AN EXPLORATION OF NEW METHODS OF CERAMIC ANALYSIS: EXAMINING POTTERY SHERDS FROM AMERICAN SAMOA USING COMPUTED TOMOGRAPHY, PHYSICAL EXAMINATION, AND RESIDUE ANALYSIS

A Thesis
Submitted to the Graduate Faculty
of the
North Dakota State University
of Agriculture and Applied Science

By

Brett James Tanselle

In Partial Fulfillment of the Requirements
for the Degree of
MASTER OF SCIENCE

Major Department:
Sociology and Anthropology

January 2016

Fargo, North Dakota

North Dakota State University
Graduate School

Title

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MASTER OF SCIENCE

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ABSTRACT

Materials from archaeological assemblages around the world have been examined using a variety of methods in order to obtain data that can contribute to our understanding of past societies, cultures, and behaviors. In particular, ceramics have been analyzed to obtain data that can be used to determine how pottery was manufactured and how its use changed over time. While many ceramic analyses employ established methods of examination such as physical analysis, new methods have been developed. This thesis explored the use of computed tomography (CT), physical examination, and residue analysis to examine a collection of pottery sherds from four archaeological sites in American Samoa. The results obtained from this research were used to determine if CT and residue analysis could be viable for ceramic analysis in addition to determining if changes in ceramic manufacture could be documented over space and time in American Samoa.

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LIST OF ABBREVIATIONS

AS	American Samoa
CT	Computed Tomography
GC	Gas Chromatography
GC-MS	Gas Chromatography-Mass Spectrometry
irm GC-MS	Isotope Ratio Monitoring GC-MS
NDSU	North Dakota State University
UK	United Kingdom

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CHAPTER 1. INTRODUCTION

Materials from archaeological assemblages around the world have been examined using a variety of methods in order to obtain data that will contribute to our understanding of past societies, cultures, and behaviors. Within the past few decades, multiple methods of study have become possible due to the continuous development of new technology, from more powerful computers to sophisticated software packages, to new analytical equipment. Although new methods have been developed, some have not yet seen extensive use in archaeology. Instead, many traditional methods of study have continued to be utilized for archaeological research. One of the most important areas for applying the traditional methods has been for ceramic analyses. Ceramic studies have been very informative for expanding our understanding of sites that contain pottery because the baked clays are relatively durable, abundant, and can reflect important information based on stylistic as well as functional attributes. The main use of ceramic analysis for most studies has been to determine how the production of pottery has changed over time, how it varied from region to region, and contacts between different peoples. By having access to these types of data, scholars are able to better understand how past populations interacted with their environments and with each other.

Ceramic analysis has been a staple of archaeology across many regions of the world for addressing a variety of questions specific to the region. At the same time, such studies typically also address the same small set of core questions:

- *What methods of manufacture were used to produce pottery?*
- *Did changes in ceramic manufacture occur across space and time?*
- *What was the function of pottery? Was it utilitarian, ceremonial, or something else?*

- *What can pottery tell us about the people who produced it?*

By addressing these questions, scholars are able to learn about aspects of culture that lay behind the production of the pots and other assorted vessels. While this thesis will provide data relevant to those four general questions, it will focus on a set of questions specific to American Samoa.

The ceramics examined for this study were obtained from excavations at four sites in American Samoa, in West Polynesia. This research will contribute to the understanding of ceramic technology in Samoa, and the degree of variability in that technology over space and time. To carry out this study, traditional ceramic analysis was coupled with Computed Tomography (CT) as the primary methods of analysis. The application of CT scanning in archaeology, particularly for ceramics, is rare so a methodological goal of this work was to explore the usefulness of CT scanning to identify attributes of ceramics. In addition, geochemical residue analysis was employed to identify lipids in order to determine what was cooked or contained in pottery recovered from the sites under study.

Geographic and Historic Context

The Samoan Archipelago is located in Polynesia, which is a distinct cultural region in the larger culture area of Oceania. Polynesia is typically divided into two subregions, West Polynesia and East Polynesia. While all Polynesian cultures have many traits in common, the island groups of West Polynesia differ from those of East Polynesia in a number of important features. One of those differences is that the prehistoric cultures in West Polynesia made pottery in the early centuries of human settlement, only to have pottery making die out before European contact, while the cultures of East Polynesia were always effectively aceramic.

The Samoan Archipelago is divided into two distinct polities (Figure 1). In the west lies the Independent Nation of Samoa, or simply Samoa, which was formerly known as Western Samoa. The nation of Samoa consists of the two largest islands of the Samoan Archipelago, ‘Upolu and Savai’i, in addition to the smaller islands of Manono and Apolima. In order to maintain clarity of terms, in the pages that follow the term Samoa will be used in reference to the entire archipelago, and Western Samoa will be used to refer to the modern nation of Samoa. The eastern islands of Samoa make up the U.S. Territory of American Samoa (or simply American Samoa). The focus of this thesis, American Samoa, is composed of the inhabited islands of Tutuila, Aunu‘u, Ofu, Olosega, and Ta‘u, with the latter three islands collectedly referred to as Manu‘a. Two much smaller islands, Swains and Rose Atoll, are also in the group but today have few or no occupants.

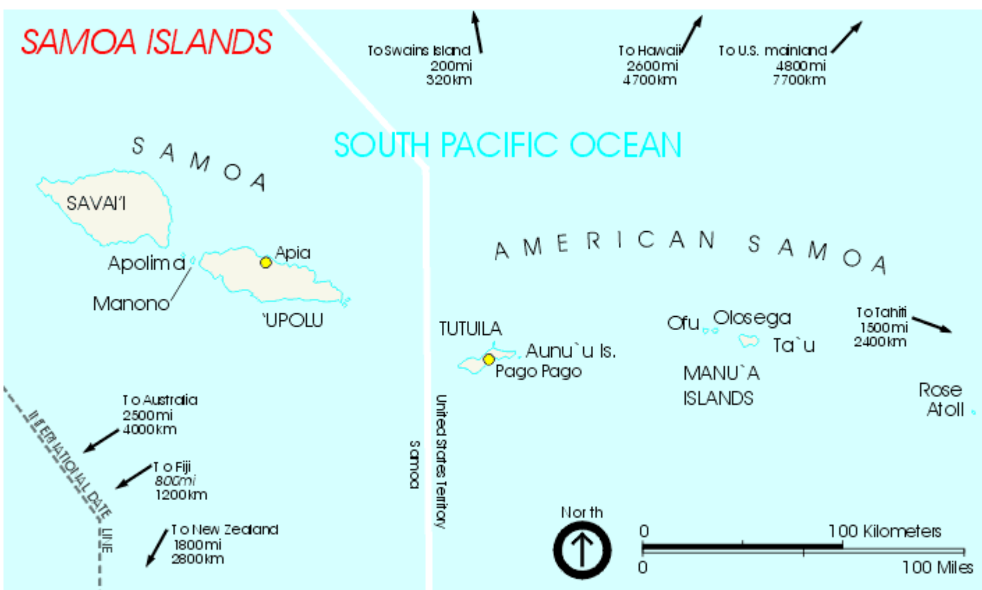

Figure 1. Map of the Samoan Archipelago. From proceedings.esri.com.

The Samoan Archipelago was first inhabited by seafaring people known as the Lapita who migrated from an ancestral homeland in Southeast Asia or far western Melanesia, through Melanesia into West Polynesia beginning over 3,000 years ago (Green 1979; Spriggs 1984), and ending in the Samoan Archipelago just a few hundred years later (Clark et al. 2016). A common artifact found at most Lapita sites is pottery. Highly decorated dentate-stamped pottery has been used as the diagnostic indicator of Lapita sites. This form of pottery gradually transitioned into less ornate pottery often referred to as Polynesian Plainware, or simply Plainware. The use of ceramics eventually declined to the point of abandonment. Pottery manufacture had completely died out by the time of European contact in 1722 when Roggeveen visited the archipelago (Clark 1996). Due to the discontinuation of ceramic production prior to European contact, no historical record discusses pottery manufacturing in Samoa. As a result, archaeology is a necessary tool for learning about the importance of pottery in the archipelago, with implications for understanding other prehistoric populations in West Polynesia.

Specific Research Questions

This thesis will attempt to answer questions relating to how pottery from ceramic deposits at four sites fit into the larger sequence of ceramic production in American Samoa specifically, and the Samoan Archipelago more generally. A set of six specific questions will be addressed:

1. *Do ceramics from these four sites fall into distinct wares (i.e., "thin fine ware" and "thick coarse ware") or other groupings that are representative of different periods of ceramic production?*
2. *If wares or groups can be ascertained, how do they compare to the reported variability in ceramic collections from other sites excavated in Samoa?*
3. *Can CT scans be used to determine the method of pottery construction in American Samoa?*

4. *Does the data acquired from CT scans support the results obtained from the physical analysis of sherds in terms of construction methods and variability within and between sites?*
5. *Is CT a viable tool for ceramic analysis, particularly of large collections?*
6. *Can geochemical residue analysis be used to determine what was cooked in pots produced in American Samoa?*

The results obtained from exploring these six questions will contribute to our understanding of general archaeological issues, such as the core questions mentioned above, to be addressed for American Samoa. While the majority of the six questions deal with technology applications, each question can provide data valuable for understanding the role of pottery in the prehistory of the islands. By answering these questions, data on manufacturing techniques used and types of construction materials employed can be obtained. With these data, a model of ceramic production in American Samoa can be formed that demonstrates change through time and space.

To accomplish these goals, this thesis evaluated a collection of pottery sherds recovered from four sites excavated in American Samoa by Professor Jeffrey Clark and dating to the first millennium BC. These sites are found on two islands: on Ofu Island, sites AS-13-13 (Va‘oto), AS-13-41 (Ofu Village), and AS-13-37 (Coconut Grove); and on Tutuila Island, site AS-21-5 (‘Aoa). A large sample of 1,424 sherds from six excavation units at the Va‘oto site was examined to provide a representative view of the Va‘oto site, but only small samples were examined from the other sites in order to provide comparative materials with the Va‘oto collection. Traditional laboratory analysis of physical attributes was carried out on all of the sherds, but a sample of 34 of those sherds, representing all of the sites, was examined more intensively with the use of computed tomography. In addition, 10 sherds from two sites on Ofu were chosen for residue analysis.

The combination of traditional ceramic examination, CT, and residue analysis applied to sherds recovered from multiple sites in American Samoa was designed to reveal methods of ceramic production and vessel use over time and space. By providing data that can help address these aspects of Samoan prehistory, this research will contribute to the field of archaeology, specifically for American Samoa and its surrounding region.

The thesis is organized into six chapters. Following this introduction, chapter two provides background material on previous archaeological research in American Samoa. Chapter three provides information on the methods employed in this study. Chapter four discusses data collection and analysis. Chapter five provides the results of the three analyses. The final chapter discusses the conclusions formed from this study in addition to providing recommendations for future research projects involving ceramic analysis employing computed tomography and residue analysis. Following chapter six is an appendix containing the detailed data obtained through this research.

CHAPTER 2. CONTEXT AND BACKGROUND

Many archaeological studies have been undertaken in Oceania that dealt in part with ceramics. The earliest archaeological work involving ceramics in Polynesia was that of McKern (1929) in Tonga. McKern was the first to recognize that Tongan ceramics fell into stratigraphic layers that could be used to identify different ceramic types over time. He used the idea that ceramics from different stratigraphic layers could represent varying pottery types to argue that Tongan culture changed over time (1929:116). Other archaeologists have since expanded upon McKern's work to suggest that changes in ceramics over time could be used to identify changes in culture and people in Oceania.

Ceramic sherds are among the most prevalent form of artifact recovered from early archaeological sites in the Pacific (Dickinson and Shutler 2000:203). The most distinctive early ceramics from these regions were decorated with dentate stamping in a range of motifs that varied over time and space. Those ceramics are named after site 13 on the Foué peninsula of Grande Terre, the main island of New Caledonia by Edward W. Gifford and Richard Shulter Jr in 1952 (Green 1979). Green (1979) and many subsequent writers (e.g., Spriggs 1984; Kirch 1997) regarded the distinctive sherds as part of a larger Lapita Cultural Complex that characterized seafaring populations referred to as Lapita peoples (Kirch 1997). The geographic extent of Lapita ceramics in Oceania ranges from Papua New Guinea in the West to Samoa in the east (Bedford 2006:544).

Lapita ceramics are distinct from other forms of pottery found in Oceania due to the unique decoration associated with Lapita vessels. Lapita pottery is decorated with distinctive dentate-stamping produced with a comb-like tool. Although this dentate-stamping is diagnostic of Lapita pottery, not all Lapita pots are completely covered with decoration and many pots were completely undecorated; thus, most pottery sherds found at Lapita sites do not have this decoration. A form of Plainware is commonly present in Lapita assemblages, especially sites that are more recent in age (Spriggs 1984:202).

In addition to dentate-stamping on early Lapita vessels, another interesting characteristic was the presence of face motifs on some Lapita ceramics. Multiple face designs have been found at different Lapita excavations, but all share basic traits that are common amongst sites. Generally, these motifs are in the form of a human-like face and are either found on dentate-stamped pots or as three-dimensional clay heads formed through molding. Face motifs are most prevalent in far western Melanesia, and as one travels further east into western Polynesia, motif designs become less diverse and less common (Chiu 2007:242).

The place of origin for the Lapita Cultural Complex is a matter of considerable debate. Most researchers accept that Lapita peoples were speakers of Austronesian languages (Clark and Kelly 1993). Although multiple scholars have supported the interpretation of the Lapita peoples originating in Southeast Asia, some have suggested that the group originated in far western Melanesia (Spriggs 1984). In a melding of ideas, Green proposed a Triple I model in which the formation of the Lapita Cultural Complex emerged over time through the processes of Intrusion (into Melanesia from Southeast Asia), Integration (of Melanesian and Southeast Asian cultural traits), and Innovation (created with the movement into new areas) (Green 1991).

Regardless of the origin of the cultural traits, the appearance of Lapita pottery, on current evidence, appears to have been around 1350 BC (Carson et al. 2013; Denham et al. 2012). Many habitation sites were on small offshore islands instead of the larger, already inhabited islands. From western Melanesia, Lapita spread eastward into Remote Oceania, which refers to the islands east of the Solomon Island chain (Green 1991), eventually reaching the islands of West

Polynesia. On islands throughout most of that range, Lapita populations represent the initial inhabitants (Spriggs 1984:203; Sheppard et al. 2015). Lapita has been taken by most researchers to have been the culture group that gradually transformed into the ancestral population of subsequent Polynesian peoples. Based upon ceramic and linguistic analyses, Groube (1971) suggested that the first true Polynesians likely originated in Tonga and spread to other islands in Polynesia including Samoa. Burley (1998) provided evidence for this interpretation based upon results obtained through dating pottery-bearing sites in Tonga. Burley et al. (2015) used U/Th dating of coral to determine that decorations on Lapita pottery disappeared within three generations of initial arrival in Tonga. This indicated decorated Lapita pottery quickly declined in Tonga and was replaced by pottery lacking dentate stamping called Polynesian Plain Ware, or simply Plainware that has been found at post-Lapita sites elsewhere in Remote Oceania, including in Samoa.

The category of Polynesian Plainware includes ceramics that lack dentate stamping along with most other forms of decoration (Green 1974c:253). In addition to a general lack of decoration, Plainware ceramics were composed of a more restricted variety of pottery forms compared to Lapita ceramics. Vessels that are classified as Plainware (or Polynesian Plain Ware) are generally considered utilitarian ware (Burley 1998:359-360).

Burley (1998:353) suggested that the end of the Lapita period in Polynesia correlated with the loss of decorated pottery that occurred around 650 BC. In Samoa, Clark et al. (2016) have recently argued that Lapita ceramics were replaced by Plainware shortly after Plainware appeared in Tonga. Data obtained through U/Th dating of coral as well as radiocarbon dating of charcoal in Tonga and Samoa suggest a rapid adoption of Plainware, thus raising the question of whether Plainware evolved out of Lapita or represents a population and culture distinct from Lapita.

Most pottery found at Pacific sites regardless of age was manufactured with clay and sand temper local to the area surrounding a site, although there are documented cases involving the transfer of materials between islands (Dickinson and Shutler 2000:211). Multiple manufacturing methods were utilized for producing ceramics in the Pacific, but some methods were more prevalent than others. Slab construction supplemented by paddle and anvil was one of the most common methods of ceramic manufacture found at Oceanic sites, especially those containing Lapita ceramics, although coiling was also utilized (Chiu 2007:241). After manufacture, vessels were fired in open-air kilns at temperatures between 600-900 degrees Celsius (see Claridge 1984; Intoh 1990; Clough 1992). Due to the range of temperatures used to fire ceramics in Oceania, pottery from the region is considered earthenware. Some traits of earthenware ceramics such as temper composition can be more easily examined than in other forms of ceramics.

Many researchers have examined attributes of pottery to understand their significance. Dickinson and Shutler (2000) performed petrographic analysis to determine where tempers used in Oceanic vessels originated. The pair examined 1,558 thin-sections of sherds recovered from nearly 100 islands (2000:207). They found that vessels produced in Oceania had distinct geological compositions that could be used to determine which island a pot originated. By being able to source sherds, the pair argued that it is possible to track the movement of ceramics within Oceania. This is important information that can be used to expand the ceramic record of Oceania, and more specifically Samoa.

Samoan Ceramic Background

Pottery production in the Samoan Archipelago has a long history that has not yet been fully interpreted by archaeologists. As a result, the sequence of ceramic production in American Samoa has not been completed and likely misses important information (Ayres et al. 2000:228). In early analyses based on the collections that had been found, it was argued that Samoan ceramic production lasted for a roughly thousand-year period and contained many characteristics similar to those found in pottery from Tonga (Green 1974c:245). Groube suggested that due to the similarity between Samoan and Tongan ceramics, the Samoan ceramic tradition likely evolved from the Tongan tradition (1971:312). Some of the earliest pottery found in American Samoa was recovered from To‘aga on Ofu Island that was dated to 800 BC or earlier, and it has been suggested that ceramics from Layers VII and VIII of ‘Aoa on Tutuila Island date to the same period (Clark and Michlovic 1996:163).

There has been only one site found in the Samoan Archipelago that produced dentate-stamped Lapita sherds. The Mulifanua site on ‘Upolu was found underwater during dredging prior to the construction of a ferry landing in 1973 (Jennings 1974). A total of roughly 5,000 sherds were recovered with 5-7% being dentate-stamped (Green and Richards 1975). Due to the presence of dentate-stamped sherds, Mulifanua represents the easternmost extent of Lapita expansion. Radiocarbon dating has indicated the site was probably first occupied between 930-800 BC (Petchey 2001). Mulifanua is considered both the oldest known site in the Samoan Archipelago and the only site that is definitively Lapita in origin. All other pottery in the archipelago has been classified as what Green (1974b) termed Plainware.

Green argued that ceramic production lasted in Samoa until around AD 200-400 when all unequivocal evidence of pottery use disappeared from the archaeological record (Green

1974a:174). While many accept Green's early model of pottery production in Samoa, Clark and Michlovic have suggested that the ʻAoa Valley of Tutuila produced pottery until roughly AD 1600 (Clark and Michlovic 1996:163). Although a sequence has been created for Samoan ceramic production as a whole, local sequences have not yet been developed for most of the Samoan islands that have been considered acceptable to the majority of scholars (Hunt and Kirch 1988:153).

One of the most significant problems in Samoan archaeology has been the dating of sites. Many excavations in Samoa have provided radiocarbon dates that cover over 2,500 years. Although many dates have been proposed, some scholars critique the acceptability of many of the early dates. One of the main reasons that dates are disputed is the lack of dated materials recovered from secure depositional contexts. Rieth and Hunt (2008:1905) have suggested that radiocarbon dates assigned to Samoan sites should undergo "chronometric hygiene" in order to determine if they are acceptable. Of the 236 radiocarbon dates analyzed by Rieth and Hunt, only 147 (62.3%) were considered acceptable for use under their criteria (Rieth and Hunt 2008:1906). Rieth and Hunt's analysis demonstrated the need to evaluate carefully the dates assigned to Samoan sites by their excavators in order to develop a timeline for Samoan ceramic production that is backed by evidence considered academically acceptable.

Clark et al. (2016) have recently used Bayesian modeling of charcoal radiocarbon dates together with U/Th dating of coral to refine the initial date of occupation of Ofu Island. They produced a date of colonization that fell between 2774-2647 calBP (95.4%). This date places the occupation of Plainware sites on Ofu Island in the supposed chronological gap suggested by Rieth and Hunt between the Lapita site of Mulifanua and the later Plainware sites of the Samoan

Archipelago. This example demonstrates the need for further research to be undertaken to develop a more complete chronology of ceramic manufacture in the archipelago.

Classifying Samoan Pottery

Archaeologists have typically divided pottery into categories that allow for easier analysis between sites and through time. The term “ware” has been used by many scholars as a way to refer to specific groupings of ceramics. While researchers use the term as a way to classify pottery, it has had multiple definitions based on the individuals using the concept (Shepard 1956). Ware could be defined as a broad class that is based on ceramic attributes such as decoration and function that are unattached to location or time. Another interpretation of ware is that it is a synonym for type, representing a category based upon technical or stylistic similarities of sherds that can be used to develop chronological sequences. These definitions are problematic in that they do not accurately reflect change over space and time. As such, terms such as “ware” need to be evaluated carefully to determine if they hold significance when examining ceramic assemblages.

Samoan ceramics can be divided into two categories with one category consisting of two subcategories. The first category includes pottery that meets the diagnostic criteria of Lapita. This group contains a highly diverse collection of ceramic vessel types that includes jars and bowls. Lapita pottery found in Samoa is similar to other Early Eastern Lapita assemblages excavated in Tonga. The Lapita ceramics that have been recovered are the most complex form of pottery found in Samoa. These sherds are decorated with a variety of methods; primarily dentate stamping with some incising, slipping, and lip modifications (Green 1974a:173). The second category includes pottery that has been classified as Plainware. The first subcategory of this group is what Green termed “fine-tempered thin ware” ceramics that occurred early in the period of Samoan ceramic manufacture. This subcategory of pottery contains some non-dentate decoration near the vessel rims, but mostly contains sherds without decoration (Green 1974b:118-121). This group of ceramics also contains fewer types of vessels when compared to earlier Lapita assemblages. Simple bowls were the predominate form of pottery for this subcategory. The second subdivision is "coarse-tempered thick ware" pottery that in Green's scenario occurred near the end of ceramic production in Samoa. The thick ware ceramics found do not contain any form of decoration and are generally of lower quality than thin ware pots (Green 1974b:118-121). While the category of Plainware has been separated into two subcategories based upon temper size and sherd thickness, the importance of these distinctions is still a subject for debate.

Although Green created the categories of "thin ware" and "thick ware", he did not provide detailed criteria for how to place sherds into the two groups. As a result, scholars have used their own criteria for determining what constitutes thin ware and thick ware ceramics, leading to conflicting definitions for the categories. While few scholars agree on how to classify thin and thick sherds, many, following Green, have suggested that there was a general transition from thin-walled pottery into thick-walled pottery across Samoa. Cochrane et al.'s (2013:508) analysis of Tula Village sherds from Tutuila led them to suggest that the transition from thin to thick pottery occurred at roughly the same time across Samoa, and that radiocarbon dates from both 'Upolu and Ofu support this view.

Classifying ceramics based upon thickness and other changes over time has occurred in regions outside of Oceania. In North America, Braun (1991) recognized that Woodland ceramics changed in thickness over time. Contrary to the pottery of Samoa, Woodland ceramics decreased in thickness overtime while increasing in quality (1991:373-374). Braun proposed that thick-walled vessels were dominant in early Woodland ceramic assemblages due to being able to hold larger capacities than thin-walled vessels. Only with the introduction of new manufacturing methods were larger, thin-walled vessels able to be produced. The ability to create thin-walled vessels with similar capacities as thick-walled pottery was the likely cause of thick-walled pottery falling out of use (1991:376). Although this study does not represent the changes that occurred in ceramic technology in Samoa, it does show that archaeologists have recognized that changes in ceramic thickness can be used to interpret changes in ceramic manufacture.

Many scholars have struggled to further divide categories of Samoan ceramics. Holmer (1980) attempted to divide Green's categories into smaller groups. He identified seven types of pottery from sites excavated in Western Samoa. These types are included within the Lapita Brown Ware and Samoan Brown Ware divisions. Lapita Brown Ware consists of the Mulifanua Brown Series that is represented by the Mulifanua Lapita type. The Samoan Brown Ware division is larger and contains both the Manono Brown and ʻUpolu Brown Series, both of which are Plainware assemblages. The Manono Brown Series contains a coarse, fine, and tan version of the Falemoa type. The ʻUpolu Brown Series contains a coarse, fine, and slipped version of the Faleasiʻu type (Holmer 1980:108-109). These categories may be useful for classifying sherds collected from sites examined in western Samoa, but do not necessarily apply to ceramic assemblages elsewhere in Samoa, namely in American Samoa. For example, different sherd fabric is likely to be a result in large part of different clay sources as well as firing conditions. Due to this, few scholars have accepted Holmer's method of classification as useful for application to Samoan ceramics on a larger scale.

In addition to Holmer's classification categories, ceramic attributes such as temper have been used to assign sherds relative ages that fit into the conventional sequence of Samoan pottery production. Dickinson and Shutler (2000) determined that tempers used in Samoan ceramics included beach and colluvial sands in addition to angular basaltic material believed to originate from adze quarries. Grog temper produced from previously crushed pottery was also used in some vessels found on Tutuila and Ofu, although this temper type is relatively uncommon in Samoa when compared to other island groups (2000:250). Ceramics that are early in age generally have a higher percentage of calcareous sand temper present when compared to pots produced near the end of ceramic manufacture in Samoa (Kirch et al. 1989b:31). Hunt and Erkelens (1993:129) found that thin-walled ceramics, which are usually associated with calcareous temper, have a higher proportion of lithic temper when compared to calcareous temper. Generally it has been assumed that calcareous temper is associated with early thin-walled pottery.

The petrographic analysis performed by Dickinson and Shutler (2000) supports the conclusion that calcareous temper is most common early in the archaeological record in Oceania and slowly declines in prevalence over time. The pair suggested that calcareous temper use was likely discontinued due to its association with increased spalling of vessels during the firing process unless saltwater was used during manufacture (2000:214). In comparison, thick-walled pottery that is later in age contains a high percentage of coarse non-plastic temper usually consisting of andesite and feldspar. Kirch has implied that this non-plastic temper is not manually added to the clay and is instead naturally present (Kirch et al. 1989b:33).

