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Elemental Analysis of Colonial Period Ceramics from Moquegua, Peru

by

JOSHUA WACKETT

Under the Direction of Nicola Sharratt, PhD

ABSTRACT

Recent scholarship demonstrates growth in archaeological analysis of Spanish colonial *reducciones* in Andean South America. Critical to understanding the impact of *reducciones* on indigenous populations is examining production and circulation of craft goods after Spanish conquest. Because it characterizes the elemental composition of archaeological pottery, Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) is an invaluable tool for examining resource procurement and long distance exchange. In this thesis, I report data derived from XRF and LA-ICP-MS analyses of pottery from two sites in the Moquegua Valley, Peru: Torata Alta and Sabaya. Both sites were founded during Inca control of the valley (c. 1450-1535) but were also occupied into the seventeenth century and have strong Spanish colonial components. Comparing the data with an existing ICP-MS database on locally available clays, I examine differential resource procurement as well as access to imported goods among indigenous and Spanish communities in early colonial Moquegua.

INDEX WORDS: LA-ICP-MS, Inca, Spanish, Colonialism, Ceramic, Analytical Chemistry

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Introduction

Processes of colonization constitute periods of considerable upheaval for both the colonizer and colonized cultures. The reworking of social relations is an intrinsic component of imperial expansion and cultural interchange is both reflected in and mediated by material objects. As such, the archaeological study of craft goods offers a critical perspective on moments of conquest and colonization. This thesis examines resource access and exchange networks in early Colonial (A.D. 1535-1600) Andean South America. Specifically, it examines pottery production and circulation at two sites in the Moquegua Valley, located in modern day southern Peru. The two sites, Torata Alta and Sabaya are both located near the modern village of Torata. These two sites were likely founded by the Inca and occupied into the seventeenth century, and exhibit considerable Spanish influence. However, they also represent two different kinds of Spanish settlement in the Colonial Andes; one a *reducción* and the other a part of an *encomienda*. By examining the elemental composition of ceramics from Torata Alta and Sabaya, this thesis explores differences and similarities in resource acquisition, craft good production, and exchange networks at the two sites.

1.2 Craft Production in Archaeology

Craft goods are critical media for expressing ideologies, for mediating social and political ties, and for asserting and redefining cultural identities. As such, their analysis provides a critical component of archaeological reconstructions of social organization as well as political and economic systems in the past, and their study is particularly important for archaeologists working on moments of major socio-political change, including episodes of imperial expansion and colonization.

The organization of craft production is closely tied to political organization. Centralized and specialized craft production is frequently associated with complex state organization (Costin and Hagstrum 1995; Underhill 1991). A high degree of uniformity (in form, style, size, and composition) may signify centralized workshops, organized by a central power. Similarly, variation in composition between goods may suggest dispersed craft production, perhaps being made at a household level. Identifying the levels of uniformity of craft goods is one means by which archaeologists measure the level of political involvement and elite control over craft production. This can be seen in the production of Inca *aryballoids* (Costin and Hagstrum 1995). This study of the pre-Contact Inca in highland Peru compared ceramic production to the Wanka culture. The Wanka were a Late Intermediate Period (ca. 1250-1450) culture who occupied the central highlands of Peru (Moseley 2001:257). The Inca vessels display a high level of uniformity in production and decoration, along with being very labor intensive. The Wanka vessels were multifunctional, able to be used for wet or dry goods, and were less labor intensive then *aryballoids*. Therefore, the authors of this study argue, that the Inca state sponsored craft specialists were producing the *aryballoids*, while the Wanka appear to have been produced by specialists within individual communities

Craft goods are also important for materializing political ideologies. By restricting the production and distribution of craft goods, those in control are able to promote specific ideologies (D'Altroy and Bishop 1990; DeMarrais, et al. 1996; Sinopoli 1991:159). The promotion of political ideology through craft goods can be seen through the centralized production and distribution of the goods to various regions of the state. By incorporating political ideology into frequently used goods, the controlling power inserts themselves into the daily lives of the population. The Moche were heavily involved in the distribution of ceramics decorated with symbolic meanings (DeMarrais, et al. 1996:25). The Moche were an Early Intermediate Period (200 B.C. to A.D. 550) state who occupied the North Coast of Peru. The Moche elite participated in religious rituals that in turn legitimized their power. These rituals were frequently depicted on ceramic vessels as well. The finest of these decorated ceramics would be exchanged between elites of different regions of the Moche state. This served to reinforce and further legitimize the dominant political ideology of the Moche.

Long distance exchange of craft goods is also common in Andean culture. This movement of goods can result in groups having access to goods they would not otherwise be able to obtain. Understanding this movement of craft goods can reveal cultural ties and interactions. In the Late Archaic Period in the Lake Titicaca basin, inhabitants of the Island of the Sun were obtaining obsidian from as far as 275 km away (Stanish, et al. 2002). By combining this data with knowledge of similar ceramic stylistic patterns, it can be inferred that the inhabitants of the island were maintaining long distance exchange networks with groups on the mainland. Despite being separated by hundreds of kilometers, the occupants of the Island of the Sun were able to remain part of a broader cultural tradition through the exchange of craft goods.

Advances in craft production techniques and complex political systems are frequently associated with one another. Political elites have long reinforced their own power with goods which require significant labor to specialized knowledge to produce

(Peregrine 1991). By controlling the knowledge and related goods, elites are able to legitimize their authority and control over the lower class.

1.3 Analytical Chemistry

The use of analytical chemistry in archaeological investigations is not new. The earliest use of compositional analyses on archaeological materials occurred in the eighteenth and early nineteenth centuries (Glascock 2008; Pollard, et al. 2007:6). In the 1980s, inductively coupled plasma mass spectrometry was introduced as a method for conducting elemental analysis of artifacts. In the 21st century, two of the most popular methods of analytical chemistry in the Andes are laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) and X-ray Fluorescence (XRF).

In recent years, techniques from analytical chemistry have become particularly popular in Andean archaeology (Dussubieux, et al. 2007; Piscitelli, et al. 2015; Sharratt, et al. 2015; Sharratt, et al. 2009). Analytical chemistry has contributed significantly to the knowledge of ceramic production and acquisition in the Moquegua Valley in southern Peru. Studies have been conducted in the Moquegua region have identified the raw clay resources available for ceramic production (Sharratt, et al. 2009). With these data available, it is possible to identify from which clay group sampled ceramics were produced. This allows for questions of resource access and exchange networks to be addressed at a finer grained resolution than does visual analyses. Visual analysis demonstrates that material styles are widely shared, but analytical chemistry can trace movement of the actual craft goods.

1.4 Thesis Outline

This thesis is organized into six chapters. Chapter 2 describes the cultural and environmental background of Peru and the Moquegua Valley. It briefly describes the various states that have controlled Moquegua, as well as the particularities of its ecological setting. Chapter 3 presents the methodologies used in this thesis project, as well as a brief history of compositional analyses in archaeology. Chapter 4 describes the research design of the study. This chapter also includes descriptions of the two archaeological sites studied, research questions, and the procedures for conducting the analyses. Chapter 5 presents the data derived from compositional analyses of early Colonial pottery. Lastly, chapter 6 discusses the results and presents interpretations of the data.

2 CULTURAL AND ENVIRONMENTAL BACKGROUND

2.1 Introduction

This thesis compares craft production at two types of colonial Spanish settlement in the Moquegua Valley, Peru; an *encomienda* and a *reducción*. The *encomienda* system was not a grant of land, but rather the right to collect tribute, and utilize indigenous inhabitants within a set of boundaries for labor (Lockhart 1994:11). A *reducción* was the resettlement of local Andean populations into one town, to enable oversight by the Spanish. These two systems worked in conjuncture to facilitate the control of, and exploit labor from, the indigenous population. Establishment of the *reducción* and *encomienda* system arose from a long history of colonization by many states throughout Andean pre-history.

2.2 Chronology

2.2.1 The Late Pre-Contact Andes

The pre-Contact Andes are chronologically divided into a series of Horizons and Intermediate Periods. Horizons are defined by widespread similarity of artifacts and architecture across a broad geographical range (Stone-Miller 1993). In Andean chronologies, the horizons are separated by Intermediate Periods, which are characterized by considerable diversity in material styles. While there is continued debate as to the exact delineations between each subdivision of time, there are commonly agreed date estimates (Table 1) (Stone-Miller 1993). Because this thesis focuses on the Spanish Colonial era, I only briefly describe earlier periods of Andean pre-history and focus more extensively on the social and political landscape in the century before Spanish conquest, as well as the early Colonial Period itself.

Table 1 Late pre-Hispanic and Colonial Period Chronology of Southern Peru and Moquegua
(Rice 2011:69)

General Period	Dominant Polity	Moquegua Phase	Calendar Years AD
Middle Horizon	Tiwanaku, Wari	Omo, Chen Chen	500-1000/1150
Late Intermediate	___________	Estuquiña: Tumilaca and Chiribaya (coast)	1000/1150-1475
Late Horizon	Inca		~1450-1535
Colonial	Spanish	Early Colonial Middle Colonial Late Colonial	1535-1600 1600-1778 1778-1820

The Late Horizon in Peru (ca. A.D. 1450-1532) is characterized by the rapid ascent of the Inca Empire. The Inca Empire spread out from the Cuzco Valley initially across the highlands of Peru and was able to take advantage of, and eventually conquer through force and ideology, the balkanized Andean population (Bauer and Covey 2002). The rise and expansion of the Inca Empire was rapid. In approximately one century the Inca took control of 5,500 km of the Andes Mountain range of South America (Moseley 2001:7). The Inca sphere of influence stretched from modern day Ecuador south into Chile, and the vast empire was known as Tahuantinsuyu, or "The Land of the Four Quarters" (Moseley 2001:7).

The Inca exercised a variety of strategies to grow their empire. The establishment of these methods can be traced back to the origins of the Inca in the Cuzco Valley. Political control was both direct and indirect. Direct control of the surrounding valleys was established through force, while indirect control of other valleys was enacted through marriage alliances (Bauer and Covey 2002; Rice 2011:71; Wernke 2013:30). Despite the range of approaches utilized by the Inca in their statecraft, the Inca Empire lasted only a short time. The decline of this vast empire resulted not only from Spanish arrival in South America but also from internal conflict among the Inca elite.

Prior to the arrival in the first half of the 16th century of the Spanish *conquistadors* in South America, European disease was spreading south rapidly in the form of Small Pox. The disease decimated the indigenous population of North and South America, weakening populations and leaving them vulnerable (Larsen 1994). The last Inca emperor prior to the arrival of the Spanish, Wayna Capac, died unexpectedly. This left the Inca Empire in a state of civil war over who was the rightful heir of Wayna Capac. Two-half brothers, Huascar and Atahualpa, fought for the right to succeed Wayna Capac as emperor. It was Atahualpa who eventually took the throne. He was also in power when the Spanish arrived on the periphery of the Inca Empire.

2.2.2 Spanish Conquest

The Inca Empire was ultimately a short-lived endeavor with the arrival of the Francisco Pizarro and the Spanish at Coaque, Ecuador in 1531 (D'Altroy 2002:311). Not long after, by November 1532, the Spanish began to venture into the Andes region of South America (D'Altroy 2002:312). This exploration marks the beginning of the Colonial Period in the Andes (Rice 2011:69). On 15 November 1532 that the Spanish arrived in Cajamarca, Peru and encountered the Inca leader Atahualpa (D'Altroy 2002:312). The Spanish captured and held the Inca emperor for ransom. After eight months, despite the ransom being met, the Spanish executed Atahualpa (Moseley 2001:11).

With the execution of Atahualpa, the Spanish were left with the problem of how to control the vast Inca Empire. The method of control attempted by the Spanish was the establishment of a puppet ruler. The first ruler was Thupa Wallpa, but his reign was short-lived. Following his rule, a series of puppet rulers occupied the throne, but none of them stayed in power long.

Perhaps the most noteworthy puppet leader was Manco Inca who was placed on the Inca throne by the Spanish in 1533. Manco Inca went on to lead a rebellion against the Spanish in 1536 and escaped. This resulted in the Inca escaping to Vilcabamba, Peru where he laid siege to Cuzco and the Spanish for forty years (Bauer, et al. 2016). This rebellion ended when Viceroy Francisco de Toledo demanded an attack on the mountain stronghold in 1572. This resulted in multiple executions of indigenous leaders, such as Tupac Amaru I, and the fall of the final Inca holdout.

Spanish infiltration through the Andes region was a slow process. Franciscan friars went ahead of the *conquistadores* and colonists. These friars established *doctrinas* during the 1540's in an effort to Catholicize the indigenous population. These *doctrinas* were towns focused around a church and constructed following the Spanish architectural canon. The *doctrinas* were purposefully constructed at Inca administrative sites due to their significant role in pre-Contact economic, political, and ritual activities (Wernke 2013:168). Dispersed local populations were then consolidated and made to live by Spanish standards, under the watchful eyes of the friars. Wernke's excavations at Malata, in the Colca Valley of Peru, provides the first archaeological evidence for these early points of contact between Spanish clergy and the indigenous Andean population (Wernke 2013:Ch 5).

In many ways *doctrinas* can be seen as a precursor to the Toledan *reducción* system, established by Viceroy Francisco de Toledo between A.D. 1569-1575 (Rice 2011:117; VanValkenburgh, Walker, et al. 2015). The *reducción de los indios* (or *pueblo de indios*), or simply *reducción*, system saw the consolidation of various villages of indigenous Andeans into large towns. Over one thousand Toledan *reducciones* were established, displacing an estimated 1-1.5 million Andeans (Rice 2011:117). The towns were constructed with set architectural requirements such as a central plaza, straight pathways, a church, and municipal buildings (Rice 2011:117; VanValkenburgh, Walker, et al. 2015:117). These specifications were occasionally altered in order to better suit each individual *reducción* and its particular requirements (i.e. geography, climate) (Wernke 2013:215). Similar to the *doctrinas*, Toledo also recommended that *reducciones* be constructed at existing pre-Contact settlements so that continuity could be maintained within daily Inca life, and existing structures could be reutilized (Wernke 2013:215).

Social ranking and hierarchy were very important within Spanish culture. Terms of residency, such as *vecino*, *estantes*, and *heredados* were all used to define an individual's social ranking (Rice 2011:97). Continuity of the social hierarchy can be observed in the Spanish colonies as well. The term *indio* is heavily laden with meaning in Spanish colonial society. While some *indios* were absorbed into Spanish society, many remained outsiders and were heavily restricted by social constraints (Lockhart 1994:225). Marriage, economic, and social restrictions prevented enculturation for the vast majority of Andeans.

The Spanish king awarded, and Francisco Pizarro distributed, *encomiendas* to colonists in the Viceroyalty of Peru. *Encomiendas* are defined by boundaries of land, but the award itself was of the rights to all indigenous peoples and resources within those lands. Because of this, a small *encomienda* could potentially be vastly more valuable to the owner than a large one. This practice was not unique to Peru, and was practiced in many Spanish colonies. Through the *encomienda* system, the Andean landscape was carved into pieces and divided amongst the Spanish. These awards were for "*dos vidas*," or two generations, after which it would return to the colonial government to reallocate as appropriate. Commonly the *encomenderos*, those who had been granted an *encomienda*, would live in a large town and appoint an overseer to monitor any agriculture, mining or other resource procurement taking place on their *encomienda*. These overseers were commonly local indigenous leaders.

To the indigenous Andeans, the *encomienda* system had varying significance. The local indigenous leaders, or *caciques*, often had close relationships with the *encomenderos*. In an effort to closely allign themselves with the new colonial power, the *caciques* would dress in Spanish style and even take Spanish names (Lockhart 1994:236). To lower class Andeans, *encomiendas* meant a continuation of forced labor and tribute, similar to the *mit'a* system utilized by the Inca. *Encomenderos* fought to ensure all tribute paying Andeans remained within the *encomienda* land, so as to not lose this flow of goods and services (Lockhart 1994:227). The *encomidenda* system restricted the movements of individuals, thereby cutting off access to markets which Andeans traditionally had access.

Spanish colonization and resettlement affected craft production in the Andes. For example, Early Green Glazed wares began to be produced on the north coast of Peru in the Colonial Period (VanValkenburgh, Kelloway, et al. 2015). These wares were produced by the indigenous populations, but incorporated nonindigenous design patterns and lead glaze. These two design factors were not introduced until after Contact, and therefore suggest that the Andean peoples were adopting non-local crafting practices in order to better suit the new dominant political presence in the region.

Spanish control of the Andes, and the associated *encomienda* and *reducción* systems, lasted for several centuries, but came to an end when South American countries began to win their independence in the early nineteenth century. To this day, vestiges of the region's colonial history are evident in towns and in the countryside. The ruins of these settlements stand as physical reminders of Spanish colonization and a legacy of forced resettlement and labor.

