THE COLORS OF PRESTIGE: AN ANALYSIS OF THE FORMS, DECORATIONS, AND USES OF INCA STONE VESSELS

by

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ABSTRACT

CYRUS D. BANIKAZEMI. The Colors of Prestige: An Analysis of the Forms, Decorations, and Uses of Inca Stone Vessels. (Under the direction of DR. DENNIS OGBURN)

The ethnohistoric and archaeological record provides ample evidence of the ideological significance of metals and pigments in the pre-Columbian Andean world. This study explores the use of these materials in the complex decorative techniques utilized by the Inca when finishing stone vessels. This research integrates data generated from ethnohistoric sources, portable X-Ray Fluorescent (pXRF) tests, and reconstructive experimentation in order to provide a better understanding of how metals and pigments were used by the Inca to signify the elevated status of certain stone vessels. My objective is to show that the decorative processes implemented in the construction of stone vessels can illuminate how these artifacts were used within Inca society.

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LIST OF ABBREVIATIONS

PXRF	Portable X-Ray Fluorescent spectrometer
LOD	Limit of Detection
SD	Standard Deviation
CV	Coefficient of Variation
ND	Not Decorated
PSO	Possible Surface Treatment Observed
MCS	Multi-colored Stone Material

CHAPTER 1: INTRODUCTION

The quality of Inca craftsmanship has consistently astounded the world. Everything from the workmanship of walls to the weaves of woolen textiles has been the subject of scholarly research for centuries. One technology that has been mostly overlooked is the construction and preparation of ceremonial stone vessels. Although it is well known that the Inca decorated stone vessels with elaborately carved motifs, there seems to be a vacuum regarding how the forms and decoration of these vessels reflect their status and possible usage. This has led many past studies to examine stone vessels strictly as functional goods and has meant that there has been little work focused on what these artifacts represented or their ritual use within Inca society. For this reason, I have examined the decorative techniques used by the Inca when producing stone vessels. In this study, I will examine some of the different forms and decorative techniques that the Inca implemented when producing stone vessels and show how this reflects social status, religious significance, and potential usage.

The first part of this study is intended to provide a little background information on the Inca Empire and to highlight some of the material goods they produced that have been understood to reflect complex ideas of identity and prestige. In this part of the study I intend to provide a broad context for understanding the materiality of prestige and ritual in the Inca world as well as to show how some of these same ideas may be reproduced in stone vessels. This will be followed with an overview of some of the work that has focused on stone vessels, an analysis of some of the symbolic motifs that these goods are often associated with, and an examination of some of the additive decorative materials that are thought to be associated with some stone vessels. These ideas will help form a theoretical backbone for this study that will be continuously revisited.

The next part of this study is dedicated to examining a collection of 30 vessels housed at the Field Museum of Natural History in Chicago, IL. In this section I will first introduce the stone vessels examined in this study and some of the considerations involved with this study. I will then introduce a typology of the studied vessels that will be used for the remainder of this study. This will be followed by a detailed description of how these vessels were studied using portable X-Ray Fluorescence spectrometer (pXRF) analysis as a way to detect for potential elemental concentrations indicative of past surface treatment and will then provide the results of this examination. Finally, I will describe an experiment in which I used a pXRF housed at the University of North Carolina at Greensboro to examine the elemental concentrations of different surface treatments potentially used by the Inca. I do this by measuring the change in key elemental signatures as I apply and remove various surface treatments to basalt stone samples. This is later used as a comparative basis to better understand the readings taken from the vessels at the Field Museum. In sum, I am creating a typology to interpret the studied forms of stone vessels, collecting data relevant to the presence or absence of additive decorative material, and compiling a comparative sample to better interpret how traces of additive decorative materials may be detected post-removal.

The findings of this study will then be considered in the greater context of Inca culture and religion in order to understand how the observed decorative strategies reflect complicated and nuanced ideas of religious practice and prestige. The goal of this study is project is to elucidate how the many styles and decorative strategies displayed in Inca stone vessels can inform the status and use of these vessels will provide illuminating information on the labor invested during the construction of Inca stone vessels and provide a better understanding of how metals and pigments were used by the Inca to signify the elevated status of certain stone vessels.

CHAPTER 2: THE INCA AND THEIR MATERIAL CULTURE

2.1 IDENTITY AND PRESTIGE IN THE INCA WORLD

The Inca Empire, also referred to as *Tawantinsuyu* or "land of the four quarters" by its denizens, reigned from around 1400-1532 C.E. The empire stretched across the Andes mountains and dominated much of the western portion of South America, stretching from its northernmost reaches in Ecuador to its southern boundaries in central Chile (Stanish, 2001). At the navel of the Inca empire was their capital city, Cuzco, which functioned as a ritual epicenter and was home to various buildings of both religious and political significance. While European colonialism ultimately led to the collapse of this state, the efforts of Spanish and indigenous chroniclers has left a wealth of ethnohistoric reports regarding the social, political, and religious practices of the Inca Empire and its people (Murra 1961; Stanish 2001; Bauer and Covey 2002). In conjunction with archaeological findings, these ethnohistoric records can be used to make important inquiries regarding how prestige was materially manifested and displayed. With this in mind, my goal is to illustrate the relationship between high status artifacts and the people that used them by considering how decorative techniques and motifs reflect the function and status of these artifacts. In order to do this, it is first important to examine how status was demonstrated through material objects in the Inca world.

The Inca produced a range of material objects thought to be special, high-value goods intended for elite use. These prestige goods are relevant because they are often culturally imbued with religious, socioeconomic, and/or sociopolitical significance. As Costin notes, items can be interpreted as culturally significant based on: “the rareness and/or inherent value of the materials used to make them, the amount of labor invested in their production, the symbolic meanings of the materials and design motifs, the social identity of the person(s) who manufactured them, and the social identity of the person(s) who distributed or initially used them" (1998: 125). While strict adherence to these criteria may not be useful when examining all types of prestige goods, Costin (1998) uses them effectively to describe how sociopolitical significance is imbedded in cloth.

Textiles serve as a powerful means of understanding Inca material culture and high-status goods because of their strong association with status and ritual throughout Andean history. When discussing Inca textiles, many past scholars have differentiated the quality of these goods with the categories *awasqa* and *qompi* -- *Awasqa* used to refer to textiles made from coarse wools or cotton thread and constructed with a plain weave, and *qompi* used to describe decorated and dyed cloth made from high quality wool or cotton (Costin 1998; Femenías 2017). Although these categories have been criticized for being overly simplistic, these terms can be used here in order to talk about Inca textiles in a general sense (Murra 1962; Cobo 1990 [1653]; Costin 1998; Femenías 2017).

Ethnohistoric and modern observations suggest that while *awasqa* fabrics were used to satisfy various utilitarian functions, *qompi* blankets, shirts, and other garments were treated with a more sacred reverence (Murra 1962; Cobo 1990 [1653]; Costin 1998). *Qompi* goods are thought to have been associated with ritual offerings, used to dress religious totems, and worn by elite members of society, including the ruler of the Inca Empire, known as the Sapa Inca. In addition to this, the production of *qompi* is thought to have been state-controlled, in which the Inca administration carefully recorded the *qompi* tributes from conquered provinces, and then distributed them among political, religious, and military institutions throughout the empire (Murra 1962; Costin 1998). By using Costin's (1998) criteria (stated above), we can see that, unlike *awasqa*, *qompi* textiles were imbued with important sociopolitical significance, and can be viewed as prestige goods. To treat *qompi* as simply a type of prestige good is, however, reductive. As numerous scholars have shown [see: Murra 1962; Cobo 1990 [1653]; Costin 1998; Katterman 2002; Phipps 2010; Femenías 2017], the patterns, colors, and weaves of *qompi* reflect invaluable information regarding the gender, regional identity, and social rank of the person(s) and rites with which the objects are associated. I will show that by examining stone bowls in a similar fashion to how textiles have been studied in the past, it is possible to glean equally rich information from such objects.

Similar to the way that textiles can be used to study sociopolitical identity, we can examine the presentation of prestige by investigating *keros*. The term *kero* refers to a type of tall, wooden drinking vessel with flared walls. These vessels were produced in pairs and are thought to have been primarily used for the ritual consumption of *chicha* (an Andean maize alcohol) throughout Andean prehistory and into the present (Pearlstein et al. 2000; Allen 2002; Kirsop 2013). When studying *keros*, scholars have noticed a wide variance in styles. In the study "Technical Analyses of Painted Inka and Colonial Qeros" (2000), Ellen Pearlstein and others examined over 150 *keros* and found that while a some of these vessels were decorated with vibrant paints, the majority were bare of pigments. Of those that were painted, Pearlstein et al. found that the Inca were using an abundance of pigments that were either dangerous to procure, scarce, or otherwise valuable minerals, such as: cinnabar, realgar, pararealgar, orpiment, cerussite, hydro-cerussite, malachite, brochantite (Peterson et al. 2010; Rapp 2009). Pearlstein et al. goes on to note that, "Earth pigments, i.e., those derived from iron compounds, appear only rarely to form browns" (2000: 99). Considering that earth pigments would have been more accessible, and thus considered less valuable than the pigments Pearlstein et al. most commonly observed, it seems that when the Inca were painting *keros*, they preferred rare pigments that would have reflected status. This means that the act of painting may have operated as a way of not only decorating but also of increasing the perceived value of the *kero*, thus transforming a less formal vessel into a more formal vessel. While it should be stated that all keros, regardless of decoration, would have been highly valued as ritual goods, the use of pigments would have been an important way to add both color and prestige to a good.

2.2 DECORATIVE TECHNIQUES AND SYMBOLISM

The way in which stone was perceived by the ancient Andean people presents a crucial consideration when studying the symbolic significance of Inca stone vessels. While it is undoubtedly true that most stone tools served primarily utilitarian functions and did not possess a greater symbolic meaning, the potential religious significance of a stone artifact is amplified when these goods were fashioned from an uncommon type of stone or was quarried from a religiously noteworthy locale (Ogburn 2004; Dean 2010; Fortin 2015). This is because stone and stone artifacts were capable of being an incredibly important religious and symbolic material to the Inca peoples. As Kevin Vaughn and Nicholas Tripcevich note regarding the pre-Hispanic peoples of the Andes, "The power inherent in material from the earth to simultaneously contain physical presence, social linkages to places where mining occurs, and sacred power derived from an animated landscape brings the materiality of mined substances to foreground in many of these studies" (2013: 9). In this way, stone goods forged a profound connection between the physical and spiritual worlds for the Andean peoples, and thus suggests that some stone vessels may have been considered innately sacred based on the material from which they were constructed (Cobo 1990 [1653]; Garcilaso de la Vega 2006 [1609]; Dean 2010; Bray 2013; Fortin 2015).

One of the most detailed treatments of stone artifacts that I have been able to find comes from Burger and Salazar's work *Machu Picchu: Unveiling the Mystery of the Incas* (2004). While this publication does an exquisite job at detailing the forms, carved iconography, and dimensions of the vessels catalogued, it makes little attempt to distinguish vessel types or interpret how the Inca people used these vessels and, as a result, simplifies the range of artifact types it includes. Despite this perceived lack of nuance, Burger and Salazar (2004) detail a range of stone vessels that encompasses both utilitarian and prestige goods. This work has thus served as an invaluable asset for both developing my typology and understanding how the Inca used these goods.

Burger and Salazar (2004) describe a range of stone vessels, some of which were decorated and some not. Of those that were decorated, a common motif observed was snakes and felines. While it is often difficult, if not impossible, to discern the exact meanings of all iconographic and symbolic depictions, it is necessary to recognize how recurring themes may reflect the culture in which they are found. Thus, here I provide a general overview of the cultural significance of these motifs, which will later be discussed in the specific contexts in which they are found.

Chroniclers such as Father Bernabe Cobo (1990 [1653]), Garcilaso de la Vega (2006 [1609]) and Cristóbal de Molina (2011 [16th cent.) all report the cultural and religious relevance of these animals within the Inca world. In particular, the waving form in which snake motifs are commonly represented throughout Andean cultures has led some scholars to propose that this imagery is in some way representative of the flowing nature of liquid (Allen 2002; Burger and Salazar 2004). This association between snakes and water has also been noted by chroniclers such as Father Barnabe Cobo, who states:

> However, what I think is that by saying that a serpent encircled the whole island, they meant, and it should mean, the water of the island, and on clear days the rays of the sun shimmer on the water is such a way that from the beach the waves seem like painted snakes of various different colors. (1990 [1653]: 98)

This marriage between water and serpent iconography is further exemplified when looking at a type of vessel known as a *paccha*. The word "paccha" translates from Quichuan to "correr el agua" (Joyce 1922: 145) or "running water," and refers to "any vessel designed so that liquid poured in one end circulates through the vessel and flows out an opening at the other end" (Allen 2002: 182). People likely drank from these vessels by pouring a liquid into a bowl-shaped basin that would drain into either a zig-zag or double zig-zag channel running through a "plank" and then be poured into one's mouth (Joyce 1922; Joyce 1924; Allen 2002). Not only are the *pacchas* commonly adorned with snake iconography, but it is possible that the channels themselves resemble and represent the sinuous form in which snake motifs have most commonly been represented throughout Andean culture (Allen 2002).

Like serpents, feline imagery was culturally significant to the peoples of the Inca Empire, and is thought to have been an important symbol of power (Cobo 1990 [1653]; Allen 2002; Burger et al. 2004; Garcilaso de la Vega 2006 [1609]). This symbolic association between felines and power is supported by Garcilaso de la Vega, who states,

"…For this reason they call this entry of the stream and the street the gate of sanctuary while the place where the stream left the city was called 'the lion's tail,' indicating that [Cuzco] was sacred… and a lion in their arms and warfare" (2006 [1609]: 68). Scholars have shown that Cuzco was both the administrative and religious epicenter of the Inca empire and that the city itself was perceived as a symbol of the authority of the Inca empire (Ogburn 2004; Besom 2010). By claiming that Cuzco was "a lion in their arms and warfare," Garcilaso de la Vega is not only describing the city's military and political importance, but he is also inadvertently characterizing the lion as a symbol of these qualities.

In addition to carved motifs, the status and use of stone bowls may be reflected by certain surface treatments, specifically surface treatments involving pigments or metals. The term "pigment" is defined as an insoluble, organic or inorganic, natural or artificial colorant that is suspended in a medium such as natural resin, glue, animal tallow, blood, casein, eggs, urine, oil, wax, or human saliva (Rapp 2009). It is beneficial to differentiate pigments from dyes, as dyes, by definition, are soluble organic colorants that are incapable of imparting color into paints alone, though they can be retained by a pigment in order to produce what is called a 'lake' (Rapp 2009). Over the course of this study, I will focus specifically on "mineral pigments", or inorganic pigments that have been geologically sourced. This is because most mineral pigments are resistant to decay, detectable through pXRF analysis, and were commonly used throughout the Andes. In order to produce a rich range of colors and finishes, the Inca exploited various oxides, hydroxides, and carbonates of copper, iron, and manganese as well as clays and other natural earth substances in order to produce vibrant mineral pigments (Rapp 2009; Peterson 2010; Siracusano 2011; Sepúlveda et al. 2013).

The Inca collected mineral pigments in high volume by maintaining dedicated mining operations. Much like resources that were selected to be used for lapidary or metal production, some pigments were considered a high status good and were specifically targeted for procurement (Rapp 2009; Sepúlveda et al. 2013; Peterson 2013). While pigments were sought out independently of ore, it is important to note that ores and mineral pigments often occur in geologic tandem. For example, the pigments malachite ($CuCO_3 \cdot Cu(OH)_2$) and azurite ($2CuCO_3 \cdot Cu(OH)_2$) were exploited alongside copper ore, and, similarly, cinnabar (HgS) was commonly found in relation to silver ore (Rapp 2009; Cooke et al. 2011; Peterson 2013). Mineral pigments were often used to decorate high status goods and could have been used as means to demonstrate the religious significance of certain goods. This is because of the ability for pigments to bestow color onto a person or object.

Colors are reported to have had important symbolic attachments in the Inca world. Not only would specific colors have been used to represent certain deities, but the use of colors and colored objects may have been a way to direct offerings to particular gods. This is reported by Father Cobo when he describes a ceremony involving animal sacrifice,

> Each one of the Gods was assigned certain of these animals according to color and markings. Brown sheep of the color of guanacos were sacrificed to Viracocha; white ones to the Sun, and of these, the smooth-furred were sacrificed for certain purposes with different ceremonies… In the city of Cuzco, a smooth-furred sheep was sacrificed to the Sun every day. This

> animal was dressed in a red vest before it was burnt. This was the Sun's offering. (1990 [1653]: 113)

Specific pigments of certain colors were likely used for similar religious purposes. If these pigments were used to draw specific connections to deities, it seems likely that treated as an important religious material independently of the goods they were used to decorate.