Similar evaluation of Samoan ceramics as is completed in this project was performed by Smith in the mid-1970s. He looked at sherds from the Paradise, Ferry Berth (aka Mulifanua), and Jane's Camp sites of ʻUpolu in western Samoa (Smith 1976:86). Smith recorded multiple ceramic attributes in order to create distinct groupings of pottery. Three categories were defined based upon sherd thickness and temper size. Type I sherds were classified as "coarse thick ware", while type II included sherds that were "fine thin ware". Type III ceramics were fine textured similar to type II, but varied in thickness (Smith 1976:86). These three categories were taken to demonstrate the transition from Lapita ware to that of Polynesian Plainware as proposed by Green (1974:249-250). Cochrane et al.'s analysis of sherds recovered from the Tula Village site supports this model of thin-walled ceramics transitioning into thick-walled pottery, although it is noted that there is deviation present in most collections (Cochrane et al. 2013:505). Hunt and Erkelens' study of sherds from Toʻaga also supports the presence of distinct thin and thick categories of pottery (Hunt and Erkelens 1993:123).

Excavations in American Samoa

Since the early 1980s, multiple excavations have been undertaken in American Samoa, although fewer excavations have taken place in the Manuʻa group compared to Tutuila. Even so, multiple excavations at ceramic-bearing sites have occurred on the island of Ofu. Test pits by Best (1992) established the presence of ceramics at the site of Vaʻoto (AS-13-13) and Clark has directed six seasons of excavation at the site (reports and publications forthcoming). Clark and colleagues have excavated ceramic deposits at the Coconut Grove and Ofu Village sites also on Ofu. Radiocarbon dating puts initial occupation at all of these sites at 2717-2663 calBP (68.2%) (Clark et al. 2016).

On Ofu Island, Hunt and Kirch (1993) carried out excavations at the Toʻaga site (AS-13-1). The 1,464 sherds collected from this site do not have decorations commonly seen on Lapita sherds of similar age. All sherds found were Plainware, with only 5% being rims. Both thin and thick ceramics were present with thin sherds being found in lower stratigraphic levels than thick sherds (Kirch et al. 1989b:30). The fine-tempered thin-walled sherds were highly oxidized and have thicknesses that ranged from 4.2-7.7 mm. In contrast, coarse-tempered thick-walled sherds contained incompletely oxidized cores with thicknesses ranging from 11.7-17.0 mm (Kirch et al. 1989b:30). Radiocarbon dates gathered by Kirch for To‘aga indicated the then-accepted model of human occupation for Ofu beginning at 1700-1300 BC (Kirch et al. 1989a:10), but those early dates have been criticized by Rieth and Hunt and others. The recent Bayesian modeling by Clark et al. (2016) suggests that occupation was more in line with the dates at the other early sites on the island, i.e., 2717-2663 calBP (68.2%). To‘aga is important due to it being one of the largest finds of sherds in Samoa. The site itself is well-stratified and covers an extended period of ceramic production (Hunt and Erkelens 1993:123). Similar data have been gathered from other excavations in American Samoa.

At the site of ‘Aoa (AS-21-5) in Eastern Tutuila, Clark and Herdrich (1993:170) recovered sherds of varying thickness similar to those found by Kirch and Hunt at To‘aga. Clark and Michlovic (1996) further excavated ‘Aoa in 1991. The total sherd count for the site is 878, including 31 rims. Two categories of pottery were defined with X-ray diffraction based upon paste composition. As seen at To‘aga, thick sherds are found in higher levels, while thinner sherds are more common in lower levels of the deposit (Clark and Michlovic 1996:161).

Two distinct periods of ceramic use have been proposed for ‘Aoa. Layer VII was dated to the period of initial occupation of Samoa roughly 3,000 years ago. This age is contemporaneous with the Lapita site of Mulifanua on ‘Upolu and To‘aga (Clark 1993:325). Although ‘Aoa was suggested to have been the same age as the Mulifanua site, it did not produce sherds that are of Early Eastern Lapita Style as reported by Green and Richards (1975:313).

Instead, all sherds found at A’oa are Plainware. Radiocarbon dates obtained from materials directly overlying layer VII suggest that ‘Aoa is the oldest site found in American Samoa so far with a calibrated date of 1439 BC (Clark 1993:325). However, few if any scholars today, including Clark, accept that as a valid date. Layers II-V are much more recent and have been dated to AD 1400-1600 (Clark and Michlovic 1996:163). A few other excavations in American Samoa have produced ceramics with similar dates as those found in the upper layers at ‘Aoa, but many of these dates have been attributed to the disturbance of older deposits due to a lack of conformity with Green’s model of Samoan ceramics (Clark 1996:451). However, hydration-rim analysis of volcanic glass from both the upper and lower layers refuted the idea of disturbance between the layers, thus supporting the argument for late ceramics (Clark et al. 1997:902-903). Nevertheless, many people question the late ceramic dates at ‘Aoa.

Suafo‘a’s excavation of Malaeimi on the Tufuna Plain, on Tutuila, as cited in Ayres et al. (2000:229), has yielded one of the largest collections of ceramics from American Samoa. Over 5,000 thin and thick sherds were recovered from this site with a relatively late date of AD 800-1200. This site is important because it appears to demonstrate a progression from fine-tempered thin sherds to coarse-tempered thick sherds.

Addison’s excavations at the Pava‘ai‘i site in Tutuila provide further evidence of pottery use in American Samoa. Sixty sherds were recovered that have been classified as Polynesian Plainware (Addison et al. 2006:11-12). Pava‘ai‘i is significant due to the geology associated with the site. Volcanic activity occurring around the time of human occupation resulted in a layer of volcanic ash forming directly above the pottery-bearing level of the site (Addison et al. 2006:13). This layer of ash allowed Addison to date when pottery use declined at Pava‘ai‘i. A radiocarbon date of AD 240-640 was obtained that is thought to be representative of the abandonment of ceramics at this site (Addison et al. 2006:13).

The combination of data acquired from these sites has allowed archaeologists to develop a tentative history of ceramic production for American Samoa. While a history has been created, few accept all aspects of it. As a result, more research is needed to further strengthen what is known about the ceramic record of American Samoa. It is important to note, however, that thus far, no dentate-stamped sherds indicative of true Lapita pottery have been found at any archaeological deposits in American Samoa, or for that matter at any sites in the entire Samoan Archipelago other than Mulifanua. With this background and context in mind, I turn to the investigation that is the subject of this thesis.

CHAPTER 3. METHODS

This chapter will present background information on the methodological approaches utilized in this thesis: physical analysis, computed tomography, and residue analysis. These methods will be employed to address the set of questions laid out in the introduction. Through the use of these methods, data can be obtained that can determine the viability of each method in addition to documenting changes in ceramic manufacture in American Samoa.

Physical Analysis

Physical analysis has been the primary method of study used to obtain data from ceramic analyses. This thesis uses "physical analysis" to describe conventional laboratory inspection. The main use of this method has been to record the physical properties of sherds (Shepard 1956). Through this form of examination, scholars have been able to document changes in ceramic manufacture by recording a wide variety of measurements (see Orton et al. 2013; Rice 1987; Shepard 1956; Sinopoli 1991). Conventional analysis is often performed in an archaeological laboratory employing a combination of tools including microscopes, calipers, scales, and color charts. During physical examination ceramic attributes are documented including sherd weight, thickness, size, and decoration. Other attributes such as temper type and size, temper percentage, color, and oxidation pattern are also typically recorded. Measurements are compiled into large datasets that are used for interpretation.

The data obtained from examining these sherd attributes can provide significant information about the vessel from which that a pottery sherd came. Through physical analysis it is sometimes possible to determine what techniques were used to manufacture pots, what materials were utilized, and the temperatures used to fire pottery. While much data can be gathered from conventional analysis, information can be missed due being unable to examine the clay matrix of sherds. This makes it difficult to accurately document attributes such as the amount of temper present throughout a sherd and whether temper was manually added to clay or is naturally occurring. These attributes can better be examined using the next method of analysis discussed in this chapter, computed tomography.

Computed Tomography

Background

Computed tomography (CT) has been a very important method of study for a variety of disciplines. CT scanning was originally developed as a non-destructive radiological technique for medical purposes (Applbaum and Applbaum 2005:232). The first CT scanner was developed in the early 1970s thanks to the invention of personal computers with more processing power than what had previously existed (Hughes 2011:58). CT scanners work in a manner similar to that of conventional x-rays by using an x-ray source to penetrate an object in order to determine the rate of absorption of x-rays over the entirety of the object under study. Multiple slices of the item are captured that can be manipulated to view the study sample in three-dimensional (3-D) perspective, as compared to the two-dimensional (2-D) images produced by conventional x-ray (Hughes 2011:58-59).

Although computed tomography has been explored for archaeological purposes, it is not the only digital imaging method to be tested over the last few decades. Greene and Hartley (2007) explored the use of digital radiography for ceramic analysis. The goal of their study was to develop a series of parameters for utilizing digital radiography in the examination of Eurasian pottery sherds. The pair was able to determine that digital radiography could be used in a manner similar to CT for ceramic analysis. They were able to discern attributes such as manufacturing method, void presence, and inclusion distribution within the clay matrix of sherds

(Greene and Hartley 2007:11-12). Although results were obtained that they used to determine ceramic characteristics, the images produced with their exploratory method were not as clear as those produced with the CT scanner utilized for this thesis.

Computed tomography can be divided into two categories: traditional CT and micro-CT. The main difference between these two forms is the relationship between the x-ray source and the object of study, and which of those is rotating around the other. For standard CT scanners, the x-ray source rotates around the object of study allowing for a rapid collecting of scans (Applbaum and Applbaum 2005:233). Micro-CT scanners instead have a stationary x-ray source and a rotating platform holding the object of study. The benefit of a stationary x-ray source is that it provides better stability allowing for easier alignment of scans in later reconstructions. Another benefit of micro-CT over traditional CT is that more subtle variations in the objects examined can be detected (Kosar 2013:48).

A major advantage of CT scanning over other methods of examination is that the images produced display the interior of an object in three-dimensions without compromising the integrity of the item being studied. Another benefit of CT is that it requires fewer conditions to be met for usable results to be produced compared to methods such as MRI and ultrasound. CT can be used on items that have variable levels of both moisture and air present; while MRI and ultrasound are rendered ineffective by those conditions (Hughes 2011:59). It is this capability for use in a variety of different conditions that makes CT scanning beneficial for disciplines such as archaeology.

Although CT scanners can be beneficial for archaeological studies, careful analysis is needed when comparing results obtained from multiple machines. Levi et al. (1982) have suggested that values can vary between scanners when scanning the same material or object.

Nevertheless, the level of variation between scanners is negligible for most studies. As a result, scholars are able to compare data obtained from different sources with relatively little issue.

Since the development of the first CT scanner, some scholars have proposed using the technology for archaeological purposes. Applbaum and Applbaum (2005) have presented multiple reasons for the use of CT scanning in the study of artifact assemblages. CT is a non-destructive and fast method for examining artifacts. The results obtained from CT scans can also be stored for use in future studies minimizing the need to reexamine an artifact. According to Applbaum and Applbaum (2005:232), one of the greatest benefits of CT is the widespread availability of the machines required to produce scans. Most modern hospitals contain CT scanners that potentially can be rented out for use in archaeological studies. But, even though CT scanners are found in many hospitals, few are set up in a manner useful for archaeological research. As a result, few institutions may be willing to adjust their CT scanners for examining archaeological materials.

Supporters of CT in archaeology have also suggested that the method could be used to link archaeological studies from around the world. These supporters have promoted the idea of a "virtual museum" that could house the data files from CT scans used within individual research projects (Abel et al. 2011:882). The combination of these traits make computed tomography an ideal candidate as a method that could be used in future archaeological research.

Uses of CT in Archaeology

While CT scanning has many potential benefits in archaeological studies, few scholars have utilized the method for artifacts such as pottery. Instead, the main use of CT scanners has been for the study of mummies. The first examination of a mummy with a CT scanner occurred in 1977 as part of Harwood-Nash's research in Toronto (Hughes 2011:60). Since Harwood-

Nash's work, many other scholars have utilized CT scanners for mummy research. One of the most prominent demonstrations of CT use occurred in Austria during the early 1990s. A CT scanner was employed during the examination of Otzi the Ice Man and revealed the probable cause of his death. The scans displayed an arrowhead embedded in the shoulder of the Ice Man, along with health issues including arteriosclerosis (Hughes 2011:62). The results obtained from the examination of Otzi demonstrate some of the possible benefits of using CT scanning for archaeology. CT scans can provide results that might be overlooked if other methods of examination are used in their place.

Another example of CT use in archaeology would be that undertaken by Baumann et al. (2008). Baumann and colleagues utilized micro-CT in their study of papyrus scrolls that could not be unrolled safely for physical examination. In order to test the effectiveness of this method, micro-CT was used to examine a fifteenth century manuscript that had been reused as the binding of a more recent book (Baumann et al. 2008:5). The results obtained from this experiment indicated that CT is useful for examining the interiors of objects without the need for physical inspection. Due to the potential of CT, Baumann and colleagues have planned future research utilizing micro-CT to examine a scroll from the Egyptian Book of the Dead (Baumann et al. 2008:6).

Although most examples of CT use within archaeology involve non-ceramic artifacts, there has been some exploration of the method for the study of ceramics. Two of the most prominent scholars to utilize CT for the study of ceramics are Applbaum and Applbaum (2005). They have used CT for examining cuneiform tablets contained within clay envelopes from Mesopotamia. The pair also tested other methods such as traditional x-rays and conventional tomography, but neither of those methods was able to produce a clear image that could be used to examine the tablets. The use of a CT scanner allowed Applbaum and Applbaum to produce images that displayed the cuneiform text written on tablets without damaging them or their clay envelopes, which usually also contained valuable information (Applbaum and Applbaum 2005:234-236).

Applbaum and Applbaum also used CT scanning to determine how ancient clay figurines from Jordan were created. They examined an anthropomorphic figure from the site of Shaar Hagolan using a third generation CT scanner. The results produced by their CT scans demonstrated that multiple construction techniques were used to produce clay figurines found at the site. Previous to the scholars' research, it was commonly believed that Yarmukiam figurines were created using a standard core method (Applbaum and Applbaum 2005:240-241). The results of the CT scans revealed that slab construction and modeling were also used at this early site. The CT images displayed air voids produced by the folding of the clay during the construction stage along with areas of the figurine that were produced by adding additional pieces of clay to the main body (Applbaum and Applbaum 2005:243). These methods of construction would not have been discovered without the use of a CT scanner unless the figurine was physically broken for examination. The research of Applbaum and Applbaum demonstrates the potential effectiveness of CT scanners for the study of ceramics.

Residue Analysis for Ceramics

Background

Residue analysis is a method that has not seen widespread application to ceramics from Oceania. This is especially true for pottery recovered from archaeological sites in American Samoa. There are, however, case studies of the method being applied to pottery from other regions of the world. The idea of analyzing residues adhered to pottery sherds was first suggested by Gill during his study of Mycenaean pottery found in Egypt (1906). While Gill was the first to propose residue analysis for ceramic studies, the method was not considered viable until the 1970s when instruments were developed for interpreting chemical compounds found within residues. Residue analysis as a method was continuously refined throughout the 1980s and 1990s providing more accurate results for ceramic analyses involving organic residues (Reber and Hart 2008:129).

Although many ceramic analyses involving residue analysis have focused on determining the type of organic materials held in vessels, some studies have had a more general goal. Dunnell and Hunt's work attempted to determine what ceramic vessels were used for, whether for food preparation, water boiling, or some other use (1990:331). To accomplish this, phosphorus levels were analyzed in sherds to determine the use of the examined ceramics prior to deposition. A series of sherds including three from American Samoa were examined for phosphorus. The pair found that sherds from vessels used for cooking contained a distinctive phosphorus residue that could be used to potentially identify the ceramics' previous use. Although Dunnell and Hunt obtained results similar to previous phosphorus studies, such as that of Cackette et al. (1987), they have cautioned that additional work needs to be undertaken to confirm the method's validity for determining how ceramics were used (1990:334).

An early case study of residue analysis involving ceramics was performed by Evershed et al. in 1990. The group utilized high temperature gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) to examine sherds obtained from excavations in the United Kingdom (UK) (Evershed et al. 1990:1339). The sherds examined for residues in that study were destroyed in order to provide powder that could be combined with an organic solvent prior to GC-MS. This technique is different from that used in other studies due to the requirement that the sherds be completely destroyed. Through this study, Evershed et al. came to the conclusion that pottery sherds are an ideal type of artifact for residue analysis due to lipids being absorbed into the porous walls of ceramic vessels. This absorption decreases the breakdown of lipids in addition to limiting the amount of lipid contamination that could occur allowing for more accurate residue identification (Evershed et al. 1990:1339).

In 1994, Evershed and colleagues explored other methods of residue analysis for the study of ceramics. For that research, isotope ratio monitoring gas chromatography-mass spectrometry (irm GC-MS) was applied to sherds from the UK that were similar to those examined in 1990 to determine what lipids that had adhered to the examined sherds represented (Evershed et al. 1994:909). This study was the first to use irm GC-MS to examine residues recovered from archaeological sites. Irm GC-MS is less frequently used due to having more requirements than other methods for obtaining usable data. Traces of sulfur cannot be present in samples in addition to 100 ng of material per component being necessary for completion of a successful analysis. Single, well-resolved components are also required for this method (Evershed et al. 1994:910). Due to the strict requirements of this technique, irm GC-MS has been used mainly in molecular organic biogeochemistry studies. For the Evershed et al. study, portions of each sherd were ground up in order to examine the absorbed residues contained in the samples. Each sample was then mixed with an organic solvent and sonicated for thirty minutes. After sonication, the solvents were removed from the samples allowing the residues to be analyzed with GC, GC-MS, and irm GC-MS. The results obtained from the three investigations indicated that irm GC-MS is a viable method for the residue analysis of ceramics. Each analysis resulted in similar findings indicating that *Brassica* (wild cabbage) vegetables were cooked in the vessels (Evershed et al. 1994:914).

Another case study of residue analysis applied to ceramic sherds is that of Copley et al. and their study of Egyptian pottery (2001). The goal of this study was to determine if palm fruit was consumed in antiquity similar to how it is in the present. Copley and colleagues utilized three forms of Gas Chromatography (GC) to complete their research. Similar to the Evershed et al. 1990 study, sherds were pulverized with a mortar and pestle in preparation for GC. The results obtained from this study indicated that palm fruits such as dates were prepared in ceramic vessels at the site of Qasr Ibrim in Egypt. The researchers arrived at this conclusion through the examination of short-chain fatty acids. These chains are considered unique for each organic material allowing for accurate identification of residues adhered to pottery walls (Copley et al. 2001:597).

Craig et al. (2011) performed residue analysis in their study of Northern European ceramics and the relationship between the establishment of farming and pottery vessels. The goal of the study was to determine how ceramics were used in the Early Neolithic during the period when domesticates were being introduced in Northern Europe. Craig and colleagues wished to determine if domesticated plants, wild plants, or marine resources were consumed from the vessels examined. The scholars analyzed lipids found on the walls of ceramics (Craig et al. 2011:17910). Portions of each of the 220 sherds selected for the study were crushed and mixed with an organic solvent to extract residues. The residue-solvent mixture was then analyzed with GC-MS. The results obtained from the research indicated that Northern European populations used all three sources of food over the entirety of the period being examined. This conclusion contradicted previous research that stated there was a change in resource utilization that directly correlated with the introduction of a new economic package to the region (Craig et al. 2011:17912).

Oudemans and Boon's 1991 study of Roman pottery employed a relatively uncommon form of residue analysis for examining the organic residues on pottery. They used Curie-point pyrolysis GC-MS (CuPy-GC-MS) to identify charred residue found on sherds from the Uitgeest-Groot Dorregeest site in the Netherlands. This method is different from other forms of residue analysis in that samples can be compared to each other on a molecular level (Oudemans and Boon 1991:198). Another difference in this method is that residues are evaporated and pyrolysed into volatile fractions prior to GC-MS (Oudemans and Boon 1991:202). The goal of that research was to test the applicability of CuPy-GC-MS for examining organic residues adhering to sherds and to determine if multiple residues could be differentiated from one another. Residues were scraped from sherd surfaces in addition to small amounts of the sherds being pulverized for separate examination. The thirty-three samples examined provided evidence for multiple residues being present on the sherds (Oudemans and Boon 1991:206). As a result, the pair has recommended the use of CuPy-GC-MS as a viable method for future ceramic analyses (1991).

Reber and Hart (2008) examined lipids found on sherds from the American-Northeast, specifically New York State. One of the goals of that study was to analyze residues to determine the types of resin used to seal vessels in the region. Two different forms of residue were examined, i.e., absorbed residue and visible residue. Absorbed residues are those found within the clay matrix of a sherd resulting in the need to pulverize sherds in preparation for analysis. Visible residues are found on the surfaces of sherds and can be removed without compromising sherd integrity. Visible residues are also believed to represent the last use of a vessel. Absorbed residues are thought to have three possible sources. These sources include the use of a vessel, the burial environment, and organic material present in the clay prior to vessel manufacture

(Evershed et al. 1994:909)   Reber and Hart stated that absorbed residues could provide more information than visible residues, however, examining visible residues is not destructive to pottery sherds, thus allowing for future analysis (Reber and Hart 2008:129,131). Those researchers used GC-MS to analyze both categories of residues, and the results indicate that both absorbed and visible residues found on the sherds represented three categories of organic material. Meat and plant biomarkers were found in addition to pine residue. The pair suggested that the presence of pine resin in both forms of residue indicates that Northeastern vessels similar to those examined were waterproofed using the resin (Reber and Hart 2008:133).

Similar to Reber and Hart's study, Mitkidou et al. (2007) performed residue analysis of ceramics from Northern Greece to determine what kind of tar was used to waterproof pottery vessels in addition to gluing broken pots back together. Three previously identified tree resin tars were selected for comparison to the residues found on the sherds examined. These tree tars were prepared through pyrolysis of silver birch, hop hornbeam, and Eastern hornbeam bark. Visible and absorbed residues were obtained from the selected sherds by scraping sherd surfaces in addition to grinding up a portion of each sherd. These residues were then sonicated and analyzed with GC-MS (Mitkidou et al. 2007:494-495). The results obtained indicated that birch tar was common in the examined residues, although pine pitch and resin were also present in high amounts. Tars made from either species of hornbeam were not found in any of the residues. Mitkidou and colleagues concluded that birch tar was likely the primary tar used to seal ceramic vessels in Northern Greece. The presence of pine resin and pitch was unexpected because the substance was not commonly reported in previous studies. As a result, the scholars proposed that pine, used as both a glue and a sealant, may have been more extensively utilized in Neolithic Greece than previously thought (2007:498).

Summary

These methods have provided important information that can be beneficial for the study of pottery. Traditional physical analysis has been the source of most data obtained during ceramic analyses, although new methods have been developed that can also be employed. Both CT scanning and residue analysis have been used to gather important information that might otherwise go unfound. While these two methods have many beneficial attributes, there are issues with each that have to be addressed. CT has limited application and the full capabilities of the technique are not yet known. Residue analyses are few in number and prior uses of the method have been destructive to pottery sherds. This thesis will use a combination of these three techniques to determine the capabilities of each method in addition to examining changes in pottery in American Samoa.

CHAPTER 4. DATA COLLECTION AND ANALYSIS

In this study I evaluated a collection of ceramic sherds recovered from four sites excavated in American Samoa by Professor Jeffrey Clark. The study sample consisted of 43 sherds that were examined using CT scanning, 10 sherds from the Ofu Village and Va‘oto sites were evaluated through residue analysis, and 1,424 sherds from the Va‘oto site were examined through physical analysis. This chapter discusses the procedures employed for each of the three methods utilized in this research.

Study Sample

While most sherds were archaeological in nature, a set of nine experimental sherds was manufactured to be used as comparative samples for the CT and physical analysis portions of this thesis. These nine sherds were produced from clay samples recovered from the Ofu Village and Va‘oto sites. Two methods of construction were employed in addition to multiple temper sizes being used. This allowed for better comparison to archaeological samples to verify if attributes such as construction method and temper distribution were similar between samples.

Archaeological Sample

These sites are found on two islands: on Ofu Island, sites AS-13-13 (Va‘oto), AS-13-41 (Ofu Village), and AS-13-37 (Coconut Grove); and on Tutuila Island, site AS-21-5 (‘Aoa). In order to analyze ceramics from these sites, measurements were obtained in the NDSU Archaeological Materials Lab. The sherd characteristics used by Hunt and Erkelens (1993:124-125) in their analysis of To‘aga assemblage have been employed in a modified form for this study. A copy of the record sheet used for recording measurements can be found in Appendix A.

After completion of the physical analysis portion of this study, a sample of 34 sherds from the assemblages collected from the sites was selected for expanded study. Of these, four sherds were selected for each of the sites of Ofu Village and Coconut Grove. Eight sherds were chosen from ‘Aoa, on Tutuila, with four sherds representing each of the two pottery-bearing components. Sixteen sherds came from the Va‘oto assemblages, four from each of four distinct layers in order to determine if there were changes in ceramic production at the site through time. Two additional sherds from Va‘oto were scanned that are thought to be part of a single, nearly complete, vessel.

Experimental Sample

An additional nine sherds were used that were part of an experimental collection produced to serve as control samples for examining temper distribution and manufacturing methods found in the Samoan sherds. These sherds were produced in the NDSU Art Department using clays recovered from non-cultural deposits at Va‘oto and Ofu Village. Due to the dryness of the clays after being stored for over a year, the clay was re-hydrated so it could be used to form ceramic disks. To re-hydrate the two clays, water was added to the clays in separate buckets. To prevent adding too much water, a proportion of 3/4 cup water was added to one cup clay. Additional water was added as needed for the re-hydration process. This proportion was suggested by members of the NDSU Art Department who had previous experience with re-hydrating clay. The clays were left to soak in water overnight. After the clays were satisfactory re-hydrated, they were brought to the NDSU Art Department and used to produce ceramic disks that would be examined for multiple sherd attributes present in this study’s archaeological sherd collection.

Each of these nine test disks was produced and fired in the ceramics room of NDSU’s Art Department under the supervision of ceramicist David Swenson. An undergraduate student helped during the formation process of these pieces. Each ceramic disk was produced to be the same relative size and thickness. For disks produced with clay from Va‘oto, this was difficult to achieve due to the low viscosity of the clay after re-hydration. The clay from the Va‘oto site was difficult to work with when compared to the clay from Ofu Village. The low viscosity of the Va‘oto clay made producing coiled disks impossible. As a result, all coiled samples were produced using Ofu Village clay. Overall, the Ofu Village clay was much easier to work with when compared to the Va‘oto clay. Due to the material's superior workability, seven out of nine test disks were produced using Ofu Village clay. The two samples produced with Va‘oto clay consisted of a disk with no temper added (natural temper) and a coarse sand-tempered disk produced with slab construction. The seven disks produced with Ofu Village clay represent each category of fine, coarse, and natural temper, in addition to both coiling and slab construction.