2.3 Moquegua Geography and Geology

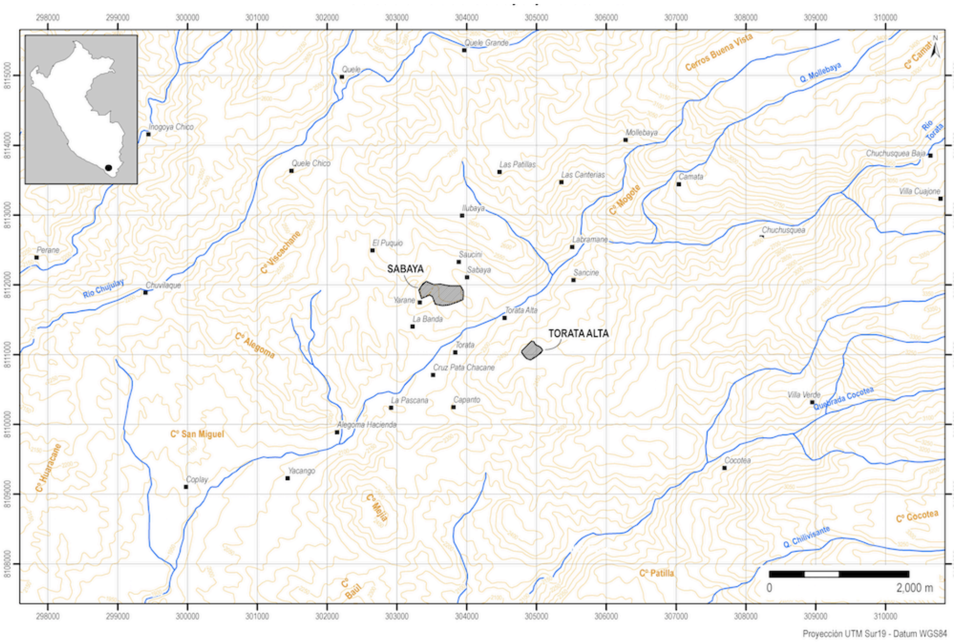


Figure 2.1 Torata Alta and Sabaya in Moquegua, Peru
(Chacaltana Cortez 2014:Plano 1)

The Department of Moquegua is located in the very south of modern Peru. The Department of Moquegua encompasses a total area of 15,734 km^2, and is among the smallest departments (a modern political designation) of Peru (Rice 2011:61; Stanish 1985:18). The Department of Moquegua has a coastline and stretches into the Andes mountains. There are three principle rivers in Moquegua the Río Huaracane, Río Torata, and Río Tumilaca. Each of these rivers also incorporates multiple tributary rivers with headwaters at higher altitudes up to 5,000 masl (Stanish 1985:18). These headwaters are partially fed by melting snow in the *puna* region (high altitude grasslands) along with occasional rains.

These three main tributary rivers make up the Río Osmore drainage. The Río Osmore drainage is climatically characterized as very arid with moderate seasonal temperature variability (Van Buren 1993:62), but along the margins of the rivers and its tributaries is land that is suited to agriculture. The modern city, and department capital, Moquegua is located at the confluence of the three rivers. The part of the valley where the city of Moquegua is located is known as the "middle valley." The middle valley is the stretch of the valley from approximately 1,100 to 1,700 masl (Rice 2011; 2013:192). Located between 1,700 and ca. 4,000 masl, the upper valley stretches up to the headwaters of the tributaries of the rivers. The sites examined in this study are located within the upper valley. After converging into the Río Osmore, the river flow changes to below ground and eventually exits into the Pacific Ocean, near the modern port city of Ilo, Peru.

Moquegua is on the fringes of the Atacama Desert, one of the most arid deserts in the world. The opposition of green farmland and plant life around the river is abruptly met with the tan and brown of desert sand along the multiple rivers in the valley. The region receives so little rainfall that what does fall is measured in millimeters (Stanish 1985:18). The large areas of artificial agricultural terraces that have been constructed for at least 1,500 years are designed to facilitate farming in this challenging environment.

Today, there are approximately 2,810 ha of farmable land along the Río Osmore Valley. It is this large area of agricultural land that has made the valley attractive to colonial forces throughout the region's history. This agricultural area was also supplemented during pre-Contact with terraces and canals, thereby increasing the amount of arable land further. Agricultural land at varying elevations is used for growing a variety of crops, such as, maize, quinoa, *rocoto* pepper, *ají*, coca, cotton, and potatoes (Rice 2011:67; Stanish

1985:18). Along with agriculture, this region has also been used to raise livestock. In the pre-Contact era, camelids and *cuy* (guinea pig) were common domesticates. Post-Contact, the variety of animals in the region grew due to the introduction of Old World domesticates. The newly introduced livestock species included; domestic fowl, cattle, horse, pig, donkey, sheep, and goat (deFrance 1996:20; Rice 2011:249).

The region also has rich mineral resources (Rice 2012:5). The Río Osmore Valley is located within the Pacific Copper Belt (Rice 2011:62). It is partially due to this geographic formation that archaeology has been conducted in the Moquegua Valley, as mining companies sponsored archaeological research in the final decades of the 20th century (de Preble 1997:16). Other naturally occurring minerals in the southern regions of Peru and northern regions of Chile include lead and iron ores (Rice 2011:63).

The Andean region is extremely volcanically active. One particular volcanic eruption serves as a clear stratigraphic marker, and *terminus ante quem* for early sixteenth century deposits, for archaeologists in southern Peru. Huaynaputina erupted on the 19th of February 1600 and was well documented in Spanish chronicles (Moseley 2001:28; Rice 2013:63; Smith 1997). The eruption caused significant damage to the nearby city of Arequipa and the *bodegas* of the Moquegua Valley (Rice 2011:63; Smith 1997).

2.4 History of the Department of Moquegua

2.4.1 The Middle Horizon in Moquegua

The first wave of political colonization of the Moquegua Valley occurred during the Middle Horizon (ca. A.D 600-1000) and is archaeologically visible in the presence of Wari and Tiwanaku archaeological sites and material culture. These two expansive states appear to have coexisted within the valley, within sight of one another's occupations. The Wari, who spread out from the Ayacucho region of Peru, occupied the hilltop site of Cerro Baúl which towers over the landscape in the upper valley (Moseley 2001:28; Williams 2001). The Wari also settled the adjoining hilltop of Cerro Mejía, among other settlements in the upper valley (Nash 2001). At these two sites, the Wari carried out ritual practices, produce *chicha* (maize beer), and lived their daily lives. Down river, the Tiwanaku, who spread out form the Lake Titicaca Basin in Bolivia, established a number of settlements in the middle Moquegua Valley (Moseley 2001:239). Despite being two competing states, they appear to have coexisted peacefully within valley, although the nature of their interaction continues to be debated (Goldstein 2013; Williams 2013).

2.4.2 The Late Intermediate Period in Moquegua

Around AD 1000, the Tiwanaku and Wari states both began a process of collapse. In Andean chronologies, the end of these polities marks the transition to the Late Intermediate Period (ca. A.D. 1000-1450). The collapse of the Tiwanaku and Wari states is archaeologically visible in the destruction of monumental architecture, the ransacking of elite burials, the smashing of idols, and the destruction of residential and corporate storage areas (Goldstein 2005; Moseley 2001; Moseley, et al. 2005; Owen 2005). During the downfall of the Tiwanaku and Wari states populations dispersed across the landscape to form new small, often defensibly located, settlements. Evidence suggests that LIP settlements were at constant threat of raid from one another, as signified by *pukaras* (Arkush 2008). *Pukaras* are defensive structures built on hilltops, typically taking advantage of steep inclines and other defensive topography. These structures were likely temporary refuges for when hostile parties arrived.

2.4.3 The Late Horizon in Moquegua

Taking advantage of the fragmented political landscape, the next colonizing force in the Moquegua Valley was the Inca Empire. Spanish chroniclers recorded an Inca legend of the conquest of what is likely the Moquegua Valley. In this legend, the ruler Inca Mayta Capac sent troops to bring the region under control. Upon their arrival, the local community was said to have retreated to a hilltop fortress where they stayed for only fifty days, at which point the local population surrendered (Rice 2011:72; 2013:55). Colonists were then sent from the altiplano region down to the Moquegua Valley where they settled two towns, Moquehua and Cuchuna. It has been suggested that the Lupaqa, from the Lake Titicaca basin, are the colonists who moved to the Moquegua Valley (Van Buren 1996). The Lupaqa would have been occupied the valley at the end of the Late Horizon and into the early Colonial Period. Although recorded by a Spanish chronicler many years removed from the described event, this still provides an interesting perspective on how the Inca possibly went about conquering and settling the Moquegua Valley.

2.4.4 The Spanish in Moquegua

Spanish arrival in the Moquegua Valley occurred relatively soon after their arrival into Andean South America. The Spanish likely first came to the area in the mid-1530s (Rice 2011:120; 2013:101). Local tradition holds that the town of Moquegua was founded on the 25th November 1541, yet no documentary evidence survives to support this statement (Rice 2011:120). This date was specifically chosen in honor of the patron saint, Santa Catalina de Alexandría. Across the river, the first Spanish settlement in the valley, the town of Escapagua was founded on the 20th of January 1541 (Rice 2011:120; 2013:208).

After the Spanish established permanent settlements in the region, it was only a matter of time before they began to spread throughout the valley. One of the most extensively studied types of Spanish settlements within Moquegua is the *bodega* system. *Bodegas* were wine production sites, which provided alcohol to much of the region and to the important mining town of Potosi, Bolivia. Potosi is approximately 1000 km away from Moquegua and was the richest city in Colonial Period South America because of silver mining. This connection to Potosi is significant because it demonstrates how the Spanish settlement in Moquegua brought the valley into long distance networks that were critical to the colonial economy. Wine served a variety of purposes in Spanish life, including in religious ceremonies as well as in routine consumption. Due to the peripheral nature of the Viceroyalty of Peru to the core of the Spanish empire, wine could not be shipped from Spain, thus necessitating its production within South America. Prudence Rice conducted the Moquegua Bodegas Project from 1985-1990 in an effort to locate and record as much information about these settlements as possible (Rice 2011; Rice and Ruhl 1985, 1989). One hundred and thirty *bodegas* were located within the region. It is likely more existed but had been destroyed (Rice 2011:xiii; Rice and Beck 1993).

As well as *bodegas*, the Spanish established *encomiendas* in Moquegua. On the 22nd of January 1540 Francisco Pizarro awarded *encomiendas* in what would become the Department of Moquegua (Rice 2011:96). The official counts vary, but anywhere between ten and sixteen Spaniards were awarded *encomiendas* in the region. These *encomiendas* took advantage of the various mineral resources from within the valley (Rice 2013). They included land in the altiplano (the climatically harsh high altitude plains), down through the valley to the Pacific coast. As mentioned previously, many *encomenderos* did not live on their land, and likely lived in a large, nearby city, perhaps Arequipa to the northwest. The site of Sabaya, discussed in greater depth in Chapter 4, was probably a central point for one such *encomienda* in the Moquegua Valley.

The Spanish also established a *reducción* in the Moquegua Valley. Up-valley from the town of Moquegua, Torata Alta was founded as part of the *reducción* system created by Viceroy Toledo. This particular *reducción* combined a number of nearby indigenous settlements into this single town. A significant portion of the population at Torata Alta was the Lupaqa. Torata was included in an *encomienda* controlled by the Spanish monarchy (Van Buren 1996:344). This placed the occupants of Torata Alta in a unique position of privilege among Andeans because royal *encomienda* ownership was preferred over private ownership (Van Buren 1996:344). This hilltop site overlooks the surrounding valley, including the previously mentioned site of Sabaya. I discuss Torata Alta and Sabaya in more detail in Chapter 4.

2.5 Summary

The Moquegua region has been subject to multiple colonial forces throughout its long history. Through encounters with the expansive Middle Horizon states as well as the Inca and Spanish, the population of Moquegua learned how to adapt to and adopt the different lifeways being imposed upon them. Colonial forces became so common throughout the Andean past that the people being colonized learned to incorporate some aspects of ideologies of the colonizer within their own ideologies.

This thesis focuses on craft production in early Colonial Period Moquegua by examining ceramics from Torata Alta and Sabaya. Specifically, it utilizes techniques from analytical chemistry to derive data on the elemental composition of ceramics from these two sites in order to examine whether production strategies as well as access to different kinds of pottery varied between different kinds of Spanish settlement.

3 METHODOLOGY

3.1 Introduction

Since its first use in the late eighteenth century, analytical chemistry in archaeology has developed into a wide variety of techniques that are used to study a range of materials, including, ceramics, lithics, as well as human remains (Pollard, et al. 2007:6). The use of techniques from analytical chemistry provides new insight into archaeological materials that would otherwise be unobtainable through strictly visual analyses. Elemental analyses allow for the examination of the circulation of material goods rather than just styles. Elemental analysis of artifacts has become an important tool for archaeologists in understanding the production and movement of craft goods in the past.

X-ray Fluorescence and Inductively Coupled Plasma Mass Spectrometry are currently two of the most widely used analytical chemistry techniques in archaeology. With these techniques, archaeologists are able to analyze the elemental composition of artifacts, with varying limitations and accuracy, and provide information otherwise unavailable. This information, coupled with other research, such as regional clay databases and visual analyses, adds more to archaeological knowledge of production and exchange of craft goods by allowing for the identification of sources of resources and the movement of objects.

3.2 A History of Elemental Analysis in Archaeology

The field of analytical chemistry has largely built upon the work which was started by Martin Heinrich Klaproth in the late eighteenth and into the early nineteenth centuries (Glascock 2008:489; Pollard, et al. 2007:6). The nineteenth century saw more research conducted in analytical chemistry, with archaeological materials frequently being the object of study. The technology boom after the Second World War provided an even greater stimulus to research in analytical chemistry.

Out of the post-war technology boom came Neutron Activation Analysis (NAA), Optical Emission Spectrometry (OES), and several other analytical techniques. With increases in technology, many methods came into use only to be rendered obsolete by improved methods with greater detection ranges and the ability to isolate a greater number of elements. For example, OES has now largely been replaced by inductively coupled plasma mass spectrometry and atomic absorption spectrometry (Renfrew and Bahn 2008:366). The improvement of technology led to X-ray florescence (XRF) and inductively coupled plasma mass spectrometry (ICP-MS), with the latter coming into use as an analytical method in the 1980s. Since then ICP-MS has become one of the choice techniques for analytical chemistry (Kennett, et al. 2001; Pollard, et al. 2007:195).

3.3 Elemental Analysis Research

As discussed in Chapter 1, understanding production and exchange is critical for reconstructing past societies, and technological advances have permitted archaeologists new means of addressing the manufacture and circulation of goods in the past. These new techniques are used to compliment traditional visual analyses. Elemental analysis of obsidian has been conducted to determine its source, along with possible procurement or exchange methods (Gratuze 1999; Loendorf, et al. 2013; Moholy-Nagy, et al. 2013). Although obsidian is the most common lithic material to be analyzed compositionally, elemental data have been derived for some other lithic types, including greenstone (Palumbo, et al. 2015). Elemental analysis has been conducted on ceramics, in order to determine the possible origin of clays used in their production and any possible exchange (Bartlett, et al. 2000; Dorais, et al. 2004; Hein, et al. 2004; Niziolek 2013, 2015; Thomas, et al. 1992).

3.4 Elemental Analysis Techniques

3.4.1 Optical Emission Spectrometry

Optical emission spectrometry (OES) was one of the first trace-element analyses used on archaeological materials (Renfrew and Bahn 2008:366). The method originated in 1930, but was not utilized in archaeology until the 1950s and 1960s. OES displays readings for more common elements in percentages. But the readings of these elements tended to be fairly unreliable (Renfrew and Bahn 2008:368). The analysis involves heating an artifact in a manner to produce wavelengths that are then processed through a prism. Elemental composition is then determined by the presence or absence of certain wavelengths (Renfrew and Bahn 2008:368). The plate which collects the wavelengths is capable of capturing all wavelengths put out by the artifact (Pollard, et al. 2007:48). OES is no longer widely used and has been for the large part been replaced by ICP-MS and AAS.

3.4.2 Atomic Absorption Spectrometry

Atomic absorption spectrometry (AAS) replaced OES during the 1980s. This destructive technique uses principles similar to that of OES. This method requires the destruction of the artifact by acid, followed by heating of the resulting solution. Wavelengths are then focused through the solution in order to identify a single element (Renfrew and Bahn 2008:368). The limitation of only being capable of recognize one element at a time is a major disadvantage of this method. This being said, the accuracy which this analysis provides can be equal to, or better than, ICP-MS (Pollard, et al. 2007:49).

3.4.3 Instrumental Neutron Activation Analysis

Instrumental neutron activation analysis (INAA) was subsequently developed around 1950 and widely came into use around 1970. INAA involves bombarding the artifact with neutrons which cause the production of radioactive isotopes. These radioactive elements then decay into stable isotopes and produce radiation. This radiation is then read by the machine which is able to determine the corresponding elemental signatures which depend on the half-life of the isotopes which decayed (Pollard, et al. 2007:123; Renfrew and Bahn 2008:369). ICP-MS has largely replaced this process. Significantly, these early INAA elemental readings are comparable to ICP-MS readings, presuming that same elements were being measured in both methods of trace-element analysis. This is demonstrated in a study of Nasca ceramics (Vaughn, et al. 2011). This study examined ceramics in groups predefined by INAA in order to test the results against each other. The study demonstrated that similar results are generated by both methods, affirming LA-ICP-MS as a viable alternative to INAA.