Not only would pigments have been religiously important, the act of procuring them would have been labor intensive. Ethnohistoric and archaeological findings show that the Inca constructed mines exclusively for the procurement of pigments such as cinnabar (Garcilaso de la Vega 2006[1609]; Suarez 2016). Even with dedicated mines, the availability of some pigments still seem to have been societally limited. Garcilaso de la Vega notes:

> As the Indians became so attached to the color *ichma* (cinnabar)… that they would go to all lengths to get it, the Inca feared they would come to harm in caverns and prohibited its use by the common people, restricting it only to women of the royal bloodline… The pallas (women of royal blood) used no other cosmetics but powered ichma, and that not every day but only occasionally on feast days… The color ichma was used sparingly as I have mentioned in order to spare the vassals the danger of mining. (2006 [1609]: 79)

While aspects of this account are intended to justify the restriction of cinnabar to the elite class, there is likely truth to Garcilaso de la Vega's observation regarding the hazards of mining. This is because of the way that some minerals form in tandem. Even in situations where the intended resource being mined is not toxic itself, the miner may still be risking exposure to other potential geological toxins (Rapp 2009; Peterson 2010). The limited social accessibility of certain pigments is likely due to a combination of factors including: the labor cost involved with general mining, the potential dangers associated with mining toxic pigments, and the general scarcity of minerals of this type (Peterson 2010). Rare and difficult to obtain pigments would have been more accessible to the Inca nobility and are more likely to have been used for elite purposes.

Though metal gilding and painting are two radically different processes, it is conceivable that these two procedures may have been undertaken for similar purposes. This is because of the unique way in which metal was perceived in the Andes. As Heather Lechtman notices:

> Color was the single property of metal, whose achievement and manipulation stimulated the most innovative and sophisticated developments of the technology… In Europe and the Near East the manufacture of bronze and iron tools of war, agricultural tools, and wheeled conveyances provided avenues of utility enabling the metallurgical revolutions of the Bronze and Iron ages. In the Andes, the locus of attention of the metallurgy is not to be found in the realm of utility but in the realm of the symbolic. Thus, Andean metallurgy received its greatest stimulus in the arena dominated by status and political display, and the objects that carried such normative power lay squarely within the aesthetic locus of Andean societies… (1994: 5-6)

What this means is that while the Inca made use of metal for pragmatic purposes, a main driver for metallurgic development was the pursuit of new and unique colors. This close association between metallurgical development and color was also noticed by researchers such as Scott (2011) and Siracusano (2011) who both note the inseparable nature of metallurgic technologies and color production in the Andean world. While metals were a more versatile material, both materials fulfilled a similar symbolic role as both were sought and processed for the purpose of producing meaning through color (Letchmen 1994; Scott 2011; Siracusano 2011).

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Not only were both of these metals and pigments rare or otherwise difficult to obtain, but they were perceived by the Inca as unique materials that were capable of endowing social and religious significance through color. The use of these materials when decorating stone vessels would have not just been a way to make the good more visually striking, but also a way of endowing ritual significance to it in a way that would increase its perceived value and prestige. While it may be difficult to ascertain the exact symbolic associations of this type of expression, we can begin to appreciate this type of expression by examining stone vessels in a holistic manner.

CHAPTER 3: ANALYSIS

3.1 SAMPLE

This research project was designed to examine Inca stone vessels in a holistic manner that encompasses form, decorative motifs, and potential surface treatments achieved through the use of pigments and metals. For this study, I examined a sample of 30 Inca stone vessels housed at the Field Museum of Natural History. All vessels examined in this study are thought to be Inca, however, I did not acquire detailed provenience information regarding any of these vessels. Because of the antiquity of the collection and ambiguities involved with the donation process, it is likely that any existing provenience information regarding these vessels is misleading. This means that it is likely that some of the vessels I am calling Inca in this study may not actually be Inca in origin. While this incertitude may problematize aspects of this analysis, the key ideas this study addresses regarding religious practice and the presentation of prestige are not specific to the Inca and are likely to still apply.

Due to limitations of time and resources, the collection studied does not represent the total collection of stone vessels housed in the museum, but rather a sample that is meant to encapsulate the relationship between stone vessels and decorative strategies. While some of these vessels show visible signs of decoration, such as carved motifs or preserved exterior pigmentation, other vessels seemed more utilitarian in design. The range of vessel types selected is meant to represent a range of forms, ornamentations, and potential uses. Of the artifacts studied, all are thought to have served more than a purely aesthetic function and were likely used to contain things -- either liquids or solids, though specifics are yet to be determined. In this section, I first present a typology to characterize the specific type of stone vessel being analyzed, then evaluated the chemical signatures from the interior and exterior of the selected vessels, as measured through use of pXRF, and finally, compared these signatures with the signatures generated through experimental decorative reconstructions. Throughout this study, I refer to specific vessels by the artifact number assigned by the Field Museum.

3.2 TYPOLOGY

To my knowledge, a detailed typology of Inca stone vessels has yet to be formalized, careful treatment has been given to establishing this typology in order to create a comparative basis with which to examine how vessels may vary based on decorative strategy. The forms of these vessels are characterized based on structural qualities such as size, shape, interior depth, interior surface type, and presence/absence of handles. Based on these criteria, I have defined six distinct types pertinent to this study: Cocha, mini-cocha/cocha-like, handled-bowl, teacup mortar, stationary mortar, and miscellaneous. In addition to form, I have noted the use of exotic, multi-colored stone that may reflect distinctive cultural significance (Table 1).

Of the thirty samples, five vessels have been identified “cochas” (A2246, A3225 A3256, A3271, and A3325). I have identified *cochas* as large, circular vessel with a shallow basin, flat interior surface, a vertical rim and flat bottom. While this vessel type is often accompanied by handles and exterior carved motifs, there is sufficient stylistic variation to assume that these characteristics are not a defining quality. This is most clear when comparing the shapes and styles of the vessels to each other. As seen in Figure 1, these vessels all share the same rudimentary form and approximate size, however, the presence of handles and carved iconography is variable. Of the three vessels that did have handles (A2246, A3271, and A3256), all had two looped handles on opposing sides. Although past researches have referenced these vessels as mortars (Burger and Salazar 2004), their definitive flat interior surfaces and horizontal lip would likely present a surface difficult to use for grinding. Interestingly, A3271 and A3225 are both decorated with carved iconography and are both made from exotic, multi-colored stone. This will be revisited in the discussion section of this paper. It is worth noting that although these vessels appear to be similar to those reported from Machu Pichu by Burger (2004), none of these vessels show any evidence of fracture on the distal surface that might be indicative of a previous mounting or pedestaling.

Two vessels have been identified as “mini-cocha/cocha-like” (A3274 and A3324). As seen in Figure 2, both of these artifacts have the same circular shape, shallow basin, flat interior surface, and flat bottom as the *cochas* examined, but are considerably smaller, measuring less than 15cm in diameter and 7.5cm in height. Neither vessel displayed any carved iconography. Vessel A3324 had two intact looped handles on either side of the vessel, while A3274 had two fracture scars on one side, indicating the past presence of a single looped handle. In addition to only having had a single looped handle, A3274 has an atypical convex exterior surface.

Six vessels have been identified as “handled-bowls” (A3229, A3233, A3238, A3259 A3301, and A3309). These vessels have been defined by: large bodies, bowl-like exterior shape, concave interior surface, and the presence of one or more handle. As displayed in Figure 3, all vessels of this type display some type of exterior surface treatment, either in the form of carved iconography or an additive surface treatment. A

3229, A3233, A3238, and A3301 prominently display feline imagery incorporated into the handles of the vessels. In addition, A3233 and A3238 also display serpents zig-zagging vertically along the base of the bowl. The only vessels to not incorporate any feline iconography were A3259 and A3309, lack carved designs. Instead, A3259 was made from an exotic, multi-colored material and seemed to be finished with a semi-reflective clear coat preserved along the top portion of the vessel. Similarly, A3309 displays signs of a surface treatment on a single spot along the exterior profile of the vessel (Figure 7). This area preserved brownish red, yellow, and black pigments, indicating that the vessel may have had a patterned exterior in the past. The only other vessel to display any visible pigment is A3238, which had the remains of a bright red pigment preserved between the carved serpent imagery.

Nine vessels have been identified as “teacup mortars” (A2211, A3276, A3277, A3294, A3300, A3310, A3328, A3329, and A3346). Vessels of this type are small enough to comfortably fit in one’s palm, have confining concaved interior surfaces, and exhibit signs of post-production grinding and/or pulverizing. As presented in Figure 4, there is some morphologic variation amongst this category. In particular, vessels A2111 and A3328 have straighter exteriors and flat, well-defined distal surfaces that allow the vessels to rest without spilling. The other vessels all displayed a dome shaped exterior with a slight, if not entirely nonexistent, resting surface. Furthermore, of this type, A3328 is the only vessel to have a handle. Given the size and general shape of these mortars, I believe all of them were meant to be held while in use. The reason behind these morphological variations may have to do with the specific type of material each vessel was intended to be used to process or may be the result of regional typological variation.

Many of these vessels seem to have stain marks lingering in their interior bowls, which are assumed to be the remnants of the material processed in these mortars or some type of lubricant used to ease the grinding. In the case of A3294, the stains found were a distinctive blue color, leading me to believe that this vessel may have been used during the production of a valuable pigment, such as azurite. Aside from the handle associated with A3228, none of these vessels have any signs of carved or painted ornamentation.

One vessel, A3278, has been identified as a “semi-stationary mortar”. This vessel is comparatively large bodied, with a disc shaped exterior and a deep concaved interior. The interior shows signs of post-production grinding and pulverizing (Figure 5). Notably, this particular vessel has a hole located in the middle of the interior bowl, which may be the result of aggressive use, a ritual in which the vessel was “killed”, or clumsy excavation, transportation, and/or storage practices. Unlike the teacup mortars discussed above, the stationary mortar is large with a solid flat bottom. Although A3278 was not so big that it could not be easily moved, this vessel would have likely remained stationary when it was in use.

I have categorized seven vessels as miscellaneous type (A3247, A3254, A3289 A3323, A4187, A4157, and A4252). Both A3323 and A4187 are palm-sized shallow disc-shaped tools with no discernable resting surface and only a slight lip to demarcate the interior of the vessel from the mouth. While A4187 has visible staining on the interior, it remains unclear whether these vessels were used in a manner similar to the tea cup mortars, or if they served some other purpose.

Artifacts A3254 and A4252 are interesting as they are both extremely large, roughly rectangular vessels with thick, distinct lips. The interior surface of both vessels is slightly bowled, and there is clear evidence of grinding, pounding and staining. While both vessels are somewhat similar to *batán*s, (a common style of large grind stones used to process foods) the steep, well-defined walls of these vessels are uncharacteristic of most examples seen. This may indicate that these grinding tools are separate from classic *batanes*.

Artifacts A3289, and A4157 are perhaps the most perplexing stone vessels examined in this study. A3289 and A4157 are both rectangular stone vessels with shallow rectangular basins and mostly flat interior surfaces. Interestingly, both vessels have a single notched opening along the top of one of the walls of the vessel that seems to be intentionally designed (Figure 6). A3284, which is particularly well-crafted and finely polished, has this opening along one of the smaller sides of the rectangle while A4157 has this opening along one of the longer side of the rectangle.

3.3 PXRF LAB ANALYSIS

For this portion of the study, I used pXRF spectrometry as a tool for detecting and analyzing the inorganic trace residues left over from decorative surface treatments that may no longer be visible. This tool allows me to circumvent many of the innate limitations and difficulties involved with visual analysis and identification. This is because many of the visual qualities of mineral pigments, such as vividness (the hue of the colorant), hiding power/opacity (a pigment's ability to obscure the covered surface), and permanence/light-fastness (a pigment's resistance to fading from photochemical deterioration) are subject to change based on the type of pigment, the quality of the artifact's initial preservation, and the conditions in which the artifact has been subsequently stored (Rapp, 2009). These factors may also lead a once pigmented artifact to no longer express any visual presence of coloration. This problem closely echoes difficulties when trying to determine if an object was once adorned in metal. By coupling potential optical cues with chemical data, it is possible to more accurately ascertain if an object received any type of surface treatment.

PXRF serves as an efficient and cost-effective tool to use for this mode of analysis. Some of the most notable advantages of using XRF are that it is non-destructive, comparatively inexpensive, relatively quick – gathering reliable results in as few as 1 ½ - 2 minutes – and easy to use, as it requires minimal preparation of both the equipment and samples (Shackley 2011; Shackley 2012). Despite these advantages, there are certain innate limitations to XRF analysis that deserve consideration for this study. PXRF analysis is most accurate when analyzing samples that are >2mm thick and that completely cover the sensor, which is around 10 mm in diameter. This means that the instrument will primarily be reading the chemical composition of the object itself, and not just the potential remnants of any pigments or adorned metals. Additionally, when compared to other tools used for spectral analysis, pXRF is more restricted in terms of the number of elements it is capable of detecting. PXRF's ideal detection range is limited to elements between the range of Titanium (Ti) (atomic number 22) to Tin (Sn) (atomic number 50). PXRF is capable of detecting many elements outside of this range, however, the farther the subject element is removed from this range, the less accurate the results become, and the less capable the instrument is at detecting minute concentrations. This is especially true with lighter elements (Shackley 2011; Shackley 2012).

These weaknesses can be addressed by taking multiple readings of each artifact. For most, I took at least 4 readings, which were taken from the interior bowl, the exterior sides, and the bottom. Additional readings were taken of particularly large vessels and specific areas that expressed visible remnants of pigmentation or staining, and fewer readings were taken from particularly small vessels in which the pXRF could not safely make contact with the interior surface. When studying the results, I primarily focused on relevant elements that can be closely associated with specific pigments, all of which tend to be within or near the instrument's ideal precision detection range. These elements include lead (Pb), mercury (Hg), gold (Au), tin (Sn), silver (Ag), arsenic (As), copper (Cu), iron (Fe), zinc (Zn), calcium (Ca), and sulfur (S). The presence, absence, and combination of these elements across the exteriors of the vessels should be sufficient for indicating the past presence of metals and alloys such as gold, silver, copper, bronze, and *tumbaga* (a copper-silver or copper-gold alloy in which the copper is chemically subtracted from the surface) and pigments such as cinnabar (HgS), realgar (As_4S_4)/ orpiment ($As_2 S_3$), ochers (iron oxide based), sphalorite (ZnS), cerussite (also called white lead ore) ($2PbCO_3 \cdot Pb(OH)_2$), malachite ($Cu_2 (CO_3/OH_2)$), and azurite ($CuCO_3 \cdot Cu(OH)_2$) (see Table 7) (Rapp 2009; Peterson 2010). For the purposes of this study, these elements are evaluated in terms of "concentration spikes," which can be defined as a concentration of an element that is significantly over the "expected average." The expected average is determined based on the comparison of the readings taken from the rest of the vessel and the data gathered during the experimental phase of this study (Alberghina et al. 2012; Roberta et al. 2015). A common point of reference when determining relevant concentration spikes is the bottom of the vessel. Keeping in mind that many pigments would have been considered prestige goods meant to be displayed, the bottoms of most vessels would have been less likely to have been decorated. This means that for most vessels, the bottom should provide a baseline composition of unaltered stone material, allowing for the assessment of how the chemical make-up on the rest of the vessel may have been altered. While this research criteria may be somewhat speculative, it is important to note that the majority of the artifacts selected for this study are carved from igneous stone in which a high concentration the targeted elements would be uncharacteristic. For instance, basalt does not usually contain significant amounts of lead, so unusually high concentration of lead may be used to suggest a lead-based pigment, such as cerussite.

All artifacts examined during this part of the project were analyzed in March of 2017 using a Thermo Scientific Niton XL3t Goldd+ pXRF. The instrument was set to the "Test All - GEO" mode and readings were allowed to cycle for 2 minutes per reading. There was a minimum of three readings taken per vessel with two being taken from opposing sides and one from the bottom. A fourth reading was taken for all cases in which the vessel was large enough to safely fit the muzzle of the pXRF into the interior of the vessel without risking damage. Additional readings were taken of particularly large vessels, or from any spot that seemed discolored, stained, or potentially pigmented. Points selected in this analysis were chosen to avoid any potential modern contamination caused by the application of artifact numbers, or other types of museum treatment.

3.4 PXRF RESULTS

The findings from the pXRF analysis help to shed light on the past presence of surface treatments, particularly in regards to the cocha and handled-bowl type vessels. Of the cocha type vessels, A3325 deserves particular attention. Because of its size, I took a total of five readings of this vessel: two from the interior, one from the bottom, and two from opposing sides. This vessel had no outward indication of previous surface treatment; however, when chemically analyzed, I found elevated levels of silver (Ag) coming from the interior surface. The levels of silver detected from the dead-center of the vessel measure to 18±7ppm, and the silver content detected from a point halfway between the center of the vessel and the rim measure to 92±8ppm. Additionally, Hg concentrations from the interior center (36±9) and from the interior halfway point (90±10) correspond with the concentrations of silver in a way that may be suggestive of a fire gilding process. While these readings may not appear significant in themselves, there were no detectable levels of silver from the readings taken on the outside of the vessel (Table 2). These exterior readings suggest that silver is not an innate component of the stone, which implies that the readings of silver detected from the interior surface of this vessel are in some way deviant, suggesting silver had been formerly applied to the surface. While the silver levels found on the interior may initially be interpreted as somewhat low, these numbers will be later reexamined in the discussion section of this paper.