After the test disks were produced they were placed on a humidity-controlled shelf to dry slowly for seven days in order to minimize cracking of the clay that commonly occurs if pieces are dried too quickly. After drying the samples were placed in an electric kiln and fired overnight using a 018 firing cone to regulate the temperature of the kiln. When the kiln reached a pre-defined temperature, the cone melted and triggered the shut off switch of the kiln (NDSU Ceramicist David Swenson personal correspondence). With this cone, the kiln's firing temperature reached a maximum of 734 degrees Celsius (1,353 degrees Fahrenheit). This firing temperature falls into the range of temperatures proposed in E. Cochrane's (2002:42) analysis of Fijian ceramics and R. Cochrane's (1978:100) study of pottery from Panay Island in the Philippines. After the control sherds went through a cooling period of one day, they were collected for analysis. Physical measurements were recorded for these sherds for comparison to data obtained from the 34 Samoan sherds and can be found in Appendix D. After physical analysis of these sherds was completed, each of the nine clay disks was scanned with the micro-CT scanner.

Procedure

In order to evaluate the results obtained from both the CT scanner and the physical analysis, a series of specific attributes and general characteristics was examined for each of the sherds selected for evaluation. These characteristics and attributes included:

- Method of manufacture
- Temper type
- Temper distribution within the clay matrix
- Temper size
- Thickness of sherds (average based on maximum and minimum measurements)

Each of these characteristics, with the exception of temper distribution, was evaluated through the use of traditional laboratory methods including caliper measurements and microscope analysis. The results acquired from the physical analysis were compared to data obtained from CT scans. Temper distribution was determined solely based upon the examination of CT data. The program Volume Graphics (myVGL) was utilized for reviewing CT images in order to examine the internal structure of each sherd representing a distinct category or site. The results obtained from examination were entered into a spreadsheet to chart possible trends within the ceramic groupings preliminarily identified in the assemblage. The results acquired from physical analysis in addition to CT provided sufficient data to demonstrate that ceramic production varied between sites of different locations and through time in American Samoa.

For the residue analysis portion of this study, ten sherds thought to have organic residue on their surfaces were examined at NDSU's Core Synthesis and Analytical Services Facility by Dr. Narayanaganesh Balasubramanian for traces of lipids. These sherds were sonicated to remove residues adhered to the surfaces of the samples. After completion of sonication, residues obtained were analyzed with Gas Chromatography-Mass Spectrometry (GC-MS) to determine what chemical compounds were contained in the residues. The chemical compounds were then compared to collections of known plant and animal materials in order to determine what pottery from sites in American Samoa were used for.

This thesis explored both new and old methods of residue analysis. The use of sonication for extracting residues from intact sherds during residue analysis is uncommon for the study of ceramics. As a result, this research tested the viability of a new technique of sonication for residue extraction. This form of sonication was explored because it is a less destructive method compared to those used in previous case studies involving ceramics. In addition to sonication, GC-MS was used for analysis. GC-MS was chosen because it has been the preferred method in previous residue studies. The method allows for multiple chemical compounds to be identified from the same sample allowing for a wider range of materials to be included in residue identification (Reber and Hart 2008:129). Due to the success of this method, the results obtained are used as supporting evidence demonstrating varying uses for ceramics in addition to aspects of diet in American Samoa.

Physical Analysis

For the physical analysis portion of this study, sherd attributes were measured and documented in the NDSU Archaeological Materials Lab for sherds recovered from the Va‘oto site. Six excavation units were chosen to represent the ceramic assemblage of Va‘oto. These units are: 36E/7N, 37E/7N, 38E/7N, 38E/9N, 39E/9N, and 40E/9N. These six units were adjacent to one another allowing for a larger area of the site to be examined and contained a combined total of 1,424 sherds. Each unit was two meter by one meter in size. In addition to their size and position, the units were chosen due to the relatively well-defined stratigraphic layers found in the units when compared to other areas of the site. The clarity between layers was beneficial in allowing for changes in ceramic manufacture to be charted through time. This information was combined with data obtained from CT scanning to determine if there were visible changes in ceramic production present in the archaeological record of American Samoa.

NDSU archaeology lab technicians worked on recording sherd attributes over multiple semesters. Additional analysis was completed for this research that supplemented previous work. As part of this thesis, 15 sherd attributes were recorded in a spreadsheet that can be found in Appendix A. These attributes are as follows: sherd form, surface finish, minimum thickness, maximum thickness, median thickness, average thickness, variance in thickness, sherd size, color, decoration, weight, oxidation pattern, construction method, temper type, and percentage of temper. Measurements of sherd width and length were documented with the use of a digital caliper. Thicknesses were also recorded with a caliper by averaging three measurements that included the apparent thickest point, the apparent thinnest point, and an average taken from across the surface of each sherd. Sherd color was evaluated with a Munsell soil color book for both the interior and exterior surfaces of each sample. Along with color, each sherd was examined for the presence of slipping or other forms of decoration. Cross sections were inspected for oxidation patterns that could be used to determine firing conditions. Each sherd was then weighed and evaluated for temper type. The percentage of temper in each sherd was estimated based on templates of density and recorded in a spreadsheet along with all other attributes.

Temper Analysis

The first of the characteristics examined through CT scanning and analysis was the inclusion of temper in the sherds. In order to test for the presence of added or naturally present temper in the sherds recovered from Samoan sites, three categories of temper were included in the experimental sherds. These categories were: no temper added (natural clay), screened fine sand temper less than 1/8 inch, and greater than 1/8 inch coarse sand temper. Based upon which category of temper held the most similarities with the temper distribution found in the Samoan sherds, it was possible to determine if temper was added to the clay, and if so, whether the temper could be considered fine or coarse. Further, as a control sample, the experimental sherds, made from clay obtained from the same general area as the Va‘oto and Ofu Village site sherds, were also examined through CT analysis to aid in the determination of whether temper was added to the Samoan clays for manufacturing pottery.

A previous attempt to determine if temper is naturally occurring or is manually added was performed by Dickinson and Shutler (2000). They were able to detect if certain forms of temper such as beach or stream sand were added to clay due to the presence of calcareous material. Although the pair had some success with examining temper, they cautioned that it could be difficult to determine if temper is added to clay if the clay is from a similar environmental source as the temper material (2000:213).

Braun (1982) also examined temper distribution within Woodland ceramics in North America. His goal was to detect changes in ceramic manufacture that could be attributed to changes in subsistence patterns. He used X-radiography to determine the size, shape, density, and orientation of temper particles found in the sherds analyzed. Braun determined that X-radiography would be a viable method for temper analysis if the method was further refined (1982:191).

Manufacture Method

In addition to testing the temper distribution of the sample collection, the experimental sherds were also used as a way to determine if attributes seen in CT scans of the experimental sherds were similar to what was seen in scans of the Samoan pottery. Two primary methods of manufacture were used to produce the experimental disks. These methods were coiling and slab manufacture. For disks produced with slab construction, two forms of slabs were used. Slabs were both placed next to each other and on top of one another for this form of ceramic disk. The slabs joints were then blended together for concealment. Eight ceramic disks were produced utilizing these two methods. The ninth control sample was created to test how the two collared rims recovered from the Coconut Grove site were produced. The collar of this sample was created by folding over clay and blending the seams to create what appeared to be a rim made of a single piece of clay. The rim was made this way in order to test an interpretation developed when analyzing the CT scans of the collared rims.

Micro-CT

For the CT analysis, 43 sherds were examined: 34 from archaeological sites and 9 experimental sherds. The CT investigation was completed at the NDSU Electron Microscopy Core Laboratory under the supervision of Scott Payne and Jayma Moore. A General Electric (GE) Phoenix v|tome|x s micro-CT scanner was used for this analysis (Figure 2).

Figure 2. Phoenix v|tome|x s Micro-CT Scanner.

This model of CT scanner is different from traditional CT scanners in that it is smaller in size. The dimensions of the scanner are 2,170 mm x 1,690 mm x 1,500 mm (85.4” x 66.5”x 59”). Since this scanner is smaller than other models, the size of the object that can be scanned is limited by the size of the detector. The maximum size of an object that can be examined with this machine is 260mm x 420mm. A benefit of the Phoenix v|tome|x s is that the resolution is among the highest available for micro-CT scanners. The minimum voxel size to which the scanner can zoom is two microns. The voxel is a three-dimensional unit of measurement used in CT scanning. Sample details can be detected that are less than one micron in size. The Phoenix v|tome|x s also has the ability to adjust current and voltage levels to an optimal level for each sample. The maximum voltage and power that can be used during scanning with this scanner is 240kV/320W. Adjusting these power levels was important for scanning the samples due to the idea that the higher the voltage and power during scanning, the more penetration of a sample is possible, allowing for a more detailed set of scans to be produced (General Electric 2014).

The CT analysis completed for this thesis used steps established by the NDSU Electron Microscopy Core Laboratory for all research undertaken utilizing the lab's equipment. For each day of scanning, the micro-CT scanner was warmed up for 30 minutes prior to the first scan. Identifying information for each sherd was recorded in a logbook in order to provide a record of each scan that could be accessed at a later date. After recording the information in the logbook, sherds were prepared for scanning. Each sherd was mounted on a glass rod using hot glue. This method was chosen because it is less destructive to the sherd while effectively holding the sample without movement inside the micro-CT scanner. After each sherd was prepared for scanning, a series of steps was followed for each scan in order to streamline the process. Although there are multiple methods for running a CT scan, this method was chosen as the method of choice in the Electron Microscopy Core Laboratory. Steps were followed in a manner that allowed the toolbar on the upper portion of the screen to be followed from left to right. This minimized the likelihood that steps would be overlooked or forgotten. Because CT scanning of pottery is a new technique, the sequence of steps in the procedure is outlined in detail below.

1.) Creation of a folder named after the sample's identifying number in which all CT scans and photos for the sherd were saved. These folders aided in allowing for easier access to the data for other parts of this analysis.

2.) The sample was mounted in the CT scanner's mounting assembly and secured with a chuck key (Figure 3). Securing the sherd in the mounting assembly was important to prevent the sample from moving during scanning rotations. If the sherd moved during scanning, the compiled x-ray images would not align properly with one another.

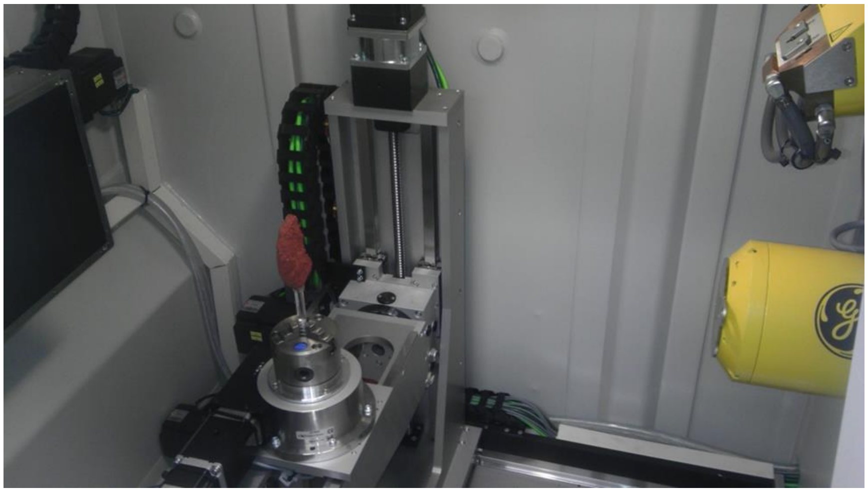

Figure 3. Sherd mounted in assembly inside scanner.

3.) This step involved configuring the scanner through the use of its monitor. To begin this process, the *live* and *histogram* options were selected and the timing was set to 100 microseconds (Figure 4). These options were found on the top of the screen on the left side of the toolbar. The *histogram* option provided details on the scanner's x-ray output which would be used in a later step. The *live* option turned on the camera of the scanner allowing the sample to be viewed on the screen. By setting the timing to 100 microseconds, the image on the screen could be manipulated in real time. If the time was set higher, the camera took images of the sample at a slower rate causing movement of the sample to appear sluggish on the monitor.

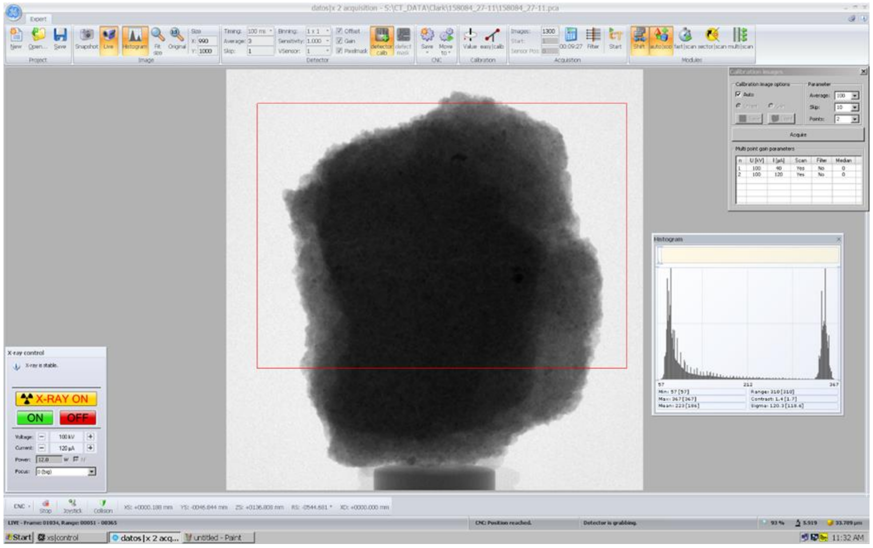

Figure 4. Centering sherd with live, x-ray, and histogram functions turned on.

4.) The x-ray was turned on using the option found on the lower left of the screen and the sample was moved and centered on the screen through the use of the console joystick and surrounding controls. The joystick allowed the sample to be moved in the X or Y direction. To the left of the joystick was a button for moving the sample in the Z direction. To the right of the joystick was a button for rotating the sample. The sample was slowly rotated to verify the sherd stayed completely on the screen. If a portion of the sherd was not visible on the screen, the sherd needed to be moved away from the x-ray source using the Z direction button. After the sample was centered in a satisfactory position, a small square was highlighted in the lower right of the screen away from the sherd. After this square was highlighted, the *set observation ROI* option was selected by right clicking the mouse to provide better contrast for the sherd during scanning. After selecting the observation position, the sherd was re-highlighted in order to view the sherd contrast. Next, the *save* option was selected from the center of the toolbar. *Save acquire position* was then clicked on. The *acquire position* function was important because it allowed the sample to be moved to its saved location after being moved away from the x-ray source during the following steps.

5.) After saving the acquire position, the sherd was rotated until the thickest portion of the sherd was visible on the screen. The cursor was then moved over this section to view the values that became visible on the monitor. The number needed to be at a grayscale value of 200 or more. If the value was less, the timing on the toolbar had to be adjusted. Most sherds scanned had a timing of 1000ms, although 333ms was also used. After adjusting the timing, the sherd was rotated until the widest side was facing the screen. The sample was then right clicked to select the *measurement* option. The widest point on the sherd was then measured. If the value was less than 1500 pixels, the number was multiplied by 1.5. This value became the number of images that were taken during the scanning process. This value was then imputed in the *Images* option located on the right side of the toolbar. The higher the number of images taken during scanning would affect the time that it took to complete the scan. All sherds examined during this study had a value of less than 1500 pixels and took between 20-90 minutes per scan.

6.) The x-ray source was turned off using the selection found on the lower left side of the screen. When the x-ray was off, the sherd was moved in the X direction out of the path of the detector. After the sample was moved, the detector had to be calibrated. Detector calibration needed to be performed in order to decrease the level of background noise recorded during the scanning process. The calibration was performed by selecting the *acquire selection* on the right side of the screen after the grayscale value on the histogram had decreased to below ten. The calibration process took around five minutes to complete per sample. The process of detector calibration could be viewed on the lower left corner of the screen. After the calibration finished, the *move to acquire position* located in the center of the toolbar was selected. Once the sample had been repositioned, the x-ray source was turned on using the selection found on the lower left side of the monitor. In addition to turning the x-ray on, the *live selection* was activated and the sherd was re-highlighted on the screen.

7.) To begin a scan, the *start* button found on the right side of the toolbar was selected. An initializing process began after selecting start that took 2-3 minutes. Once this process had been completed, the scan completion time became visible in the lower left corner of the screen. Each scan varied in the time it took to complete the scanning process based upon the timing and image values that were selected for use. Each scan took between 20-90 minutes to complete with larger, thicker sherds taking more time than smaller, thinner samples.

8.) After completing a scan, the *phoenix datosx 2 rec* program found on the computer used to format and analyze the CT scans was opened. Once the program was open, the *open PCA file* button was pressed and the folder for the sample was found. The folder was opened to allow the scan to load on the screen.

9.) Necessary values were recorded in the second logbook. This record was kept in order to allow the machine to be quickly set to the same conditions for additional scanning of similar sized sherds. The values needed for the logbook were found under the *xs control* tab located on the CT scanner monitor in addition to the *info* tab of the *phoenix datosx 2 rec* program (Figure 5).

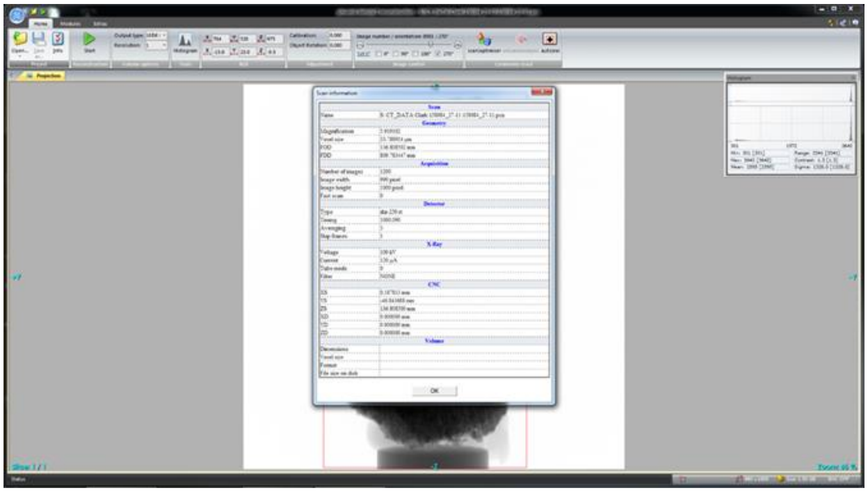

Figure 5. Finding values on screen for documentation.

10.) The *info* tab was closed and the *auto/roi* tab was selected and the *start* button was pressed. Once the auto/roi was open, each of the four angle values found in the center of the toolbar was selected sequentially. For each angle, it was verified that the red box surrounding the sherd did not cut off any portion of the sample. If an edge was outside of the box, it would not appear in the final version of the scan that was examined in *Volume Graphics*.

11.) The *scan/optimiser* function found on the right side of the toolbar was opened and the *difference (A-C)* selection was selected. An image of the sample could be seen on the right side of the window that appeared to have a “salt and pepper” coloration (Lab Director Scott Payne’s description Feb 2015). The image appeared this way in order to demonstrate the contrast in values obtained during scanning. The *compute* option found under the *automatic estimation* section was then pressed, followed by clicking on *apply*, *yes*, and *accept*.

12.) The final step of scan formatting was to reconstruct the file so it could be read in volume graphics. To do this, *start reconstruction* found on the left side of the toolbar was selected. This reconstruction took around ten seconds. After the reconstruction was completed, the *save* function was selected followed by the *volume/analysis* function located on the right side of the toolbar. This opened the program *Volume Graphics (VG Studio Max 2.2)* with the scan nearly ready for analysis.

13.) The *phoenix datosx 2 rec* program was then closed and *Volume Graphics* was opened. The sample was visible on the screen, but needed further formatting prior to analysis. This was done by clicking on the *Volume 1* option found under the *screen tree* on the right side of the screen. After clicking on *Volume 1,* the *volume rendering* box opened beneath the *screen tree*. A graph then opened displaying multiple peaks and two lines. For most scans, the first peak represented the air values recorded during the scanning process. This peak could be ignored for the analysis. The left endpoint of the diagonal line was moved past the peak representing air. This move darkened the background behind the sample allowing for air (low density) to be represented as black. If the sherd itself was too dark to be clearly viewed, the right endpoint of the diagonal line was moved closer to the graph peaks. By moving the endpoint closer, the sherd became lighter in color. A position was then selected that best allowed the sample to be examined. Next, the vertical line was moved away from the air peak and into the second main peak. This second peak represented the values recorded during scanning for the sherd. As this line was moved, it was important to watch the lower left image of the sherd. By moving the vertical line, the sherd would become either more or less focused. A position that provided the best clarity for viewing the sherd had to be found. After adjusting these volume values, the final step was to click *file* and select *save*. The sample was then ready for analysis (Figure 6).

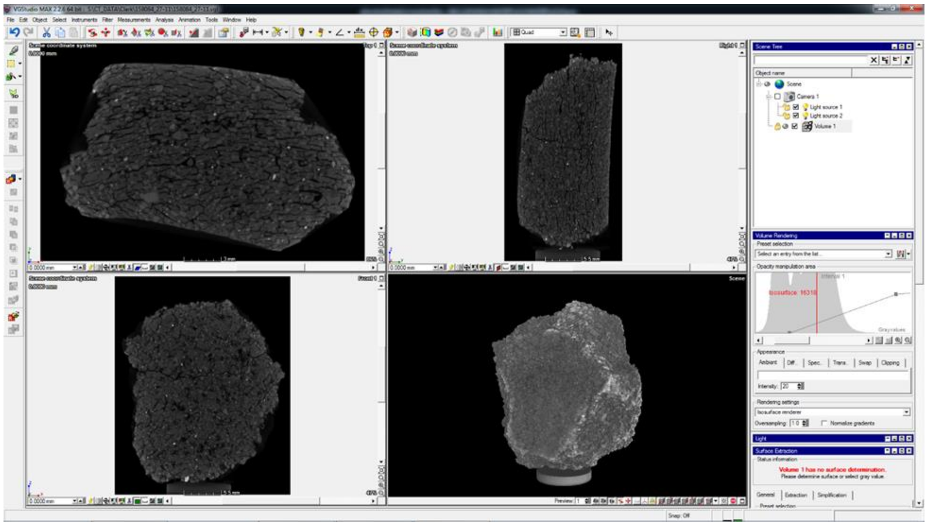
Figure 6. Using VG Studio Max 2.2 for analysis.

Organic Residue Analysis

For the residue analysis portion of this study, a sample of 10 sherds was selected for analysis using the Gas Chromatography Mass Spectrometer housed in NDSU's Core Synthesis and Analytical Services Facility. The residue analysis was performed under the supervision of Dr. Narayanaganesh Balasubramanian (Ganesh Bala), who identified chemical markers and also participated in interpreting the data gathered from the analysis. The goal of the residue analysis was to determine what organic materials were contained -presumably cooked- in vessels found in American Samoa. The data acquired from this study were combined with the results of other portions of this research to determine if presumably distinct ceramic types had different uses.

In addition to examining what organic materials were cooked in American Samoan pottery vessels, a new method of sonication was explored to determine if the technique is viable for ceramic analysis. Most previous residue analyses involving ceramics used a method of sonication where sherds are pulverized with a mortar and pestle to extract residues from both the interior and exterior of sample sherds (see Craig et al. 2011; Evershed et al. 1990; Eversherd et al. 1994; Oudemans and Boon 1991; Reber and Hart 2008). This thesis tested a new method of sonication developed by Dr. Balasubramanian. With this method, sherds were not pulverized prior to analysis. Instead, each sherd was placed in a beaker of solvent to loosen up any residues attached to sherd surfaces. After a period of soaking, the beakers containing the sherds were placed into a Fisher Scientific sonicator for sonication. This technique holds multiple benefits over other methods of sonication. With this method, sherd samples were not completely destroyed, as is common with other methods of residue extraction. Consequently, sherds analyzed with this technique could be used subsequently for other analyses.

There were two goals for exploring this method of sonication. The first goal was to determine if residues could be obtained from sherds in sufficient amounts to allow for successful analysis and interpretation of residues. The second goal was to test how destructive the method was compared to those used in previous case studies involving residue analysis. With the exception of this exploratory test of sonication, traditional steps of residue analysis were utilized in this study.

A series of steps was followed during the residue analysis in order to minimize the time it took to obtain and analyze organic residues found on the sherd samples, as follows.

1.) The first step was to select sherds that were believed likely to contain traces of organic residue due to the context in which they were found and/or the possible presence of residues based on visual examination – namely, the presence of carbonization. The selected sherds were then examined with a Crimescope ultraviolet light to further confirm the presence of organic material. After verification, the ten sample sherds were brought to Dr. Balasubramanian to begin residue analysis. In addition to the ten sherds selected for examination, a Va‘oto soil sample and a *Trochus* shell sample were selected for the analysis as controls. The soil sample was analyzed to determine what residues found on sherds could have originated from the ground after deposition. The *Trochus* shell sample was examined to determine if the shell could have been the source of indigo found on the base of a large nearly intact pot found at Va‘oto.

2.) Each sherd was submerged in an organic solvent for a period of a few hours in preparation for sonication. This was done to loosen any organic particles that were adhered to the surfaces of the ceramics. Multiple organic solvents were tested for this step of the analysis. Some solvents worked better than others for loosening residues from the sherds due to the varying types of adhering materials. The solvents that were used for extracting residues included: methanol, ethanol, hexane, chloroform, methyl ethyl ketone, ethyl acetate, and acetone. The solvents that provided the best results were methanol, ethanol, and hexane. These three solvents were used on each sample to extract residues.

3.) After soaking each sherd in a beaker of organic solvent, the beakers were suspended in a Fisher Scientific sonicator (Figure 7). The purpose of placing sherds in the sonicator was to extract residues from the surfaces of the samples that could be analyzed with a mass spectrometer. Each sherd was sonicated for a period ranging from twenty minutes to four hours, with the average sonication period being two hours. After sonication was completed, the residues contained in the solvent were collected and transferred into two 50mL Erlenmeyer flasks for each sample. 2mL of 0.5 Molar sodium methoxide in a methanol solution was added to the extract and stirred for five minutes. The resulting solution was then filtered and injected into the GC-MS.

Figure 7. Fisher Scientific sonicator.

4.) A series of test tubes containing residues obtained from each sample was analyzed with an Agilent Gas Chromatography-Mass Spectrometer (GC-MS) equipped with a triple axis mass detector (Figure 8). The second set of test tubes containing residues for each sherd was saved to be analyzed further if interesting results were obtained from the initial residue analysis. Each of the ten primary test tubes was placed in the GC-MS for analysis. After the spectrometer completed a scan, the results were displayed in graphs produced using Chemstation software (Figure 9).