3.4.4 Scanning Electron Microprobe

Scanning electron microprobe (SEM) is based on a similar idea to XRF, discussed later, but data are collected through the use of electrons, rather than X-rays (Pollard, et al. 2007:109). Special steps must be taken in the preparation and mounting of the artifact for analysis. Despite these requirements, the beam produced by an SEM machine allows for pinpoint analysis up to 1000th of a millimeter in size (Renfrew and Bahn 2008:368). This facilitates analysis of specific portions of artifacts, such as the slip on a ceramic.

OES, AAS, INAA, and SEM have all been, and in some cases still are, used in trace-element analyses of archaeological artifacts. These analytical techniques are capable of providing a range of elemental data, from single elements to a large array. OES and SEM established fundamental principles and methodologies for the use of XRF and ICP-MS analyses.

3.4.5 X-Ray Florescence

X-ray Fluorescence (XRF) provides a quick and relatively simple method of trace-element analysis. The process involves either placing the sample in a container, a holding device, or a plastic sheet for scanning (Pollard, et al. 2007:107). The XRF machine bombards the sample with X-rays, which then excite the electrons in the sample. The electrons interact with, and fill in the missing electrons in the upper shell. When the electrons move back to their original places they give off a unique signal. Lastly, the X-rays return to the machine which carry the elemental data to the device (Renfrew and Bahn 2008:368).

XRF offers a wide range of possibilities for analyzing the trace elements within a sample. As described above, the sample can be placed or held by a variety of different items and containers, thereby allowing a large variety of items to be analyzed. Along with being able to analyze a multitude of materials, such as obsidian and greenstone, XRF instantly receives the elemental readings. Once scanned, the results can be loaded to and viewed on a computer screen, allowing for rapid analysis.

Most XRF machines utilize a filament, which is heated, as the source of electrons. This filament is encased in a small, sealed vacuum tube (Craig, et al. 2007:2015; Pollard, et al. 2007:100). These elements are then encased in plastic shell that protects the inner mechanics, along with the user from x-rays. When the device is constructed in a small portable manner (portable or pXRF), it can be used in a variety of settings, and pXRF is a particularly useful tool for archaeologists travelling in the field.

XRF analysis does have some drawbacks. This method is not as effective for analyzing heterogeneous materials as some techniques, such as INAA and ICP-MS (Pollard, et al. 2007:119) because of the broad spectrum readings taken by XRF. This can be countered by utilizing a control substance for standardization, such as a piece of stainless steel (Forouzan, et al. 2012). By performing control readings frequently, it can be ensured that the elemental readings of the object(s) can be ensured, at least with that particular instrument for a given time. Further, the X-rays are also only capable of penetrating the top millimeter of the sample (Pollard, et al. 2007:107). This limitation can prevent the analysis of samples with varying layers of composition, such as ceramics with a thick slip. Despite these setbacks, XRF can provide rapid, cheap, and fairly accurate results.

pXRF offers many similar capabilities to XRF, but has a lower range of detectable elements. pXRF does have several other limitations as well, these include minimum size in order to obtain accurate readings, and the necessity for a use of a standard control material to account for drift of the readings (Shackley 2010). Overall, pXRF offers the portability that no other analytical chemistry technique can offer, but at the cost of accuracy and detection limits.

When examined in its entirety, XRF is an archaeology friendly method of compositional analysis. A combination of at which results are derived, relatively low overall cost, and portability has made XRF an extremely popular method of trace-element analysis within archaeology. Until an equally portable method of trace-element analysis is developed, XRF will certainly be one of the methods of choice for archaeology. Examples of the utility of XRF are broad reaching, such as the analysis of Chalcolithic clay figurines and tokens from Iran (Forouzan, et al. 2012). Further, XRF studies of obsidian prove particularly successful due to the homogeneity of the material (Loendorf, et al. 2013; Moholy-Nagy, et al. 2013). Additionally, the rapidity with which XRF analysis can be undertaken facilitates the collection of very large data sets (Moholy-Nagy, et al. 2013).

3.4.6 Inductively Coupled-Plasma Mass Spectrometry

Since its beginnings in the 1980s, ICP-MS has become a very popular method of analysis among archaeologists. ICP-MS provides quick results and low detection limits, making this method of trace-element analysis one of the preferred techniques (Golitko 2011:252). Minimal preparation is required for the analysis, contributing to its popularity as an analytical technique.

Analyzing samples through ICP-MS involves several steps. First, the sample itself must be prepared. The two principal methods for introducing a sample are laser ablation (LA) and micro-wave digestion (MD). The only preparation for laser ablation required is that the sample must fit within the sample chamber. While the size of the chamber may be a limiting factor, this does allow for analysis of small portions of artifacts, thereby preserving the majority of the artifact. Microwave digestion involves the dissolving of the sample, usually around 100 mg, in a highly corrosive acid (Kennett, et al. 2001). Once completely dissolved, the sample is prepared.

The next step involves superheating the sample. This step uses a laser to vaporize a small amount of the sample. The laser plasma is heated to 10,000°C and remains in the same position on the sample for over 60 seconds (Pollard, et al. 2007:196). Despite sounding as if this method is destructive, the laser leaves a mark 50-200 μm in diameter (Golitko 2011:253; Gratuze, et al. 2001). The remaining mark left by the laser is not visible to the naked eye, thus making it a viable option when conducting research on rare or precious objects. This process is then repeated several times on the same artifact to collect several readings that are averaged, with anomalous readings removed from the average. Laser ablation is the method utilized by the LA-ICP-MS machine at the Field Museum's Elemental Analysis Facility (EAF) (Dussubieux, et al. 2007; Golitko 2011; Golitko and Terrell 2012)

Once the laser ionizes the sample, the machine gathers all of the ionized elements in receiver cups; the count can vary depending on the machine. The ionized atoms are then organized by the machine based upon their mass/charge ratio (Golitko 2011:252). Based upon these readings, the elemental composition of the sample is then processed by the machine.

Research conducted with ICP-MS offer a wide variety of possibilities. The limits of detection (LOD) for ICP-MS are very low, offering a very comprehensive set of results. Analyses conducted with ICP-MS can offer detection for a variety of elements down to the parts per billion, possibly even trillion (Pollard, et al. 2007:195). This is a much greater range of elemental detection than other techniques, such as AAS and XRF, can offer.

This being said, no analytical method is perfect in its execution and results. In LA-ICP-MS, the laser that is used to ablate the samples can cause erroneous readings. This error is a result of the lack of a set standard for readings, which is particularly problematic for LA and less so for MD (Pollard, et al. 2007:207). Being unable to have a set standard for what readings should be leaves the possibility of small variation from sample to sample. Many facilities do use glass or a sample of clay as the standard in attempt to address this problem, but minor variation will remain due to elemental composition of these samples.

MD has a distinct advantage over LA as a form of analysis. LA is 1,000 times worse than MD solution analysis in terms of limits of detection (Pollard, et al. 2007:199). This problem can be traced to the method in which the sample is being ionized. The plasma laser used in LA analyses is less controllable than the solution used in MD, making MD the superior method in terms of purely elemental detection capabilities. However, MD is much more hazardous to the individual conducting the analysis due to the chemical used in dissolution, these chemicals also destroy the sample being analyzed entirely. Further, MD results in bulk analysis, while LA is a spot analysis (Larson, et al. 2005:97). Therefore, LA allows for the identification of a specific part of a material, such as ceramics where the clay can be targeted, while avoiding large temper or inclusions. MD has been used in the tracking of trade and production of ceramics in the south Pacific region of Lapita ceramics, allowing for greater understanding beyond what previous visual analyses permitted (Kennett, et al. 2004).

LA-ICP-MS can also be used in conjunction with other types of elemental analyses, such as INAA. In a study of Early Green Glazed (EGG) wares from the north coast of Peru, INAA was used in the analysis of ceramic clays, and LA-ICP-MS was used in the analysis of the glazes. Through this analysis the data suggested that indigenous potters were producing these glazed wares, a technique not seen until the Colonial era, and were not under the direction of Spanish instructors (VanValkenburgh, Kelloway, et al. 2015). This difference is signified by the elemental variation between the EGG wares. This suggests that the ceramics were not being produced in a few workshops, but rather by potters dispersed across the landscape. Elemental analysis allows archaeologists to address questions regarding colonial interactions and craft production, such as those seen on the north coast of Peru, in new ways. Visual analysis is incapable of distinguishing the differences in the lead glazes that the elemental analyses were able to pick up on.

3.5 Compositional Analysis

Building a database of regional clay sources allows for even greater detail in the identification of ceramic production centers. Trace-element readings from the samples can be compared and contrasted with readings taken from raw clay sources that were utilized in historic and prehistoric times.

One such study was conducted in the Moquegua Valley of southern Peru. Five chemically unique clay groups were identified in this region. These groups are: Moquegua Valley clays, Torata Valley clays, Tumilaca Valley clays, Otora Valley 1 clays, and Otora Valley 2 clays (Sharratt, et al. 2009). By identifying these clay sources, new questions regarding resource access and the clay preference of potters can be addressed more thoroughly.

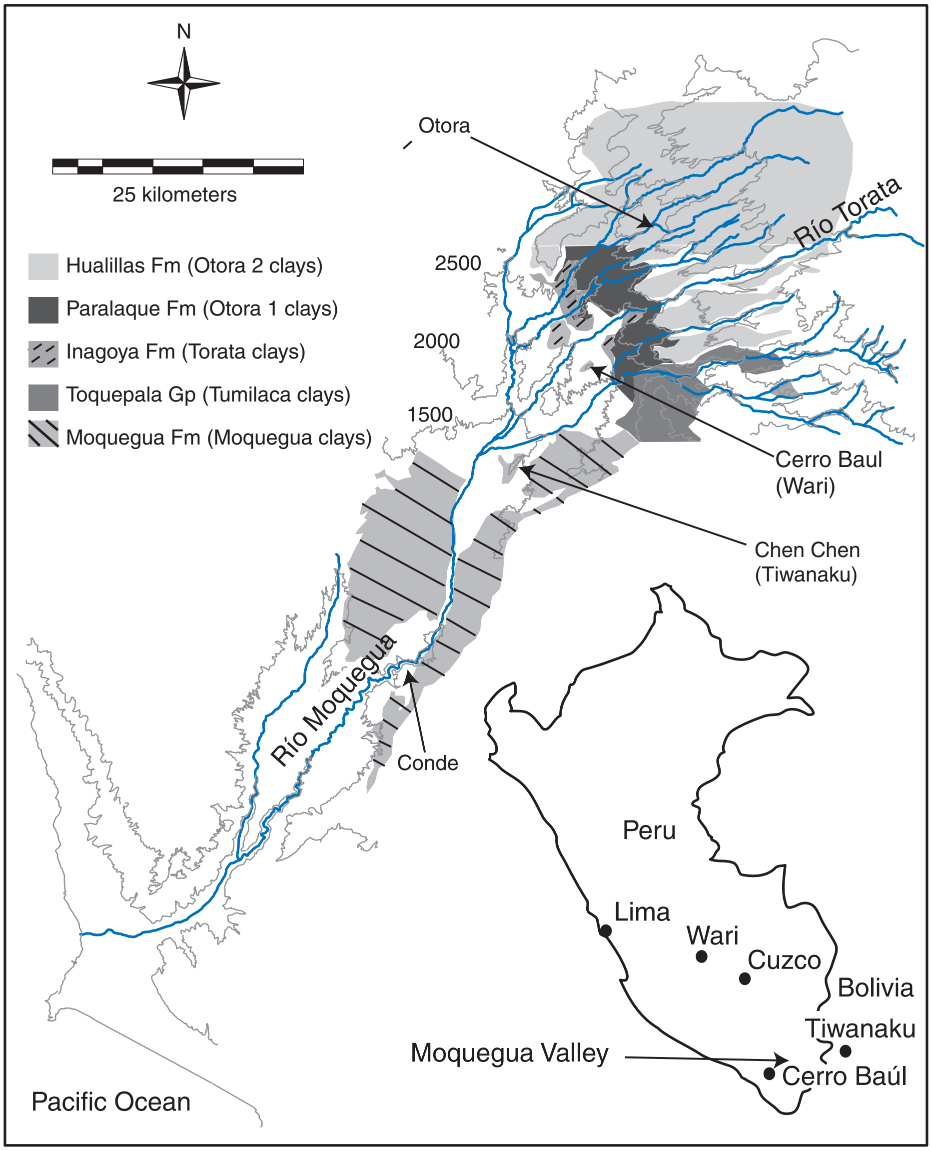


Figure 3.1 Moquegua Clay Source Map
(Sharratt, et al. 2009)

It is assumed that not every clay source used throughout history in the Moquegua Valley was sampled in this study. In order to account for this, trend surface analysis was carried out. This technique is "a means of 'smoothing' the distributional data collected at isolated points to examine spatial trends on a regional level" (Sharratt, et al. 2009:812). Through the use of ArcGIS, a map of clays is generated using these data.

Accounting for temper within the clays has also been addressed in a study comparing data derived from INAA and ICP-MS analyses of Wari ceramics (Dussubieux, et al. 2007). In this study, it was found that the results produced by INAA and ICP-MS were similar. Because INAA is a method which analyzes the entire artifact, and does not pinpoint within the matrix as LA-ICP-MS does, the study indicated that much of the elemental variability was from the clays and not the temper used to produce the ceramic.

ICP-MS analyses provide archaeologists with data regarding choices about clay made by potters. In the production of ceramics, potters do not always access the clays closest to them, this decision may be a result of social connections (Arnold 1972; Livingstone-Smith 2000). The social connections could be due to the potter's training and knowledge of specific clay sources that are not local, or ties to distant groups who may be located near a clay resource. A variety of factors can influence the social decisions made by the potter when selecting the clays, but factors other than social may also influence the decision making process. These preferences may be for specific clay sources which hold certain qualities, such as their drying rate, and presence of specific minerals can be reflected in elemental analyses (Arnold, et al. 1991:71). The elemental data then allow for archaeologists to begin attempting to understand these preferences in ceramic production.

Tempering is an important step in the ceramic production process and can potentially alter the elemental reading. A large variety of materials can be used in the tempering process, such as, minerals, shell, organic material, as well as crushed ceramic (Rice 2015:79). In the elemental study of Egyptian ceramics, researchers found that ceramics tempered with silt or granite were clearly distinguishable elementally, when compared to ceramics tempered with other materials, and may even signify continuity in the ceramic recipes over millennia (Mallory-Greenough and Greenough 1998).

3.6 Summary

Analytical chemistry has provided major contributions to the field of archaeology by providing another avenue of research. Analytical chemistry provides an alternative to solely visual analyses of artifacts. While visual analysis can indicate the widespread sharing of material styles, analytical chemistry allows for the tracking of the movement of actual craft goods. Overall, analytical chemistry proves to be an invaluable tool for archaeologists who will continue to push the discipline as existing techniques are improved upon and new methods are developed.

Analytical chemistry does have its own set of limitations though. Perhaps the most significant limitation is that typically with improved accuracy of readings comes increased damage to the artifacts. While LA-ICP-MS is minimally destructive, almost invisible damage is nonetheless done to the samples. XRF does not damage the samples at all, but does not offer the range of detection that many other methods ensure. Further, in the case of analytical techniques such as LA-ICP-MS and INAA, the samples must be able to be brought to the facility, thereby frequently requiring exportation permits from foreign governments. This analysis also requires collaboration with chemists and is not a technique which archaeologists can do isolation. These factors limit who is able to conduct these analyses and the type of work done. Despite these limitations, analytical chemistry still provides many opportunities for analysis of artifacts at a level never before conducted.

Within the past several years, the use of analytical chemistry has grown in the Andes region. These studies have largely focused on obsidian and on ceramics (Burger and

Glascock 2000; Dussubieux, et al. 2007; Jamieson, et al. 2013; Sharratt, et al. 2015; VanValkenburgh, Kelloway, et al. 2015; Vaughn, et al. 2011). This shift from purely visual analyses to elemental analyses provides new takes on production, exchange, and interaction between groups. These studies provide the opportunity to address questions of group interaction and resource access, which are topics of intense study and debate in Andean archaeology.

Despite the overall increased use of analytical chemistry in Andean archaeology, most studies have been of pre-Contact materials, aside from a few studies on historic period materials (Jamieson, et al. 2013; VanValkenburgh, Kelloway, et al. 2015). Yet, Spanish conquest of South America brought about broad changes to the political, social, and economic landscapes of the Andes. As such, it is particularly important that we look at production and exchange during the early Colonial Period. Focusing on the Moquegua Valley, where compositional analyses have been dominated by Middle Horizon material, this thesis examines ceramic production and exchange during this period of significant socio-political transformation.

4 RESEARCH DESIGN

4.1 Introduction

The sites of Torata Alta and Sabaya were selected for this thesis project because of their respective histories and available archaeological data. Torata Alta was occupied as a *reducción* during the Colonial era. Sabaya was as an Inca administrative center in the pre-Contact period, and possibly also served as an administrative center in the Colonial era. Two units/structures were selected from each site based upon their occupational histories and a sample of ceramic sherds chosen from those structures.

