25.8436	11.24807	827.0958	0.417587	6.526572	88.69285
HUA-21	2.957189	42322.51	17.29551	47.28254	12.27548	760.0076	0.404667	6.142756	69.97874
HUA-22	3.644408	39269.55	14.9132	36.92178	10.29022	893.1755	0.470824	6.778509	51.68424
HUA-23	3.652628	38527.29	11.28329	39.24009	9.531371	912.078	0.613391	6.607515	49.61479
HUA-24	3.569157	40237.21	16.84438	34.04695	11.21271	786.1302	0.505781	6.844718	56.95514
HUA-25	3.642828	42692.67	11.58327	32.08108	10.97909	899.7653	0.514799	6.579838	52.2736
HUA-27	3.558146	40320.53	22.79453	33.8771	10.08476	904.6251	0.58118	6.499185	73.63846
HUA-29	4.084437	39641.06	11.86907	35.65412	9.582946	772.015	0.492137	7.020979	75.8728
HUA-30	3.783686	38474.67	16.82134	37.13739	10.03348	709.2426	0.502099	6.5412	67.14325
HUA-32	3.696035	41148.59	17.27182	33.37002	11.43123	859.9628	0.458874	7.281807	53.26058
HUA-34	3.51293	40618.78	24.75283	44.43568	10.99246	918.4189	0.560664	6.988041	61.57849
HUA-37	3.467962	40191.57	17.63663	36.87479	11.13195	815.0716	0.484692	6.296742	61.32608
HUA-38	4.364408	43639.05	16.39483	35.89092	12.04391	952.7869	0.49086	7.405824	66.45538
HUA-41	3.935006	37475.92	14.63877	34.64366	10.01906	861.6528	0.454112	6.163876	56.3784
HUA-42	3.175254	42052.99	15.00303	36.29939	12.12779	725.7354	0.490951	6.477002	61.01933
HUA-43	4.022516	41000.17	25.55663	40.56073	13.36676	774.5841	0.53929	7.278482	69.48974
HUA-45	3.731366	41410.51	21.97727	30.82415	11.16011	851.3864	0.50012	6.918507	64.82294
HUA-47	3.803241	37917	21.84347	38.35621	10.44916	799.632	0.538429	7.286526	62.92631
HUA-50	4.534987	45710.95	20.54375	29.66395	13.4183	860.0402	0.601294	7.674745	57.46691
HUA-52	3.678186	41946.23	17.22026	45.63895	11.03253	1017.906	0.504484	5.884356	64.3032
HUA-53	3.79068	38368.15	10.86916	45.50505	9.449638	645.4564	0.456335	5.611914	68.12135
HUA-55	4.252456	38364.84	23.7569	53.82874	10.70248	863.226	0.598193	7.070806	58.9024
HUA-56	3.749779	43809.45	18.2795	46.08205	11.34871	876.2011	0.65737	7.000187	64.30203
HUA-57	4.08402	42267.23	12.5323	46.91532	10.63009	857.8019	0.543755	6.212071	65.64774
SDV-34	4.028808	44034.07	20.59881	47.77022	9.749921	780.494	0.663894	6.901152	60.56516

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
SDV-35	4.355444	49678.06	21.03297	37.45445	11.10154	725.5463	0.699454	7.431943	58.61211
SDV-37	3.921525	44810.14	26.25313	38.64746	11.19854	712.0113	0.484933	7.027377	58.56348
SDV-51	3.929339	44515.77	16.30093	33.81586	11.11768	689.0715	0.495683	6.101468	54.20881
SDV-52	3.735172	46231.2	11.75108	49.66611	10.88287	584.6444	0.57293	6.667057	59.47612
SDV-53	4.012003	42060.39	18.06191	37.82212	9.196355	673.1812	0.48721	6.114578	69.04169
SDV-56	3.980753	44394.04	21.21322	48.62329	9.829277	673.1428	0.548981	6.735534	68.80347
SOL-10	4.212895	40188.54	28.76126	43.21877	9.986901	959.5812	0.539719	7.250569	62.54542
TAJ-05	3.347815	47204.2	15.46434	42.07945	11.65255	833.1417	0.491362	5.464378	81.75371
TAJ-06	3.609664	44727.36	23.05869	42.1321	11.04284	690.6005	0.461782	6.127023	80.92957
TAJ-08	3.408011	43474.45	23.46125	40.10891	10.34698	671.013	0.347169	6.077657	74.09901
TAJ-11	3.442826	45615.85	14.74262	47.69735	11.10977	851.9057	0.434228	5.325107	78.64806
TAJ-12	3.39162	41015.67	14.78954	48.15119	10.23689	621.7299	0.345459	4.942665	84.01389
TAJ-13	3.847918	46554.03	16.76498	47.05888	11.12157	816.0283	0.53923	6.372849	80.93063
TAJ-14	3.467424	43545.1	11.64765	57.22526	9.793067	860.0596	0.3593	5.440903	74.02664
TAJ-15	3.268994	46364.47	20.43888	50.32176	10.86917	674.1455	0.47719	5.56802	102.2342
TAJ-16	3.430578	46492.58	16.96776	42.49956	10.92659	758.823	0.402579	5.729877	81.68488
TAJ-17	4.173211	46398.8	26.12612	40.87993	12.03772	800.9892	0.525041	7.439755	91.37568
TAJ-18	3.410448	43367.59	18.75967	49.68826	10.78771	641.249	0.495184	5.499515	161.3127
TAJ-19	3.180794	43434.59	26.40888	40.49348	11.00343	457.7477	0.437186	5.428318	138.2974
TAJ-20	4.336569	50269.4	20.91321	43.00563	12.22988	569.873	0.584519	7.779855	147.616
TAJ-21	3.396633	43513.77	14.544	49.95444	10.95926	690.791	0.385712	5.447962	168.1188
TAJ-22	3.641318	45015.73	16.41415	40.69258	11.11858	705.6908	0.475441	6.71552	168.6229
TAJ-23	4.394923	50455.3	24.67535	43.97373	11.96205	480.5311	0.542285	7.884613	177.9826
TAJ-26	3.506524	44887.61	15.87147	53.18073	11.56503	706.1691	0.343415	5.679286	155.18
TAJ-27	3.626977	47142.49	25.10685	51.29268	10.54241	797.6911	0.55194	6.33626	158.6757
TAJ-28	3.852755	45278.41	23.66499	49.84142	11.30684	567.658	0.532482	6.968244	123.3824
TAJ-29	3.708676	43818.12	18.5596	50.70908	11.65857	815.149	0.466098	6.483014	162.4206
TAJ-30	3.343715	47047.4	13.87702	46.4151	11.60287	646.7529	0.368268	5.379399	126.7447
TBL-33	3.79837	45613.41	14.62022	30.40435	12.44136	826.7713	0.490689	6.39248	64.8788
TBL-35	3.71611	39623.56	12.25918	51.28128	9.236504	618.0886	0.672231	7.631474	59.00143
TBL-44	3.554882	37693.39	16.60798	41.46318	10.03562	637.9773	0.578724	6.447969	61.38179
TUL-01	3.478847	47381.49	11.55619	41.01369	11.70033	773.0959	0.414878	5.925524	97.77368
TUL-02	3.262141	45584.87	13.1788	49.29229	10.66527	918.0443	0.438358	5.074593	108.5303
TUL-03	3.579062	43883.25	12.2487	60.41557	11.5493	956.6428	0.423007	5.485968	109.6697

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
TUL-04	3.048546	45923.36	13.95441	46.30714	11.66784	795.066	0.403088	4.935048	113.7206
TUL-06	4.02269	48484.43	13.10091	105.3518	11.9819	836.0602	0.510692	7.386058	105.7826
TUL-07	3.755003	45116.67	19.09223	47.46583	11.00667	824.3437	0.412498	6.681818	93.68934
TUL-08	3.909495	44254.55	15.14902	46.08918	11.85821	919.1971	0.548707	6.723404	68.21546
TUL-09	3.854137	48875.94	15.37972	44.6143	11.28007	918.96	0.510296	6.940227	73.13781
TUL-10	3.719759	45741.69	17.48142	52.66687	12.06387	688.7355	0.510256	6.546911	77.06219
ANG_005	3.810492	41765.66	15.54923	99.50711	9.586427	557.7971	0.6423504	7.281712	66.73798
ANG_006	3.109122	38135.36	18.08573	55.00244	11.04085	630.0852	0.5784597	5.014518	80.81823
ANG_012	4.12015	40216.21	26.57263	50.48917	9.784139	638.275	0.7017249	7.624783	62.30429
ATU-04	3.874764	34733.21	9.512842	39.08585	8.665909	593.2777	0.6115369	7.415296	53.72829
ATU-05	4.05316	39729.94	16.12158	41.12819	11.081	624.5042	0.5156438	6.749285	72.43509
ATU-06	3.825605	43953.41	14.45354	41.35759	11.40474	742.0565	0.5498459	6.945694	62.68937
ATU-07	4.032846	42568.24	14.43713	38.05798	12.55612	526.8832	0.5581719	6.562263	71.29478
ATU-08	4.267121	42381.23	17.93565	49.23951	10.64595	605.6239	0.6935591	7.922778	60.95432
ATU-09	3.469302	39435.33	10.25386	33.43068	11.34137	631.5284	0.4831128	6.730341	54.19052
ATU-10	3.673355	44910.63	12.94501	28.578	13.14801	649.0698	0.5326598	5.610971	50.66549
ATU-11	3.170005	42537.03	11.76352	40.59182	11.87045	613.8724	0.4197858	4.617517	63.46642
ATU-15	3.899522	39846.24	15.77448	40.20171	11.42447	676.5916	0.4920629	6.770077	69.55247
ATU-16	3.393703	41942.59	15.88134	40.55064	12.29486	778.9269	0.5248277	6.156912	73.18724
ATU-30	4.478395	43090.03	20.41834	36.37882	10.96042	591.6199	0.6431017	8.356057	49.86634
ATU-33	3.47052	39735.79	16.22591	59.08998	11.89972	678.6263	0.4826381	6.701027	61.88531
ATU-34	4.187927	42035.89	24.88319	44.46109	10.79691	706.0284	0.5924652	8.330883	70.03854
ATU-36	3.876832	43019.22	11.71338	49.60511	11.6669	822.0549	0.4734718	6.924308	55.49981
ATU-37	3.755574	39180.91	17.58959	41.00656	10.44937	655.676	0.4383491	6.648766	68.40803
ATU-39	3.732709	39732.17	22.13554	40.39959	10.85326	656.5895	0.5516955	6.769029	61.50881
CAR_013	3.655955	40589.29	17.11842	33.82239	11.05651	882.7245	0.5455489	6.485439	67.24368
CAR_017	4.262586	46749.25	24.47815	28.35113	12.66279	664.919	0.7087452	8.162621	59.7999
CAR_018	3.637812	39902.71	11.66288	44.35022	11.19951	810.7678	0.450728	6.814258	73.81465
CAR_019	3.344816	39708.05	16.22036	43.40391	10.19175	703.6008	0.4740844	6.872345	56.39377
PUN-01	3.53927	42839.39	27.59922	58.1247	10.43684	600.6777	0.6089215	6.867945	67.25694
PUN-02	3.284417	42923.86	17.70354	54.69123	10.44794	1104.727	0.4418223	6.723534	87.32327
PUN-03	3.769752	46235.27	17.84624	50.23768	10.84155	736.3516	0.5314474	7.512836	66.28368
PUN-04	3.53369	42494.32	10.80465	54.42443	10.82244	743.163	0.559956	5.774783	71.364
PUN-05	3.559578	40522.24	17.10841	43.53209	9.851321	806.6075	0.4869207	6.600883	77.50449

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
PUN-06	4.503433	47252.92	36.48934	44.45649	11.72452	749.7399	0.5516338	7.815894	80.11607
PUN-07	4.3755	49596.66	24.93371	47.62435	11.13717	797.0652	0.5821002	7.346658	85.21677
PUN-08	3.962113	42833.23	25.07012	44.81602	10.90114	869.6466	0.5642552	6.927258	70.94813
PUN-09	4.404502	47577.61	35.62315	56.01461	11.1442	904.5163	0.6108099	7.352669	92.46177
PUN-10	3.871574	50024.16	17.95051	46.67889	10.96683	819.6535	0.4906753	6.785398	75.18626
PUN-12	3.37592	42331.11	18.23772	53.09319	10.1022	693.8796	0.4636124	6.006568	76.99245
PUN-13	3.827864	49826.34	16.16698	44.42887	12.58854	930.8364	0.5758842	6.481621	92.86283
PUN-14	4.220701	46832.59	15.08422	48.66632	11.08311	845.312	0.6292478	6.915828	71.98743
PUN-15	3.677248	47884.83	25.02946	49.68071	11.13642	956.4938	0.5629458	7.156749	94.00036
PUN-16	3.408921	43729.35	20.39295	38.24617	10.83628	765.3152	0.5722273	6.2736	86.1032
PUN-17	3.620369	43669.95	18.81225	39.94225	10.7048	667.5205	0.4713297	6.750963	78.15865
PUN-18	3.922719	43251.42	21.80378	48.44991	10.49844	740.545	0.5098556	7.718005	62.13307
PUN-19	4.706657	49326.91	13.97147	58.25484	11.4639	766.0358	0.6421698	6.941038	81.09853
PUN-20	3.876801	43983.21	17.26756	49.34507	10.35101	666.8114	0.4868095	6.001492	83.92739
PUN-21	3.674821	45736.5	24.80978	49.3204	11.0146	736.671	0.5564123	6.766452	84.75595
PUN-22	3.865465	44906.9	22.43113	47.65168	10.55264	711.5916	0.5692182	7.017994	72.20229
PUN-23	3.839465	49376.73	28.38989	44.1113	11.67492	693.7621	0.5744954	6.97359	64.23174
PUN-25	4.014295	47856.46	22.84456	53.45998	12.20284	650.7717	0.643806	7.200837	83.07262
PUN-26	3.263065	41956.78	22.99358	59.74452	9.637798	692.2313	0.5874587	6.348988	94.40523
PUN-27	3.539495	44205.44	17.2799	50.02475	10.11718	637.8727	0.5343329	6.37274	75.86002
PUN-28	3.637756	43404.05	24.26401	48.70247	10.86357	818.1187	0.5090278	6.688423	71.70624
PUN-29	3.279227	43155.23	17.2952	50.53096	11.58237	681.6353	0.4670241	5.521275	73.37766
PUN-30	3.401248	45772.22	27.93726	53.72636	11.47052	761.713	0.5486979	6.485802	82.69459
PUN-32	3.782197	49257.77	25.22993	44.38399	12.04906	763.9039	0.6429372	7.045317	68.53458
PUN-33	3.777732	47360.04	23.56823	50.876	11.12884	817.5386	0.5587472	6.869486	71.72238
PUN-34	3.475767	41729.41	21.07758	49.26525	10.28402	735.4805	0.5222465	6.623798	60.70935
PUN-35	3.870905	47792.19	22.4833	47.50468	12.06929	701.8358	0.5507054	6.177017	75.87227
PUN-36	3.955188	45053.23	22.1908	50.87147	10.49133	741.6948	0.5868133	7.011247	74.23029
PUN-37	4.102226	50100.91	22.63695	49.9602	11.88754	828.6015	0.6881383	7.522455	71.45168
PUN-38	3.846676	46682.86	24.79374	41.39561	11.22576	651.5209	0.4592372	7.009462	62.18435
PUN-39	3.846836	47890.47	17.20771	49.37431	11.34784	794.4161	0.5362925	6.981305	80.05632
PUN-40	3.668682	50599.18	19.57705	37.24245	12.47599	714.4208	0.6056955	6.397276	62.00845
PUN-42	4.468281	48181.29	24.26071	34.17887	11.3086	776.7768	0.7476369	8.804036	66.63045
PUN-43	3.584859	45770.76	10.58607	40.9672	11.84118	794.2739	0.6349113	6.076506	60.03766

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
PUN-44	3.713899	42894.71	18.22828	45.84939	10.67512	654.7753	0.5891588	6.903708	69.41556
PUN-45	3.952095	47403.16	25.39313	49.15026	11.523	595.7683	0.6571872	6.850556	64.39374
PUN-46	3.832706	45127.78	26.74999	31.37532	11.19646	519.8267	0.6016947	6.422013	56.81802
PUN-47	4.116504	45562.22	24.34611	40.51611	10.84863	592.776	0.6185867	6.96781	71.10538
PUN-48	3.997196	46725.77	26.80632	45.11437	10.74194	540.1667	0.6608921	7.509761	59.37968
PUN-50	3.903699	45971.35	28.24337	32.18762	11.31035	649.2071	0.6279391	6.61061	56.70784
PUN-51	4.068591	47435.18	16.87572	41.92685	11.80123	622.5452	0.6049884	6.820663	66.72959
PUN-53	3.782842	53967.2	30.79041	35.93168	11.86295	676.6741	0.6421725	6.902555	73.98822
PUN-54	4.007426	47526.66	21.20337	41.65557	11.71515	516.676	0.6130208	6.515915	73.53583
PUN-55	3.966196	45220.44	18.26424	50.03363	10.57249	586.0645	0.5523651	6.826125	59.82309
PUN-57	4.010041	48482.1	25.592	37.16814	11.65983	547.0604	0.6149036	6.838706	60.20514
PUN-58	4.050725	48989.48	27.73171	44.55756	11.26201	558.9791	0.6753567	7.256001	59.21093
PUN-59	4.274952	49324.49	36.6919	39.50967	11.82198	549.4224	0.6562232	7.568607	66.00101
PUN-60	4.609423	46861.4	25.51294	40.10715	10.74562	642.7437	0.6164469	7.446482	60.02409
ROQ_001	3.990072	43515.43	21.15371	38.1227	12.01846	798.4714	0.5189499	6.810696	66.05711
ROQ_004	3.428904	39621.5	18.41372	47.49265	10.44065	742.0209	0.5181955	6.131487	67.72806
ROQ_005	4.014699	43673.53	25.54539	32.41843	11.82772	835.9764	0.5946127	7.181963	63.59367
ROQ_007	3.883134	41506.8	14.32561	37.65416	10.36583	820.1417	0.4999953	5.898299	72.94958
ROQ_008	3.696393	40748.29	18.98047	38.37665	10.02562	804.2556	0.5156347	5.717524	72.3372
ROQ_009	3.878114	41251.56	15.50246	35.01618	9.951046	737.0913	0.51732	5.799896	64.78976
ROQ_011	3.927487	43138.58	19.1693	33.35051	11.80002	806.3351	0.5783754	7.354165	64.34787
ROQ_012	4.650013	45177.73	23.39554	35.57136	12.14117	735.3315	0.6962065	8.653239	65.10801
ROQ_013	3.706728	38620.62	22.6994	49.16951	8.671417	741.3833	0.6319399	7.966055	70.81027
SDV-04	3.622298	44439.41	19.5507	52.35495	10.7308	625.2023	0.4360521	6.326851	70.13094
SDV-06	3.894413	48937.18	19.99626	40.67631	12.10074	545.4393	0.541601	6.966655	79.58257
SDV-12	4.101475	47725.15	25.64074	45.62634	11.75276	842.4223	0.5746085	7.280495	73.13993
SDV-13	3.86699	45760.08	23.88229	36.61595	11.56068	625.0908	0.5131896	6.156266	63.38554
SDV-15	4.184397	46478.61	21.3203	38.11369	10.7507	744.9095	0.6224861	7.934293	58.10044
SDV-16	3.740089	42903.02	11.15846	41.97565	9.68891	588.6412	0.5024645	5.081556	60.07364
SDV-17	3.755792	48807.19	15.9166	46.974	10.70126	602.3157	0.4908391	5.864515	67.04416
SDV-18	3.566835	46111.27	17.29922	42.63045	10.96096	718.0983	0.4920813	5.994245	62.47634
SDV-19	4.095715	47103.37	18.34722	40.94914	10.73309	802.3221	0.5641165	6.713601	57.38966
SDV-24	4.108786	42690.11	18.22733	45.27423	9.75614	690.6509	0.5688147	7.097041	66.30013
SDV-25	3.612411	48860.49	25.9979	44.41003	11.67524	745.7656	0.48652	6.387942	71.4322

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
SDV-27	3.816555	45665.63	20.65191	42.01235	11.11225	788.4016	0.5529497	6.610662	76.74474
SDV-32	4.184879	44010.15	17.55596	44.33749	9.480008	623.817	0.6242032	6.673006	58.35559
SOC-03	3.906619	42319.48	19.30013	46.61339	10.24726	604.7139	0.5603021	6.961154	66.18243
SOC-05	3.905804	40560.29	20.88713	39.41071	9.575781	535.0613	0.5553985	7.405914	67.12773
SOC-06	3.598264	42950.68	13.93297	34.0946	11.60212	656.6619	0.5254093	7.094658	54.74281
SOC-09	4.337955	43311.34	18.05182	38.7515	11.59487	753.1957	0.6023318	6.470178	69.84561
SOC-10	3.565959	42995.79	16.06752	42.39981	11.83238	594.4458	0.3790561	5.491796	69.9493
SOC-12	4.397709	38986.64	12.74355	37.08293	8.762817	768.7559	0.6339431	7.903046	76.58738
SOC-13	3.669807	46086.82	20.55231	42.00586	11.78728	702.9737	0.4809585	6.593969	78.83179
SOC-14	3.617433	40356.04	19.76929	36.21354	10.44973	553.7203	0.5101082	6.554867	65.65877
SOC-17	4.117274	41802.43	19.63356	40.64079	10.89105	715.0009	0.7104811	7.89604	43.63623
SOC-20	3.406588	41543.68	12.85999	44.16433	11.30825	632.0662	0.5329307	7.317683	69.25425
SOC-37	4.318917	40201.73	12.14637	50.04607	10.27853	778.9653	0.5009314	7.126272	58.39014
SOC-41	4.719135	43792.37	26.57058	44.62191	11.53265	795.2308	0.5548646	7.852305	58.04567
SOC-44	3.73524	45446.63	13.29872	35.10934	11.39639	675.2535	0.4585655	6.539423	65.09252
SOC-46	4.446553	41408.2	15.80953	47.11153	10.35439	636.7919	0.5023866	6.880943	83.28179
SOC-47	3.707793	39235.87	16.24991	39.57399	9.654284	663.8445	0.6274381	7.381945	65.30721
SOC-56	3.681757	37358.81	14.13541	31.04032	9.445404	569.4877	0.5483062	6.440821	55.71169
SOC-60	3.965404	40578.68	17.04332	53.9321	10.06254	442.5706	0.555394	6.866381	51.64478
SOC-61	4.054651	42872.61	20.59193	44.67078	11.77073	551.2009	0.5552745	7.095196	63.76453
SOC-62	3.39247	41794.46	10.33771	32.44541	10.31298	645.5688	0.4373864	5.76895	67.04072
TBL-07	4.329835	41763.04	24.5146	33.52273	11.14245	564.7322	0.5760046	6.644759	84.10389
TBL-17	3.808884	41052.82	17.93468	38.25327	10.42134	567.5063	0.5953738	6.382674	73.74013
TBL-24	4.056763	43189.11	18.2511	39.07253	10.51271	525.4161	0.6211058	7.258908	84.06392
MON-03	4.564146	26046.73	13.62994	43.23252	7.156565	740.6125	1.093596	10.53119	51.55054
MON-04	4.634255	18627.1	22.42768	32.60545	7.043169	988.7695	0.935191	10.5942	44.40209
MON-05	4.726941	23195.38	13.94366	34.6721	7.289878	967.8906	1.169946	11.31294	43.52596
MON-06	4.648661	19077.57	16.2044	21.93962	7.09874	966.2555	1.015429	11.2872	46.06673
MON-10	4.56775	20195.62	34.79882	35.86403	8.316183	1076.375	1.034032	11.28506	45.58463
MON-11	4.508022	18964.59	34.41909	38.78236	7.863965	986.3905	0.972443	11.40619	39.99873
ANG_002	4.078221	22415.22	11.46675	36.82767	6.059916	611.4993	0.844084	9.236736	34.23758
POR_001	5.493185	21075.24	17.91018	45.73214	7.140788	614.1418	1.022034	10.84119	60.32734
POR_003	5.680473	22489.38	29.04207	41.73088	7.898629	540.111	0.9544544	10.4838	44.14933
POR_004	5.125546	20382.8	24.03778	47.16778	6.887914	577.5393	1.112394	10.43567	55.73457

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
POR_006	5.323002	23617.81	27.82122	33.80869	8.594799	677.4488	0.7859657	11.33727	70.02357
POR_009	5.203221	20771	25.20873	33.09624	7.193882	721.075	0.9694604	12.3294	35.2692
PUN-49	4.066077	24527.94	27.84112	39.11804	9.428648	573.3522	0.5866704	7.26698	60.03016
SOC-04	5.427656	19421.32	34.71122	40.38686	7.903825	717.1766	1.066289	11.16518	50.68693
SOC-31	5.378306	20846.43	17.2421	50.60925	7.310462	808.7123	0.8523528	10.26512	57.94188
SOC-32	6.076989	24282.31	22.75547	39.45884	8.095327	1093.058	1.048781	11.62644	55.72635
SOC-55	4.219534	22082.64	8.32242	43.25197	5.651289	764.4234	0.9085976	7.96229	32.08065
HUA-05	3.384149	34831.15	10.33927	48.00267	8.764151	694.6443	0.366436	5.453326	53.77657
HUA-06	2.937378	36539.93	8.186109	23.16455	11.24821	573.0671	0.344501	3.598308	57.02567
HUA-14	4.080551	31666.61	11.55881	32.53402	10.79752	707.328	0.612579	6.435222	45.09439
HUA-16	3.46039	40729.26	8.461075	39.77318	10.54535	636.3949	0.463085	5.953887	55.35387
HUA-26	4.104212	38669.52	12.86988	33.32626	10.4644	890.3899	0.743328	7.525415	43.22265
HUA-28	3.984425	35005.7	9.815529	32.12284	8.043126	696.6525	0.411547	5.63849	52.74254
HUA-44	4.156973	42168.3	18.38	10.41908	11.86474	891.3679	0.459602	5.677547	56.70999
HUA-46	3.806178	39202.44	12.9571	20.77158	14.08019	697.1444	0.430946	5.661692	62.50516
HUA-49	3.767953	35153.95	10.81903	24.27952	11.7314	804.4631	0.399206	5.469892	59.21571
MAS-01	3.706032	46552.48	10.39684	50.99016	14.59475	525.6322	0.410516	5.496435	65.83167
MAS-02	3.601143	45779.05	20.61131	38.99598	13.01092	347.933	0.644513	5.615038	73.6151
MAS-03	3.210197	42045.18	12.5414	21.57995	13.55126	632.5069	0.322669	4.969069	59.60439
MAS-06	3.239141	36521.69	14.82992	40.09489	9.985962	1279.56	0.396345	4.915738	172.3125
SOL-01	3.776171	43068.75	14.03975	77.00893	12.25788	694.3672	0.494982	6.509261	98.54874
SOL-02	3.536629	39457.45	13.17292	26.20113	11.59637	712.7677	0.37805	5.4637	68.14943
SOL-03	3.887641	42564.36	14.45218	53.19011	12.48006	644.0128	0.48967	6.532964	77.11813
SOL-05	4.160611	43007.86	10.45983	46.57856	13.07782	541.933	0.56163	6.711049	69.90016
SOL-06	3.912112	41213.05	10.28514	59.03304	12.46791	599.1957	0.493945	5.049957	62.77107
SOL-09	3.62118	40855.59	11.32597	66.72611	11.25449	790.4877	0.49386	5.29842	66.64319
SOL-11	3.716278	38805.91	11.83215	60.09258	11.14676	659.2935	0.413933	5.635405	76.89492
SOL-14	3.875703	45391.54	11.09551	65.23263	12.81133	603.7702	0.512123	6.095221	79.59924
ATU-02	3.695742	40684.32	10.55002	34.90374	12.40823	571.6961	0.4954519	4.875997	69.80733
ATU-12	4.106158	45766.42	9.926874	41.86044	13.87723	420.9049	0.577664	6.842381	46.82597
ATU-18	4.193784	43890.3	9.595037	37.58099	12.41112	396.4922	0.4320191	6.448331	52.73252
ATU-19	3.821625	41631.93	9.320912	42.6802	11.3405	562.7379	0.4607504	6.046349	50.71958
ATU-20	3.702586	45857.98	11.83464	36.78291	14.05873	605.9208	0.303977	5.119315	80.36787
ATU-22	3.449403	42939.93	10.19156	24.85249	13.2829	627.2568	0.4398552	5.251191	59.37292

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
ATU-23	3.930566	43861.79	19.92614	39.11082	13.45521	593.1328	0.4984565	7.043165	76.15916
ATU-25	4.098185	48531.96	12.27225	40.91576	13.17473	811.6977	0.4726543	5.827919	98.3288
ATU-38	3.955928	40188.59	15.52236	27.87216	9.553207	788.1149	0.5037548	5.410243	45.96075
CAR_011	3.550592	43435.29	9.02243	35.35241	13.10132	716.5038	0.4684548	5.044034	67.55782
CAR_012	3.196011	46697.03	14.87103	20.74717	14.99818	766.2642	0.5135218	5.201796	87.79523
CAR_014	3.532235	42639.86	6.190707	44.44524	12.16056	647.5875	0.3611882	5.052781	76.90665
CAR_015	3.299669	44981.45	6.318967	38.76803	9.458946	698.0775	0.5161424	5.17966	104.4344
CAR_016	4.025939	48313.75	12.04166	41.36903	14.34205	410.5875	0.484675	5.327847	72.51659
SDV-54	4.820819	40950.84	35.97651	99.02921	14.59708	269.6872	1.057336	14.48744	98.08649
TAJ-01	5.373088	45676.79	31.42019	95.79865	15.44095	307.5095	1.199684	15.53854	118.5072
TAJ-02	6.054404	44095.36	32.5843	89.35882	14.71253	175.6676	1.221871	14.27121	136.3191
TAJ-03	4.487432	48475.21	45.08792	126.0972	16.60956	414.4438	1.203938	17.6236	134.5454
TAJ-10	5.321253	45084.57	32.18542	102.1207	15.3429	230.0544	1.232588	15.16282	118.1417
TBE007	5.68	45500	-	115	15.8	-	1.24	16.3	132
TBE00X/254	5.19	45200	-	135	16.2	-	1.19	16.7	138
TBE015	6.71	44000	-	110	15.6	-	1.1	15.6	134
TBE016	6.11	48500	-	121	16.3	-	1.16	16.8	135
TBE027	5.86	55100	-	115	16.7	-	1.31	16	156
TBE028	4.49	43500	-	131	15.6	-	1.15	15.3	148
TBE032	5.06	46500	-	113	15.5	-	1.23	15.5	142
TBE043	4.66	49900	-	112	16.7	-	1.21	17.2	150
TBE047	5.53	44200	-	115	14.8	-	1.19	15	132
TBE071	5.57	44400	-	122	15.4	-	1.17	15.3	140
TBE119	4.79	41500	-	106	14.9	-	1.14	16.4	126
TBE136	4.78	42800	-	100	14.7	-	1.03	14.6	117
TBE144	5.13	42200	-	114	15	-	1.28	16.8	132
TBE149	5.53	45300	-	108	14.8	-	1.15	16.5	135
TBE153	4.69	46500	-	117	16.6	-	1.19	17.5	133
TBE189	6.18	45000	-	109	15.3	-	1.14	16	131
TBE194	5.08	46500	-	110	15.8	-	1.06	16.3	137
TBE256	5.5	44000	-	114	15.8	-	1.28	16.4	136
TBE38A	6.1	44500	-	113	14.8	-	1.29	16.9	137
TBE38B	5.75	46900	-	97	15	-	1.23	16.6	150
TBE39A	5.92	44500	-	116	16.2	-	1.34	17.8	160

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
TBE39B	4.89	45000	-	115	15.4	-	1.12	16.3	147
TBE443	5.18	50800	-	132	17.1	-	1.24	18.7	152
TUN_005	5.412453	45878	47.96222	131.3285	16.67444	398.7069	1.411187	20.13949	81.84333
CRM-01	5.190778	46693.33	11.58583	51.15482	10.03194	953.4394	0.72477	8.473246	71.65234
CRM-03	5.109255	49663.93	12.30263	27.45343	11.24429	666.744	0.748966	8.291825	85.40554
TAJ-09	3.909412	35735.01	29.34035	49.7537	8.479618	956.1209	0.819429	11.19762	100.0362
TBL-60	4.20979	41453.78	26.3664	45.38686	9.686797	660.5275	0.671	8.539525	70.72587
POR_002	4.813815	34460.02	23.2004	47.10402	9.078114	626.7378	0.8567816	9.711516	62.12053
POR_015	5.883632	40050.28	30.79071	54.06891	13.3698	365.1084	0.9622912	12.25498	91.9938
CRM-08	3.806361	39093.05	15.52253	42.42683	10.66896	765.6807	0.491655	6.089426	73.49222
DBS-01	3.375762	40406.82	22.68318	38.61898	11.89086	674.9752	0.421899	5.709471	73.21746
HLV-02	4.098606	50070.69	11.31088	52.62936	9.029937	749.0519	0.787488	8.594008	82.63179
HLV-03	3.695371	63536.31	11.16409	50.3147	8.059574	800.7623	0.582562	6.95805	66.06306
HLV-04	4.029254	50881.31	10.76271	37.37144	8.361464	645.5198	0.578362	7.786263	67.39528
HLV-07	3.998032	58850.57	12.24596	34.16386	12.3451	654.6818	0.544589	6.696602	60.52712
HUA-02	3.471105	55682.09	11.50726	11.51232	10.64205	682.9391	0.401255	4.278658	38.91422
HUA-03	3.801576	31958.06	17.26159	51.89918	7.479092	749.3262	0.634775	7.894386	53.78849
HUA-09	3.400762	37116.95	26.42528	37.19574	10.12173	893.3589	0.581192	6.701877	74.45625
HUA-13	3.810431	35657.59	18.50294	57.06735	8.239322	855.2615	0.695079	7.788102	50.92861
HUA-20	4.359228	38335.43	18.80536	36.23484	9.878286	1219.671	0.731424	8.697955	57.66979
HUA-35	4.855143	37991.09	26.03387	83.23294	13.38237	528.2417	0.843835	14.18823	113.6675
HUA-36	3.472267	35460.32	8.802352	45.5639	8.576235	933.7642	0.545071	6.702827	62.70677
HUA-39	3.452772	33714.61	15.65606	58.22629	7.251022	645.7484	0.532529	5.927874	63.83198
HUA-48	4.152885	43928.4	26.00813	43.71138	12.0136	814.8353	0.55486	7.803423	59.20823
MAS-05	3.419464	37308.29	24.31164	45.01846	8.845886	985.3471	0.686386	7.102202	51.26488
MAS-09	4.207397	49025.11	12.93057	37.66347	11.42924	824.3728	0.850765	9.491134	92.86607
MON-02	4.143022	38634.81	12.98756	66.24264	8.802085	759.9045	0.718684	8.514701	72.89732
MON-07	4.5564	38752.66	12.61288	62.68783	8.929927	678.2528	0.873966	8.952024	62.02325
PJL-01	4.782704	44063.21	25.94795	42.58216	11.63841	632.4353	0.708778	8.047279	136.1342
SDV-44	4.393412	51339.5	30.23245	34.16315	11.82812	833.4008	0.69382	8.249302	62.33352
TAJ-04	3.990934	34946.8	21.88934	56.52275	8.480865	755.409	0.740687	8.199221	81.59722
TAJ-07	3.974143	52525.63	15.88843	49.75877	12.41313	964.3243	0.580839	6.600896	103.9616
TAJ-25	3.973815	49913.4	18.28106	39.80048	13.73063	591.33	0.503857	6.152227	137.5782
TBL-34	3.703626	41154.13	19.82503	41.13341	9.316487	888.9457	0.554105	6.796495	59.44719

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
TBL-48	3.589466	35868.1	6.789503	44.40769	8.712907	797.9559	0.51472	6.126688	69.9863
TBL-56	3.604901	38848.9	19.36167	51.20232	8.942576	642.5784	0.626531	7.561821	55.18223
TUL-05	4.326798	52293.86	22.52348	71.9478	13.06748	1066.997	0.514155	7.561782	117.0788
TUL-11	3.788917	37687.57	17.55416	49.6334	9.905847	917.3581	0.507149	6.62911	108.6365
ANG_001	4.854536	43548.5	37.3055	110.5113	15.37886	271.1897	1.225828	15.6395	135.69
ANG_007	3.920534	53639.77	16.03276	46.47674	8.491005	615.5478	0.6993628	6.797077	54.14956
ANG_008	4.253599	37827.03	18.66452	57.17532	9.269973	777.5996	0.7083193	8.060016	59.87171
ANG_010	4.279035	40448.65	19.45468	41.53304	10.53539	727.6934	0.7989725	8.661774	95.77007
ANG_015	3.84056	38569	22.783	49.87944	11.5352	699.3768	0.6050842	7.48118	61.08605
ATU-35	4.044015	33848.34	11.83316	47.63247	8.798444	672.8801	0.698129	8.176181	51.63285
ATU-40	4.11832	34228.38	21.99662	50.34507	8.643703	798.6008	0.5172886	7.745696	74.41532
CAR_021	4.058737	38525	15.9709	34.74021	9.158779	580.7006	0.6584612	8.042966	59.08487
POR_007	6.220033	31308.3	23.16857	52.80851	8.623668	518.4514	0.9869428	11.20251	49.0648
POR_008	6.728622	28804.66	30.6369	50.17089	8.363816	566.1819	1.180422	13.0577	53.58419
POR_012	4.617346	30414.89	5.507271	39.4144	8.868271	411.4034	0.943423	10.34379	25.47681
POR_013	4.287598	28595.36	10.25313	42.90621	9.292093	303.8345	0.8169168	9.740862	29.79559
POR_014	5.490307	35089.57	17.63296	38.62136	9.825498	335.4635	0.9895044	11.46626	46.85952
PUN-56	4.317248	50345.79	20.82866	45.52637	12.32798	516.5223	0.6820597	6.940735	68.97523
ROQ_002	3.377037	37330.02	16.62712	38.37046	8.923369	726.95	0.575065	7.315211	62.85825
SDV-03	4.162864	47989.26	25.77119	48.49804	11.09052	608.3587	0.4868484	6.368577	67.97517
SDV-10	4.460258	37216.79	26.3333	49.45533	11.92892	595.2143	0.5576895	8.194634	76.98019
SOC-08	4.530895	37646.97	12.67987	39.56231	9.415259	457.6625	0.5910668	7.932229	67.54552
SOC-11	3.797553	36482.52	17.63168	42.0178	8.819236	575.0449	0.569165	7.124414	64.85295
SOC-23	3.691535	53329.82	19.82355	29.61872	12.90739	860.6938	0.5884972	6.874832	77.15937
SOC-24	3.590496	35161.48	17.55983	45.15414	8.069845	579.433	0.5602971	6.968167	57.87115
SOC-30	5.058823	35230.97	12.18801	29.72303	9.85332	588.1581	0.6764663	7.594629	67.83391
SOC-36	3.517716	48907.5	13.49719	31.04561	11.55663	621.7167	0.4289558	5.233968	74.99834
SOC-49	5.222589	31124.44	13.17987	47.5339	8.525722	903.4647	0.8455364	9.297276	56.69883
SOC-51	4.367069	52931.57	16.31885	50.33825	16.18737	741.9827	0.432199	5.664163	86.01238
SOC-54	3.280111	33999.04	16.85433	32.43283	9.543193	527.9893	0.5368035	6.547581	62.67981
SOC-58	3.072396	36745.39	14.34072	32.10687	9.358372	506.9659	0.4204565	5.357948	43.18059
TBL-02	3.483606	37468.38	19.49977	42.81494	8.771503	595.9443	0.5397675	6.54238	70.01376
TUN_001	6.031601	49712.01	39.03568	98.93127	16.45675	358.0343	1.265481	16.25165	131.1366
TUN_002	5.006793	45816.99	39.571	105.6669	15.22781	399.8208	1.114362	15.52559	146.8629