Figure 8. Agilent 7890 GC Gas Chromatography-Mass Spectrometer.

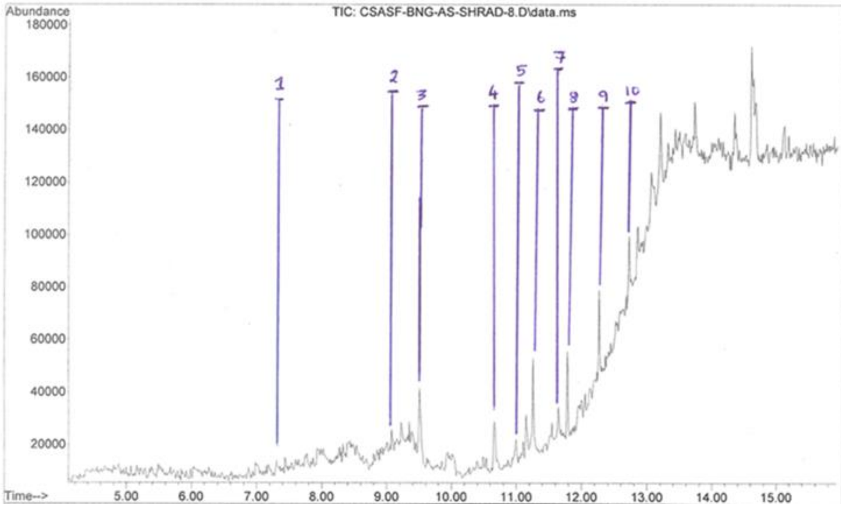

Figure 9. Example residue graph produced with Chemstation software.

5.) The 10 graphs created through GC-MS were analyzed to determine what residues found on the sherds represented. Each organic residue found was identified by its unique chemical signature. These chemical markers were compared to known residue signatures kept in the CAS (Chemical Abstract Services) database of known flora and fauna (www.cas.org). Residues found during analysis were compiled in a spreadsheet along with interpretations of what each residue likely represented. These interpretations were used during other portions of this study as evidence for how ceramics from these two American Samoan sites were used in addition to the types of foods potentially cooked within the vessels.

CHAPTER 5. RESULTS AND EVALUATION

Results of Physical Analysis

The results of the traditional ceramic analysis provided data that could be compared to that obtained through CT scanning. This allowed the viability of CT to be tested against proven methods of ceramic examination. For this physical analysis, six excavation units of the Va'oto site were examined: 36E/7N, 37E/7N, 38E/7N, 38E/9N, 39E/9N, and 40E/9N (Table 1). The six units were chosen because they contained defined stratigraphic layers with little evidence of disturbance. Radiocarbon dating for the layers throughout the site is only partially complete, so precise ages of the sherds cannot be given. At this point, however, relatively little time appears to separate layers IV, V, and VI. The beginning of the site occupation, at Layer VI, dates to about 2600 BP, with Layer IV probably only about 200 years later (Clark, pers. comm.). Additional dates will be run in the future that may bring greater clarity to layer ages.

Sherds recovered from each unit were examined for a variety of characteristics. A spreadsheet containing data recorded for the physical analysis can be found in Appendix D. A goal of this analysis was to determine if ceramics in American Samoa could be divided into distinct categories based upon thickness. To accomplish this, data were compiled into spreadsheets and scatter-plot graphs were created demonstrating changes in ceramic thicknesses for each unit over time.

Table 1. Va‘oto sherds examined through physical analysis.

Unit	Layer	Level	# of Sherds
36E/7N	III	L1-7	5
36E/7N	IV	L1-9	2
36E/7N	IV	L1-10	3
36E/7N	IV	L1-11	3
36E/7N	IV	L1-12	5
36E/7N	IV	L1-13	5
36E/7N	IV	L1-14	10
36E/7N	V	L1-15	9
36E/7N	V	L1-16	39
36E/7N	V	N/A	2
36E/7N	VI	L1-17	2
37E/7N	III	L1-7	9
37E/7N	IV	N/A	15
37E/7N	IV	L1-8	36
37E/7N	IV	L1-9	32
37E/7N	IV	L1-10	5
37E/7N	IV	L1-12	8
37E/7N	IV	L1-13	10
37E/7N	IV	L1-15	60
37E/7N	IV	In Wall	2
37E/7N	V	L1-16	27
37E/7N	V	L1-17	27
37E/7N	V	N/A	2
37E/7N	V	In Wall	2
37E/7N	Feature 59	N/A	2
37E/7N	Feature 63	N/A	2
37E/7N	Feature 64	N/A	6
37E/7N	N/A	N/A	12
38E/7N	III	L1-6	7
38E/7N	III	N/A	1
38E/7N	IV	N/A	1
38E/7N	IV	L1-7	16
38E/7N	IV	L1-10	2
38E/7N	IV	L1-11	8
38E/7N	IV	L1-12	4
38E/7N	IV	L1-13	36
38E/7N	N/A	In Wall	2
38E/7N	Feature 47	N/A	1
38E/7N	Feature 49	N/A	1
38E/9N	II	L-2	6
38E/9N	III	L-5	18
38E/9N	IV	L-6	8
38E/9N	IV	L-7	16
38E/9N	IV	L-9	22
38E/9N	IV	L-10	7
38E/9N	IV	L-11	80
38E/9N	IV	L-12	88
38E/9N	IV	N/A	3
38E/9N	V	N/A	18
38E/9N	VI	N/A	2

Table 1. Va‘oto sherds examined through physical analysis (continued).

Unit	Layer	Level	# of Sherds
38E/9N	Feature 64	N/A	68
38E/9N	Feature 66	N/A	2
38E/9N	Feature 62	N/A	8
38E/9N	Feature 65	N/A	141
38E/9N	Feature 69	N/A	4
38E/9N	N/A	N/A	18
38E/9N	In Wall	N/A	10
39E/9N	II	L-2	1
39E/9N	III	L-2	3
39E/9N	IV	L-2	20
39E/9N	IV	L-1	2
39E/9N	IV	L-5	1
39E/9N	IV	N/A	7
39E/9N	V	L-2	15
39E/9N	V	L-5	3
39E/9N	V	L-8	8
39E/9N	V	L-1	2
39E/9N	V	N/A	2
39E/9N	VI	L-2	54
39E/9N	VI	L-1	7
39E/9N	VI	L-15	17
39E/9N	VI	N/A	6
39E/9N	Feature 74	L-2	59
39E/9N	Feature 68	N/A	13
39E/9N	Feature 75	L-2	31
39E/9N	Feature 69	N/A	11
40E/9N	III	L-5	1
40E/9N	IV	L-1	6
40E/9N	IV	L-2	50
40E/9N	IV	L-3	6
40E/9N	IV	L-5	8
40E/9N	IV	N/A	15
40E/9N	VI	L-1	2
40E/9N	VI	L-2	8
40E/9N	VI	N/A	2
40E/9N	Feature 70	L1-2	31
40E/9N	Feature 74	L1-5	71
40E/9N	Feature 75	N/A	21
40E/9N	Feature 76	L-2	1

The sherds recovered from 36E/7N had average thicknesses that followed a trend throughout the unit over time (Figure 10). The lowest pottery-bearing level (level V) contained sherds that had average thicknesses that fell into a concentrated range. The range of these thicknesses was from 5.89 cm to 9.08 cm. The most recent pottery-bearing level (level III) consisted of sherds that displayed a greater variance in average thicknesses. The thicknesses for this level were between 5.34 cm and 13.67 cm. With one exception (146-1891) variance in thickness for sherds recovered between level III and V gradually increased nearer to the surface. This trend fits with an interpretation that ceramics became less uniform in thickness over time. Although there appears to be a gradual increase in thickness over time, the data do not provide strong support for Green's interpretation that "fine-tempered thin ware" transitioned to "coarse-tempered thick ware". Instead, multiple examples of sherds with average thicknesses less than 6cm were found in the uppermost sherd-bearing level of 36E/7N. This demonstrates ceramics containing thicknesses traditionally classified as "thin ware" were present during the most recent period of ceramic use represented in this excavation unit.

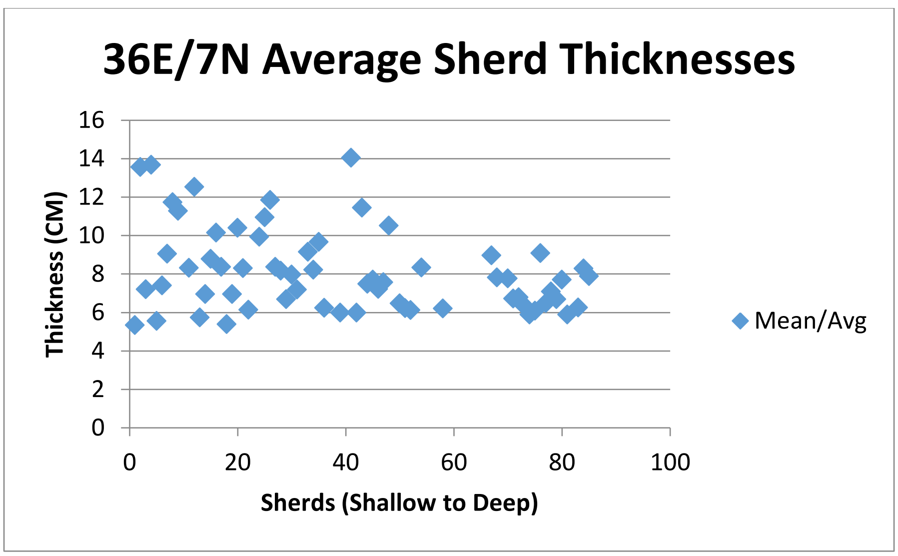

Figure 10. Sherd thicknesses for 36E/7N.

The sherds recovered from 37E/7N had average thicknesses that did not follow the same trend as strongly as those from 36E/7N (Figure 11). Instead of having thicknesses that increased in variance over time, the measurements recorded for 37E/7N had roughly the same minimum and maximum values throughout the unit. Most thicknesses were between 4 cm and 16 cm with two samples having measurements outside this range. While thicknesses covered a greater range in this unit, the oldest pottery bearing layers contained sherds that held less varied values. Most sherds recovered from level V had measurements that ranged from 6 cm to 12 cm with a majority being concentrated between 8 cm to 10 cm. Sherds recovered from the most recent ceramic-bearing level of 37E/7N, level III, had thicknesses that ranged from 5 cm to slightly over 14 cm. The values recorded for this level were not concentrated. Instead, they were relatively evenly spread throughout the recorded range. Sherds found between levels III and V held thicknesses that varied based upon depth. Sherds found in level IVb and below had more concentrated thicknesses than those recovered above this sublevel. When combined, the data from this unit demonstrate a pattern in sherd thickness that is not as defined as that seen in 36E/7N. The oldest sherds from this unit held thicknesses that were relatively concentrated between 8 cm and 10 cm. While this appeared to be the case, variance in sherd thickness was much greater than that seen in 36E/7N. Sherds recovered from upper layers of the unit held thicknesses that were more varied with fewer similar values for samples. Similar to 36E/7N, the data obtained from this unit do not support a transition from thin to thick pottery over time. Instead the data support an interpretation of sherd thicknesses becoming more varied over time.

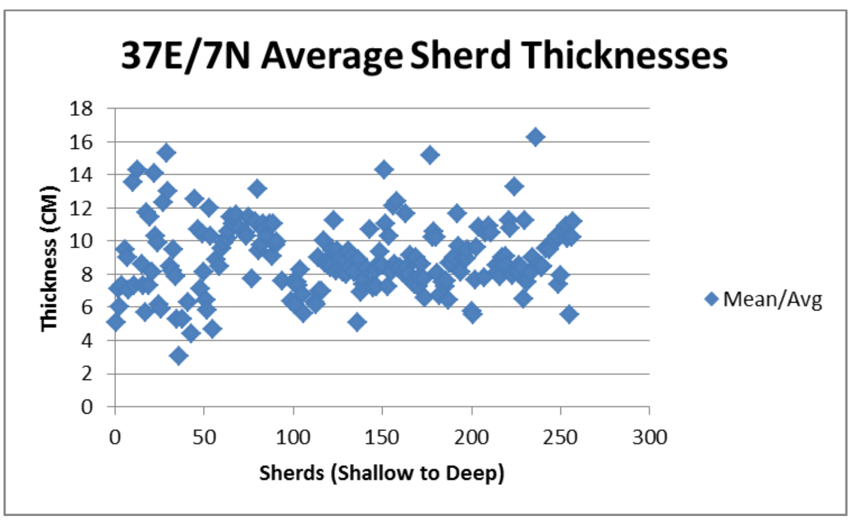

Figure 11. Sherd thicknesses for 37E/7N.

The sherds recovered from 38E/7N contained data that differed from those found in 36E/7N and 37E/7N (Figure 12). For most pottery-bearing levels in this unit sherd thicknesses were concentrated in bands of similar values. Level IVc was the deepest level in the unit that contained sherds. Most sherds from this level had average thicknesses between 8 cm and 11 cm, although thinner sherds were also present. The variance in thicknesses for this level was minimal when compared to other levels in this unit and other units. The most recent ceramic-bearing level in this unit, level III, contained sherds that had greater variance when compared to deeper layers in the unit. The values for samples recovered from this level ranged from 10 cm to just under 18 cm. The thicknesses for these sherds were not as tightly concentrated as those from deeper levels. As a result, data do support an interpretation that sherd thicknesses increased in variance over time, similar to what was seen in other units. While this appears to be true, when taken as a whole the data suggest that sherd thickness increased over time as has been proposed by Green and others.

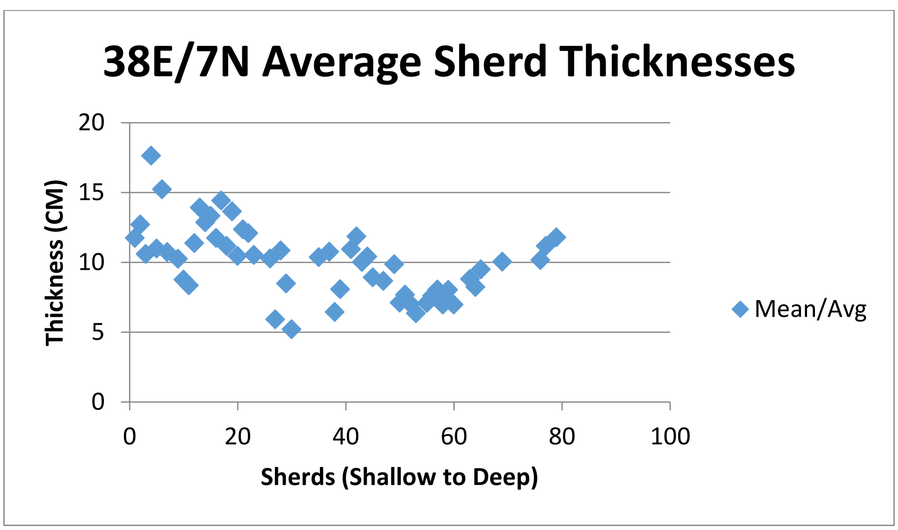

Figure 12. Sherd thicknesses for 38E/7N.

The sherds recovered from 38E/9N provided data that differed from what was found in any of the units discussed above. When viewed as a whole, the data for this unit displayed less variance for average sherd thickness when compared to 36E/7N, 37E/7N, and 38E/7N (Figure 13). Most sherds had thicknesses that fell between 5 cm and 12 cm over the entirety of the unit. Within this range, most samples had measurements concentrated between 7 cm and 10 cm. While most sherds shared similar thicknesses, some samples had measurements that were either well above (19.45 cm) or well below (1.71 cm) this range. Unlike other units, the sherds recovered from 38E/9N had average thicknesses that did not dramatically vary over time. Similar thicknesses were recorded across levels. Although this appears to be the case, variance in sherd thickness did increase in the most recent pottery-bearing levels when compared to the oldest ones. This provides some support for the interpretation that formed from data obtained from other units that variance in sherd thicknesses increased over time. The data from this unit also do not support Green's interpretation that "thin ware" transitioned into "thick ware". Instead, sherd thickness appeared to remain relatively stable with the possible exception of level II.

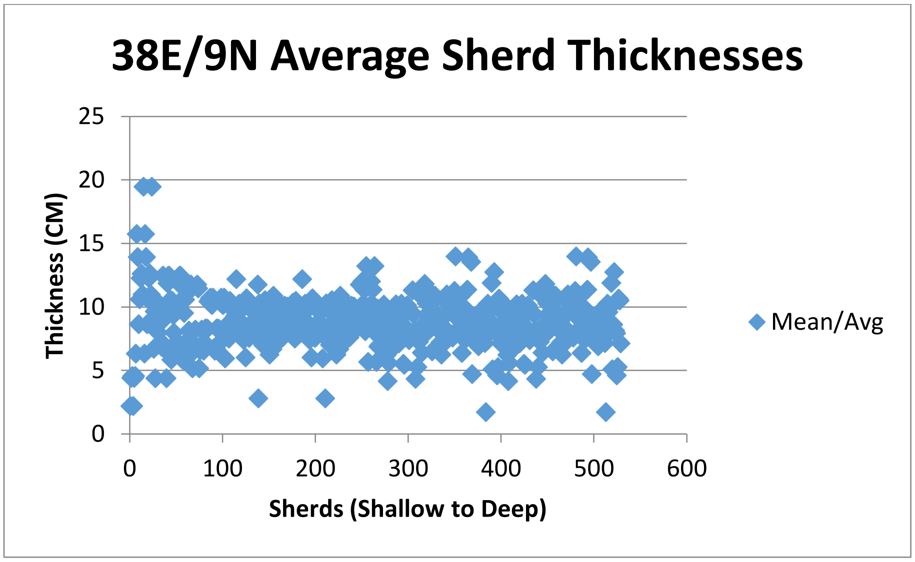

Figure 13. Sherd thicknesses for 38E/9N.

The sherds recovered from 39E/9N provided data similar to that obtained from 38E/9N (Figure 14). The average sherd thicknesses recorded for this unit were relatively concentrated between 6 cm and 12 cm with some sherds having measurements either above or below this range. This range remained relatively stable for each pottery-bearing level of the unit. The variance in sherd thickness was minimal for most of the unit with one notable exception. Sherds from level V displayed a greater variance in thickness when compared to other levels. As a whole the data obtained from 39E/9N do not support a general increase in variance of sherd thicknesses over time as was found for 36E/7N, 37E/7N, and 38E/7N. While this unit did not provide support for the interpretation of sherd thickness becoming more diverse over time, it did provide some evidence for thin-walled pottery transitioning into thick-walled pottery. There appeared to be a slight increase in sherd thickness over time for this unit, although this increase is minimal. Stronger evidence is needed to confirm whether or not thin pottery transitioned into thick pottery. This unit did not provide sufficient data to accurately address this issue.

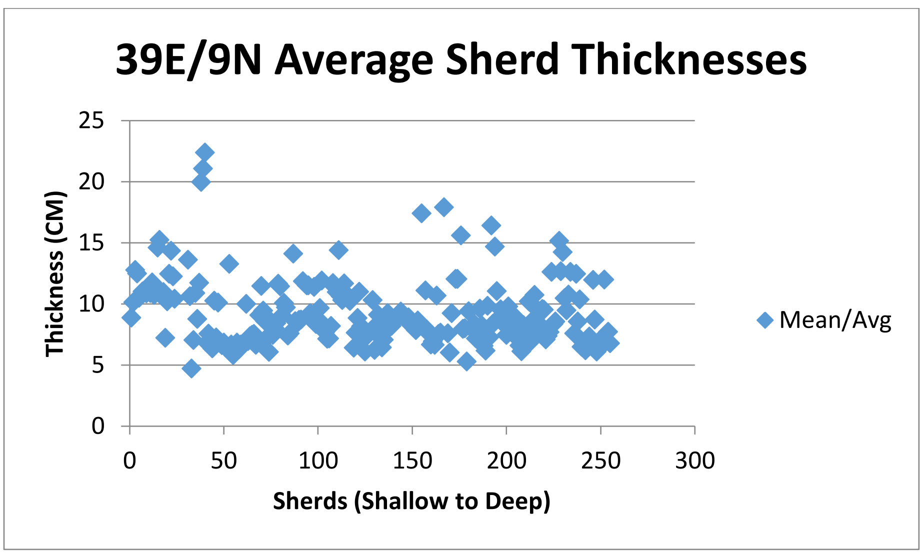

Figure 14. Sherd thicknesses for 39E/9N.

The sherds recovered from 40E/9N provided data that indicated a high level of variance was present in sherd thicknesses throughout the unit (Figure 15). There was little evidence for thicknesses being within a concentrated range. Most samples had thicknesses that were between 4 cm and 12 cm. Some sherds were found outside this range including those both thicker (14.94 cm) and thinner (3.05 cm). Variance in this unit appeared to be at its highest in more recent pottery-bearing levels and lowest in older levels. The range of variance for sherd thicknesses found in this unit does not provide strong support for an interpretation that variance increased over time. Instead, the data suggest variance was relatively common throughout time in this unit although there is a slight increase in thickness variability present in level IV. The data also do not support a transition from thin to thick ceramics.

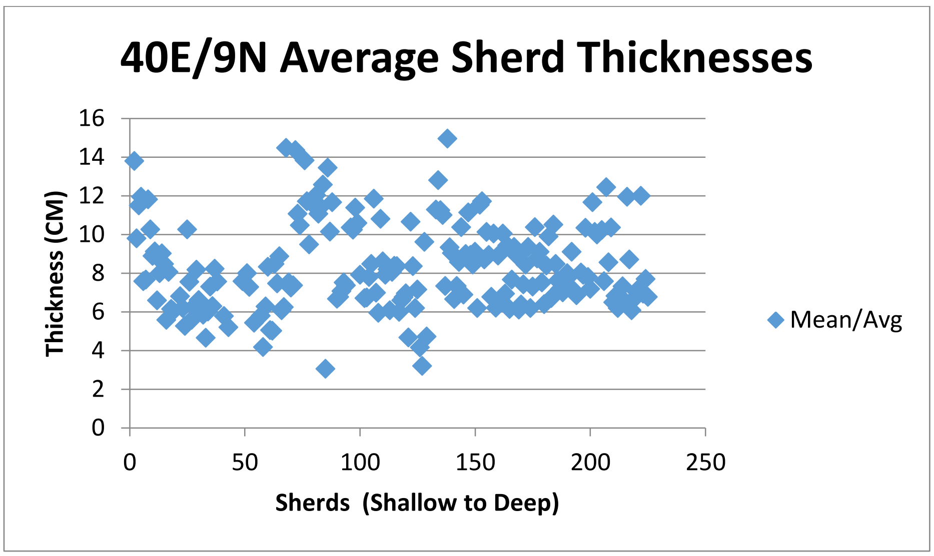

Figure 15. Sherd thicknesses for 40E/9N.

Summary of Thickness Data from Physical Examination

When combined the data obtained from each of these six excavation units provided evidence for the attribute of sherd thickness at the Va‘oto site. At least five of the six units provided data that supported an interpretation of sherd thickness becoming more varied over time. This occurrence fits into the larger history of ceramic production in Oceania. Pottery that was earlier in age has been widely considered better constructed than that manufactured towards the end of ceramic production in the Samoa (Green 1974b). The earliest pottery was likely better made leading to less variance in wall thickness between vessels. There is a high probability that this lack of difference between vessels is what is seen in the data obtained from the oldest pottery-bearing levels in this analysis. The increase in variability seen in the data can likely be attributed to an overall decline in ceramic production: less effort was put into producing pots leading to a higher level of variability between vessels. In order to confirm that variance in sherd thickness is tied to age of the ceramics, more sherds recovered from other areas of American Samoa need to be examined. If confirmed, sherd thicknesses in an assemblage could be used as a way to attain a rough relative estimate of how old a ceramic assemblage is. Higher variance in average thicknesses could indicate a collection is more recent in age than an assemblage that has a low level of variance in sherd thicknesses. This could be useful for examining excavation units prior to analyzing datable material.

The data obtained through this analysis did *not* provide strong evidence supporting Green's interpretation that "thin ware" transitioned into "thick ware" over time. Instead data show that sherds traditionally classified as thin ware are present in the most recent pottery-bearing levels of Va'oto along with sherds that could be classified as thick ware. While there does not appear to be evidence for thin-walled ceramics transitioning into thick-walled ceramics, data do show that some sherds had greater thicknesses in the most recent levels. This could indicate that thicker pottery became more prevalent over time, but did not necessarily evolve from thinner pottery. Instead the data suggest thin and thick vessels were present at Va'oto throughout the site's period of ceramic manufacture with ceramics becoming thicker over time, or, with the thinner vessels dropping out of the inventory.

Results of CT Scanning

The results obtained from the CT portion of this thesis provided valuable data for determining if computed tomography could be a useful tool for ceramic analysis. Scans of each of the 43 sherds examined displayed characteristics typically recorded during traditional ceramic analysis. In addition, traits such as temper distribution and density were also recorded. These characteristics are difficult to accurately record during traditional analysis without destroying sherds. While CT scans did verify attributes such as temper size and physical sherd measurements recorded during traditional analysis, some traits differed between laboratory examination and CT. These characteristics included amount of temper present, decoration, and most importantly, method of manufacture.

CT seemed most useful for determining how ceramics from American Samoa were manufactured. Two main methods of production, coiling and slab construction are believed to have been used in American Samoa and other areas of Oceania (Chiu 2007:241). Generally it is thought that smaller vessels were produced through coiling, while larger, thicker vessels were created with slab construction (Shepard 1956; Tite 1999). The results obtained through this study do not necessarily support this interpretation. Data suggest that larger, thick-walled vessels could be produced with coiling and smaller vessels could be constructed of slabs. Physical analysis did not provide the same interpretation as what was formed from the CT data. This discrepancy was most visible for the base sherd from a large pot recovered from Va‘oto. The physical examination of the base sherd did not provide evidence for coiling being used. With no visible coils present, it was thought that the large pot was produced using slab construction. When analyzed with the CT scanner, evidence was found indicating coils were present within the sherd leading to an interpretation that the Va'oto "Big Pot" was manufactured using coiling.

Each of the 43 sherds provided useful information that could be combined with data obtained through physical analysis. Following are short descriptions of CT results for sherds containing data believed to demonstrate the benefits of using computed tomography for ceramic analysis. Short descriptions of other sherd CT results can be found in Appendix B.

Ofu Village Sherds

88-2: This sherd had fine temper present throughout the sherd that was not evenly distributed. The random distribution of temper could be indicative of temper being added to clay during the manufacturing process. Most temper was concentrated in curved layers away from sherd surfaces that might represent compression. Compression lines were also found that support an interpretation that the surface of the vessel was compressed either by hand or through the use of a paddle and anvil similar to how ceramics from Oceania and other regions were produced (Chiu 2007; Shepard 1956). Few air pockets were present in the sherd, but many small fractures were found throughout its interior. A ridge was also present that ran the length of the sherd's exterior (Figure 16). Beneath the ridge was an air void that ran its entirety that indicated the feature was added to the sherd instead of being formed from it (Figure 17).