Sampled ceramics were analyzed using pXRF and LA-ICP-MS. The elemental data were then processed using GAUSS procedures. GAUSS is a program that provides advanced, multi-variate statistical tools, such as Hierarchical Cluster Analysis and Principle Component Analysis.

4.2 Sample Selection

From Sabaya and Torata Alta, one hundred ceramic samples, fifty from each site, were selected for this study. In collaboration with Dr. Chacaltana Cortez in the summer of 2015, I identified four units/structures (two from each site) from which to take ceramic samples. From Torata Alta, Structure 161 and Structure 269 were sampled. From Sabaya, Unit 3 and Unit 5 were sampled. The ceramics were then exported from Peru to the U.S. under a permit issued by the Peruvian Ministry of Culture (permit number 005-2016-VMPCIC-MC).

All ceramics selected for the study are unglazed, but are slipped. Any decoration on the ceramics is painted. Attempts were made to sample evenly between decorated and undecorated, along with sampling evenly between structures/units. However, due to availability and variances between each structure/unit, this was not wholly feasible.

4.3 Vessel Forms

Colonial period Moquegua appears to lack utilitarian imports (Rice 2011:229). Therefore, utilitarian wares were likely being produced locally in a variety of forms, such as ollas, pitchers, *tostadores*, pedestal vessels, flared rim jars, cups, and bowls. These findings are somewhat similar to those found during excavations of an elite Spanish residence near Potosí, Bolivia (Van Buren 1999). Of the recovered ceramics from this structure, 83.86% were visually classified as indigenous or *colono* (indigenous wares produced in European forms) wares. In addition to these presumably locally produced wares were 9.28% European utilitarian wares (such as lead glazed cooking vessels and *botijas*), and 3% *majolica* were all visually identified as well. While significantly lower in total number, imported ceramics at the excavation in Potosí still totaled roughly 12% of the overall ceramic assemblage.

Many examples of these vessel forms were found during Van Buren's excavations at Torata Alta (Rice 2011:230; Van Buren 1993). Examples of double handed ollas, or cooking pots, account for 29% of the utilitarian ware sherds recovered (Van Buren 1993:295). Pedestal vessels (Figure 4.1) were comprised 6.2% of the recovered utilitarian ware sherds (Van Buren 1993:296). Flared rim jars (Figure 4.2) accounted for 20.4% of recovered utilitarian ware sherds (Van Buren 1993:301). Bowls account for 14% of recovered utilitarian ware sherds (Van Buren 1993:306). Similar vessel forms were recovered from Sabaya, such as plates (Figure 4.3), ollas, and *aryballi* (Bürgi 1993:260).

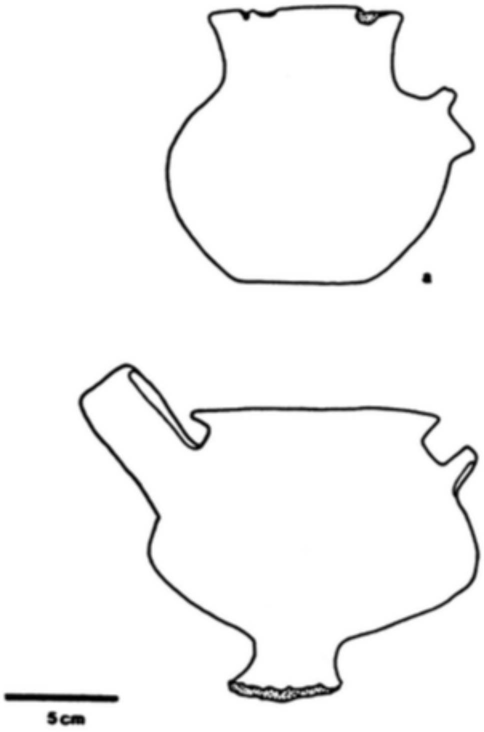


Figure 4.1 Intact Vessel from Torata Alta
(Van Buren 1993:Figure 43)

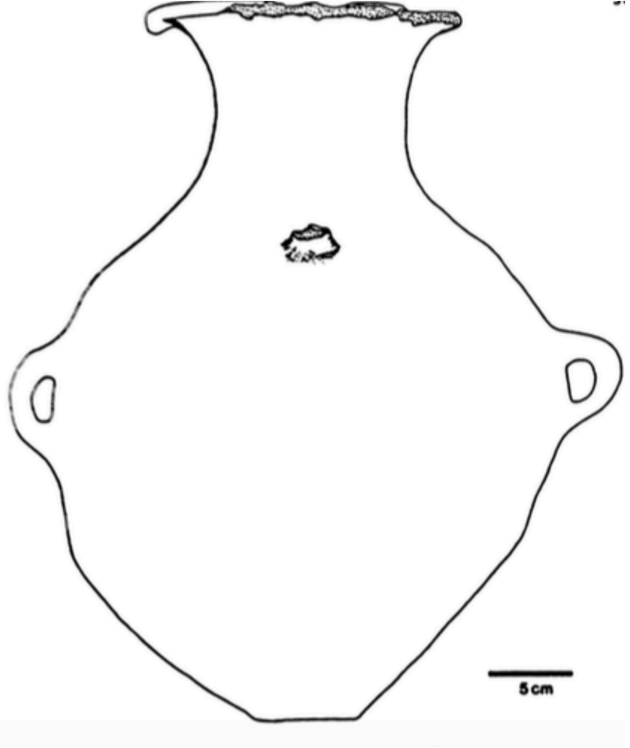


Figure 4.2 Flared-rim jar from Torata Alta
(Van Buren 1993:Figure 44)

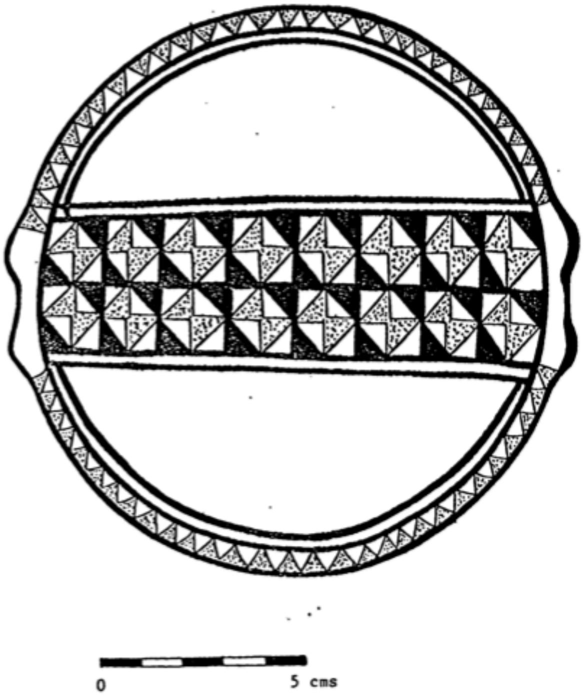


Figure 4.3 Ceramic plate from Sabaya
(Bürgi 1993:Figure 79)

The vessel forms for sherds sampled for this thesis were of unknown vessel form. The sherds were largely non-diagnostic and not of European production (i.e. *majolica*). The reason for selecting sherds with little diagnostic information is two-fold. The first reason is that the Peruvian Ministry of Culture is more willing to allow for the exportation and study of sherds that are not diagnostic or decorated. The second reason is further information can be gathered from sherds which offer comparatively little information otherwise.

4.4 Sites

4.4.1 *Torata Alta*

Figure 4.4 Torata Alta site map
(Chacaltana Cortez 2014:Plano 60)

Torata Alta is located about 20 km northeast of the modern city of Moquegua, Peru and 2 km northeast of the modern village of Torata (Chacaltana Cortez 2014). Torata Alta lies within the Río Osmore drainage on a low hill on the south side of the Río Torata (Van Buren 1993:59). The site presently covers about 4.1 ha, although a portion of the site has been destroyed by modern occupation (Chacaltana Cortez 2014). The site is located at 2,493 masl.

The origin of the word "Torata," which can also be spelt "Tarata," comes from the Quechua word "*thurita*." This word translates to "stand firm, seize without falling" (Kuon

Cabello 1981:470; Rice 2013:72). Rice suggests the site is named Torata because of it link to the Inca siege of nearby Cochuna (Rice 2013:72).

The first appearance of a geographical location named Torata in a written document is from 1540. Francisco Pizarro reassigned *encomiendas* in the region of Ubinas to Noguerol de Ulloa. Included in the list of pueblos Noguerol de Ulloa controlled were Tarata, Sibaha, and Camata (Rice 2011:106). All three sites are located within the same region of the Moquegua Valley and are possibly the same modern sites, which have slightly altered spelling of the names. Alternatively, the "Tarata" referenced in the document may refer to a general grouping of peoples in an area, and not the modern town of Torata, or the *reducción* of Torata Alta (Van Buren 1993:67).

Torata Alta was possibly founded by the Inca to be an administrative garrison to oversee agricultural production in the surrounding valleys (Rice 2012:4; 2013:66). Archaeologically, this has yet to be proven. The exact date of founding is unclear at present, but the site was clearly occupied during the Colonial Period and functioned as a *reducción*.

Colonial Period occupation of the site is confirmed through the recovery of artifacts including both indigenous wares and European artifacts, such as majolica and glass beads. During this time period, the site became a *reducción* and was occupied by both Spaniards and native Andeans. Site occupation continued after the eruption of Huaynaputina in 1600, as signified by the presence of artifacts recovered from above the ash layer.

According to historical documents, the *reducción* at Torata Alta was comprised of native Andeans from "Yacango, Tumilaca, Pocata, Chuquisquea, Otora, Queli, and Iluvaia (Ilubaya)" (Rice 2011:118). This follows Toledo's instruction of combining several small villages into one town. The most notable admission from the list of included groups is the population from nearby Sabaya. This documentary evidence is supported archaeologically by occupation of structures at Sabaya post-1600, demonstrated by the cleaning of ash layer deposited by Huaynaputina across the region.

Torata Alta includes all of the architectural elements required by Toledo when he established the *reducción* system. The site is laid out on a grid pattern, with domestic structures facing out onto the streets. A church is located in the northeastern portion of the site. A plaza, which has been disturbed for a modern soccer field, is located on the northern portion of Torata Alta. Terraces are also present on the far eastern portion of the site. A modern dirt roadway runs southeast to northwest through the site. Irrigation canals have also been cut into the far northeast and southwest parts of the site.

It is unclear exactly when Torata Alta was abandoned, although domestic refuse has been found both above and below the Huaynaputina ash layer suggesting occupation into the seventeenth century (Van Buren 1996:342). What is clear about the site's abandonment is that it was not a sudden event. Instead the abandonment may have been a planned or drawn out process (Rice 2012:24; Van Buren 1993:355). Many structures appear to have been cleaned prior to abandonment. The relative absence of large artifacts at the site reinforce this idea. The slow abandonment allowed for time to carry off these larger items. It is also possible that the larger artifacts were scavenged from the site post-abandonment.

Torata Alta has been the subject of study by several archaeologists over the past three decades. Dr. Charles Stanish produced the first site map in 1982. Dr. Geoffrey Conrad conducted surface survey and improved upon the site map in 1987. After the initial mapping and survey of the site, Dr. Prudence Rice conducted excavations in 1987, Dr. Mary

Van Buren along with Dr. Peter Bürgi in 1988-1989, and Dr. Sofia Chacaltana Cortez in 2013 (Chacaltana Cortez 2014; Van Buren 1993).

4.4.1.1 Structure 161, Torata Alta

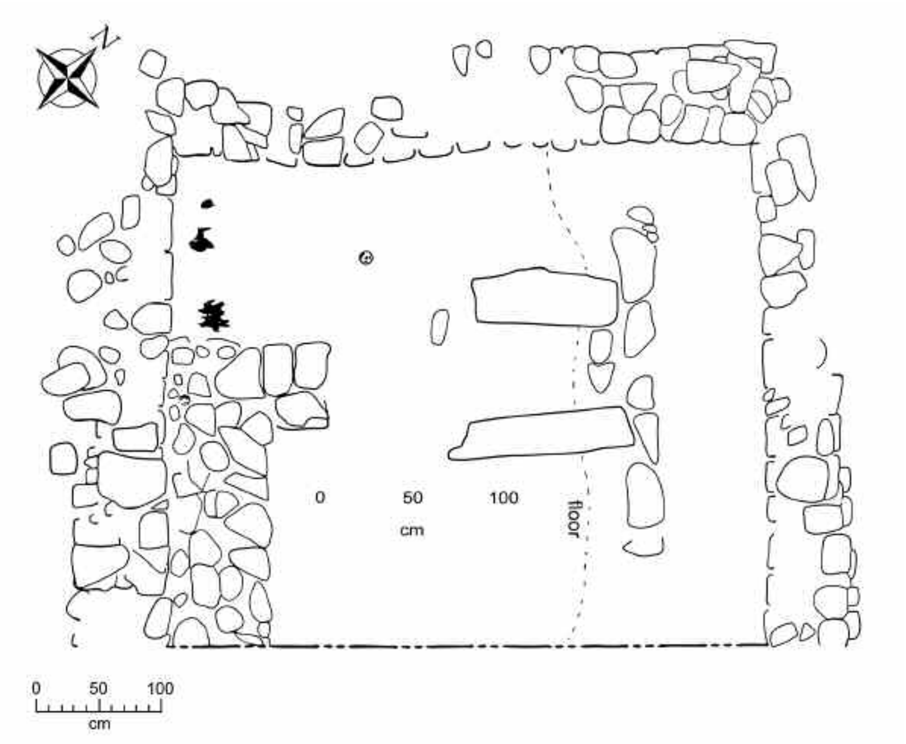


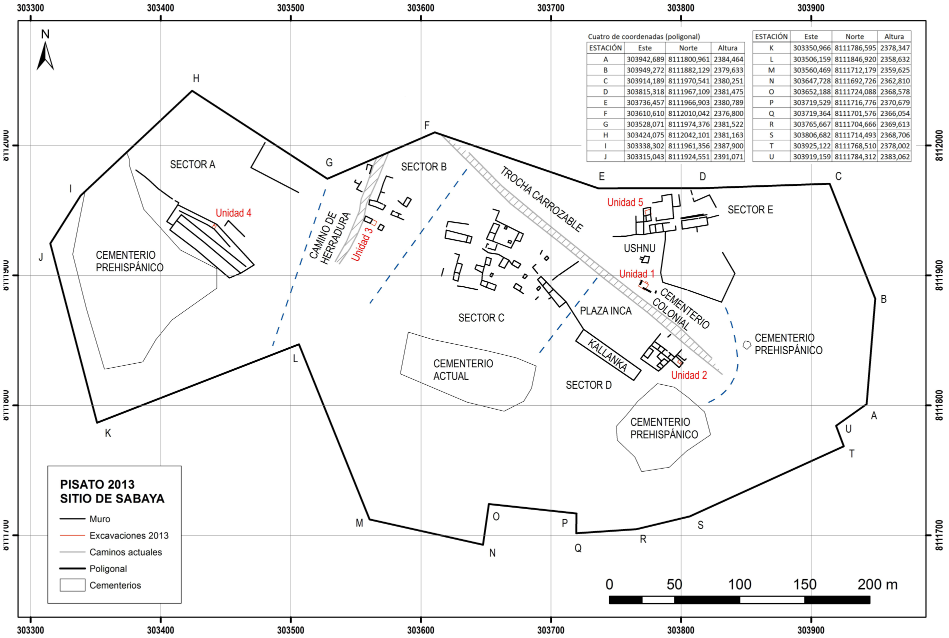
Figure 4.5 Torata Alta Structure 161
(Rice 2012:14)

Structure 161 at Torata Alta, excavated by Van Buren in 1989, is located on the northeastern section of the site near the church. This structure, along with the adjoining Structure 162, is interpreted as a friary for full time or visiting religious persons (Rice 2012:13; 2013:135). Huaynaputina ash is absent from this structure, suggesting it had been cleaned and occupied post-1600 (Van Buren 1993:367). The samples from Structure 161 comprised a total of 17 decorated ceramics and 8 undecorated ceramics.

4.4.1.2 Structure 269, Torata Alta

Structure 269 is located in the southeastern section of Torata Alta. Van Buren also excavated the structure in 1989. This structure is interpreted as an elite residence, with the inhabitants engaging in feasting and textile production (Rice 2012:18). From this came a variety of artifacts relating to textile production; such as, a thimble, pins, scissors, and spindle whorls (Rice 2012:18). The stratigraphy was complicated, with wall fall intermixed with discontinuous pockets of volcanic ash, suggesting the structure was abandoned prior to the eruption of Huaynaputina (Van Buren 1993:372). The sampled ceramics were from below the ash layer. From Structure 269, 13 decorated and 12 undecorated ceramics were sampled for this thesis.