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
TUN_003	5.834576	48799.69	35.8419	111.318	16.41714	230.5355	1.130862	16.2542	136.47
TUN_004	4.797289	45828.16	38.58727	94.86146	15.52408	301.1351	1.139358	15.2488	103.2542
SOL-07	3.991222	48679.77	21.27099	55.01344	15.04868	743.562	0.476347	6.446491	86.02868
SOL-13	3.376857	44546.96	11.19524	54.61946	13.60766	823.207	0.397178	5.309287	72.86721
TBL-50	4.00492	47815.07	18.51914	45.95494	13.88499	796.9202	0.599113	7.32307	85.10449
CAR_010	4.190377	57849.57	18.27578	20.99668	17.65735	449.339	0.5192266	6.768057	99.19864
SOC-19	3.186302	50390.34	11.48975	31.30225	16.0172	536.4819	0.60953	4.963377	63.62516
SOC-45	4.49593	50101.37	15.81127	40.61398	15.71147	719.791	0.5392389	6.398104	73.35401
ECU_002	3.619397	64952.49	19.7948	41.62603	26.28189	488.7527	0.2959182	5.005541	76.1098
ECU_003A	3.797081	48491.08	17.2059	39.60136	15.21869	389.4299	0.5785171	6.290069	84.744
ECU_003B	4.057003	48212.41	14.05622	32.6669	15.51618	322.2769	0.5653988	6.145215	82.66709
ECU_003C	3.405593	45774.7	16.48936	44.02312	14.84237	475.7884	0.4157396	5.385695	82.0004
ECU_004A	4.846957	53305.01	18.72834	32.69984	14.92844	486.9327	0.6160012	7.507099	98.76415
ECU_004B	4.407403	53050.05	16.79125	30.89747	14.89913	530.0939	0.5909103	7.27088	99.42092
ECU_005A	4.459012	66853.96	37.05013	126.0354	26.36055	206.3661	1.106047	15.69906	142.3278
ECU_005B	5.361894	43141.03	42.03576	138.9948	15.22293	291.1584	1.077393	14.68629	96.00948
ECU_005C	5.96301	40583.75	34.36266	128.7286	15.97993	287.5027	1.134464	12.09856	117.9747
ECU_005D	2.917927	31016.99	10.43248	21.36518	10.10472	494.4935	0.2307277	1.593519	64.70045
ECU_005E	5.420686	42913.15	39.9436	116.4534	15.15288	333.8299	1.081059	13.23541	94.24207
ECU_006A	3.741862	39957.06	12.87289	38.04355	10.34387	449.1948	0.5916066	7.026158	82.28024
ECU_006B	4.748878	48835.64	20.82489	39.46639	11.20461	579.8422	0.7799534	8.641798	84.48113
ECU_006C	2.745868	49331.88	13.76726	41.12157	20.10756	592.3517	0.4111928	3.408889	96.90374
ECU_006D	3.818837	45357.3	12.90249	22.16621	17.04338	293.545	0.4413328	4.436295	70.99173
ECU_006E	4.182814	46254.96	21.64902	25.40732	12.67809	531.9609	0.6701371	7.195895	78.76474
ECU_008A	3.580126	38119.67	15.07565	42.54745	10.46951	718.4028	0.5354555	6.808266	63.34162
ECU_008B	3.481601	71785.27	11.80059	26.86905	12.52929	812.5706	0.4759634	4.172101	55.64378
ECU_009A	3.396511	48695.21	15.51694	32.69923	15.69445	631.1627	0.3689945	5.74542	79.43607
ECU_009B	3.992342	43567.45	16.69239	41.69212	12.92287	600.2125	0.5129598	7.678044	60.5716
ECU_010B	3.604161	45003.67	16.65609	32.65984	13.52255	659.212	0.5504323	5.208658	70.67411
ECU_011	4.830259	50652.61	26.93802	54.85944	12.48981	831.395	0.7504526	9.712605	86.77623
ECU_012	4.35962	54013.35	23.67121	52.88919	13.68541	759.8131	0.6415244	8.00341	90.44711
ECU_013A	4.194009	51205.19	25.75576	52.81547	12.35164	803.3941	0.5966572	7.420045	71.06008
ECU_013B	3.627088	50130.44	23.40541	38.6664	12.84254	808.2319	0.5169715	6.048001	85.99191
ECU_014A	4.282566	39394.99	18.12777	54.8961	9.383787	688.373	0.6272786	8.753938	86.5271

Table B.3: INAA Values and Mahalanobis Distance Results, Part 3 (continued)

INAA ID	Hf *482.2 keV*	Fe *1099.3 keV*	Nd *91.1 keV*	Rb *1076.7 keV*	Sc *889.3 keV*	Sr *514 keV*	Ta *1221.4 keV*	Th *312 keV*	Zn *1115.5 keV*
ECU_014B	4.075438	37200.53	22.62605	46.26857	10.15208	977.3901	0.6810933	7.922178	74.6697
ECU_014C	3.686493	38022.2	19.21971	54.23232	12.1568	594.6161	0.3720305	4.897276	107.1104
ECU_016B	3.402645	35265.43	18.45428	42.79414	13.3856	552.5148	0.5497168	5.517217	100.1764
ECU_016C	3.537242	46030.18	17.40298	60.78438	12.76883	691.6239	0.5218984	5.418118	81.67186
ECU_018A	4.839504	43974.31	21.25784	52.26589	11.85814	727.8445	0.7169663	9.366412	85.6808
ECU_018B	4.350503	44757	25.55386	46.955	11.73174	782.6232	0.670121	8.67783	101.7498
ECU_018C	4.792417	43271.84	21.85991	47.566	11.45968	896.3329	0.7516152	8.550086	131.8288
ECU_018D	4.602766	43076.91	22.64103	43.50381	11.32053	725.7537	0.6851389	8.679603	106.9219
ECU_018E	4.718417	44001.65	29.09029	47.91693	11.41246	637.0247	0.6236473	8.829616	83.74348
ECU_018F	4.620046	43288.33	24.41929	44.15728	11.48177	801.9188	0.7182206	8.713451	104.3593
ECU_018G	4.530237	42174.34	23.79141	47.94846	11.03976	814.9016	0.69362	8.839695	379.0005
ECU_018H	4.591313	44824.46	23.34184	48.12431	11.71408	699.3347	0.7071283	8.91263	77.67077
ECU_018I	3.212896	45961.65	15.73997	31.92496	11.96813	809.5597	0.4863119	5.71496	92.85456
ECU_019A	15.41126	39463.48	61.86742	78.87888	13.69198	175.6223	2.805119	32.22079	76.83428
ECU_019B	14.7369	36512.53	65.32735	80.38512	12.97756	171.792	2.679377	31.24036	59.24009
ECU_019C	15.14885	37826.37	72.31425	84.17041	13.21454	177.7426	2.718689	31.74337	65.61865
ECU_020A	6.073688	67412.58	16.26026	10.02662	19.55834	162.3959	1.048927	11.35508	88.8876
ECU_020B	3.410771	36889.27	19.40292	45.16035	11.25631	491.7294	0.442317	6.297679	92.93265
ECU_020C	2.969285	40984.14	12.32885	41.78323	12.47859	572.2087	0.3717629	4.374085	90.16404
ECU_021A	3.39302	35833.99	15.69452	49.37181	9.823421	725.1547	0.5035062	6.545418	67.49677
ECU_021B	3.230508	42233.89	18.73031	45.84284	12.74478	749.993	0.4170147	4.933262	101.1717
ECU_022A	3.21043	68689.27	16.06334	24.8559	30.5136	293.8986	0.2863816	4.579677	70.35905
ECU_022B	3.108179	70159.67	19.95246	30.15316	32.18768	283.0141	0.3487962	5.597215	67.69094

APPENDIX C:

Quality Assurance Tables

Table C.1: Check Standard Quality Assurance Values, PT Count (Consensus Values from Glascock 2006)

INAA ID	Batch	Al	Ca	Ti	V
		1779	***3084.54***	***320.1***	***1434.1***
NORC	RC1950-1	99743	1631	7672	210.18
NORC	RC1950-3	98334	1404	7179	213.91
NORC	RC1950-5	95558	1634	6750	199.47
NORC	RC1950-7	100078	1663	6274	209.32
NORC	RC1950-9	97071	1746	6338	211.06
NORC	RC1950-11	96805	1357	6605	212.94
NORC	RC1950-13	95758	1492	6536	195.52
NORC	RC1950-15	98043	1117	6007	204.91
NORC	RC1950-17	96396	1613	6586	209.35
NORC	RC1950-19	98312	1612	6089	207.83
NORC	RC1950-21	97935	1671	6830	195.05
NORC	RC1950-23	96222	1864	6641	198.98
NORC	RC1950-25	99147	1355	6163	214.81
NORC	RC1950-27	99719	1806	6230	203.43
NORC	RC1950-29	102068	1416	6316	204.74
NORC	RC1950-31	96491	1443	7001	192.30
	Mean	97980	1552	6576	205
	St. Dev.	1820	195	441	7
	CV	0.02	0.13	0.07	0.03
	Consensus	-	-	5940 ± 630	211 ± 26
INAA ID	**Batch**	**Al**	**Ca**	**Ti**	**V**
		1779	***3084.54***	***320.1***	***1434.1***
NIST1633B	RC1950-1	145607	12111	7862	298.32
NIST1633B	RC1950-3	147305	15253	7839	304.26
NIST1633B	RC1950-5	147086	16070	7799	286.92
NIST1633B	RC1950-7	151374	15041	8125	306.00
NIST1633B	RC1950-9	146494	11546	7548	304.72
NIST1633B	RC1950-11	147411	15931	7950	292.73
NIST1633B	RC1950-13	147941	15150	7298	303.34
NIST1633B	RC1950-15	147134	-4245	7249	310.21
NIST1633B	RC1950-17	146308	13547	7725	291.80
NIST1633B	RC1950-19	147233	14665	7326	300.94
NIST1633B	RC1950-21	148778	12617	7645	308.30
NIST1633B	RC1950-23	147658	11405	7256	297.45
NIST1633B	RC1950-25	147280	12993	7576	307.61
NIST1633B	RC1950-27	150441	9175	8430	305.38
NIST1633B	RC1950-29	149169	12103	7413	305.81
NIST1633B	RC1950-31	148165	13186	8136	292.33
	Mean	147836	12284	7699	301.01
	St. Dev.	1492.45	4797.22	350.95	6.96
	CV	0.01	0.39	0.05	0.02
	Consensus	148000	16100	7300	300

Table C.2: Check Standard Quality Assurance Values, H2 Count (Consensus Values from Glascock 2006)

INAA ID	Batch	Dy	Mn	K	Na
		94.7	***846.8***	***1524.6***	***1368.6***
NORC	RC1950-1	7.64	270.38	36895	1435
NORC	RC1950-3	7.58	261.64	36319	1496
NORC	RC1950-5	7.09	264.16	30640	1375
NORC	RC1950-7	6.64	272.56	37496	1463
NORC	RC1950-9	7.11	252.66	29981	1439
NORC	RC1950-11	7.05	273.71	36970	1462
NORC	RC1950-13	6.98	262.72	35166	1418
NORC	RC1950-15	8.04	282.94	36041	1414
NORC	RC1950-17	8.17	277.18	37383	1527
NORC	RC1950-19	7.88	270.90	35838	1449
NORC	RC1950-21	6.99	268.45	40534	1422
NORC	RC1950-23	7.03	260.61	35656	1452
NORC	RC1950-25	9.64	279.25	43509	1371
NORC	RC1950-27	8.00	267.54	37350	1421
NORC	RC1950-29	7.04	49.43	-7141	-102
NORC	RC1950-31	6.83	261.00	33824	1440
	Mean	7.48	254.69	33528.89	1342.77
	St. Dev.	0.75	55.30	11310.11	387.27
	CV	0.10	0.22	0.34	0.29
	Consensus	7.40	253.00	35500.00	1400.00
INAA ID	**Batch**	**Dy**	**Mn**	**K**	**Na**
		94.7	***846.8***	***1524.6***	***1368.6***
NIST688	RC1950-1	3.01	1296.24	-4632	14287
NIST688	RC1950-3	3.43	1300.58	-4469	15029
NIST688	RC1950-5	3.04	1298.34	-4631	14424
NIST688	RC1950-7	3.42	1323.29	-4635	14752
NIST688	RC1950-9	3.54	1270.06	-4434	14064
NIST688	RC1950-11	3.58	1300.88	-4942	14839
NIST688	RC1950-13	4.98	1292.14	-4904	14499
NIST688	RC1950-15	3.33	1339.48	-4375	14700
NIST688	RC1950-17	3.94	1317.92	-4767	14795
NIST688	RC1950-19	2.83	1269.90	-4772	14193
NIST688	RC1950-21	1.62	991.28	-5229	11823
NIST688	RC1950-23	3.78	1301.61	-4326	14657
NIST688	RC1950-25	3.67	1341.17	-8226	14924
NIST688	RC1950-27	4.20	1309.35	-6161	14680
NIST688	RC1950-29	4.70	1346.48	-10724	14700
NIST688	RC1950-31	3.03	1282.08	-4465	14543
	Mean	3.51	1286.30	-5355.87	14431.78
	St. Dev.	0.78	82.01	1728.27	743.39
	CV	0.22	0.06	-0.32	0.05
	Consensus	3.30	1250.00	-	-

Table C.2: Check Standard Quality Assurance Values, H2 Count (continued)

INAA ID	Batch	Dy	Mn	K	Na
		94.7	***846.8***	***1524.6***	***1368.6***
NIST1633B	RC1950-1	15.90	138.56	20191	1950
NIST1633B	RC1950-3	14.96	138.83	20234	1931
NIST1633B	RC1950-5	15.56	135.08	20840	1842
NIST1633B	RC1950-7	14.36	149.21	20459	2143
NIST1633B	RC1950-9	14.96	136.01	17307	1915
NIST1633B	RC1950-11	15.96	141.77	20310	1993
NIST1633B	RC1950-13	16.07	138.69	18628	1892
NIST1633B	RC1950-15	16.18	146.24	20005	1921
NIST1633B	RC1950-17	15.30	146.59	16056	1923
NIST1633B	RC1950-19	14.80	141.75	18280	1933
NIST1633B	RC1950-21	16.51	152.55	18642	2001
NIST1633B	RC1950-23	16.00	140.28	18291	1945
NIST1633B	RC1950-25	15.08	147.51	12930	1964
NIST1633B	RC1950-27	16.18	141.68	17917	2069
NIST1633B	RC1950-29	17.21	146.18	29635	1930
NIST1633B	RC1950-31	14.76	139.27	19001	1945
	Mean	15.61	142.51	19295.37	1956.12
	St. Dev.	0.76	4.99	3403.16	70.36
	CV	0.05	0.04	0.18	0.04
	Consensus	15.5	143	20000	1940

Table C.3.1: Check Standard Quality Assurance Values, Week 1 Count, Part 1

INAA ID	Batch	As	Ba_123	Ba_496	La	Lu	Nd
		559.1	***123.8***	***496.3***	***1596.5***	***208.4***	***531***
NORC	RC1950-2	14.76	547.32	581.37	47.52	0.56	41.37
NORC	RC1950-4	14.67	594.54	665.15	49.69	0.56	48.83
NORC	RC1950-6	14.90	643.48	677.17	50.74	0.61	48.28
NORC	RC1950-8	14.95	666.37	670.39	51.95	0.61	66.19
NORC	RC1950-10	15.37	607.99	596.52	50.92	0.56	50.63
NORC	RC1950-12	14.92	576.11	567.96	49.43	0.55	38.22
NORC	RC1950-14	15.86	690.05	548.90	49.26	0.57	45.37
NORC	RC1950-16	14.53	717.15	583.29	49.95	0.59	37.49
NORC	RC1950-18	15.16	621.91	611.71	49.92	0.65	48.45
NORC	RC1950-20	13.98	591.36	627.91	49.36	0.56	56.63
NORC	RC1950-22	14.82	648.84	639.40	51.26	0.59	43.04
NORC	RC1950-24	15.18	564.65	623.37	49.81	0.57	57.71
NORC	RC1950-26	15.77	632.83	680.31	52.34	0.62	-19.28
NORC	RC1950-28	15.06	596.85	537.53	50.75	0.60	53.42
NORC	RC1950-30	14.79	626.28	563.41	49.85	0.56	53.64
NORC	RC1950-32	13.90	702.18	625.44	51.73	0.62	35.47
	Mean	14.91	626.75	612.49	50.28	0.59	44.09
	St. Dev.	0.53	49.35	46.40	1.22	0.03	18.78
	CV	0.04	0.08	0.08	0.02	0.05	0.43
	Consensus	14.80	-	612.00	50.10	0.59	46.10

Table C.3.1: Check Standard Quality Assurance Values, Week 1 Count, Part 1 (continued)

INAA ID	Batch	As	Ba_123	Ba_496	La	Lu	Nd
		559.1	***123.8***	***496.3***	***1596.5***	***208.4***	***531***
NIST688	RC1950-2	-3.77	261.52	177.59	5.31	0.29	-21.26
NIST688	RC1950-4	-2.20	182.64	99.85	5.36	0.30	-20.67
NIST688	RC1950-6	3.38	197.81	200.65	5.43	0.28	-17.75
NIST688	RC1950-8	2.97	131.49	166.04	5.29	0.29	-26.67
NIST688	RC1950-10	-3.71	229.22	-95.57	5.11	0.27	-19.38
NIST688	RC1950-12	-2.11	213.87	176.56	5.23	0.26	-18.79
NIST688	RC1950-14	-3.74	208.36	235.86	5.32	0.27	-21.22
NIST688	RC1950-16	2.63	248.75	163.50	5.13	0.26	-20.73
NIST688	RC1950-18	-2.18	252.46	169.43	5.15	0.28	-19.51
NIST688	RC1950-20	-1.91	241.98	276.13	5.26	0.29	-23.11
NIST688	RC1950-22	-2.14	166.97	189.65	5.19	0.29	-18.11
NIST688	RC1950-24	-2.13	188.51	-101.82	5.25	0.30	-19.92
NIST688	RC1950-26	-2.39	233.27	-147.61	5.28	0.28	-22.84
NIST688	RC1950-28	-2.16	153.33	85.12	5.31	0.28	-20.32
NIST688	RC1950-30	-3.47	224.77	188.21	5.11	0.28	-23.19
NIST688	RC1950-32	-3.63	205.52	-127.45	5.25	0.26	-23.14
	Mean	-1.66	208.78	103.51	5.25	0.28	-21.04
	St. Dev.	2.41	37.16	139.66	0.09	0.01	2.31
	CV	-1.45	0.18	1.35	0.02	0.05	-0.11
	Consensus	2.40	-	-	5.30	0.32	8.90
INAA ID	**Batch**	**As**	**Ba_123**	**Ba_496**	**La**	**Lu**	**Nd**
		559.1	***123.8***	***496.3***	***1596.5***	***208.4***	***531***
NIST1633B	RC1950-2	128.39	775.42	664.04	83.31	1.04	75.25
NIST1633B	RC1950-4	127.31	712.24	606.40	83.10	1.04	97.12
NIST1633B	RC1950-6	138.88	816.97	750.14	86.63	1.10	72.77
NIST1633B	RC1950-8	132.67	780.06	634.16	86.69	1.05	73.49
NIST1633B	RC1950-10	128.26	821.11	666.14	82.18	1.00	89.84
NIST1633B	RC1950-12	128.27	788.66	574.90	83.72	0.95	80.82
NIST1633B	RC1950-14	131.24	850.35	729.58	85.51	1.00	77.75
NIST1633B	RC1950-16	129.08	773.70	769.18	85.79	1.07	76.36
NIST1633B	RC1950-18	131.27	764.20	671.13	82.98	1.01	111.78
NIST1633B	RC1950-20	130.88	809.53	718.02	84.54	1.00	91.58
NIST1633B	RC1950-22	129.60	805.24	651.23	84.54	1.01	83.63
NIST1633B	RC1950-24	130.11	713.94	652.38	85.83	1.05	81.05
NIST1633B	RC1950-26	126.97	658.07	764.37	82.85	0.97	67.74
NIST1633B	RC1950-28	128.89	724.67	687.96	84.17	1.00	88.35
NIST1633B	RC1950-30	131.19	761.35	690.41	83.80	1.04	103.66
NIST1633B	RC1950-32	135.82	875.34	680.15	87.93	1.06	84.65
	Mean	130.55	776.93	681.89	84.60	1.02	84.74
	St. Dev.	3.14	55.42	54.58	1.64	0.04	11.90
	CV	0.02	0.07	0.08	0.02	0.04	0.14
	Consensus	132	-	683	85.5	1.05	82

Table C.3.2: Check Standard Quality Assurance Values, Week 1 Count, Part 2

INAA ID	Batch	K	Sm	Na	U_228	U_277	Yb
		1524.6	***103.2***	***1368.6***	***228.2***	***277.6***	***396.3***
NORC	RC1950-2	35481	8.32	1371	2.96	3.02	4.09
NORC	RC1950-4	35510	9.17	1408	3.28	3.21	4.45
NORC	RC1950-6	41585	9.24	1481	3.41	3.98	4.77
NORC	RC1950-8	33711	9.75	1452	3.79	3.15	4.27
NORC	RC1950-10	35873	9.70	1427	3.05	3.76	4.09
NORC	RC1950-12	32494	8.75	1440	3.09	3.42	4.10
NORC	RC1950-14	34220	8.89	1397	3.79	3.68	4.07
NORC	RC1950-16	41257	9.69	1459	3.34	3.16	4.02
NORC	RC1950-18	36033	9.25	1441	3.22	2.89	4.46
NORC	RC1950-20	38344	9.18	1410	3.17	3.46	4.08
NORC	RC1950-22	34270	9.43	1424	3.18	3.67	4.05
NORC	RC1950-24	36116	9.36	1440	3.10	3.39	4.04
NORC	RC1950-26	36264	9.55	1515	4.52	3.79	4.52
NORC	RC1950-28	38064	9.61	1479	2.55	3.22	4.22
NORC	RC1950-30	32979	9.53	1315	3.10	2.47	4.08
NORC	RC1950-32	43508	9.93	1325	2.13	3.99	4.31
	Mean	36606.73	9.33	1423.95	3.23	3.39	4.23
	St. Dev.	3188.50	0.42	53.45	0.53	0.41	0.22
	CV	0.09	0.04	0.04	0.16	0.12	0.05
	Consensus	34600	9.17	1357.00	3.24	3.24	4.32
INAA ID	**Batch**	**K**	**Sm**	**Na**	**U_228**	**U_277**	**Yb**
		1524.6	***103.2***	***1368.6***	***228.2***	***277.6***	***396.3***
NIST688	RC1950-2	-34363	2.36	15651	-0.89	-0.87	2.06
NIST688	RC1950-4	-12862	2.57	15336	-0.70	-0.70	2.22
NIST688	RC1950-6	-13284	2.49	16137	-0.76	-0.78	2.11
NIST688	RC1950-8	-8864	2.76	14125	-0.90	0.93	2.15
NIST688	RC1950-10	-31506	2.64	15290	-0.88	-0.87	1.99
NIST688	RC1950-12	-11855	2.34	15298	-0.67	-0.68	2.38
NIST688	RC1950-14	-29704	2.56	14935	-0.90	-0.90	2.14
NIST688	RC1950-16	-12308	2.42	15164	-0.81	-0.89	2.11
NIST688	RC1950-18	-12671	2.58	15578	-0.80	-0.75	2.06
NIST688	RC1950-20	-10329	2.55	15338	-0.73	-0.73	2.37
NIST688	RC1950-22	-11017	2.52	15199	-0.78	-0.75	2.04
NIST688	RC1950-24	-11058	2.58	15626	-0.77	-0.79	2.14
NIST688	RC1950-26	-10250	2.56	15141	-1.05	-1.06	2.25
NIST688	RC1950-28	-13872	2.52	15489	-0.74	-0.72	2.41
NIST688	RC1950-30	-23247	2.58	14917	-0.88	-0.93	2.15
NIST688	RC1950-32	-29865	2.56	15519	-1.10	-1.26	2.13
	Mean	-17315.97	2.54	15296.45	-0.84	-0.73	2.17
	St. Dev.	8987.07	0.10	432.72	0.12	0.47	0.12
	CV	-0.52	0.04	0.03	-0.14	-0.64	0.06
	Consensus		2.40	15800	-	-	2.03

Table C.3.2: Check Standard Quality Assurance Values, Week 1 Count, Part 2 (continued)

INAA ID	Batch	K	Sm	Na	U_228	U_277	Yb
		1524.6	***103.2***	***1368.6***	***228.2***	***277.6***	***396.3***
NIST1633B	RC1950-2	-34790	17.92	1937	8.79	8.08	7.18
NIST1633B	RC1950-4	-11789.30	18.18	1868.04	8.90	8.60	7.25
NIST1633B	RC1950-6	18496.42	19.49	2066.46	10.13	9.43	7.14
NIST1633B	RC1950-8	14476.41	19.36	1751.30	9.02	9.44	8.67
NIST1633B	RC1950-10	-30069.83	18.13	1834.07	8.55	8.46	7.03
NIST1633B	RC1950-12	-10599.36	17.88	1984.45	8.89	8.38	7.28
NIST1633B	RC1950-14	-27624.25	18.68	2055.50	9.51	8.76	7.45
NIST1633B	RC1950-16	-10822	18.43	1927	8.76	9.31	7.06
NIST1633B	RC1950-18	15379	18.48	1976	9.20	8.31	7.46
NIST1633B	RC1950-20	21176	18.23	1954	9.37	9.19	7.20
NIST1633B	RC1950-22	-10049	18.35	1860	8.88	8.60	7.16
NIST1633B	RC1950-24	-9940	18.78	1937	9.16	9.10	7.90
NIST1633B	RC1950-26	-9465	18.21	1871	7.62	8.57	7.87
NIST1633B	RC1950-28	18891	18.60	1953	8.86	9.11	7.32
NIST1633B	RC1950-30	-21552	18.42	1960	8.44	8.23	7.37
NIST1633B	RC1950-32	-30600	18.76	1949	9.06	8.90	8.30
	Mean	-7430.08	18.49	1930.23	8.95	8.78	7.48
	St. Dev.	19401.85	0.45	79.71	0.54	0.44	0.47
	CV	-2.61	0.02	0.04	0.06	0.05	0.06
	Consensus	20000	18.60	1940	8.80	8.80	7.43

Table C.4.1: Check Standard Quality Assurance Values, Week 4 Count, Part 1

INAA ID	Batch	Sb	Ba	Ce	Cs	Cr	Co	Eu	Hf	Fe	Nd
		1691	***496.3***	***145.4***	***795.9***	***320.1***	***1332.5***	***1408***	***482.2***	***1099.3***	***91.1***
NORC	RC1950-2	1.25	592.29	114.06	9.93	91.11	23.07	1.74	8.23	51685	48.13
NORC	RC1950-4	1.08	656.72	113.98	9.69	95.31	23.02	1.75	7.68	51839	44.75
NORC	RC1950-6	1.10	584.69	114.72	10.61	94.22	23.33	1.71	7.98	51681	45.67
NORC	RC1950-8	1.19	799.17	117.50	10.41	98.11	23.27	1.88	8.22	52604	53.57
NORC	RC1950-10	1.17	640.38	111.59	9.82	93.01	22.59	1.67	6.93	50029	53.56
NORC	RC1950-12	1.00	576.38	117.24	10.39	94.38	22.95	1.74	7.59	52176	49.83
NORC	RC1950-14	1.16	531.91	108.02	10.06	90.99	24.14	1.70	7.79	49692	44.44
NORC	RC1950-16	1.10	679.81	111.68	10.55	95.01	22.55	1.75	7.31	50550	55.19
NORC	RC1950-18	1.00	655.49	109.23	10.22	90.08	22.30	1.68	7.10	51027	39.00
NORC	RC1950-20	1.11	582.91	114.33	10.71	90.89	22.97	1.80	7.77	51351	42.95
NORC	RC1950-22	1.08	504.40	116.31	10.36	91.09	22.69	1.77	7.34	50532	50.65
NORC	RC1950-24	1.14	530.88	111.90	10.30	88.98	22.68	1.73	7.12	50407	45.01
NORC	RC1950-26	1.15	667.46	116.46	10.98	96.91	23.21	1.83	7.78	52136	49.13
NORC	RC1950-28	1.34	604.74	116.99	10.86	97.98	23.35	1.74	7.30	51943	48.00
NORC	RC1950-30	1.20	458.66	115.00	9.94	95.96	22.71	1.90	7.45	51042	50.91
NORC	RC1950-32	1.04	775.53	118.21	10.54	93.32	22.31	1.82	7.25	50515	56.28
	Mean	1.13	615.09	114.20	10.34	93.58	22.95	1.76	7.55	51200.6	48.57
	St. Dev.	0.09	91.43	3.01	0.37	2.86	0.46	0.07	0.39	853.03	4.77
	CV	0.08	0.15	0.03	0.04	0.03	0.02	0.04	0.05	0.02	0.10
	Consensus	1.10	612.0	112.3	10.1	90.20	22.7	1.72	7.34	50480.0	46.1

Table C.4.1: Check Standard Quality Assurance Values, Week 4 Count, Part 1 (continued)

INAA ID	Batch	Sb	Ba	Ce	Cs	Cr	Co	Eu	Hf	Fe	Nd
		1691	***496.3***	***145.4***	***795.9***	***320.1***	***1332.5***	***1408***	***482.2***	***1099.3***	***91.1***
NIST688	RC1950-2	-0.26	-267.69	8.84	-0.54	323.72	47.81	0.95	1.93	71399	-22.40
NIST688	RC1950-4	-0.23	-230.96	11.59	-0.55	323.91	49.26	1.05	1.44	73271	-18.71
NIST688	RC1950-6	-0.26	-216.12	11.49	-0.57	325.59	47.23	0.99	1.60	72271	-16.66
NIST688	RC1950-8	-0.32	-308.99	11.63	-0.77	321.66	46.30	1.14	1.51	71725	-29.17
NIST688	RC1950-10	-0.24	-228.15	11.06	-0.54	320.56	47.46	1.01	1.98	70077	-17.60
NIST688	RC1950-12	-0.25	-208.45	10.81	-0.58	320.47	48.13	1.08	1.71	71584	-19.15
NIST688	RC1950-14	-0.24	-216.08	9.64	-0.56	312.15	47.34	0.97	1.27	70447	-17.31
NIST688	RC1950-16	-0.28	-205.48	11.10	-0.59	320.16	48.18	1.00	1.62	71912	-15.73
NIST688	RC1950-18	-0.29	-274.91	9.99	-0.57	314.31	46.87	1.00	1.06	69749	-22.04
NIST688	RC1950-20	-0.27	-246.74	11.39	-0.59	321.36	48.17	0.93	1.58	71802	-19.06
NIST688	RC1950-22	-0.25	-225.35	10.31	-0.57	323.45	48.96	1.08	2.03	71367	-19.08
NIST688	RC1950-24	-0.26	-226.61	10.44	-0.61	314.85	48.22	0.98	1.37	72252	-18.37
NIST688	RC1950-26	-0.24	-224.47	10.70	-0.61	318.31	46.73	0.94	1.77	69726	-18.08
NIST688	RC1950-28	-0.25	-228.33	12.71	-0.60	324.34	48.17	1.02	1.35	71102	-16.90
NIST688	RC1950-30	-0.24	-203.86	9.67	-0.55	328.32	47.99	0.93	1.71	71866	-18.83
NIST688	RC1950-32	-0.26	-306.10	11.70	-0.73	328.24	48.86	1.00	1.58	73807	-16.86
	Mean	-0.26	-238.64	10.82	-0.60	321.34	47.86	1.01	1.59	71522.31	-19.12
	St. Dev.	0.02	33.43	0.97	0.07	4.68	0.82	0.06	0.26	1143.05	3.22
	CV	-0.09	-0.14	0.09	-0.11	0.01	0.02	0.06	0.17	0.02	-0.17
	Consensus	260.00	-	12.50	-	321.00	48.00	1.00	1.55	71600	-
INAA ID	**Batch**	**Sb**	**Ba**	**Ce**	**Cs**	**Cr**	**Co**	**Eu**	**Hf**	**Fe**	**Nd**
		1691	***496.3***	***145.4***	***795.9***	***320.1***	***1332.5***	***1408***	***482.2***	***1099.3***	***91.1***
NIST1633B	RC1950-2	4.98	540.66	187.58	10.41	198.96	50.16	4.31	7.33	80403.65	88.75
NIST1633B	RC1950-4	4.52	856.13	180.00	10.04	198.82	48.70	3.93	6.69	77048.41	75.77
NIST1633B	RC1950-6	5.00	681.99	181.78	10.39	192.41	47.96	3.92	6.78	77958.44	78.05
NIST1633B	RC1950-8	4.95	793.43	181.61	10.43	196.66	47.72	4.05	7.13	76331.28	96.41
NIST1633B	RC1950-10	4.70	821.18	181.77	10.00	195.45	48.92	3.89	7.24	77612.48	85.01
NIST1633B	RC1950-12	5.02	654.75	180.00	10.64	190.13	47.92	3.85	7.45	76088.88	96.61
NIST1633B	RC1950-14	4.52	808.94	174.65	10.41	190.09	47.56	3.97	6.47	74948	85.70
NIST1633B	RC1950-16	5.03	653.42	179.48	10.98	188.79	48.34	3.82	7.11	76052	76.35
NIST1633B	RC1950-18	4.98	749.45	172.21	10.73	189.03	46.91	3.76	6.35	74887	108.55
NIST1633B	RC1950-20	4.85	629.55	184.04	11.05	204.21	49.61	3.92	6.65	77594	95.85
NIST1633B	RC1950-22	5.02	622.05	179.65	9.78	193.95	48.89	3.99	7.15	75612	96.63
NIST1633B	RC1950-24	4.94	780.94	181.87	10.21	182.22	48.21	3.95	6.68	76150	77.81
NIST1633B	RC1950-26	4.68	612.70	183.14	10.89	206.62	48.74	4.17	7.09	77338	76.56
NIST1633B	RC1950-28	4.69	501.52	187.68	10.86	206.01	49.39	3.89	7.17	77528	84.01
NIST1633B	RC1950-30	5.08	603.17	186.05	10.77	200.29	49.94	4.14	7.30	77083	86.86
NIST1633B	RC1950-32	5.01	783.42	193.05	11.13	206.69	50.13	4.08	7.30	78389	98.43
	Mean	4.87	693.33	182.16	10.55	196.27	48.69	3.98	6.99	76939.01	87.96
	St. Dev.	0.19	107.17	5.01	0.40	7.33	0.97	0.14	0.34	1390.53	9.88
	CV	0.04	0.15	0.03	0.04	0.04	0.02	0.04	0.05	0.02	0.11
	Consensus	4.85	683	184	10.53	197	48.6	3.93	6.76	77100	82

Table C.4.2: Check Standard Quality Assurance Values, Week 4 Count, Part 2

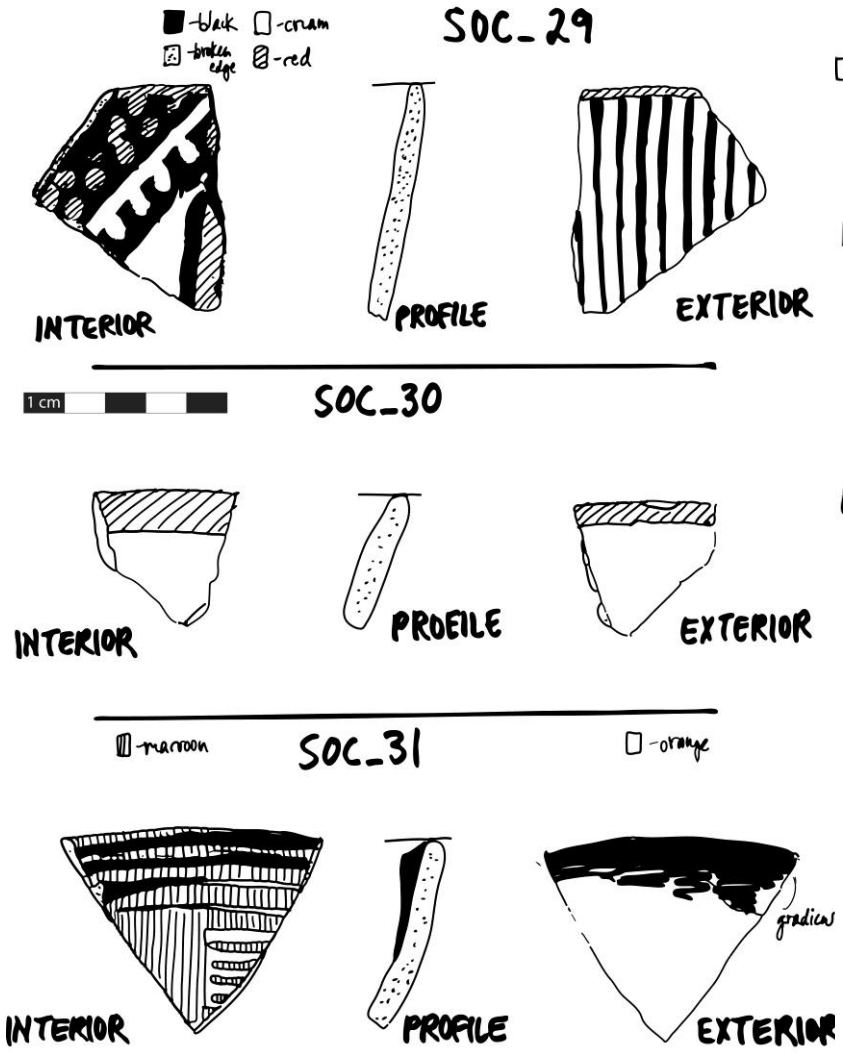
INAA ID	Batch	Ni	Rb	Sc	Sr	Ta	Tb	Th	Zn	Zr
		810.77	***1076.7***	***889.3***	***514***	***1221.4***	***879.4***	***312***	***1115.5***	***756.76***
NORC	RC1950-2	-61.39	156.20	18.54	-226.31	1.37	1.22	15.55	83.51	114.06
NORC	RC1950-4	-59.89	185.84	18.52	-190.22	1.62	1.21	15.85	82.37	119.13
NORC	RC1950-6	0.00	195.33	18.66	-205.97	1.61	1.41	16.21	81.09	220.78
NORC	RC1950-8	-68.44	180.87	18.91	-332.48	1.62	1.21	15.93	84.74	142.37
NORC	RC1950-10	86.40	181.21	18.27	-203.77	1.52	1.43	15.03	92.18	141.22
NORC	RC1950-12	82.06	175.79	18.85	-176.60	1.64	1.26	16.00	84.89	239.10
NORC	RC1950-14	-58.11	169.61	17.92	-202.02	1.45	1.05	14.85	86.91	166.45
NORC	RC1950-16	-70.72	180.22	18.29	-207.73	1.52	1.44	15.10	86.31	0.00
NORC	RC1950-18	-78.58	193.82	18.37	-243.13	1.36	1.15	15.82	79.64	0.00
NORC	RC1950-20	-81.75	165.77	18.55	-244.17	1.43	1.31	15.52	80.74	185.49
NORC	RC1950-22	-57.26	196.42	18.60	-235.24	1.50	1.39	15.52	77.39	146.30
NORC	RC1950-24	-57.27	195.23	18.22	-249.50	1.47	1.30	15.53	81.45	0.00
NORC	RC1950-26	-59.67	191.79	18.65	-251.19	1.51	1.18	15.56	82.82	160.87
NORC	RC1950-28	-62.39	191.88	18.85	-265.63	1.40	1.36	16.30	82.80	205.34
NORC	RC1950-30	-61.36	176.29	18.47	-212.15	1.56	1.24	15.92	85.34	106.37
NORC	RC1950-32	0.00	197.79	18.66	-229.58	1.55	1.38	16.04	153.66	-141.01
	Mean	-38.02	183.38	18.52	-229.73	1.51	1.28	15.67	87.87	149.81
	St. Dev.	52.99	12.34	0.26	36.80	0.09	0.11	0.42	17.87	100.71
	CV	-1.39	0.07	0.01	-0.16	0.06	0.09	0.03	0.20	0.67
	Consensus	76	180.8	18.30	-	1.49	1.24	14.9	92.8	179.0
INAA ID	**Batch**	**Ni**	**Rb**	**Sc**	**Sr**	**Ta**	**Tb**	**Th**	**Zn**	**Zr**
		810.77	***1076.7***	***889.3***	***514***	***1221.4***	***879.4***	***312***	***1115.5***	***756.76***
NIST688	RC1950-2	146.82	-18.04	36.47	-308.36	0.14	-0.40	-0.45	112.53	-151.10
NIST688	RC1950-4	147.83	-16.71	36.87	-250.10	0.29	-0.41	-0.41	15.58	-153.51
NIST688	RC1950-6	0.00	-16.75	36.60	-270.68	0.28	-0.41	-0.40	101.99	-151.95
NIST688	RC1950-8	89.94	-21.79	35.94	-432.32	0.21	-0.54	-0.56	23.09	-183.07
NIST688	RC1950-10	103.55	-15.12	36.00	-271.44	0.15	-0.39	-0.39	116.53	-147.65
NIST688	RC1950-12	107.88	-15.69	36.47	-233.73	0.26	-0.42	-0.39	110.02	-163.26
NIST688	RC1950-14	199.76	-15.53	36.26	-275.08	0.15	-0.40	-0.39	99.49	-152.60
NIST688	RC1950-16	94.48	-16.98	36.98	-278.54	0.31	-0.43	-0.38	103.23	0.00
NIST688	RC1950-18	-104.76	-19.20	35.71	-325.32	-0.16	-0.42	-0.44	100.96	0.00
NIST688	RC1950-20	109.18	-17.02	36.68	-323.12	0.16	-0.40	-0.44	102.38	-192.88
NIST688	RC1950-22	127.98	-17.34	36.94	-309.45	0.17	0.32	-0.41	81.30	-189.66
NIST688	RC1950-24	97.88	-17.71	37.00	-343.58	0.22	-0.43	-0.42	99.60	0.00
NIST688	RC1950-26	137.31	-17.22	35.51	-330.90	0.15	0.55	-0.41	102.48	-162.49
NIST688	RC1950-28	149.07	-17.27	36.53	-354.46	-0.15	0.45	-0.41	102.03	-181.96
NIST688	RC1950-30	160.90	-16.34	36.65	-289.79	0.23	0.61	-0.41	116.69	-139.53
NIST688	RC1950-32	0.00	-21.11	37.89	-311.88	-0.19	0.56	-0.51	149.03	-188.43
	Mean	97.99	-17.49	36.53	-306.80	0.14	-0.13	-0.43	96.06	-134.88
	St. Dev.	75.23	1.84	0.58	47.47	0.16	0.45	0.05	33.05	68.95
	CV	0.77	-0.11	0.02	-0.15	1.16	-3.32	-0.11	0.34	-0.51
	Consensus	152.00	-	36.60	-	0.31	-	-	81.00	-

Table C.4.2: Check Standard Quality Assurance Values, Week 4 Count, Part 2 (continued)

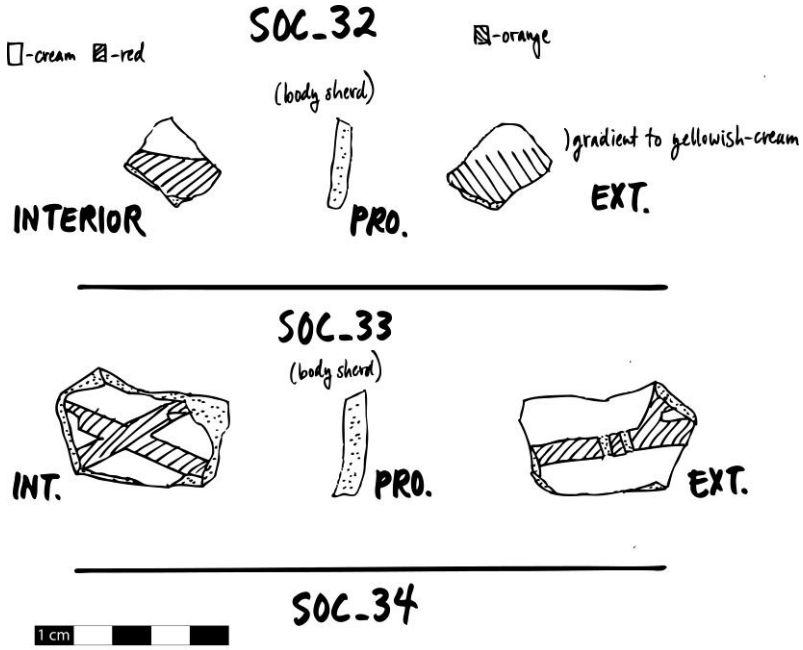
INAA ID	Batch	Ni	Rb	Sc	Sr	Ta	Tb	Th	Zn	Zr
		810.77	***1076.7***	***889.3***	***514***	***1221.4***	***879.4***	***312***	***1115.5***	***756.76***
NIST1633B	RC1950-2	90.31	137.15	41.11	1045.98	1.71	2.80	25.80	225.81	234.27
NIST1633B	RC1950-4	138.47	127.81	40.08	1146.23	1.81	2.64	25.03	209.29	165.10
NIST1633B	RC1950-6	0.00	148.00	40.17	991.30	1.95	2.77	25.27	210.34	164.10
NIST1633B	RC1950-8	96.04	141.59	40.57	884.80	1.71	2.75	25.70	230.99	200.16
NIST1633B	RC1950-10	79.40	143.38	40.23	1052.50	1.82	2.80	24.39	221.55	165.07
NIST1633B	RC1950-12	93.14	131.44	39.95	745.21	2.14	2.81	24.54	208.77	191.88
NIST1633B	RC1950-14	82.15	131.13	39.33	988.47	1.79	2.70	23.88	197.26	161.20
NIST1633B	RC1950-16	99.68	145.05	39.94	1204.58	2.07	2.86	24.59	204.49	0.00
NIST1633B	RC1950-18	109.39	120.47	38.79	1260.59	1.67	2.85	24.45	195.89	0.00
NIST1633B	RC1950-20	117.32	145.82	40.53	1279.32	1.97	2.86	25.25	208.30	211.66
NIST1633B	RC1950-22	80.93	158.25	40.09	934.18	1.73	2.59	24.76	180.38	339.31
NIST1633B	RC1950-24	119.14	154.89	40.13	1016.45	1.76	2.59	24.38	223.02	0.00
NIST1633B	RC1950-26	70.69	144.37	40.42	1095.80	1.66	2.52	25.28	222.59	174.36
NIST1633B	RC1950-28	89.28	159.09	40.54	1238.28	1.85	2.47	25.45	229.48	-199.96
NIST1633B	RC1950-30	88.72	143.35	41.30	1013.21	1.82	2.92	25.61	209.94	-153.61
NIST1633B	RC1950-32	0.00	153.18	41.76	991.63	2.09	2.99	26.32	143.61	-202.96
	Mean	96.76	142.81	40.31	1055.53	1.85	2.74	25.04	207.61	90.66
	St. Dev.	37.27	11.03	0.71	144.66	0.15	0.15	0.65	21.79	163.86
	CV	0.39	0.08	0.02	0.14	0.08	0.05	0.03	0.10	1.81
	Consensus	116	138.5	40.2	1036	1.84	2.73	24.4	206	223

APPENDIX D:

Ceramic Sample Drawings


-black
-cream
-broken edge
-red
SOC_29
INTERIOR
PROFILE
EXTERIOR
1 cm
SOC_30
INTERIOR
PROEILE
EXTERIOR
-maroon
SOC_31
-orange
gradient
INTERIOR
PROFILE
EXTERIOR

1


-cream
-red
SOC_32
-orange
(body sherd)
gradient to yellowish-cream
INTERIOR
PRO.
EXT.
SOC_33
(body sherd)
INT.
PRO.
EXT.
1 cm
SOC_34
carbonized exterior
INT.
PRO
EXT.