Figure 16. 88-2 with visible ridge.

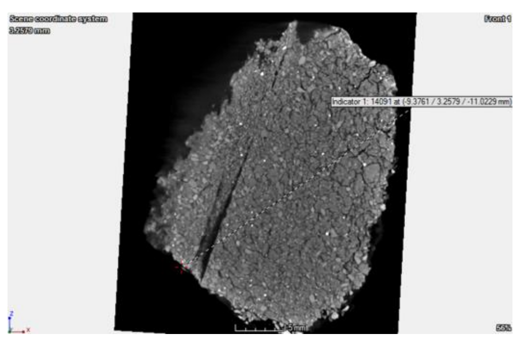

Figure 17. CT scan of 88-2 displaying air void.

This sherd provided some of the strongest evidence for the usefulness of CT in ceramic analysis. Prior to CT scanning, it was believed that the ridge found on the sherd was formed from the wall of the vessel. This interpretation was formed through traditional laboratory analysis. There was no physical indication that the ridge was applied to the vessel. The air void found through CT was not visible during physical analysis, even with the use of a microscope. Without using CT, the origin of the ridge would have been overlooked lessening the accuracy of analysis for this sherd.

88-1: This decorated sherd had the most prominent compression lines of any sherd examined for this study. The heaviest concentration of compression lines was found near the rim of the sherd indicating the rim was heavily modified during manufacture. Compression lines followed incisions on the rim surface leading to an interpretation that the incisions were made on the rim prior to firing. Coarse temper was found throughout the sherd, but was relatively sparse when compared to the amount of temper present in other samples leading to difficulty in determining if temper was manually added to clay or was naturally present.

81-26: Temper ranging in size from fine to very coarse was found spread throughout the sherd, but finer temper seemed to have a much higher density than either the coarse temper or the clay. This higher density was documented during examination of the CT scan due to the fine temper displaying as bright white (white represents high density), while the coarse temper displayed as a slightly lighter grey than the surrounding clay (grey and black indicate low density). Many fractures were present throughout the sherd in addition to a few possible compression lines. This sherd also had a small ridge similar to sherd 88-2. Unlike that sherd, the ridge on this sample did not have any underlying compression lines or air void. The lack of air void or compression lines near the ridge led to an interpretation that the ridge was not added to the vessel wall but, instead, was a naturally occurring feature that was not intentionally created. From physical examination it was proposed that the ridge was manually added, but CT analysis did not support that interpretation.

The combination of data obtained from sherds 88-2 and 81-26 demonstrate how CT can be used to detect sherd characteristics that would likely be missed if physical examination was the only method of ceramic analysis undertaken. Each sample provided an example of how interpretations formed during physical analysis could be disputed, or supported, by computed tomography. Inconsistencies such as these are likely the result of physical analysis focusing on visible features on the exterior of sherds while CT is able to view a sherd through its entirety, not just the surfaces.

'Aoa Sherds

AU-1: This sample was the first of sherds representing the upper component of the 'Aoa site. This sherd had mostly fine temper with some coarse inclusions that were randomly distributed throughout the clay matrix. Temper was unequally spread throughout the sherd with some areas having high concentrations of temper and other areas being devoid of it indicating that the material was likely added to clay during manufacture (Figure 18). Possible compression lines were found throughout the sherd in addition to many small fractures. Small air voids were also common throughout the sample. Two linear air voids that extended half the length of the sherd were present leading to an interpretation that the clay was either folded during manufacture or was comprised of multiple slabs. A possible finger pinch indentation was also found that had faint compression lines underneath it likely indicating that finger pinching was employed during manufacture.

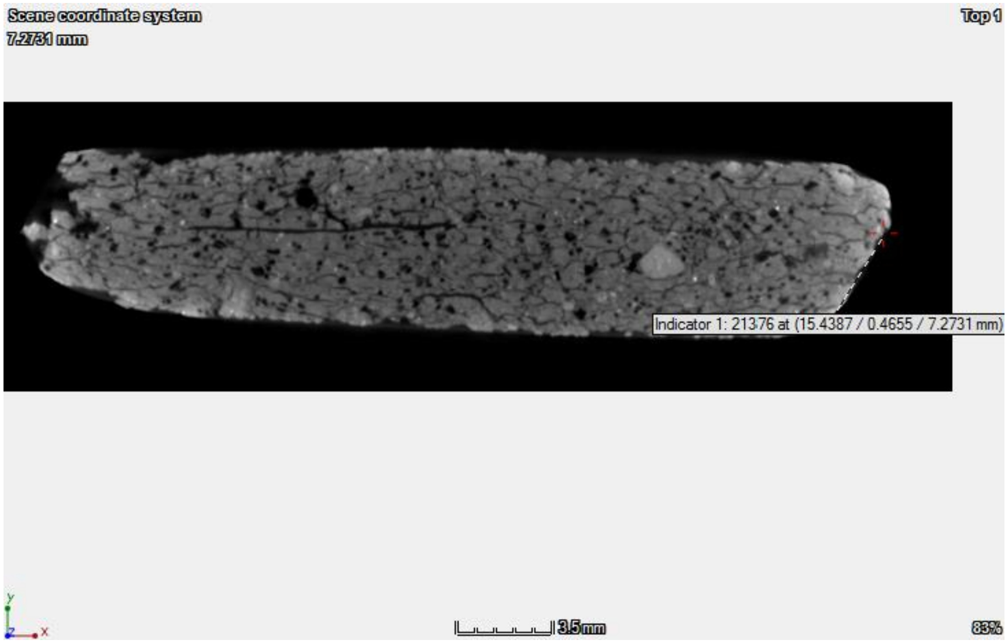

Figure 18. AU-1 displaying temper different from ‘Aoa sherds with coarse temper.

AU-2: This sherd had extremely coarse temper when compared to most sherds examined. While there were few if any compression lines in the sherd, large cracks were present around coarse temper particles concentrated near the center of the sample (Figure 19). Few small fractures or air voids were present in the sherd resulting in a very compact material. While temper was randomly distributed, it was relatively widespread throughout the clay matrix. The defining characteristic of this sherd was that the coarsest temper was extremely dense when compared to the finer temper found in the sherd. This dense temper was displayed as extremely white when compared to other sherd materials. This is strong evidence for coarse temper being added to clay in preparation for manufacture of this form of pottery.

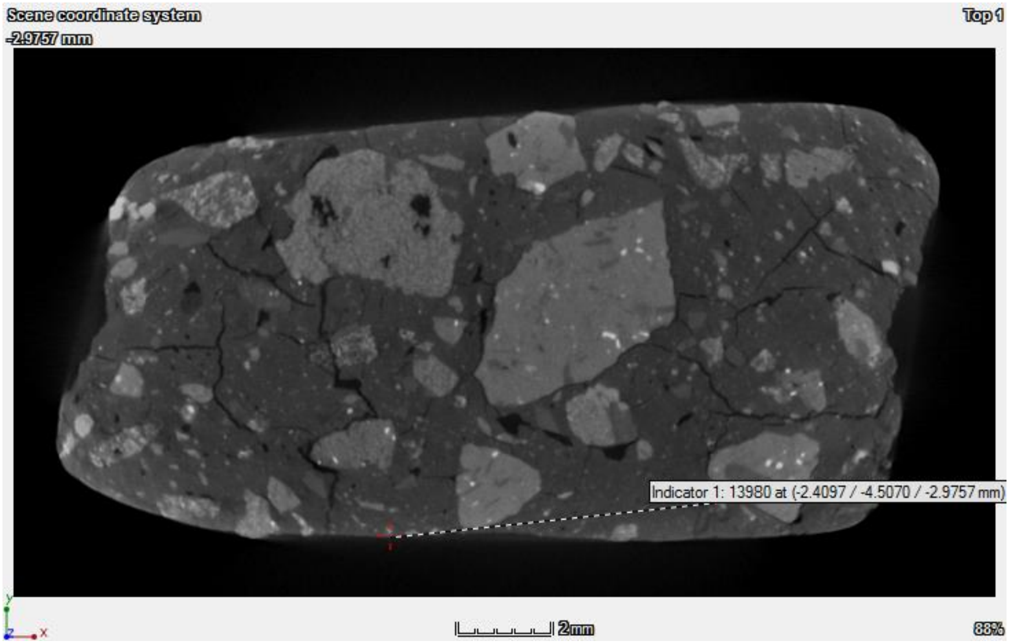

Figure 19. AU-2 with coarse temper spread throughout sherd.

AL-1: This sherd marked the first of four samples examined that represent the lower pottery-bearing component of the ‘Aoa site. This sherd had extremely coarse temper similar to sherds AU-2 and AU-4 from the upper component of ‘Aoa. While coarse temper was present in the sherd, the size of temper in the sample was more even than that of other samples and was also less angular. Larger, coarse particles were more evenly dense when compared to upper component sherds in that they had a “salt and pepper” appearance instead of solid white when viewed in Volume Graphics. Temper found in AL-1 and all other lower component samples was distinct in that the density of temper was higher than that found in the upper component. While coarse temper was denser in this layer, there was also a greater range of temper densities present. The differences in temper between pottery components likely indicate a change in temper material utilized during ceramic production at ‘Aoa. This sherd had no discernable compression lines, but multiple fractures associated with coarse particles were found near the center of the sherd. Few air voids were found in the clay matrix, although some voids were present in large temper particles further strengthening the interpretation that temper material changed at the site over time.

AL-3: This sherd had finer temper than either AL-1 or AL-2 with few coarse particles present. Multiple compression lines and finger impressions were found that followed the curvature of the sherd. Many of the compression lines and finger impressions were found near the exterior surface of the sample indicating that the surface was modified during manufacture likely through finger pinching. In addition to these features, multiple small fractures and air voids were found throughout the sherd. The most significant characteristic of this sherd found during CT was a long linear air void situated at the center of the sherd (Figure 20). This void is strong evidence for slab construction being used to produce pottery at ‘Aoa.

Figure 20. AL-3 displaying linear void indicative of slab construction.

AL-4: This rim sherd had a mixture of coarse and fine temper present throughout the sherd with fine temper being more prevalent. Compression lines were common across the sherd, but were concentrated near the surface of the rim edge. The compression lines near the rim were curved in the same direction leading to an interpretation that clay was folded over to produce the rim. Multiple linear air voids were found in this sample extending both vertically and horizontally. The two different directions of the voids indicate two methods of slab construction were used during manufacture. Slabs were placed both sided by side and one on top of another. Slabs side by side were likely the primary method of producing vessel walls, while slabs placed one on top of another were used as a way to retain heat more efficiently during cooking (personal correspondence with Michael Strand, ceramicist artist at NDSU). This find is important due to no other known instances of this method of slab construction being present in the ceramic record of Samoa (Figure 21).

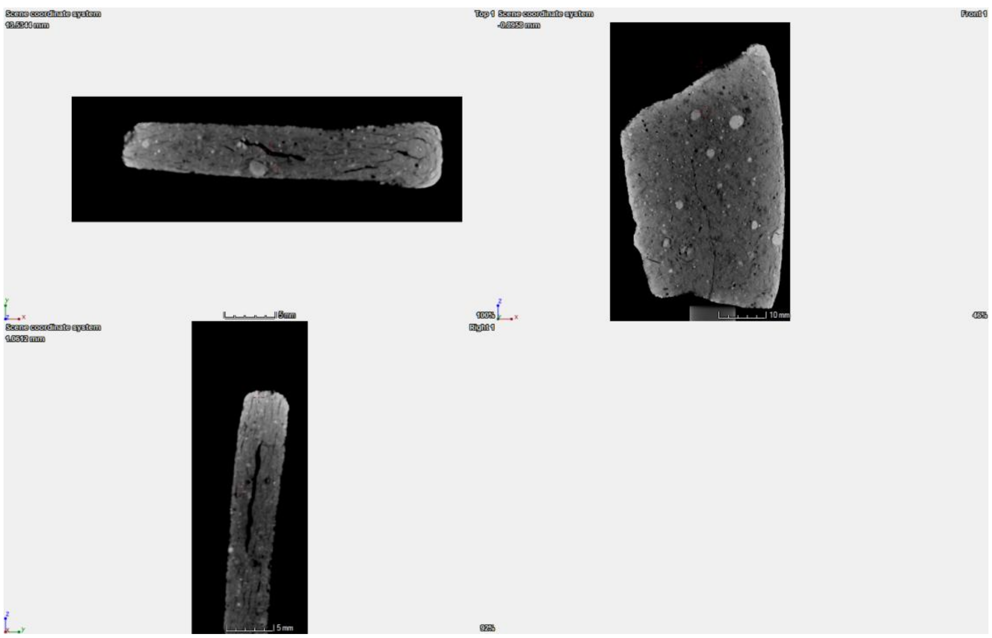

Figure 21. AL-4 displaying evidence of compression lines and slab construction.

Coconut Grove Sherds

33-42: This collared rim had highly dense, fine temper concentrated in layers surrounding compression lines. The compression lines were prominent and found throughout the sherd. Although compression lines were present throughout the clay matrix, most were found following the surface of the rim top and collar. The orientation of compression lines indicated clay was folded over to form the collar of the rim instead of additional clay being added during manufacture. Additionally, no evidence for air voids was found beneath the collar further strengthening an interpretation of collared rims being formed from a single piece of folded clay (Figure 22). While this interpretation could be correct, another interpretation is that clay forming the collar of a rim was folded over a core. More work is needed to determine how collared rims were manufactured. This find was important due to not being able to determine through physical analysis how collared rims were produced.

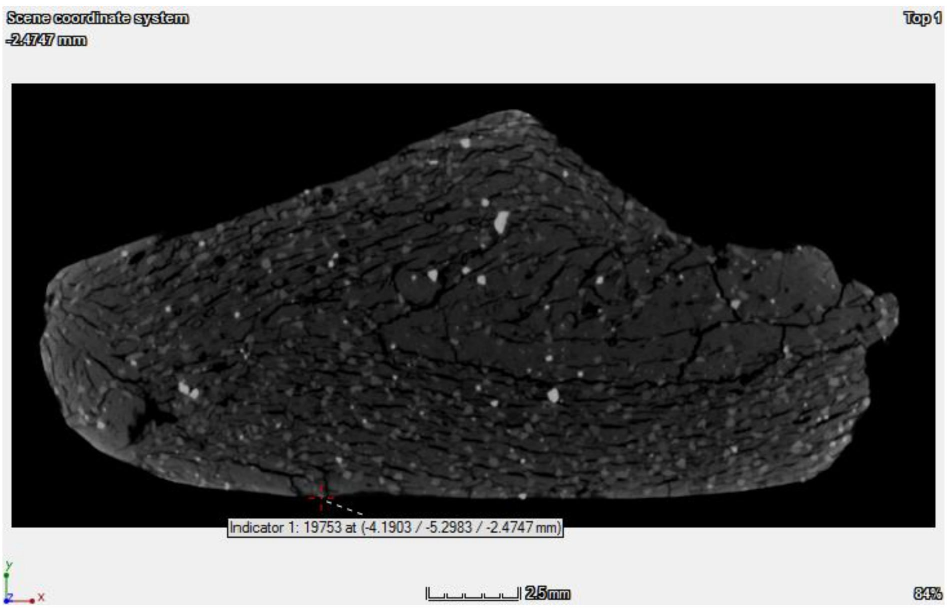

Figure 22. 33-42 collared rim displaying evidence of folding and compression.

Va'oto Layer III Sherds

15-2: This sherd had very jagged, medium to coarse temper with few instances of fine temper. The temper was found throughout the sherd and was only slightly denser than the surrounding clay. Some temper particles were much denser than others indicating that multiple tempers were utilized during production. Many fractures were found throughout the sample in addition to air pockets. The largest temper particles found in the sherd contained small air pockets reinforcing an interpretation of different temper material being utilized at Va'oto when compared to other sites examined. No evidence of compression lines or a linear void was found making it difficult to determine if slab construction was utilized during manufacture for this sample.

Va'oto Layer IV Sherds

44-2: This sherd had a mixture of fine and coarse temper spread throughout the clay matrix. The temper was slightly denser than the surrounding clay similar to temper found in Layer III samples. During CT analysis what appeared to be a small shell was found within the clay matrix. The presence of this shell could be indicative of calcareous temper being used in addition to lithic material during ceramic production. An effort was made to identify the shell but was unsuccessful. Few compression lines were found in the sherd, but many fractures were present. A layer of coarse temper was found near the sherd surface adjacent to compression lines indicating some surface modification occurred. No linear void could be discerned during analysis making it difficult to verify if slab building was used during manufacture.

34-1: This sherd had mostly fine temper spread throughout the sample. Temper particles were denser than the clay. Some areas of the sherd had higher concentrations of temper than others indicating temper was added to clay during production. Most fine grained temper was found near the surface of the sherd adjacent to compression lines indicating some surface modification occurred. Fractures were found throughout the sample in addition to a linear void that could represent slab construction (Figure 23). An interpretation of slab construction for this sherd is strengthened by the combination of compression lines with the linear void. The compression lines on each side of the void differ in directionality indicating two pieces of clay were joined to form this sample.

Figure 23. 34-1 displaying evidence of temper manually added and a linear void.

Va'oto Layer V sherds

64-1: This sherd had fine to medium-grained temper with some coarse particles concentrated in layers around compression lines. The orientation of temper around compression lines indicate some surface modification occurred during manufacture. Temper was randomly distributed throughout the sherd with some areas containing high concentrations of temper and other areas being devoid of it indicating it is likely that the material was added to clay during production. The temper in this sample was very different from other samples in that particles had highly dense bands surrounded by lower density material. It is likely that the temper of this sample was either a different material or was from a different temper source. Many compression lines and fractures were found throughout the sample in addition to a central void that is indicative of slab construction being used during manufacture.

67-3: This sherd had fine to medium-grained temper spread throughout the sample with concentrated layers of temper near the exterior surface adjacent to compression lines. The presence of temper layers near compression lines indicates that surface modification occurred during manufacture. The temper from this sample was similar to that of sherds from other

Va‘oto layers in that the temper was slightly denser than the clay. Multiple fractures were found throughout the sherd. An interesting find during analysis was a layer of temper concentrated at the center of the sherd. This could represent two slabs pressed together to form the wall of the sherd, although no linear void similar to that of other slab-built samples was visible in the scan.

83-9: This sherd had fine to coarse temper with larger porous temper particles spread throughout the sample. Possible compression lines were found in the sherd, but were less distinctive than those found in other samples. Fractures were found that seemed to be curved in a uniform direction. These fractures could represent coils or compression lines that have deteriorated. If the fractures actually represent coiling, this would be one of the only examples of coiling found during CT analysis. No linear void was found in the sherd lending credence to the idea that coiling could have been used to construct this sample.

Va‘oto Layer VI Sherds

85-1: This sherd had fine to medium grain temper randomly distributed throughout the clay matrix. Most temper was slightly denser than the surrounding clay, but a small percentage of particles were of a much higher density. Compression lines were found near the curvature of the sherd and near the surface. A linear void was also found indicating slab construction could have been used during manufacture. This sherd was unique among the collection examined in that it contained a thin layer of charcoal on its interior surface. When examined with CT, the charcoal layer was determined to be less dense than either the clay or temper. This information could possibly be used to determine if organic material is present on a sherd surface based upon changes in density from the residue to the fired sherd.

85-8: This rim sherd had fine to medium grain temper spread throughout the clay matrix with some concentrations of coarser temper near the exterior surface of the sample. The temper of this sherd was mainly oriented in layers that did not necessarily coincide with compression lines. Similar to sherds from other Va‘oto layers, the density (mass) of temper particles was higher than the density of the clay. Compression lines were located mainly near the surface of the rim while fractures were found throughout the sherd. A possible linear void was found, but was not as distinct as in other samples. Two methods of manufacture could have been used to produce this sherd. The possibility of a linear void suggests slab construction, although evidence is ambiguous. Coiling could have also been used to produce this piece, as suggested by the distinct bands of temper found in the sherd. Each band could represent a coil used to produce the sample. If coiling was not used to produce the entire vessel from which the sherd came, the temper bands could indicate that the rim was added to the pot during manufacture. Due to the variety of interpretations for this sample, further analysis is needed.

Va‘oto "Big Pot" Sherds

178-3: This sherd had fine to coarse-grain temper that represented a larger percentage of the sherd body than the clay. Few fractures or air pockets were present in the sherd. Compression lines were common in the sample following the curvature of the piece. A linear void was present at the center of the sherd suggesting that two forms of slab construction were used. Slabs were likely joined side by side and one on top of another. The linear void also had a slight curve indicating coiling could potentially have been used during manufacture in addition to slabs (Figure 24). One notable difference in this sample when compared to 204-13 ("Big Pot" Base) was that temper was finer-grained and clay appeared less dense. These discrepancies could indicate that the two samples are not from the same pot. When found, the base was not attached to sherds from the side of the vessel. An interpretation was initially proposed by Dr. Clark suggesting the supposed base was actually a plate placed inside a broken pot as part of an offering. The data obtained from CT analysis for the two “Big Pot” sherds support this interpretation.

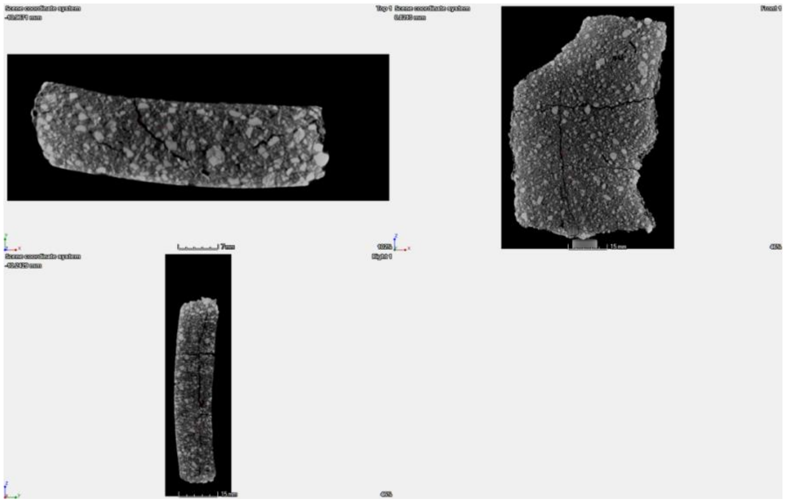

Figure 24. 178-3 displaying evidence of construction and temper different from 204-13.

204-13: This sherd had fine to coarse-grain temper spread throughout the clay matrix with temper being slightly denser than the clay. Some fractures and air voids were found in the sherd, but no compression lines were discernable. A curved void was found that likely indicates coiling was used during manufacture (Figure 25). This interpretation is supported by the orientation of temper in the sample. The temper appeared to follow the void in curved bands that suggest the presence of coils. Due to the strong evidence for coiling, this sherd is likely of a different origin than sample 178-3. This is reinforced by the temper contained in each sherd. In this sample the temper was larger than that of 178-3, but was present in a lesser amount. An additional difference in this sherd was that the clay appeared denser than the clay of the side sherd of the “Big Pot”. With the combination of these data, it is proposed that the supposed base sherd of the “Big Pot” is not from the same vessel as the body sherd.

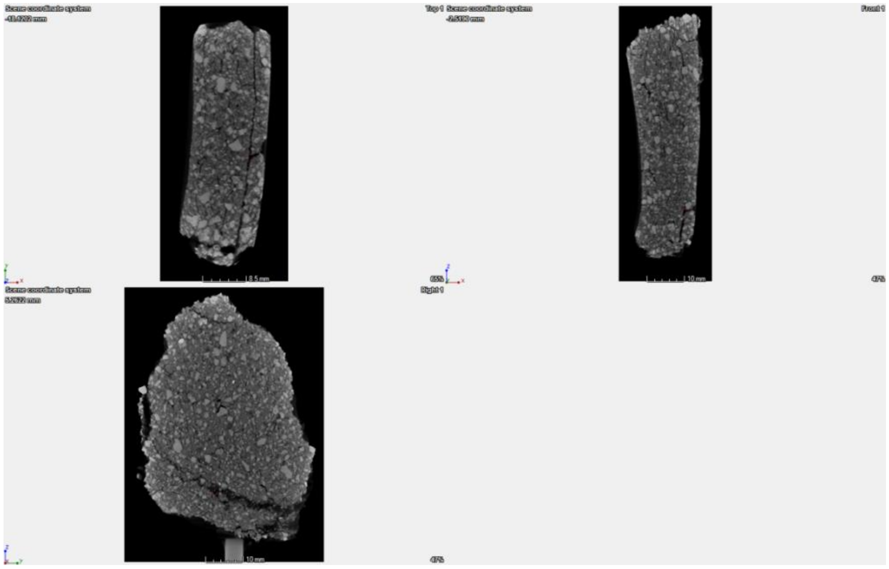

Figure 25. 204-13 displaying evidence of coiling and temper different from 178-3.

Experimental Sherds

EX-3: This experimental disk was produced using slab construction from Va‘oto clay with coarse (larger than 1/8 in) sand temper added during manufacture. The temper was spread throughout the sherd and displayed nearly identically to the medium to coarse-grain temper found in Samoan sherds. Most temper was slightly denser than the clay, although a few particles of very high density were present. Many fractures were found throughout the sherd making it difficult to confirm the method of manufacture. No evidence was found for the seam of the slabs. This was likely due to the low viscosity of the clay. Clumps of unfired clay were found in the disk, although in a much lower number than in either EX-1 or EX-2. This occurrence is likely due to the added temper present in the sherd affecting the clay during firing.

EX-4: This experimental disk was produced using coiling from Ofu Village clay with no temper added during production. No discernable temper was found during analysis indicating temper had to be added to vessels manufactured from clay near the Ofu Village site. Few to no compression lines were present in the sample, although multiple fractures were found. Evidence for coiling was found during analysis, but was not as distinctive as the presumed coils found in the Vaʻoto Big Pot base sherd. This provided strong evidence that the Big Pot base sherd was produced with coiling. Large clumps of unfired clay were found in this sample similar to other experimental sherds indicating the firing temperature was lower than that used for producing Samoan ceramics.

EX-7: This experimental disk was produced using slab construction from Ofu Village clay with no temper added during manufacture. Few particles of temper were found during analysis, although the few present had relatively high densities. Few compression lines were found in the sample, but fractures and air pockets were common. Clumps of unfired clay were also found in the disk. A linear void was present in this sherd demonstrating joined slabs. Although this void was found, it was not as pronounced as the voids found in the archaeological sherds. This provides strong evidence for slab construction being utilized for constructing some Samoan vessels.