4.4.2 Sabaya



Cuatro de coordenadas (poligonal)

ESTACIÓN	Este	Norte	Altura
A	303942,689	8111800,961	2384,464
B	303949,272	8111882,129	2379,633
C	303914,189	8111970,541	2380,251
D	303815,318	8111967,109	2381,475
E	303736,457	8111966,903	2380,789
F	303610,610	8112010,042	2376,800
G	303528,071	8111974,376	2381,522
H	303424,075	8112042,101	2381,163
I	303338,302	8111961,356	2387,900
J	303315,043	8111924,551	2391,071

ESTACIÓN	Este	Norte	Altura
K	303350,966	8111786,595	2378,347
L	303506,159	8111846,920	2358,632
M	303560,469	8111712,179	2359,625
N	303647,728	8111692,726	2362,810
O	303652,188	8111724,088	2368,578
P	303719,529	8111716,776	2370,679
Q	303719,364	8111701,576	2366,054
R	303765,667	8111704,666	2369,613
S	303806,682	8111714,493	2368,706
T	303925,122	8111768,510	2378,002
U	303919,159	8111784,312	2383,062

Figure 4.6 Sabaya Site Map
(Chacaltana Cortez 2014:Plano 2)

Sabaya is located 300 m north of the modern village of Torata, Peru (Chacaltana Cortez 2014). This site lies on the north bank of the Río Torata and is visible from the summit of Torata Alta. The architectural remains at Sabaya cover five to six ha, but the architecture is dispersed over an area of 15 ha (Bürgi 1993:176; Chacaltana Cortez 2014:14; Rice 2012:7). The site is located at 2,357 masl.

The site is placed in an indefensible valley bottom. Nearby the site are productive agricultural lands, and terraced hillsides. This is unlike many pre-Contact sites that are located on defensive landscapes, such as ridges or hilltops. The descent from the town of Ilubaya to Sabaya features several natural springs, or *puquios*, which provide water for agriculture into the modern era (Bürgi 1993:178).

The origin of the name Sabaya is uncertain. It is suggested that Sabaya comes from the now extinct Pukina language. Pukina is thought to have been a high status language, which would explain why some Inca rulers had Pukina names (Rice 2013:71). The ending of "*–aya*" is what suggests that Sabaya is of Pukina origin. This suggestion is slightly contentious though, because the presence of Pukina speakers in the Moquegua region is not completely agreed upon (Rice 2013:71).

As with Torata Alta, the first documentary evidence for a location by the name of Sabaya is in Pizarro's assignment of *encomiendas* in the region of Ubinas to Noguerol de Ulloa (Rice 2011:106). In this document a location called "Sibaha" is listed. This document from 1540 could be the first document referencing to Sabaya.

Sabaya occupation possibly began before Spanish conquest. It has been suggested that Sabaya was an Inca settlement, occupied by elites and functioned as an administrative center (Bürgi 1993:276; Rice 2013:66). This claim is supported by the presence of Inca ceramics and the *kallanka*, which is a large hall presumed to have been housing for transient labor groups (Bürgi 1993). Due to these factors, and the general layout of the site which is in a typical Inca style, it is suggested that the site was an administrative site in the Late Horizon Inca era (Bürgi 1993:204).

Spanish colonial occupation of the site is clearly visible based on the presence of post-Contact artifacts, such as glass and glazed ceramics. Evidence suggests that the Spanish reutilized Sabaya as a prebuilt center for their own administrative purposes (Bürgi 1993:204). Sabaya could have been the staging point for controlling this particular portion of the Moquegua Valley, or as a center for an *encomienda* (Bürgi 1993:204). Documentary research suggests that the indigenous occupants of Sabaya during the Colonial period were Qollas, who originated from the high altiplano around Lake Titicaca (Rice 2012:5; 2013:63).

The site of Sabaya exhibits many features of an Inca settlement. Located within the central plaza, in the northeastern portion of the site, is an *ushnu*, which is a ceremonial platform mound. Interestingly, from the top of the *ushnu* the site of Cerro Baúl, a regionally significant mountaintop Wari site, is visible. Located opposite the *ushnu*, on the other side of the plaza is a *kallanka* (Bürgi 1993:265). The *kallanka* appears to have been coopted by the Spanish in the Colonial Period and transformed into a church (Bürgi 1993:218). Small domestic structure groupings are located on the northeast, central, and northwestern portions of the sites. There is a small pre-Contact cemetery on the far eastern edge of the site, southeast, and a larger cemetery on the western edge of the site. A colonial period cemetery is located within the central plaza, to the south of the *ushnu*. A modern cemetery is located in the south-central portion of the site. A modern dirt road runs from northwest to southeast through the central plaza.

Sabaya has not been extensively excavated or studied. There have only been two archaeological excavations at the site: the first directed by Dr. Peter Bürgi in 1990-1992, and the second directed by Dr. Sofia Chacaltana Cortez in 2013.

4.4.2.1 Unit 3, Sabaya

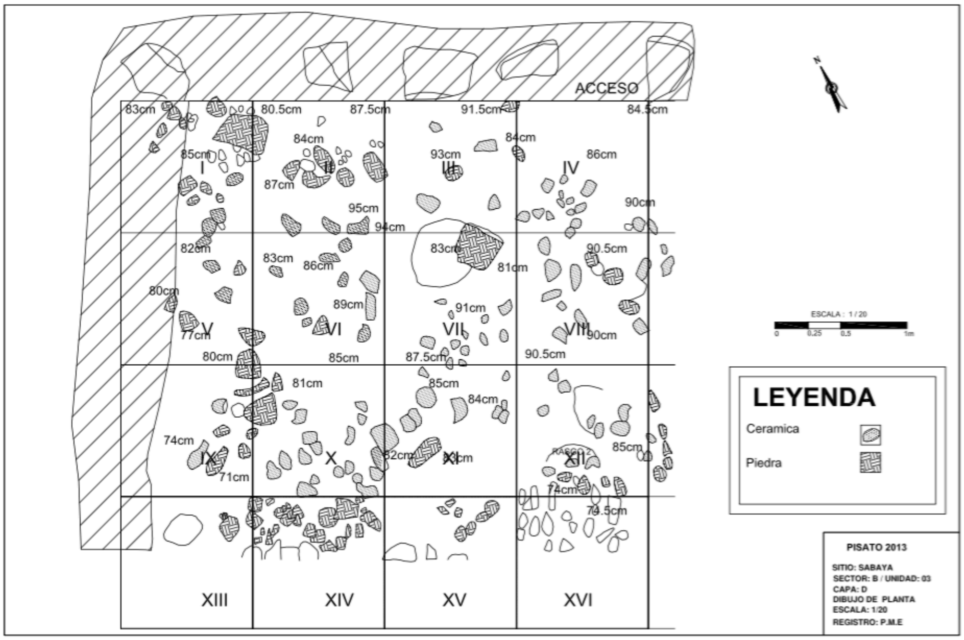


Figure 4.7 Sabaya Unit 3
(Chacaltana Cortez 2014:Plano 41)

Chacaltana Cortez excavated Unit 3 in 2013 and it is located in the northwestern portion of the site. This structure is interpreted as a domestic structure in the non-elite sector of Sabaya (Chacaltana Cortez 2014:41). From this structure, ceramics from *Capa* (or Layer) D were sampled. This level consists of a layer of intentionally smashed ceramics directly below volcanic ash from the eruption of Huaynaputina (Chacaltana Cortez 2014:42). From Unit 3, nine decorated and 16 undecorated ceramics were analyzed for this study.

4.4.2.2 Unit 5, Sabaya

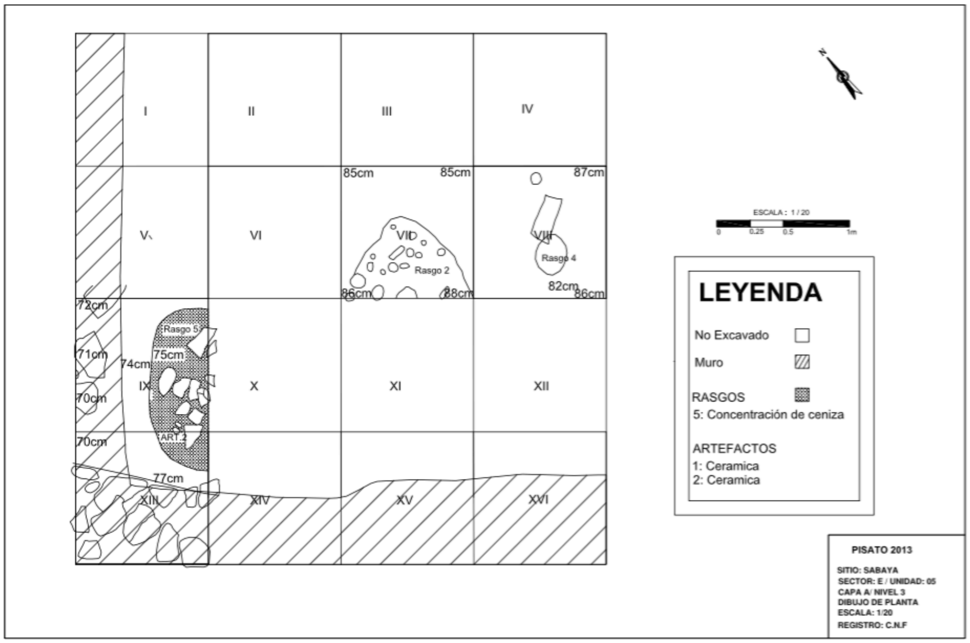


Figure 4.8 Sabaya Unit 5 Capa A Level 3
(Chacaltana Cortez 2014:Plano 55)

Unit 5 is located in the northeastern section of Sabaya and was excavated by Chacaltana Cortez in 2013. This structure is also a domestic structure in the elite sector of the site (Chacaltana Cortez 2014:47). Colonial ceramics were encountered in situ on the floor of the structure (*Capa* A Level 3), suggesting occupation during the Colonial Period. This interpretation is further reinforced by the absence of ash from the eruption of Huaynaputina, suggesting the structure was cleaned and occupied post-1600 (Chacaltana Cortez 2014:49). From Unit 5, eight decorated and 17 undecorated ceramics were sampled for this study.

4.5 Research Hypotheses

Based on understandings of *encomiendas* and *reducciones* in the Colonial Andes, on existing scholarship on Moquegua's place in the colonial economic system established in the wake of Spanish conquest, on the occupations at Sabaya and Torata Alta, and on published descriptions of ceramic assemblages at the sites and in the region more broadly, a series of hypotheses can be formulated about pottery production, resource acquisition and access to imported ceramic goods. Utilizing compositional data, this thesis tests those hypotheses.

- It is expected that imported ceramics will be present at Sabaya and Torata Alta because of Moquegua's role in the long distance trade network with the global Spanish Empire as well as producing wine for the Viceroyalty of Peru.
- It is expected that ceramic production strategies differed between Torata Alta and Sabaya because of the sites' different functions and occupation histories as a *reducción* and *encomienda*.
- Imported ceramics are expected in structures at Torata Alta (Structure 161) and Sabaya that were occupied by Spanish individuals, rather than indigenous individuals, because of their access to markets not available to indigenous Andeans.

4.6 Sample Processing and Statistics

Preliminary pXRF analysis was conducted on all sampled ceramics from Torata Alta and Sabaya. Chacaltana Cortez conducted the analysis at the Field Museum of Natural History Elemental Analysis Facility (EAF) in Chicago, Illinois with a Niton XL3t GOLDD+ pXRF device in February 2016.

LA-ICP-MS analysis was conducted on all sampled ceramics from Torata Alta and Sabaya. Wackett conducted the analysis using an ESI UP-213 laser ablation system and a Thermo Scientific iCAP RQ ICP-MS. These instruments are also housed at the Field Museum of Natural History EAF in Chicago, Illinois.

4.6.1 LA-ICP-MS Procedures

Procedures for LA-ICP-MS at the Field Museum EAF are discussed at length by Dussubieux and colleagues (Dussubieux, et al. 2007), but will be described briefly here. Several samples, typically five, are placed within the laser ablation sample chamber that has a diameter of 6 cm and height of 5 cm. Also included in the sample chamber are three reference material standard samples; N610 (glass), brick clay, and Ohio Red clay. Reference materials are run in order to ensure consistency of the readings being taken by the device. The chamber must then be purged, to allow for clean reading and transmission of the ablated material to the mass spectrometer.

Once purged, the laser can then be targeted. Two blank laser fires are initially taken to determine the baseline readings for the machine. Ten ablations are conducted per ceramic sample. Five ablations are conducted on each reference material. The laser warms up for five seconds prior to every ablation and an ablation dwell time of sixty seconds. The dwell time allows for penetration of the surface and any potential contamination, thereby allowing for a more accurate reading of the elemental composition. The ablation mark is 100 μm, about the width of a human hair. Ablation marks are usually not visible on the sample, which further displays this technique's potential as a minimally destructive method of elemental analysis.

The data produced are then cleaned in order to remove any erroneous readings, such as those that may have been caused by accidental ablations of temper. No more than three of the ten readings taken are removed per element. While not every reading will be identical due to the heterogeneous nature of clay, the readings should ideally be fairly close. Upon completion of cleaning the sample and the reference materials, the readings are averaged together. In this study, the elements Ta, Au, W, Mo, Na, Mg, Al, Si, P, Cl, K, Ca, Ti, Mn, Fe, Se, As, Cu, and In were removed from the data set. Removal was based upon erroneous readings from the laser ablation system. Elements were also removed to make the list compatible with elements present in the Moquegua clay database readings, thereby facilitating comparison between the two sets of readings.

4.6.2 Statistical Methods

The averaged readings are then analyzed using GAUSS routines. GAUSS is a non-commercial statistical program that was developed by Hector Neff at the University of Missouri Research Reactor Center (MURR). Once imported into the program, the data are transformed to a logarithmic scale (base 10 logarithms). There are several reasons for performing this transformation. One of the reasons for this transformation is that trace elements are more normally distributed in log form. Also, the transformation reduces the bias produced by large elemental readings which would then skew the analysis (Niziolek 2011:250).

4.6.2.1 Hierarchical Cluster Analysis

Hierarchical Cluster Analysis (HCA) was then performed on the data. This method places samples into groups of other like samples. The items in each group are more similar to each other than with the items in other groups (Niziolek 2011:258). Utilizing HCA allows for archaeologist to begin interpretation of the similarities and differences among the samples analyzed. HCA can be conducted on both Principle Components or logged data values. While this method of visualization is rather rudimentary, it is useful for understanding the basics of how the samples are grouped. When coupled with Principle

Component bi-plots, and Mahalanobis distance measurement, HCA can aid in the determination of strong groups.

4.6.2.2 Principle Component Analysis and Bi-plots

Principle component analyses (PCA) use the elemental information of the samples to provide data on the most abundant elements between the samples. This process reduces the amount of variability between the samples, making the variables more manageable. This type of analysis does not assume groupings within the samples, and searches for patterns within the elemental readings (Niziolek 2011:255). Typically, the first several principle component groups account for the majority of the elemental differences between the samples. After these major groups, the differences are reduced to tenths or even hundredths of a percent of differences.

By displaying principle component groups on bi-plots, it is possible to begin to determine groupings of samples based upon their elemental readings. The bi-plots are displayed with ellipses of ninety percent confidence. Based upon the information gathered from the bi-plots, it is then possible to determine larger patterns based upon the observed patterns. After examining several bi-plots, factor loading is used to determine which elements weigh most positively and negatively. These elements are then visualized on bi-plots.

4.6.2.3 Mahalanobis Distance Measurement

Possible groups are determined by PCA and bi-plots of specific elements. These groups are then tested by Mahalanobis distance measurement. Mahalanobis distance measurement tests the likelihood of samples belonging to the groups which they have been assigned (Niziolek 2015). In measuring the distance of multiple groups, it is possible for samples to be reassigned to different groups based upon elemental similarities. The groupings tested by Mahalanobis distance measurement are those that are observed based upon the principle components displayed on bi-plots.

4.7 Summary

A total of 100 ceramic sherds were selected from Torata Alta and Sabaya. These were exported to the USA where they were subject to analysis using pXRF and LA-ICP-MS at the EAF at the Field Museum of Natural History. The elemental data derived from compositional analysis were processed using GAUSS statistical procedures. Hierarchical cluster analysis grouped the samples in a tree according to relationship based upon principle components. Bi-plots were then produced based upon the elemental data. The groups observed in the HCA and bi-plots were then verified using Mahalanobis distance measurement.

5 Results

5.1 Introduction

By subjecting the elemental data derived from the pXRF and the LA-ICP-MS analyses to a series of statistical procedures using SPSS and GAUSS, specifically Hierarchical Cluster Analysis, Principle Component Analysis, Mahalanobis Distance Measurement and by displaying the data on bi-plots of specific elements, it was possible to discern two principle compositional groups in the data set. One group (Group 1) includes ceramics from both Torata Alta and Sabaya. The other group (Group 2) is comprised entirely of Torata Alta ceramics.