2

SOC_35

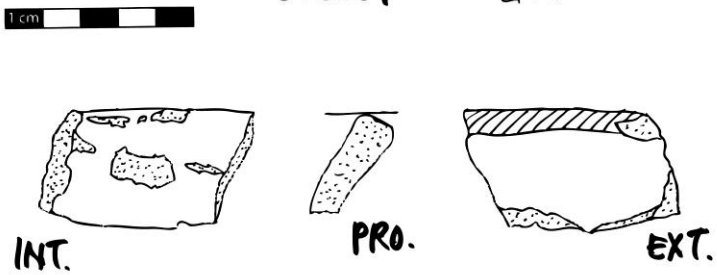
carbonized exterior

SOC_36

carbonized exterior

SOC_37

☒-red

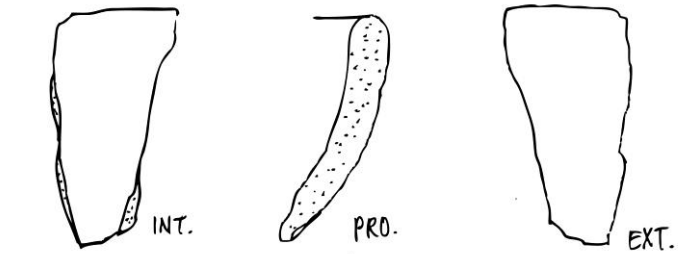


3

SOC_38

SOC_39

SOC_40



4

SOC_41

SOC_42

SOC_43

-red slip

5

SOC_44

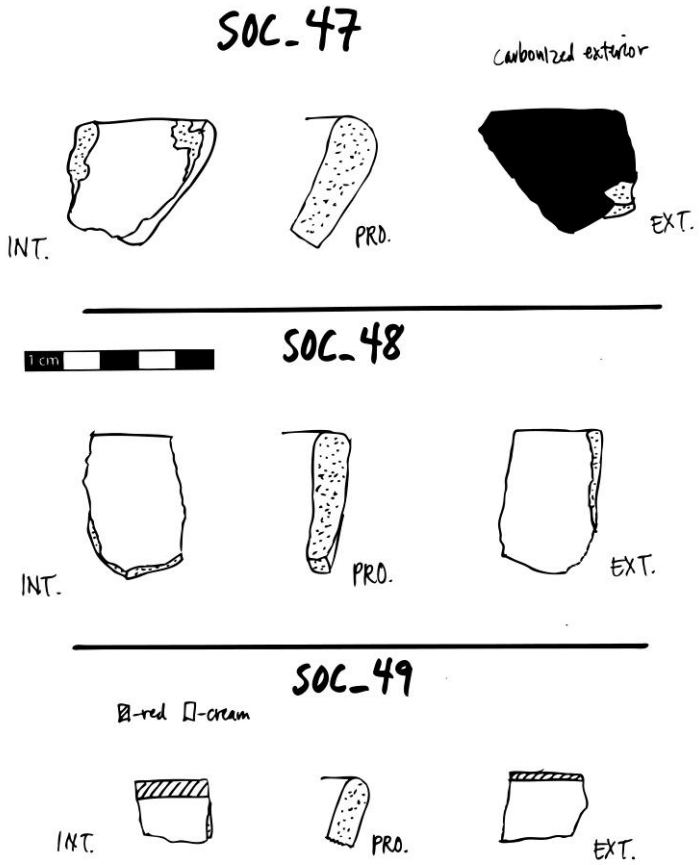
-red slip

SOC_45

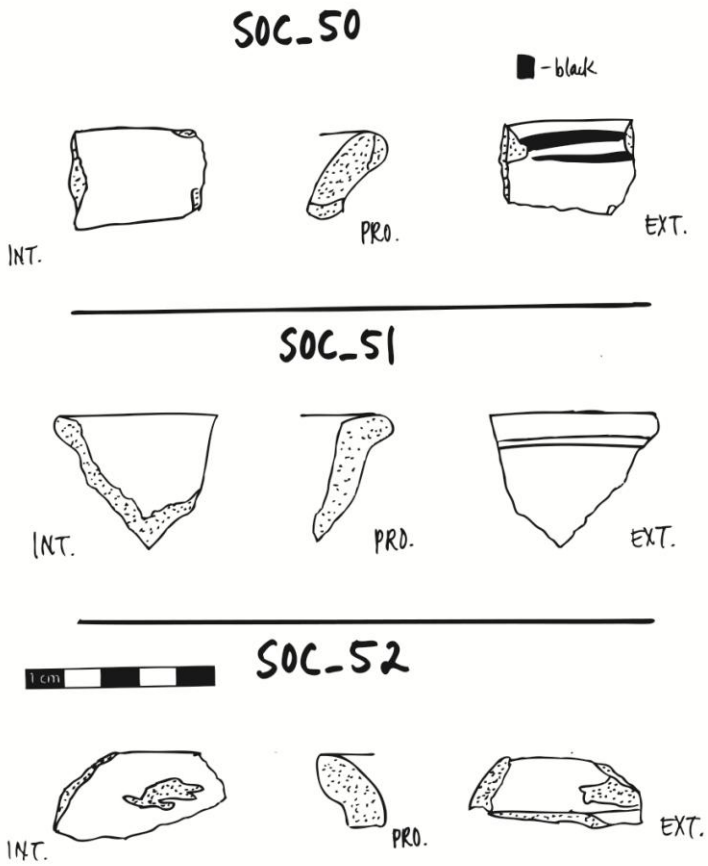
-carbonized

SOC_46

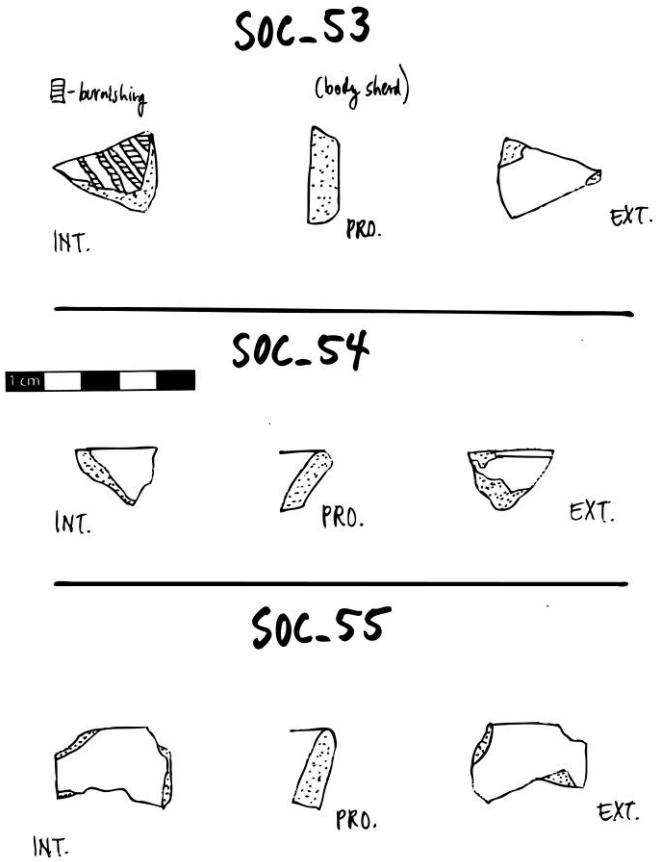
6


SOC_47
carbonized exterior
INT.
PRO.
EXT.
1 cm
SOC_48
INT.
PRO.
EXT.
SOC_49
-red -cream
INT.
PRO.
EXT.

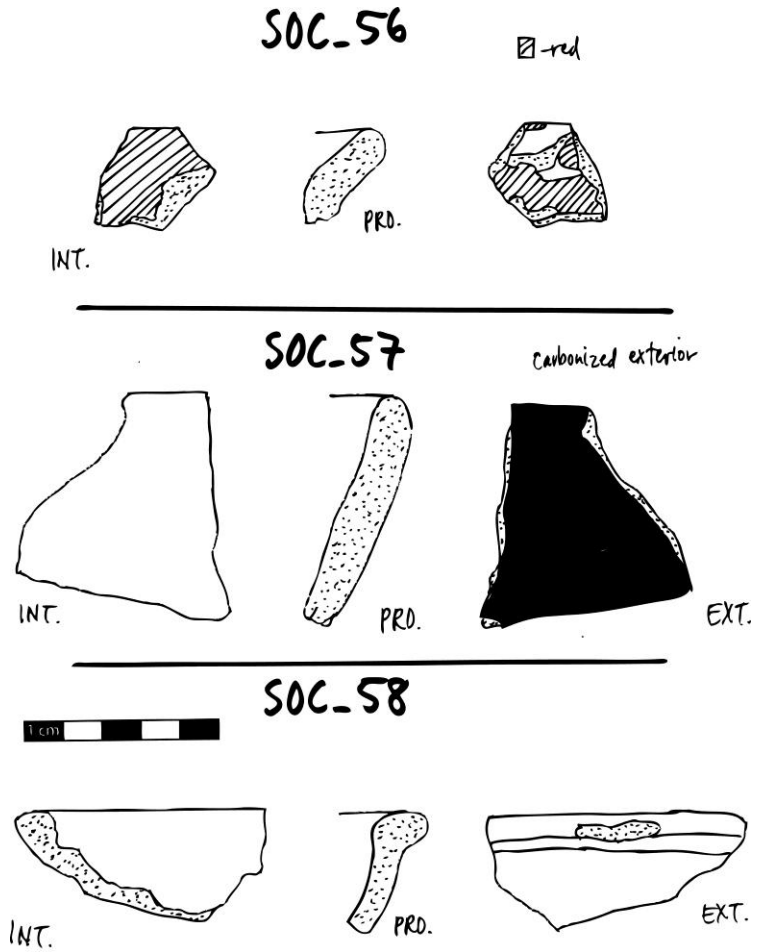
7


SOC_50
-black
INT.
PRO.
EXT.
SOC_51
INT.
PRO.
EXT.
1 cm
SOC_52
INT.
PRO.
EXT.

8


SOC_53
- burnishing
(body sherd)
INT.
PRD.
EXT.
SOC_54
1 cm
INT.
PRD.
EXT.
SOC_55
INT.
PRD.
EXT.

9

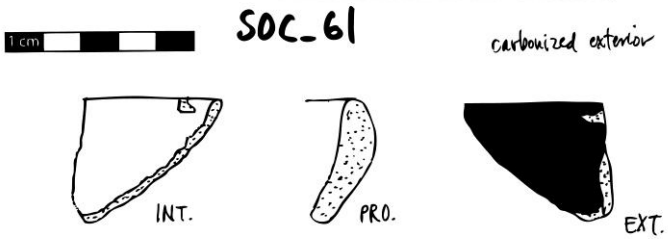

SOC_56
- red
INT.
PRD.
SOC_57
carbonized exterior
INT.
PRD.
EXT.
SOC_58
1 cm
INT.
PRD.
EXT.

10

SOC_59

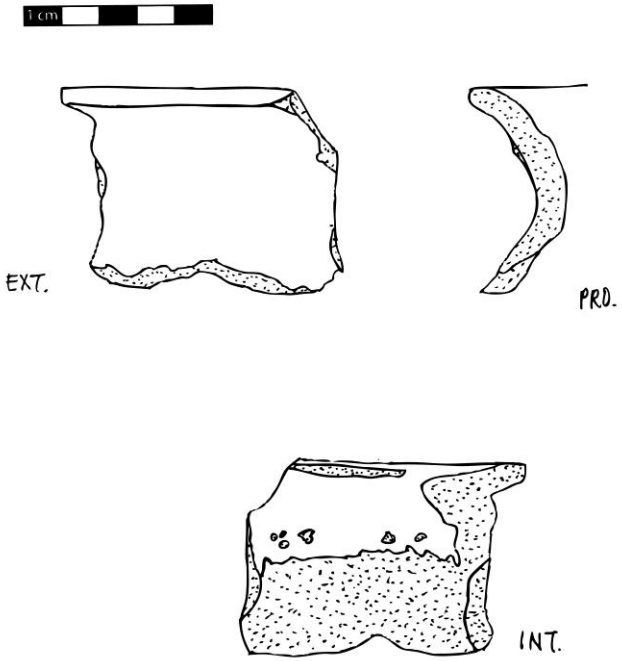
SOC_60

SOC_61

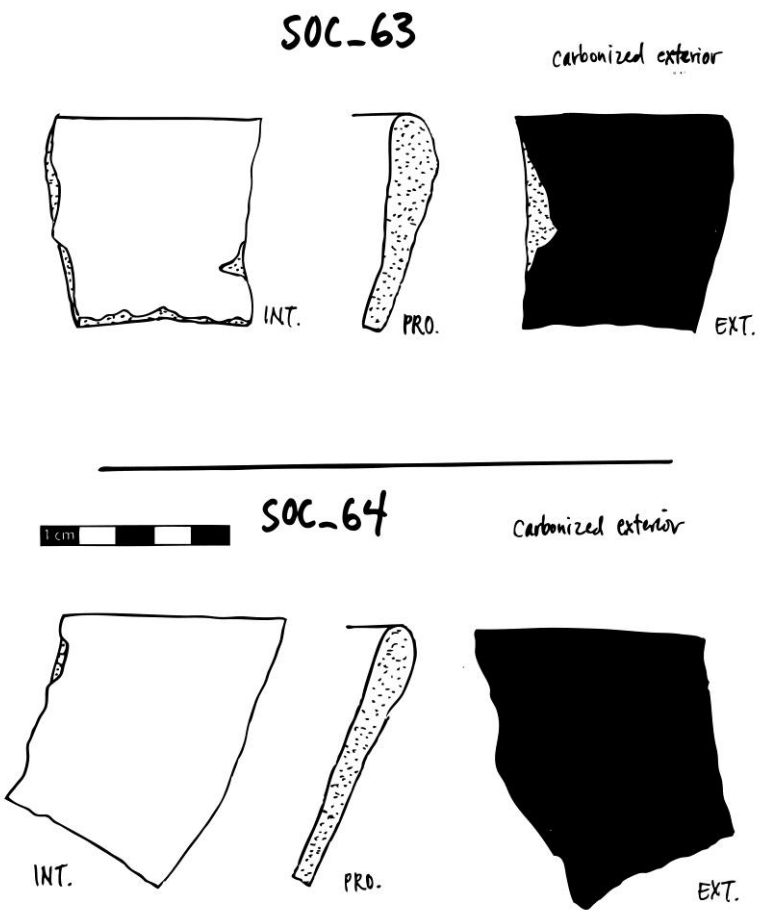


11

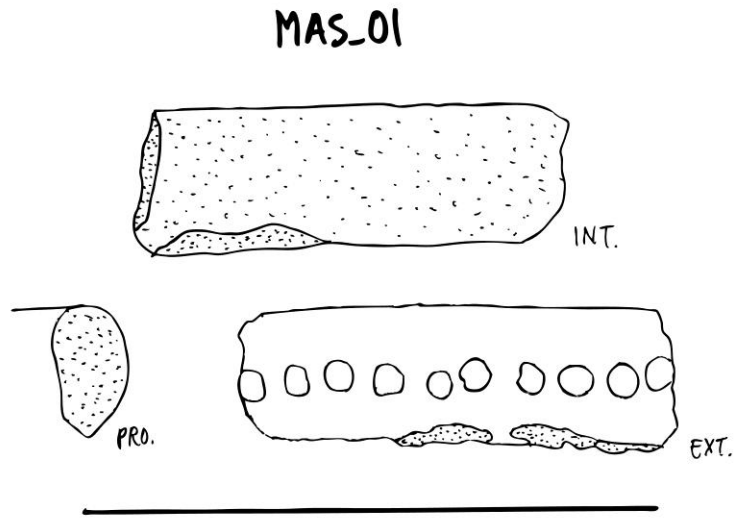
SOC_62



12

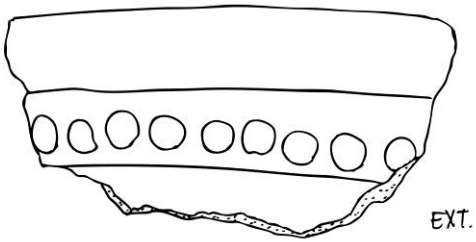

SOC_63
Carbonized exterior
INT.
PRO.
EXT.
SOC_64
Carbonized exterior
1 cm
INT.
PRO.
EXT.

13


MAS_01
INT.
PRO.
EXT.
MAS_02
1 cm
INT.
PRO.

14

MAS_02

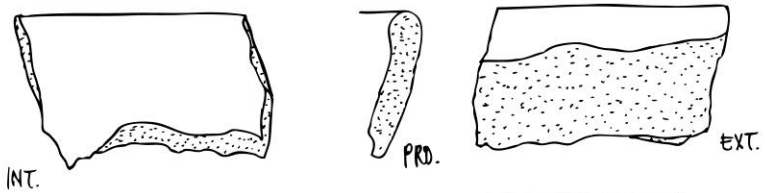


MAS_03

MAS_04

15

MAS_05



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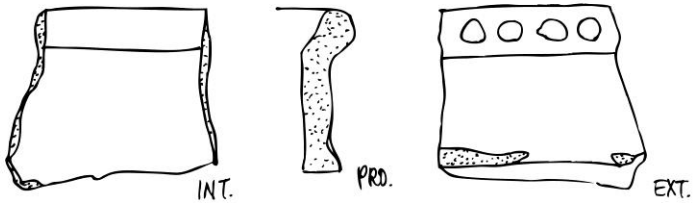
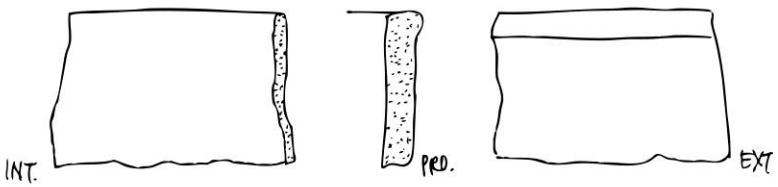


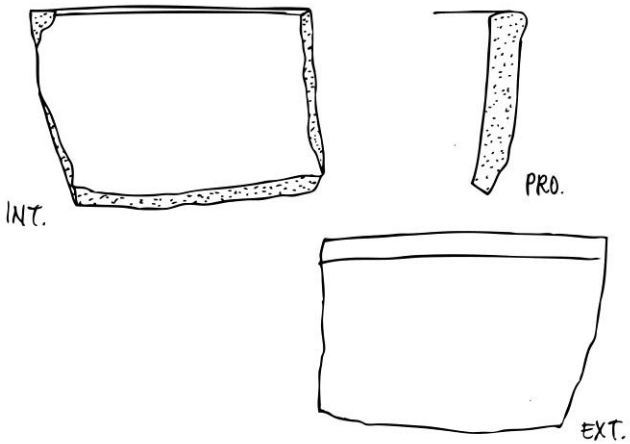
MAS_07

16

MAS_08

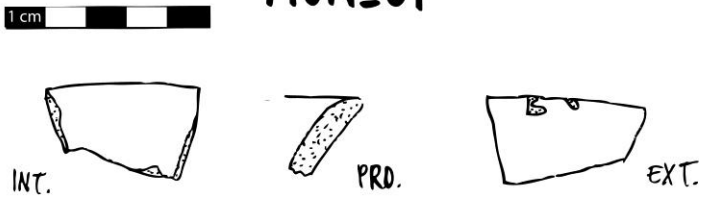


MAS_09



17

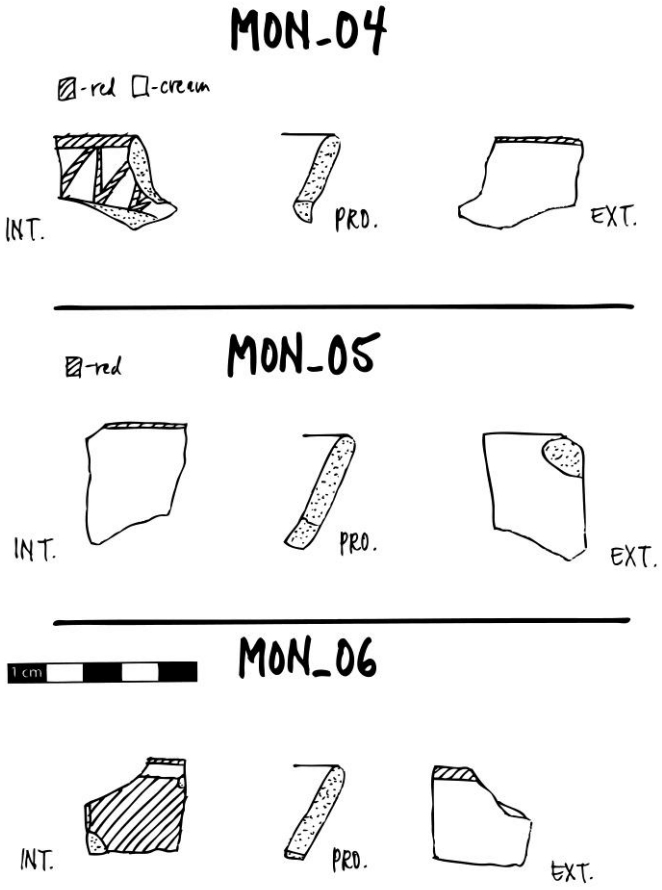
MON_01



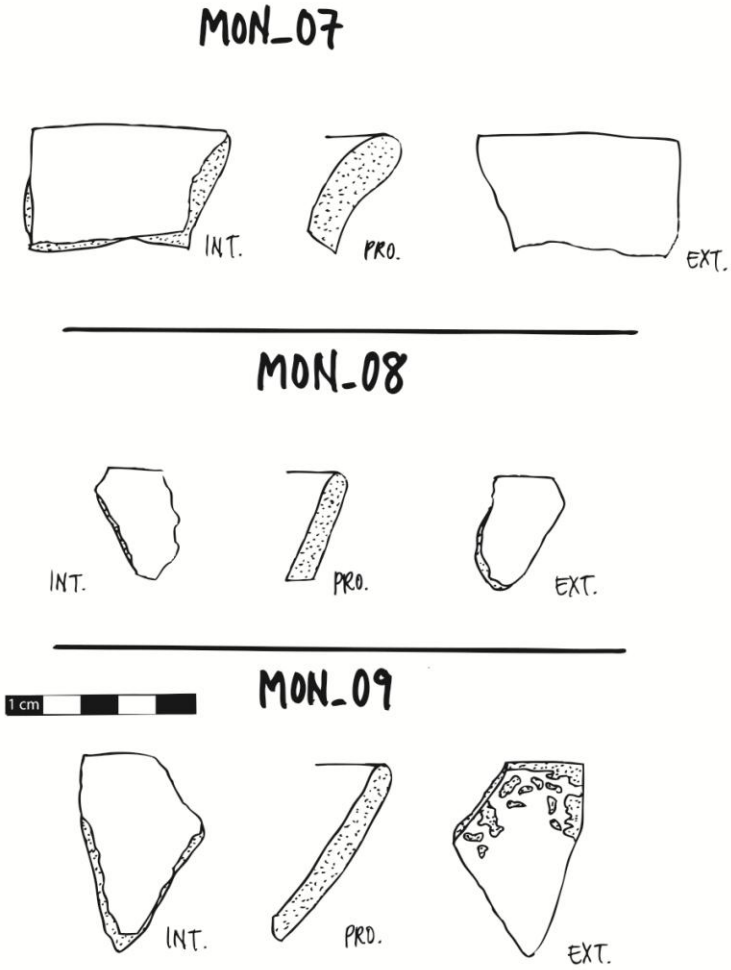
MON_02

MON_03

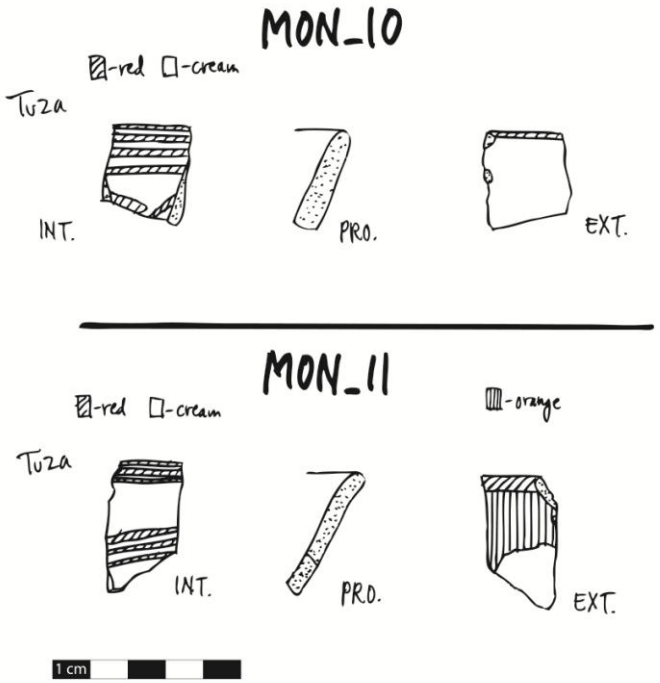
18


MON_04
-red -cream
INT.
PRO.
EXT.
MON_05
-red
INT.
PRO.
EXT.
1 cm
MON_06
INT.
PRO.
EXT.

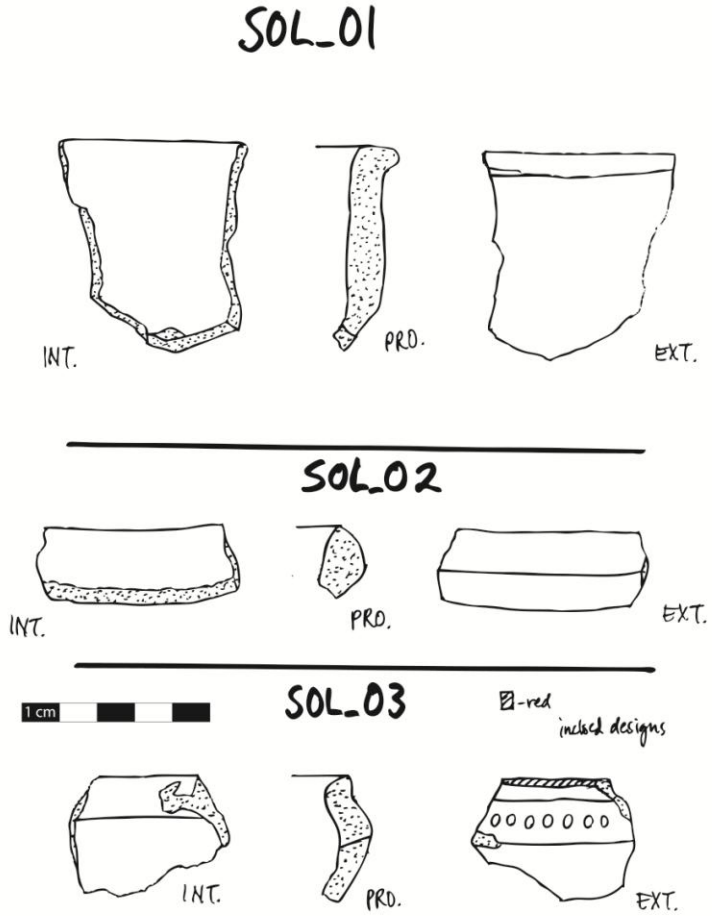
19


MON_07
INT.
PRO.
EXT.
MON_08
INT.
PRO.
EXT.
1 cm
MON_09
INT.
PRO.
EXT.

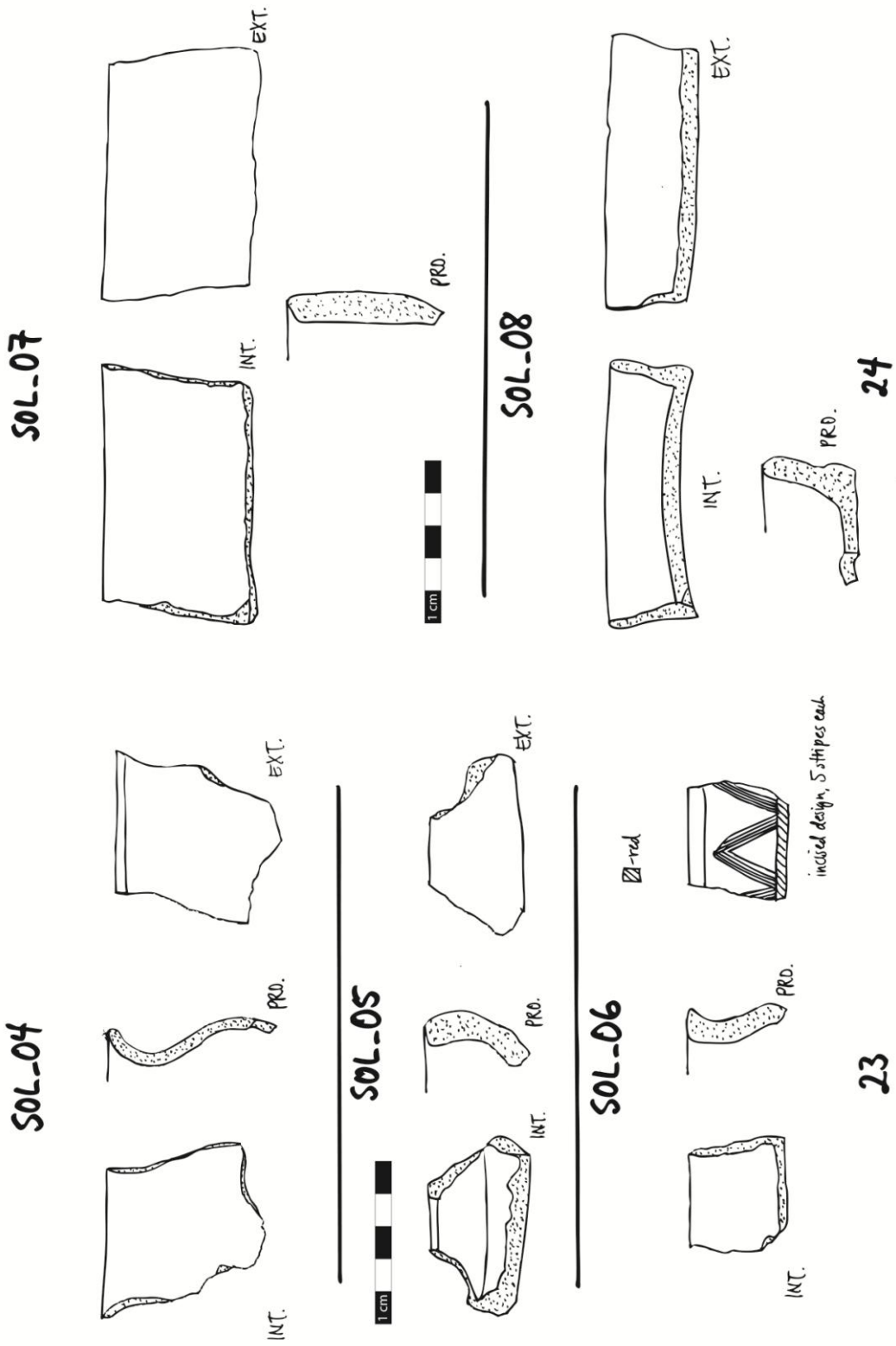
20

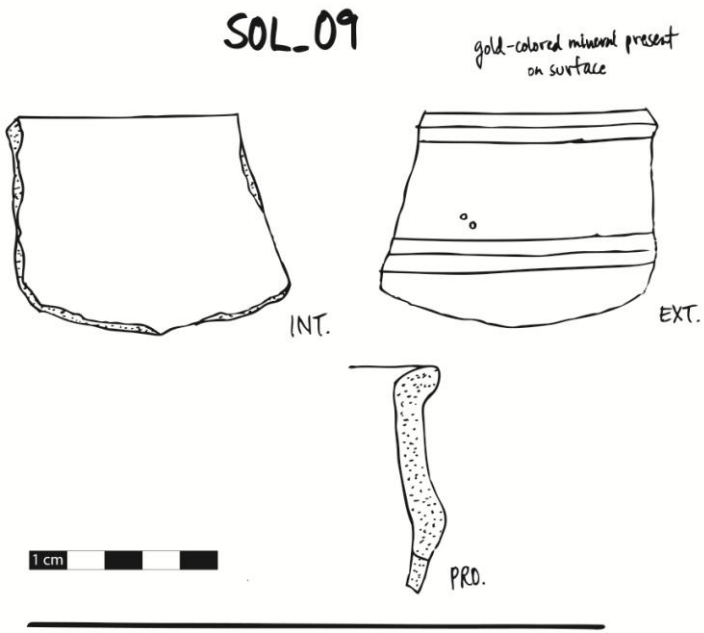

MON_10
-red -cream
Tuza
INT.
PRO.
EXT.
MON_11
-red -cream
-orange
Tuza
INT.
PRO.
EXT.
1 cm

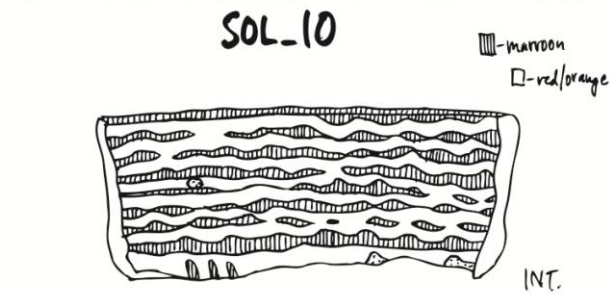
21


SOL_01
INT.
PRO.
EXT.
SOL_02
INT.
PRO.
EXT.
1 cm
SOL_03
-red
incised designs
INT.
PRO.
EXT.

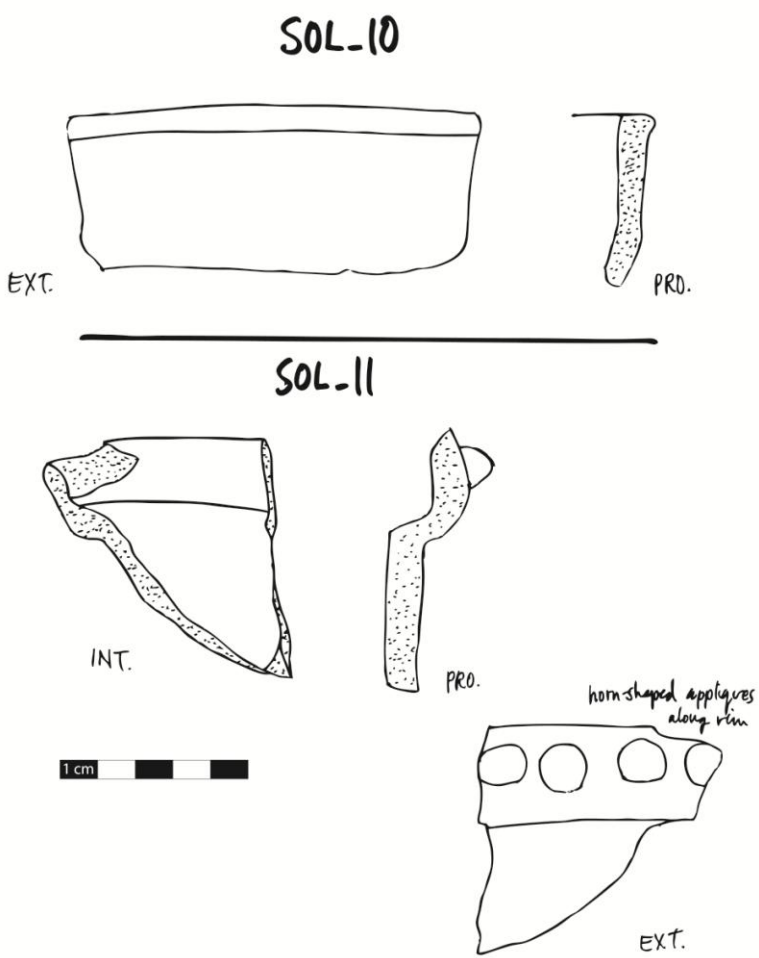
22


SOL_04
EXT.
PRO.
INT.
SOL_05
EXT.
PRO.
INT.
1 cm
SOL_06
EXT.
PRO.
INT.
Ø-red
incised design, 5 stripes each
23
SOL_07
EXT.
INT.
PRO.
SOL_08
EXT.
INT.
PRO.
1 cm
24


SOL_09
gold-colored mineral present on surface
INT.
EXT.
PRO.
1 cm

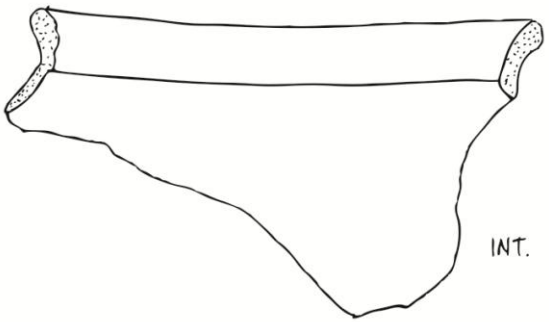

SOL_10
-maroon
-red/orange
INT.