Issues of CT analysis and Experimental Disks

Multiple issues arose during CT scanning in this research. These issues did not hinder the completion of the study, but did have an effect on the data obtained. Future research involving the methods used in this thesis would benefit from taking into consideration these concerns.

One issue that had to be addressed during the CT portion of this study was how to properly mount sherd samples in a manner that both provided a secure hold to the mounting rod and minimized the potential for damaging sherds when detaching the samples from the rods. For this analysis, a hot glue gun was selected for attaching sherds to glass rods. This method was successful for mounting samples that could be considered well-made and did not contain structural issues. Hot gluing became problematic for mounting sherds that were beginning to deteriorate. This was especially true for sherds that were extremely thick, which were typically somewhat friable. Due to the fragile nature of these samples, portions of the sherds would break off when attempting to detach the glass rods from the samples. Three of the samples (14-1, 63-7, 85-10) chosen for CT analysis broke during this study due to detaching the sherds from rods after scanning was completed. Each of the three sherds that broke was relatively thick and in a state of deterioration when compared to the rest of the sample collection. Due to this occurrence, it is recommended that future studies of ceramics utilizing CT either minimize the number of visibly fragile sherds or use a different mounting method, such as holding samples in Styrofoam cups attached to glass rods. As long as the power and current values are slightly increased, cups should not appear in scans of sherds.

Other issues arose from the manufacture and CT scanning of the nine experimental sherds. Production of these sherds was difficult due to the low viscosity of the clay after re-hydration. The issue may have been that too much water was added to the clays during re-hydration. Although the clays were difficult to work with, the clay from Ofu Village was easier to work with than the clay from Va‘oto. This inconsistency could have been due to the chemical composition of each clay source.

Firing the experimental sherds was a minor issue encountered during this study. The NDSU Art Department did not have the necessary clay cone in stock for firing the samples. As a result, the samples were fired at a slightly lower temperature than was originally planned. The clay disks were fired at 734 degrees Celsius instead of the desired 800 degrees Celsius. Although the samples were fired to a satisfactory level, the disks seemed more friable than the sherds recovered from American Samoa. This likely attributed to the difficulty encountered in mounting the samples in preparation for CT analysis.

An additional issue relating to the experimental samples was that the results obtained from CT scanning did not match up with the scans produced of sherds from American Samoa. This could have been due to a number of possibilities such as firing temperature and the source of clay used for the ceramics. Based upon the range of firing temperatures provided by both R. Cochrane (1978) and E. Cochrane (2002), it is believed that these test samples were fired at a slightly lower temperature than what is currently accepted for Samoan ceramics, although the temperature used falls into the range proposed by Dickinson and Shutler (2000). The use of a lower temperature could be the reason why what appeared to be “clumps” of clay were present in scans of test sherds, but not in those of most Samoan samples. These “clumps” could represent portions of clay that did not fully fire.

Another issue arose that could potentially be linked to the temperature used to fire the test samples. When examining the CT scans of test sherds, it was not possible to find compression lines. The lack of definite compression lines made it difficult to determine how the clay was modelled prior to firing. The lack of compression in the experimental samples mainly impacted the analysis of the study’s collared rims. Unlike the collared rims from the Coconut Grove site, compression lines were not present in the test sherd representing a collared rim. This made it difficult to determine how the collars were made for vessels from Coconut Grove. It was believed that compression lines in the experimental collared rim could be used to confirm how the Samoan rim form was manufactured. Without this confirmation, conclusions about how the rims were produced were based solely upon examination of CT scans of the collared rims recovered from the Coconut Grove site.

An interesting occurrence involving the experimental ceramics was the color of the sherds after firing. Each of the nine samples fit into the same four Munsell color categories, i.e., 5yr 4/6, 7.5yr 3/4, 7.5yr 4/6, and 10yr 4/4. Each sample appeared a reddish color similar to that described by Poulsen (1964) during his analysis of Tongan sherds. This reddish color obtained through firing was likely due to the minerals, such as iron, contained in the clays obtained from Va‘oto and Ofu Village.

Results of Residue Analysis

The data obtained through residue analysis were more beneficial than originally anticipated. It was believed that due to sherds being over two thousand years old residues might not yield sufficient chemical markers for identification of organic materials. After an initial set of GC-MS runs, however, evidence for multiple organic materials were found. Over fifty percent of the sherds examined during initial residue analysis yielded results that could be used to identify materials believed to represent foods that were cooked in the pottery. Six out of ten initial scans provided evidence for organic substances including pig, fish, sea shell, seeds, roots, coconut, and other materials (Table 2).

Table 2. Initial results of residue analysis.

Sample #	Identification	Major Compounds	Interpretation
1	1500-287	Undetermined	Undetermined
2	170-43	C18, C16 fatty acids,	Dairy residues, animal based diet
3	87-35	Undetermined	Boar
4	83-10	Undetermined	Terrestrial mammals, Fish
5	97-2	Undetermined	Greens,
6	69-64	Undetermined	Seeds and Roots
7	66-17	Undetermined	Undetermined
8	Big pot Base	Indigo, Isatin	Sea shells
9	83-11	Undetermined	Undetermined
10	1500-119	Undetermined	Undetermined

An interesting result from the initial GC-MS analysis was from the "big pot" base of the Va'oto site. The chemical markers found on the sherd indicated that indigo and isatin were present. These substances are commonly found in dyes of vibrant colors. This find was important due to how few organic materials found in American Samoa are vibrantly colored. Indigo is not endemic to Samoa but was, instead, introduced in the historic era. One possible organic source was found upon further research that was thought might contain indigo dye, or something chemically very similar, the *Trochus* sea snail. *Trochus* was identified as a possible source of the indigo in the residues because of the vibrant reddish-pinkish shell colors of living *Trochus* –shellfish, and because it is well represented in the midden of the sites. In addition, no other shellfish represented in the middens at Samoan sites are as vibrantly colored.

To test this interpretation, further GC-MS analysis was performed on the sherd. GC-MS was also used to examine four *Trochus* shells recovered from coasts in Samoa to test for the presence of indigo and isatin in the shells. Although these shells were not recovered from archaeological sites, they were chosen for analysis due to retaining more color than the shells recovered from excavations. It was thought that these shells were a close representation of the shellfish consumed at sites in American Samoa. Any indigo and isatin held in these control shells would likely be of similar levels as those cooked in Samoan ceramics. After completing the GC-MS analysis of both the sherd and the shells, the results provided little evidence that could be used to confirm that the shell was the source of indigo found on the base sherd. A second round of GC-MS was performed, but did not provide different results. This lack of evidence may be due to how the shells were prepared for analysis. The four shells were not cooked prior to examination- and it is possible that the indigo contained in the shells did not leach out during sonication resulting in indigo not being present in data obtained through GC-MS.

Further examination of *Trochus* shells would be useful for confirming the origin of the indigo found if shells were heated to a temperature similar to that used during cooking. Without doing this, it is difficult to confirm or reject the proposition that *Trochus* was cooked in pots by ancient Samoans. It is still possible that the indigo came from some plant source in Samoa not known to me or to Dr. Clark, but that is a possibility that will be pursued in the future.

For most data, only basic interpretations such as whether samples represented a source of flora or fauna could be made. If residues contained high levels of chemical markers, further classification could be made, but it is rare to obtain the level of identification associated with the base sherd of the Va‘oto vessel.

Although the initial data obtained through residue analysis could be used to determine what organic substances were adhered to the examined sherds, not all of the interpretations made sense for materials utilized in Samoa. Sherd 170-43 of the Ofu Village site contained organic material that was initially interpreted as dairy residue. This interpretation was impractical since there was no dairy production in Pacific prehistory. As a result, this interpretation was discredited leading to further examination of the residues associated with sherd 170-43. After further analysis of the sherd, evidence was found indicating residues originally interpreted as dairy were broken-down molecules representing fish. When broken down, the molecules that form dairy products and fish proteins have the same basic structure resulting in potential for misidentification.

Additional GC-MS was performed after reviewing the results of the initial analysis. This set of scans allowed for more accurate interpretations of residues to be formed. As a result, some initial interpretations were dismissed while others were strengthened. GC-MS was performed on each of the ten sherds along with a soil sample recovered from the Va‘oto site and four *Trochus* shells. GC-MS data were interpreted by Dr. Balasubramanian and compiled in a table (Appendix C).

The results obtained through the final GC-MS analysis were used to determine that a variety of organic materials were present in the sample collection (Table 3). These materials included: fish, pig, seeds, roots, nuts, shellfish, and vegetables along with more general indicators of terrestrial mammals and plants. In addition, multiple residues were found on individual samples indicating vessels were used for preparing multiple items including both plant and animal sources. This information is important in pots were used to cook a variety of materials and designated for preparing specific food type.

Table 3. Sherds examined through residue analysis.

Excavation Year	Site Code	Site Name	Sample #	Catalog Number	Unit	Layer	Level	CM BD	Residues Found
2013	AS-13-13	Va'oto	2	170-43	21E/15N	IV	1c	104-114	Fish residues, terrestrial mammals, shellfish
2010	AS-13-13	Va'oto	10	1500-119	37E/9N	IVb	13	N/A	Plants, coconut, vegetable residues, fish
2010	AS-13-13	Va'oto	1	1500-287	37E/9N	IVb	N/A	N/A	Fish, animals
2013	AS-13-13	Va'oto	8	Big Pot Base	37E/9N	V	11 & 12	93-121	Shellfish, fish from warm seas, oily vegetables
2013	AS-13-13	Va'oto	4	83-10	39E/9N	Vc	12	119-126	Terrestrial mammals, fish
2013	AS-13-13	Va'oto	9	83-11	39E/9N	Vc	12	119-126	Marine animal oils, nuts
2013	AS-13-13	Va'oto	3	87-35	39E/9N	Feature 74	N/A	123	Pig, residues from heating vegetables
2013	AS-13-13	Va'oto	5	97-2	39E/9N	VI	14	135-145	Greens, fish
2013	AS-13-41	Ofu Village	6	69-64	XU-4	VI	8	245-255	Seeds and roots
2013	AS-13-41	Ofu Village	7	66-17	XU-4	VI	7	235-295	Mostly plant residues

The residues identified in this study are important in that they demonstrate which food sources were utilized during the period of ceramic manufacture in American Samoa. By determining the age of the ceramics examined, it is possible to chart when certain foods came into use and when they declined. While it is possible to determine when certain foods were utilized in American Samoa through this study's residue analysis, a much larger sample size is needed for developing an accurate timeline for prehistoric food utilization in the islands.

The results obtained demonstrate that a wide variety of food sources were utilized at the Ofu Village and Va'oto sites in American Samoa during the period of ceramic production. The two sherds from Ofu Village contained residues from mostly plant materials including seeds and roots. These materials likely included vegetables such as taro that have been considered a staple of Samoan diet. Little evidence for marine resources or terrestrial mammals was found for Ofu Village. This lack of animal residue was likely due to the small sample size examined during residue analysis.

The eight sherds examined from the Va‘oto site contained a wider variety of organic residues than those associated with Ofu Village. The materials represented at Va‘oto include: fish, shellfish, pig, vegetables (oily and cooked), coconut, and nuts in addition to more generalized indicators of terrestrial mammals and plants. Five out of eight of the sherds contained a combination of plant and either marine or terrestrial fauna sources. This combination heavily supports an interpretation that ceramics in American Samoa were used to prepare multiple food sources. Plant, marine, and terrestrial fauna sources appear to be present throughout the Va‘oto site in the levels associated with the sherds examined. While each of these three sources was found, terrestrial fauna was present in a lower proportion of samples. This source likely consisted of pig and small mammals such as bat and rat. This is supported by the identification of residues associated with pig in sample 87-35. Evidence for terrestrial mammals was also found in sherds 1500-287, 170-43, and 83-10 that could potentially represent pig. The presence of pig is concentrated in upper levels of Va‘oto instead of lower levels. Further examination would need to be undertaken to analyze a larger collection of sherds spanning the entire depth of the site in order to verify when pig was utilized in comparison to other food sources.

Multiple residues from vegetables were found indicating a variety of plants were prepared in pottery. These included nuts, seeds, roots, and other more generalized indicators of plants. The more generalized residues of plant remains likely represent crops such as taro. Residues representing “oily” and “cooked” vegetables were also found. The residues identified as cooked vegetables indicate plant materials were prepared in pots. The residues identified as oily vegetables likely represent a specific type of plant, although more analysis is needed to confirm which plant is present. A variety of marine resources were also identified through GC-MS. Both fish and shellfish residues were found in samples from Vaʻoto. Seven out of eight sherds contained residues that were of marine origin. This strongly suggests marine resources were a vital part of the prehistoric diet.

In summary, the residue analysis performed in this study provided useful data that could be used to determine aspects of the diet of ancient Samoans. Through GC-MS, multiple organic residues were found that could be identified as distinct categories of food. These included terrestrial flora and fauna in addition to marine resources. These data were useful in providing information that can usually only be found through examining physical remains of cooked food such as bones or burnt seeds. By providing usable data, this thesis demonstrated the viability of residue analysis in identifying aspects of diet in American Samoa.

CHAPTER 6. CONCLUSIONS AND FUTURE WORK

Through this thesis a variety of data were obtained that can benefit ceramic analysis and archaeology as a whole. New methods of analysis were tested and compared to traditional means of examination to verify their effectiveness. In addition to exploring new analytical methods, data were obtained that can help better understand the ceramic record in American Samoa. With these data, issues were addressed such as the importance of ceramic thickness and whether thin pottery transitioned into thick pottery over time as was suggested by Green and others.

Each of the three analyses included in this thesis were used to address the initial questions laid out in the introduction chapter. These six questions will each be addressed in this conclusion using the results obtained through this research.

Do ceramics from these four sites fall into distinct wares (i.e., "thin fine ware" and "thick coarse ware") or other groupings that are representative of different periods of ceramic production?

The data obtained from traditional physical analysis were most useful for addressing this question. For the six units of the Va‘oto site, little evidence was found for a transition from fine-tempered thin ware to coarse-tempered thick ware. Instead there was a trend of sherd thickness increasing in variability over time in five of the six units. Sherds with thicknesses falling into traditional categories of "thin ware" and "thick ware" were found throughout the majority of sherd bearing levels in these units. This was especially true for the most recent ceramic bearing levels. With these data, there is little to support Green's (1974b) interpretation of thin ware transitioning into thick ware. Instead, this thesis suggests both thin and thick pottery were present throughout the latter half of the period of ceramic production at the Va‘oto site. While there was no evidence to support thin-walled vessels transitioning into thick-walled vessels, a general increase in sherd thickness did occur. This indicates thicker pots were produced in higher numbers later in the period of ceramic manufacture in American Samoa. Although thick ceramics do appear to become more prevalent, thinner ceramics continued to be produced near the end of pottery production in American Samoa.

The data obtained from the ʻAoa site was similar to those from Vaʻoto in that a lack of evidence was found supporting Green's interpretation. There was no evidence for thin-walled pottery transitioning into thick-walled pottery found in the two ceramic-bearing components of the site. It should be noted, however, that environmental factors such as "downslope superpositioning" could have caused patterns to be missed (Clark and Michlovic 1996:163). Through the analysis of ʻAoa sherds, two distinct forms of pottery were found that were classified based upon temper size. These forms were fine-grained temper thin pottery and extremely coarse-grained temper thick pottery. These two "wares" were found in both the upper and lower components of ʻAoa. The results obtained through CT also support these two sherd forms being distinct from one another.

While changes in sherd thickness did not appear at ʻAoa over time, the material used as temper did vary between the upper and lower components. This occurrence was documented through CT imagery. The coarse temper used in sherds recovered from the lower component was higher in density and also covered a greater range than the temper from the upper component. Sherds from the upper component had temper with a more uniform density that was less dense than the temper from the lower component. These data suggest that the source of temper used at ʻAoa changed over time. The greater range in density seen in the lower component (early first millennium BC) suggests that multiple lithic materials were being utilized. By the time of the upper component (late in the ceramic sequence of Samoa, with dates at ca. AD 1400-1600), fewer temper sources were utilized indicating a preferred lithic material was likely found. When taken as a whole this change in temper material likely represents early experimentation in temper use leading to a small number of materials being preferred for pottery production at ‘Aoa.

The data obtained from the Coconut Grove and Ofu Village sites were too limited to be used to address this question.

When combined, the data obtained from this thesis do not support the interpretation that fine-tempered thin ceramics transitioned into coarse-tempered thick ceramics in American Samoa. Instead, these data support an interpretation that variability in sherd thickness increased over time. This is most evident when comparing average thicknesses of sherds recovered from the oldest and youngest sherd-bearing levels of the Va‘oto site. Variability in sherd thickness was at its lowest in the oldest levels and at its highest in the most recent levels. This trend likely represents changes in ceramic manufacture as whole. The quality of ceramics produced over time declined leading to an increase in thickness variability that continued until pottery manufacture ceased in American Samoa.

Distinct “wares” such as thin ware and thick ware do not appear to be useful classifications, particularly if those categories are taken to represent different periods of ceramic production. Sherds that fell into the categories of thin ware and thick ware proposed by Green were found throughout the sherd-bearing levels of the Va‘oto site. The presence of both thin and thick sherds in multiple levels indicates traditional “wares” used in Pacific archaeology are not adequate indicators of where a ceramic assemblage falls in the period of ceramic production for American Samoa. Other sherd characteristics need to be examined to determine if an indicator of ceramic age can be found. One characteristic examined in this thesis that might be useful for providing a rough relative estimate of where a ceramic assemblage falls in the period of ceramic production in American Samoa is variability in sherd thickness across a level. The data obtained through this research indicated variability increased over time in a majority of the excavation units examined. While this could be used as an indicator of how old a collection of sherds is, more research is needed to verify that variability in thickness can be a useful indicator of age for ceramic analyses of sherds recovered from American Samoa.

If wares or groups can be ascertained, how do they compare to the reported variability in ceramic collections from other sites excavated in Samoa?

The data obtained through physical analysis and CT were most useful for addressing this issue. As previously stated, little evidence was found for distinct wares being present in the sherd collection examined for this study. Although this appears to be true, traits were found that differentiated sherds recovered from the four sites explored. This was most clearly seen with sherds recovered from ‘Aoa. These eight sherds contained temper that was very different from what was found in sherds from the other sites examined. During CT, it was found that ‘Aoa sherds had angular, coarse-grained temper that was very dense when compared to samples examined from other sites. These characteristics were sufficient for determining if samples originated from ‘Aoa or one of the other three sites.

The sherds recovered from Coconut Grove, Ofu Village, and Va‘oto all shared similar characteristics that were documented during both physical analysis and CT. These sherds had temper that varied in size and density, but fell into a range of similar values. These sherds were very different when compared to those collected from ‘Aoa. The thicknesses of sherds from these three sites were also similar in that both thin and thick sherds were recovered. Although there was variation in thickness, sherds from Vaʻoto tended to be thicker than those from either Coconut Grove or Ofu Village.

Due to the number of sherds from the site examined during both the physical analysis and CT, Vaʻoto provided the best data for comparing sherds examined in this thesis to those recovered during other studies. Sherds from this site held many of the same characteristics documented for sherds found in other areas of American Samoa. Both thin and thick sherds were found that fall into the "thin ware" and "thick ware" categories proposed by Green and accepted by many Pacific archaeologists. Although Vaʻoto sherds fall into these categories, this thesis does not support the use of thin ware and thick ware as diagnostic categories that can be associated with specific periods of ceramic manufacture in American Samoa.

When combined, the data obtained from the three analyses of this thesis do not indicate distinct wares were present in American Samoa that can be associated with specific time periods. This does not mean there were no ceramic forms present in the Samoan Archipelago that could be tied to specific periods of ceramic production. Ample evidence has been documented solidifying the position that Lapita ceramics were produced near the beginning of ceramic manufacture across Oceania, including into Samoa. Ceramics that do not contain distinctive Lapita characteristics have been much more difficult to associate with distinct periods of ceramic production. This was the case for sherds examined in this thesis.

Sherds were found at multiple sites with thicknesses that could be placed in the categories of thin ware and thick ware proposed by Green. While thin and thick sherds were found, they were recovered from the same pottery bearing levels rather than thin sherds being recovered from older deposits than thick sherds. By being found in the same levels across both time and space, thin ware and thick ware are not categories that hold temporal significance. With the exception of samples from ‘Aoa, the sherds examined for this research contained similar physical characteristics as sherds recovered from excavations across American Samoa. This suggests that other ceramic assemblages likely share many of the traits discussed in this thesis with the sites examined. While there appears to be variability between sites and through time, there is not sufficient evidence for categorizing sherds into categories that have temporal significance, with the exception of Lapita ceramics. This suggests the categories of “thin ware” and “thick ware” need to be redefined to exclude any attachment to specific periods of ceramic production in American Samoa.

Can CT scans be used to determine the method of pottery construction in American Samoa?

The results obtained through CT scanning provided strong evidence for the technique being a reliable way to determine how ceramics were manufactured. Through CT analysis two methods of manufacture were found: slab construction and coiling. Evidence for these methods was not found during physical examination lending credence to the use of CT for ceramic analysis. If CT was not used to examine this collection of sherds, methods of manufacture would have been overlooked or misidentified. This is especially true for slab construction. No evidence for slab use was found during physical analysis, but many of the sherds displayed evidence of slab construction when examined with CT. Two methods of slab construction were revealed. Slabs were either placed sided by side to form vessel walls or placed one on top of another to create thicker walls that are believed to have helped retain heat during cooking. Both methods could, of course have been used for the same vessel, possibly for different parts of the vessel, such as walls and rims.

Surprisingly little evidence was found for coiling in the collection with the exception of four sherds recovered from Va‘oto. These sherds were recovered from layers V (83-9) and VI (85-8) in addition to Feature 90 (178-3 and 204-13). The position of these sherds indicates coiling was employed early on in the period of ceramic production represented at Va‘oto. Prior to this analysis, it was generally believed that coiling would be prominent in the collection especially for thicker samples and there was also little indication of slab construction in American Samoa. After examining CT scans, however, it was found that slab construction was found in a much higher percentage than coiling (13 slab-constructed sherds vs. 4 coiled sherds). A reason that coiling might not have been found in many sherds could have been due to the size of sherds. Smaller sherds would have had a greater chance of not containing coils than larger sherds leading to an inaccurate identification of samples containing coils in the examined collection.

Does the data acquired from CT scans support the results obtained from the physical analysis of sherds in terms of construction methods and variability within and between sites?

The data obtained through CT both supported and contradicted the results obtained through physical analysis. As discussed above, CT provided evidence of manufacture methods that differed from the data obtained from physical examination. No evidence was found for slab construction during physical analysis while coiling was documented in only four sherds through CT. This occurrence indicates CT should be combined with physical examination to obtain comprehensive data that can be used to form more accurate interpretations.

While there were contradictions in data obtained through CT and physical analysis, there were also indications that CT data could support results obtained through physical analysis. This was clearly seen when documenting temper size and percentage. These characteristics were recorded through physical analysis and expanded upon with CT. Physical examination was able to provide an estimate of temper size and percentage by examining the visible surfaces of sherds. CT was able to expand upon these data by recording sherd interiors. This allowed for temper size and percentage to be documented with greater accuracy throughout the clay matrix of the sherd in addition to visible surfaces. CT use also provided evidence that physical analysis could not, and did so without destroying the samples. This was the case for sherd 88-2 from Ofu Village. Through physical examination a raised ridge was documented on the exterior surface of the sample. Physical analysis was unable to determine if the ridge was an attachment. Through CT it was determined that the ridge was added to the sample due to the presence of a linear void and compression lines beneath the ridge. This example best demonstrates the benefits of using multiple methods of ceramic analysis.

CT data were used to expand upon the data obtained through physical analysis that documented ceramic variability within and between sites. CT was able to confirm that sherds from ‘Aoa were indeed distinct when compared to sherds from the other three sites. In addition, the ability to examine sherd interiors with CT allowed changes to be visualized between soil layers of sites. For ‘Aoa a change in temper material was documented between pottery-bearing components indicating a change in temper material occurred. This change was not documented with physical analysis. For sherds from Va‘oto subtle variations were documented between layers. Temper density varied between layers indicating some change in temper material occurred, although the change was not as drastic as what was documented for ‘Aoa. Temper size and angularity also varied between layers of Va‘oto.

One characteristic for which CT could not provide data while physical examination could was sherd color. This was exclusively documented through traditional examination using a

Munsell chart. This occurrence demonstrates how CT cannot fully replace physical examination for ceramic analysis. CT should be thought of as a supplemental method that can provide more detailed data than physical analysis alone. A variety of information would go undocumented if CT was used as the only method of examination for ceramic analyses.

Is CT a viable tool for ceramic analysis, particularly of large collections?

Data can be obtained through CT scanning that cannot be obtained through physical examination in a non-destructive manner. While the method is useful for analyzing pottery sherds, there are a few issues that could be detrimental to examining large collections of sherds with CT. In this thesis each of the 43 sherds examined with CT had to be scanned individually. This was largely due to the size of the micro-CT scanner. Initially sherds were to be scanned together on a tray that would rotate inside the scanner. This method was not used due to the difficulty of digitally cutting a scan file into smaller sections for analyzing samples individually. A large scan containing multiple sherds would be difficult to examine. Sherds would not be able to be rotated in Volume Graphics without having overlap present from other sherds. This issue ultimately led to samples being scanned individually for this study.

Another issue that would arise from analyzing large sherd collections would be cost. Each run of the CT scanner was slightly below one hundred dollars although the price was negotiated for this research. If sherds have to be scanned individually the price could be impractical for a large collection of samples. One way to avoid this issue could be to use a full size CT scanner like those housed in hospitals. While multiple sherds could be scanned with this form of scanner, scanning human tissue require a different calibration from effective scanning of dense objects such as artifacts, and most medical institutions would likely be unwilling to recalibrate their machines both before and after ceramic analyses. As a result it is best to scan diagnostic sherds that represent a larger collection, similar to what was done for this study. Scanning representative sherds could dramatically lower the price of using CT while still maintaining the variation present in a collection.

While there are many issues that need to be resolved prior to using CT to examine sherds on a large scale, the method does provide many benefits over other methods of analysis. Sherds can be examined in 3-D allowing for traits to be documented that are not visible on sample surfaces. Also, sherds do not need to be destroyed to be analyzed with CT. This allows samples to be stored for future examinations. Another benefit of CT is that it is easy to send other scholars CT scans of sherds allowing for analysis by others without having to risk transporting samples. The only issue with this is that scans are large files, usually ranging between two to three gigabytes per scan. Although aspects of the method need to be refined and costs need to be reduced, CT can be considered a viable tool for ceramic analyses of collections that vary in size.

Can geochemical residue analysis be used to determine what was cooked in pots produced in American Samoa?