5.2 Statistical Results for XRF

XRF results were processed utilizing SPSS statistical routines. Despite being a different statistical program, the results of the study are still comparable to the GAUSS results of LA-ICP-MS analyses. The elements removed due to the XRF Limit of Detection include Cl, Sc, Co, Se, Mo, Pd, Ag, Cd, Sn, Sb, Te, Cs, Hf, Ta, W, Re, Au, Hg, U, and Ni. XRF Factor 1 is positively loaded on Titanium and Niobium, Factor 2 on Thorium and negatively loaded on Calcium, and Factor 3 is positively loaded on Strontium

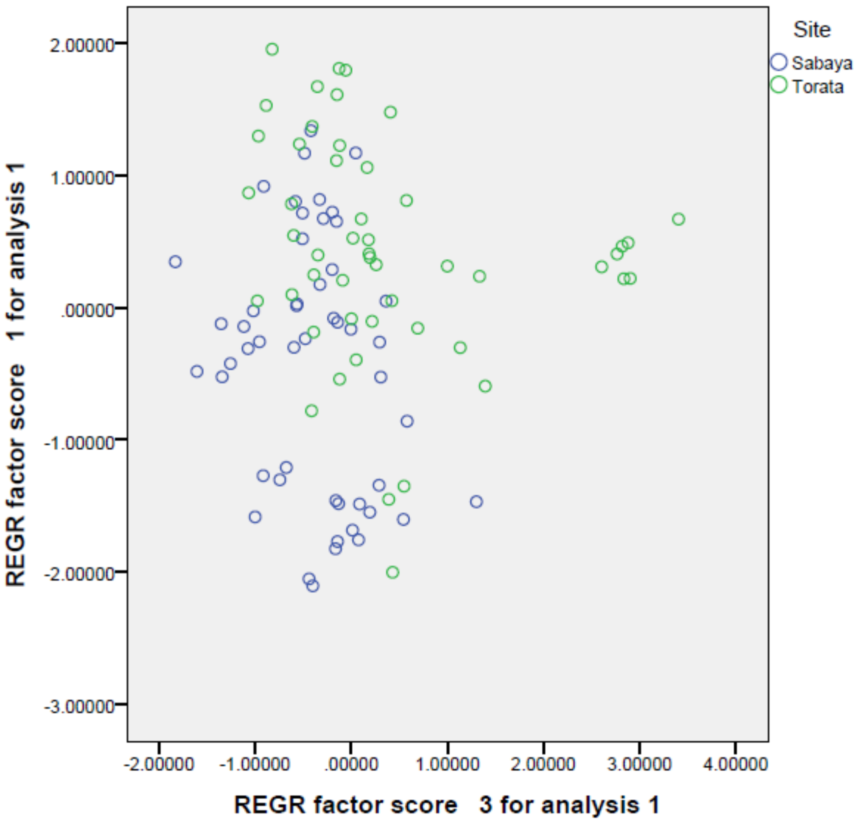


Figure 5.1 XRF Factors 1 and 3 Bi-plot

From the XRF bi-plot of Factors 1 and 3 it is possible to identify seven outliers from the main grouping of samples, with one outlier slightly separate from the grouping of other outlier samples. The main group is comprised of samples from both Torata Alta and Sabaya. The outliers are from Torata Alta Structure 161. The outliers are also very visible in bi-plots of Strontium and Ytrium, and Strontium and Niobium (Figures 5.2 and 5.3).

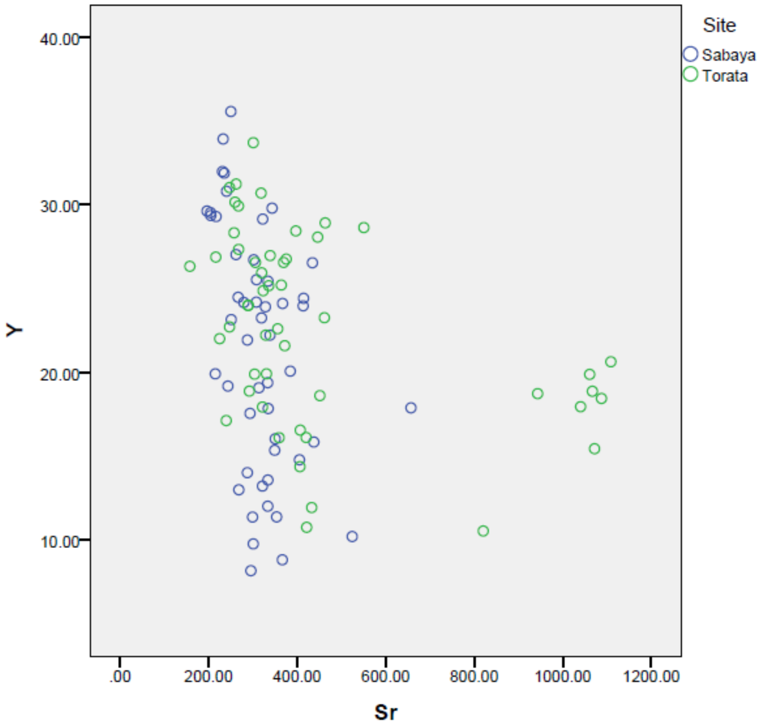


Figure 5.2 Strontium and Ytrium XRF Bi-plot

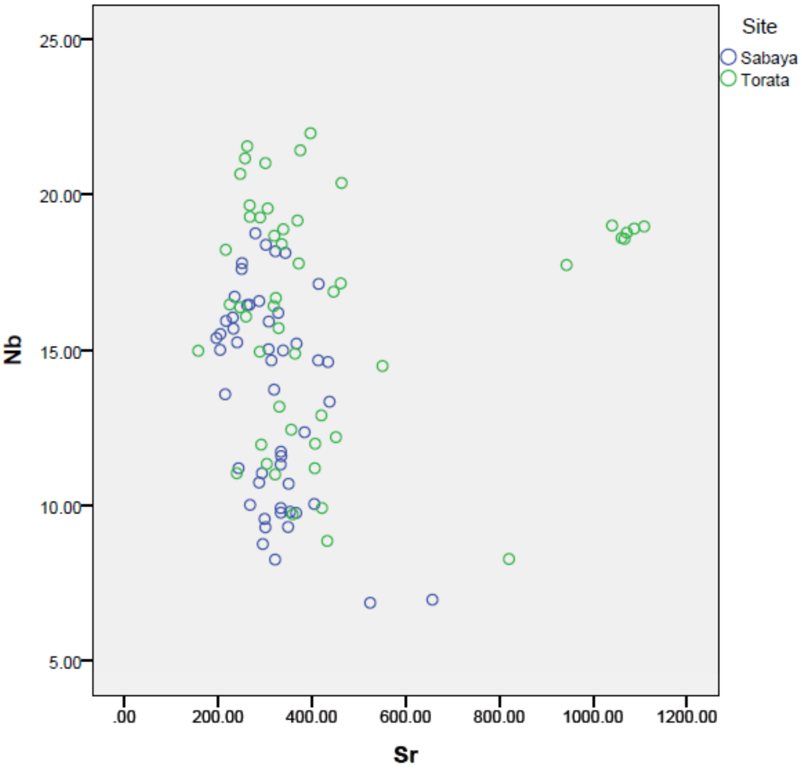


Figure 5.3 Strontium and Niobium XRF Bi-plot

5.3 Statistical Results for LA-ICP-MS

5.3.1 Hierarchical Cluster Analysis Results

Based upon the Hierarchical Cluster Analysis (Figure 5.4), the ceramics fell largely into two groupings. Group 1 is comprised entirely of thirty-one ceramics from Torata Alta, with one possible outlier related to this group. The remaining sixty-eight ceramics fall into Group 2, made up of ceramics from both Torata Alta and Sabaya. As discussed in Chapter 4, HCA is problematic because it groups samples together based on limited variables and may misrepresent relations between samples. Nonetheless, the initial processing of the ICP-MS data using HCA provided a useful visualization tool and helped guide subsequent steps in the analytical process. The HCA indicated a clear division in the ceramic ICP-MS data. This division was also apparent when samples were viewed in bi-plots of specific elements.

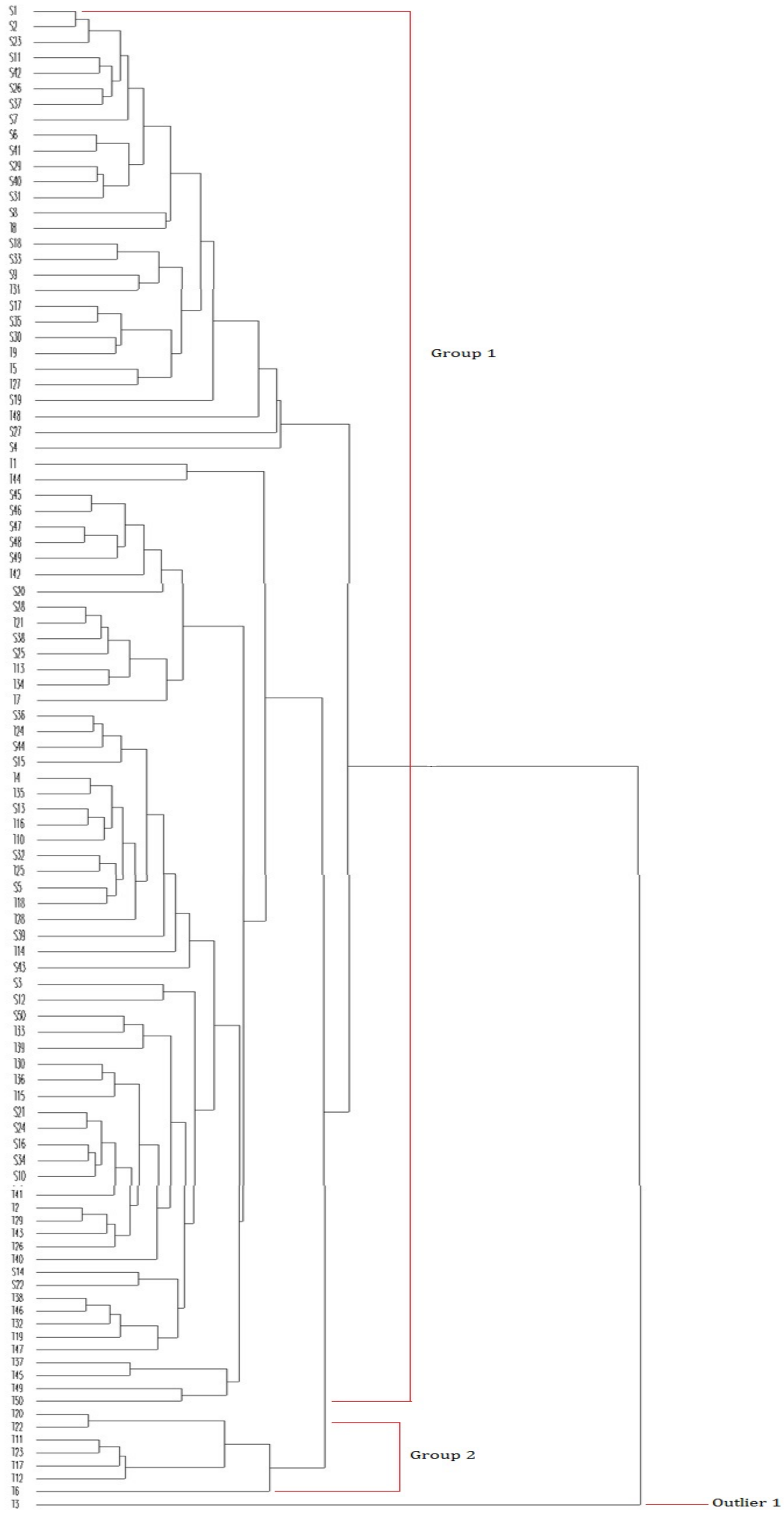


Figure 5.4 Hierarchical Cluster Analysis

5.3.2 Bi-plot Groupings

Bi-plots were constructed based upon the principle components of the samples. This allowed for the understanding of the grouping of the samples based upon multiple variables. Bi-plots were designed using 90% confidence ellipses for grouping similar samples. The bi-plots further demonstrate what the HCA suggested, the samples group into two groups.

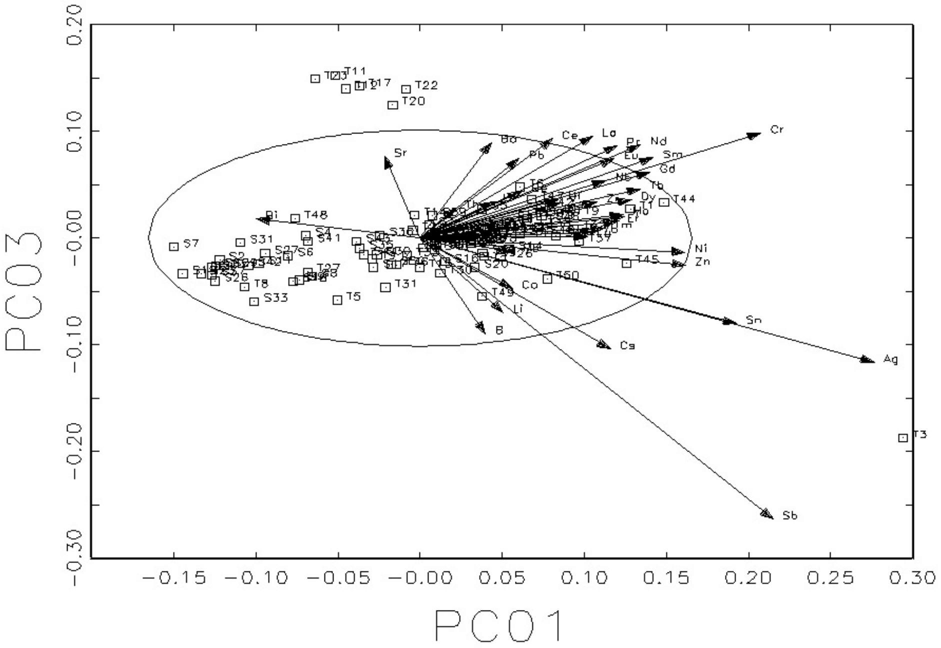


Figure 5.5 Bi-plot of PC1 and PC3

The bi-plot of principle components 1, 2, and 3, (Figure 5.5) which account for 72 percent of the elemental variation between the samples, demonstrate similar groupings to those present in the Hierarchical Cluster Analysis. Group 1 includes 93 ceramics. These sherds are from Torata Alta and Sabaya. Group 1 may contain subgroupings based upon the groupings on the bi-plots. Group 2, which is clearly visible on the bi-plot of PC1 and PC3 contains only ceramics from Torata Alta. Group 2 includes six samples, 1235.07, 1235.08, 1236.02, 1242.03, 1242.05, and 1242.06. Notably, all six are not only from the same site

(Torata Alta), they are also all from the same structure, Structure 161. The one outlier, sample 1233.03, also from Torata Alta Structure 161, remained isolated from the majority of the samples.

PC 1 is positively loaded with elements Ag, Sn, Sb, and Cr. PC 2 is positively loaded with elements Bi and Sn. While PC 3 is positively loaded with elements Cr and Sr, but is negatively loaded with elements Sb, Ag, Sn, Ca. These elements define the Principle Component groups and are used in the definition of Groups 1 and Group 2, along with Outlier 1.

5.3.3 Mahalanobis Distance Measurement Testing

Mahalanobis distance measurement was then conducted on the groupings observed in the HCA and bi-plots. The HCA grouped the samples in a chart to demonstrate the elemental relation and differences between the samples. Bi-plots of the Principle Components were also generated which demonstrated the elements weighing most heavily and negatively for groups of elements. Based upon the groupings observed within the HCA and bi-plot, groups were formed and tested for accuracy. Due to the number of samples, only a subset of elements was selected to test the group accuracy. This was due to the limitations of the statistical procedures. For testing accuracy, the number of variables could not surpass the number of samples being verified. Therefore, the elements were chosen based upon the positive or negative weight on Principle Component groups 1, 2, and 3. The results of these tests did not reassign any samples placed into Group 2. Several variations of subgroupings of Group 1 were tested, but the Mahalanobis distance measurements never definitively confirmed a group. This subgrouping of Group 1 may be determinable based upon different elements than have been tested.