Of the vessels studied, A3238 shows the most distinct chemical indicators of past surface treatment. Five readings were taken from this vessel, one from the interior, one from the bottom, two from opposing sides, and one targeting a distinctive patch of red staining thought to be the result of a surface treatment. When looking at the results from the area of red staining, I observed a mercury (Hg) concentration of 5095±57ppm and a sulfur level of (55124± 533ppm). By comparing the observed color of the staining to these high levels of mercury and sulfur, I have concluded that this staining is the result of a cinnabar (HgS) based surface treatment. As seen in Table 3, these readings are especially high when reviewing the readings taken from the other concentrations on the artifact, which did not show any discernable levels of mercury anywhere except for one reading taken from the side of the vessel, measuring to 157±12ppm. Despite this area showing no visible mercury characteristics, this elevated reading likely shows that this area was pigmented in the past. Considering the expected geochemistry of the stone as indicated by the readings taken from the interior and bottom of this vessel, both which showed no detectable levels of mercury, this relatively small concentration of mercury suggests that this region of the vessel was previously pigmented with cinnabar and this surface treatment has been subsequently eroded. In addition to mercury and sulfur levels, it is worth examining iron levels, which could indicate the presence of a red ochre, one of the most popular red colorants used in the Andean world (Rapp, 2009). Based on the geochemistry displayed, however, we see that iron levels are consistent throughout the vessel and are in fact lowest in the pigmented spot (Table 3). This suggests that iron is likely innate to the vessel, and that the red material found on this vessel is not a red ochre.

Like A3238, I have identified A3309 as a ‘handled-bowl’ type vessel. A total of five readings were taken from this vessel: one from the interior, one from the bottom, two from opposing sides, and one targeting a distinctive patch of reddish brown, yellow, and black thought to be the results of a painted design. Based on the visual characteristics of the painted section, I expected a high presence of iron (Fe), which would be indicative of ochre mineral pigments (Rapp 2009; Petersen 2010). After comparing the levels of iron in the painted area to the concentration of iron found on different parts of the vessel, however, I found that iron content within the painted area (79201±631) was within one standard deviation of the mean iron content of the vessel (80570), and thus cannot be considered statistically meaningful. Because the area that was painted was relatively small with multiple types of preserved pigment, the reading taken might represent an assemblage of pigment types rather than an isolated pigment, making it difficult to identify the pigments at this time. While I am currently unable to definitively identify the types of pigments used to decorate this vessel, it is worth noting that the painted area showed particularly high signs of lead (2622.04±42ppm), copper (1058± 38ppm), and arsenic (959± 36ppm) and notable levels of mercury (57±10) and silver (41±5). As exhibited on Table 4, these concentrations are considerably higher than those detected from anywhere else on the vessel. This may suggest a combination of the pigments realgar and cerussite.

After looking at the total collection, I observed an important theme regarding the concentrations of arsenic and lead across the entire collection. When looking at the total collection, I found that the bottoms of vessels tended to express higher levels of arsenic and lead than the sides and interiors of the same vessels. When looking at the bottoms of the vessels, 11 vessels showed extremely high concentrations of arsenic and 14 expressed high levels of lead. As shown on Table 8, most vessels that expressed high levels of lead also expressed a high level of arsenic, and a minority of these artifacts are "Teacup Mortar" type vessels despite this being the largest typological category. With these observations in mind, it seems likely that these readings represent a common storage condition rather than a consistent treatment involved with the production of these goods.

In her 1996 study, Lisa Goldberg found that the Smithsonian Institute's National Museum of Natural History used a combination of arsenical and mercuric compounds to treat their collections for pests during the mid-19^{th} century. It is possible that spikes in arsenic on the bottoms of many of these vessels may be the result of a similar practice. This is because vessels that have been sitting in collections for long enough may have ended up inadvertently absorbing the residual compounds used as pesticides that were left to accumulate on the shelves. This would also explain why the smaller teacup mortars were less likely to adopt these chemical profiles, as these goods would have generally been stored in drawers rather than left out on shelves. In a similar way, the detected levels of lead on the bottoms of these vessels may be the result of these vessels having sat on shelves that had been treated with lead-based paint.

3.5 EXPERIMENTAL STUDY

The intention of this aspect of the study is to gain a better understanding of what techniques the Inca may have implemented when decorating stone vessels and how these decorations would display chemically on the treated surface after the decorative material is removed. This is important, as many types of surface treatments may not preserve well due to natural erosional processes, the decay of pigments caused by light, or the intentional stripping of valuable metallic surface treatments by the Spanish or looters. This experiment was not to reconstruct all surface treatments employed by the Inca, but rather a small selection of some of the suspected treatments found over the course of this study. This can be considered a preliminary experiment that is intended to give me a general idea of how some surface treatments may chemically express post-removal.

To do this, I used 9 untreated, smoothed basalt stones to serve as proxies for Inca stone vessels. Basalt was specifically selected for this experiment due to its well-documented use throughout Andean pre-history for building material, and for making grindstones, mortars, and bowls (Rapp 2009; Peterson 2010). Basalt was not only a commonly used material in the Inca world, but is also cheap and accessible today, making it an ideal fit for this study. Basalt is also a fine grained volcanic stone, and the material within a stone is usually chemically homogeneous, which means all pXRF readings to should be fairly consistent throughout the stone and not have anomalies that could skew my results.

After the basalt samples were procured, they were gently sanded, and each was marked with a sample number (E1-E9). Once the samples were prepared, each was weighted on a 0.01g scale, and readings were then taken using an INNOV-X Model Delta Dynamic XRF DC-4000. Samples E2-E5 were marked with a line running down the middle and divided into side A and side B. Sample E1 was left blank over the course of the study in order to serve as a standard and detect for potential environmental contamination that might result from the preparation of the other samples. Four paints were then made, three were made by mixing pulverized cinnabar pigment with whipped egg whites, and one paint was made by mixing the cinnabar with pig blood. The three paints produced with egg whites were mixed to produce a light paint (1:10 emulsion), a medium paint (2:10 emulsion), and a heavy paint (3:10 emulsion). The paint made with pig blood was mixed using most of the remaining cinnabar pigment, resulting in a ratio of 1:4.

Samples E6 and E7 were both treated with multi-purpose gold leaf sheets. E6 was meant to reproduce a leafing technique, while E7 was meant to replicate a foiling technique. To achieve this, E6 was treated with alternating applications of egg whites and gold leaf sheets for a total of five layers of gold leaf sheet. For sample E7, I first heated the stone with a butane torch for about 1 minute, then applied a single gold leaf sheet, heated the sample again, and repeated the process until five gold leaf sheets had been applied. This proved to be more difficult than expected as the force of the butane torch was enough to displace the thin layers of gold leaf. This resulted in a dime-sized hole to erupt on the left side of the gold foiled surface. Despite this, gold layered on the right side of the sample seemed to have melded with the surface of the stone, which allowed for readings to be taken from the foiled surface. This can be seen in Figure 7.

Sample E8 was treated with unprocessed pig blood in order to examine how the metallics naturally present in blood may influence the interpretation of sample E5. The inclusion of sample E9 was not initially planned, but after the discovery of the inclusion of 10 sample sheets of silver leaf in the purchased gold leaf packet, I decided to prepare an additional sample. Because this sample was not initially planned, I did not have prepared basalt stone of the same source used for samples E1-E8. Instead, I used a similar type of basalt stone but of a different brand that I had purchased during a failed pilot of this experiment. During the failed trial, the stone that would become sample E9 was used as a standard, so it had not been subjected to any previous surface treatment. It should be noted that because E9 is a different brand of stone, it exhibits unique characteristics and will thus be treated separately when calculating the average weights and chemical composition between the stones. I treated this stone with the same techniques I implemented with sample E7, in which I heated the stone with a butane torch, applied a single layer of silver sheet, heated the silver sheet, and repeated until 5 layers of silver sheet had been applied. The types of treatments associated with each sample and the relevant readings are presented in Table 6.

After surface treatment, all samples were then left to dry and/or settle for three and a half hours. Once the samples appeared completely dry, they were all weighed, and then a second coat was applied to the B side of samples E2-E5. All samples were then left to dry and/or settle for an additional three and a half hours and then all were weighed again. Then I took additional pXRF readings of each sample and sample side (when applicable) in order to measure the chemistry of the surface treatments. Once readings were completed, I abraded the surface of each sample with course sandpaper for approximately 30 seconds. After this, I measured the final weights of the samples, and took pXRF readings of each sample and sample side.

3.6 EXPERIMENTAL RESULTS

The data from this experiment reveals a number of key insights. First, by measuring the changes in weight, it is possible to gain an understanding of how uniform the application and removal processes were. Samples E2-E8 had an average weight of 218.75g (sd=3.64) with a coefficient of variation (CV) 1.66%. After both coats applied had dried, the average weight of the stones increased to 219.00g (sd=3.57g) with a CV of 1.63%. This indicates that all surface treatments added an average of 0.25g (sd=0.076g) with a CV of 29.68%. After the removal process, the average weight of the stones was reduced to 218.761 (sd=3.63g) with a CV of 1.66%, which indicates an average drop in weight of 0.24g (sd=0.072g) with a CV of 30.00%.

By first comparing the CV calculated based on the weight of the stones before application (1.63%), after application (1.63%), and post-removal (1.66%), and then examining the CV calculated based on the weight of the material gained (29.68%) to the amount lost (30.00%), it is possible to make two observations. First, it is clear that the average weight of the stones was minimally affected by the addition of surface treatments, implying that the surface treatment applied did not dominate the basalt sample. Second, and more importantly, these statistics suggest that amount of surface treatment added is statistically comparable to the amount removed. This is to say that while not all of the material added was removed, the amount removed was substantial.

After looking at the pXRF readings, the first thing I found is that all tested surface treatments appear to obstruct measurements of the underlying stone. I have concluded this after looking at the general trend of how rates of iron fluctuate across all samples during the experimental process. Before any surface treatment, iron was detected in an average concentration of 24146ppm (sd= 4070ppm) with a CV of 17%. After a surface treatment was applied, the average concentration of iron dropped to 11081ppm (sd=4508ppm) with a CV of 41%. Finally, when examining the samples after the materials were removed, I have found that the iron rates raise back to 23675ppm (sd=4220ppm) with a CV of 18%. What this shows is that the average rate of detected iron and titanium across all samples prior to surface treatment are more than halved once decorated; however, once the decorated surface is removed, the average rates return to close to those detected prior to the decorating process. These findings were particularly surprising when considering sample E5 and E8, both of which were treated with the pig's blood binder. I had expected that the iron content of the blood itself would drastically increase the iron levels detected in the samples. Instead, what I found was that both E5 and E8 presented within a single standard deviation of the average for the dataset. While these numbers suggest that the decorated surface is shielding the host stone surface, it is important to note that the high CV value for the iron values show that there is considerable variability in how much each specific treatment actually masks the surface. This is significant as it addresses one of the considerations going into this study. As stated above, pXRF is most accurate with samples that are >2mm thick (Shackly 2011). While this is certainly true, there was an initial concern that a pXRF may primarily read the geochemistry of the host material, and not truly reflect elemental concentrations resulting from any surface treatment. What this data shows, however, is that when present, these surface patinas produced in this experiment were substantial enough to cause noticeable alterations to the detected elemental signatures.

Another finding that directly addresses the concerns involved with this study is that all the surface treatments tested for during the experiment left detectable elemental traces post-removal. The choice to use cinnabar, gold, and silver surface treatments for this experiment is due to the fact that each of these materials do not naturally occur in significant concentrations in basalt (along with being known to have been used by the Incas for decorating other items). For this reason, I will focus specifically on mercury, silver, and gold signatures. When looking at the readings taken from the bare stone samples, the mercury contents detected in the stone were negligible, with the highest mercury content detected amongst all samples being 8±3ppm. After the application of the cinnabar emulsions, there are not only discernable concentrations of Hg, but as seen on Table 6, these concentrations echo specific preparation styles. Measurements taken from these same vessels once the materials were removed showed clear evidence of the past presence of mercury, with the lowest reading coming from E2 Side B which showed a mercury concentration of 608±9ppm. Curiously, the highest mercury reading from the post-removal dataset also came from E2 Side A (2277±20). As seen on the post-removal section of Table 6, readings taken from the post-removal phase show a much more complicated relationship, and do not mirror the preparation patterns of the samples.

When looking at the samples treated with metallic sheet, I observed a similar trend to those treated with the cinnabar egg white emulsion, in which there was virtually no silver or gold detected prior to application, a substantial increase while decorated, and a marked decrease post-removal. Despite the steep decrease observed in the post-removal phase, there were still discernable metallic concentrations among all three samples. As displayed on Table 6, when looking at samples E6 and E7, sample E6 displayed higher concentrations of gold during both the decoration phase, and in the post-removal phase. This seems to imply that the leafing technique implemented was more successful in producing a firm bond with the host basalt stone than the foiling technique. Admittedly, this may not be an accurate reflection of the difference between how these techniques produce chemical imprints in their host material but may instead reflect my own ineptness in gold gilding. Regardless, the data produced by this experiment indicates that stone materials are capable of retaining metal and pigment surface treatments in a quantity that can be detected by pXRF after these materials have been stripped.

One important consideration that needs to be addressed is the manner in which the surface treatments were removed. The mechanical abrasion I used to remove the surface treatment on the samples does not accurately represent any natural erosional process that may affect archaeological samples. While this treatment may resemble the reckless manner in which precious goods were stripped from stone materials by the Spanish invaders, they would have likely scrapped gold and silver materials of a surface rather than ground it way. This is of concern when considering that while grinding the surface treatments off the material, I may have inadvertently been working the materials into the surface of the stone by pushing and grinding the samples with the sandpaper. Future studies may benefit by avoiding this technique.

CHAPTER 4: DISCUSSION

As stated previously, a central issue I hope to remedy is that there has been an unfortunate lack of work dedicated to stone vessels in the past. As such, the goal of this project is to elucidate how the many styles and decorative strategies displayed in Inca stone vessels can inform the status and use of these vessels. In this section, I will first review the main points to be taken from the typology, pXRF lab analysis, and the experimental study. After this, I will show how the findings from these three sections relate to one another and enrich our understanding of Inca stone vessels. Finally, I will analyze what these findings say about the status of these goods and how this helps inform our understanding of how these artifacts were used by the Inca peoples.

The purpose of the typology I have established over the course of this study is meant to expand the way we view stone vessels. As explained above, past studies have treated stone vessels as mortars designed for utility and neglected the possibility that these were ritually significant goods imbued with religious significance. This is not to imply that ritual goods and utility goods are mutually exclusive categories but meant to show that we can greatly expand our understanding of these goods by considering their social significance. This is most clear when examining the structural differences between *cochas*, teacup mortars, and handled-bowls.

As discussed above, the most unique features of cocha-style vessels are their large circular bodies, horizontal lips, and shallow, flat interior basins. These qualities would likely make it difficult to grind and extract materials, especially considering that not all vessels of this style include handles. This is not the case for teacup mortars, whose generally deep, concave interior would have produced an ideal surface for pulverizing and grinding. Considering the presence of interior stains and the lack of exterior decorations, it seems clear that this vessel type was likely valued as a utility good. Handled-bowls, however, seem to fill the gap between *cochas* and teacup mortars, as they were highly stylized, implying they were meant to be exhibited, and included an interior surface that could be used for processing and/or serving. In this way, these three types of goods express a range of prestige and use.

The inferences I have made about these vessels by examining their form are supported by the findings of the pXRF lab analysis. Of note are vessels A3325 and A3238. A3325 is significant as it is the only cocha-style vessel included in this study that chemically expressed any indication of previous surface treatment. This vessel exhibited silver in the center of the interior of the vessel and from the periphery of the interior of the vessel. While the levels of silver detected were relatively low, there were no detectable traces of silver anywhere on the exterior of the vessel, implying that these readings are not reflective of the innate geochemistry of the stone material. Furthermore, mercury concentrations from the interior of the vessel seem to be elevated when compared to the readings taken from the bottom and side of the vessel. The combination of silver and mercury readings suggest that the interior of this vessel may have been once been fire gilded with silver foil (Oddy et al. 2012). It seems likely that this vessel was decorated with silver rather than used as a surface to work silver when considering that working metal is a generally rough process that would likely affect the entirety of the vessel and leave distinctive visible signs of pounding, grinding, and shaping metal (Grossman 1972; Temme 1994). Furthermore, this utilitarian interpretation of this vessel does not explain the presence of mercury detected in the sample.