The data obtained through residue analysis provided evidence for multiple organic materials being prepared in vessels recovered from Va‘oto and Ofu Village. Evidence for fish, shellfish, pig, seeds, nuts, and roots in addition to more generalized indicators of terrestrial plants and animals were found through GC-MS. The two samples examined for Ofu Village contained only plant based residues while samples for Va‘oto contained a mixture of marine and terrestrial resources including flora and fauna. The data obtained from Va‘oto samples were especially significant in that plant and animal residues were found together on individual sherds. This provided strong evidence for vessels being used to prepare a variety of goods. If multiple food sources were prepared in the same pots it would indicate vessels were multi-purpose at the Va‘oto site and probably elsewhere in American Samoa.

Summary

These six questions and the data used to address them provide insight into ceramic technology in American Samoa in addition to multiple methods of ceramic analysis. The utilization of computed tomography as a viable method of ceramic examination was confirmed through the results obtained in this research. CT scanning can provide data in a manner that cannot be matched by other methods. Although CT can be used to obtain important information, the method cannot be used as the primary method of analysis. Instead, CT should be considered a supplementary method that can provide data that other methods would overlook.

When combined the data obtained through CT and physical analysis provide evidence for multiple changes occurring in ceramic production at the four sites examined. Multiple methods of manufacture were found in addition to changes in temper material utilized through time. Variation was documented between sites and through time. One of the most important results of this thesis was the development of an interpretation of the importance of thin and thick ceramics. Little evidence was found to support Green's interpretation of thin ware transitioning into thick ware over time. Instead evidence was found indicating thin and thick sherds were present throughout the period of ceramic manufacture in American Samoa at the sites examined. Instead of thin ceramics becoming thicker over time, a general increase in thickness variability was documented. This indicates that the terms "thin ware" and "thick ware" do not have temporal significance and should be redefined.

The results obtained through residue analysis also provided information that was important for understanding ceramic use in American Samoa along with confirming the viability of a new method of sonication for GC-MS. This thesis demonstrated how sherds do not need to be destroyed to extract residues for GC-MS. Instead of creating a powder out of sherds, entire samples can be placed into solutions and be sonicated. While this method does not destroy sherds, they still suffer some slight damage from the process. The benefit of the method is that sherds can still be examined after residue analysis and stored for future analyses. The residues obtained in this study suggest a variety of resources were prepared in pots in American Samoa indicating vessels were multi-functional. In addition to indicating how vessels were used, the results of residue analysis provided evidence for some of the foods that likely formed part of the diet of inhabitants of American Samoa during the period of ceramic production.

In conclusion, this thesis provided evidence for the viability of computed tomography for the analysis of pottery sherds recovered from four sites in American Samoa. This study also tested a new method of sonication for residue analysis to determine if residues could be obtained from intact sherds in sufficient amounts to be identified. The results from those new methods of examination, taken in conjunction with conventional physical analysis, provided data useful for determining various aspects of the importance of pottery in American Samoa including how vessels were manufactured, how ceramic production changed over time, and what foods were prepared in pots at the sites examined.

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APPENDIX A. SPREADSHEET FOR RECORDING SHERD MEASUREMENTS DURING CERAMIC ANALYSIS

	SHERD CATALOG NO.										
	PROVENIENCE La / le										
1	SHERD FORM										
2	SURFACE FINISH										
3	DECORATION POS.										
4	PADDLE IMPRESSED										
5	DENTATE										
6	INCISED										
7	CORDMARKING										
8	SIDE TOOL IMPRESS										
9	APPLIQUÉ										
10	MODELLED										
11	MIN. THICKNESS										
12	MAX. THICKNESS										
13	MORM / MEDIAN										
14	MEAN / AVG										
15	VARIANCE										
16	SIZE										
17	WEIGHT										
18	EXTERIOR COLOR										
22	INTERIOR COLOR										
26	OXIDATION PATTERN										
27	CONSTRUCTION										

28	TEMPER: calcareous										
29	TEMPER: lithic										
30	TEMPER GRAIN SIZE										
31	TEMPER: grog %										
32	ORGANIC RESIDUE										
RIMS AND NECKS											
	SHERD CATALOG NO.										
	PROVENIENCE La / le										
33	CARINATION ANGLE										
34	RIM-BODY CONTOUR										
35	RIM ORIENTATION										
36	RIM COURSE										
37	RIM PROFILE										
38	LIP SHAPE										
39	LIP THICKNESS										
40	ORIFICE DIAMETER										
41	RIM LENGTH (TOP)										
42	NECK INCLIATION										
43	NECK DIAMETER										

APPENDIX B. CT SCAN SHERD DESCRIPTIONS

Ofu Village Sherds

182-1: This sherd had a high percentage of temper evenly distributed through the clay matrix of the sherd. Due to the even distribution of the temper it could be naturally occurring. Temper particles had a higher density (mass) than the clay. Fractures ranging in size were found throughout the sherd with larger fractures concentrated near the sherd center. Small air voids were also present in the sherd that seemed to be found in patterns that were not naturally occurring that could be indicative of shell temper or some form of organic material.

'Aoa Sherds

AU-3: The characteristics of this sherd were very different from those of AU-2. Extremely fine temper was found randomly distributed throughout the sherd with coarser temper being relatively sparse. Many compression lines and small fractures were found that likely indicate compaction of clay during manufacture. While there were few air voids present in the sherd, there was one large air void present similar to that of AU-1. This void was likely formed when two clay slabs were joined to form a wall of a vessel providing strong evidence for the use of slab manufacture to produce pottery at 'Aoa.

AU-4: This sherd had coarse, angular temper similar to that of AU-2 randomly distributed throughout the clay matrix. Much of the coarse temper was extremely dense when compared to the clay and finer temper present in the sherd, although the density of the temper as a whole was lower than that found in AU-2. No discernable compression lines were present in the sherd, although many large fractures were found concentrated near the center of the sample. The interior of the sherd was very compact with few to no air pockets present likely attributing to the lack of discernable compression lines in this sherd.

AL-2: This sherd had very coarse temper similar to that of AL-1, but was of a much lower density. Few to no compression lines were present, although multiple fractures were found concentrated near the center of the sherd around coarse particles. The temper of this sample was evenly distributed across the clay matrix and consisted of a higher percentage of fine temper than that found in AL-1. The relatively even distribution of temper in this sample could indicate temper was not manually added to clay during manufacture. While much of the coarse temper found in the sample was angular, it was more rounded than temper found in upper component samples.

Coconut Grove Sherds

33-43: This rim sherd had highly dense, fine temper similar to that of 33-42, but was slightly denser. Although temper was widespread, the majority was present near the surface of the sherd indicating compression occurred during manufacture. While compression lines were also found throughout the sample, most were concentrated in tightly stacked layers near the surface of the rim. Fractures were found spanning the width of the sherd near the area of greatest curvature. In addition to fractures, a linear void was present in this portion of the sherd. The presence of a linear void and fractures could be used as evidence for two different interpretations. The void and fractures could either represent stress marks at the greatest curvature of the rim, or could be indicative of the rim being added to the vessel body during manufacture. The presence of a relatively linear void suggests that the rim was likely added during production.

33-45: This collared rim had fine to slightly coarse temper spread throughout the sherd in addition to small air pockets being common. Two “inclusions” of clay were found near the sherd surface likely representing partially unfired clay. Multiple compression lines were found near the collar and rim surface, similar to sherd 33-42. In addition, no linear void was found beneath the collar further supporting an interpretation that the collar was formed from folded clay instead of being added during manufacture.

27-11: This sherd had fine to slightly coarse temper spread throughout the clay matrix. Compression lines in addition to fractures and air pockets were common across the sample. A thin linear void or fracture was found at the center of the sherd that could represent slab construction. While there is what appears to be a linear void present, there is not enough evidence when compared to other sherds to confirm the use of slab construction as the method of manufacture for this sample.

Va‘oto Layer III Sherds

9-1: This sherd had very abundant medium to coarse temper randomly distributed throughout the clay matrix. The highest concentration of temper was found near the sherd surface around compression lines indicating the surface was modified during manufacture. The temper of this sample was less dense than that found in sherds from other sites signifying utilization of a different temper source. Air pockets and fractures were present near especially large temper particles. In addition, a linear void or fracture was found at the center of the sherd indicating slab construction was used during manufacture.

14-1: This sample had medium to coarse temper randomly distributed throughout the sherd with concentrated layers of temper near compression lines at the surface. Temper particles had a higher density (mass) than the clay. The concentration of temper near the surface in addition to compression lines indicate the exterior of the sample was modified during manufacture. Small fractures and air pockets were found throughout the clay matrix along with a linear void at the center of the sherd spanning the length of the sample. This linear void is likely indicative of slabs being used during the manufacturing process.

15-1: This sherd had medium to coarse temper with few examples of fine particles present. There was also less temper present when compared to sherd 14-1. With this sherd, temper was found to be concentrated near the center of the sample with fewer particles near the exterior. The density of temper was slightly higher than the clay, although some coarse temper particles had specks of very dense material. The temper of this sample along with that of other Va'oto layer III sherds indicate a different material was utilized for temper at the site when compared to previously discussed samples from other sites. Multiple fractures and air pockets were also found in the sherd near coarse temper particles. Compression lines were also found, but do not seem to have affected temper distribution indicating surface modification was not extensive. Contrary to sample 14-1, no central linear void was found making it difficult to determine the method of manufacture for this piece.

Va'oto Layer IV Sherds

46-1: This sherd had very abundant medium to coarse temper spread throughout the clay matrix with temper being slightly denser than the clay. Most temper was angular, but with more rounded edges than temper associated with other sites. A small amount of temper contained highly dense particles likely signifying the use of a second temper material in the sample. This sherd contained a higher percentage of temper than most other samples examined in this study. A curved temper particle was found that could represent shell temper, although there is not enough evidence to determine it is not lithic material. No linear void could be discerned in this sample.

26-6: This sherd had mostly fine temper although some coarse material was present. The temper was denser than the clay matrix with some particles having specks of extremely dense material. Multiple compression lines were found adjacent to the exterior of the sample. Fractures were also present throughout the sherd. A possible linear void was found in the sample indicating slab construction was likely used during manufacture.

Va'oto Layer V Sherds

83-5: This sherd had fine to coarse temper randomly distributed throughout the clay matrix. While temper was present throughout the sherd, most was concentrated near the exterior around compression lines indicating surface modification occurred during manufacture. The temper was slightly denser than the clay with some particles having specks of very high density. Some very coarse temper particles had air pockets within the material signifying at least two types of temper being present in the sample. Fractures and air pockets were present throughout the sherd while no linear void was found. The lack of a linear void made it difficult to determine if slab construction was used to manufacture this sample.

Va'oto Layer VI Sherds

85-9: This rim sherd had fine to coarse grained temper spread throughout the clay matrix. Most temper in the sample was slightly denser than the clay, although the finest grained temper seemed to be the densest. Compression lines were found throughout the sherd with most concentrated near the rim edge. Fractures and air pockets were also present throughout the sherd. Possible evidence for either coiling or rim attachment was found in the form of a curved void. The void was not like those found in sherds believed to have been produced through slab construction. This void was smaller and curved from the interior to the exterior of the sherd.

Due to the presence of this curved void, it is likely the sample was produced either through coiling or the rim was added to the vessel during manufacture.

85-10: This rim sherd had fine to coarse temper randomly distributed throughout the sample with some clustering occurring indicating temper was manually added. The temper was slightly denser than the clay with some particles having specks of high density. Most coarse temper was found away from the surfaces of the sherd. Compression lines were found to be concentrated near the edge of the rim indicating surface modification occurred. No evidence was found to determine the method of manufacture for this sample.

Experimental Sherds

EX-1: This experimental collared rim was produced from clay obtained from Ofu Village with no temper added. Very little temper was present in the sample with the exception of a few medium to coarse particles. This indicates temper was added to clay during production of vessels in American Samoa at the Ofu Village site. The temper of this sample was slightly denser than the clay matrix similar to Samoan sherds. Many fractures and air pockets were present in the sherd in addition to clumps of what are presumed to be unfired clay. These unfired clumps are likely present due to the firing temperature used for this analysis. A smaller number of compression lines were present near the edge of the rim although fewer lines were found than what were in samples from AS. No evidence could be obtained to indicate how the collared rim was formed. During manufacture, the collar was formed by folding clay and blending the seams. This did not show up in the CT scans likely due to the low viscosity of the clay.

EX-2: This experimental disk was produced from clay recovered from Va‘oto with no temper added. A higher percentage of natural temper was present in the Va‘oto clay when compared to that of Ofu Village. The temper of this sample was slightly denser than the clay with a few particles of high density. Many fractures were present throughout the sample including a large fracture at the center of the disk. Small air pockets were also common in the sample. Similar to most other experimental sherds, clumps of what are assumed to be unfired clay were present in the sample.

EX-5: This experimental disk was produced using coiling from Ofu Village clay with fine grained (less than 1/8 in) temper added during manufacture. During analysis, very little temper was found except for a few particles of high density. This suggests coarser temper was added to clay to obtain the temper concentration found in AS sherds. A small number of compression lines, fractures, and air pockets were found throughout the sherd. Clumps of unfired clay were also present throughout the sample. Individual coils could not be discerned during analysis likely due to the low viscosity of the clay.

EX-6: This experimental disk was manufactured using coiling from Ofu Village clay with coarse (greater than 1/8 in) temper added during production. Temper was present throughout the sample and had a density slightly higher than the clay. This result was very similar to what was recorded for a majority of AM sherds examined, although the temper in this sherd was present in a lower percentage. No compression lines were found in this sherd, but fractures and air pockets were common throughout the sample. Small clumps of clay were also found in the sherd presumably the result of a low firing temperature. Little evidence for coiling was found likely due to the low viscosity of the clay during production.

EX-8: This experimental disk was produced using slab construction from Ofu Village clay with coarse grained (greater than 1/8 in) temper added during manufacture. A surprisingly small amount of temper was found in this sample during analysis when compared to other coarse tempered experimental disks. Possible compression lines in addition to fractures and air pockets were found throughout the sherd. A few clumps of unfired clay were also present in this sample. Little evidence was found for slab construction in the sherd with the possible exception of a faint seam. This lack of evidence was likely due to the low viscosity of the clay prior to firing indicating more viscous clay was used to produce AS ceramics.

EX-9: This experimental disk was manufactured using slab construction from Ofu Village clay with fine grained (less than 1/8 in) temper added during production. A small percentage of temper was discernable during analysis that was slightly denser than the surrounding clay with some particles of high density. No compression lines were found in the sample, although multiple fractures and air pockets were present. A few large clumps of unfired clay were also found in the sample. Evidence for a linear void at the center of the sherd was found supporting the interpretation of some Samoan pottery being constructed using slab building. Although a linear void was found it was not as distinct as those found in samples from American Samoa.

APPENDIX C. FINAL RESULTS OF RESIDUE ANALYSIS

Organic Residue Analysis

Sample #	Identification	Major Compounds Identified	Interpretation (Potential Sources)
1	1500-287 (Va'oto)	C18:0 , C22:0, Branched fatty acids,	Fish, animals
2	170-43 (Va'oto)	C18, C16 fatty acids, 2-hydroxy eicosanoate, C12:0, Methyl sinnapate, C22:6 (n-3)	Fish residues, terrestrial mammals, shell fish
3	87-35 (Va'oto)	C18 fatty acids, Ketoacids (majorly bile acids), branched fatty acids	Pig, residues from heating vegetables
4	83-10 (Va'oto)	Ketoacids	Terrestrial mammals, fish
5	97-2 (Va'oto)	Methyl sinapate, C22:0, hydroxy fatty acids	Greens, fish
6	69-64 (Ofu Village)	Oleic, linoleic and palmitic acids, glycans, hydroxy fatty acids	Seeds and roots
7	66-17 (Ofu Village)	Traces of saturated fatty acids	Mostly plant residues
8	Big Pot Base (Va'oto)	Ketones from C18:0 and C22:0, C22:4 (n-3), n-6 polyunsaturated fatty acids	Shell fish, fish from warm seas, oily vegetables
9	83-11 (Va'oto)	Saturated Fatty acids, C22:0,	Marine animal oils, nuts
10	1500-119 (Va'oto)	C12:0 (significant), C18:0, C22:0, C26:2, C16:0, C18:1, C14:0	Plants, coconut, vegetable residues, fish
11	Native Sea Shells	Extraction methods in progress	N/A
12	Va'oto Soil Sample	Little to no organic residue found	N/A

APPENDIX D. SHERD DATA FROM PHYSICAL ANALYSIS

Table D1. Sherds examined with CT.

Excavation Year	Site Code	Catalog #	Unit	Layer	Level	Avg Thickness (mm)
2013	AS-13-13	152-1	21E15N	IV	8	16.08
2012	AS-13-13	9--1	38E/9N	III	5	15.71
2012	AS-13-13	14-1	38E/9N	III	5	19.45
2012	AS-13-13	15-1	39E/9N	III	2	10.12
2012	AS-13-13	15-2	39E/9N	III	2	12.76
2012	AS-13-13	44-2	39E/9N	IV	7	10.92
2012	AS-13-13	46-1	39E/9N	IV	1	10.61
2012	AS-13-13	26-6	40E/9N	IV	6	13.44
2012	AS-13-13	34-1	39E/9N	IV	5	13.6
2012	AS-13-13	64-1	38E/9N	IVc	11	8.48
2012	AS-13-13	67-3	39E/9N	V	5	22.35
2012	AS-13-13	83-5	39E/9N	Vc	12	13.24
2012	AS-13-13	83-9	39E/9N	Vc	12	6.65
2012	AS-13-13	85-1	39E/9N	VI	2	9.99
2012	AS-13-13	85-8	39E/9N	VI	2	9.06
2012	AS-13-13	85-9	39E/9N	VI	2	11.45
2012	AS-13-13	85-10	39E/9N	VI	2	9.42
2012	AS-13-13	178-3	22E15N	Feature 90	N/A	14.41
2012	AS-13-13	204-13	22E15N	Feature 90	N/A	15.68
2012	AS-13-37	27-11	XU-11	II	3	13.68
2012	AS-13-37	33-42	XU-12	II	4	8.61
2012	AS-13-37	33-43	XU-12	II	4	7.49
2012	AS-13-37	33-45	XU-12	II	4	8.1
2013	AS-13-41	88-2	4	VI	12	9.74
2013	AS-13-41	88-1	4	VI	12	7.03
2013	AS-13-41	81-26	4	VI	11	6.28
1992	AS-21-5	AU-1	XU-8	II	24-34cm	6.82
1992	AS-21-5	AU-2	XU-8	V	54-64cm	8.93
1992	AS-21-5	AU-3	XU-8	V	54-64cm	6.57
1992	AS-21-5	AU-4	XU-8	V	64-74cm	9.52
1992	AS-21-5	AL-1	XU-8	VI	74-84cm	10.09
1992	AS-21-5	AL-2	XU-8	VII	108-118cm	9.37
1992	AS-21-5	AL-3	XU-8	VII	138-148cm	6.72
1992	AS-21-5	AL-4	XU-8	VII	138-148cm	5.62
2015	Experimental	EX-1	N/A	N/A	N/A	17.8
2015	Experimental	EX-2	N/A	N/A	N/A	12.51
2015	Experimental	EX-3	N/A	N/A	N/A	15.95
2015	Experimental	EX-4	N/A	N/A	N/A	14.32
2015	Experimental	EX-5	N/A	N/A	N/A	14.15
2015	Experimental	EX-6	N/A	N/A	N/A	13.53
2015	Experimental	EX-7	N/A	N/A	N/A	12.89
2015	Experimental	EX-8	N/A	N/A	N/A	12.87
2015	Experimental	EX-9	N/A	N/A	N/A	12.76

Table D2. Sherds examined through residue analysis.

Excavation Year	Site Code	Site Name	Sample Number	Catalog Number	Unit	Layer	Level	CM BD
2010	AS-13-13	Va‘oto	1	1500-287	37E/9N	IVB	N/A	N/A
2013	AS-13-13	Va‘oto	2	170-43	21E/15N	IV	1c	104-114
2013	AS-13-13	Va‘oto	3	87-35	39E/9N	Feature 74	N/A	123
2013	AS-13-13	Va‘oto	4	83-10	39E/9N	Vc	12	119-126
2013	AS-13-13	Va‘oto	5	97-2	39E/9N	VI	14	135-145
2013	AS-13-41	Ofu Village	6	69-64	XU-4	VI	8	245-255
2013	AS-13-41	Ofu Village	7	66-17	XU-4	VI	7	235-295
2013	AS-13-13	Va‘oto	9	83-11	39E/9N	Vc	12	119-126
2010	AS-13-13	Va‘oto	10	1500-119	37E/9N	IVB	13	N/A
2013	AS-13-13	Va‘oto	8	Big Pot Base	37E/9N	V	11&12	93-121

Table D3. Va‘oto sherds examined through physical analysis.

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2010	55-1851	36E/7N	III	L1-7	Body	5.34
2010	55-1852	36E/7N	III	L1-7	Body	13.56
2010	55-1853	36E/7N	III	L1-7	Body	7.2
2010	56-1854	36E/7N	III	L1-7	Body	13.67
2010	57-1855	36E/7N	III	L1-7	Body	5.55
2010	70-1856	36E/7N	IV	L1-9	Body	7.39
2010	70-1857	36E/7N	IV	L1-9	Body	9.05
2010	81-1858	36E/7N	IV	L1-10	Body	11.72
2010	81-1859	36E/7N	IV	L1-10	Body	11.27
2010	81-1860	36E/7N	IV	L1-10	Shatter	N/A
2010	117-1861	36E/7N	IV	L1-11	Body	8.32
2010	96-1862	36E/7N	IV	L1-11	Body	12.53
2010	96-1863	36E/7N	IV	L1-11	Body	5.74
2010	121-1864	36E/7N	IVd	L1-12	Rim	6.95
2010	121-1865	36E/7N	IVd	L1-12	Body	8.78
2010	121-1866	36E/7N	IVd	L1-12	Body	10.14
2010	121-1867	36E/7N	IVd	L1-12	Body	8.36
2010	121-1868	36E/7N	IVd	L1-12	Body	5.38
2010	130-1869	36E/7N	IVd	L1-13	Rim	6.95
2010	130-1870	36E/7N	IVd	L1-13	Body	10.4
2010	130-1871	36E/7N	IVd	L1-13	Body	8.29
2010	130-1872	36E/7N	IVd	L1-13	Body	6.13
2010	130-1873	36E/7N	IVd	L1-13	Shatter	N/A
2010	136-1874	36E/7N	IVd	L1-14	Body	9.93
2010	136-1875	36E/7N	IVd	L1-14	Body	10.95
2010	137-1876	36E/7N	IVd	L1-14	Body	11.85
2010	137-1877	36E/7N	IVd	L1-14	Body	8.37
2010	137-1878	36E/7N	IVd	L1-14	Body	8.17
2010	137-1879	36E/7N	IVd	L1-14	Body	6.68
2010	137-1880	36E/7N	IVd	L1-14	Body	7.96
2010	137-1881	36E/7N	IVd	L1-14	Body	7.19
2010	137-1882	36E/7N	IVd	L1-14	Shatter	N/A
2010	137-1883	36E/7N	IVd	L1-14	Body	9.15
2010	146-1884	36E/7N	V	L1-15	Body	8.22

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2010	146-1885	36E/7N	V	L1-15	Body	9.66
2010	146-1886	36E/7N	V	L1-15	Body	6.23
2010	146-1887	36E/7N	V	L1-15	Body	N/A
2010	146-1888	36E/7N	V	L1-15	Body	N/A
2010	146-1889	36E/7N	V	L1-15	Body	5.98
2010	146-1890	36E/7N	V	L1-15	Body	N/A
2010	146-1891	36E/7N	V	L1-15	Body	14.04
2010	146-1892	36E/7N	V	L1-15	Body	5.99
2010	154-1893	36E/7N	V	L1-16	Body	11.44
2010	154-1894	36E/7N	V	L1-16	Body	7.48
2010	154-1895	36E/7N	V	L1-16	Body	7.7
2010	154-1896	36E/7N	V	L1-16	Body	7.21
2010	154-1897	36E/7N	V	L1-16	Body	7.57
2010	154-1898	36E/7N	V	L1-16	Body	10.51
2010	154-1899	36E/7N	V	L1-16	Shatter	N/A
2010	154-1900	36E/7N	V	L1-16	Body	6.47
2010	154-1901	36E/7N	V	L1-16	Body	6.21
2010	154-1902	36E/7N	V	L1-16	Body	6.12
2010	154-1903	36E/7N	V	L1-16	Body	N/A
2010	154-1904	36E/7N	V	L1-16	Body	8.33
2010	154-1905	36E/7N	V	L1-16	Body	N/A
2010	154-1906	36E/7N	V	L1-16	Body	N/A
2010	154-1907	36E/7N	V	L1-16	Body	N/A
2010	154-1908	36E/7N	V	L1-16	Body	6.2
2010	154-1909	36E/7N	V	L1-16	Body	N/A
2010	154-1910	36E/7N	V	L1-16	Body	N/A
2010	154-1911	36E/7N	V	L1-16	Body	N/A
2010	154-1912	36E/7N	V	L1-16	Body	N/A
2010	154-1913	36E/7N	V	L1-16	Body	N/A
2010	154-1914	36E/7N	V	L1-16	Body	N/A
2010	154-1915	36E/7N	V	L1-16	Body	N/A
2010	154-1916	36E/7N	V	L1-16	Body	N/A
2010	154-1917	36E/7N	V	L1-16	Body	8.97
2010	154-1918	36E/7N	V	L1-16	Body	7.81
2010	154-1919	36E/7N	V	L1-16	Body	N/A
2010	154-1920	36E/7N	V	L1-16	Body	7.76
2010	154-1921	36E/7N	V	L1-16	Body	6.71
2010	154-1922	36E/7N	V	L1-16	Body	6.78
2010	154-1923	36E/7N	V	L1-16	Body	6.35
2010	154-1924	36E/7N	V	L1-16	Body	5.89
2010	154-1925	36E/7N	V	L1-16	Body	6.09
2010	154-1926	36E/7N	V	L1-16	Body	9.08
2010	154-1927	36E/7N	V	L1-16	Body	6.49
2010	154-1928	36E/7N	V	L1-16	Body	7.08
2010	154-1929	36E/7N	V	L1-16	Body	6.69
2010	154-1930	36E/7N	V	L1-16	Body	7.69
2010	154-1931	36E/7N	V	L1-16	Body	5.89
2010	168-1932	36E/7N	VI	L1-17	Body	N/A
2010	168-1933	36E/7N	VI	L1-17	Body	6.25
2010	211-1934	36E/7N	V	NA	Body	8.28
2010	212-1935	36E/7N	V	NA	Body	7.88
2010	1500.1	37E/9N	IV	B	Body	14.07
2010	1500.2	37E/9N	IV	B	Body	15.04
2010	1500.3	37E/9N	IV	B	Body	N/A
2010	1500.4	37E/9N	IV	B	Body	N/A
2010	1500.5	37E/9N	IV	B	Body	N/A
2010	1500.6	37E/9N	IV	B	Body	N/A
2010	1500.7	37E/9N	IV	B	Body	N/A
2010	1500.8	37E/9N	IV	B	Body	N/A
2010	1500.9	37E/9N	IV	B	Body	N/A