5.4 Clay Source Database

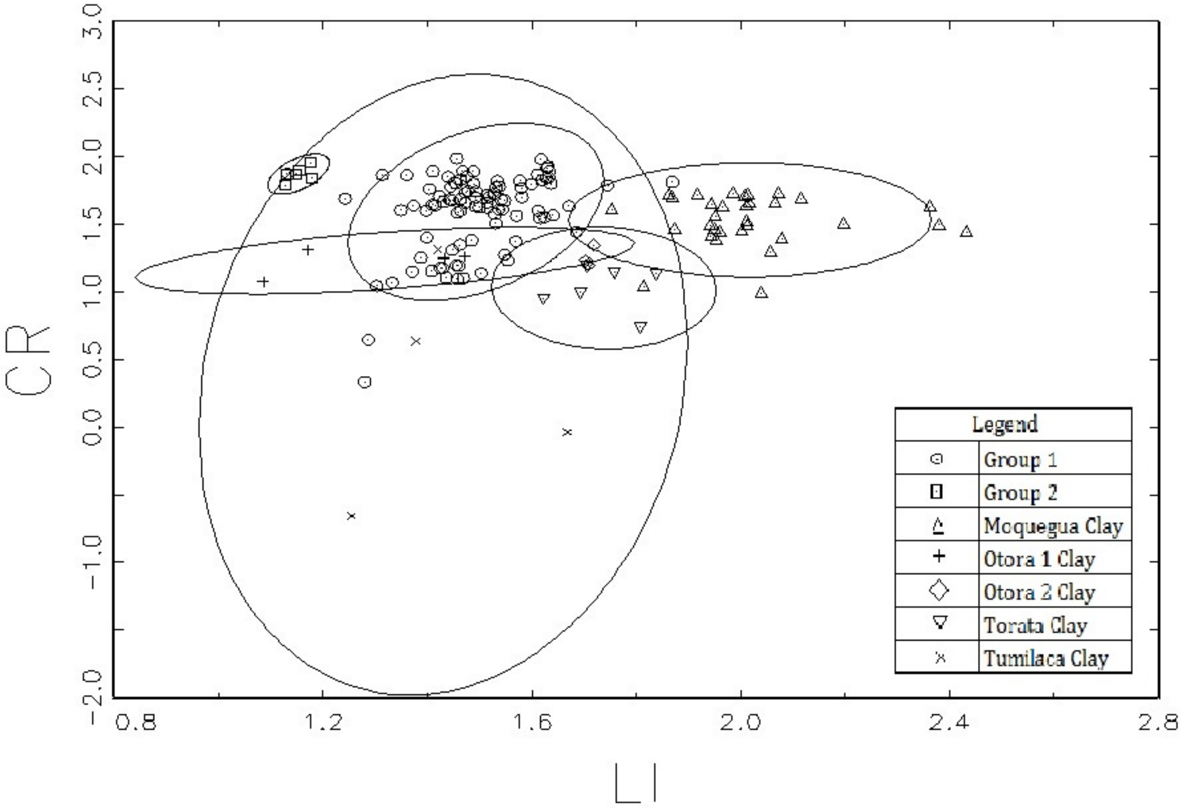


Figure 5.6 LA-ICP-MS Samples and Clay Database Bi-plot

The LA-ICP-MS sample results were then plotted against the Moquegua clay database (Figure 5.6). The comparison of the clay database with the samples from Torata Alta and Sabaya was carried out in order to better understand the differences in production, such as access to different resources or differences in production strategies. Group 1 overlaps with the Otora 1 clay grouping, with some overlap into the Tumilaca, clay group as defined by Sharratt and colleagues (Sharratt, et al. 2009). Group 2 also fell onto the outer edge of Otora 1 clay group. Outlier 1 was also plotted against the Moquegua Valley clay database. On most elemental bi-plots, the outlier fell within the Tumilaca and Otora 1 clay groups. But on bi-plots of Ni, Zn, Nb, Ag, Sn, and Sb, the Outlier 1 was significantly beyond the ellipses of the clay groups.

5.5 XRF and LA-ICP-MS Results Compared

The XRF analyses were able to identify Group 2 from Torata Alta Structure 161 that the LA-ICP-MS also identified. But in the XRF data, Outlier 1 from the LA-ICP-MS results groups much more closely with Group 2 than it does in the LA-ICP-MS results. The difference in the number of measured elements as well as the precision of the technique is likely the reason for the XRF limitations. Outlier 1 was composed of Moquegua Valley clays, but was dramatically different in the case of several elements, which may have been beyond the readable elements for XRF analysis. Because XRF is incapable of distinguishing between the different clay groups, LA-ICP-MS is necessary to make these distinctions.

Comparing the two results validates the use of XRF as a preliminary method analyzing the compositional signature ceramics. However, the heterogeneous character of ceramic composition makes it necessary to utilize a technique that allows for greater detection limits and improved accuracy. LA-ICP-MS provides this increased accuracy and limits of detection that XRF does not.

5.6 Conclusion

The XRF statistical results defined a group of six samples, with one outlier that also grouped fairly close, all of which were from Structure 161. These results were seen in the bi-plots of Factors 1 and 3, along with bi-plots of Strontium and Ytrium, and Strontium and Niobium. Similar results were displayed by the LA-ICP-MS statistical results. Bi-plots of Principle Components 1 and 3 defined Group 1 and 2, along with Outlier 1. Group 2 and Outlier 1 are also samples from Structure 161, while Group 1 is made of samples from both Torata Alta and Sabaya. All of these groups were further reinforced through Mahalanobis distance measurement.

6 Discussion and Conclusions

6.1 Discussion

In chapter 4, I outlined a series of hypotheses. Here, I draw on the data presented in chapter 5 to test those hypotheses, before offering a discussion of the findings.

- It is expected that imported ceramics will be present at Sabaya and Torata Alta because of Moquegua's role in the long distance trade network with the global Spanish Empire as well as producing wine for the Viceroyalty of Peru. No ceramics appear to have been produced from outside of the Moquegua Valley.
- It is expected that ceramic production strategies differed between Torata Alta and Sabaya because of the sites' different functions and occupation histories as a *reducción* and *encomienda*. As displayed by Group 1 of the LA-ICP-MS results, Torata Alta and Sabaya appear to have shared a similar ceramic production strategy.
- Imported ceramics are expected in structures at Torata Alta (Structure 161) and Sabaya that were occupied by Spanish individuals, rather than indigenous individuals, because of their access to markets not available to indigenous Andeans. While Group 2 was not imported, this grouping of ceramics do appear to have been produced using a different production strategy when compared to Group 1.

LA-ICP-MS Group 1 demonstrates similar access to raw materials and goods at both Torata Alta and Sabaya. Torata Alta served as a *reducción* and was therefore occupied by people from across the region. Sabaya served as an administrative center and was likely occupied by Andeans from the highlands. With this in mind, the fact that both sites shared similar production strategies is somewhat of a surprise. As discussed previously, ethnoarchaeological studies demonstrate that modern potters frequently travel to clay sources with which they were familiar or had near-by cultural connections (Arnold 1972; Livingstone-Smith 2000). The populations of the two sites were likely familiar with clays in their regions of origin throughout the Moquegua Valley and the Lake Titicaca basin, but they did not utilize them, which necessitated learning about new, local clay sources.

The possibility of potters who were already living in the region during the late pre-Contact to early Contact periods providing ceramics for the settlements is also worth consideration. While this would likely have required ceramic production on a massive scale, the Spanish did require *mit'a* tribute payment. Ceramic production may have been included in this payment, with the potters also producing ceramics for the local population. Likewise, these potters may have shown the new residents and potters where to access the local clays.

Group 2 ceramics may reflect Spanish privilege within the colonial system. These ceramics were produced locally, using similar clays to those used in the production of Group 1, but are distinctly different in their chemical signature. It is striking that all of the sherds in Group 2 were recovered during excavations in Structure 161, a possible friary near the church. This indicates that religious personnel utilized craft goods produced through a different strategy than the rest of the population at Torata Alta and at Sabaya.

Viceroy Marqués de Cañete (1556-1561), who ruled prior to Toledo, established the right for friars to have access to tributary goods, such as maize and other staple goods (Wernke 2013:190). Ceramics may have fallen within the list of tributary goods, thereby allowing the friars access to ceramics from a variety of sources depending upon where they were serving at the time. These goods may have then moved with them as the friars moved from one community to another.

Other than the fact that religious personnel occupied Structure 161, it is also possible that the occupants were of Spanish descent and that this allowed them access to markets not available to the indigenous population. Spanish occupations throughout the valley, particularly at *bodegas*, are well documented (Rice 2011; Rice and Beck 1993). Ceramic production has been recorded archaeologically at the *bodegas* as well, so there is the possibility that the ceramics originated at one of the numerous *bodegas* (Rice and Beck 1993). Therefore, it is possible that the ceramics were produced elsewhere in the valley and in the process of interacting with other Iberian colonists, the occupants of Structure 161 obtained these ceramics and transported them to Torata Alta.

Similar conclusions can be made regarding Outlier 1 from Structure 161. Its presence in the friary may have been due to a friar's privileged access to goods. However, because this piece is so elementally distinct from the others analyzed in this study, another interpretation may be offered surrounding its production. As discussed previously regarding Early Green Glazed (EGG) wares, it is highly likely that indigenous potters were attempting to replicate Spanish ceramic production techniques (VanValkenburgh, Kelloway, et al. 2015). While little is known regarding elemental composition of Spanish ceramic production in the Andes, it remains a possibility that this outlier represents an attempt at replicating local Spanish ceramic production. This replication of traditional Spanish wares could be a result of the lack of imports available in Moquegua. The peripheral nature of Moquegua may have impeded the importation of goods, thus necessitating the use of locally produced goods by the Spanish, despite frequent trade with larger colonial towns such as Arequipa and Potosí.

The Lupaqa affiliation of some the residents of Torata Alta and Sabaya is also worth considering (Van Buren 1996). Sampled ceramics from Unit 3 at Sabaya are produced in a colonial altiplano style, but as demonstrated in the elemental analyses, the ceramics are produced locally. This demonstrates a conscious attempt by the local potters to imitate either a style that was in high demand, or a style with which they were familiar.

6.2 Future Research

The study of the early Colonial Period in the Andes provides a unique opportunity for examining the interaction of colonizers and the colonized. The interactions between these groups are reflected in the items which were used and produced during that time period. By analyzing these goods, it is possible to better understand these interactions and the influence they had on exchange and production.

One way of further analyzing these interactions is by expanding upon clay database samples. Compiling a broader clay database from other regions would enable the comparison of ceramics which do not align with the Moquegua Clay database. The creation of larger clay databases could potentially allow for the identification of the origin of outliers which occur occasionally in current elemental analysis studies. This would permit the examination of broader cultural interactions which would supplement the current valley specific research already conducted.

Additionally, LA-ICP-MS should be adopted as the preferred method of analytical chemistry. While not portable, and only available at a few facilities, this method demonstrates immense capability in detecting a large array of elements. As discussed in chapter 5, pXRF analysis, when compared to LA-ICP-MS results, is a good starting point but simply cannot match the range of elemental detection offered by the latter. LA-ICP-MS offers a minimally destructive method of acquiring detailed elemental analysis, and for this reason I expect the method to continue growing in popularity among archaeological studies.

Finally, further study of the early Colonial Period is also necessary. Archaeologists largely neglected this time period until recently. This period offers rich data for exploring the rapid impacts of multiple colonial forces on a landscape within a century. Examining these dramatic shifts from one colonial force to another allow for a deeper understanding of how the colonized negotiated the influences of new goods and ideas as they became involved in a rapidly growing world system.

REFERENCES

Arkush, E.

2008 War, Chronology, and Causality in the Titicaca Basin. *Latin American Antiquity* 19(4):339-373.

Arnold, D. E.

1972 Native Pottery Making in Quinua, Peru. *Anthropos* 67(5/6):858-872.

Arnold, D. E., H. Neff and R. L. Bishop

1991 Compositional Analysis and "Sources" of Pottery: An Ethnoarchaeological Approach. *American Anthropologist* 93(1):70-90.

Bartlett, M. L., H. Neff and P. A. McAnany

2000 Differentiation of Clay Resources on a Limestone Plain: the Analysis of Clay Utilization during the Maya Formative at K'axob Belize. *Geoarchaeology* 15(2):95-133.

Bauer, B. S. and A. R. Covey

2002 Processes of State Formation in the Inca Heartland (Cuzco, Peru). *American Anthropologist* 104(3):846-864.

Bauer, B. S., M. Halac-Higashimori and G. E. Cantarutti

2016 *Voices from Vilcabamba: Accounts Chronicling the Fall of the Inca Empire*. University Press of Colorado, Boulder.

Burger, R. L. and M. D. Glascock

2000 Locating the Quispisisa Obsidian Source in the Department of Ayacucho, Peru. *Latin American Antiquity* 11(3):258-268.

Bürgi, P. T.

1993 The Inka Empire's Expansion into the Coastal Sierra Region West of Lake Titicaca, Department of Anthropology, University of Chicago.

Chacaltana Cortez, S.

2014 *Programa de Investigaciones Arqueológicas - Sabaya y Torata Alta en el valley alto de Moquegua*.

Costin, C. L. and M. B. Hagstrum

1995 Standardization, Labor Investment, Skill, and the Organization of Ceramic Production in Late Prehispanic Highland Peru. *American Antiquity* 60(4):619-639.

Craig, N., R. J. Speakman, R. S. Popelka-Filcoff, M. D. Glascock, J. D. Robertson, M. S. Shackley and M. S. Aldenderfer

2007 Comparison of XRF and PXRF for Analysis of Archaeological Obsidian from Southern Peru. *Journal of Archaeological Science* 34:2012-2024.

D'Altroy, T. N.
2002 *The Incas*. Blackwell, Malden.

D'Altroy, T. N. and R. L. Bishop
1990 The Provincial Organization of Inka Ceramic Production. *American Antiquity* 55(1):120-138.

de Preble, M. A.
1997 Presentation. In *Contisuyo: Memories of the Civilizations of the South of Peru*, pp. 15-17. Asociación Contisuyo, Moquegua.

deFrance, S.
1996 Iberian Foodways in the Moquegua and Torata Valleys of Southern Peru. *Historical Archaeology* 30(3):20-48.

DeMarrais, E., L. J. Castillo and T. Earle
1996 Ideology, Materialization, and Power Strategies. *Current Anthropology* 37(1):15-31.

Dorais, M. J., M. Lindblom and C. M. Shriner
2004 Evidence for a Single Clay/Temper Source for the Manufacture of Middle and Late Helladic Aeginetan Pottery from Asine, Greece. *Geoarchaeology* 19(7):657-684.

Dussubieux, L., M. Golitko, P. R. Williams and R. J. Speakman
2007 Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry Analysis Applied to the Characterization of Peruvian Wari Ceramics. In *Archaeological Chemistry: Analytical Techniques and Archaeological Interpretation*, edited by M. D. Glascock, R.J. Speakman, & R.S. Popelka-Filcoff, pp. 349-363. American Chemical Society, Washington, D.C.

Forouzan, F., J. B. Glover, F. Williams and D. Deocampo
2012 Portable XRF Analysis of Zoomorphic Figurines, "Tokens," and Sling Bullets from Chogha Gavaneh, Iran. *Journal of Archaeological Science* 39:3534-3541.

Glascock, M. D.
2008 Archaeometry. In *Encyclopedia of Archaeology*, edited by D. M. Pearsall. Academic Press, New York.

Goldstein, P. S.
2005 *Andean Diaspora: The Tiwanaku Colonies and the Origins of South American Empire*. University Press of Florida, Gainesville.

2013 Tiwanaku and Wari State Expansion: Demographic and Outpost Colonization Compared. In *Visions of Tiwanaku*, edited by A. V. a. C. Stanish, pp. 41-63. Cotsen Institue of Archaeology, Los Angeles.

Golitko, M.

2011 Provenience Investigations of Ceramic and Obsidian Samples Using Laser Ablation Inductively Coupled Plasma Mass Spectrometry and Portable X-Ray Fluorescence. *Fieldiana Anthropology* 42:251-287.

Golitko, M. and J. E. Terrell

2012 Mapping prehistoric social fields on the Sepik coast of Papua New Guinea: ceramic compositional analysis using laser ablation-inductively coupled plasma-mass spectrometry. *Journal of Archaeological Science* 39(12):3568-3580.

Gratuze, B.

1999 Obsidian Characterization by Laser Ablation ICP-MS and its Application to Prehistoric Trade in the Mediterranean and the Near East: Sources and Distribution of Obsidian within the Aegean and Anatolia. *Journal of Archaeological Science* 26:869-881.

Gratuze, B., M. Blet-Lemarquand and J. N. Barrandon

2001 Mass Spectrometry with Laser Sampling: A New Tool to Characterize Archaeological Materials. *Journal of Radioanalytical and Nuclear Chemistry* 247(3):645-656.

Hein, A., H. Mommsen and G. Zender

2004 Pliocene Clays from Aegina (Greece): Reference Material for Chemical Provenance Studies on Bronze Age Pottery from the Island. *Geoarchaeology* 19(6):553-564.

Jamieson, R. W., R. G. V. Hancock, L. A. Beckwith and A. E. Pidruczny

2013 Neutron Activation Analysis of Inca and Colonial Ceraics form Central Highland Ecuador. *Archaeometry* 2(2013):198-213.

Kennett, D. J., A. J. Anderson, M. J. Cruz, G. R. Clark and G. R. Summerhayes

2004 Geochemical Characertization of Lapita Pottery via Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). *Archaeometry* 46(1):35-46.

Kennett, D. J., H. Neff, M. D. Glascock and A. Z. Mason

2001 A Geochemical Revolution: Inductively Coupled Plasma Mass Spectrometry. *The SAA Archaeological Record* 1(1):22-26.

Kuon Cabello, L. E.

1981 *Retazos de la historia de Moquegua* Abril, Lima.

Larsen, C. S.

1994 In the Wake of Columbus: Native Population Biology in the Postcontact Americas. *Yearbook of Physical Anthropology* 37:109-154.