While three of the handled-bowls exhibited direct or indirect evidence of a surface treatment, A3238 was the only one in which it was possible to directly identify the pigment. As discussed above, by comparing the levels of mercury to iron, it seems clear that the red pigment observed on the surface of this vessel was cinnabar and not a red ochre, or a cinnabar and red ochre blend (see Table 3). Both the archaeological record and ethnohistoric reports show that cinnabar was a particularly valuable pigment in the Inca world with limited social accessibility (Cobo 1990 [1653]; Siracusano 2005; Garcilaso de la Vega 2006 [1609]; Rapp 2009; Peterson 2010; Suarez 2016). Additionally, the color red is reported by chroniclers such as Cobo (1990 [1653]) to have important religious significance. This indicates that while this vessel could have been - and likely was - used for practical purposes, it was also a religiously significant good that was presumably used in a specific, deliberate way that involved ceremony.

Another substantial finding from this portion of the project is that elevated levels of arsenic and lead concentrated on the bottoms of the vessels. These findings are particularly interesting because they show evidence for modern contamination stemming from past preservation treatments. While these practices have long since abandoned, this shows that this treatment of collections has left a lasting chemical imprint on the stone vessels, and that people working with such vessels should take precautions when handling these items.

While the pXRF lab results provided key insights into the decorative materials and strategies associated with these vessels, the experimental study allows for a comparative basis so that these readings can be properly understood. The most important finding from the experimental study was that all surface treatments tested for displayed discernable elemental signatures. What this tells us is that pXRF is not only capable of detecting surface treatments after they have been either forcibly removed or naturally eroded, but that in some cases, it is capable of identifying specific types of surface treatments.

After reviewing the form and decorative styles observed in this collection, I propose that *cochas* were most likely used as a ritual basin for holding water and/or other liquids. This interpretation is supported by the recurrent serpent iconography found on both the cocha-style vessels I studied and those documented by Burger and Salazar (2004). As stated previously, past scholars and ethnohistorians noted the symbolic association between serpents and water made by the past Andean peoples. It has been well-documented that water was a symbolically significant good which was often incorporated into administrative and ritual displays (Cobo 1990 [1653]; Glowacki and Malpass 2003; Bray; 2013). Considering the ritual significance of water, it seems likely that there would have been specific objects meant to hold, display, and/or serve water. The diversity in types of rituals that could have necessitated the use of water bearing *cochas* may explain the assorted decorative styles seen in these vessels. Since the use and offering of water was fairly common in the Andean world, certain designs, material, and decorative styles may have been a way to specifically associate a given *cocha* with a specific ceremony.

Regardless of whether one accepts this particular interpretation of cocha-style vessels, there is still a lot to be said about the way highly decorated stone vessels can and should be treated within the archaeological record. As previously stated, careful examinations of high status goods such as textiles and ceremonial drinking vessels have offered valuable insights into ideas of gender, regional identity, and social rank in the Andean world. Much in the same way, the evidence here shows that stone vessels are symbolically saturated with many of the same types of cultural significance but are still yet to be thoroughly deciphered.

Over the course of my study, I have observed that many of the elaborate and decorated styles of vessel were made from a variety of vibrant, multi-colored stone materials. These same vessels are also often finely crafted and carved with elaborate iconographic motifs. Those that were made from less vivid materials were occasionally decorated with rare, socially restricted materials such as cinnabar and other unidentified pigments. This set of qualities all suggest that these goods were meant to be presented, appreciated, and revered as spectacular goods. The lionization of these goods is evident when considering on the additional measures implemented for presenting these goods.

Over the course of this study, I have found that of the 30 items sampled 2 displayed demonstrable evidence of the use of pigment(s) and 1 showed evidence of metal. Both vessel A3238 and A3309 had pigment(s) added to their exterior surfaces which means it would have been visible to those viewing these goods from a distance, as well as to those directly engaged with potential ritual processions. This would have not only been a way of amplifying the perceived value of these goods, but possibly a way of associating these goods with specific rites or deities. Vessel A3325 was the only good examined that showed evidence for the past presence of metal, which is suggested by two pXRF readings taken from the interior surface of the good that showed characteristically high levels of silver. Based on the form, associated motifs, and pXRF readings, it seems like this vessel and possibly other vessels of this type were somehow associated with water and likely used in a ritualistic way. While highly stylized stone vessels would likely have been valued in and of themselves, the extra considerations exhibited through the use of additive decorative materials shows that these goods played a substantial role in pre-Hispanic Andean culture.

CHAPTER 5: CONCLUSION

The goal of this project has been to expand the way we perceive and treat stone vessels in the archaeological record. While it has been suggested that *cochas* and handled-bowls were used as mortars, there is a clear and significant distinction to be made based on whether a vessel was intended to be displayed. This is to say that while stone vessels were likely valued for their durability and functionality, the careful way that some of these goods were prepared shows that these items were more than just utilitarian – they were precious ritual goods intended to signal prestige. The labor investment and artisanship required to source, carve, and polish vessels like cochas and handled-bowls indicates that these goods would have likely played a special role in Inca society. Decorating these goods even further by bedecking them with metals and pigments would amplified the prestige of these goods because of the inherent value of these goods and their ability to impart symbolic significance. While the exact concepts that these goods were meant to portray may be difficult to ascertain, the more work done dedicated to expanding and elaborating our understanding of both pigments and stone vessels will indefinitely lead to a better understanding of Inca ritual and religion.

The more work dedicated to understanding how stone vessels were being produced and how the materials used to finish these goods were sourced and processed could lead to important insights into Inca daily life and culture. This is because prestige goods represent more than just the final product, but a constituent of tasks required to produce pieces intended for reverence. Stone vessels are a unique and rich source of information that can be studied in a multitude of fashions, including iconographic depictions, material sourcing and preference, and surface treatments. By better understanding what these details signify, we can better understand how these qualities were meant to transmit complex notions of identity and prestige.

Throughout this study, I have shown substantial results in regards to how these vessel were produced, there is still a considerable amount of research that could elucidate how this artifact type may have been used and perceived in the past. The typology I have established is only meant to be a foothold in a much larger frame of the type of stone vessels that were produced by the Inca. Furthermore, there is considerable information that may be garnered through ethnographic research dedicated to how similar vessels may be used by peoples living today. By expanding our vocabulary, repertoire, and understanding of stone vessels, we can gain a more nuanced understanding of the past peoples of the Andes.

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APPENDIX A: TABLES

Table 1: Artifacts by type and decoration

Artifacts by Type and Decoration		
Artifact #	**Type**	**Decoration**
A2246	Cocha	Carved
A3271	Cocha	Carved/MCS
A3225	Cocha	Carved/MCS
A3256	Cocha	ND
A3325	Cocha	Silver?
A3324	Mini/Cocha Like	ND
A3274	Mini-Cocha Like	ND
A3309	Handled-Bowl	Painted
A3301	Handled-Bowl	Carved
A3238	Handled-Bowl	Carved/Cinn.
A3233	Handled-Bowl	Carved
A3229	Handled-Bowl	Carved
A3259	Handled-Bowl	PSO/MCS
A3310	Teacup Mortar	ND
A3294	Teacup Mortar	ND
A3328	Teacup Mortar	ND
A3329	Teacup Mortar	ND
A3346	Teacup Mortar	ND
A3300	Teacup Mortar	ND
A2211	Teacup Mortar	ND
A3276	Teacup Mortar	ND
A3277	Teacup Mortar	ND
A3278	Stationary Mortar	ND
A3247	Misc.	ND
A3289	Misc.	ND
A4157	Misc.	ND
A4252	Misc.	ND
A3254	Misc.	ND
A4187	Misc.	ND
A3323	Misc.	ND

Table 2: Relevant pXRF readings for vessel A3325

A3325						
Location	Ag	Ag Error	Au	Au Error	Hg	Hg Error
Bottom	<LOD	8.57	<LOD	7.87	15.43	7.93
Side	<LOD	8.32	<LOD	7.91	<LOD	11.88
Inside C2	92.32	8.44	<LOD	8.57	89.7	10.24
Inside C1	18.26	6.5	<LOD	8.26	36.33	8.82

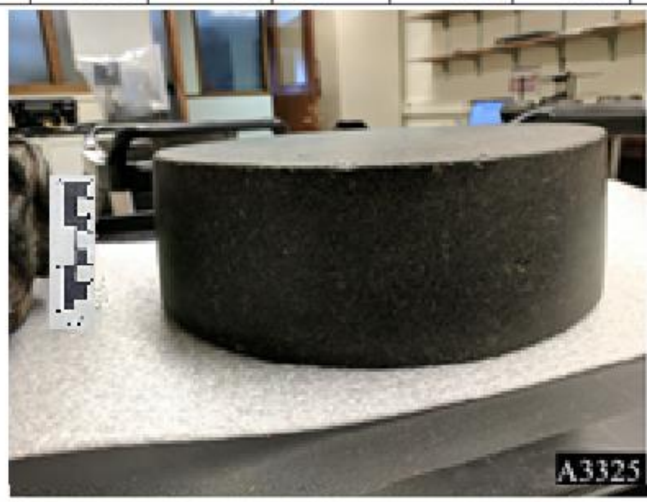

Table 3: Relevant pXRF readings for vessel A3238.

A3238						
Location	Hg	Hg Error	S	S Error	Fe	Fe Error
Inside	<LOD	11.9	16861.8	272.2	75281.7	616.69
Red Pigment	5094.8	57.33	55124.1	532.82	70992.2	627.41
Side	156.99	11.72	6242.55	158.32	85372.8	648.02
Backside	<LOD	12.17	5347.08	157.16	83204.9	677.08
Bottom	<LOD	12.44	9729.11	191.79	81015.5	675.92

Table 4: Relevant pXRF readings for vessel A3309

A3309						
Location	Cu	Cu Error	As	As Error	Pb	Pb Error
Paint	1058.36	37.77	958.77	36.26	2622.04	42.31
Bottom	77.83	19.33	32.12	7.74	87.09	9.3
Side	167.61	21.41	566.8	31.64	2008.62	38.14
Reverse Side	92.01	18.78	17.47	5.24	28.07	6.15
Inside	70.58	20.32	25.65	8.11	66.64	8.13

Table 5: Relevant pXRF readings for vessel A3259

A3259						
Loc	Ca	Ca Error	Al	Al Error	Hg	Hg Error
Insi	2195.8	69.37	27572.59	1106.6	<LOD	10.27
Stai	14178.25	401.68	3513.12	519.49	<LOD	9.75
Side	2530.94	78.73	38196.17	1163.49	<LOD	8.79
Bac	3197.58	105.55	44643.99	1368.54	9.84	6.45
Bott	4156.76	93.13	52150.94	1358.24	<LOD	8.58

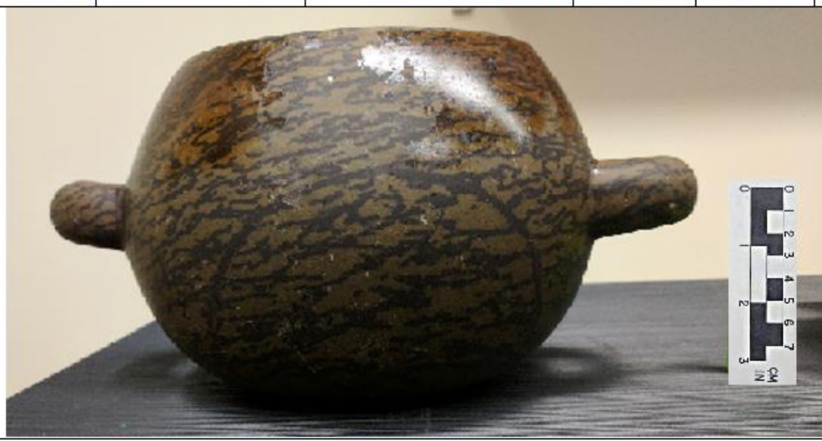

Table 6: Experimental Treatments and Readings

Prior to Treatment									
Samples	Treatment	Hg	Hg Error	Au	Au Error	Ag	Ag Error	Fe	Fe Error
E1	None	3	2	5	2	8	6	22720	146
E2	None	4	2	2	2	2	6	22464	145
E3	None	0	2	2	2	3	6	19356	129
E4	None	<LOD	2	<LOD	2	1	6	25407	161
E5	None	1	3	<LOD	2	16	6	31320	197
E6	None	3	3	4	2	3	6	22422	146
E7	None	8	3	0	2	<LOD	6	21064	136
E8	None	0	3	1	2	4	6	26987	171
E9	None	7	3	0	2	6	6	22869	145
While Treated									
Samples	Treatment	Hg	Hg Error	Au	Au Error	Ag	Ag Error	Fe	Fe Error
E1	None	2	2	0	2	6	6	21376	138
E2(A)	Light Coat (Single)	51754	394	<LOD	46	20	8	11561	122
E2(B)	Light Coat (Doub)	122842	1296	<LOD	101	39	12	5949	113
E3(A)	Med. Coat (Single)	73091	626	<LOD	63	22	10	13553	156
E3(B)	Med. Coat (Doub)	102725	1011	<LOD	85	115	12	12252	168
E4(A)	Heav Coat (Single)	180974	2250	<LOD	141	65	15	7644	157
E4(B)	Heav Coat (Doub)	338936	5818	<LOD	259	130	22	4933	176
E5(A)	Blood Coat (Single)	66366	548	<LOD	57	15	9	14351	157
E5(B)	Blood Coat (Doub)	260468	3874	<LOD	201	85	18	5456	156
E6	Gold Leaf (Egg)	<LOD	71	37751	280	481	10	11909	120
E7	Gold Foil (Heat)	<LOD	32	11301	76	149	7	18381	134
E8	Plain Blood	2	2	5	2	-1	6	15905	106
E9	Silver Foil (Heat)	<LOD	3	77	4	5390	28	5119	45
Post-Removal									
Samples	Treatment	Hg	Hg Error	Au	Au Error	Ag	Ag Error	Fe	Fe Error
E1	None	13	3	<LOD	2	9	6	21454	139
E2(A)	Light Coat (Single)	2277	20	<LOD	7	0	6	18553	124
E2(B)	Light Coat (Doub)	608	9	<LOD	4	7	6	20599	134

E3(A)	Med. Coat (Single)	2089	19	<LOD	7	<LOD	6	20814	137
E3(B)	Med. Coat (Doub)	1658	17	<LOD	6	<LOD	6	25778	167
E4(A)	Heav Coat (Single)	801	11	<LOD	5	11	6	21946	144
E4(B)	Heav Coat (Doub)	1772	17	<LOD	7	13	6	24632	159
E5(A)	Blood Coat (Single)	974	12	<LOD	5	5	6	31851	200
E5(B)	Blood Coat (Doub)	9819	67	<LOD	16	1	6	30542	204
E6	Gold Leaf (Egg)	<LOD	8	640	10	<LOD	6	22333	147
E7	Gold Foil (Heat)	11	3	28	3	9	6	20646	135
E8	Plain Blood	20	3	1	2	<LOD	6	22727	145
E9	Silver Foil (Heat)	93	4	55	4	61	6	20163	129

Table 7: Pigments of Interest

Pigments	**Associated Color(s)**	**Chemical Makeup**	**Elements of Interest**
Azurite	Light Blue to Blue	$(CuCO_3 \cdot Cu(OH)_2)$	Cu
Cerussite	White, Red, Black	$(2PbCO_3 \cdot Pb(OH)_2)$	Pb
Cinnabar	Red	(HgS)	Hg
Malachite	Various Greens and Blue Greens	$(Cu_2 (CO_3/OH_2))$	Cu
Ochre	Reds, Yellows, and Browns	Various Iron Oxides	Fe
Orpiment	Lemon Yellow to Orange Yellow	$(As_2 S_3)$	As
Realgar	Yellow to Orange Yellow	(As_4S_4)	As
Sphalorite	Various Whites and Greys	(ZnS)	Zn

Table 8: Arsenic and Lead Readings

Artifact	Type	Location	As Readings	As Error	Pb Readings	Pb Error
A2246	Cocha	Bottom	662.71	33.91	2538.86	41.22
		Backside	87.43	12.61	310.09	14.67
		Side	237.87	21.9	550.73	20.97
		Inside (C2)	11.66	4.45	19.62	5.36
		Inside (C1)	9.24	4.24	19.83	5.2
A3225	Cocha	Bottom	Not Applicable		56.33	6.45
		Backside			35.11	5.38
		Side			24.76	4.54
		Inside (C1)			25.4	5.48
		Inside (C2)			49	6.3
A3274	Mini-cocha	Bottom	193.74	18.63	653.07	21.35
		Side	21.84	7.52	54.29	7.7
		Inside	0	11.28	18.45	7.9
A3259	Handled Bowl	Bottom	59.21	7.87	170.04	9.44
		Stain	9.68	4.07	22.4	4.95
		Backside	14.1	4.37	27.65	5.23
		Side	11.05	4	25.81	4.85
		Inside	12.67	4.57	27.93	5.49
A3233	Handled Bowl	Bottom	295.65	23.23	1166.4	27.86
		Backside	15.23	4.89	32.51	5.91
		Side	17.35	5.16	35.74	6.18
		Inside	13.81	7.23	38.86	7.46
A3238	Handled Bowl	Bottom	95.37	13.49	334.72	15.67
		Backside	13.86	5.01	24.34	6.02
		Side	16.07	4.97	27.54	5.89
		Inside	40.25	8.29	123.61	9.74
A3278	Stationary Mortar	Bottom	33.18	8.28	119.78	9.98
		Side	14.96	4.95	34.29	5.98
		Inside	16.89	6.14	23.54	6.16
A3300	Teacup Mortar	Bottom	Not Applicable		116.64	8.05
		Backside			50.55	5.67
		Side			65.45	6.34
A3324	Teacup Mortar	Bottom	Not Applicable		89.82	8.98
		Backside			21.87	5.89
		Side			55.26	7.52