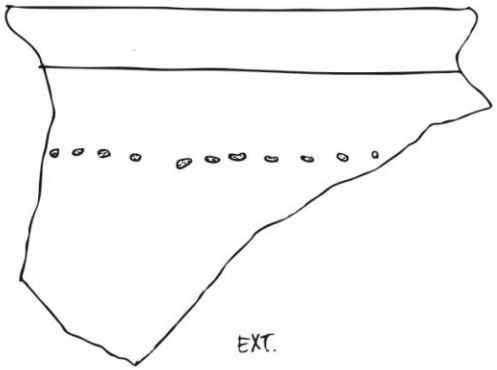
25


SOL_10
EXT.
PRO.
SOL_11
INT.
PRO.
1 cm
horn-shaped appliques along rim
EXT.

26

SOL_12

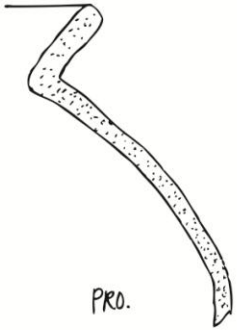




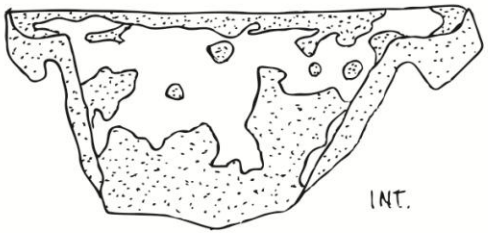
1 cm

27

SOL_12



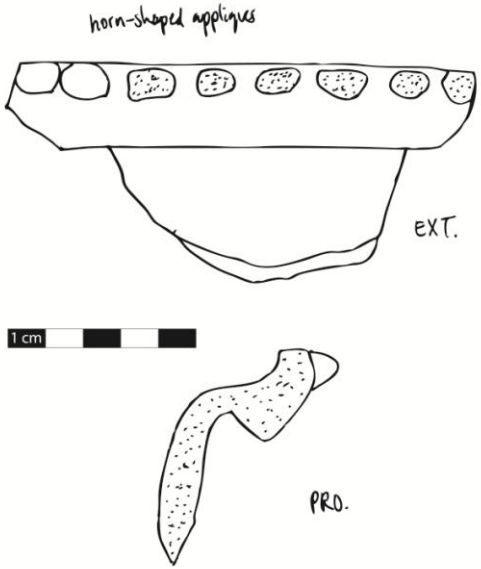
SOL_13



1 cm

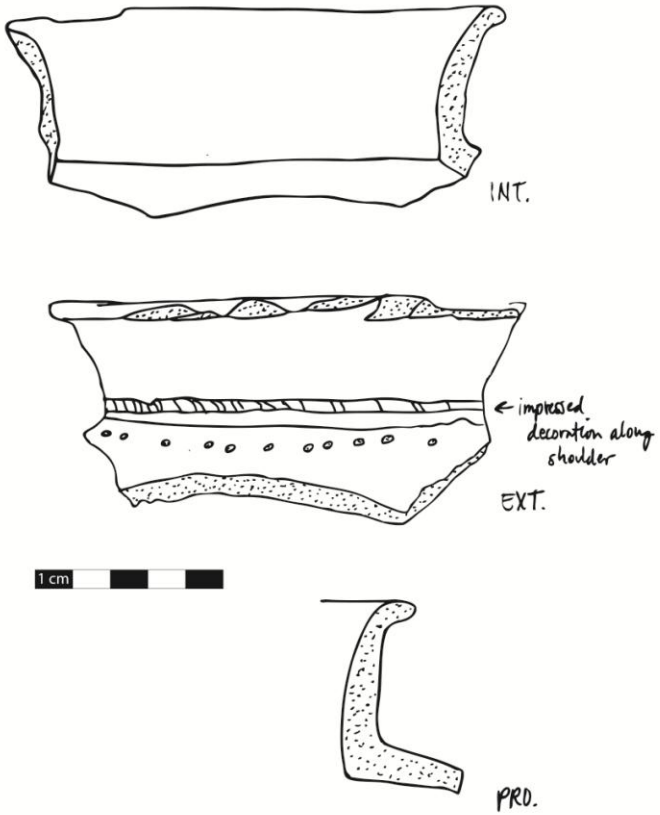
28

SOL_13

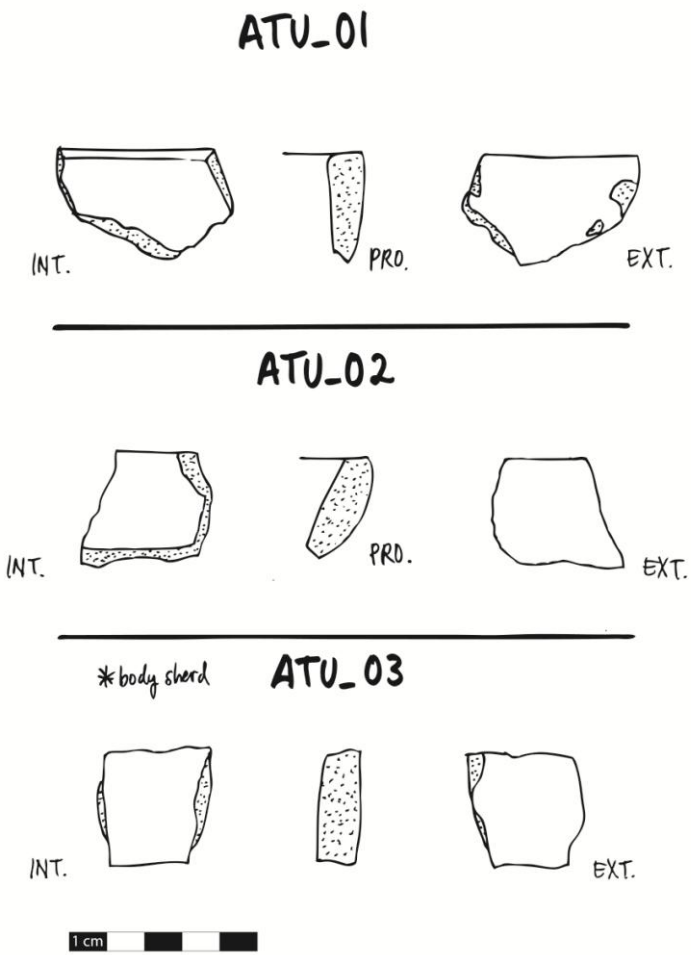


29

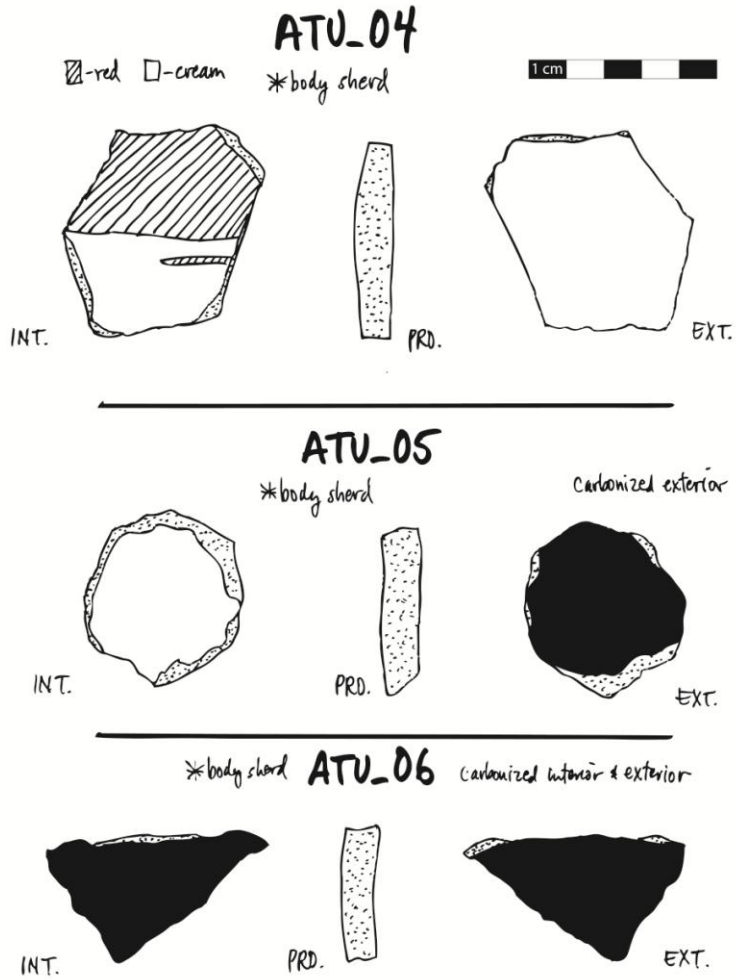
SOL_14



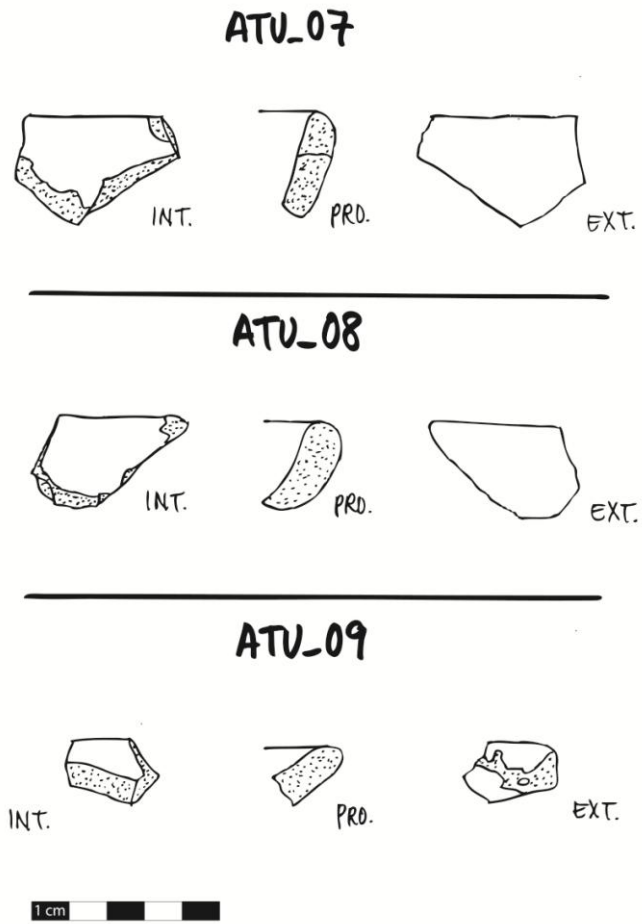
30


ATU_01
INT.
PRO.
EXT.
ATU_02
INT.
PRO.
EXT.
*body sherd
ATU_03
INT.
EXT.
1 cm

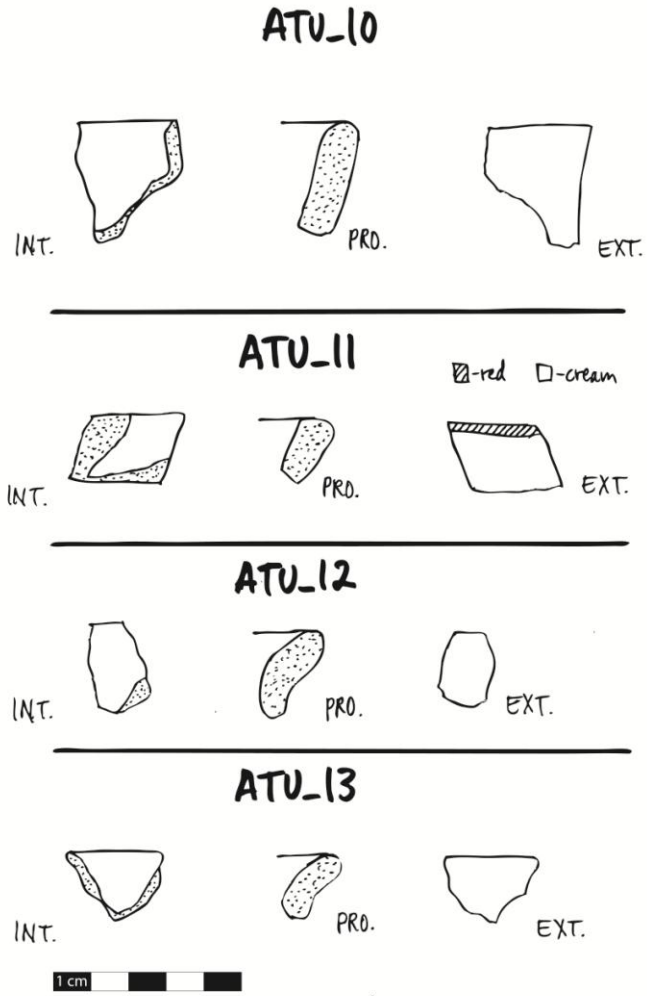
31


ATU_04
-red -cream
*body sherd
1 cm
INT.
PRO.
EXT.
ATU_05
*body sherd
Carbonized exterior
INT.
PRO.
EXT.
*body sherd
ATU_06
Carbonized interior & exterior
INT.
PRO.
EXT.

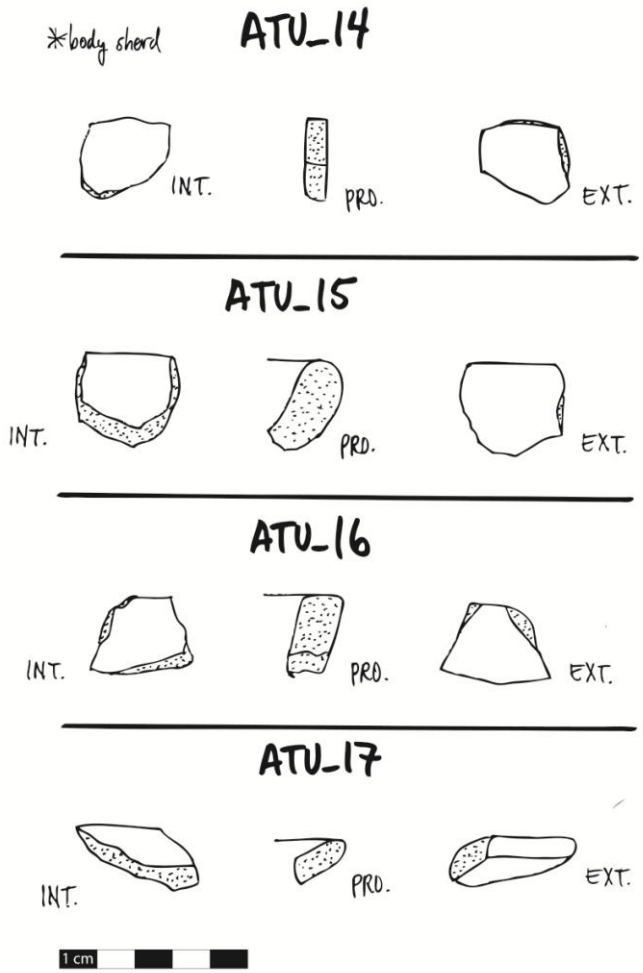
32


ATU_07
INT.
PRO.
EXT.
ATU_08
INT.
PRO.
EXT.
ATU_09
INT.
PRO.
EXT.
1 cm

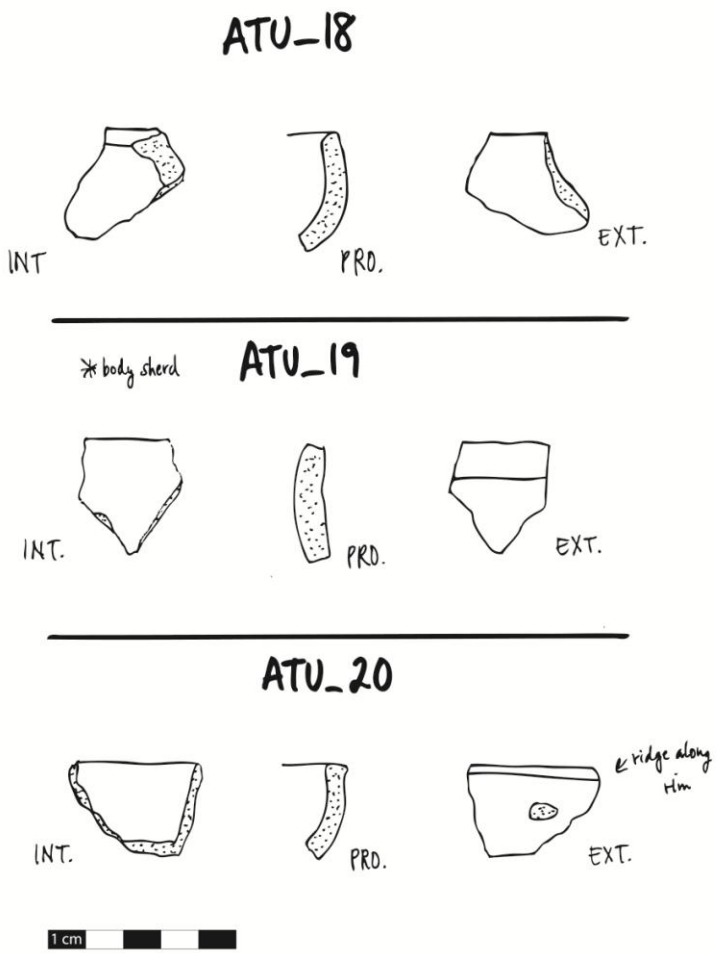
33


ATU_10
INT.
PRO.
EXT.
ATU_11
-red
-cream
INT.
PRO.
EXT.
ATU_12
INT.
PRO.
EXT.
ATU_13
INT.
PRO.
EXT.
1 cm

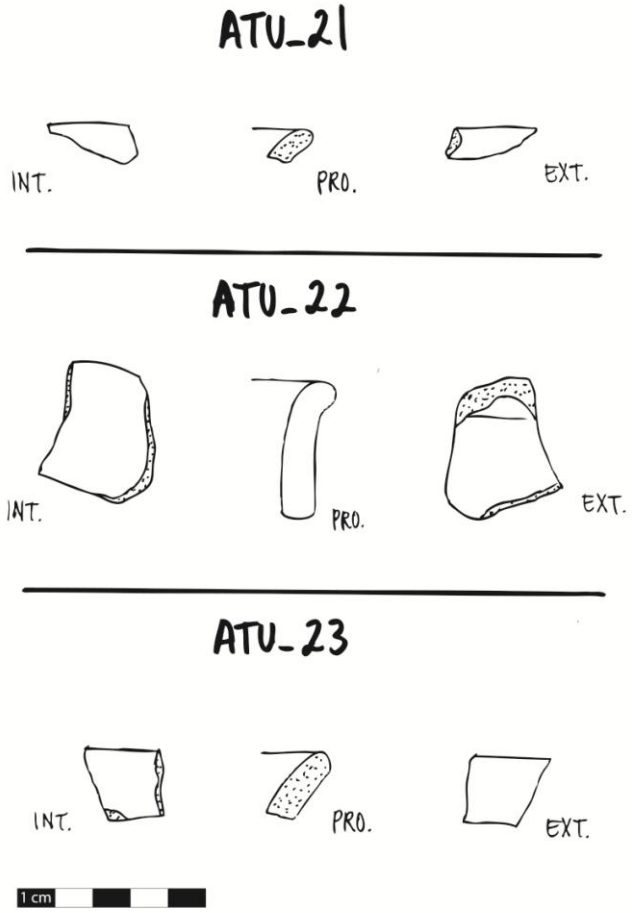
34


*body sherd
ATU_14
INT.
PRO.
EXT.
ATU_15
INT.
PRO.
EXT.
ATU_16
INT.
PRO.
EXT.
ATU_17
INT.
PRO.
EXT.
1 cm

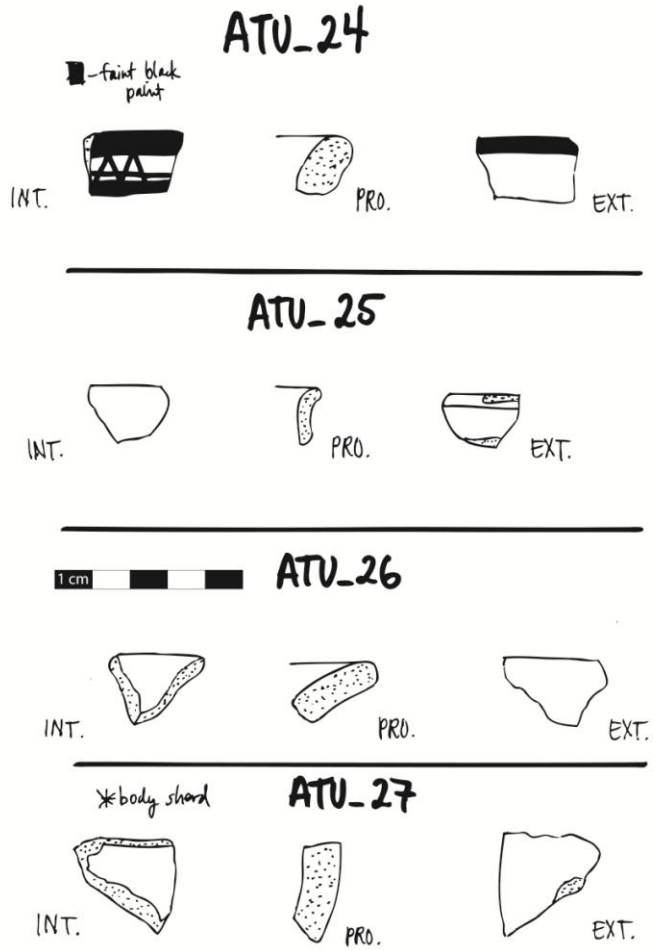
35


ATU_18
INT
PRO.
EXT.
*body sherd
ATU_19
INT.
PRO.
EXT.
ATU_20
INT.
PRO.
ridge along rim
EXT.
1 cm

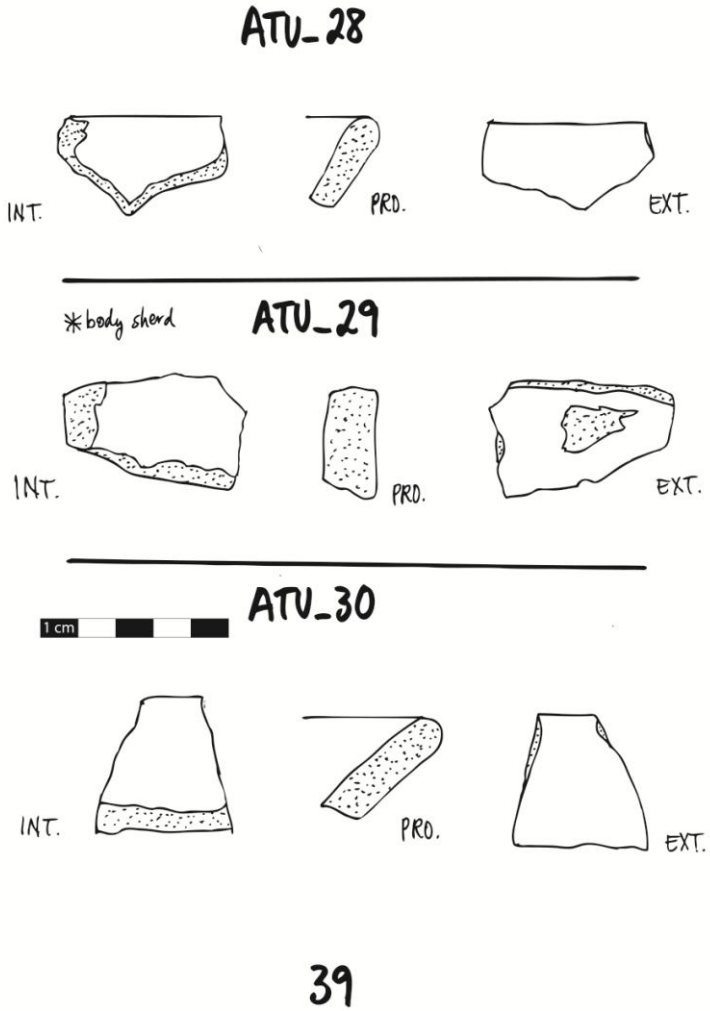
36


ATU_21
INT.
PRO.
EXT.
ATU_22
INT.
PRO.
EXT.
ATU_23
INT.
PRO.
EXT.
1 cm

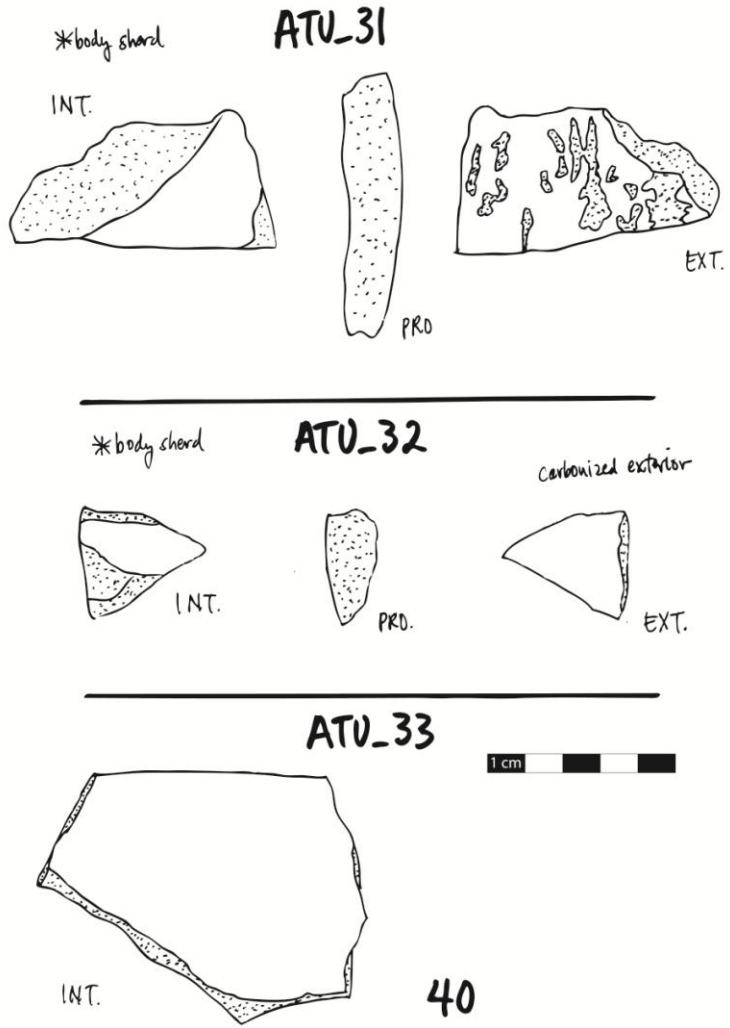
37


ATU_24
-faint black paint
INT.
PRO.
EXT.
ATU_25
INT.
PRO.
EXT.
1 cm
ATU_26
INT.
PRO.
EXT.
*body shard
ATU_27
INT.
PRO.
EXT.

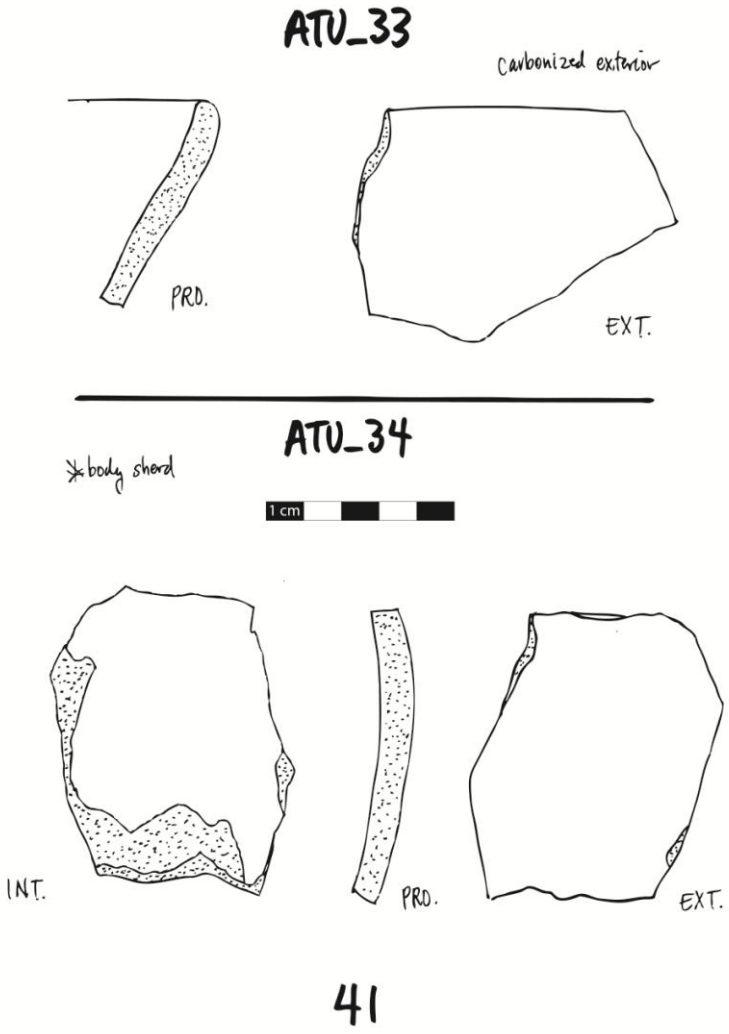
38


ATU_28
INT.
PRO.
EXT.
*body sherd
ATU_29
INT.
PRO.
EXT.
1 cm
ATU_30
INT.
PRO.
EXT.

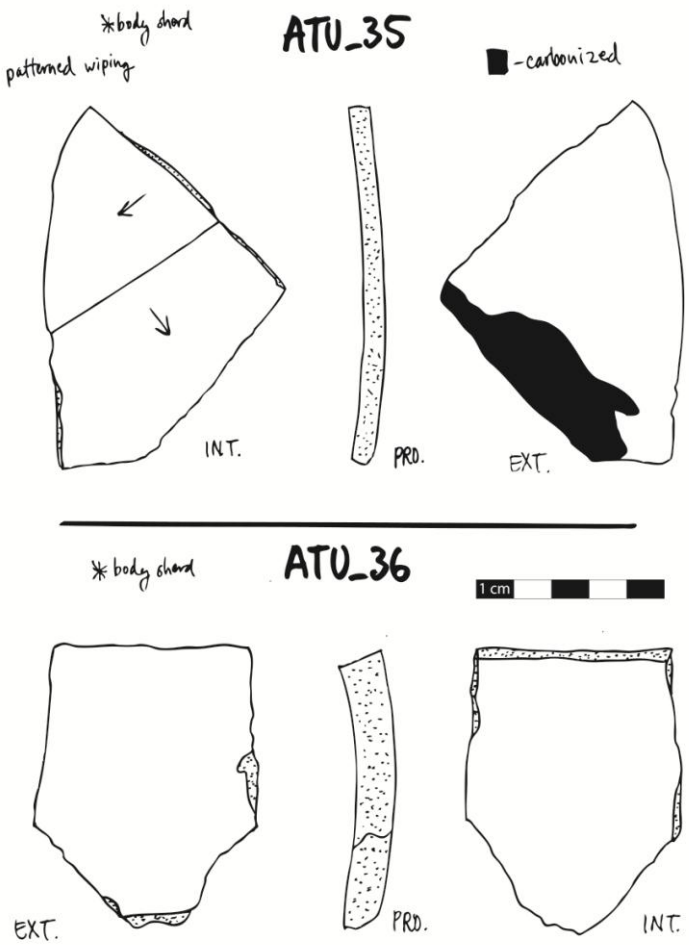
39


*body sherd
ATU_31
INT.
PRO
EXT.
*body sherd
ATU_32
carbonized exterior
INT.
PRO.
EXT.
ATU_33
1 cm
INT.

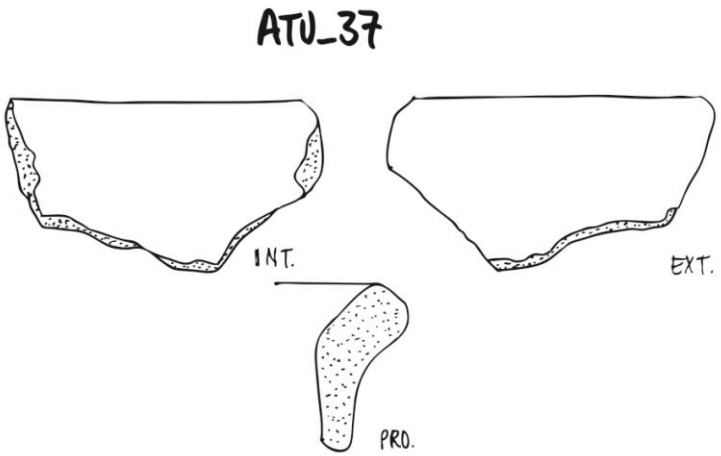
40

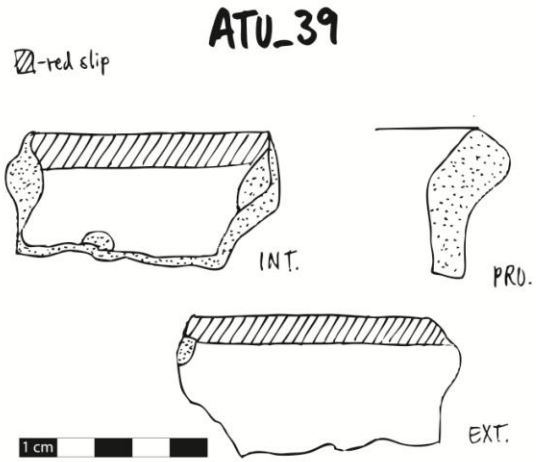

ATU_33
carbonized exterior
PRO.
EXT.
ATU_34
*body sherd
1 cm
INT.
PRO.
EXT.

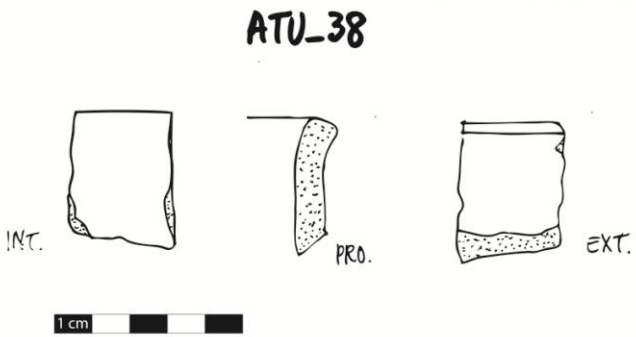
41


*body sherd
patterned wiping
ATU_35
-carbonized
INT.
PRO.
EXT.
*body sherd
ATU_36
1 cm
EXT.
PRO.
INT.

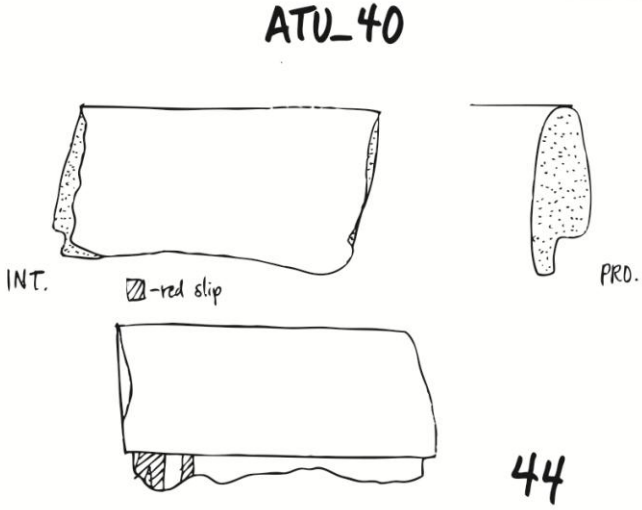
42


ATU_37
INT.
EXT.
PRO.


ATU_39
-red slip
INT.
PRO.
EXT.
1 cm

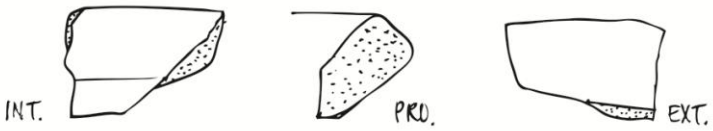

ATU_38
INT.
PRO.
EXT.
1 cm

43


ATU_40
INT.
-red slip
PRO.

44

PUN_01



PUN_02

☒-red slip ☐-cream

PUN_03

45

PUN_04

carbonized exterior

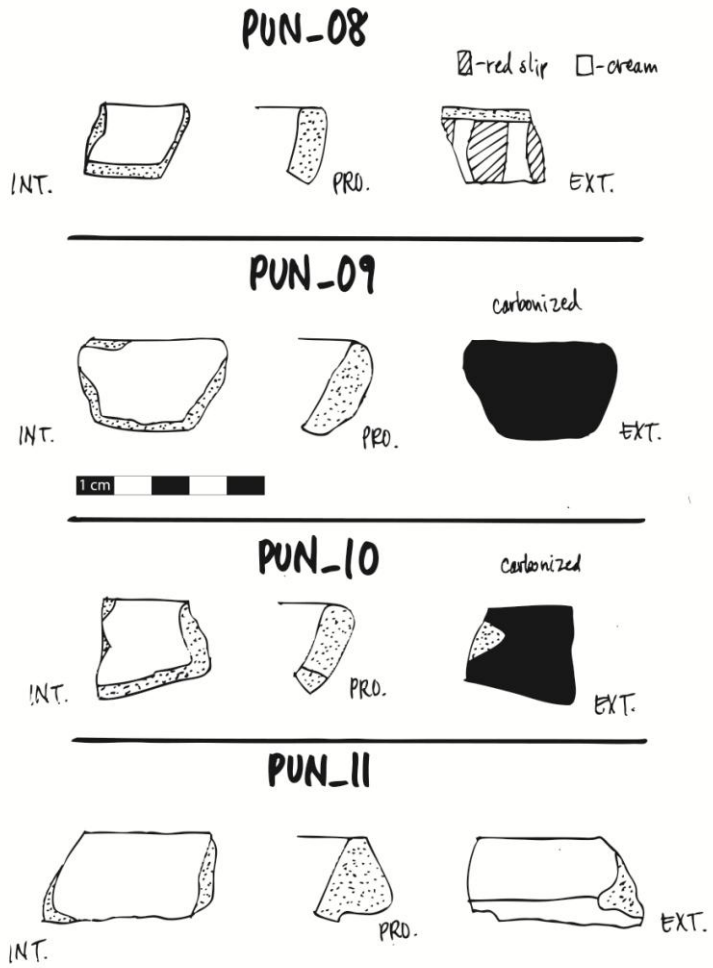
PUN_05

PUN_06

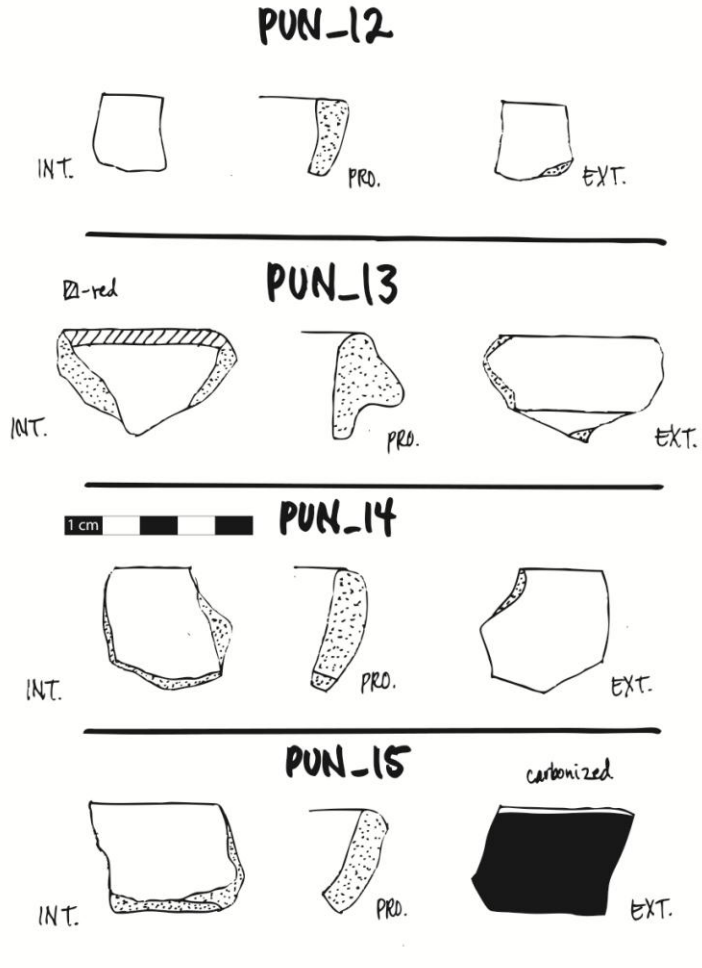
PUN_07

carbonized exterior

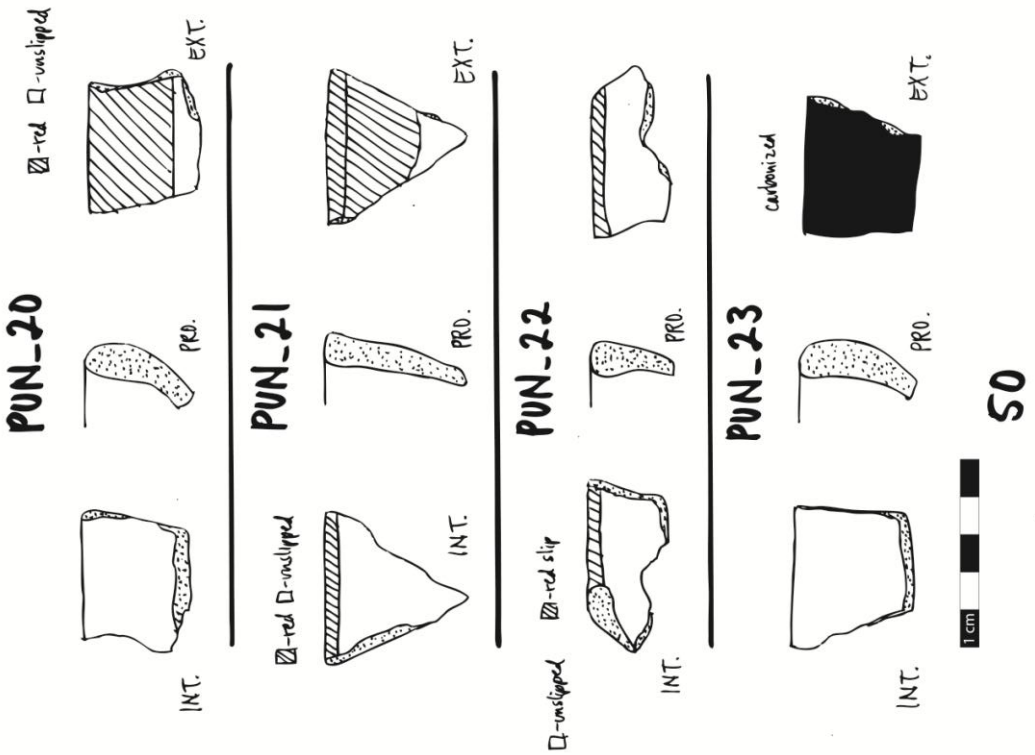
46

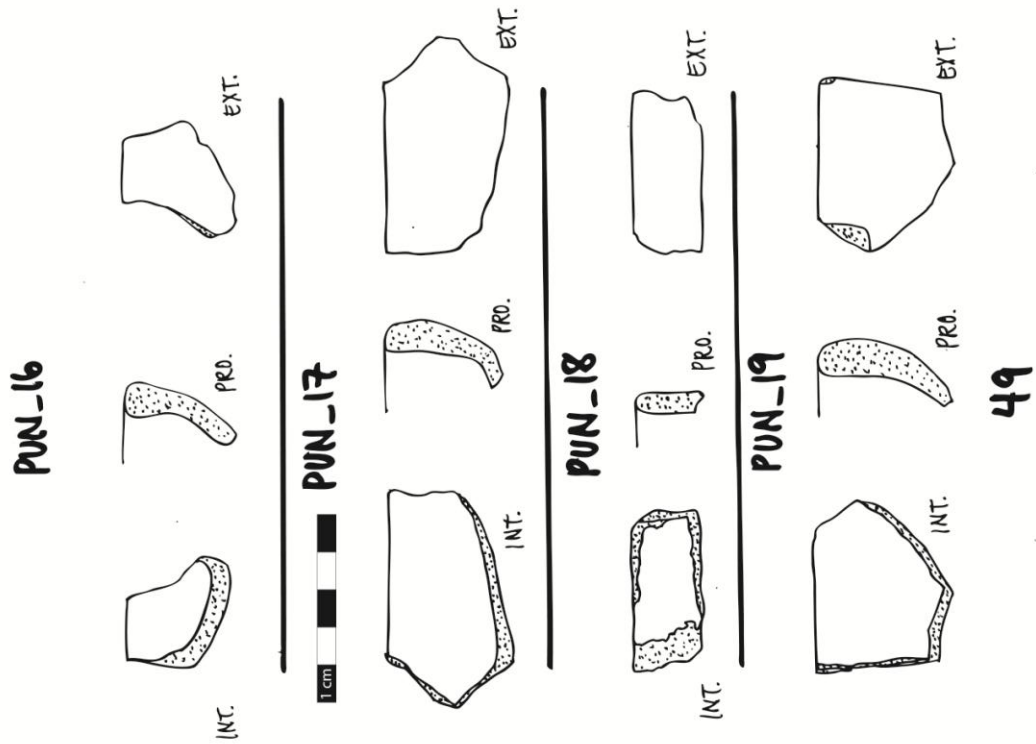

PUN_08
-red slip
-cream
INT.
PRO.
EXT.
PUN_09
carbonized
INT.
PRO.
EXT.
1 cm
PUN_10
carbonized
INT.
PRO.
EXT.
PUN_11
INT.
PRO.
EXT.