Larson, D. O., S. Sakai and H. Neff
2005 Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS) as a Bulk Chemical Characterization Technique: Comparison of LA-ICP-MS, Digestion-ICP-MS, and INAA Data on Virgin Branch Anasazi Ceramics. In *Laser Ablation-ICP-MS in Archaeological Research*, edited by R. J. Speakman, & H. Neff. University of New Mexico Press, Albuqueque.

Livingstone-Smith, A.
2000 Processing Clay for Pottery in Northern Cameroon: Social and Technical Requirements. *Archaeometry* 42(1):21-42.

Lockhart, J.
1994 *Spanish Peru 1532-1560 A Social History*. 2nd ed. The University of Wisconsin Press, Madison.

Loendorf, C. R., C. M. Fertelmes and B. V. Lewis
2013 Hohokam to Akimel O'odham: Obsidian Acquisition at the Historic Period Sacate Site (GR-909), Gila River Indian Community, Arizona. *American Antiquity* 78(2):266-284.

Mallory-Greenough, L. M. and J. D. Greenough
1998 New Data for Old Pots: Trace-Element Characterization of Ancient Egyptian Pottery Using ICP-MS. *Journal of Archaeological Science* 25:85-97.

Moholy-Nagy, H., J. Meierhoff, M. Golitko and C. Kestle
2013 An Analysis of pXRF Obsidian Source Attributions from Tikal, Guatemala. *Latin American Antiquity* 24(1):72-97.

Moseley, M. E.
2001 *The Incas and their Ancestors: The Archaeology of Peru*. Revised ed. Thames & Hudson, London.

Moseley, M. E., D. J. Nash, P. R. Williams, S. D. deFrance, A. Miranda and M. Ruales
2005 Burning down the Brewery: Establishing and Evacuating an Ancient Imperial Colony at Cerro Baúl, Peru. *Proceedings of the National Academy of Sciences of the United States of America* 102(48):17264-17271.

Nash, D. J.
2001 The Archaeology of Space: Places of Power in the Wari Empire, Anthropology, University of Florida, Unpublished.

Niziolek, L. C.
2011 Ceramic Production and Craft Specialization in the Prehispanic Philippines, A.D. 500 to 1600, Anthropology, University of Illinois at Chicago.

2013 Earthenware Production and Distribution in the Prehispanic Philippine Polity of Tanjay: Results from Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS). *Journal of Archaeological Science* 40(6):2824-2839.

2015 A Compositional Study of a Selection of Song Dynasty Chinese Ceramics from the Java Sea Shipwreck: Results form LA-ICP-MS Analysis. *Journal of Indo-Pacific Archaeology* 35(2015):48-66.

Owen, B. D.
2005 Distant Colonies and Explosive Collapse: The Two Stages of the Tiwanaku Diaspora in the Osmore Drainage. *Latin American Antiquity* 16(1):45-80.

Palumbo, S., M. Golitko, S. Christensen and G. Tietzer
2015 Basalt Source Characterization in the Highlands of Western Panama Using Portable X-Ray Fluorescence (pXRF) Analysis. *Journal of Archaeological Science* 2(2015):61-88.

Peregrine, P.
1991 Some Political Aspects of Craft Specialization. *World Archaeology* 23(1):1-11.

Piscitelli, M., S. C. Cortez, N. Sharratt, M. Golitko and P. R. Williams
2015 Inferring Ceramic Production, Social Interaction, and Political Dynamics in the Moquegua Valley Through Geochemical Analysis. In *Ceramic Analysis in the Andes*, edited by I. Druc, pp. 103-121. Deep University Press, WI.

Pollard, M., C. Batt, B. Stern and S. M. M. Young
2007 *Analytical Chemistry in Archaeology*. Cambridge University Press, Cambridge.

Renfrew, C. and P. Bahn
2008 *Archaeology: Theories, Methods, and Practice*. 5th ed. Thames & Hudson, New York.

Rice, P. M.
2011 *Vintage Moquegua: History, Wine, and Archaeology on a Colonial Peruvian Periphery*. University of Texas Press, Austin.

2012 Torata Alta: An Inka Administrative Center and Spanish Colonial Reduccion in Moquegua, Peru. *Latin American Antiquity* 23(1):3-28.

2013 *Space-Time Perspectives on Early Colonial Moquegua*. University Press of Colorado, Boulder.

2015 *Pottery Analysis: A Sourcebook*. Second ed. The University of Chicago Press, Chicago.

Rice, P. M. and S. L. V. Beck

1993 The Spanish Colonial Kiln Tradition of Moquegua, Peru. *Historical Archaeology* 27(4):65-81.

Rice, P. M. and D. Ruhl

1985 Bodegas de vid de Moquegua: Primera Temporada, Julio-Agosto 1985. *Trabajos Arqueologicos en Moquegua, Peru* 3:177-263.

1989 Archaeological Survey of the Moquegua Bodegas. In *Ecology, Settlement and History in the Osmore Drainage, Peru*, edited by D. S. Rice, C. Stanish, & P.R. Scarr. vol. 1. BAR International Series, UK.

Shackley, M. S.

2010 Is There Reliability and Validity in Portable X-Ray Fluorescence Spectrometry (PXRF)? *The SAA Archaeological Record* 10(5):17-20.

Sharratt, N., M. Golitko and P. R. Williams

2015 Pottery production, regional exchange, and state collapse during the Middle Horizon (A.D.500–1000): LA-ICP-MS analyses of Tiwanaku pottery in the Moquegua Valley, Peru. *Journal of Field Archaeology* 40(4):397-412.

Sharratt, N., M. Golitko, P. R. Williams and L. Dussubieux

2009 Ceramic production during the Middle Horizon: Wari and Tiwanaku clay procurement in the Moquegua Valley, Peru. *Geoarchaeology* 24(6):792-820.

Sinopoli, C. M.

1991 *Approaches in Archaeological Ceramics*. Springer Science+Business Media, New York.

Smith, G. C.

1997 Hispanic, Andean, and African Influences in the Moquegua Valley of Southern Peru. *Historical Archaeology* 31(1):74-83.

Stanish, C.

1985 Post-Tiwanaku Regional Economies in the Otora Valley, Southern Peru, Department of Anthropology, University of Chicago.

Stanish, C., R. L. Burger, L. M. Cipolla, M. D. Glascock and E. Quelima

2002 Evidence for Early Long-Distance Exchange and Watercraft Use from the Southern Lake Titicaca Basin and Peru. *Latin American Antiquity* 13(4):444-454.

Stone-Miller, R.

1993 An Overview of 'Horizon' and 'Horizon Style' in the Study of Ancient American Objects. In *Latin American Horizons: A Symposium at Dumbarton Oaks*, edited by D. S. Rice, pp. 15-39. Dumbarton Oaks, Washington, D.C.

Thomas, W. J., N. W. Bower, J. W. Kantner, M. L. Stoller and D. H. Snow

1992 An X-Ray Fluorescence-Pattern Recognition Analysis of Pottery from an Early Historic Hispanic Settlement near Santa Fe, New Mexico. *Historical Archaeology* 26(2):24-36.

Underhill, A. P.
1991 Pottery Production in Chiefdoms: The Longshan Period in Northern China. *World Archaeology* 23(1):12-27.

Van Buren, M.
1993 Community and Empire in Southern Peru: The Site of Torata Alta Under Spanish Rule, Department of Anthropology, University of Arizona.

1996 Rethinking the Vertical Archipelago: Ethnicity, Exchange, and History in the South Central Andes. *American Anthropologist* 98(2):338-351.

1999 Tarapaya: An Elite Spanish Residence near Colonial Potosí in Comparative Perspective. *Historical Archaeology* 33(2):108-122.

VanValkenburgh, P., S. J. Kelloway, L. Dussubieux, J. Quilter and M. D. Glascock
2015 The Production and Circulation of Indigenous Lead-Glazed Ceramics in Northern Peru During Spanish Colonial Times. *Journal of Archaeological Science* 61:172-185.

VanValkenburgh, P., C. P. Walker and J. O. Sturm
2015 Gradiometer and Ground-penetrating Radar Survey of Two Reducción Settlements in the Zaña Valley, Peru. *Archaeological Prospection* 22(2):117-129.

Vaughn, K. J., L. Dussubieux and P. R. Williams
2011 A pilot compositional analysis of Nasca ceramics from the Kroeber collection. *Journal of Archaeological Science* 38(12):3560-3567.

Wernke, S. A.
2013 *Negotiated Settlements: Andean Communities and Landscapes Under Inka and Spanish Colonialism*. University Press of Florida, Gainesville.

Williams, P. R.
2001 Cerro Baúl: A Wari Center on the Tiwanaku Frontier. *Latin American Antiquity* 12(1):67-83.

Williams, P. R.
2013 Tiwanaku: A Cult of the Masses. In *Visions of Tiwanaku*, edited by A. V. a. C. Stanish, pp. 27-40. Cotsen Institute of Archaeology, Los Angeles.

APPENDICES

Appendix A: List of Samples

Torata Alta

Block	Structure		Level	Specimen Number	Archaeologist	Date	Weight (g)
26	269	3N-1E	2	610.01	PTB	6/27/89	0.5 g
26	269	3N-1E	2	610.02	PTB	6/27/89	0.6 g
26	269	4N-1E	2	619.01	PTB	6/28/89	0.7 g
26	269	4N-1E	2	619.02	PTB	6/28/89	0.4 g
26	269	4N-1E	2	619.03	PTB	6/28/89	0.7 g
26	269	4N-1E	2	619.04	PTB	6/28/89	0.2 g
26	269	4N-1E	2	619.05	PTB	6/28/89	0.3 g
26	269	4N-1E	2	619.06	PTB	6/28/89	0.5 g
26	269	3N-3E	2	640.01	PTB	6/30/89	0.2 g
26	269	3N-3E	2	640.02	PTB	6/30/89	0.4 g
26	269	0N-1E	2	707.01	PTB	7/5/89	0.9 g
26	269	0N-1E	2	707.02	PTB	7/5/89	0.5 g
26	269	0N-1E	2	707.03	PTB	7/5/89	0.8 g
26	269	0N-3E	2	708.01	PTB	7/5/89	0.7 g
26	269	0N-3E	2	708.02	PTB	7/5/89	0.4 g
26	269	0N-3E	2	708.03	PTB	7/5/89	0.4 g
26	269	0N-3E	2	708.04	PTB	7/5/89	0.3 g
26	269	0N-3E	2	708.05	PTB	7/5/89	0.6 g
26	269	0N-3E	2	708.06	PTB	7/5/89	0.8 g
26	269	4N-3E	2	715.01	PTB	7/5/89	0.8 g
26	269	4N-3E	2	715.02	PTB	7/5/89	0.4 g
26	269	4N-3E	2	715.03	PTB	7/5/89	0.4 g
26	269	4N-3E	2	715.04	PTB	7/5/89	0.4 g

26	269	4N-3E	2	715.05	PTB	7/5/89	0.4 g
26	269	4N-3E	2	715.06	PTB	7/5/89	0.5 g
17	161	N7-E0	5	1233.01	MVB	9/4/89	0.3 g
17	161	N7-E0	5	1233.02	MVB	9/4/89	0.5 g
17	161	N7-E0	5	1233.03	MVB	9/4/89	0.4 g
17	161	N7-E0	5	1233.04	MVB	9/4/89	0.6 g
17	161	N7-E2	5	1235.01	MVB	9/4/89	0.7 g
17	161	N7-E2	5	1235.02	MVB	9/4/89	0.9 g
17	161	N7-E2	5	1235.03	MVB	9/4/89	0.4 g
17	161	N7-E2	5	1235.04	MVB	9/4/89	0.5 g
17	161	N7-E2	5	1235.05	MVB	9/4/89	0.7 g
17	161	N7-E2	5	1235.06	MVB	9/4/89	0.5 g
17	161	N7-E2	5	1235.07	MVB	9/4/89	0.5 g
17	161	N7-E2	5	1235.08	MVB	9/4/89	0.3 g
17	161	N7-E2	5	1235.09	MVB	9/4/89	0.4 g
17	161	N7-E2	5	1235.1	MVB	9/4/89	0.2 g
17	161	N7-E2	5	1235.11	MVB	9/4/89	0.4 g
17	161	N5-E0	5	1236.01	MVB	9/4/89	0.9 g
17	161	N5-E0	5	1236.02	MVB	9/4/89	0.5 g
17	161	5N-2E	5	1242.01	MVB	9/5/89	0.7 g
17	161	5N-2E	5	1242.02	MVB	9/5/89	0.6 g
17	161	5N-2E	5	1242.03	MVB	9/5/89	0.6 g
17	161	5N-2E	5	1242.04	MVB	9/5/89	0.4 g
17	161	5N-2E	5	1242.05	MVB	9/5/89	0.4 g
17	161	5N-2E	5	1242.06	MVB	9/5/89	0.4 g
17	161	5N-2E	5	1242.07	MVB	9/5/89	0.5 g
17	161	5N-2E	5	1242.08	MVB	9/5/89	0.2 g

Sabaya

Sector	Capa	Unit	Quad	Level	Art	Feature	Specimen Number	Notes	Archaeologist	Date	Pesa (g)
B	D	3	1				395.01	Group 1	PMHE	27/6/13	0.6 g
B	D	3	1				395.02	Group 1	PMHE	27/6/13	0.9 g
B	D	3	2				397.01	Group 1	PMHE	27/6/13	0.2 g
B	D	3	2				397.02	Group 1	PMHE	27/6/13	0.5 g
B	D	3	4				400.01	Group 2	PMHE	26/6/13	0.5 g
B	D	3	4				400.02	Group 2	PMHE	26/6/13	0.9 g
B	D	3	8				405.01	Group 2	PMHE	26/6/13	0.4 g
B	D	3	8				405.02	Group 2	PMHE	26/6/13	0.7 g
B	D	3	9				406.01	Group 2	PMHE	26/6/13	0.6 g
B	D	3	9				406.02	Group 2	PMHE	26/6/13	1.0 g
B	D	3	13				411.01	Group 9	CNF	19/7/13	0.4 g
B	D	3	13				412.01	Group 10	CNF	19/7/13	0.8 g
B	D	3	13				412.02	Group 10	CNF	19/7/13	0.2 g
B	D	3	14				414.01	Group 6	CNF	19/7/13	0.4 g
B	D	3	14				414.02	Group 6	CNF	19/7/13	0.5 g
B	D	3	14				415.01	Group 7	CNF	19/7/13	0.3 g
B	D	3	14				415.02	Group 7	CNF	19/7/13	0.9 g
B	D	3	14				416.01	Group 8	CNF	19/7/13	0.6 g
B	D	3	14				416.02	Group 8	CNF	19/7/13	0.6 g
B	D	3	15				418.01	Group 3	CNF	19/7/13	0.3 g
B	D	3	15				418.02	Group 3	CNF	19/7/13	1.3 g
B	D	3	15				419.01	Group 4	CNF	19/7/13	0.5 g
B	D	3	15				420.01	Group 5	CNF	19/7/13	0.4 g
B	D	3	15				420.02	Group 5	CNF	19/7/13	0.5 g
B	D	3	15				420.03	Group 5	CNF	19/7/13	0.5 g
E	A	5	9	1	5	5	925.01		EJO	19/7/13	0.1 g
E	A	5	13	3	2	5	926.01		EJO	19/7/13	0.5 g

E	A	5	13	3	2	5	926.02	EJO	19/7/13	0.5 g
E	A	5	13	3	2	5	926.03	EJO	19/7/13	0.6 g
E	A	5	13	3	2	5	926.04	EJO	19/7/13	0.7 g
E	A	5	13	3	2	5	926.05	EJO	19/7/13	0.6 g
E	A	5	13	3	2	5	926.06	EJO	19/7/13	0.4 g
E	A	5	13	3	2	5	926.07	EJO	19/7/13	0.2 g
E	A	5	13	3	2	5	926.08	EJO	19/7/13	0.8 g
E	A	5	13 y 9	3		5	928.01	EJO	22/7/13	0.4 g
E	A	5	13 y 9	3		5	928.02	EJO	22/7/13	0.8 g
E	A	5	13 y 9	3		5	928.03	EJO	22/7/13	0.5 g
E	A	5	13 y 9	3		5	928.04	EJO	22/7/13	0.3 g
E	A	5	13 y 9	3		5	928.05	EJO	22/7/13	0.3 g
E	A	5	13 y 9	3		5	928.06	EJO	22/7/13	0.2 g
E	A	5	13 y 9	3		5	928.07	EJO	22/7/13	0.6 g
E	A	5	13 y 9	3		5	928.08	EJO	22/7/13	0.5 g
E	A	5	13 y 9	3		5	928.09	EJO	22/7/13	0.4 g
E	A	5	13 y 9	3		5	928.1	EJO	22/7/13	1.0 g
E	A	5	13 y 9	3		5	928.11	EJO	22/7/13	0.6 g
E	A	5	13 y 9	3		5	928.12	EJO	22/7/13	0.5 g
E	A	5	13 y 9	3		5	928.13	EJO	22/7/13	0.7 g
E	A	5	13 y 9	3		5	928.14	EJO	22/7/13	0.4 g
E	A	5	13 y 9	3		5	928.15	EJO	22/7/13	0.6 g
E	A	5	13 y 9	3		5	928.16	EJO	22/7/13	0.8 g