A3294	Teacup Mortar	Bottom	40.74	6.3	92.84	7.6
		Backside	17.16	4.02	22.63	4.57
		Side	14.59	4.07	23.95	4.76
A3277	Teacup Mortar	Bottom	39.76	8.51	146.99	10.32
		Backside	12.12	4.8	27.53	5.89
		Side	16.3	5.73	52.3	7.08
A2211	Teacup Mortar	Bottom	203.89	31.01	Not Applicable	
		Backside	0	34.78		
		Side	0	25.05		
A4187	Misc.	Bottom	Not Applicable		58.2	7.41
		Top			21.35	6.39
A4252	Misc.	Bottom	51.83	8.46	105.76	9.49
		Backside	25.98	7.53	44.66	7.52
		Side	18.47	6.09	19.84	6.08
		Inside	11.07	6.9	18.17	7.11
A3323	Misc.	Bottom	261.23	20.46	888.67	24.06
		Top	50.17	12.88	168.82	12.85

APPENDIX B: FIGURES

Figure 1: Cocha-Style Vessels

Figure 2: Mini Cocha Style Vessels

Figure 3: Handled-Bowl Style Vessels

Figure 4: Teacup Mortars

Figure 5: Stationary Mortar

Figure 6: Miscellaneous

Figure 7: A3309 Paint Remains

Figure 8: Experimental Samples with Treatments

APPENDIX C: PXRF DATA

Sample	LOCATION	Ti	Ti Error	V	V Error	Cr	Cr Error	Mn	Mn Error	Fe	Fe Error	Co	Co Error	Ni	Ni Error	Cu	Cu Error	Zn	Zn Error	As	As Error
A3274	Bottom	17033	236	370	58	<LOD	30	2165	120	95640.3	762.6	<LOD	310	52	31.4	34	17.4	272.7	17.5	193.7	18.6
A3274	Side	13548	215	473	81	141	37	2023	123	101778	780.2	<LOD	223	<LOD	51.1	52.6	18	265.5	18.1	21.84	7.52
A3274	Inside	10962	193	115	19	69.8	34	1486	149	81425.3	854.8	<LOD	3E+05	<LOD	###	<LOD	3E+05	234.5	23.3	<LOD	11.3
A4252	Bottom	10225	183	252	48	296	25	1401	104	97919	756.6	<LOD	310	257	35	79.4	18.8	153.2	13.8	51.83	8.46
A4252	Backside	9220.9	179	359	71	451	39	1212	111	102498	806.9	<LOD	311	255	41.7	120	21.5	150.6	15.1	25.98	7.53
A4252	Side	8157.2	142	236	44	391	37	1521	115	94906.2	741.5	<LOD	3E+05	157	38.5	78.5	19.5	146.8	14.6	18.47	6.09
A4252	Inside	4497.9	74.6	138	23	120	12	1019	128	73738.4	735.6	<LOD	3E+05	<LOD	71.4	50.3	24.9	131.9	17.2	11.07	6.9
A4157	Bottom	11150	195	259	47	161	36	2299	121	89842.1	728.9	<LOD	299	65	31.8	34.8	17.5	133.7	13.3	8.13	4.59
A4157	Backside	9276.9	156	231	47	169	35	2131	115	95503.6	733.1	<LOD	299	59	30.3	90.8	18.5	149.5	13.5	22.24	5.22
A4157	Side	10197	183	220	36	159	36	2217	135	92675.3	764.8	<LOD	3E+05	<LOD	###	99.9	21.9	136.5	15.1	47.49	7.89
A4157	Inside	6540.8	118	194	36	194	33	1889	127	82336.1	690.2	<LOD	3E+05	<LOD	###	<LOD	27.1	142	14.7	16.29	6.11
A3289	Bottom	4416.5	85.1	126	27	120	14	369.9	59.3	24218.3	305	132	82.3	70	24.9	28	13.6	77.07	9.67	13.19	5.05
A3289	Backside	4188.9	84	136	27	109	14	510.7	59.8	25672.6	295.4	139	79.7	59	23.2	33.2	13	44.92	7.96	11.84	3.99
A3289	Side	4037.2	77.4	119	25	97.5	13	435.8	57.7	20829.8	266.9	<LOD	107	<LOD	33.6	49.3	13.5	45.57	7.98	11.28	4.09
A3289	Inside	4200.2	81	120	26	106	14	361	55.2	23717.9	281.9	<LOD	113	44	22.7	47.9	13.4	85.78	9.41	21.76	4.58
A3232	Bottom	4660.3	111	341	38	160	28	167.7	60.6	69155.6	538.7	273	152	<LOD	38.9	29.5	14.4	15.16	7.34	82.06	8.59
A3232	Backside	5209.8	89.6	206	29	107	20	88.92	52.1	30768.1	346.2	<LOD	142	<LOD	36.6	37.5	14.2	20.73	7.45	42.78	5.75
A3232	Side	7759.8	80.4	152	24	<LOD	15	<LOD	60	1665.35	63.02	<LOD	42.7	<LOD	30.1	22.4	11.5	19.75	6.42	25.55	4.46
A3232	Inside	5108.3	85.7	171	27	91.3	21	136.8	55.9	33870.9	376.7	<LOD	155	<LOD	39.1	36.5	15.2	112	11.7	54.18	7.87
A3225	Bottom	3328	71.7	118	24	97.1	17	89.6	46.5	18077.6	250	110	67.8	<LOD	33.4	45	13.2	39.49	7.73	35.86	5.77
A3225	Backside	6240.7	106	219	34	134	20	85.58	46.7	29904.7	311.2	152	85.1	<LOD	32.7	28.6	12.2	18.42	6.59	36.16	5.08
A3225	Side	4591.5	65.8	142	21	60.4	12	103.8	41.3	922.41	48.89	<LOD	35.6	<LOD	29.6	23.2	11	15.68	5.99	20.19	4.08
A3225	Inside (C2)	3647.6	89	225	30	135	23	91.93	55.8	53982.7	475.9	<LOD	196	<LOD	37.9	26	14.1	16.06	7.25	30.03	5.16
A3225	Inside (C1)	3714.1	88.9	163	30	139	23	181.1	54	40203.6	381.8	<LOD	156	<LOD	35.5	38	13.7	26.57	7.39	41.04	5.84
A3271	Bottom	2692	81.4	129	27	142	25	478.4	64.3	48242.1	434.3	<LOD	177	58	25.3	49	14.6	115.2	11	21.67	4.74
A3271	Backside	3315.7	92.8	132	31	103	25	515.5	67.3	47630.9	442.6	199	121	86	26.4	52.8	15	150.9	12.4	25.74	5.7
A3271	Side	3288.9	88.9	144	30	123	23	365.3	62	37740.6	391.9	<LOD	159	98	26.1	156	18	134.4	12	11.1	4.27
A3271	Inside (C2)	2980.1	82.3	121	27	104	23	430.4	63.6	37648.4	391.6	187	106	<LOD	37.7	128	17.2	107.1	11.1	12.13	4.51
A3271	Inside (C1)	2903.3	79	129	26	123	24	457.3	60.1	38085.6	364	202	99.5	46	23.7	118	15.8	104.4	10.2	14.48	4.33
A3259	Bottom	3782.9	77.8	108	26	95.5	16	139.8	44.2	5668.41	108.2	<LOD	64.5	47	20.9	28.4	11.8	376.8	15.8	59.21	7.87
A3259	Stain	2310.8	49.9	82.6	16	157	19	135.4	49.3	23181.4	288.8	121	77.7	<LOD	36.1	24.4	13.9	64.09	8.98	9.68	4.07
A3259	Backside	4172.6	84.8	156	28	147	22	141.8	50.9	34475.8	351	243	95.8	52	24.1	52.3	14.1	79.35	9.39	14.1	4.37
A3259	Side	3527.9	64.5	107	21	136	18	111.6	45.1	15188.4	221.8	<LOD	88.8	<LOD	32.7	56	13.4	60.04	8.25	11.05	4
A3259	Inside	2404.1	54	75.7	18	147	21	158.1	53.4	28726.8	335.9	209	91.4	<LOD	38.2	22.2	14.6	68.27	9.56	12.67	4.57
A3233	Bottom	7342.3	154	204	48	396	29	1227	96.7	83918.3	668.6	<LOD	277	410	36.3	89.6	18.5	218.2	15.4	295.7	23.2
A3233	Backside	5833.1	142	245	54	573	33	1165	89.1	80196.8	612.6	<LOD	251	354	32.7	63	16.1	149.2	12.5	15.23	4.89
A3233	Side	6021	141	203	56	612	32	1130	90.6	84595.8	644.4	<LOD	265	434	34.9	124	18.5	127.7	12.1	17.35	5.16
A3233	Inside	2417	64.5	87.9	21	213	15	858.5	111	79032.5	693.6	<LOD	3E+05	375	48.1	77.1	22.9	170.1	16.8	13.81	7.23
A3309	Bottom	9742.3	176	219	54	498	30	1366	106	84926.6	708.6	<LOD	295	386	38.1	77.8	19.3	733.5	27.5	32.12	7.74

A3309	Paint	7093.2	151	213	47	255	27	1041	91.9	79201	630.9	<LOD	272	330	35	1058	37.8	130.1	13.6	958.8	36.3
A3309	Backside	6494.3	156	258	58	374	36	1582	109	95876	738.3	474	211	432	38.4	168	21.4	189.3	15.3	566.8	31.6
A3309	Side	7867.6	144	174	44	432	27	1109	95.2	75251.9	636	<LOD	263	316	35.1	92	18.8	112	12.4	17.47	5.24
A3309	Inside	4468.3	89.9	115	28	202	16	731.1	104	67593.9	599	<LOD	3E+05	160	40.4	70.6	20.3	203.6	16.6	25.65	8.11
A3301	Bottom	7504.4	136	250	56	368	31	1037	85.4	72801.4	577.9	<LOD	238	277	31.7	108	17.8	118.2	11.6	12.43	4.85
A3301	Backside	11594	186	275	56	429	30	1009	86.6	79951.2	615	271	170	332	33	110	17.8	131.7	12.2	10.06	4.3
A3301	Side	7175.8	155	214	48	404	34	1177	93	83482.6	645.9	<LOD	269	322	33.6	386	25.1	119.2	12.3	13.34	4.89
A3301	Inside	5876.4	106	149	32	349	20	697.2	99.4	77414.9	633.9	<LOD	3E+05	209	39.9	83.3	20	132.8	14.2	10.96	6.06
A3238	Bottom	10491	176	216	53	356	29	1025	95.7	81015.5	675.9	<LOD	281	396	37.4	87.7	19.2	156.9	14.2	95.37	13.5
A3238	Red Pig	6121.9	118	214	37	317	22	991.3	93.1	70992.2	627.4	320	172	282	36.1	85.3	19.9	442.1	23.4	125.6	15.4
A3238	Backside	9967.6	164	215	49	365	27	1143	96.8	83204.9	677.1	<LOD	280	352	36	56.2	17.7	135.2	13.2	13.86	5.01
A3238	Side	9512.7	171	286	53	529	32	1114	91	85372.8	648	<LOD	267	417	34.7	77.1	17.2	127	12.3	16.07	4.97
A3238	Inside	5787.4	112	148	34	245	20	736.7	82.5	75281.7	616.7	<LOD	255	272	34	99	19	148.3	13.3	40.25	8.29
A3254	Bottom	12977	212	322	62	340	28	1132	97.7	94324.8	730	<LOD	300	324	35.5	147	20.6	382.9	19.7	34.68	7.96
A3254	Side	11677	205	202	33	179	17	613.8	108	78133.4	717.1	<LOD	3E+05	86	43.4	96.9	23.7	213.9	18.6	22.82	7.98
A3254	Inside (C2)	10560	181	285	48	397	36	570.9	80.9	92620.4	706.1	396	193	286	34.3	189	21.1	249	16	21.49	6.73
A3254	Inside (C1)	15783	221	329	58	308	25	601.2	85.9	96474.9	744.4	681	209	257	35.6	133	20.4	247.3	16.6	29.08	7.59
A3256	Bottom	5581.1	141	111	45	343	31	1123	94.4	68205.5	600.2	303	167	249	33.9	58.5	17.7	2308	46	22.95	6.42
A3256	Backside	4178.1	93.1	187	52	219	18	969.3	105	78567.3	642.7	<LOD	3E+05	243	40.5	61	19.3	113.8	13.5	13.41	5.54
A3256	Side	7432.9	134	176	41	317	23	985.7	89.4	77659.5	628.8	<LOD	260	282	34	36	16.9	115.8	12.1	10.38	4.39
A3256	Inside (C2)	7852.5	147	244	63	392	26	1169	90.6	74680.6	602.1	323	165	307	33.1	85.9	17.6	137.9	12.6	16.24	5.77
A3256	Inside (C1)	6213.9	179	182	60	408	28	1008	94	79666.5	665	367	184	313	35.6	103	19.3	186	14.9	24.49	6.48
A2246	Bottom	7134.8	147	268	59	434	34	1183	94.3	78559.4	622.3	<LOD	267	322	34.6	98.5	18.6	242.3	16.1	662.7	33.9
A2246	Backside	5299.6	124	249	58	466	27	1113	94.2	76174.7	648.6	297	175	271	34.3	51.9	17.5	131.9	13	87.43	12.6
A2246	Side	2491.2	60.2	71.7	19	126	12	771.7	114	56053.2	576.8	<LOD	3E+05	99	43.6	42	22.1	129.3	15.7	237.9	21.9
A2246	Inside (C2)	7834.5	138	193	42	277	32	991.6	86.4	78093.1	614	314	170	293	33	45.7	16.4	148	12.8	11.66	4.45
A2246	Inside (C1)	8213.6	137	178	41	281	23	1012	83.5	65651.3	541.4	<LOD	222	215	30.5	53.5	16.1	116.8	11.6	9.24	4.24
A3325	Bottom	7259	146	257	60	408	28	1284	94.7	87930.8	657.4	<LOD	274	527	37.1	103	18.5	195.3	14.2	8.22	3.74
A3325	Side	4710	128	285	53	510	37	1154	94	96048.2	699.8	374	197	403	35.7	62.7	17.3	342	18	8.67	4.94
A3325	Inside (C2)	7486.7	142	288	61	517	29	1080	92	88146.9	663.7	<LOD	277	416	35.8	126	19.3	296.2	17	19.92	6.46
A3325	Inside (C1)	6982.6	133	247	60	445	26	1058	91.8	85839.7	660.3	<LOD	275	335	34.8	78.8	18.2	200.1	14.7	11.53	4.64
A4227	Bottom	11107	154	208	46	177	27	694.8	73	53870.3	476.2	313	131	97	27.1	92.6	16.3	155	12.6	148.1	14.9
A4227	Side	12165	182	321	57	239	25	719.4	87.9	80512.1	685.1	474	190	117	32.1	98.2	18.8	123.1	13.2	157	16.3
A4227	Side	14560	193	443	56	566	28	631.4	79.2	59175.9	541.3	437	149	117	29.8	70.3	16.9	140.3	13	39	8.42
A3323	Bottom	18561	242	392	76	192	35	687.8	81.8	77369	624.5	353	176	156	31.1	92.8	17.9	598.8	23.5	261.2	20.5
A3323	Inside	12779	195	143	25	83.1	11	276.5	101	66161.6	655	<LOD	219	<LOD	###	77.9	24.6	288	21.7	50.17	12.9
A4187	Bottom	6375.1	120	172	37	121	26	828.3	79.4	45581.3	457.7	202	125	83	27.9	61.8	16.1	95.71	11.2	19.35	6.06
A4187	Inside	2365.2	51.6	81	17	30.2	8.7	532.8	106	35703.8	419.6	<LOD	3E+05	<LOD	###	71.8	21.2	94.99	13.7	19.79	6.55
A4181	Bottom	8561.3	152	258	47	286	33	1783	108	75467.4	636.1	<LOD	261	73	29.6	63	17.1	166.6	14.1	33.05	7.56
A4181	Backside	9634.5	167	304	51	232	33	1885	108	73600	623.4	369	171	98	30	76.9	17.3	163	13.8	11.22	4.99
A4181	Side	8252.9	149	273	46	229	31	1530	95.3	65428.3	554	<LOD	225	111	28.4	81.2	16.7	132	12.3	14.05	4.82
A4181	Inside	302.84	14.4	18.1	5	52.2	4	576.9	182	30451.5	631.7	<LOD	249	<LOD	###	78.1	51.1	62.19	25.2	<LOD	15.1
A3247	Bottom	10646	182	375	56	155	35	623.9	83.3	87707.7	700.2	400	195	92	31.2	84.6	18.2	334.7	18.8	13.7	5.29