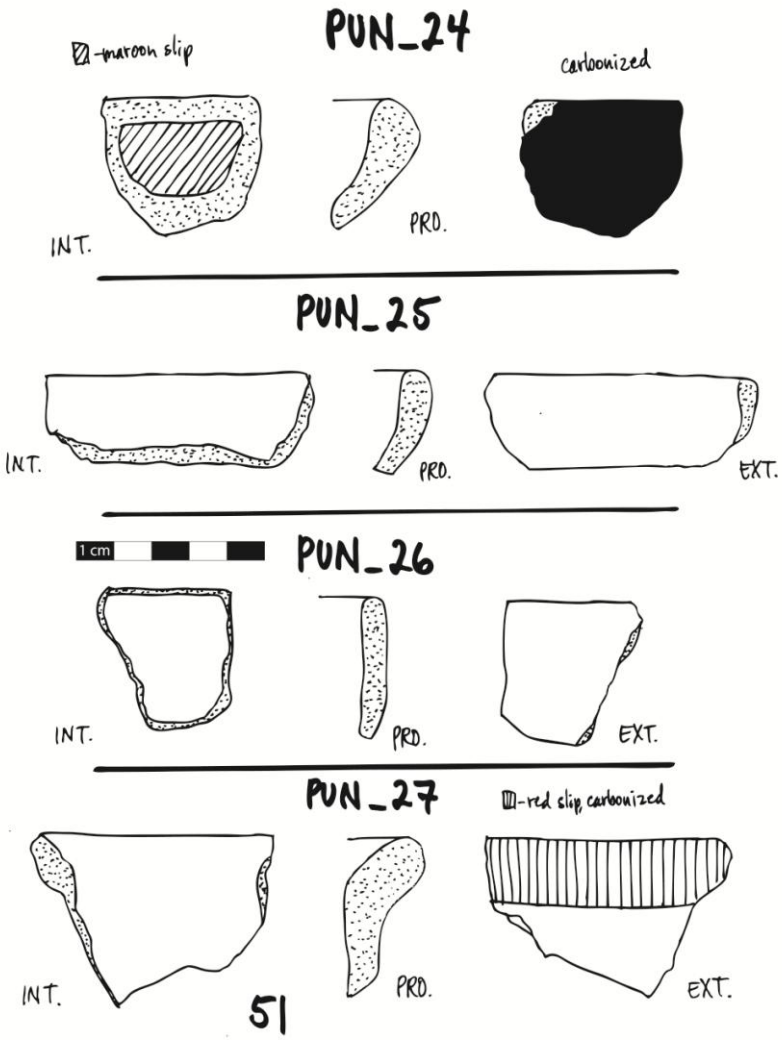
47


PUN_12
INT.
PRO.
EXT.
-red
PUN_13
INT.
PRO.
EXT.
1 cm
PUN_14
INT.
PRO.
EXT.
PUN_15
carbonized
INT.
PRO.
EXT.

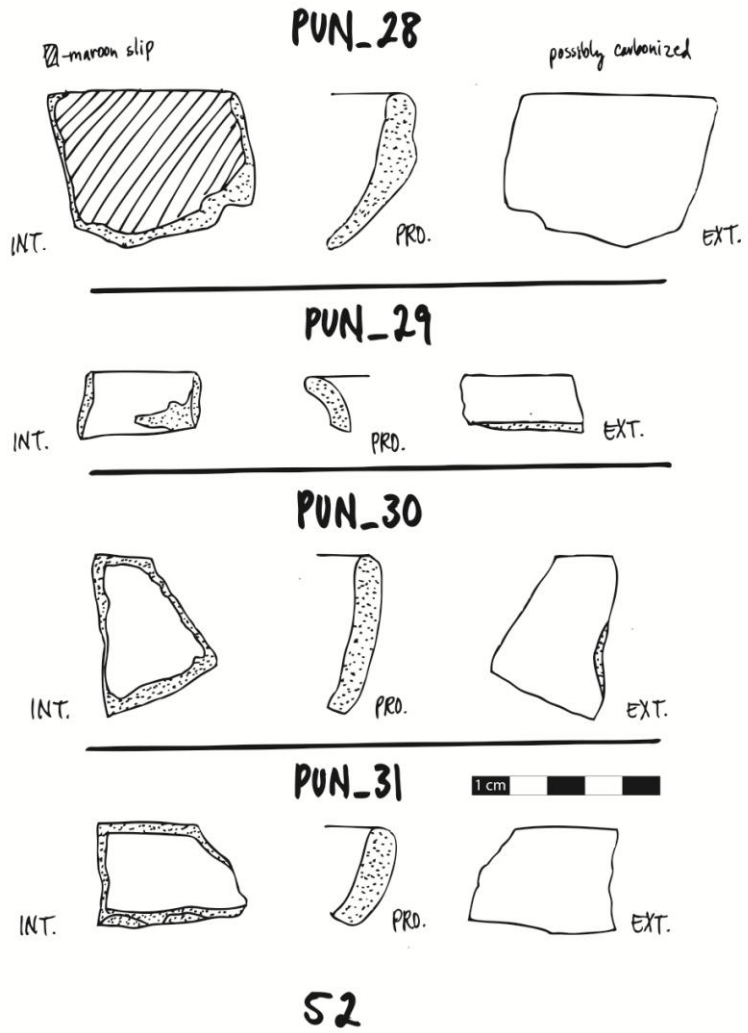
48


PUN_20
PUN_21
PUN_22
PUN_23
EXT.
PRO.
INT.
▨-red □-unslipped
▨-red slip
carbonized
1 cm
50

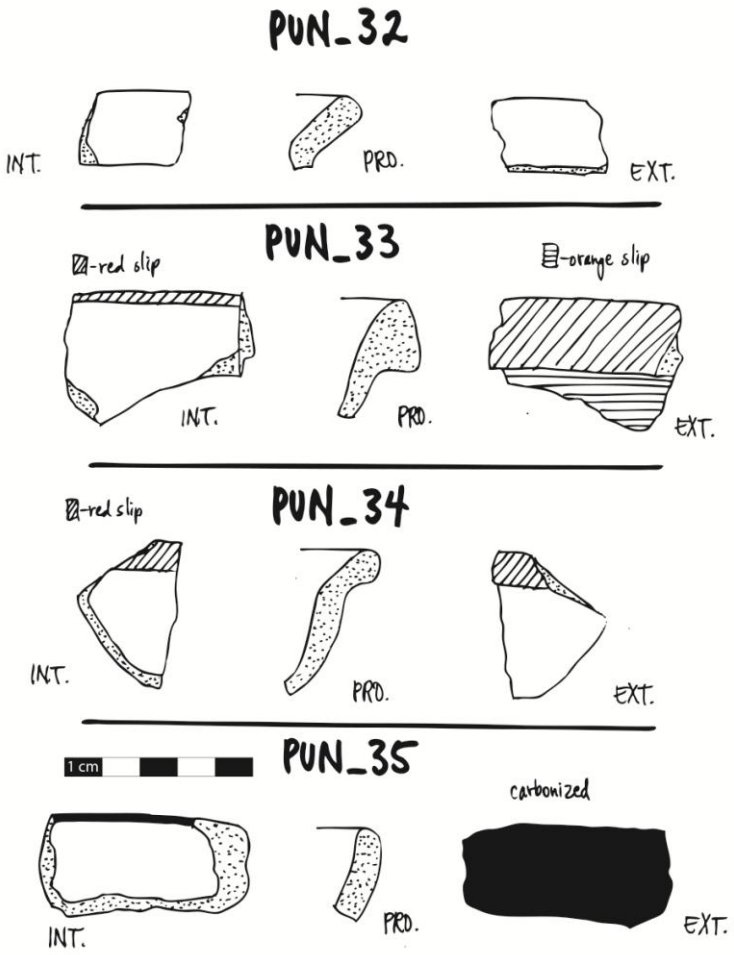

PUN_16
PUN_17
PUN_18
PUN_19
EXT.
PRO.
INT.
1 cm
49


PUN_24
-maroon slip
carbonized
INT.
PRO.
PUN_25
INT.
PRO.
EXT.
1 cm
PUN_26
INT.
PRO.
EXT.
PUN_27
-red slip, carbonized
INT.
PRO.
EXT.

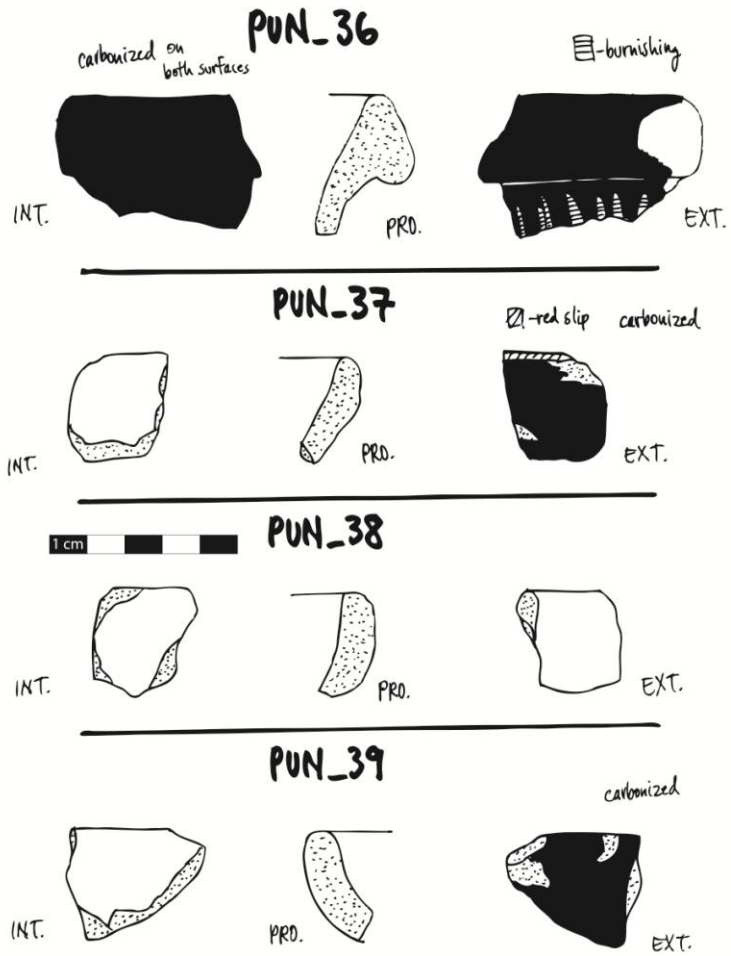
51


PUN_28
-maroon slip
possibly carbonized
INT.
PRO.
EXT.
PUN_29
INT.
PRO.
EXT.
PUN_30
INT.
PRO.
EXT.
PUN_31
1 cm
INT.
PRO.
EXT.

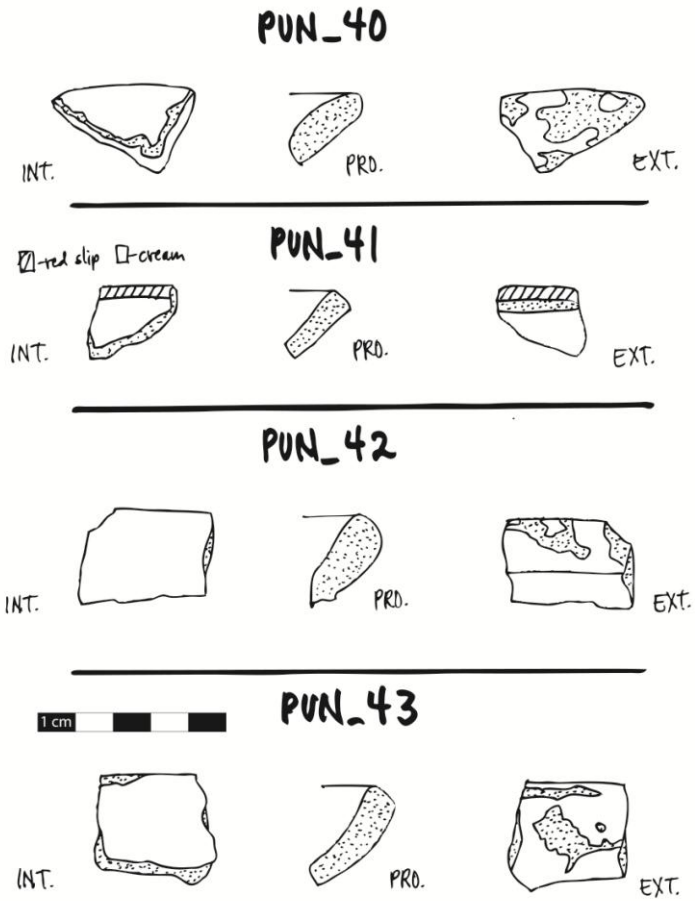
52


PUN_32
INT.
PRO.
EXT.
PUN_33
-red slip
-orange slip
INT.
PRO.
EXT.
PUN_34
-red slip
INT.
PRO.
EXT.
PUN_35
1 cm
carbonized
INT.
PRO.
EXT.

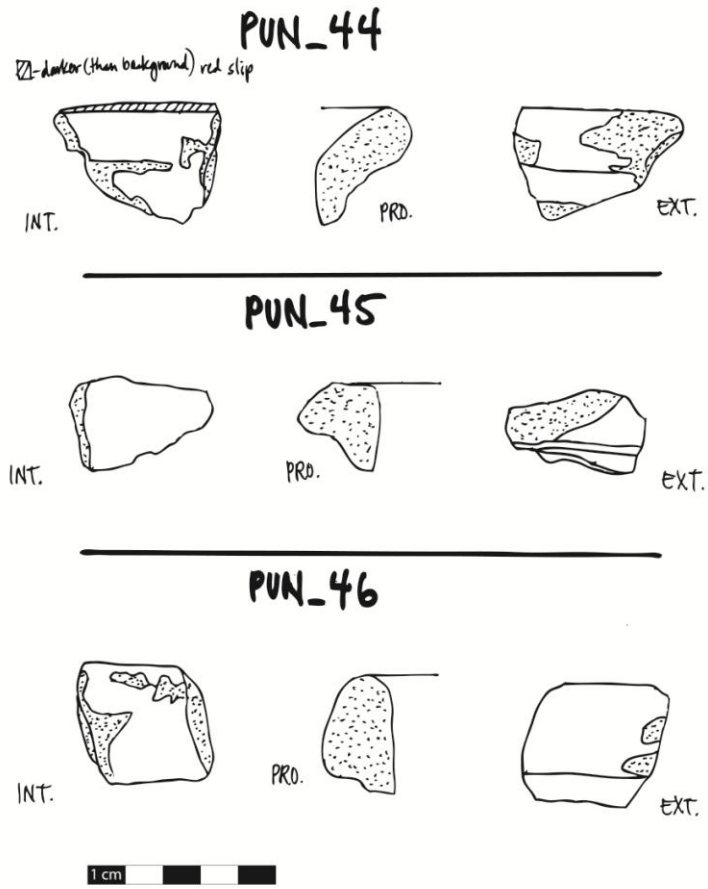
53


PUN_36
carbonized on both surfaces
-burnishing
INT.
PRO.
EXT.
PUN_37
-red slip
carbonized
INT.
PRO.
EXT.
PUN_38
1 cm
INT.
PRO.
EXT.
PUN_39
carbonized
INT.
PRO.
EXT.

54


PUN_40
INT.
PRO.
EXT.
PUN_41
-red slip -cream
INT.
PRO.
EXT.
PUN_42
INT.
PRO.
EXT.
1 cm
PUN_43
INT.
PRO.
EXT.

55


PUN_44
-darker (than background) red slip
INT.
PRO.
EXT.
PUN_45
INT.
PRO.
EXT.
PUN_46
INT.
PRO.
EXT.
1 cm

56

PUN_47

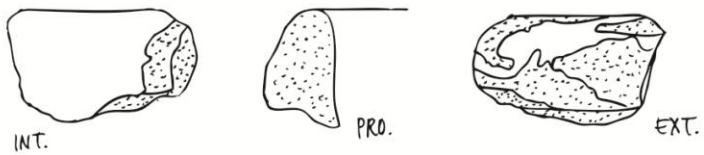
PUN_48

PUN_49

PUN_50

57

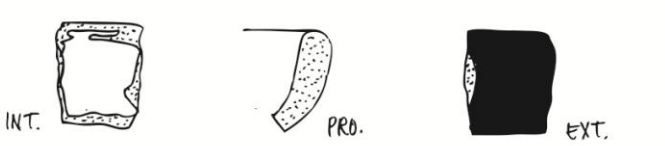
PUN_51



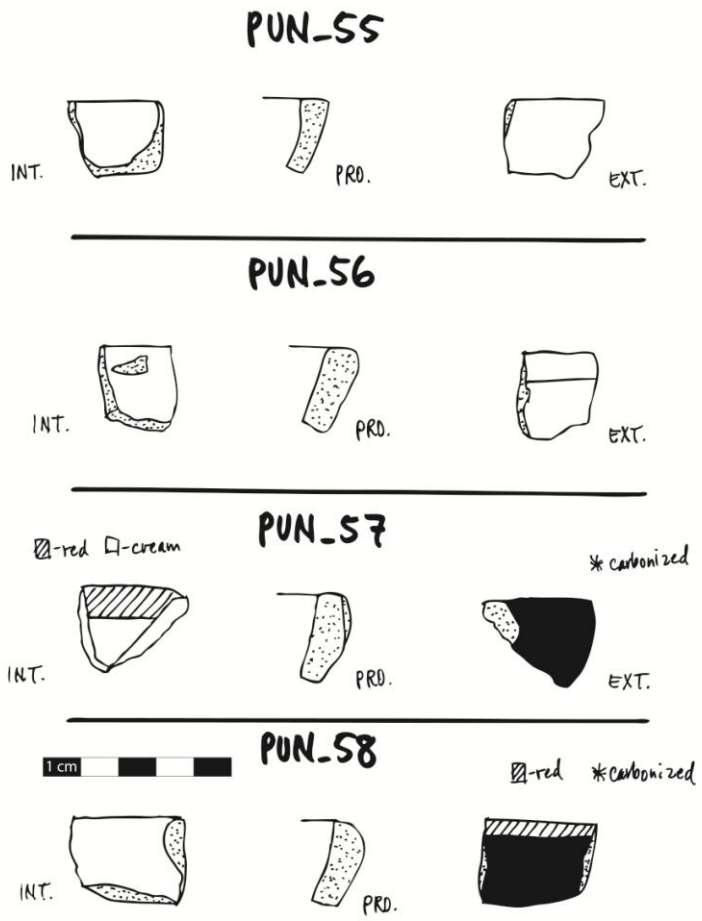
PUN_52

PUN_53

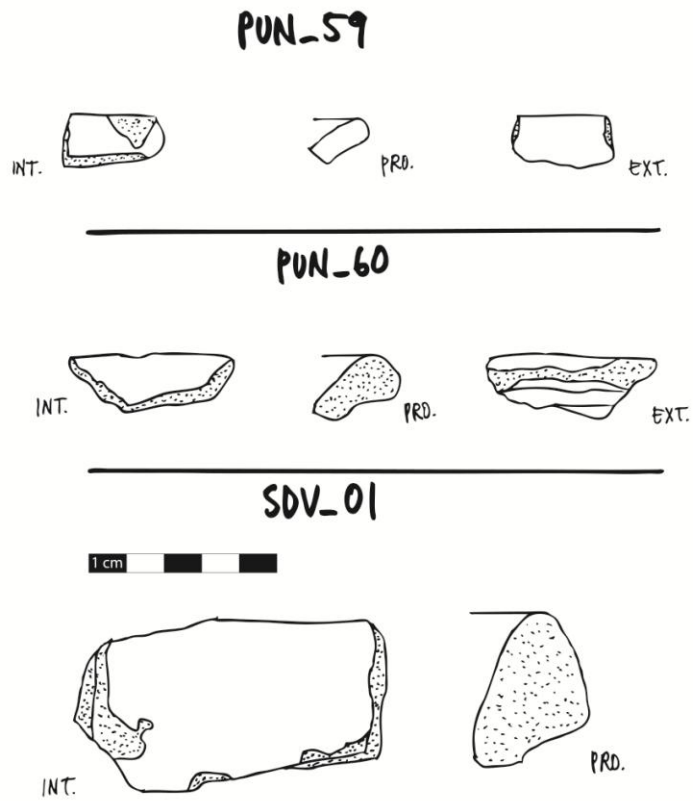
PUN_54



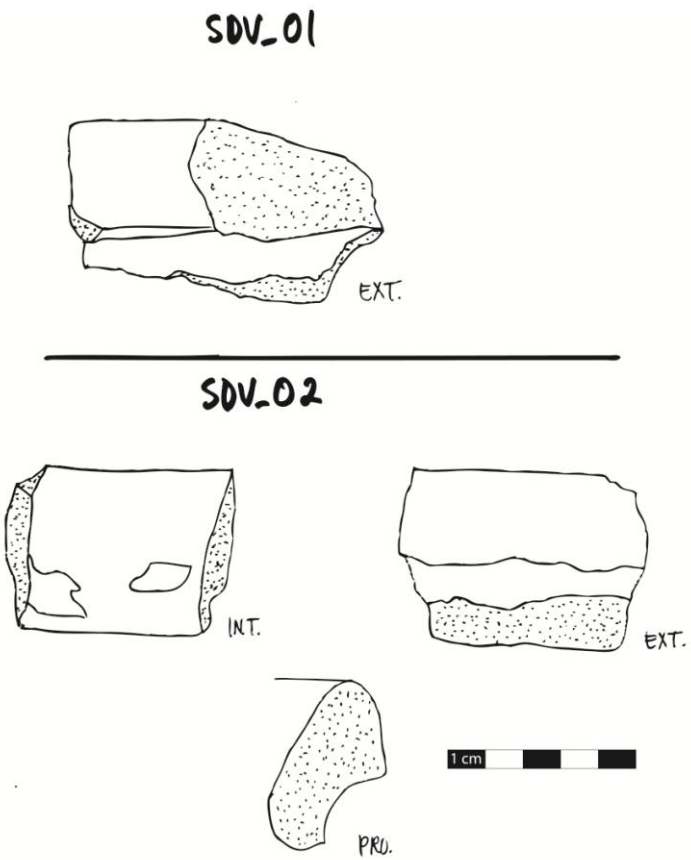
58


PUN_55
INT.
PRO.
EXT.
PUN_56
INT.
PRO.
EXT.
PUN_57
-red -cream
* carbonized
INT.
PRO.
EXT.
PUN_58
1 cm
-red
* carbonized
INT.
PRO.

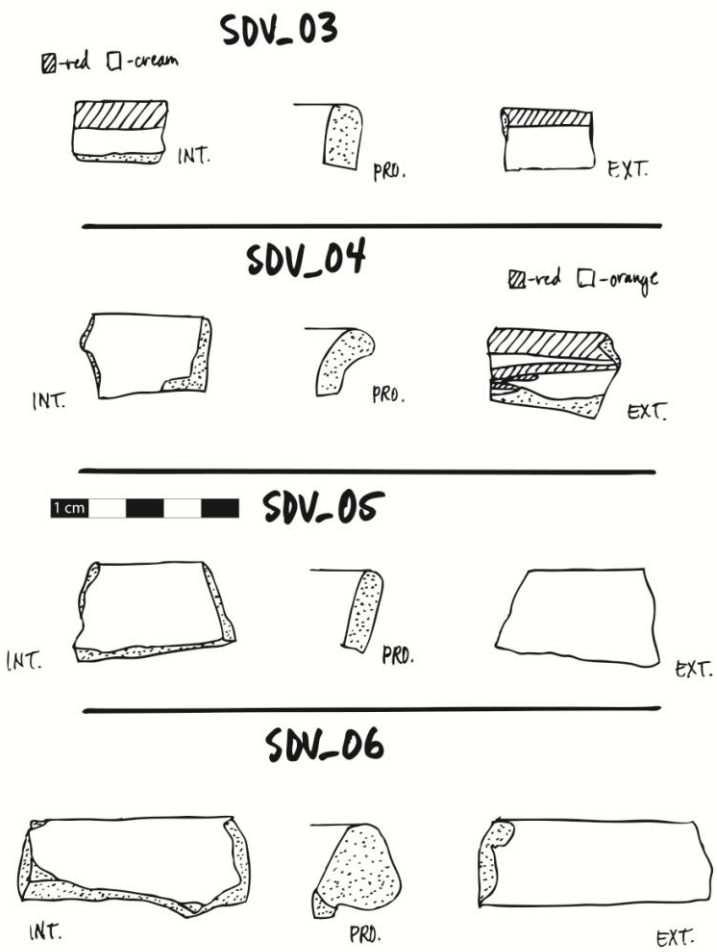
59


PUN_59
INT.
PRO.
EXT.
PUN_60
INT.
PRO.
EXT.
SDV_01
1 cm
INT.
PRO.

60


SDV_01
EXT.
SDV_02
INT.
EXT.
PRO.
1 cm

61


SDV_03
-red -cream
INT.
PRO.
EXT.
SDV_04
-red -orange
INT.
PRO.
EXT.
1 cm
SDV_05
INT.
PRO.
EXT.
SDV_06
INT.
PRO.
EXT.

62

SDV_07
INT.
PRO.
EXT.

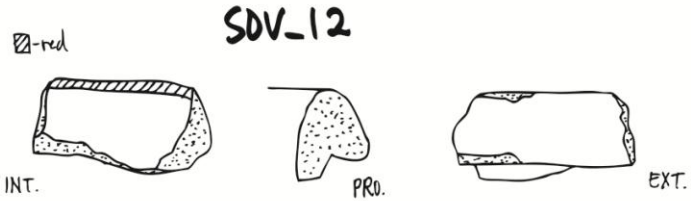
SDV_08
-red -cream
INT.
PRO.
EXT.

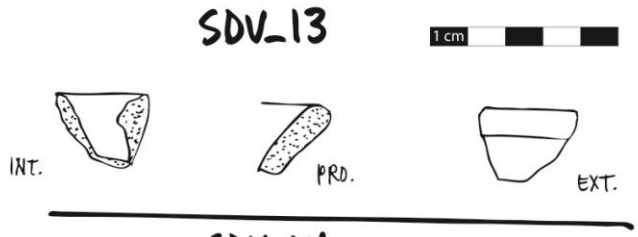
SDV_09
1 cm
INT.
PRO.
EXT.

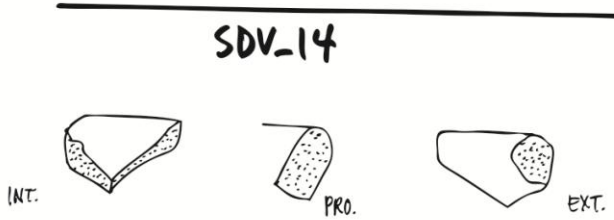
SDV_10
INT.
PRO.
EXT.

63

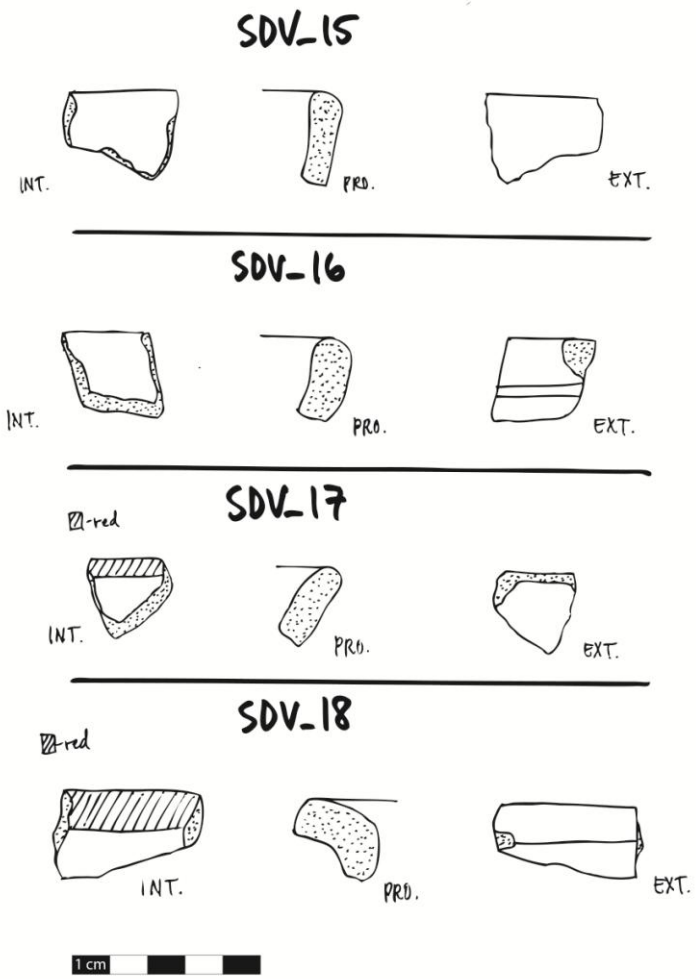
SDV_11
-red -cream
INT.
PRO.
EXT.


SDV_12
-red
INT.
PRO.
EXT.

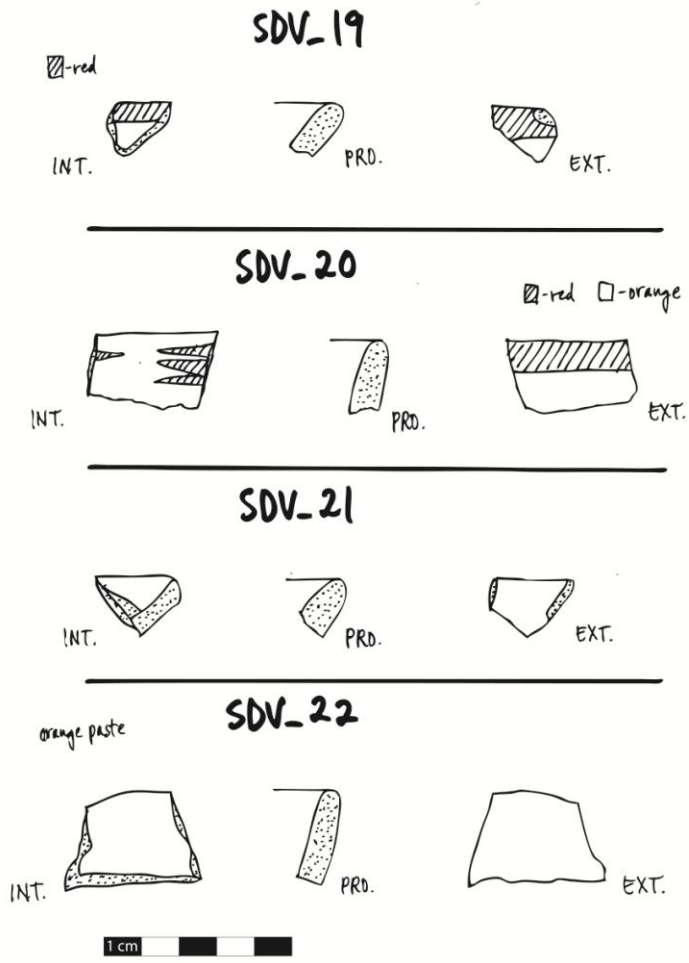

SDV_13
1 cm
INT.
PRO.
EXT.


SDV_14
INT.
PRO.
EXT.