A3247	Backside	12294	199	294	49	174	35	533	76.6	82206.7	641.3	337	178	<LOD	43.4	93.6	18.1	322.5	17.7	21.64	5.45
A3247	Side	10061	170	264	37	157	32	334.6	88	81581.7	663.7	<LOD	3E+05	<LOD	###	59.2	19	358.2	20.5	18.73	6.95
A3247	Inside	1677.1	31	67	9.9	43.3	5	<LOD	3E+05	58218.4	796	<LOD	3E+05	<LOD	###	<LOD	3E+05	235.7	27.5	<LOD	###
A3229	Side	6786.2	167	202	63	525	34	1259	102	87401.7	703.1	<LOD	293	505	39	70	18.5	108	12.4	8.38	4.15
A3229	Inside	4143.1	105	199	58	374	23	1056	93	76926.4	637.4	<LOD	261	333	35.6	36.9	17.6	94.24	11.6	<LOD	5.53
A3229	Bottom	7448.7	170	171	53	475	32	1173	92.8	83504.4	645	<LOD	268	462	36	76.9	17.5	238.6	15.5	7.55	4.07
A3278	Side	8126.8	145	230	45	273	24	1034	84.9	70611.5	569.9	<LOD	233	271	31.5	106	17.7	114.6	11.6	14.96	4.95
A3278	Inside	5451.6	110	167	34	290	21	905.3	104	80937.8	653.1	<LOD	3E+05	256	40.5	55.7	19.1	122.2	13.8	16.89	6.14
A3278	Bottom	9592.6	177	241	55	374	29	1149	96.8	79855	663.6	<LOD	273	295	34.5	65.1	17.7	187.4	14.9	33.18	8.28
A3324	Backside	9195.5	148	224	44	314	24	1000	94	71799.6	639.8	<LOD	261	259	35	97.8	19.6	81.22	11.5	12.6	4.94
A3324	Side	8595.8	146	247	44	411	26	831	88.2	76022.7	644.4	<LOD	264	274	34.7	101	19.4	100.6	12.1	19.63	6.21
A3324	Bottom	10506	196	314	65	388	32	1282	99.4	84585.7	689.8	<LOD	279	314	34.7	99.1	18.7	472.9	21.6	38.9	7.65
A3294	Backside	3043.5	61.4	51	20	59.5	15	142.2	44.4	5065.2	103.1	<LOD	62.6	71	21.5	19.7	11.4	18.51	6.38	17.16	4.02
A3294	Side	2922.7	62.1	72.1	20	62.9	12	149.4	46.7	15375.9	222.8	<LOD	89.4	59	22.1	32	12.3	31.14	7.13	14.59	4.07
A3294	Bottom	2784.6	61.1	77.7	20	40.7	12	168.3	45.8	4479.46	98.68	<LOD	60.9	59	21.5	58.5	12.8	33.17	7.12	40.74	6.3
A3277	Backside	5407.7	122	217	39	<LOD	30	1858	103	62680.9	547.7	<LOD	219	126	28.6	45.3	15.7	102.5	11.3	12.12	4.8
A3277	Side	3335.7	96.2	180	33	101	27	1489	94.6	54253.6	504.2	208	137	91	28	60.1	16	107.1	11.6	16.3	5.73
A3277	Bottom	3854.3	102	185	34	120	26	1650	97.4	52371.5	488.7	<LOD	197	86	27.4	52.5	15.6	132.2	12.3	39.76	8.51
A3276	Backside	513.31	39.1	32.7	19	<LOD	21	84.02	38.7	1655.08	59.08	<LOD	39.4	<LOD	28	107	13	26.84	6.35	82.62	10.7
A3276	Side	463.07	39.6	<LOD	27	20.6	13	108.9	39.1	1567.01	57.31	<LOD	36.9	<LOD	27.6	257	16.5	27.11	6.47	72.29	10.9
A3276	Bottom	713.56	36.5	42.4	17	27.8	14	107.6	40.6	2272.4	68.72	<LOD	44.5	34	19.4	90.9	12.8	65.21	7.97	94.04	10.9
A2211	Backside	13729	209	395	78	457	39	943.5	98.8	100830	744.3	<LOD	215	229	38	45.8	17.4	471.4	22.4	<LOD	34.8
A2211	Side	10212	180	322	60	408	32	910.5	96.8	97604.4	766.5	<LOD	323	258	35.7	57.1	18.2	376.7	20.4	<LOD	25.1
A2211	Bottom	10129	182	399	71	502	39	1043	104	98400.2	751.8	<LOD	232	223	38.8	72.3	18.7	458.6	22.8	203.9	31
A3300	Backside	1317.8	48.8	55.6	17	<LOD	16	133.8	42.1	1553.08	59.96	<LOD	41.9	52	20.3	26.1	11.2	29.95	6.67	10.73	4.52
A3300	Side	1588.5	64	48.1	22	17.2	11	124.7	43.2	3082.73	81.81	<LOD	52.7	49	20.7	17.8	11.2	48.41	7.55	14.03	5.08
A3300	Bottom	1821.4	62.7	50.9	22	31.9	14	180.7	44.7	2249.68	70.84	<LOD	46.9	53	20.6	30.5	11.5	189.1	11.7	26.46	6.37
A3346	Backside	514.56	26	<LOD	18	<LOD	16	139.1	41	1625.6	59.1	<LOD	38.7	60	19.6	39.3	11.2	27.08	6.27	7.68	3.18
A3346	Side	459.77	25.7	34.5	13	<LOD	14	134.6	41.4	1466.7	57.04	<LOD	37.9	31	19.1	36	11.1	17.53	5.95	21.98	5.22
A3346	Bottom	751.83	34	34.7	13	62.4	12	108.2	40.4	900.77	47.53	<LOD	34.6	48	19.7	33.3	11.1	41.49	7.02	26.02	5.24
A3329	Side	10444	172	292	56	184	25	500.5	77.1	78806	647.7	534	179	64	29.4	51.2	16.3	116.7	12.3	14.82	4.29
Sample	**LOCATION**	**Zn**	**Zn Error**	**As**	**As Error**	**Se**	**Se Error**	**Sr**	**Sr Error**	**Ag**	**Ag Error**	**Cd**	**Cd Error**	**Sn**	**Sn Error**	**Hg**	**Hg Error**	**Pb**	**Pb Error**	**Bi**	**Bi Error**
A3274	Bottom	272.65	17.5	194	19	<LOD	5.7	378.3	7.68	13.61	6.58	<LOD	13.5	13	6.94	13	8.57	653.1	21.4	<LOD	8.61
A3274	Side	265.45	18.1	21.8	7.5	<LOD	3.6	269.2	5.71	<LOD	5.81	<LOD	9.37	<LOD	19.7	<LOD	12.3	54.29	7.7	<LOD	5.74
A3274	Inside	234.49	23.3	<LOD	11	<LOD	##	217.4	6.5	15.28	10.15	29	14.6	44	11.4	<LOD	<LOD	18.45	7.9	<LOD	6.6
A4252	Bottom	153.16	13.8	51.8	8.5	<LOD	4.9	393.6	7.69	<LOD	9.45	<LOD	13.4	16	6.84	51.2	9.44	105.8	9.49	<LOD	6.11
A4252	Backside	150.59	15.1	26	7.5	<LOD	3.9	224.9	5.3	<LOD	7.29	<LOD	10.1	<LOD	20.4	<LOD	3E+05	44.66	7.52	<LOD	5.84
A4252	Side	146.8	14.6	18.5	6.1	<LOD	##	211.6	4.96	<LOD	10.09	<LOD	14.1	18	7.34	<LOD	3E+05	19.84	6.08	<LOD	5.03
A4252	Inside	131.93	17.2	11.1	6.9	<LOD	##	232.5	6.17	24.93	9.3	26	12.8	35	9.85	<LOD	3E+05	18.17	7.11	<LOD	6.39
A4157	Bottom	133.71	13.3	8.13	4.6	<LOD	4.7	471.2	8.52	<LOD	9.58	<LOD	13.8	17	7.09	14.8	8.3	17.77	5.71	<LOD	5.69
A4157	Backside	149.45	13.5	22.2	5.2	<LOD	4.7	417.7	7.77	10.84	6.68	<LOD	14.2	20	7.26	<LOD	11.8	23.81	5.91	<LOD	5.74
A4157	Side	136.46	15.1	47.5	7.9	<LOD	##	246.9	5.72	20.63	7.75	18	10.6	25	8.16	<LOD	3E+05	29.09	6.97	<LOD	5.66
A4157	Inside	142.01	14.7	16.3	6.1	<LOD	##	269.1	5.81	12.75	6.9	15	9.73	20	7.43	<LOD	3E+05	18.42	6.16	<LOD	5.35

A3289	Bottom	77.07	9.67	13.2	5.1	<LOD	4.2	69.47	3.14	<LOD	7.15	<LOD	10.3	11	5.28	<LOD	9.81	43.84	6.26	9.83	5
A3289	Backside	44.92	7.96	11.8	4	<LOD	3.8	91.67	3.32	<LOD	7.2	<LOD	10.4	8	5.2	<LOD	9.47	21.42	4.77	16.01	4.67
A3289	Side	45.57	7.98	11.3	4.1	<LOD	3.8	69.62	2.97	9.28	5.09	<LOD	10.7	12	5.46	<LOD	9.09	24.65	4.94	13.27	4.68
A3289	Inside	85.78	9.41	21.8	4.6	<LOD	3.7	83.34	3.17	<LOD	7.58	<LOD	10.7	8.8	5.48	<LOD	9.38	30.31	5.21	19.25	4.87
A3232	Bottom	15.16	7.34	82.1	8.6	<LOD	4.4	483.2	7.75	<LOD	8.43	<LOD	12.1	12	6.15	<LOD	10.4	124.4	9.38	11.85	4.75
A3232	Backside	20.73	7.45	42.8	5.8	<LOD	4.1	720.8	9.52	<LOD	7.47	<LOD	10.8	11	5.48	<LOD	10	33.42	5.89	27.76	5.09
A3232	Side	19.75	6.42	25.6	4.5	<LOD	3.7	595.7	7.74	<LOD	6.28	<LOD	9.05	<LOD	6.94	<LOD	8.23	27.38	4.88	24.78	4.35
A3232	Inside	111.95	11.7	54.2	7.9	<LOD	4.4	718.5	9.83	<LOD	8.31	<LOD	11.8	18	6.07	27	8	99.07	8.89	22.01	5.27
A3225	Bottom	39.49	7.73	35.9	5.8	<LOD	3.9	493.2	7.46	<LOD	7	11	6.82	14	5.17	<LOD	8.87	56.33	6.45	10.92	4.15
A3225	Backside	18.42	6.59	36.2	5.1	<LOD	3.7	509.9	7.32	<LOD	6.7	<LOD	9.57	<LOD	7.28	<LOD	8.96	35.11	5.38	22.64	4.37
A3225	Side	15.68	5.99	20.2	4.1	<LOD	3.4	428.1	6.43	<LOD	6.09	<LOD	8.93	9.6	4.52	<LOD	8.02	24.76	4.54	12.89	3.73
A3225	Inside (C2)	16.06	7.25	30	5.2	<LOD	4.2	342.5	6.69	<LOD	7.73	13	7.47	16	5.65	<LOD	9.94	25.4	5.48	<LOD	6.18
A3225	Inside (C1)	26.57	7.39	41	5.8	<LOD	4	502.9	7.63	<LOD	7.6	<LOD	10.8	<LOD	8.26	<LOD	9.57	49	6.3	9.6	4.14
A3271	Bottom	115.18	11	21.7	4.7	<LOD	4.1	291.3	5.94	<LOD	8.6	<LOD	12.3	14	6.21	<LOD	9.88	27.27	5.34	<LOD	7.02
A3271	Backside	150.88	12.4	25.7	5.7	<LOD	4.2	332.1	6.51	<LOD	8.11	<LOD	11.6	12	5.89	<LOD	10.3	50.4	6.65	7.1	4.52
A3271	Side	134.44	12	11.1	4.3	<LOD	4	279	6.02	<LOD	7.16	<LOD	10.4	11	5.36	<LOD	10.4	21.05	5.1	<LOD	8.42
A3271	Inside (C2)	107.07	11.1	12.1	4.5	<LOD	4.2	318.2	6.41	<LOD	7.59	<LOD	10.9	15	5.54	<LOD	10.3	26.02	5.42	<LOD	6.93
A3271	Inside (C1)	104.36	10.2	14.5	4.3	<LOD	3.9	306.7	5.83	<LOD	7.76	<LOD	11.1	14	5.78	<LOD	9.49	28.34	5.14	<LOD	5.93
A3259	Bottom	376.8	15.8	59.2	7.9	<LOD	3.7	55.94	2.57	<LOD	6.59	<LOD	9.38	<LOD	7.16	<LOD	8.58	170	9.44	11.2	4.7
A3259	Stain	64.09	8.98	9.68	4.1	<LOD	3.8	41.26	2.46	9.65	6.1	<LOD	12.7	24	6.74	<LOD	9.75	22.4	4.95	11.7	4.78
A3259	Backside	79.35	9.39	14.1	4.4	<LOD	4	50.96	2.65	<LOD	7.94	<LOD	11.3	10	5.76	9.84	6.45	27.65	5.23	12.81	4.9
A3259	Side	60.04	8.25	11.1	4	<LOD	3.5	51.82	2.55	<LOD	7.62	<LOD	10.9	17	5.62	<LOD	8.79	25.81	4.85	13.93	4.69
A3259	Inside	68.27	9.56	12.7	4.6	<LOD	4.2	47.34	2.7	18.72	6.47	18	8.91	32	6.98	<LOD	10.3	27.93	5.49	10.48	4.98
A3233	Bottom	218.19	15.4	296	23	<LOD	5.8	358.8	7.23	<LOD	8.41	<LOD	12	15	6.21	<LOD	12.4	1166	27.9	<LOD	10.3
A3233	Backside	149.16	12.5	15.2	4.9	<LOD	4.4	333.1	6.55	<LOD	7.77	<LOD	11.4	<LOD	8.65	<LOD	10.8	32.51	5.91	<LOD	4.52
A3233	Side	127.73	12.1	17.4	5.2	<LOD	4.4	333.7	6.66	<LOD	7.82	<LOD	11.3	<LOD	8.54	<LOD	11	35.74	6.18	<LOD	4.68
A3233	Inside	170.12	16.8	13.8	7.2	<LOD	##	151.8	4.47	12.48	7.81	19	11.1	26	8.52	<LOD	3E+05	38.86	7.46	<LOD	5.24
A3309	Bottom	733.51	27.5	32.1	7.7	<LOD	5.1	366.2	7.72	<LOD	8.65	<LOD	12.5	17	6.4	<LOD	12.5	87.09	9.3	<LOD	6.03
A3309	Paint	130.11	13.6	959	36	<LOD	7	374.7	7.42	41.45	4.78	<LOD	11.6	<LOD	9.04	56.6	10.3	2622	42.3	<LOD	14.5
A3309	Backside	189.34	15.3	567	32	<LOD	6.6	218.3	5.9	10.4	5.78	<LOD	12.2	<LOD	9.09	32.1	9.83	2009	38.1	<LOD	12.8
A3309	Side	111.98	12.4	17.5	5.2	<LOD	4.8	397.4	7.75	<LOD	8.38	<LOD	11.6	<LOD	8.89	<LOD	12.1	28.07	6.15	<LOD	5.21
A3309	Inside	203.55	16.6	25.7	8.1	<LOD	##	176.4	4.55	18.36	7.72	<LOD	15.8	21	8.1	<LOD	3E+05	66.64	8.13	<LOD	5.31
A3301	Bottom	118.16	11.6	12.4	4.9	<LOD	4.3	542	8.37	<LOD	8.34	<LOD	12.1	<LOD	9.05	<LOD	10.9	32.74	5.95	<LOD	4.73
A3301	Backside	131.67	12.2	10.1	4.3	<LOD	4.3	483.4	7.95	<LOD	8.1	<LOD	11.3	<LOD	8.69	<LOD	11.1	19.18	5.27	<LOD	5.88
A3301	Side	119.15	12.3	13.3	4.9	<LOD	4.4	502.6	8.3	<LOD	8.16	<LOD	11.6	<LOD	8.81	<LOD	11.5	28.69	5.95	<LOD	4.96
A3301	Inside	132.75	14.2	11	6.1	<LOD	##	262.3	5.57	18.38	7.12	<LOD	14.6	19	7.45	<LOD	3E+05	26.07	6.32	<LOD	4.85
A3238	Bottom	156.93	14.2	95.4	13	<LOD	5.1	424.4	8.18	<LOD	7.93	<LOD	11.5	<LOD	8.86	<LOD	12.4	334.7	15.7	<LOD	7.3
A3238	Red Pig	442.12	23.4	126	15	11.4	5.6	337.9	6.64	19.97	6.77	<LOD	13.7	20	7.04	5095	57.3	304.3	14.9	<LOD	7.36
A3238	Backside	135.22	13.2	13.9	5	<LOD	4.9	459.8	8.34	<LOD	8.41	<LOD	12.2	13	6.22	<LOD	12.2	24.34	6.02	<LOD	6.16
A3238	Side	127	12.3	16.1	5	<LOD	4.6	449.8	7.77	<LOD	8.12	<LOD	11.6	<LOD	8.87	157	11.7	27.54	5.89	<LOD	4.8
A3238	Inside	148.33	13.3	40.3	8.3	<LOD	4.6	307.5	6.63	15.57	6.55	<LOD	13.3	16	6.9	<LOD	11.9	123.6	9.74	<LOD	5.42
A3254	Bottom	382.93	19.7	34.7	8	<LOD	4.9	453.7	8.18	<LOD	9.05	<LOD	12.8	12	6.49	<LOD	12.2	104.6	9.38	<LOD	5.78
A3254	Side	213.92	18.6	22.8	8	<LOD	##	264.3	6.21	<LOD	9.72	<LOD	14.3	13	7.21	<LOD	3E+05	44.95	7.96	<LOD	6.13

A3254	Inside (C2)	248.95	16	21.5	6.7	<LOD	4.5	381.1	7.27	<LOD	8.95	<LOD	13.1	11	6.62	<LOD	11.8	80.62	8.35	<LOD	5.48
A3254	Inside (C1)	247.33	16.6	29.1	7.6	<LOD	4.8	341.1	7.19	<LOD	9.21	<LOD	13.3	<LOD	10.1	<LOD	12.3	94.85	9.29	<LOD	6.12
A3256	Bottom	2308	46	23	6.4	<LOD	4.7	534	8.98	<LOD	8.49	<LOD	12	<LOD	9.17	<LOD	12.1	57.89	7.69	<LOD	5.61
A3256	Backside	113.8	13.5	13.4	5.5	<LOD	##	286	5.87	13.8	6.91	15	9.7	19	7.38	<LOD	3E+05	10.96	5.64	<LOD	4.94
A3256	Side	115.84	12.1	10.4	4.4	<LOD	4.6	450.7	7.99	<LOD	8.93	<LOD	12.8	19	6.7	<LOD	11.7	16.25	5.3	<LOD	4.87
A3256	Inside (C2)	137.85	12.6	16.2	5.8	<LOD	4.4	576.6	8.74	<LOD	8.56	<LOD	12.3	10	6.23	<LOD	11.4	56.22	7.15	<LOD	5.02
A3256	Inside (C1)	186.01	14.9	24.5	6.5	<LOD	4.8	343.4	7.27	<LOD	8.32	<LOD	11.9	9.9	6.11	<LOD	12.2	57.24	7.72	<LOD	5.3
A2246	Bottom	242.3	16.1	663	34	<LOD	6.8	550.9	8.83	11.36	5.9	<LOD	12.3	13	6.29	66	10.2	2539	41.2	<LOD	13.8
A2246	Backside	131.87	13	87.4	13	<LOD	4.8	619	9.54	<LOD	8.6	<LOD	12.8	<LOD	9.53	83.8	10.4	310.1	14.7	<LOD	6.79
A2246	Side	129.29	15.7	238	22	<LOD	##	346.4	7.18	15.06	7.99	21	11.3	16	8.43	<LOD	3E+05	550.7	21	<LOD	8.92
A2246	Inside (C2)	148.04	12.8	11.7	4.5	<LOD	4.5	413.8	7.46	<LOD	8.65	<LOD	12.2	12	6.22	<LOD	11.5	19.62	5.36	<LOD	4.96
A2246	Inside (C1)	116.79	11.6	9.24	4.2	<LOD	4.2	588.5	8.66	<LOD	8.7	<LOD	12.4	10	6.27	<LOD	11.1	19.83	5.2	<LOD	5.95
A3325	Bottom	195.29	14.2	8.22	3.7	<LOD	4.4	447	7.71	<LOD	8.57	<LOD	12.4	<LOD	9.29	15.4	7.93	<LOD	6.77	<LOD	4.73
A3325	Side	341.98	18	8.67	4.9	<LOD	4.4	329.7	6.74	<LOD	8.32	<LOD	12.4	16	6.31	<LOD	11.9	34.91	6.29	<LOD	5.23
A3325	Inside (C2)	296.22	17	19.9	6.5	<LOD	4.6	304.3	6.49	92.32	8.44	<LOD	13.2	20	6.95	89.7	10.2	42.63	6.67	<LOD	4.69
A3325	Inside (C1)	200.07	14.7	11.5	4.6	<LOD	4.5	391.6	7.42	18.26	6.5	<LOD	13.1	18	6.79	36.3	8.82	21.72	5.62	<LOD	5.09
A4227	Bottom	154.99	12.6	148	15	<LOD	4.6	629.9	8.85	<LOD	7.29	<LOD	10.5	31	11	<LOD	10.8	542.2	17.7	<LOD	7.34
A4227	Side	123.07	13.2	157	16	<LOD	5.4	489.3	8.8	<LOD	4.98	<LOD	10.6	<LOD	8.11	17.7	8.93	479.2	18.6	<LOD	7.95
A4227	Side	140.33	13	39	8.4	<LOD	4.6	607.5	9.31	<LOD	7.47	<LOD	10.7	<LOD	8.1	12.9	7.88	132.8	10.1	<LOD	5.93
A3323	Bottom	598.82	23.5	261	20	<LOD	5.4	206.5	5.54	<LOD	6.87	<LOD	10	<LOD	7.65	<LOD	12.1	888.7	24.1	<LOD	9.6
A3323	Inside	287.98	21.7	50.2	13	<LOD	##	79.22	3.44	12.51	7.97	<LOD	16.9	24	8.68	<LOD	3E+05	168.8	12.9	<LOD	7.32
A4187	Bottom	95.71	11.2	19.4	6.1	<LOD	4.6	928.2	11.3	<LOD	7.59	<LOD	11	<LOD	8.31	<LOD	11	58.2	7.41	<LOD	7.26
A4187	Inside	94.99	13.7	19.8	6.6	<LOD	##	533.8	8.88	18.06	7.63	28	10.8	21	8.01	<LOD	3E+05	21.35	6.39	<LOD	10.4
A4181	Bottom	166.61	14.1	33.1	7.6	<LOD	4.8	568.7	9.16	<LOD	7.97	<LOD	11.2	<LOD	8.62	<LOD	11.7	92.29	9.09	<LOD	5.86
A4181	Backside	162.98	13.8	11.2	5	<LOD	4.6	532.4	8.76	<LOD	7.49	<LOD	10.8	<LOD	8.29	<LOD	11.8	30.14	6.18	<LOD	6.18
A4181	Side	132	12.3	14.1	4.8	<LOD	4.3	803	10.3	<LOD	7.91	<LOD	11.2	<LOD	8.58	52.3	8.81	27.89	5.79	<LOD	5.14
A4181	Inside	62.19	25.2	<LOD	15	<LOD	##	374.9	11.7	34.52	15.26	<LOD	30.1	35	15.6	<LOD	3E+05	<LOD	14.6	<LOD	8.73
A3247	Bottom	334.74	18.8	13.7	5.3	<LOD	4.8	170.6	5.19	<LOD	8.37	<LOD	11.6	<LOD	8.95	<LOD	12.1	32.03	6.48	<LOD	6.11
A3247	Backside	322.54	17.7	21.6	5.5	<LOD	4.8	214.3	5.52	13.73	6.5	<LOD	13.4	20	6.97	<LOD	11.5	35.83	6.37	<LOD	5.7
A3247	Side	358.24	20.5	18.7	7	<LOD	##	102.1	3.39	<LOD	6.12	<LOD	12.1	<LOD	9.25	<LOD	3E+05	42.01	7.07	<LOD	5.61
A3247	Inside	235.74	27.5	<LOD	###	<LOD	##	80.2	4.48	22.49	12.29	27	17.1	38	13.2	<LOD	3E+05	26.27	9.57	<LOD	8.47
A3229	Side	108.02	12.4	8.38	4.2	<LOD	4.7	628.8	9.84	<LOD	7.99	<LOD	11.6	<LOD	8.81	<LOD	12.5	8.29	5.06	<LOD	5.25
A3229	Inside	94.24	11.6	<LOD	5.5	<LOD	4.7	530.4	8.82	10.88	6.66	<LOD	14.1	14	7.1	<LOD	12	7.29	4.79	<LOD	4.64
A3229	Bottom	238.61	15.5	7.55	4.1	<LOD	4.6	565.9	8.75	<LOD	7.89	<LOD	11.5	<LOD	8.75	<LOD	11.6	13.48	5.07	<LOD	4.77
A3278	Side	114.63	11.6	15	5	<LOD	4.2	406.9	7.24	<LOD	8.27	<LOD	11.8	<LOD	9.04	<LOD	11.3	34.29	5.98	<LOD	4.82
A3278	Inside	122.19	13.8	16.9	6.1	<LOD	##	200.5	4.78	<LOD	9.78	<LOD	14	20	7.33	<LOD	3E+05	23.54	6.16	<LOD	4.65
A3278	Bottom	187.39	14.9	33.2	8.3	<LOD	4.7	375.5	7.57	<LOD	7.77	<LOD	11	<LOD	8.56	<LOD	12	119.8	9.98	<LOD	5.63
A3324	Backside	81.22	11.5	12.6	4.9	<LOD	4.7	311.5	7.07	<LOD	8.35	<LOD	12.2	<LOD	9.21	<LOD	12.5	21.87	5.89	<LOD	5.19
A3324	Side	100.59	12.1	19.6	6.2	<LOD	4.7	227.2	5.92	<LOD	8.6	<LOD	12.4	<LOD	9.47	<LOD	12.2	55.26	7.52	<LOD	5.03
A3324	Bottom	472.94	21.6	38.9	7.7	<LOD	4.6	263	6.31	<LOD	7.95	<LOD	11.4	<LOD	8.67	<LOD	12.1	89.82	8.98	<LOD	5.32
A3294	Backside	18.51	6.38	17.2	4	<LOD	3.5	19.25	1.76	<LOD	6.14	<LOD	9.09	<LOD	6.77	<LOD	8.57	22.63	4.57	11.25	4.11
A3294	Side	31.14	7.13	14.6	4.1	<LOD	3.6	16.05	1.71	<LOD	6.43	<LOD	9.36	<LOD	7.14	10.2	6.11	23.95	4.76	7.47	4.05
A3294	Bottom	33.17	7.12	40.7	6.3	<LOD	3.7	17.34	1.73	<LOD	6.06	<LOD	8.97	<LOD	6.74	<LOD	8.78	92.84	7.6	11.05	4.36

A3277	Backside	102.5	11.3	12.1	4.8	<LOD	4.3	484.7	8.15	<LOD	8.03	<LOD	11.6	15	6.01	11.4	7.42	27.53	5.89	<LOD	6.63
A3277	Side	107.11	11.6	16.3	5.7	<LOD	4.3	456.7	7.93	<LOD	7.54	<LOD	11	<LOD	8.33	<LOD	11.1	52.3	7.08	<LOD	6.43
A3277	Bottom	132.23	12.3	39.8	8.5	<LOD	4.6	491.4	8.17	<LOD	7.45	<LOD	10.5	<LOD	8.21	<LOD	11.2	147	10.3	<LOD	7.21
A3276	Backside	26.84	6.35	82.6	11	<LOD	3.6	33.29	1.99	<LOD	5.86	<LOD	8.37	<LOD	6.33	8.4	5.43	427.7	13.5	<LOD	5.2
A3276	Side	27.11	6.47	72.3	11	<LOD	3.5	38.17	2.07	<LOD	5.89	<LOD	8.57	<LOD	6.48	<LOD	8.2	475.7	14.1	<LOD	5.34
A3276	Bottom	65.21	7.97	94	11	<LOD	3.7	30.77	1.97	<LOD	5.81	<LOD	8.45	<LOD	6.47	12.9	5.84	423.9	13.7	<LOD	5.39
A2211	Backside	471.43	22.4	<LOD	35	<LOD	4	123.6	3.7	<LOD	5.19	<LOD	10.9	<LOD	21.8	<LOD	12.3	1059	26.6	<LOD	10.1
A2211	Side	376.68	20.4	<LOD	25	<LOD	5.1	207	5.88	<LOD	8.27	<LOD	11.9	<LOD	8.86	<LOD	12.7	667.5	22.1	<LOD	9.55
A2211	Bottom	458.6	22.8	204	31	<LOD	4.1	128.4	3.89	<LOD	6.11	<LOD	8.76	<LOD	15.7	<LOD	13.2	1686	35.2	<LOD	12.7
A3300	Backside	29.95	6.67	10.7	4.5	<LOD	3.5	36.23	2.13	<LOD	5.86	<LOD	8.51	<LOD	6.43	<LOD	8.35	50.55	5.67	<LOD	5.26
A3300	Side	48.41	7.55	14	5.1	<LOD	3.5	27.17	1.96	<LOD	6.03	<LOD	8.71	<LOD	6.65	12.5	5.87	65.45	6.34	<LOD	5.45
A3300	Bottom	189.07	11.7	26.5	6.4	<LOD	3.6	30.09	2.02	<LOD	5.91	<LOD	8.46	<LOD	6.52	<LOD	8.41	116.6	8.05	<LOD	5.67
A3346	Backside	27.08	6.27	7.68	3.2	<LOD	3.3	16.2	1.55	<LOD	5.83	<LOD	8.47	7.6	4.3	<LOD	7.75	14.94	3.8	<LOD	3.3
A3346	Side	17.53	5.95	22	5.2	<LOD	3.4	10.48	1.39	<LOD	5.76	<LOD	8.53	12	4.38	<LOD	8.09	73.23	6.32	<LOD	3.77
A3346	Bottom	41.49	7.02	26	5.2	<LOD	3.4	12.92	1.47	<LOD	5.94	<LOD	8.79	8.2	4.42	<LOD	7.96	68.56	6.2	<LOD	3.92
A3329	Side	116.7	12.3	14.8	4.3	<LOD	4.6	184.1	5.27	<LOD	7.65	<LOD	10.8	<LOD	8.25	<LOD	11.7	8.93	4.81	<LOD	4.93
Sample	**LOCATION**	**Mg**	**Mg Error**	**Al**	**Al Error**	**Si**	**Si Error**	**P**	**P Error**	**S**	**S Error**	**Cl**	**Cl Error**	**K**	**K Error**	**Ca**	**Ca Error**	**Cs**	**Cs Error**	**Ba**	**Ba Error**
A3274	Bottom	12937	4369	43144	1704	###	1588	6746	332	15281.3	268.4	1454	59.2	2186	167	###	932	60.24	8.1	514.6	47.6
A3274	Side	11219	4304	53017	1861	###	1652	6807	335	10319.7	222.8	##	64.8	###	207	###	893	39.79	7.48	327.6	52.3
A3274	Inside	<LOD	5874	12725	1080	###	##	1193	295	6401.15	230.2	1979	83.8	1003	64.1	###	772	122.6	13	818.1	75.9
A4252	Bottom	23139	4627	###	1702	###	##	5837	310	12472.1	242.2	1581	59.9	6101	236	###	921	64.75	7.96	520.3	46.6
A4252	Backside	22394	4826	38477	1680	1E+05	1501	5456	316	12071.8	248	##	70.1	6215	275	###	968	74.68	8.43	326.7	55.7
A4252	Side	11208	4427	###	1653	1E+05	##	9178	364	13461	271.1	##	83.4	###	337	###	898	65.24	8.5	548.8	50
A4252	Inside	7287.2	3587	15495	1057	###	##	1357	263	8673.94	227.1	1154	66	1836	92.8	###	826	106.2	11.2	692.3	65.4
A4157	Bottom	10490	3983	51767	1752	###	1567	6170	309	4286.23	155.7	442	48.1	5682	223	###	969	75.98	8.31	526.2	48.3
A4157	Backside	15704	4446	53875	1876	###	1560	12372	375	9197.88	211.9	652	50.8	6765	242	41113	901	85.11	8.47	513.2	48.7
A4157	Side	<LOD	5881	33745	1541	1E+05	1532	3043	299	6701.89	206.7	857	60.5	###	150	###	869	83.61	9.38	598.6	54.8
A4157	Inside	9457.5	4160	###	1626	###	1530	10038	366	14115.2	267.7	897	57.6	5251	191	###	936	70.25	8.58	517.7	50
A3289	Bottom	<LOD	5730	###	1481	###	1717	6461	309	8635.6	189.3	##	59.6	###	375	5895	121	53.22	6.19	967.9	39.5
A3289	Backside	4976.7	3009	38317	1329	###	##	9853	349	14692.3	249	2751	67.2	###	325	###	436	49.38	6.12	837.7	38.4
A3289	Side	<LOD	3942	34756	1172	###	1534	7500	305	14804.5	237.6	##	64.8	###	340	###	406	59.13	6.39	895.4	40.1
A3289	Inside	4753.1	2808	33102	1190	###	1529	3552	287	18444.3	272.8	##	118	###	336	###	379	54.47	6.45	919.5	40.8
A3232	Bottom	<LOD	5139	###	2065	###	1590	2032	252	15605.4	234.4	476	43.7	2777	143	1795	83.5	47.58	7.14	637	43.3
A3232	Backside	<LOD	5764	75144	1845	###	1607	2053	253	18820.9	269.4	##	49.5	3779	126	2854	78.1	49.14	6.39	1011	41.2
A3232	Side	3627.2	2040	75188	1503	###	1611	2364	231	11203	188.9	806	42.2	1547	69.7	3202	61.4	30.66	5.42	701.5	33.8
A3232	Inside	5139.2	2451	57536	1430	###	##	2182	238	21851.2	285.6	1455	51.8	3250	114	4866	94.9	67.87	7.03	1268	46.3
A3225	Bottom	<LOD	5091	###	1262	###	1847	2659	276	15149.1	233	##	47.5	3129	107	2814	70.2	54.91	6	949.1	38.1
A3225	Backside	<LOD	3828	###	1815	###	1706	3741	272	12733.3	208.6	1140	47.4	###	122	3826	96	16.58	5.63	676.1	35.3
A3225	Side	<LOD	4820	52857	1312	###	1855	2428	256	10352.5	178.5	549	36.6	###	79.3	2417	53.6	40.84	5.25	951.9	33.8
A3225	Inside (C2)	<LOD	5676	###	1728	###	1792	1844	265	8882.97	182.8	553	43	1676	107	1662	71.6	58.38	6.54	809.6	40.5
A3225	Inside (C1)	<LOD	5247	57819	1478	###	1675	2310	256	16909	238.3	830	43.3	###	132	3249	91	53.65	6.54	1137	42.8
A3271	Bottom	12203	3312	###	1461	###	##	1809	264	4953.46	150.4	581	45	###	303	###	632	60.5	7.23	923.3	45.4
A3271	Backside	10164	3387	51860	1597	###	1771	2067	284	6597.38	173.7	##	51.1	###	315	###	564	65.88	6.92	975	43.7