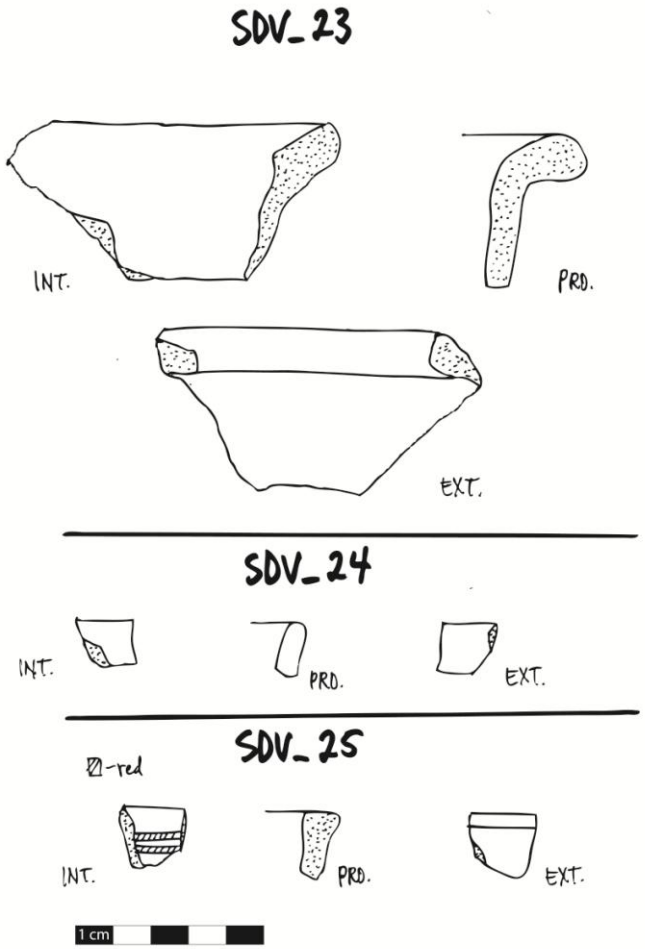
64


SDV_15
INT.
PRO.
EXT.
SDV_16
INT.
PRO.
EXT.
SDV_17
-red
INT.
PRO.
EXT.
SDV_18
-red
INT.
PRO.
EXT.
1 cm

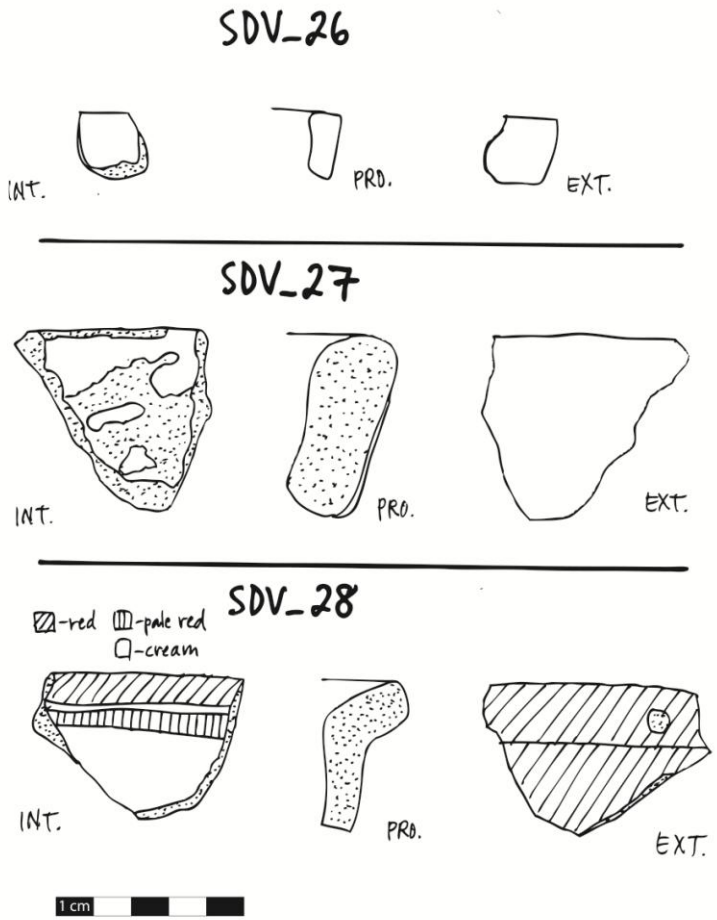
65


SDV_19
-red
INT.
PRO.
EXT.
SDV_20
-red
-orange
INT.
PRO.
EXT.
SDV_21
INT.
PRO.
EXT.
SDV_22
orange paste
INT.
PRO.
EXT.
1 cm

66


SDV_23
INT.
PRO.
EXT.
SDV_24
INT.
PRO.
EXT.
SDV_25
-red
INT.
PRO.
EXT.
1 cm

67

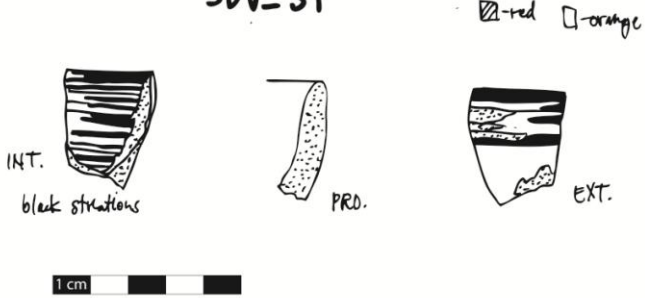

SDV_26
INT.
PRO.
EXT.
SDV_27
INT.
PRO.
EXT.
SDV_28
-red
-pale red
-cream
INT.
PRO.
EXT.
1 cm

68

SDV_29

SDV_30

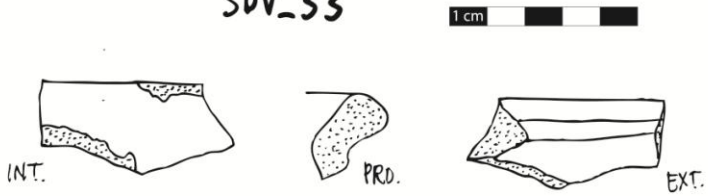
SDV_31



69

SDV_32

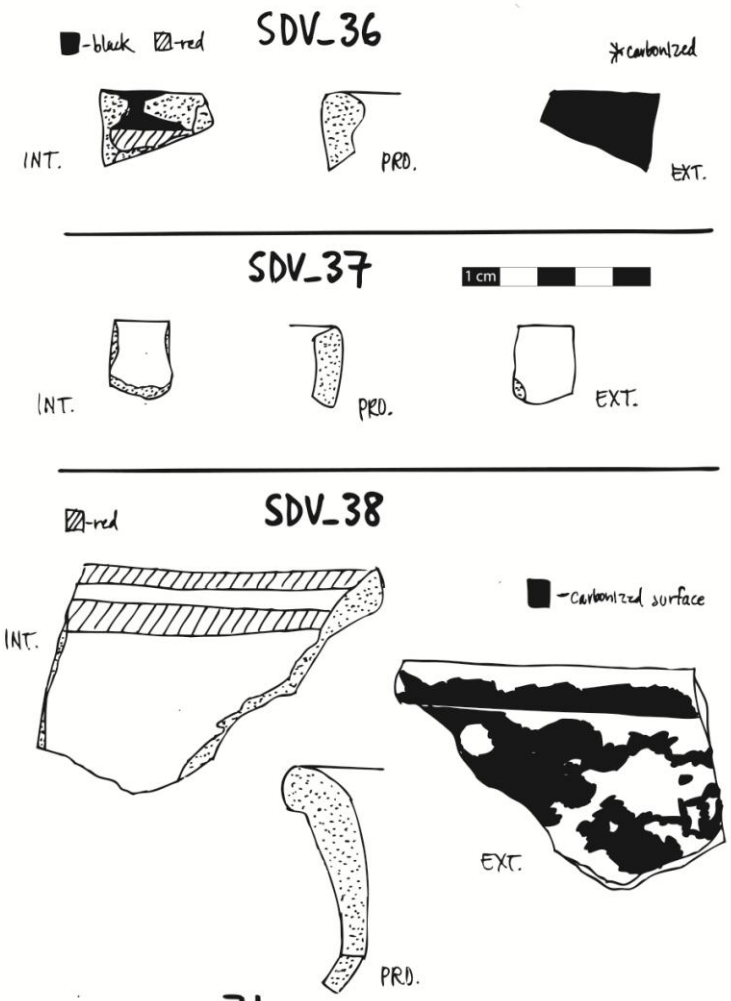
SDV_33



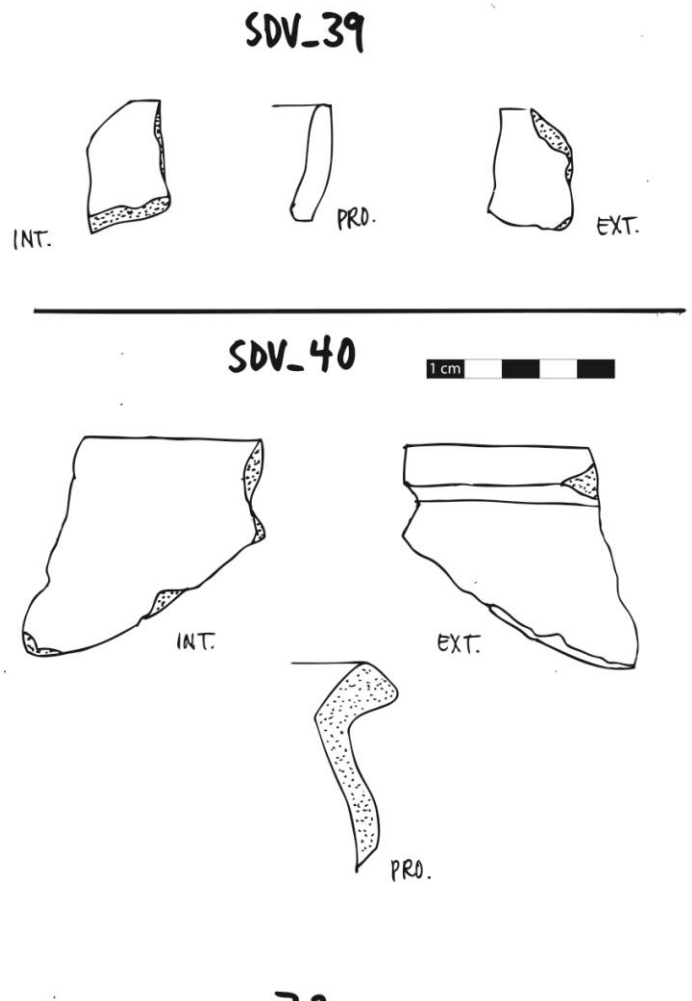
SDV_34

SDV_35

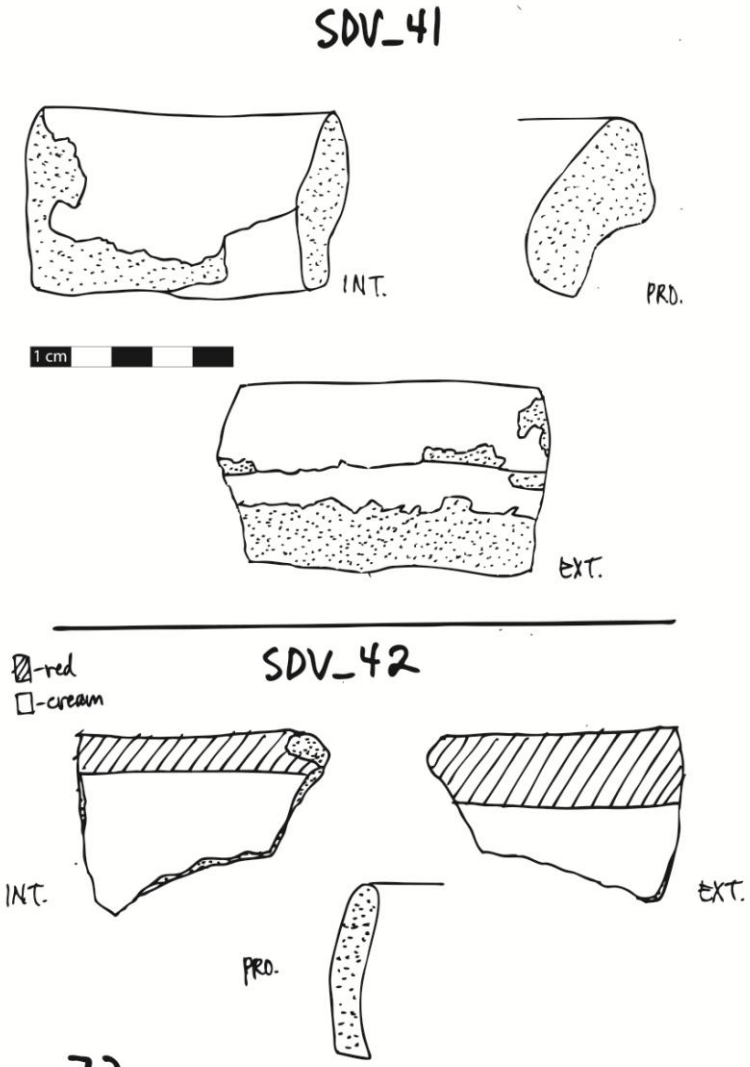
70


-black -red
SDV_36
*carbonized
INT.
PRO.
EXT.
SDV_37
1 cm
INT.
PRO.
EXT.
-red
SDV_38
-carbonized surface
INT.
EXT.
PRO.

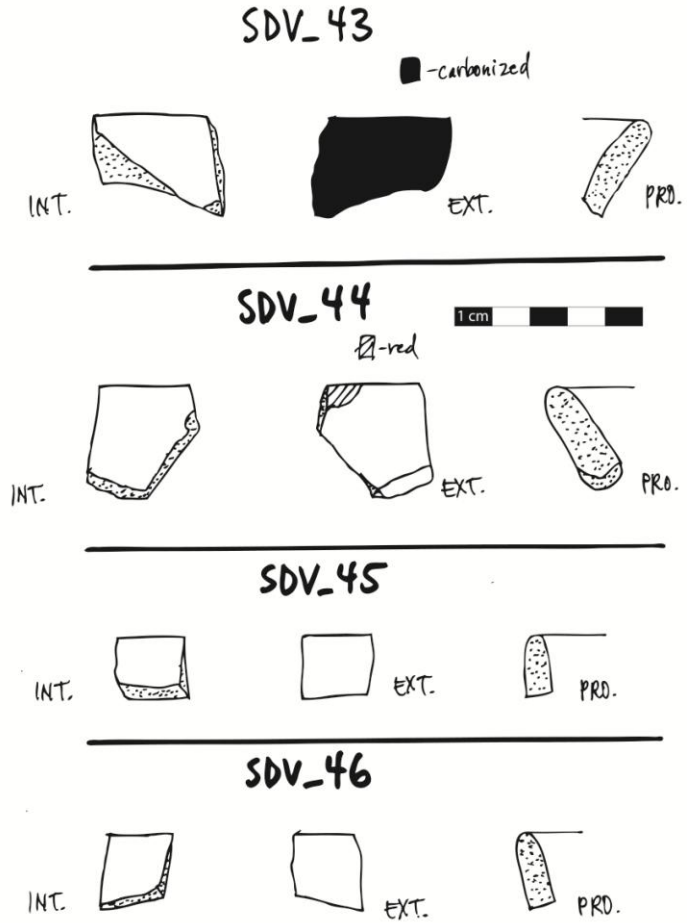
71


SDV_39
INT.
PRO.
EXT.
SDV_40
1 cm
INT.
EXT.
PRO.

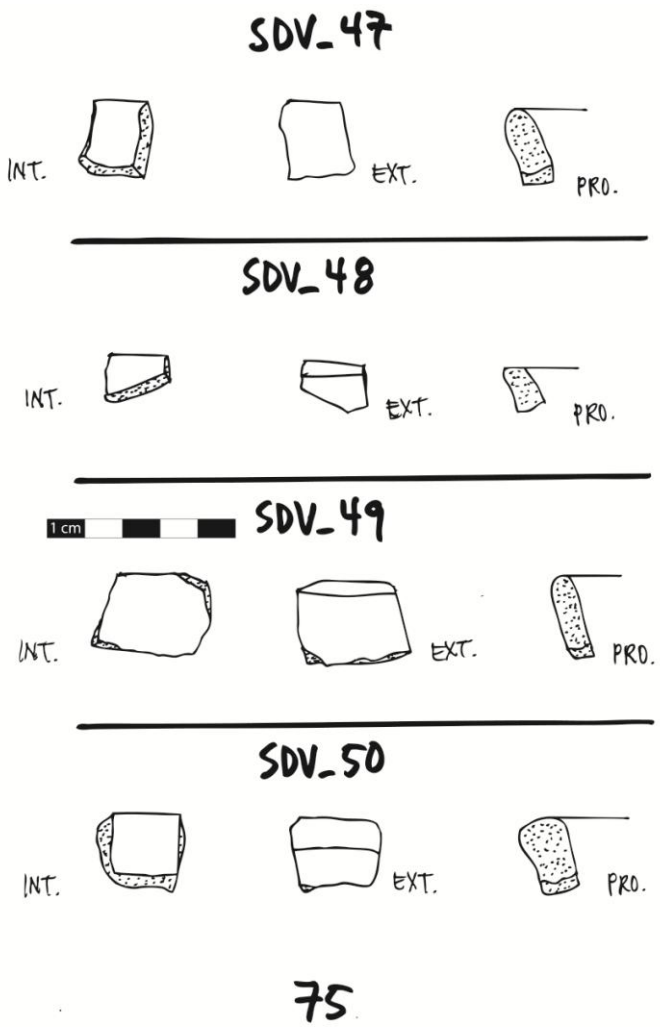
72


SDV_41
INT.
PRO.
1 cm
EXT.
SDV_42
-red
-cream
INT.
EXT.
PRO.

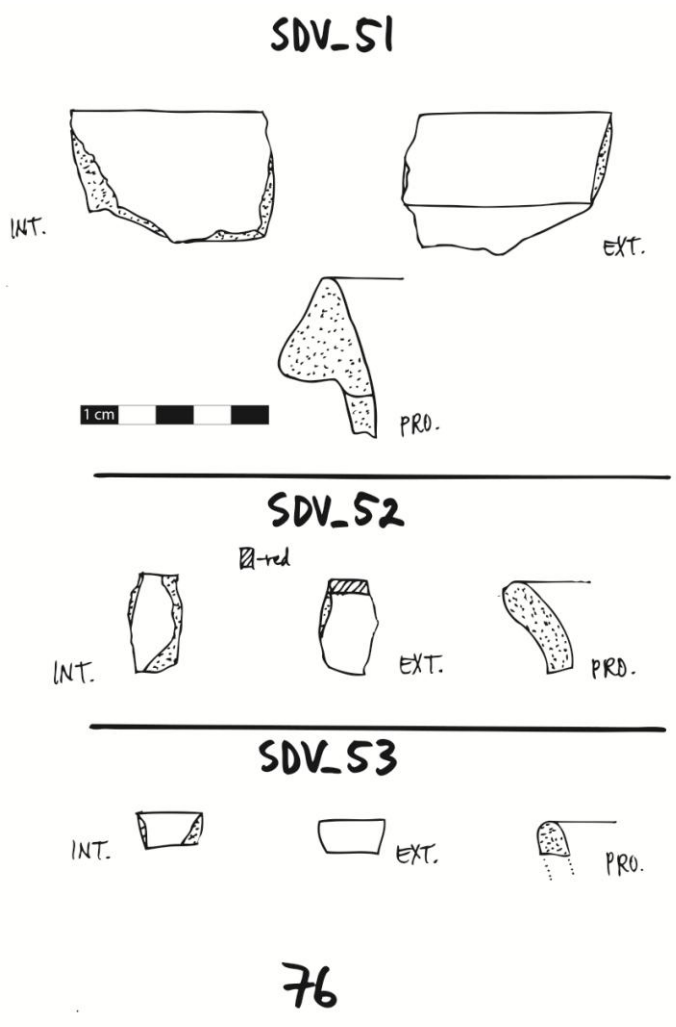
73


SDV_43
-carbonized
INT.
EXT.
PRO.
SDV_44
1 cm
-red
INT.
EXT.
PRO.
SDV_45
INT.
EXT.
PRO.
SDV_46
INT.
EXT.
PRO.

74


SDV_47
INT.
EXT.
PRO.
SDV_48
INT.
EXT.
PRO.
1 cm
SDV_49
INT.
EXT.
PRO.
SDV_50
INT.
EXT.
PRO.

75


SDV_51
INT.
EXT.
1 cm
PRO.
SDV_52
red
INT.
EXT.
PRO.
SDV_53
INT.
EXT.
PRO.

76

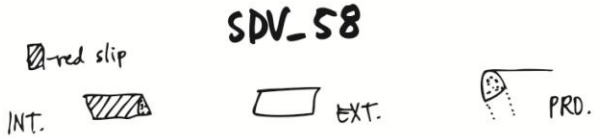
SDV_54
-black
-greenish cream
* body sherd
INT.
PRO.

SDV_55
-red
INT.
EXT.
PRO.

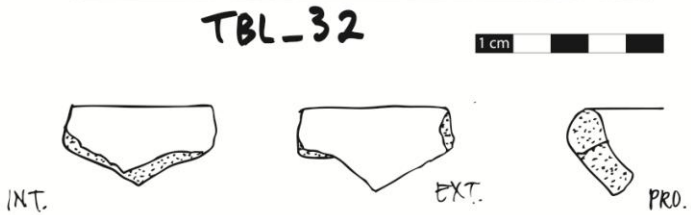
SDV_56
1 cm
INT.
striated
EXT.
PRO.

SDV_57
-red slip
INT.
striated
EXT.
PRO.

77

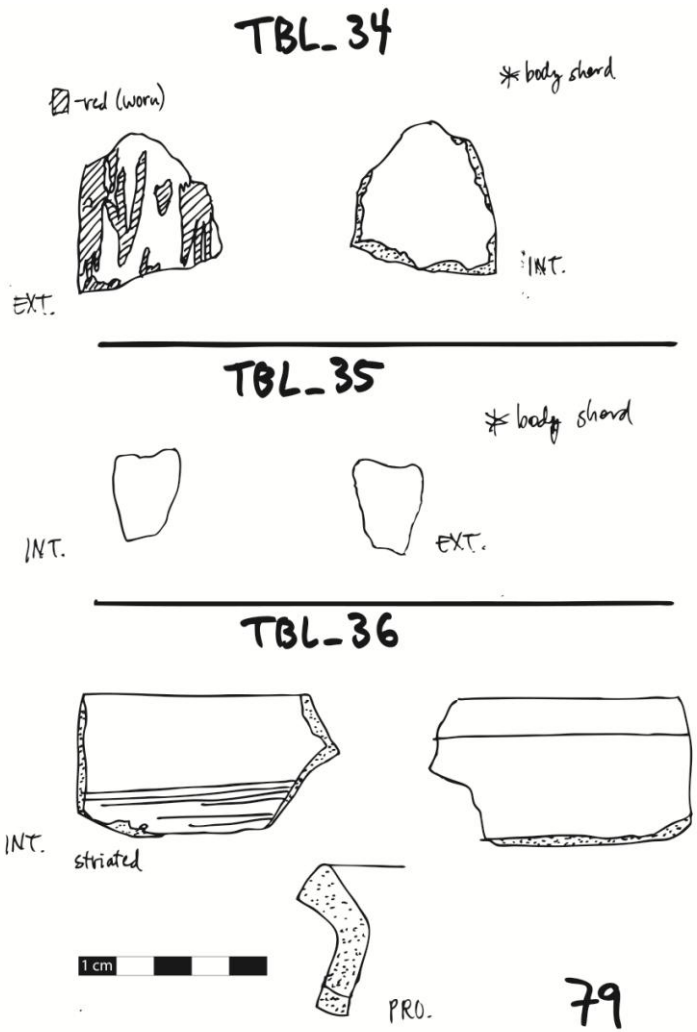

SDV_58
-red slip
INT.
EXT.
PRO.

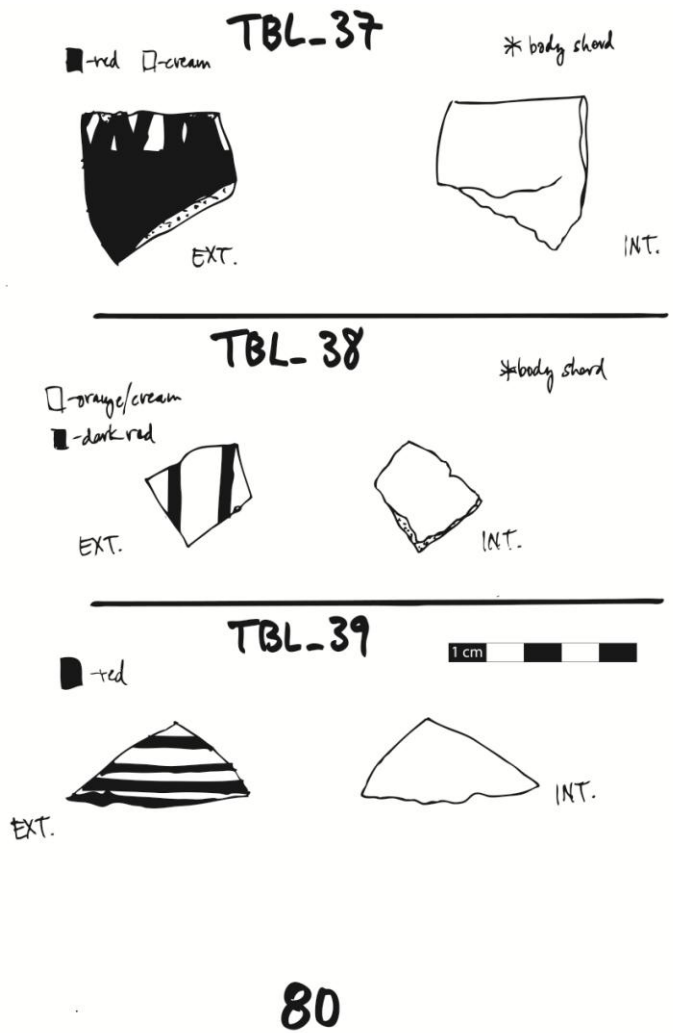
TBL_31
-carbonized
INT.
EXT.
PRO.


TBL_32
1 cm
INT.
EXT.
PRO.

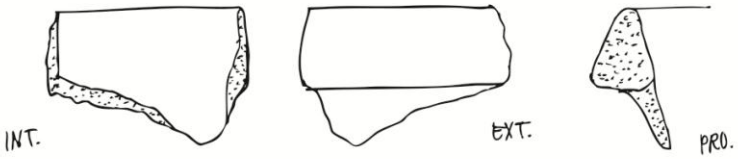
TBL_33
EXT.
INT.

78

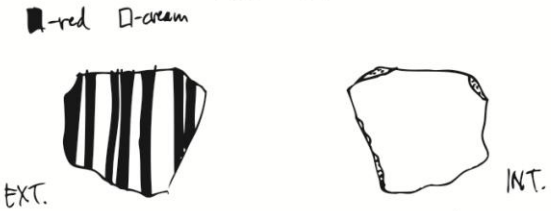

TBL_34
-red (worn)
* body sherd
EXT.
INT.
TBL_35
* body sherd
INT.
EXT.
TBL_36
INT.
striated
EXT.
1 cm
PRO.
79


TBL_37
-red
-cream
* body sherd
EXT.
INT.
TBL_38
* body sherd
-orange/cream
-dark red
EXT.
INT.
TBL_39
1 cm
-red
EXT.
INT.
80

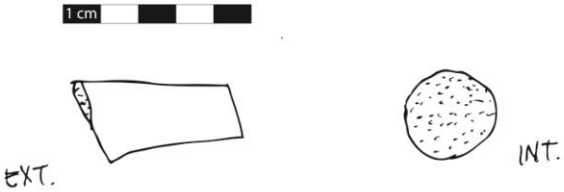
TBL_40



TBL_41

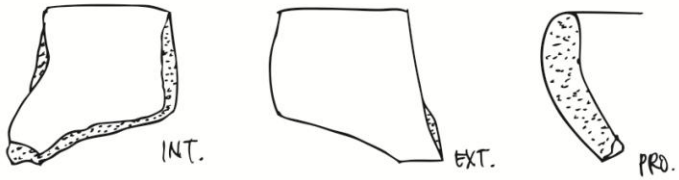


TBL_42

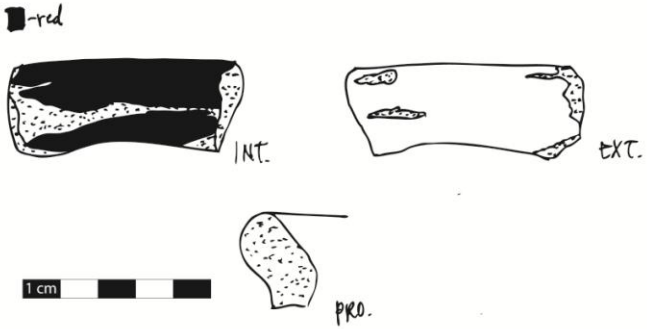


81

TBL_43

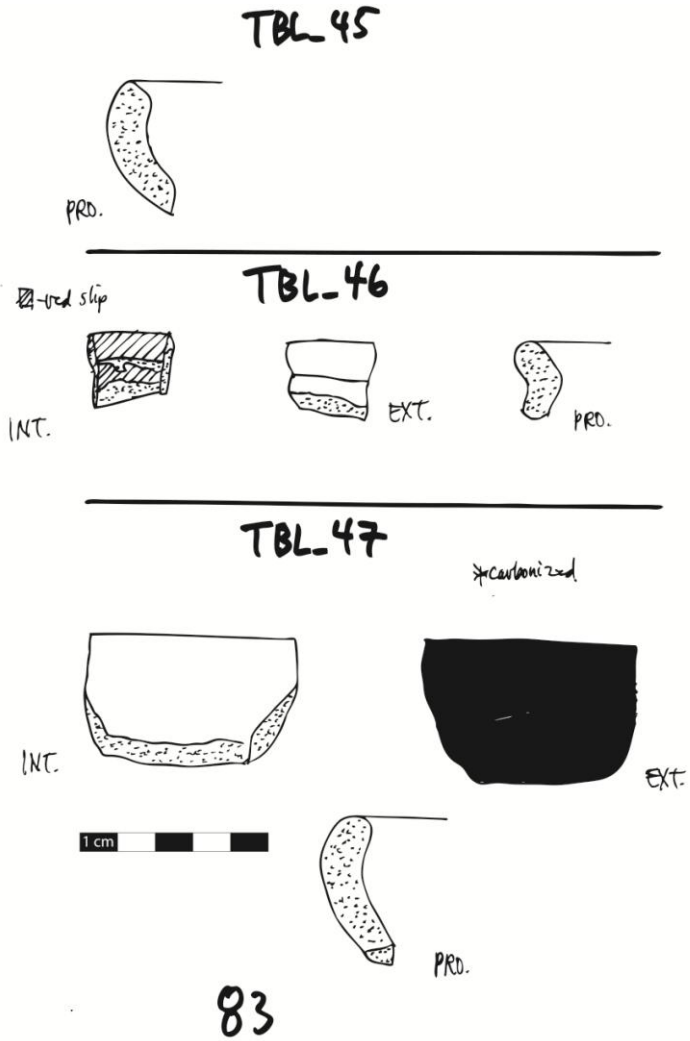


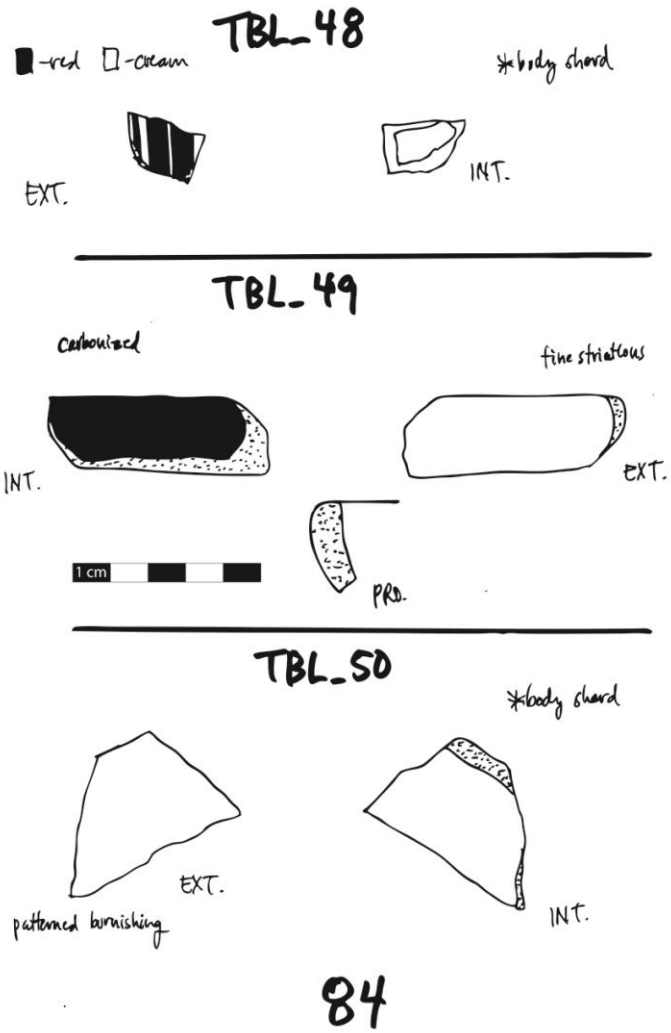
TBL_44

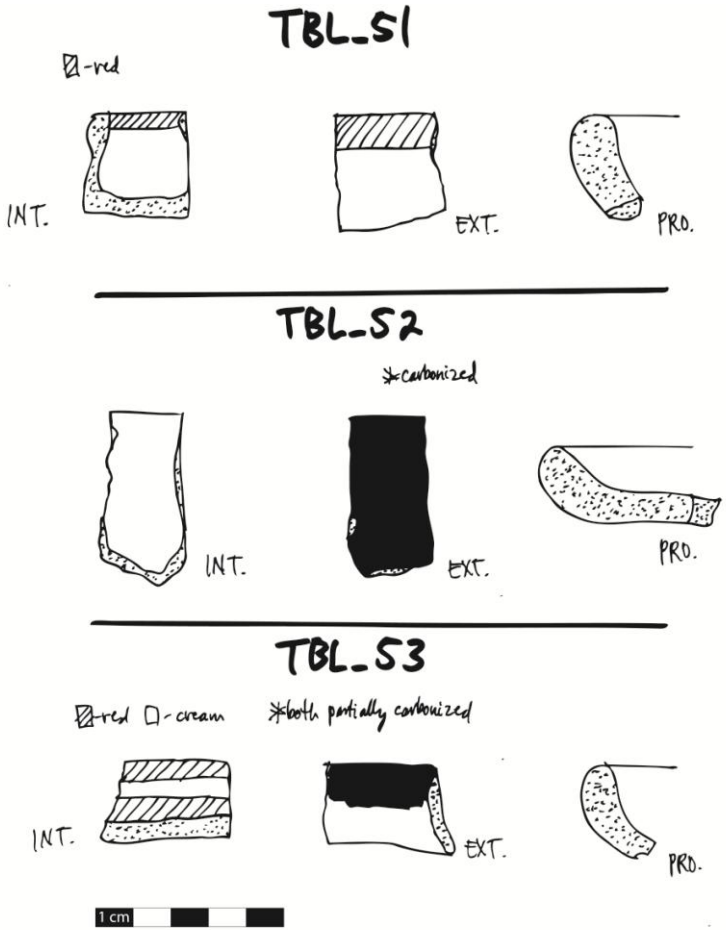


TBL_45

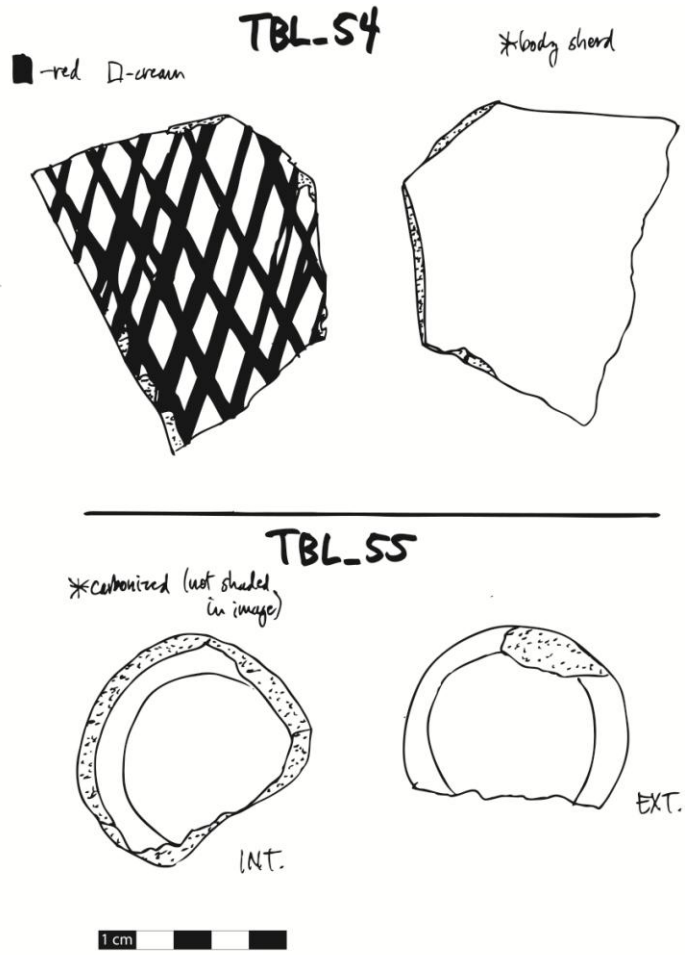
82


TBL_45
PRO.
TBL_46
-red slip
INT.
EXT.
PRO.
TBL_47
*carbonized
INT.
EXT.
1 cm
PRO.
83

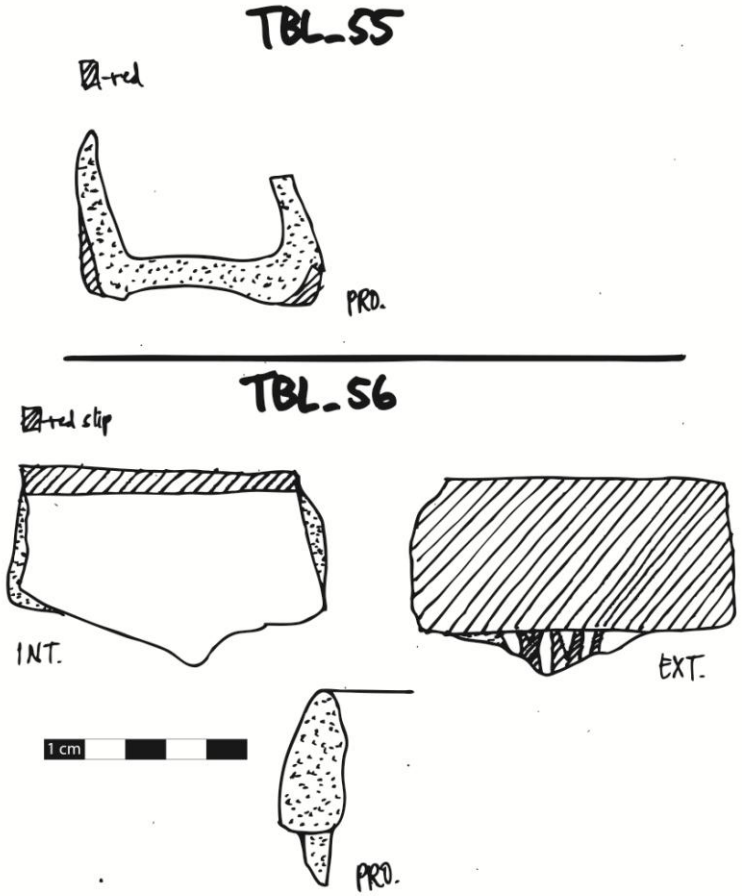

TBL_48
-red
-cream
*body sherd
EXT.
INT.
TBL_49
carbonized
fine striations
INT.
EXT.
1 cm
PRO.
TBL_50
*body sherd
EXT.
patterned burnishing
INT.
84


TBL_51
-red
INT.
EXT.
PRO.
TBL_52
*carbonized
INT.
EXT.
PRO.
TBL_53
-red -cream
*both partially carbonized
INT.
EXT.
PRO.
1 cm

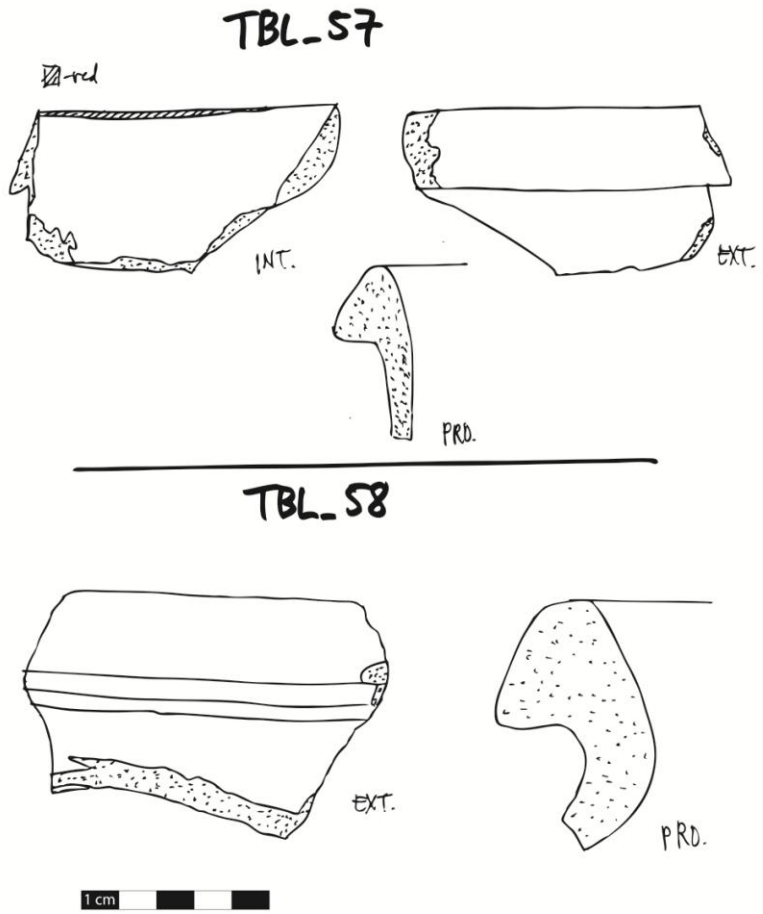
85


TBL_54
-red -cream
*body sherd
TBL_55
*carbonized (not shaded in image)
INT.
EXT.
1 cm

86

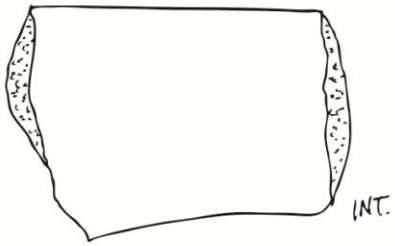

TBL_55
red
PRO.
TBL_56
red slip
INT.
EXT.
1 cm
PRO.

87

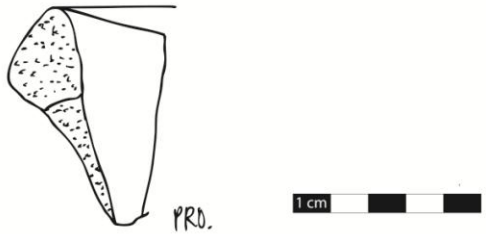

TBL_57
red
INT.
EXT.
PRO.
TBL_58
EXT.
PRO.
1 cm

88

TBL_58

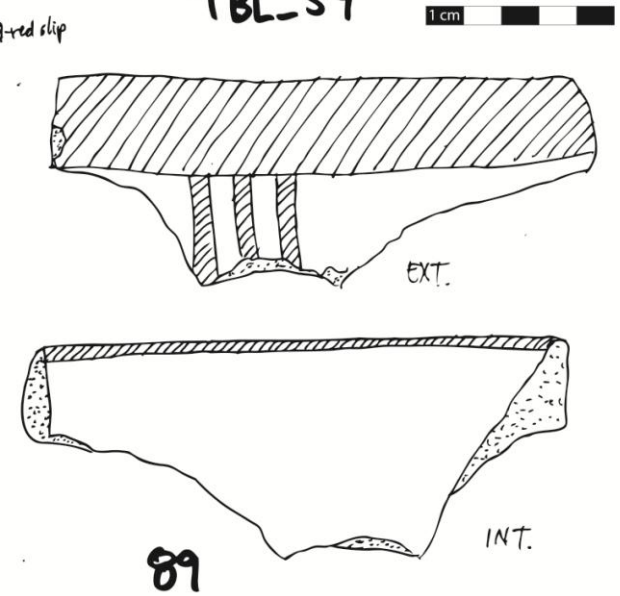


TBL_59



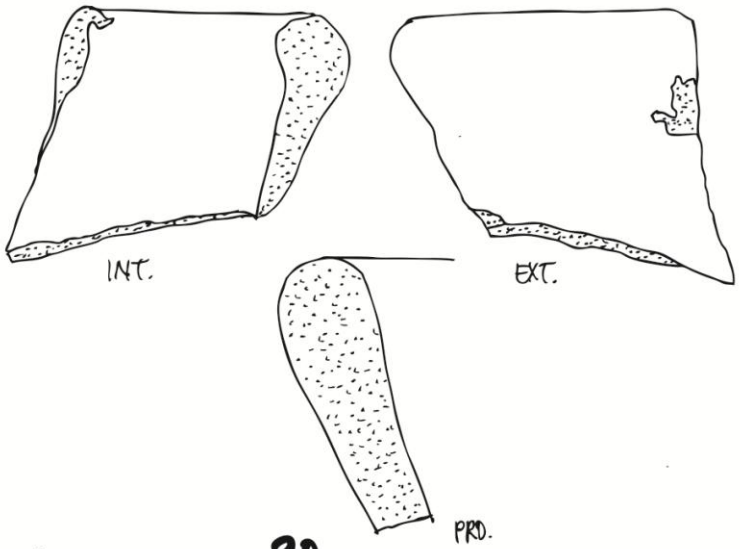
TBL_59

red slip

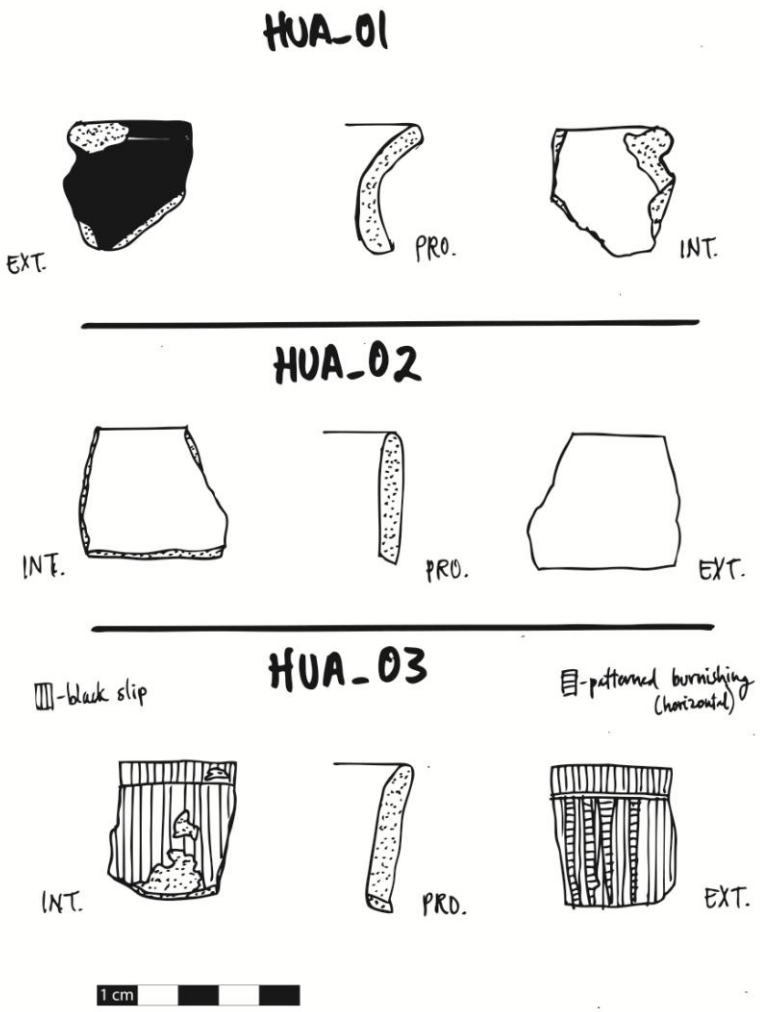


89

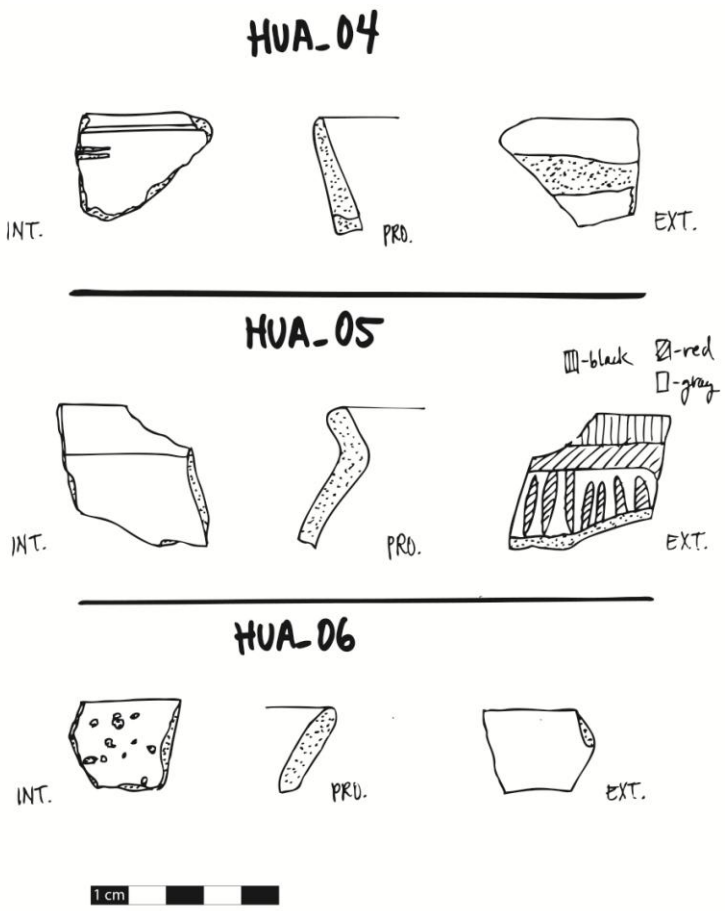
TBL_60



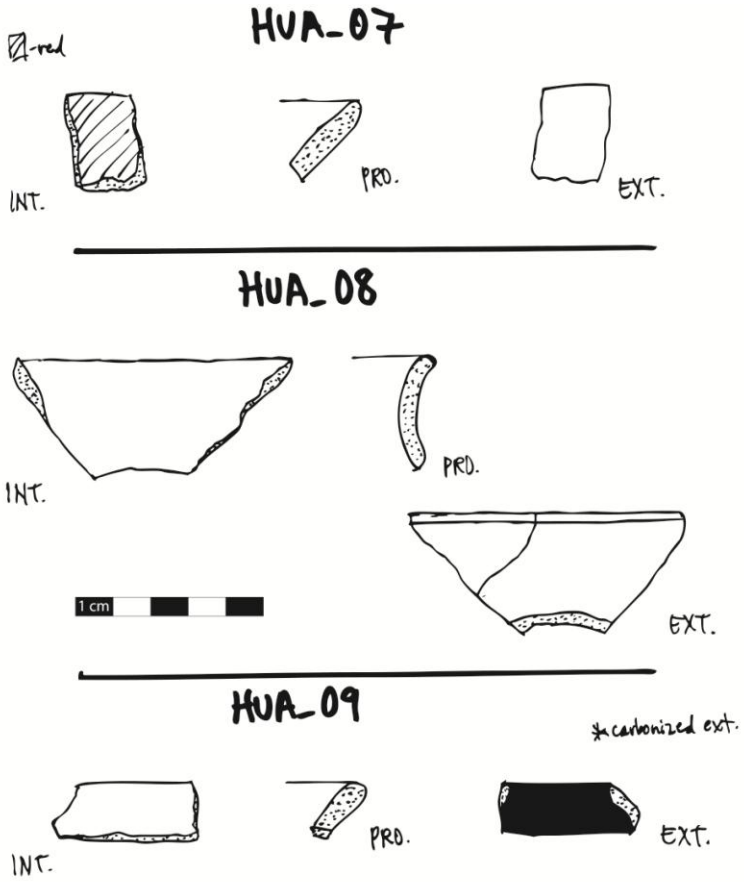
90


HUA_01
EXT.
PRO.
INT.
HUA_02
INT.
PRO.
EXT.
HUA_03
-black slip
-patterned burnishing (horizontal)
INT.
PRO.
EXT.
1 cm

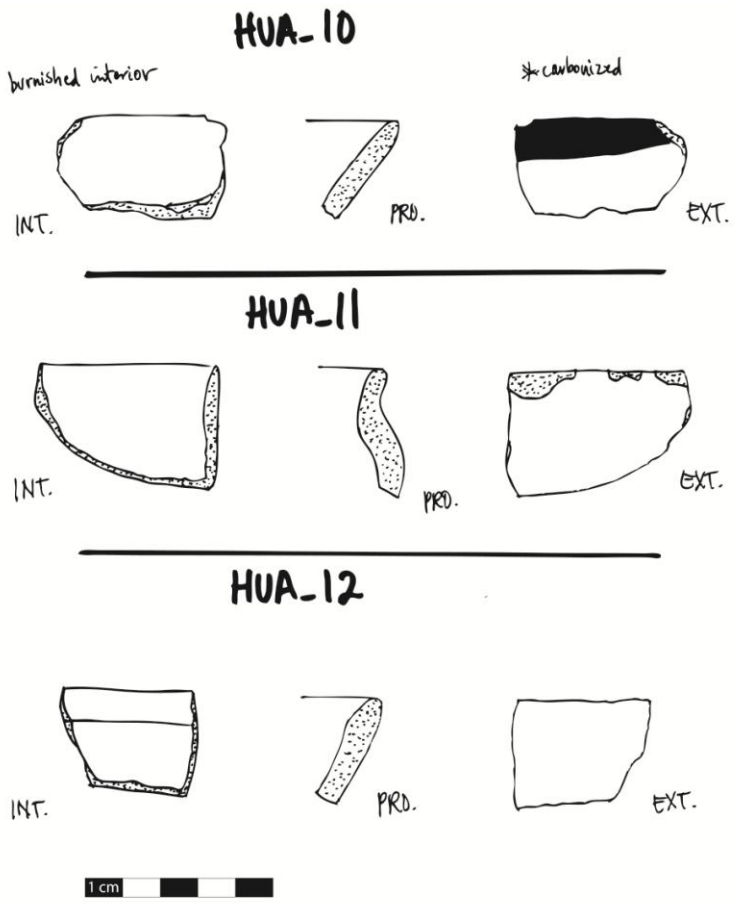
91


HUA_04
INT.
PRO.
EXT.
HUA_05
-black
-red
-gray
INT.
PRO.
EXT.
HUA_06
INT.
PRO.
EXT.
1 cm

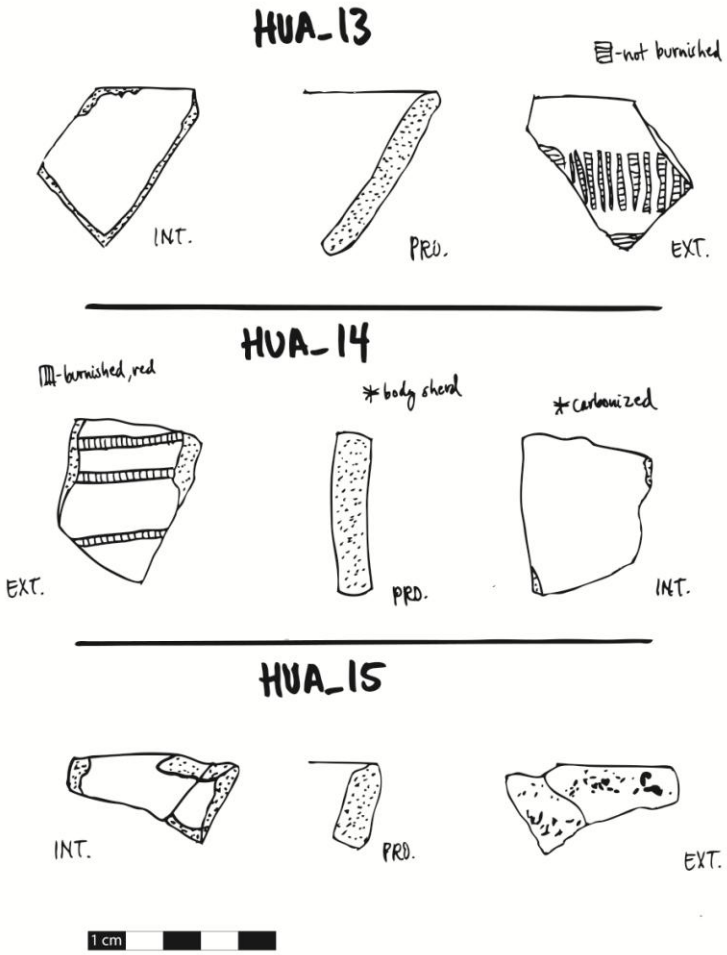
92


HUA_07
-red
INT.
PRO.
EXT.
HUA_08
INT.
PRO.
EXT.
1 cm
HUA_09
*carbonized ext.
INT.
PRO.
EXT.

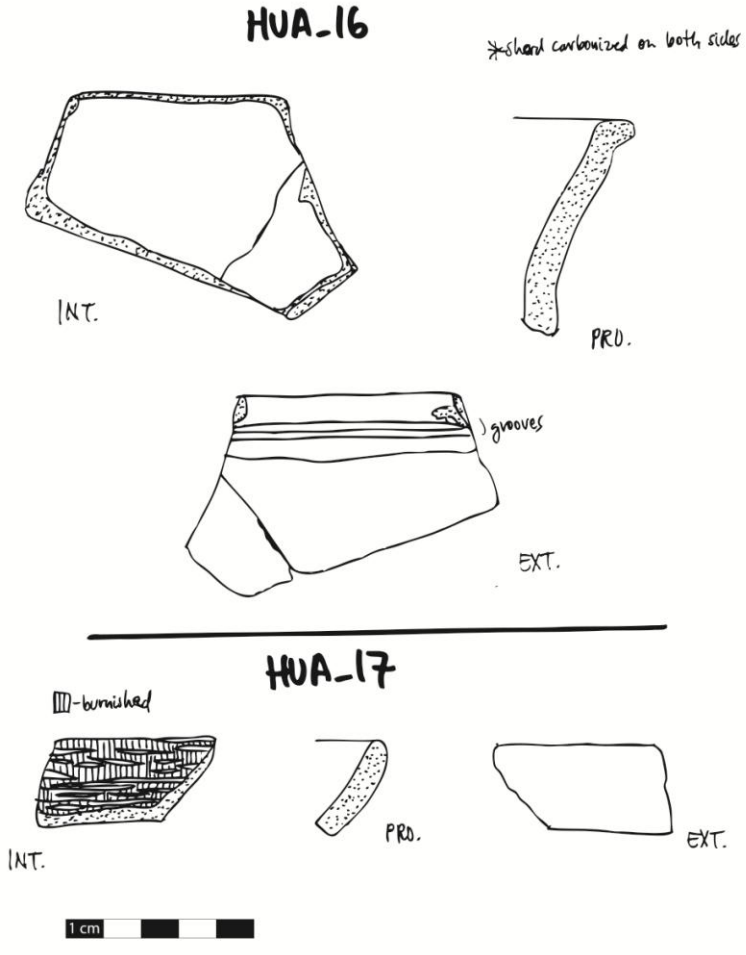
93


HUA_10
burnished interior
*carbonized
INT.
PRO.
EXT.
HUA_11
INT.
PRO.
EXT.
HUA_12
INT.
PRO.
EXT.
1 cm

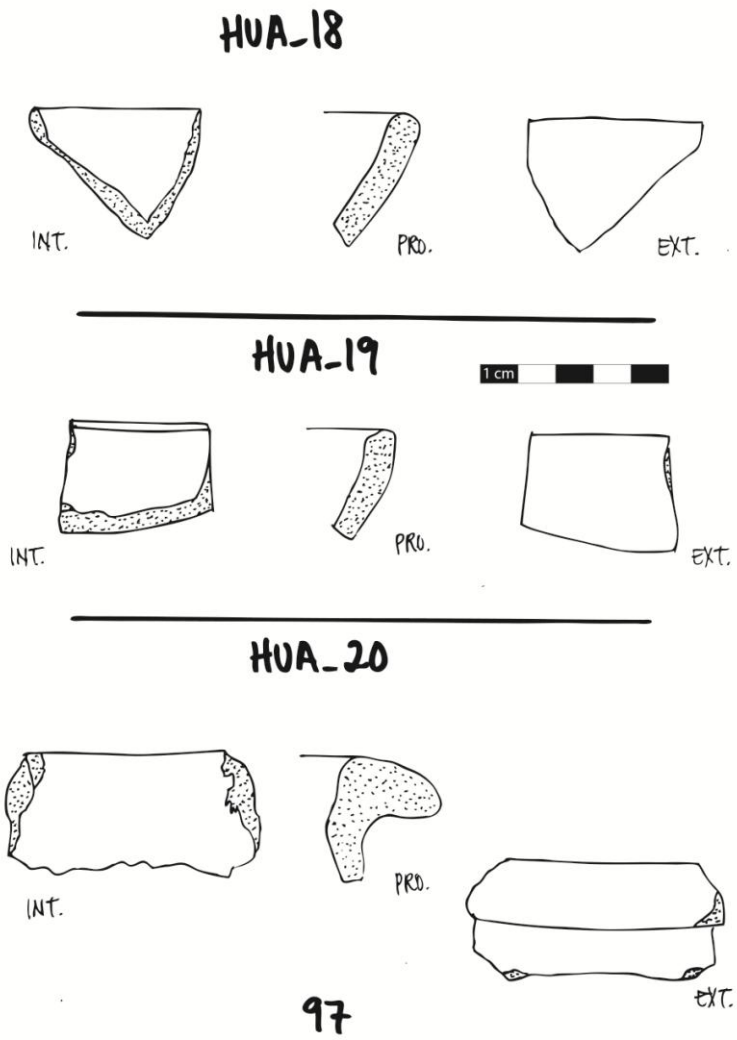
94


HUA_13
-not burnished
INT.
PRO.
EXT.
HUA_14
-burnished, red
*body sherd
*carbonized
EXT.
PRO.
INT.
HUA_15
INT.
PRO.
EXT.
1 cm

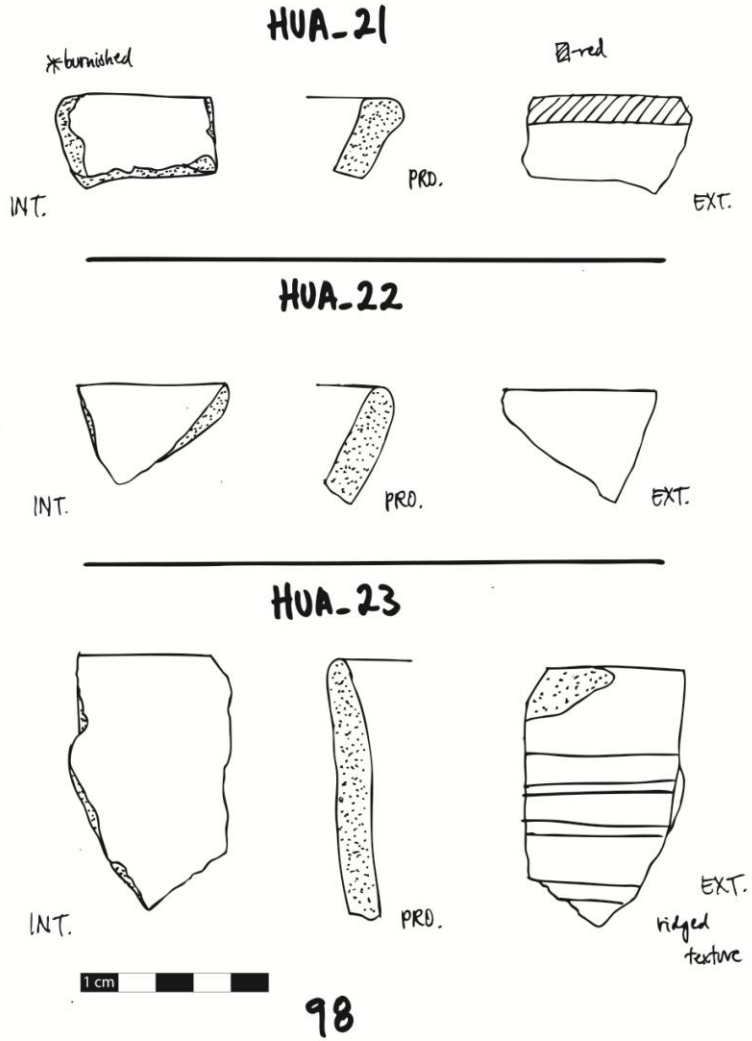
95


HUA_16
*sherd carbonized on both sides
INT.
PRO.
grooves
EXT.
HUA_17
-burnished
INT.
PRO.
EXT.
1 cm

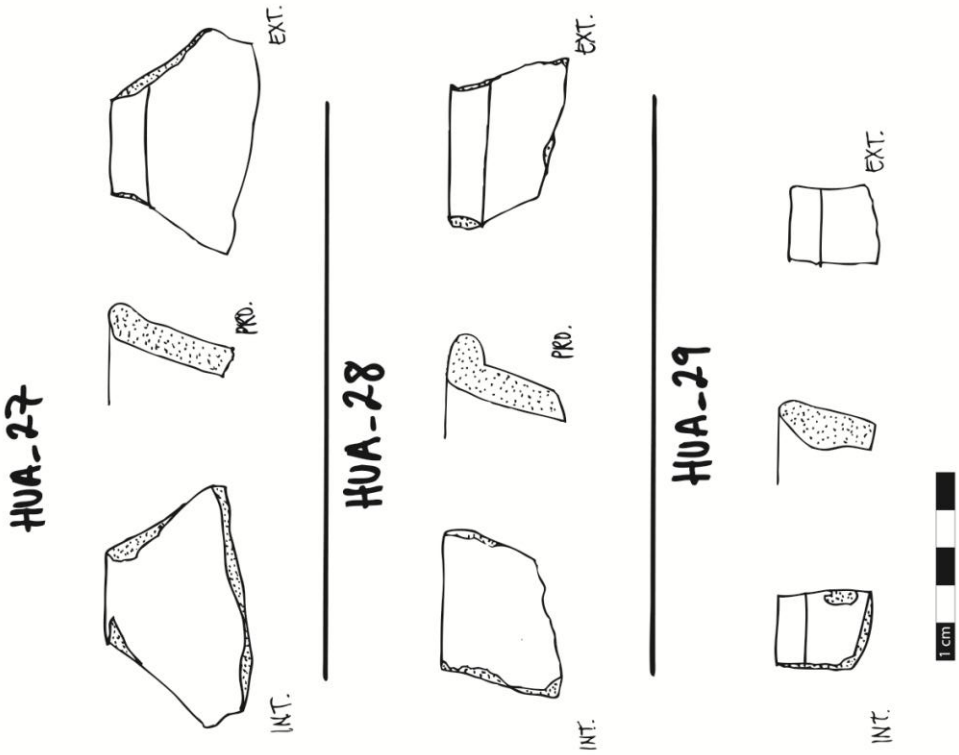
96

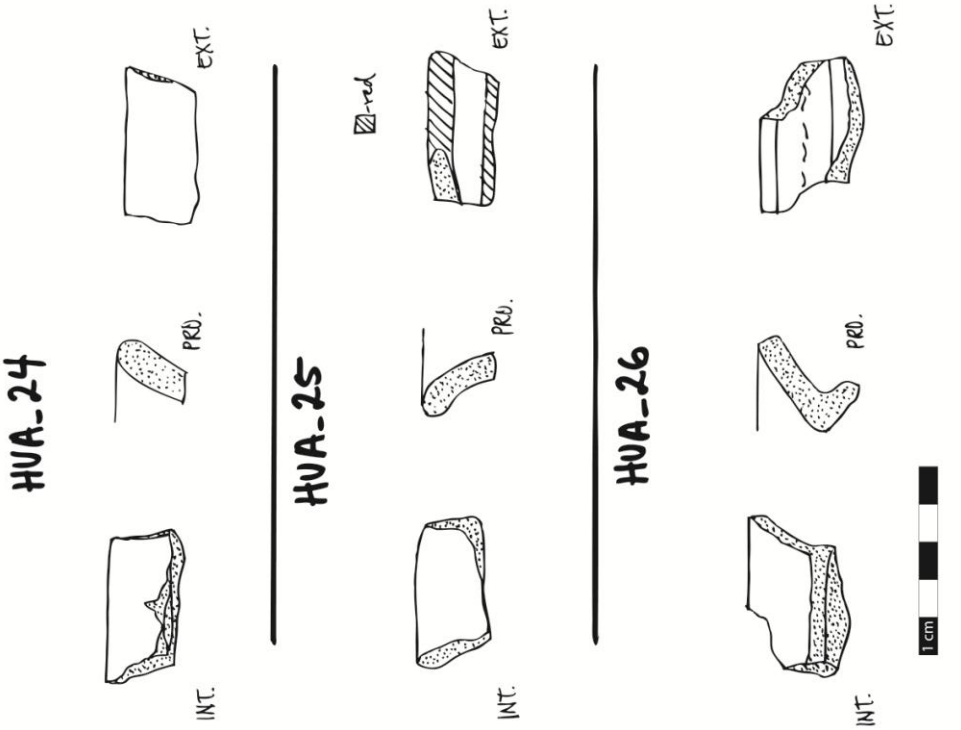

HUA_18
INT.
PRO.
EXT.
HUA_19
1 cm
INT.
PRO.
EXT.
HUA_20
INT.
PRO.
EXT.

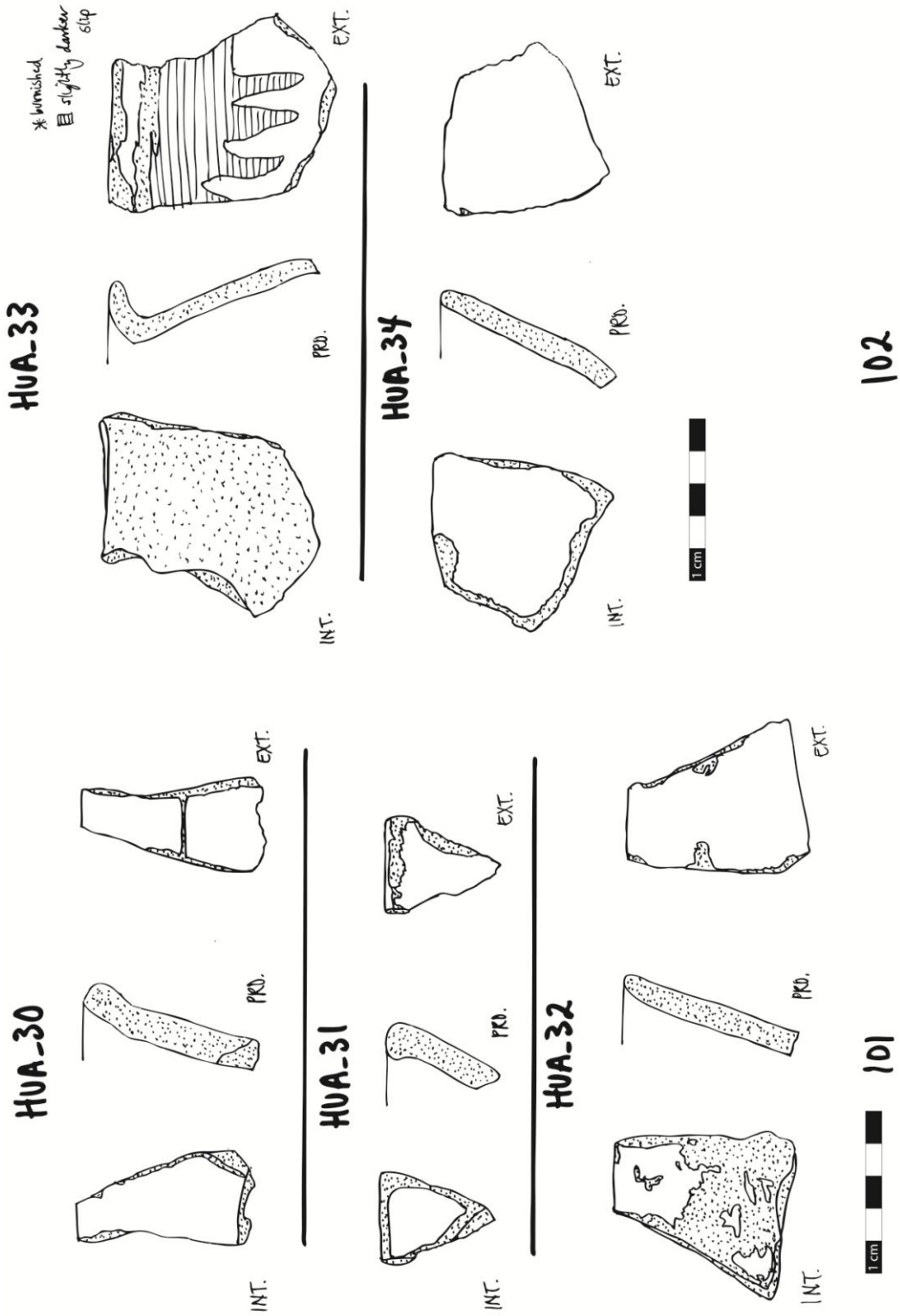
97

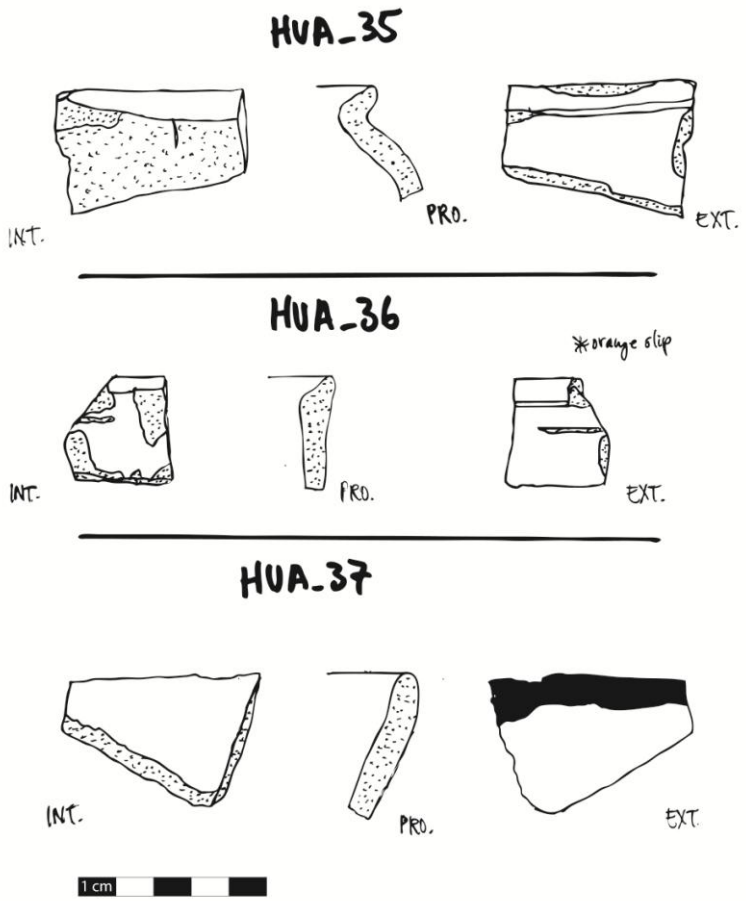

HUA_21
*burnished
▨-red
INT.
PRO.
EXT.
HUA_22
INT.
PRO.
EXT.
HUA_23
INT.
PRO.
EXT.
ridged texture
1 cm

98

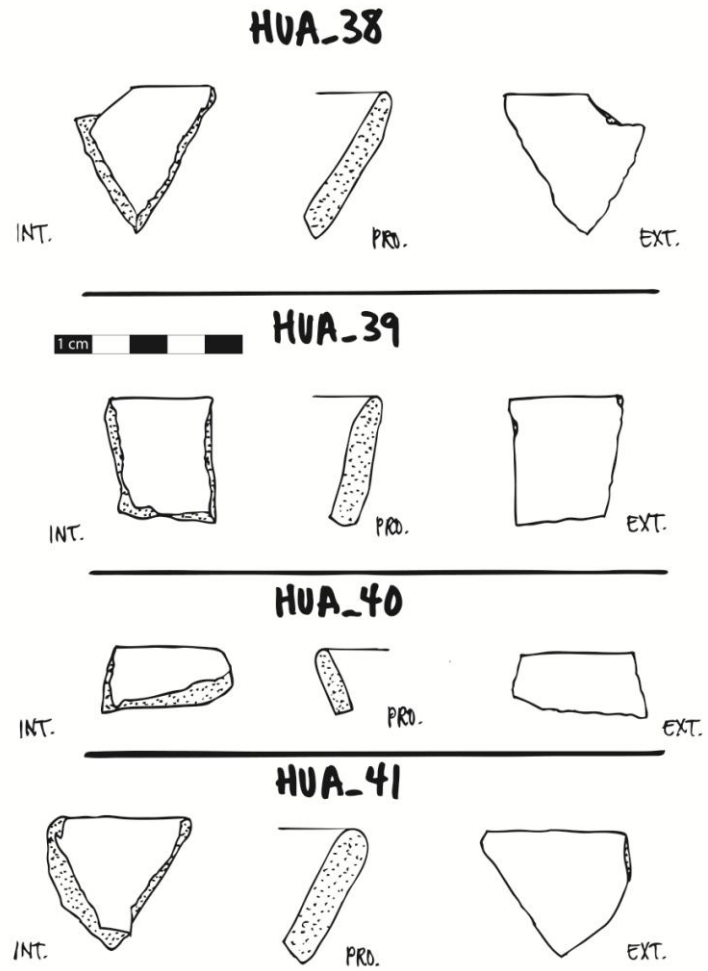

HUA_27
EXT.
PRO.
INT.
HUA_28
EXT.
PRO.
INT.
HUA_29
EXT.
PRO.
INT.
1 cm
100


HUA_24
EXT.
PRO.
INT.
HUA_25
red
EXT.
PRO.
INT.
HUA_26
EXT.
PRO.
INT.
1 cm
99

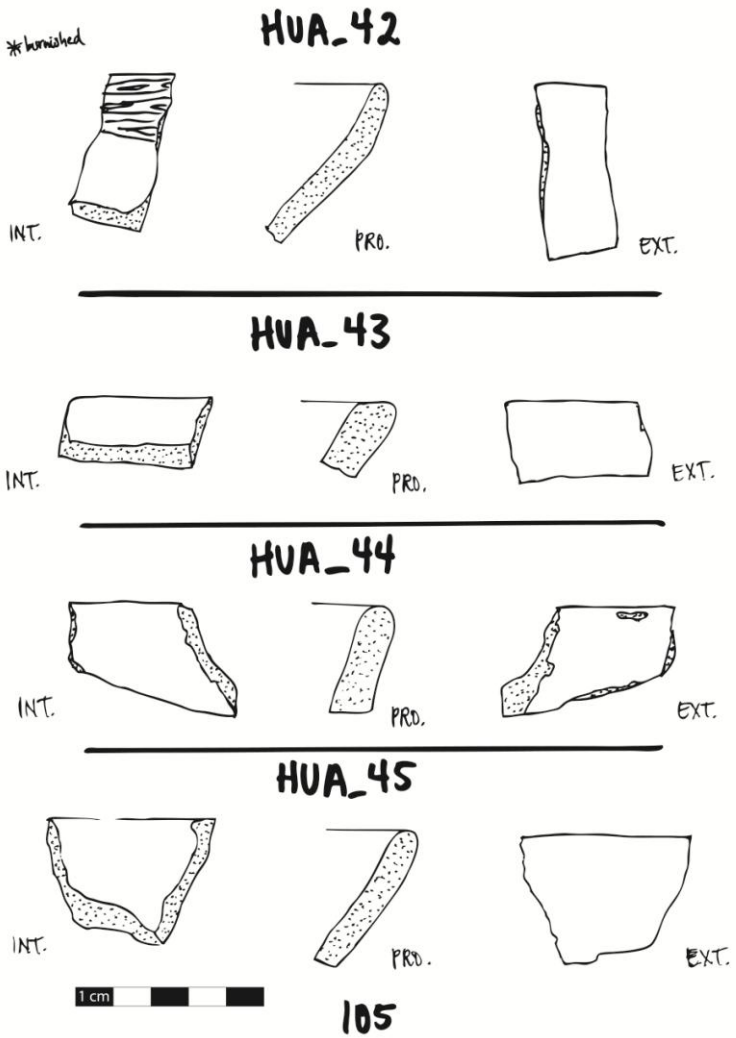

HUA_30
INT.
PRO.
EXT.
HUA_31
INT.
PRO.
EXT.
HUA_32
INT.
PRO.
EXT.
101
1 cm
HUA_33
INT.
PRO.
EXT.
HUA_34
INT.
PRO.
EXT.
1 cm
102
* burnished
slip slightly darker


HUA_35
INT.
PRO.
EXT.
HUA_36
*orange slip
INT.
PRO.
EXT.
HUA_37
INT.
PRO.
EXT.
1 cm

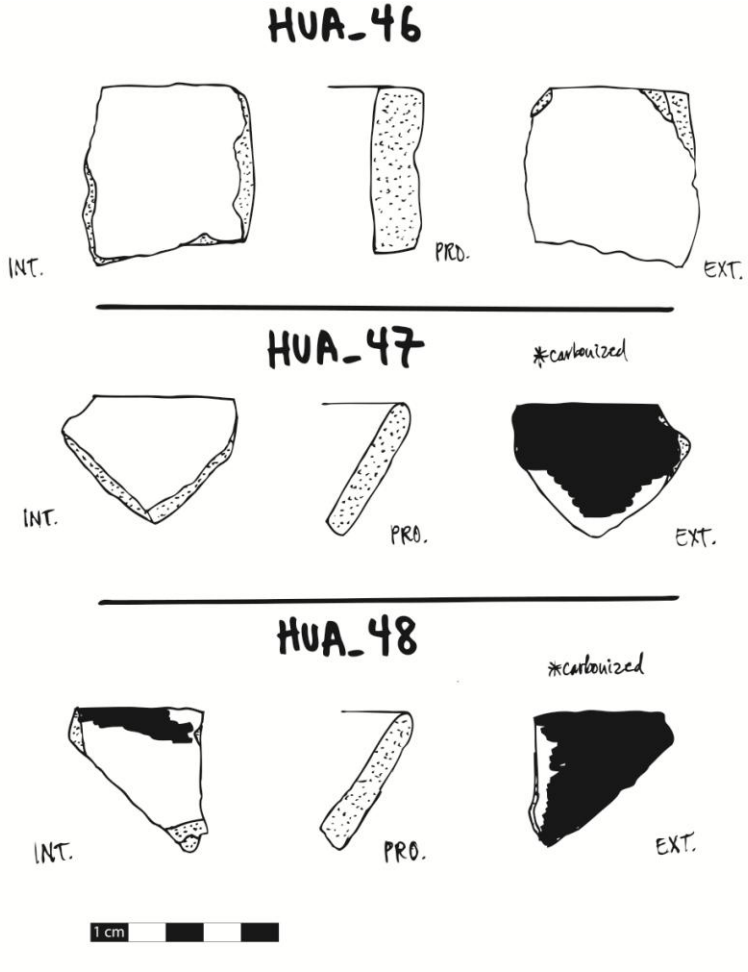
103


HUA_38
INT.
PRO.
EXT.
1 cm
HUA_39
INT.
PRO.
EXT.
HUA_40
INT.
PRO.
EXT.
HUA_41
INT.
PRO.
EXT.