A3271	Side	11999	3324	58758	1644	###	1807	1887	277	5419.92	152.8	844	46.6	###	281	###	611	55.68	6.28	836	39.2
A3271	Inside (C2)	8725.5	3057	49731	1452	###	1763	2008	268	4414.31	140.8	1005	48	13715	303	###	574	58.42	6.43	935.2	40.6
A3271	Inside (C1)	8805	3247	51361	1558	###	1754	887	273	2821.81	130.3	705	48.6	###	303	###	572	65.65	6.76	915.8	42.3
A3259	Bottom	5060.3	2623	52151	1358	###	##	2291	279	6647.19	156.7	1715	52.1	###	292	4157	93.1	37.38	5.59	587.3	33.9
A3259	Stain	<LOD	4359	3513	519	###	865	896.3	196	5376.44	160.4	1562	55.9	###	313	14178	402	67.54	7.7	858.6	47.6
A3259	Backside	<LOD	5421	###	1369	###	1674	1509	260	5496.52	154.4	722	46.4	###	418	3198	106	53.39	6.76	841.9	42.2
A3259	Side	<LOD	3994	38196	1163	###	1674	1270	251	5341.6	149.3	532	43.5	###	358	2531	78.7	47.99	6.43	785.9	40
A3259	Inside	<LOD	6211	27573	1107	###	1657	<LOD	375	5142.54	161.6	185	45.6	###	377	2196	69.4	84.02	7.88	992.5	49.1
A3233	Bottom	29842	4455	###	1464	###	##	5357	290	16342.9	256.1	1315	51.3	4213	224	###	947	58.14	7.23	625.4	43.4
A3233	Backside	19974	3940	###	1400	###	1513	7723	307	7181.81	174	1627	53.7	7914	283	###	831	41.64	6.74	524.6	40.3
A3233	Side	23909	4292	###	1429	###	1547	5160	297	7925.3	190.1	1850	58.7	###	248	###	824	45.69	6.78	768.9	42.1
A3233	Inside	9401.2	3693	16893	1108	1E+05	1416	1577	276	10822.9	247.3	##	66	2376	112	###	642	88.56	9.84	1020	61.2
A3309	Bottom	39380	4892	###	1639	###	1616	4375	289	5414.57	164.1	1279	53.6	1719	158	###	807	58.74	7.4	1662	51.7
A3309	Paint	13957	3657	###	1274	1E+05	1278	6163	290	24691.4	321.2	##	69.3	8631	285	###	800	51.32	6.98	1218	46.2
A3309	Backside	36758	4635	###	1466	###	1367	4985	283	31033	359.9	##	57.8	3533	216	###	800	66.72	7.26	1336	48.3
A3309	Side	26865	4254	36187	1456	###	1540	4138	284	11245.8	222	1256	53.1	3562	185	###	784	50.53	7.05	1045	45.5
A3309	Inside	5945.8	3369	18683	1099	1E+05	1331	2851	276	13301.2	255.7	##	69	3738	145	###	812	86.27	9.44	1220	60.6
A3301	Bottom	21442	3875	40193	1452	###	1501	5943	291	8026.26	185.1	1281	51.9	3753	181	###	724	46.91	7.09	524.3	42.2
A3301	Backside	34619	4509	49127	1676	###	1565	3830	275	5168.89	155	##	51.4	3789	208	###	751	46.84	6.86	576	41.2
A3301	Side	37230	4462	###	1582	###	1530	4372	270	6085.41	159.7	1514	51.8	3045	198	###	801	54.59	6.92	521.7	40.9
A3301	Inside	19632	3945	27854	1286	1E+05	1471	2660	270	6827.34	189.8	##	58.1	1839	119	###	658	76.58	8.65	775.7	52.3
A3238	Bottom	26356	3829	37625	1356	###	##	4176	257	9729.11	191.8	899	44.6	2572	177	###	714	54.94	7	630.6	42.2
A3238	Red Pig	<LOD	6039	17939	1144	1E+05	1164	21313	426	55124.1	532.8	##	60.5	5070	190	###	728	82.39	8.19	914.2	50.5
A3238	Backside	29589	4246	###	1435	###	1569	3239	266	5347.08	157.2	1353	52	2001	157	###	719	55.82	7.25	679.6	44
A3238	Side	26152	3881	35181	1328	###	##	3122	245	6242.55	158.3	1374	49	2142	176	###	749	48.57	6.98	668.8	42.6
A3238	Inside	10669	3476	19904	1100	1E+05	##	2540	266	16861.8	272.2	1536	58.1	2310	137	###	745	56.39	7.95	822.8	49.4
A3254	Bottom	39169	5017	40148	1612	###	1542	5074	294	6306.69	173	1152	52.1	###	342	###	808	61.99	7.63	992.9	48.4
A3254	Side	25761	5576	33871	1782	###	1795	3960	372	14264.7	310.4	##	93.8	4764	161	###	851	56.56	8.44	658.8	50.9
A3254	Inside (C2)	23309	5006	27012	1533	1E+05	1459	4349	335	43853.1	483.4	2271	71.1	###	456	###	738	54.62	7.77	779.5	47.9
A3254	Inside (C1)	29557	4476	###	1482	###	1518	2775	275	16898.7	265.7	2185	61.7	8216	250	###	520	57.4	7.95	993.9	50.6
A3256	Bottom	25139	4181	###	1388	###	##	4640	285	13241.6	239.4	##	75.1	2273	162	###	880	50.18	7.26	606.9	43.7
A3256	Backside	15004	3427	###	1045	1E+05	1301	3407	250	8095.36	187.6	959	50.1	1349	109	###	738	71.55	8.56	752	51.8
A3256	Side	16203	3676	27351	1232	1E+05	##	4599	277	10605.8	215.4	1681	58	2321	148	###	767	63.13	7.74	702.4	46.8
A3256	Inside (C2)	28401	4374	###	1428	###	1514	2187	264	10488.6	212	##	63.6	1112	147	###	954	58.29	7.33	700.1	44.6
A3256	Inside (C1)	25003	4113	35391	1416	###	##	5813	297	19019	282.2	2158	60.4	###	157	###	741	48.9	7.15	1323	48.1
A2246	Bottom	23264	4208	###	1422	1E+05	##	5435	297	22227.9	311.5	1879	59.4	2505	179	###	872	60.59	7.36	581.2	43.7
A2246	Backside	14587	4053	###	1251	1E+05	##	4966	287	8966.73	208.8	##	69.2	###	314	###	1086	54.07	7.5	657	45.4
A2246	Side	10663	4153	13882	1143	###	1355	5410	339	10846.9	265.6	##	77.3	###	120	###	988	76.7	9.89	637.1	58.5
A2246	Inside (C2)	27574	4265	37577	1477	###	1544	2905	270	7600.94	187	1356	54.2	1951	148	###	750	49.33	7.23	520.6	42.9
A2246	Inside (C1)	28805	4266	37728	1461	###	1565	3543	278	5790.38	166.7	960	50.2	1689	141	###	850	48.41	7.33	451.8	43
A3325	Bottom	44683	4735	###	1490	###	1485	1938	239	1431.75	103.2	709	44.1	604	132	###	877	48.23	7.27	567.5	43.5
A3325	Side	53183	4830	###	1465	###	##	3465	250	2925.03	118.7	##	47	928	139	###	722	59.14	7.33	775.6	45.1
A3325	Inside (C2)	36678	4679	###	1371	###	1518	3358	275	9270.7	204	1279	53.6	1507	142	###	740	71.25	7.83	702.2	47.1

A3325	Inside (C1)	36655	4499	31227	1347	###	1514	3510	269	5975.74	167.3	##	52.1	825	113	###	669	62.11	7.82	712.6	47.5
A4227	Bottom	5277.2	2897	25531	1104	1E+05	1258	10017	308	15620.8	245.3	##	53.8	###	322	###	663	22.87	6.34	301.6	37
A4227	Side	<LOD	5612	18736	1073	1E+05	1255	15388	363	15198.9	251.6	2716	64.9	###	361	###	697	16.36	6.4	356	37.9
A4227	Side	<LOD	6460	19674	1142	1E+05	1351	20079	426	11750.3	236.2	##	72.3	###	342	###	644	22.28	6.38	589.9	39.3
A3323	Bottom	7637.9	3036	###	1083	1E+05	1214	3435	249	17045.5	262.1	1586	54.1	###	284	13711	535	16.95	6.13	478.2	37.2
A3323	Inside	<LOD	4631	3443	700	###	823	535.2	242	6568.79	213.7	##	86.6	2518	96.5	3123	74.9	64.58	9.91	690	59.6
A4187	Bottom	<LOD	6408	###	1184	###	1459	3306	264	10325.4	209.7	797	47.3	###	348	###	774	51.88	6.57	1031	42.4
A4187	Inside	<LOD	5556	11131	848	89157	1179	528.6	241	6832.98	199.5	1105	62.4	###	317	###	695	85.75	9.34	1384	61.3
A4181	Bottom	<LOD	4736	25768	1144	1E+05	##	3832	247	8497.93	190.4	569	44.6	###	301	###	848	35.12	6.79	380.7	39.8
A4181	Backside	6111.6	3260	###	1286	1E+05	##	5772	279	11893.8	225.6	##	51	###	321	###	896	32.26	6.58	426.6	39
A4181	Side	<LOD	6843	###	1280	1E+05	1261	3974	260	11155.7	220.1	937	49.8	###	325	###	942	47.59	6.79	493.5	40.2
A4181	Inside	<LOD	###	<LOD	1919	18075	1097	<LOD	822	639.56	80.8	328	162	1173	39.2	25771	797	106.4	18	755.9	105
A3247	Bottom	<LOD	6330	###	1077	1E+05	1192	4195	250	9165.46	195.6	5558	86.9	###	357	15321	588	36.09	7.04	594.9	42.8
A3247	Backside	<LOD	4123	14688	952	###	##	3141	253	11483.7	230.3	##	75.2	###	355	###	554	56.26	7.96	756.4	48.9
A3247	Side	<LOD	7007	11917	1003	###	##	3068	280	15026.1	281.9	##	104	###	359	21118	647	12.28	7.3	514.1	44.7
A3247	Inside	<LOD	6077	3328	1060	###	934	2411	418	5450.11	307.4	1659	118	1940	55.5	###	522	123.2	15.2	1056	92.3
A3229	Side	56036	4974	46545	1611	###	##	1496	237	2218.71	107.6	625	40.7	736	133	###	775	55.38	6.96	2428	53.2
A3229	Inside	23755	3846	25522	1166	###	1472	1312	235	2111.59	121	524	45.1	797	108	###	797	70.54	8.33	1799	58.5
A3229	Bottom	11712	3029	13804	855	1E+05	##	1170	200	3279.65	124.5	591	40.3	717	135	###	811	43.15	6.95	2124	51.9
A3278	Side	18117	4022	27276	1314	1E+05	##	4870	295	12456.4	239.4	##	65.8	3957	193	###	859	47.2	7.17	1146	47.2
A3278	Inside	14143	3767	###	1272	1E+05	1457	1988	269	14972	263.9	##	68.3	1440	116	###	680	69.04	8.47	1264	55.5
A3278	Bottom	7712.8	2964	17464	961	1E+05	##	3104	232	7051.28	171.4	##	52.4	###	182	###	808	43.41	6.75	1127	44.4
A3324	Backside	5726.7	3090	13100	930	###	1138	3504	248	7772.58	194	##	55.4	2219	160	###	923	41.75	7.23	371.4	42
A3324	Side	4992.3	3125	13875	964	###	1197	2732	246	8648.18	204.4	##	57.3	1848	153	###	932	47.88	7.47	352.5	43
A3324	Bottom	13643	3576	17775	1059	###	1147	3224	235	7437.42	181.8	922	47.6	1861	172	###	1081	52.35	6.92	359.7	39.8
A3294	Backside	3215.4	2053	8335	597	###	1718	7238	2500	8601.15	224.8	##	44.9	12175	210	5685	98.1	30.7	5.37	522.2	32.5
A3294	Side	<LOD	5104	8623	637	###	1728	7727	2770	9471.54	247	1659	48.4	###	222	6733	109	34.89	5.67	534.6	34.2
A3294	Bottom	<LOD	2856	8329	610	###	1508	3682	245	15199.2	224.9	1258	43.8	11751	210	###	320	36.1	5.3	569.3	32.1
A3277	Backside	<LOD	6113	###	1214	1E+05	##	2073	236	6889.74	174.7	779	46.8	###	388	###	876	54.49	6.98	785.6	43.2
A3277	Side	11039	3275	31066	1239	1E+05	##	2047	242	8420.13	188.6	##	51.4	###	380	###	803	51.27	6.59	795.4	41
A3277	Bottom	4470.8	2919	30918	1206	1E+05	##	2147	242	8789.33	192.3	730	47.1	19181	371	###	728	41.68	6.44	678.4	39.6
A3276	Backside	<LOD	3555	5701	502	###	1367	5181	233	16597.1	219	##	37.5	5391	129	###	299	24.74	4.92	277.8	28.5
A3276	Side	<LOD	3531	5625	492	###	##	3376	215	14217.1	202.7	##	40.9	5317	122	###	287	26.04	5.02	383.8	29.6
A3276	Bottom	<LOD	2288	4463	478	1E+05	##	2638	211	12858	202.2	666	37	5056	124	12173	272	31.8	5.04	425.5	29.9
A2211	Backside	11631	3299	###	1116	1E+05	##	3405	237	2070.44	113.6	638	43.1	8753	317	###	577	37.85	7.02	379.9	48.9
A2211	Side	9900.7	3078	25891	1106	1E+05	##	2782	225	1487.25	101.8	590	41.4	8756	297	###	580	34.8	6.98	439	41.4
A2211	Bottom	11255	3260	###	1042	1E+05	1259	5173	255	7863.44	178.4	857	45.2	7631	298	16757	625	37.19	6.77	399.9	48.8
A3300	Backside	<LOD	4418	5281	511	###	1542	5988	251	14235.2	206.2	1158	39.3	7496	138	10155	242	34.47	5.03	458	30
A3300	Side	<LOD	2638	4940	513	###	##	3305	240	14013.3	207.3	947	38	6528	131	8344	103	34.14	5.19	411.7	30.6
A3300	Bottom	<LOD	4574	4691	582	###	1425	6006	275	23825.7	298.6	1525	48.2	8531	162	###	386	34.75	5.08	334.7	29.5
A3346	Backside	<LOD	2735	6016	489	###	1478	2759	213	9265.02	161.2	1461	40.9	7680	145	###	246	36.78	5	286.6	28.8
A3346	Side	<LOD	2681	6642	523	###	1550	3192	227	10423.2	173.7	##	39.9	7947	144	###	251	38.4	5.04	289.6	28.9
A3346	Bottom	<LOD	3200	4424	485	###	1625	2143	227	11600.7	185.4	777	35.5	4953	112	8977	102	41.48	5.15	311	29.6

A3329	Side	<LOD	4624	21952	1097	1E+05	1216	23123	414	8181.18	186.2	##	55.9	###	300	###	584	30.02	6.51	1096	43.2