104

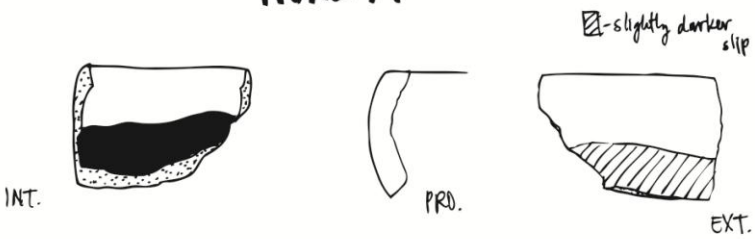

*burnished
HUA_42
INT.
PRO.
EXT.
HUA_43
INT.
PRO.
EXT.
HUA_44
INT.
PRO.
EXT.
HUA_45
INT.
PRO.
EXT.
1 cm

105


HUA_46
INT.
PRO.
EXT.
HUA_47
*carbonized
INT.
PRO.
EXT.
HUA_48
*carbonized
INT.
PRO.
EXT.
1 cm

106

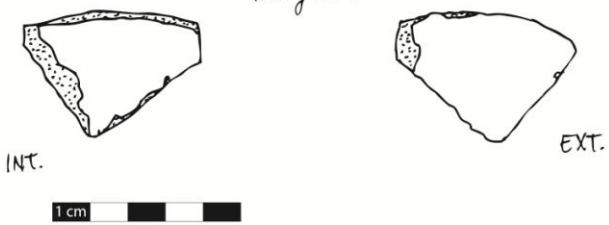
HUA_49



HUA_50 tumba #2

HUA_51 tumba #2

*body sherd



107

HUA_52 tumba #2

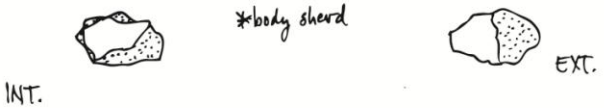
*partially carbonized

*body sherd

HUA_53 tumba #10

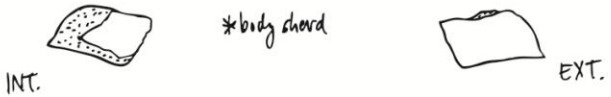
HUA_54 nivel #1

*body sherd



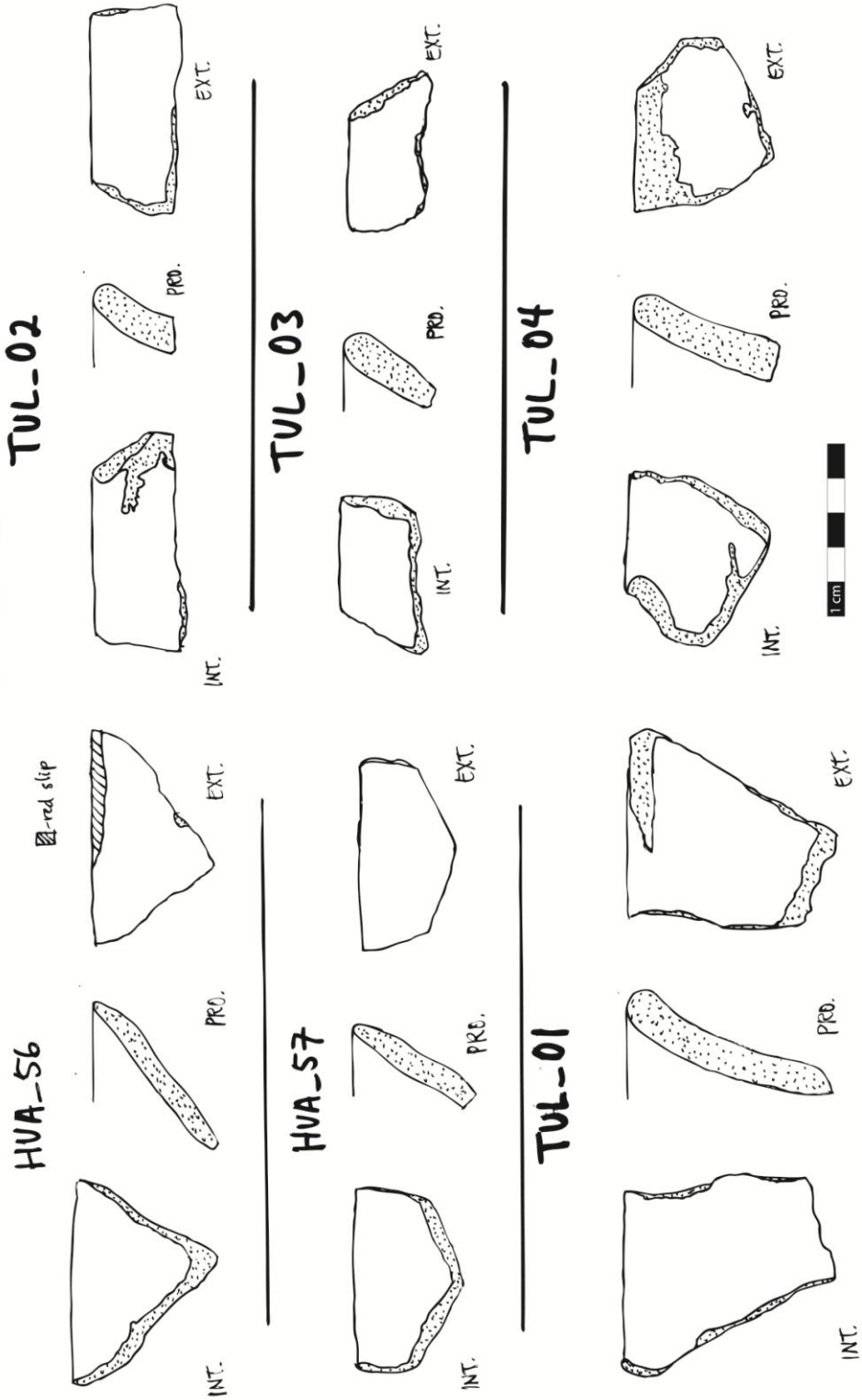
HUA_55

*body sherd



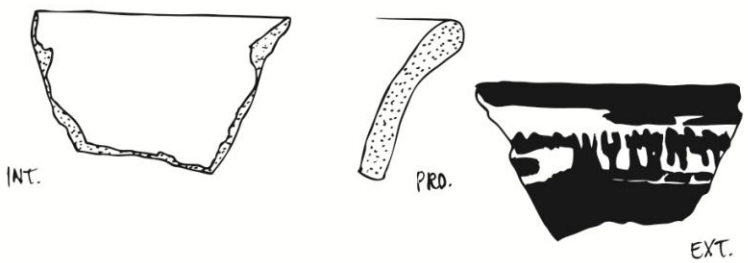
1 cm

108

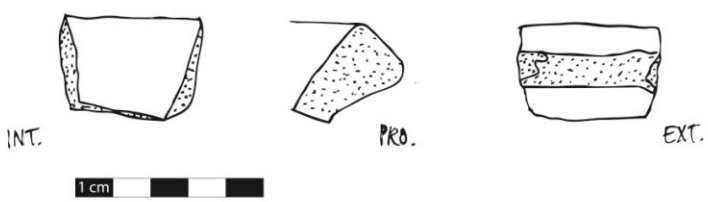

HVA_56
red slip
EXT.
PRO.
INT.
HVA_57
EXT.
PRO.
INT.
TUL_01
EXT.
PRO.
INT.
1 cm
109
TUL_02
EXT.
PRO.
INT.
TUL_03
EXT.
PRO.
INT.
TUL_04
EXT.
PRO.
INT.
1 cm
110

TUL_05

TUL_06 PL1 W



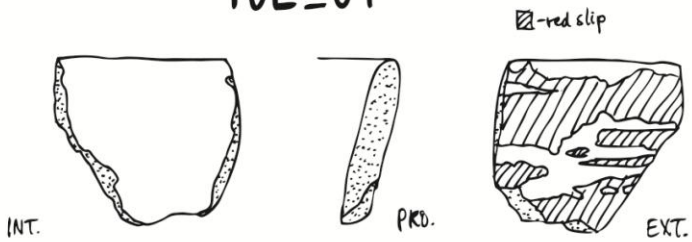
TUL_07



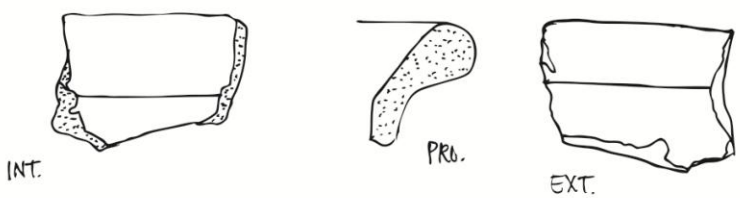
111

TUL_08

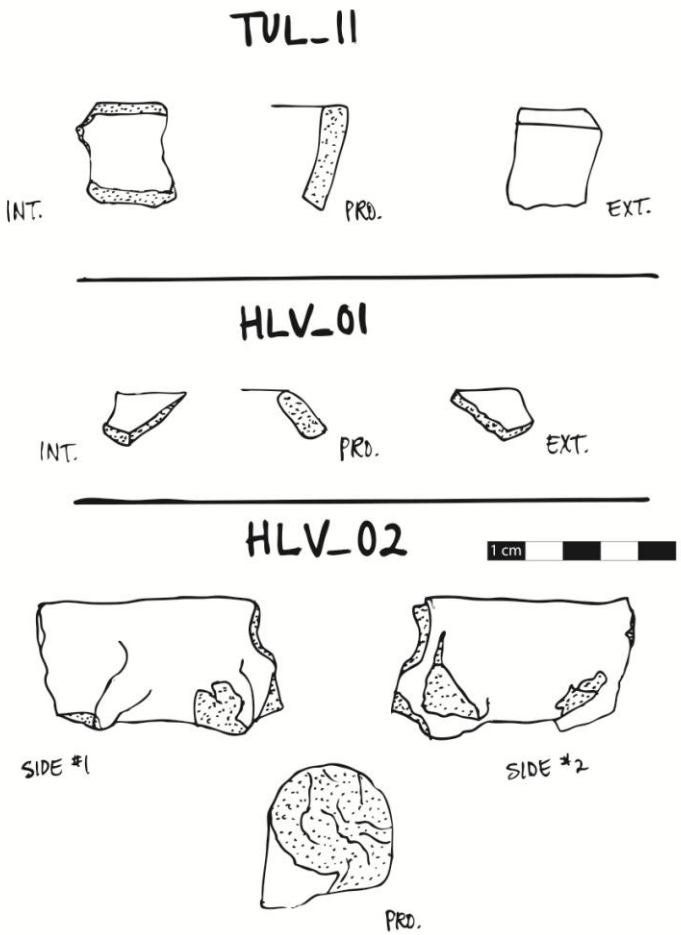
TUL_09



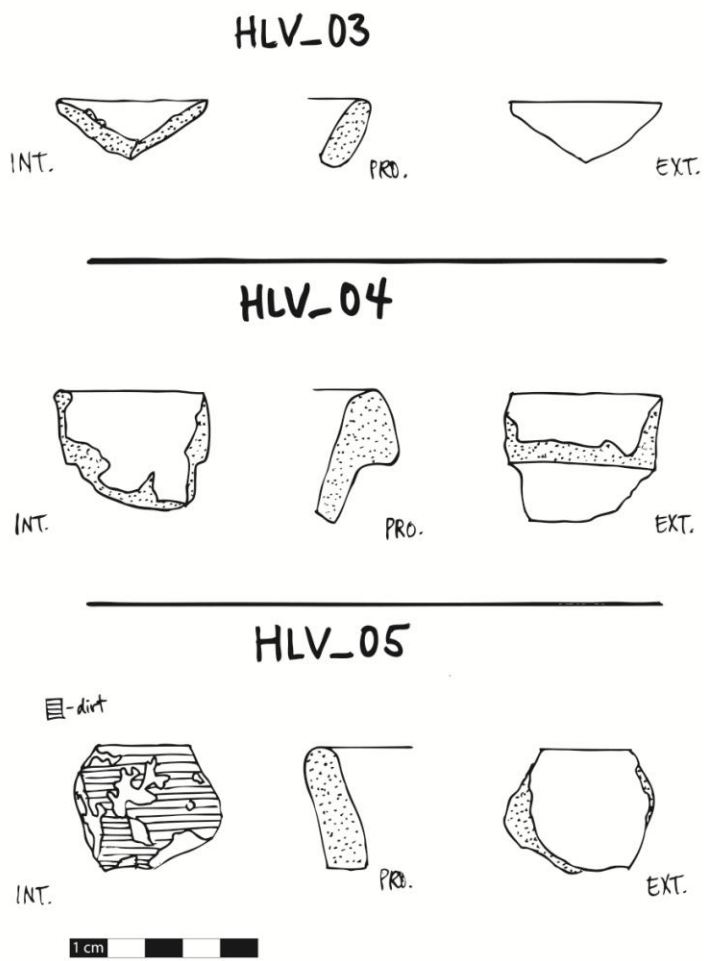
TUL_10



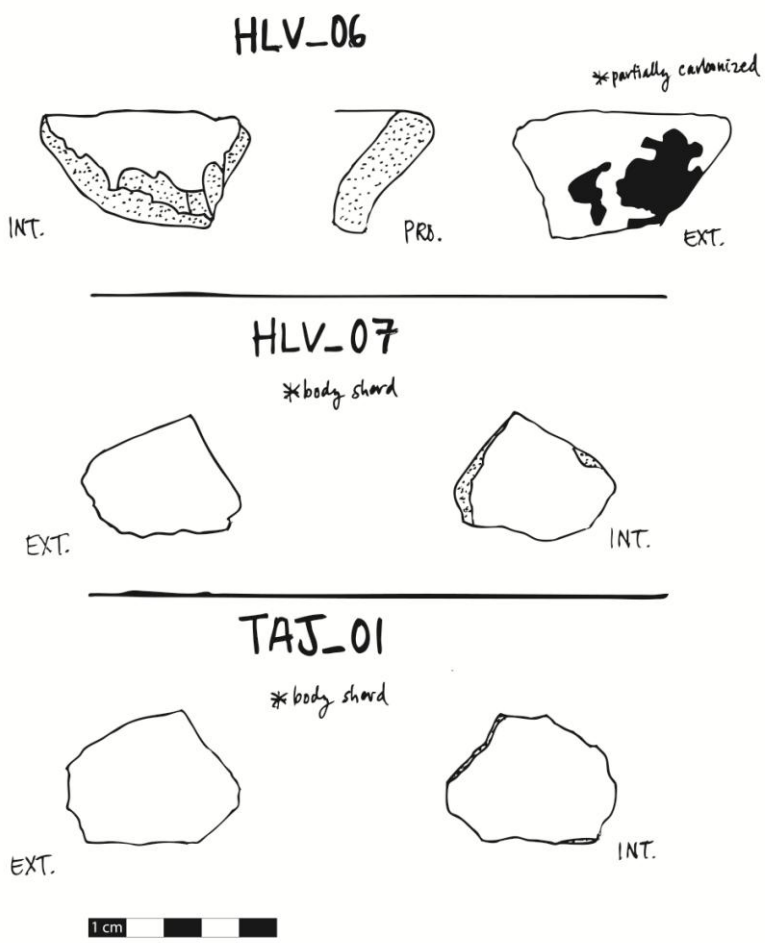
112


TUL_11
INT.
PRO.
EXT.
HLV_01
INT.
PRO.
EXT.
HLV_02
1 cm
SIDE #1
SIDE #2
PRO.

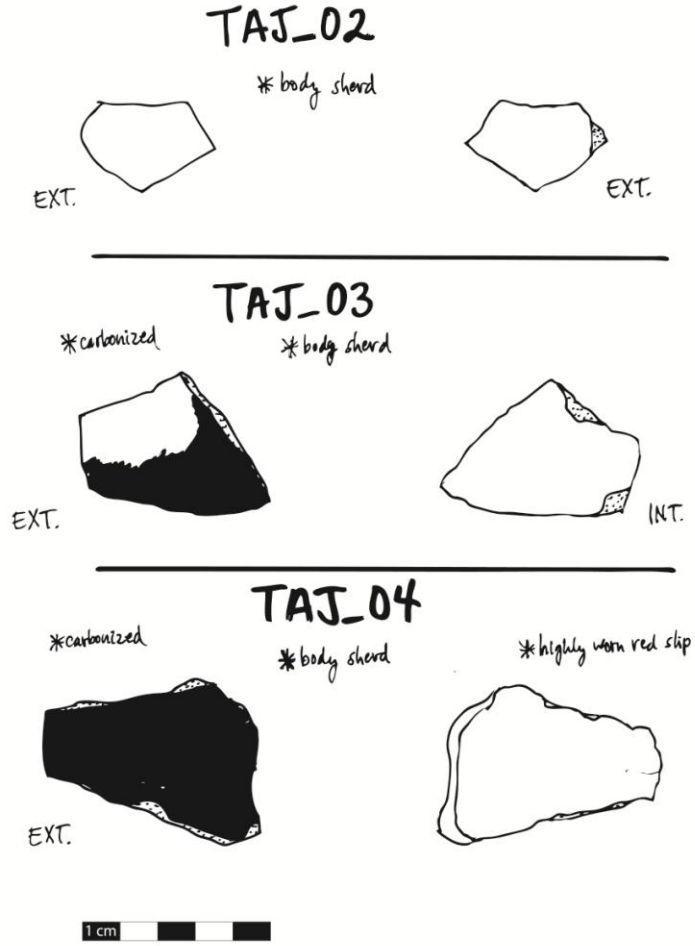
113


HLV_03
INT.
PRO.
EXT.
HLV_04
INT.
PRO.
EXT.
HLV_05
目-dirt
INT.
PRO.
EXT.
1 cm

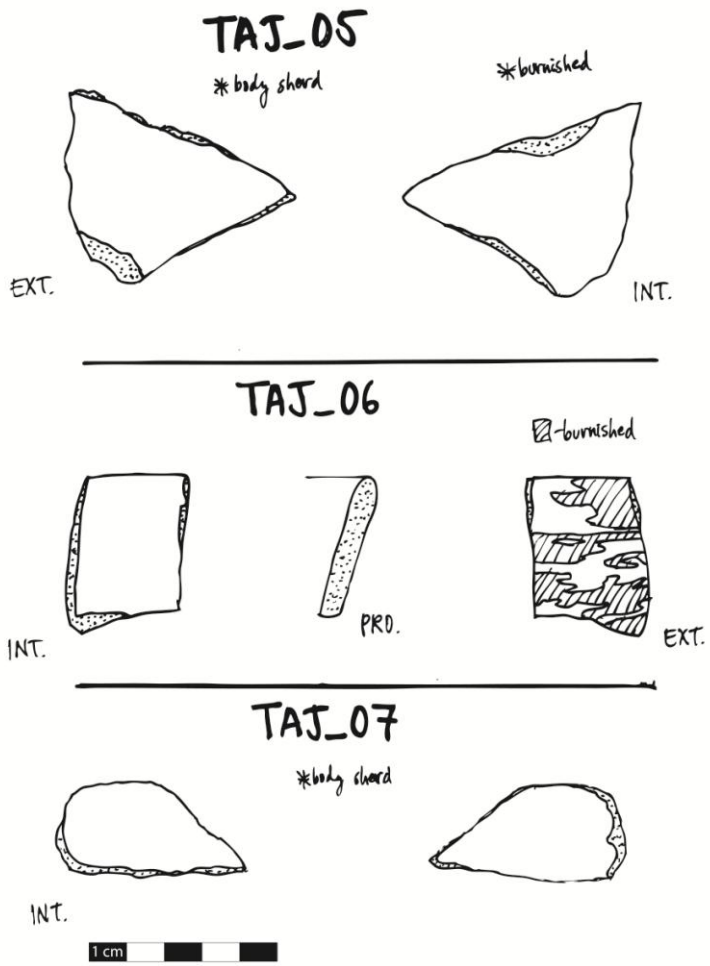
114


HLV_06
*partially carbonized
INT.
PRO.
EXT.
HLV_07
*body sherd
EXT.
INT.
TAJ_01
*body sherd
EXT.
INT.
1 cm

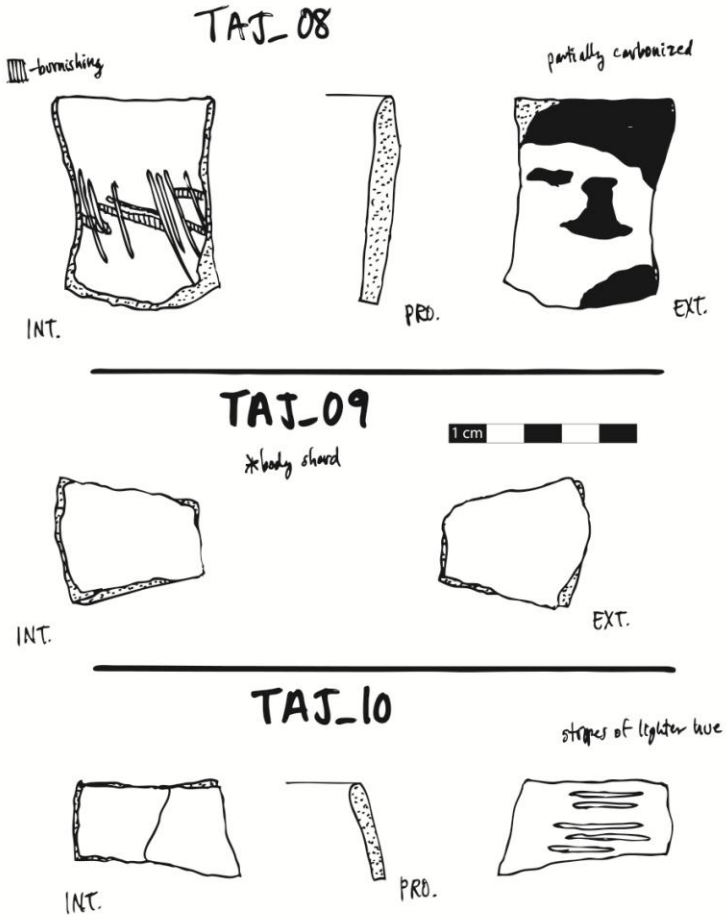
115


TAJ_02
*body sherd
EXT.
EXT.
TAJ_03
*carbonized
*body sherd
EXT.
INT.
TAJ_04
*carbonized
*body sherd
*highly worn red slip
EXT.
1 cm

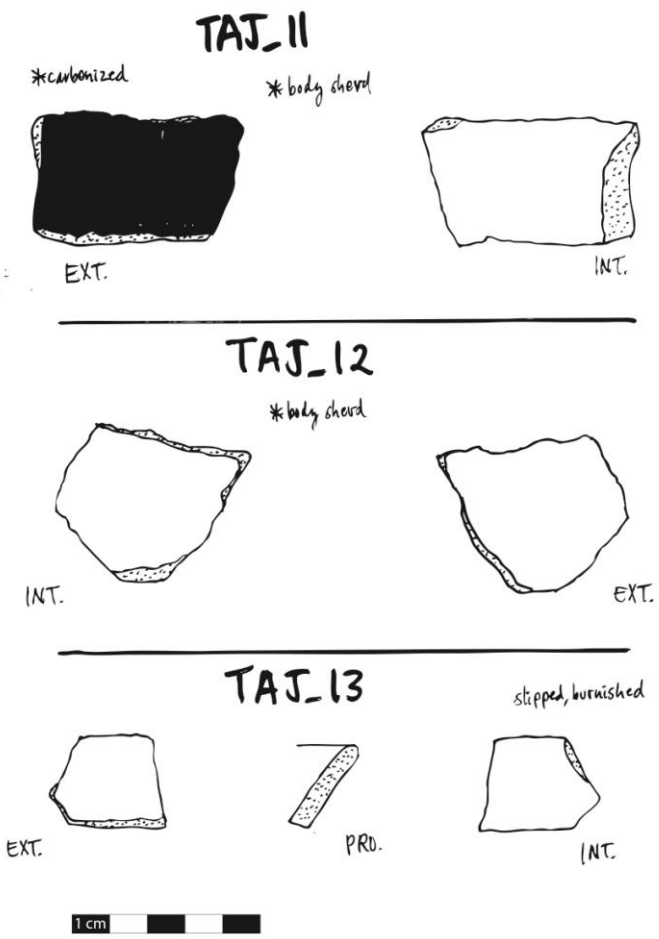
116


TAJ_05
*body sherd
*burnished
EXT.
INT.
TAJ_06
-burnished
INT.
PRO.
EXT.
TAJ_07
*body sherd
INT.
1 cm

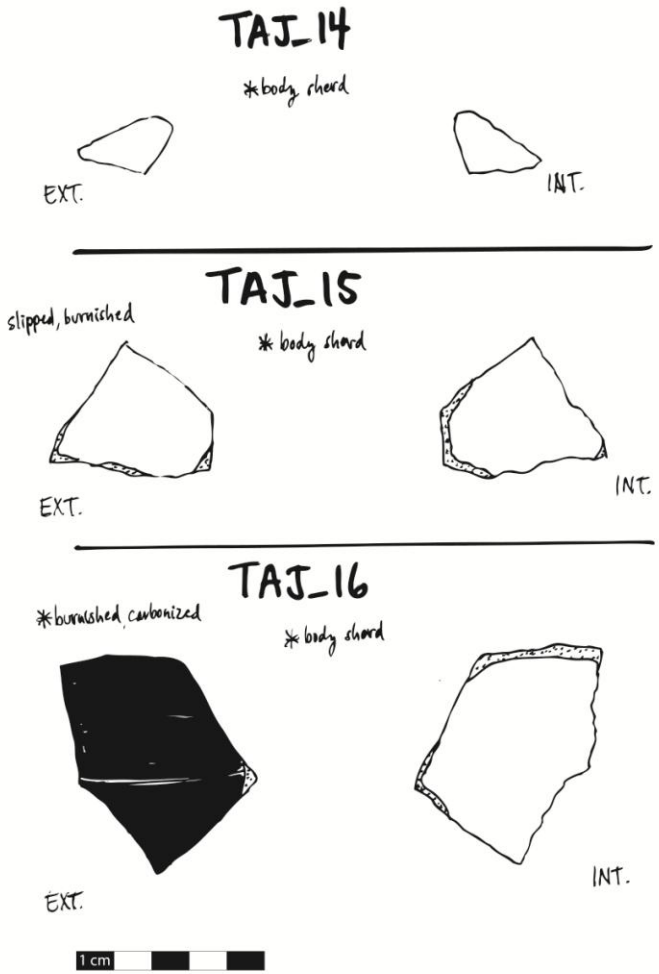
117


TAJ_08
-burnishing
partially carbonized
INT.
PRO.
EXT.
TAJ_09
1 cm
*body sherd
INT.
EXT.
TAJ_10
stripes of lighter hue
INT.
PRO.

118


TAJ_11
*carbonized
* body sherd
EXT.
INT.
TAJ_12
* body sherd
INT.
EXT.
TAJ_13
slipped, burnished
EXT.
PRO.
INT.
1 cm

119


TAJ_14
* body sherd
EXT.
INT.
TAJ_15
slipped, burnished
* body sherd
EXT.
INT.
TAJ_16
*burnished, carbonized
* body sherd
EXT.
INT.
1 cm

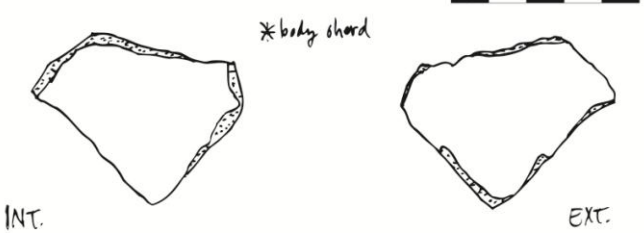
120

TAJ_17

*body sherd

TAJ_18

*body sherd



TAJ_19

*body sherd

TAJ_20

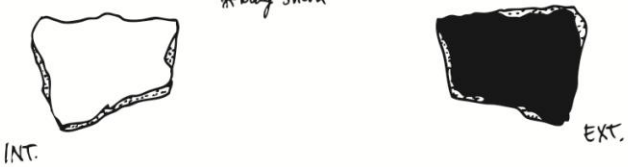
*both surfaces burnished

*body sherd

TAJ_21

*carbonized

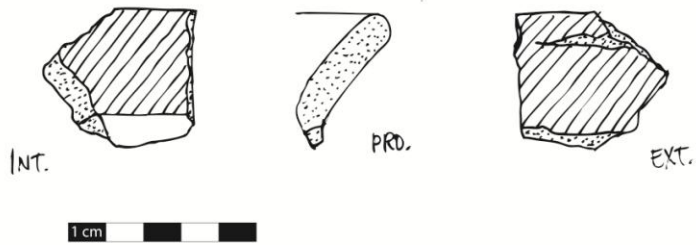
*body sherd

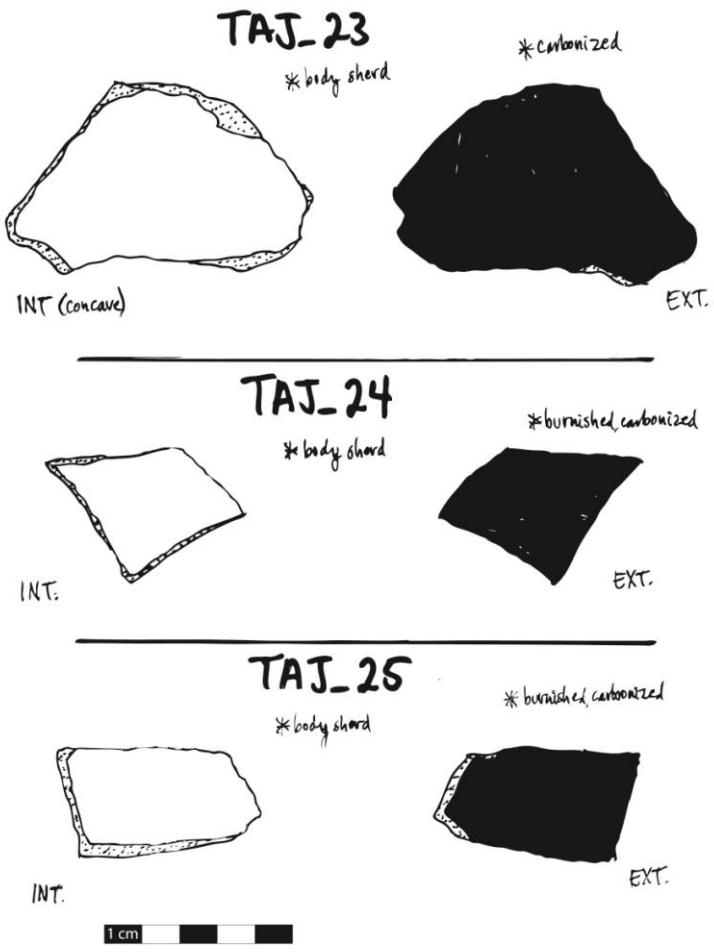


TAJ_22

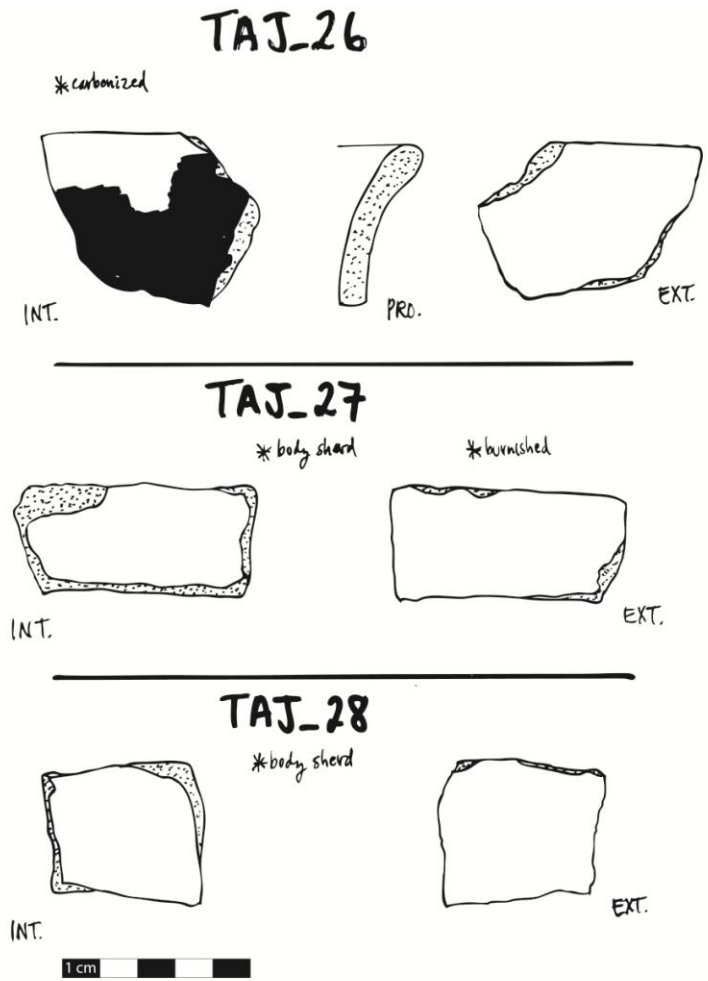
▨-red slip □-cream slip

*burnished

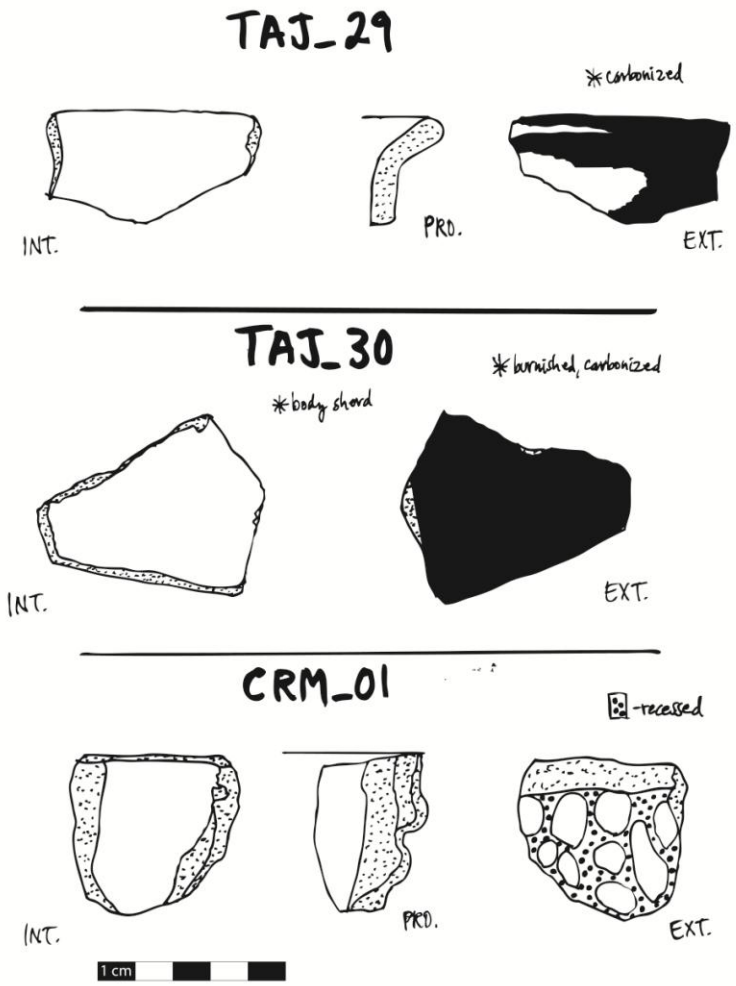



TAJ_23
*body sherd
*carbonized
INT (concave)
EXT.
TAJ_24
*body sherd
*burnished, carbonized
INT.
EXT.
TAJ_25
*body sherd
*burnished, carbonized
INT.
EXT.
1 cm

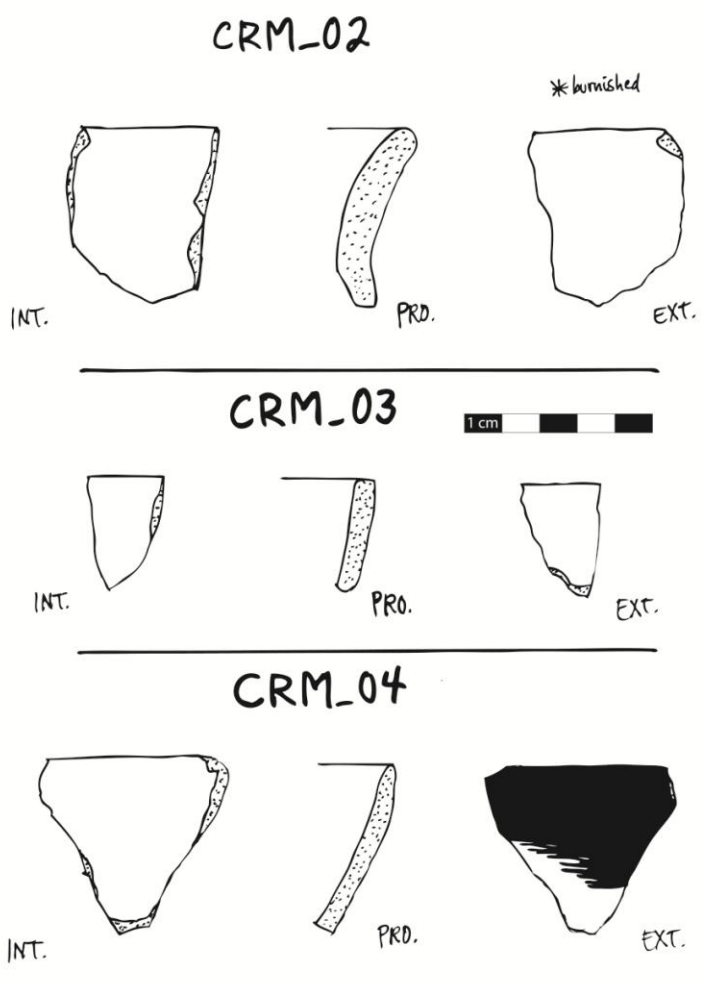
123


TAJ_26
*carbonized
INT.
PRO.
EXT.
TAJ_27
*body sherd
*burnished
INT.
EXT.
TAJ_28
*body sherd
INT.
EXT.
1 cm

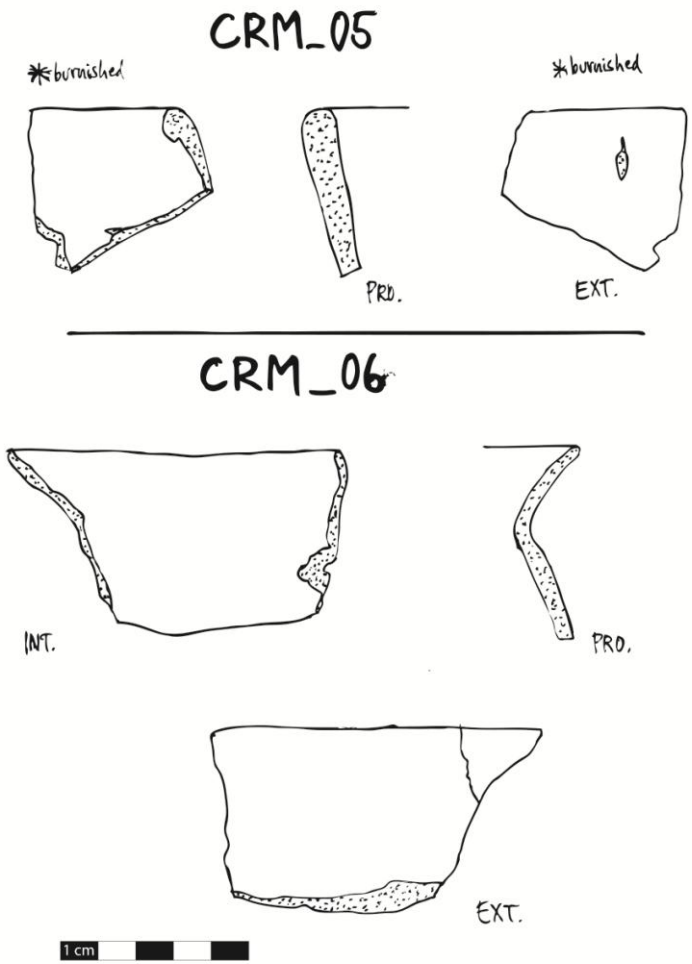
124


TAJ_29
* carbonized
INT.
PRO.
EXT.
TAJ_30
* burnished, carbonized
* body sherd
INT.
EXT.
CRM_01
recessed
INT.
PRO.
EXT.
1 cm

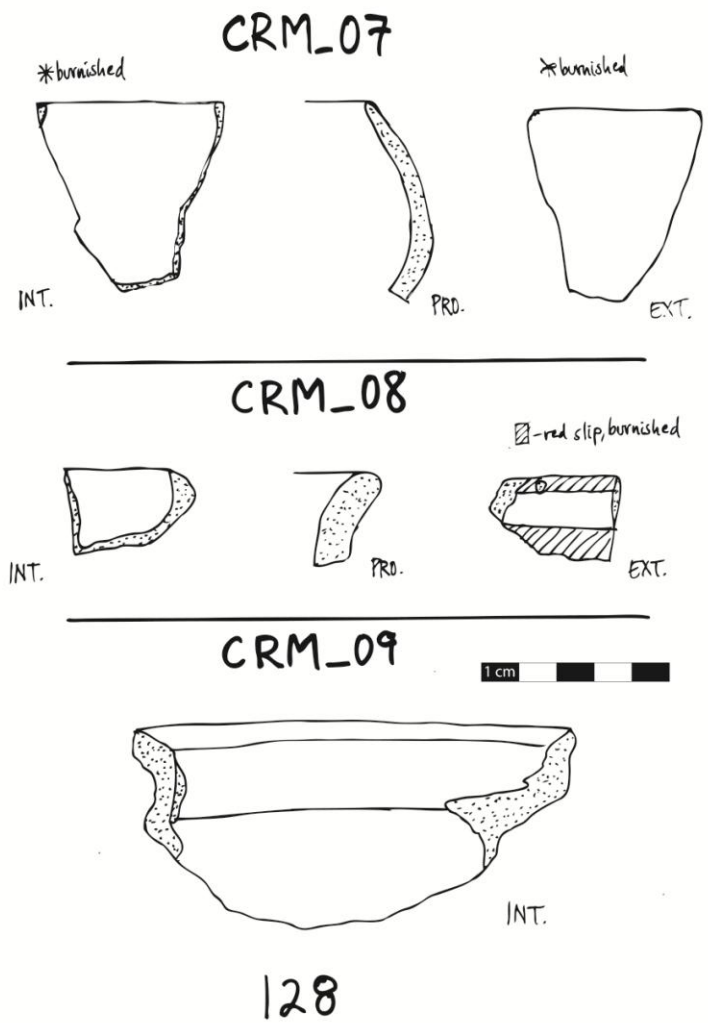
125


CRM_02
* burnished
INT.
PRO.
EXT.
CRM_03
1 cm
INT.
PRO.
EXT.
CRM_04
INT.
PRO.
EXT.

126

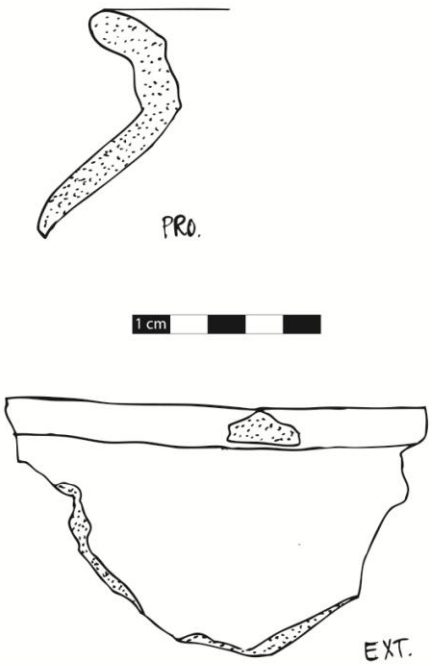

CRM_05
*burnished
*burnished
PRO.
EXT.
CRM_06
INT.
PRO.
EXT.
1 cm

127


CRM_07
*burnished
*burnished
INT.
PRO.
EXT.
CRM_08
-red slip, burnished
INT.
PRO.
EXT.
CRM_09
1 cm
INT.

128

CRM_09 cont.



129

End

APPENDIX E:

Tobler's Hiking Function Tutorial

Cost-Distance Analysis: Anisotropic Time Estimate Using Path Distance

Created by Nicholas Tripcevich, Ph.D., University of California, Berkeley (2009).

Original Webpage: <http://mapaspects.org/node/3744>

Tutorial outlines steps using ESRI © ArcMap 10.0

Tutorial:

1. Create a vertical factor table in Excel using the following equation, reflecting Tobler's Hiking Function, the reciprocal of Tobler's function:

TIME (HOURS) TO CROSS 1 METER
=0.000166666*(EXP(3.5*(ABS(TAN(RADIANS(slope_deg))+0.05))))

*A slope of 0 degrees generates a vertical factor = 0.000198541

2. Save as a .txt file with two columns, the first for slope and the second for the vertical factor.

3. Go to ArcToolbox > Spatial Analyst Tools > Distance > Path Distance

Input: Point shapefile for site of interest

Output: aniso_hrs1

Input cost: slope raster generated from 30m DEM

Output backlink raster: aniso1_bklk

Open the "Vertical factor parameters" field

Input Vertical Raster: 30m DEM

Vertical Factor: Table (select from drop-down menu)

Browse to Tobler's Hiking Function file created in step 2

Optional: Environments > General Settings > set extent to "same as display"

If tool does not complete calculation, undo this change.

4. Go to ArcToolbox > Spatial Analyst Tools > Raster Calculator

Output Calculation: [aniso_hrs1] * 60

Output raster: "aniso1_min"

-This converts the raster to minutes

5. Go to ArcToolbox > Spatial Analyst Tools > Surface Analysis > Contour

Input surface: aniso1_min

Interval: 15 (for 15 minute intervals)

Output File: aniso15

6. Extract features from "aniso15" at distances of interest and create a new shapefile. In this study, features were extracted at hour intervals (contours that were multiples of 60).