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2010	1500.1	37E/9N	IV	B	Body	N/A
2010	33-1501	37E/9N	IIIb	L1-7	Body	5.07
2010	39-1502	37E/9N	IIIb	L1-7	Body	7.12
2010	43-1503	37E/9N	IIIb	L1-7	Body	6.01
2010	43-1504	37E/9N	IIIb	L1-7	Body	7.34
2010	43-1505	37E/9N	IIIb	L1-7	Shatter	N/A
2010	36-1506	37E/9N	IIIb	L1-7	Body	9.46
2010	36-1507	37E/9N	IIIb	L1-7	Body	9.03
2010	36-1508	37E/9N	IIIb	L1-7	Body	7.08
2010	36-1509	37E/9N	IIIb	L1-7	Shatter	N/A
2010	48-1510	37E/9N	IV	L1-8	Body	13.53
2010	48-1511	37E/9N	IV	L1-8	Body	7.33
2010	48-1512	37E/9N	N/A	NA	Shatter	N/A
2010	48-1513	37E/9N	IV	L1-8	Body	14.26
2010	48-1514	37E/9N	IV	L1-8	Inconclusive	N/A
2010	48-1515	37E/9N	IV	L1-8	Body	8.63
2010	48-1516	37E/9N	IV	L1-8	Rim	7.34
2010	48-1517	37E/9N	IV	L1-8	Body	5.71
2010	48-1518	37E/9N	IV	L1-8	Body	11.75
2010	48-1519	37E/9N	IV	L1-8	Body	7.3
2010	48-1520	37E/9N	IV	L1-8	Body	11.44
2010	48-1521	37E/9N	IV	L1-8	Body	8.12
2010	48-1522	37E/9N	IV	L1-8	Rim	14.11
2010	48-1523	37E/9N	IV	L1-8	Body	10.27
2010	48-1524	37E/9N	IV	L1-8	Body	9.92
2010	48-1525	37E/9N	IV	L1-8	Body	6.17
2010	48-1526	37E/9N	IV	L1-8	Body	5.92
2010	48-1527	37E/9N	IV	L1-8	Body	12.33
2010	48-1528	37E/9N	IV	L1-8	Body	N/A
2010	48-1529	37E/9N	IV	L1-8	Rim	15.33
2010	48-1530	37E/9N	IV	L1-8	Body	12.97
2010	48-1531	37E/9N	IV	L1-8	Body	8.47
2010	48-1532	37E/9N	IV	L1-8	Body	8.2
2010	48-1533	37E/9N	IV	L1-8	Body	9.51
2010	48-1534	37E/9N	IV	L1-8	Body	7.88
2010	48-1535	37E/9N	IV	L1-8	Body	5.28
2010	48-1536	37E/9N	IV	L1-8	Body	3.08
2010	48-1537	37E/9N	IV	L1-8	Body	N/A
2010	48-1538	37E/9N	IV	L1-8	Body	5.31
2010	48-1539	37E/9N	IV	L1-8	Body	N/A
2010	48-1540	37E/9N	IV	L1-8	Body	N/A
2010	48-1541	37E/9N	IV	L1-8	Body	6.3
2010	48-1542	37E/9N	IV	L1-8	Body	N/A
2010	48-1543	37E/9N	IV	L1-8	Body	4.43
2010	48-1544	37E/9N	IV	L1-8	Shatter	N/A
2010	57-1545	37E/9N	IV	L1-8	Body	N/A
2010	66-1546	37E/9N	IVb	NA	Body	10.72
2010	66-1547	37E/9N	IVb	NA	Body	7.12
2010	66-1548	37E/9N	IVb	NA	Body	10.44
2010	66-1549	37E/9N	IVb	NA	Body	8.15
2010	66-1550	37E/9N	IVb	NA	Body	6.45
2010	66-1551	37E/9N	IVb	NA	Body	5.84
2010	66-1552	37E/9N	IVb	NA	Body	11.98
2010	66-1553	37E/9N	IVb	NA	Body	10.3
2010	66-1554	37E/9N	IVb	NA	Body	4.66
2010	66-1555	37E/9N	IVb	NA	Shatter	N/A
2010	82-1556	37E/9N	IVb	L1-9	Body	8.89
2010	82-1557	37E/9N	IVb	L1-9	Shatter	N/A
2010	82-1558	37E/9N	IVb	L1-9	Body	8.44
2010	80-1	37E/9N	IVb	L1-9	Body	9.52

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2010	80-2	37E/9N	IVb	L1-9	Body	9.86
2010	80-2	37E/9N	IVb	L1-9	Shatter	N/A
2010	80-3	37E/9N	IVb	L1-9	Body	10.17
2010	80-4	37E/9N	IVb	L1-9	Body	10.57
2010	80-5	37E/9N	IVb	L1-9	Body	11.45
2010	80-5	37E/9N	IVb	L1-9	Body	11.05
2010	80-5	37E/9N	IVb	L1-9	Body	11.37
2010	80-5	37E/9N	IVb	L1-9	Body	11.61
2010	80-5	37E/9N	IVb	L1-9	Shatter	N/A
2010	80-6	37E/9N	IVb	L1-9	Body	10.78
2010	80-6	37E/9N	IVb	L1-9	Shatter	N/A
2010	80-7	37E/9N	IVb	L1-9	Shatter	N/A
2010	80-7	37E/9N	IVb	L1-9	Body	10.5
2010	80-7	37E/9N	IVb	L1-9	Body	10.28
2010	80-8	37E/9N	IVb	L1-9	Body	11.46
2010	80-9	37E/9N	IVb	L1-9	Shatter	N/A
2010	80-9	37E/9N	IVb	L1-9	Body	7.7
2010	93-10	37E/9N	IVb	L1-9	Shatter	N/A
2010	93-10	37E/9N	IVb	L1-9	Body	11.17
2010	93-11	37E/9N	IVb	L1-9	Inconclusive	13.14
2010	1580	37E/9N	IVb	L1-9	Inconclusive	9.44
2010	93-13	37E/9N	IVb	L1-9	Rim	9.76
2010	93-13	37E/9N	IVb	L1-9	Rim	11.06
2010	93-13	37E/9N	IVb	L1-9	Rim	10.61
2010	93-13	37E/9N	IVb	L1-9	Body	10.3
2010	93-13	37E/9N	IVb	L1-9	Shatter	N/A
2010	93-13	37E/9N	IVb	L1-9	Body	11.05
2010	93-14	37E/9N	IVb	L1-9	Body	9.11
2010	126-1588	37E/9N	IVb	L1-10	Body	11.07
2010	126-1589	37E/9N	IVb	L1-10	Body	9.74
2010	126-1590	37E/9N	IVb	L1-10	Body	9.93
2010	126-1591	37E/9N	IVb	L1-10	Body	N/A
2010	126-1592	37E/9N	IVb	L1-10	Body	N/A
2010	122-1593	37E/9N	IVc	NA	Body	7.56
2010	122-1594	37E/9N	IVc	NA	Body	N/A
2010	122-1595	37E/9N	IVc	NA	Body	N/A
2010	122-1596	37E/9N	IVc	NA	Body	N/A
2010	122-1597	37E/9N	IVc	NA	Body	N/A
2010	128-1598	37E/9N	IVd	L1-12	Rim	6.4
2010	128-1599	37E/9N	IVd	L1-12	Body	7.53
2010	128-1600	37E/9N	IVd	L1-12	Body	6.2
2010	128-1601	37E/9N	IVd	L1-12	Body	7.55
2010	128-1602	37E/9N	IVd	L1-12	Body	7.32
2010	128-1603	37E/9N	IVd	L1-12	Body	8.29
2010	128-1604	37E/9N	IVd	L1-12	Body	6.8
2010	128-1605	37E/9N	IVd	L1-12	Body	5.64
2010	136-1606	37E/9N	IVd	L1-13	Body	N/A
2010	136-1607	37E/9N	IVd	L1-13	Body	N/A
2010	136-1608	37E/9N	IVd	L1-13	Body	N/A
2010	136-1609	37E/9N	IVd	L1-13	Body	N/A
2010	136-1610	37E/9N	IVd	L1-13	Body	N/A
2010	136-1611	37E/9N	IVd	L1-13	Body	6.3
2010	136-1612	37E/9N	IVd	L1-13	Body	6.19
2010	136-1613	37E/9N	IVd	L1-13	Body	9.02
2010	136-1614	37E/9N	IVd	L1-13	Rim	6.95
2010	136-1615	37E/9N	IVd	L1-13	Rim	7
2010	158-1616	37E/9N	IVd	L1-15	Body	10.05
2010	158-1617	37E/9N	IVd	L1-15	Body	8.69
2010	158-1618	37E/9N	IVd	L1-15	Body	8.64
2010	158-1619	37E/9N	IVd	L1-15	Body	8.55

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2010	158-1620	37E/9N	IVd	L1-15	Body	8.38
2010	158-1621	37E/9N	IVd	L1-15	Body	9.43
2010	158-1622	37E/9N	IVd	L1-15	Body	11.24
2010	158-1623	37E/9N	IVd	L1-15	Body	8.21
2010	158-1624	37E/9N	IVd	L1-15	Body	9.39
2010	158-1625	37E/9N	IVd	L1-15	Body	8.81
2010	158-1626	37E/9N	IVd	L1-15	Body	9.02
2010	158-1627	37E/9N	IVd	L1-15	Body	8.11
2010	158-1628	37E/9N	IVd	L1-15	Body	8.78
2010	158-1629	37E/9N	IVd	L1-15	Body	7.98
2010	158-1630	37E/9N	IVd	L1-15	Body	9.43
2010	158-1631	37E/9N	IVd	L1-15	Body	8.4
2010	158-1632	37E/9N	IVd	L1-15	Body	9.1
2010	158-1633	37E/9N	IVd	L1-15	Body	8.12
2010	158-1634	37E/9N	IVd	L1-15	Body	N/A
2010	158-1635	37E/9N	IVd	L1-15	Body	5.11
2010	158-1636	37E/9N	IVd	L1-15	Body	8.88
2010	158-1637	37E/9N	IVd	L1-15	Body	6.89
2010	158-1638	37E/9N	IVd	L1-15	Body	7.41
2010	158-1639	37E/9N	IVd	L1-15	Body	7.67
2010	158-1640	37E/9N	IVd	L1-15	Body	8.3
2010	158-1641	37E/9N	IVd	L1-15	Shatter	N/A
2010	159-1642	37E/9N	IVd	L1-15	Rim	10.72
2010	159-1643	37E/9N	IVd	L1-15	Body	7.31
2010	159-1644	37E/9N	IVd	L1-15	Body	7.17
2010	159-1645	37E/9N	IVd	L1-15	Body	8.21
2010	159-1646	37E/9N	IVd	L1-15	Body	7.23
2010	159-1647	37E/9N	IVd	L1-15	Body	8.58
2010	159-1648	37E/9N	IVd	L1-15	Body	9.36
2010	159-1649	37E/9N	IVd	L1-15	Body	8.57
2010	159-1650	37E/9N	IVd	L1-15	Shatter	N/A
2010	163-1651	37E/9N	V	L1-16	Body	15.16
2010	163-1652	37E/9N	V	L1-16	Body	10.24
2010	163-1653	37E/9N	V	L1-16	Body	10.58
2010	163-1654	37E/9N	V	L1-16	Body	10.26
2010	163-1655	37E/9N	V	L1-16	Body	8.08
2010	163-1656	37E/9N	V	L1-16	Body	6.68
2010	163-1657	37E/9N	V	L1-16	Body	N/A
2010	163-1658	37E/9N	V	L1-16	Body	7.55
2010	163-1659	37E/9N	V	L1-16	Body	7.26
2010	163-1660	37E/9N	V	L1-16	Body	7.56
2010	163-1661	37E/9N	V	L1-16	Body	6.41
2010	163-1662	37E/9N	V	L1-16	Body	8.68
2010	163-1663	37E/9N	V	L1-16	Body	8.65
2010	163-1664	37E/9N	V	L1-16	Body	9.02
2010	163-1665	37E/9N	V	L1-16	Body	8.91
2010	163-1666	37E/9N	V	L1-16	Body	11.66
2010	163-1667	37E/9N	V	L1-16	Body	9.67
2010	163-1668	37E/9N	V	L1-16	Body	8.1
2010	163-1669	37E/9N	V	L1-16	Body	N/A
2010	163-1670	37E/9N	V	L1-16	Body	8.96
2010	163-1671	37E/9N	V	L1-16	Body	8.96
2010	163-1672	37E/9N	V	L1-16	Body	9.51
2010	163-1673	37E/9N	V	L1-16	Shatter	N/A
2010	163-1674	37E/9N	V	L1-16	Body	5.78
2010	163-1675	37E/9N	V	L1-16	Body	5.56
2010	191-1676	37E/9N	V	L1-16	Body	7.63
2010	191-1677	37E/9N	V	L1-16	Rim	9.64
2010	191-1678	37E/9N	V	L1-17	Body	10.84
2010	191-1679	37E/9N	V	L1-17	Body	N/A

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2010	191-1680	37E/9N	V	L1-17	Body	N/A
2010	191-1681	37E/9N	V	L1-17	Body	7.81
2010	191-1682	37E/9N	V	L1-17	Body	10.51
2010	191-1683	37E/9N	V	L1-17	Body	N/A
2010	191-1684	37E/9N	V	L1-17	Rim	10.89
2010	191-1685	37E/9N	V	L1-17	Rim	10.48
2010	191-1686	37E/9N	V	L1-17	Body	N/A
2010	191-1687	37E/9N	V	L1-17	Body	N/A
2010	191-1688	37E/9N	V	L1-17	Body	8.51
2010	191-1689	37E/9N	V	L1-17	Body	8.14
2010	191-1690	37E/9N	V	L1-17	Body	7.84
2010	191-1691	37E/9N	V	L1-17	Body	8.99
2010	191-1692	37E/9N	V	L1-17	Body	8.54
2010	191-1693	37E/9N	V	L1-17	Body	9.09
2010	191-1694	37E/9N	V	L1-17	Body	8.54
2010	191-1695	37E/9N	V	L1-17	Body	11.25
2010	191-1696	37E/9N	V	L1-17	Rim	10.75
2010	191-1697	37E/9N	V	L1-17	Body	7.94
2010	191-1698	37E/9N	V	L1-17	Rim	13.26
2010	191-1699	37E/9N	V	L1-17	Body	8.2
2010	191-1700	37E/9N	V	L1-17	Body	8.14
2010	191-1701	37E/9N	V	L1-17	Body	8.55
2010	191-1702	37E/9N	V	L1-17	Body	8.38
2010	191-1703	37E/9N	V	L1-17	Body	6.52
2010	167-1704	37E/9N	V	L1-17	Rim	11.23
2010	64-1705	37E/9N	IV	L1-8	Body	12.54
2010	161-1706	37E/9N	IVd	L1-15	Body	14.28
2010	161-1707	37E/9N	IVd	L1-15	Rim	11.04
2010	161-1708	37E/9N	IVd	L1-15	Body	7.23
2010	161-1709	37E/9N	IVd	L1-15	Body	10.31
2010	161-1710	37E/9N	IVd	L1-15	Body	8.13
2010	161-1711	37E/9N	IVd	L1-15	Body	12.13
2010	161-1712	37E/9N	IVd	L1-15	Body	8.6
2010	161-1713	37E/9N	IVd	L1-15	Body	12.4
2010	161-1714	37E/9N	IVd	L1-15	Body	8.37
2010	161-1715	37E/9N	IVd	L1-15	Body	8.37
2010	161-1716	37E/9N	IVd	L1-15	Body	8.12
2010	161-1717	37E/9N	IVd	L1-15	Body	8.08
2010	161-1718	37E/9N	IVd	L1-15	Body	11.67
2010	161-1719	37E/9N	IVd	L1-15	Body	8.38
2010	161-1720	37E/9N	IVd	L1-15	Body	7.99
2010	161-1721	37E/9N	IVd	L1-15	Body	9.15
2010	61-1722	37E/9N	IVd	L1-15	Inconclusive	7.51
2010	161-1723	37E/9N	IVd	L1-15	Body	7.36
2010	161-1724	37E/9N	IVd	L1-15	Body	9
2010	161-1725	37E/9N	IVd	L1-15	Body	7.23
2010	161-1726	37E/9N	IVd	L1-15	Body	7.8
2010	161-1727	37E/9N	IVd	L1-15	Body	8.63
2010	161-1728	37E/9N	IVd	L1-15	Body	7.71
2010	161-1729	37E/9N	IVd	L1-15	Body	6.58
2010	161-1730	37E/9N	IVd	L1-15	Shatter	N/A
2010	218-1731	37E/9N	Feature 59	NA	Body	7.51
2010	218-1732	37E/9N	Feature 59	NA	Shatter	N/A
2010	221-1733	37E/9N	Feature 63	NA	Body	8.09
2010	220-1734	37E/9N	Feature 63	NA	Body	9
2010	225-1735	37E/9N	Feature 64	NA	Shatter	N/A
2010	243-1736	37E/9N	Feature 64	NA	Body	16.28
2010	243-1737	37E/9N	Feature 64	NA	Shatter	N/A
2010	244-1738	37E/9N	Feature 64	NA	Body	8.61
2010	245-1739	37E/9N	Feature 64	NA	Body	8.42

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2010	245-1740	37E/9N	Feature 64	NA	Body	8.48
2010	125-1741	37E/9N	LIVb/Wall sc.	NA	Shatter	N/A
2010	204-1742	37E/9N	IN WALL	NA	Rim	9.58
2010	204-1743	37E/9N	IN WALL	NA	Body	9.59
2010	204-1744	37E/9N	IN WALL	NA	Rim	9.45
2010	204-1745	37E/9N	IN WALL	NA	Shatter	N/A
2010	206-1746	37E/9N	IN WALL	NA	Body	10
2010	206-1747	37E/9N	IN WALL	NA	Body	9.97
2010	207-1748	37E/9N	LV	NA	Body	10.27
2010	207-1749	37E/9N	LV	NA	Body	7.37
2010	1750	37E/9N	LV/IN WALL	NA	Body	7.96
2010	250-1751	37E/9N	LV IN WALL	NA	Shatter	N/A
2010	200-1752	37E/9N	LIVa/b IN WALL SECTION	NA	Rim	10.65
2010	205-1753	37E/9N	IN WALL	NA	Body	10.9
2010	205-1754	37E/9N	IN WALL	NA	Body	10.16
2010	205-1755	37E/9N	IN WALL	NA	Body	5.58
2010	205-1756	37E/9N	WALL	NA	Body	10.25
2010	205-1757	37E/9N	WALL	NA	Rim	11.19
2010	205-1758	37E/9N	WALL	NA	Shatter	N/A
2010	53-1761	38E/7N	III	L1-6	Body	11.73
2010	132-1762	38E/7N	III	NA	Body	12.68
2010	49-1763	38E/7N	III	L1-6	Body	10.58
2010	49-1764	38E/7N	III	L1-6	Body	17.63
2010	49-1765	38E/7N	III	L1-6	Body	10.96
2010	49-1766	38E/7N	III	L1-6	Body	15.2
2010	49-1767	38E/7N	III	L1-6	Body	10.72
2010	49-1768	38E/7N	III	L1-6	Shatter	N/A
2010	129-1769	38E/7N	III	NA	Body	10.24
2010	67-1770.2	38E/7N	IVa	L1-7	Body	8.75
2010	67-1770.3	38E/7N	IVa	L1-7	Body	8.33
2010	67-1770.4	38E/7N	IVa	L1-7	Body	11.36
2010	67-1771	38E/7N	IVa	L1-7	Body	13.91
2010	67-1772	38E/7N	IVa	L1-7	Body	12.86
2010	67-1773	38E/7N	IVa	L1-7	Body	13.31
2010	67-1774	38E/7N	IVa	L1-7	Body	11.72
2010	67-1775	38E/7N	IVa	L1-7	Body	14.41
2010	67-1776	38E/7N	IVa	L1-7	Body	11.16
2010	67-1777	38E/7N	IVa	L1-7	Body	13.62
2010	67-1778	38E/7N	IVa	L1-7	Body	10.44
2010	67-1779	38E/7N	IVa	L1-7	Body	12.35
2010	67-1780	38E/7N	IVa	L1-7	Body	12.06
2010	67-1781	38E/7N	IVa	L1-7	Body	10.52
2010	67-1782	38E/7N	IVa	L1-7	Body	N/A
2010	67-1783	38E/7N	IVa	L1-7	Body	N/A
2010	131-1784	38E/7N	N/A	NA	Body	10.26
2010	1785	38E/7N	LIVc/l-10	L1-10	Body	5.89
2010	1786	38E/7N	LIVc/l-10	L1-10	Body	10.82
2010	115-1787	38E/7N	IVc	L1-11	Body	8.47
2010	111-1788	38E/7N	IVc	L1-11	Body	5.2
2010	111-1789	38E/7N	IVc	L1-11	Body	N/A
2010	114-1790	38E/7N	IVc	L1-11	Body	N/A
2010	114-1791	38E/7N	IVc	L1-11	Rim	N/A
2010	114-1792	38E/7N	IVc	L1-11	Rim	N/A
2010	114-1793	38E/7N	IVc	L1-11	Rim	10.34
2010	114-1794	38E/7N	IVc	L1-11	Shatter	N/A
2010	134-1795	38E/7N	IV	L1-12	Body	10.74
2010	134-1796	38E/7N	IV	L1-12	Body	6.42
2010	134-1797	38E/7N	IV	L1-12	Rim	8.05

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2010	134-1798	38E/7N	IV	L1-12	Shatter	N/A
2010	143-1799	38E/7N	IVc	L1-13	Rim	10.92
2010	143-1800	38E/7N	IVc	L1-13	Body	11.83
2010	143-1801	38E/7N	IVc	L1-13	Body	10.01
2010	143-1802	38E/7N	IVc	L1-13	Body	10.4
2010	143-1803	38E/7N	IVc	L1-13	Body	8.91
2010	143-1804	38E/7N	IVc	L1-13	Shatter	N/A
2010	150-1805	38E/7N	IVc	L1-13	Body	8.65
2010	150-1806	38E/7N	IVc	L1-13	Body	N/A
2010	150-1807	38E/7N	IVc	L1-13	Rim	9.84
2010	150-1808	38E/7N	IVc	L1-13	Body	7.1
2010	150-1809	38E/7N	IVc	L1-13	Body	7.66
2010	150-1810	38E/7N	IVc	L1-13	Body	7
2010	150-1811	38E/7N	IVc	L1-13	Body	6.33
2010	150-1812	38E/7N	IVc	L1-13	Body	N/A
2010	150-1813	38E/7N	IVc	L1-13	Body	7.08
2010	150-1814	38E/7N	IVc	L1-13	Body	7.59
2010	150-1815	38E/7N	IVc	L1-13	Body	8.04
2010	150-1816	38E/7N	IVc	L1-13	Body	6.95
2010	150-1817	38E/7N	IVc	L1-13	Body	8.01
2010	150-1818	38E/7N	IVc	L1-13	Body	6.96
2010	150-1819	38E/7N	IVc	L1-13	Body	N/A
2010	150-1820	38E/7N	IVc	L1-13	Shatter	N/A
2010	150-1821	38E/7N	IVc	L1-13	Body	8.79
2010	150-1822	38E/7N	IVc	L1-13	Body	8.21
2010	150-1823	38E/7N	IVc	L1-13	Rim	9.48
2010	150-1824	38E/7N	IVc	L1-13	Body	N/A
2010	150-1825	38E/7N	IVc	L1-13	Body	N/A
2010	150-1826	38E/7N	WALL SCRAPPINGS	NA	Body	N/A
2010	150-1827	38E/7N	IVc	L1-13	Body	10.03
2010	150-1828	38E/7N	IVc	L1-13	Body	N/A
2010	150-1829	38E/7N	IVc	L1-13	Body	N/A
2010	150-1830	38E/7N	IVc	L1-13	Body	N/A
2010	150-1831	38E/7N	IVc	L1-13	Body	N/A
2010	150-1832	38E/7N	IVc	L1-13	Body	N/A
2010	150-1833	38E/7N	IVc	L1-13	Shatter	N/A
2010	150-1834	38E/7N	IVc	L1-13	Body	10.14
2010	150-1835	38E/7N	IVc	L1-13	Body	11.15
2010	84-1836	38E/7N	Feature 49	NA	Body	N/A
2010	1837	38E/7N	Feature 47	NA	Body	11.78
2012	119-1	38E/9N	Feature 64	N/A	Body	9.74
2012	119-2	38E/9N	Feature 64	N/A	Body	9.5
2012	119-3	38E/9N	Feature 64	N/A	Body	7.49
2012	119-4	38E/9N	Feature 64	N/A	Base	10.16
2012	119-5	38E/9N	Feature 64	N/A	Body	8.27
2012	119-6	38E/9N	Feature 64	N/A	Body	9
2012	119-7	38E/9N	Feature 64	N/A	Body	6.21
2012	119-8	38E/9N	Feature 64	N/A	Body	4.14
2012	119-9	38E/9N	Feature 64	N/A	Body	5.58
2012	119-10	38E/9N	Feature 64	N/A	Neck	9.4
2012	119-11	38E/9N	Feature 64	N/A	Body	8.88
2012	119-12	38E/9N	Feature 64	N/A	Body	6.62
2012	119-13	38E/9N	Feature 64	N/A	Body	9.09
2012	119-14	38E/9N	Feature 64	N/A	Body	8.89
2012	119-15	38E/9N	Feature 64	N/A	Body	8.04
2012	119-16	38E/9N	Feature 64	N/A	Body	7.34
2012	119-17	38E/9N	Feature 64	N/A	Base	10.17
2012	119-18	38E/9N	Feature 64	N/A	Body	7.34
2012	119-19	38E/9N	Feature 64	N/A	Rim	9.63

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	119-20	38E/9N	Feature 64	N/A	Body	7.11
2012	119-21	38E/9N	Feature 64	N/A	Body	8.85
2012	119-22	38E/9N	Feature 64	N/A	Body	9.08
2012	119-23	38E/9N	Feature 64	N/A	Base	10.22
2012	119-24	38E/9N	Feature 64	N/A	Body	8.63
2012	119-25	38E/9N	Feature 64	N/A	Body	5.49
2012	119-26	38E/9N	Feature 64	N/A	Body	5.42
2012	119-27	38E/9N	Feature 64	N/A	Body	8.17
2012	119-28	38E/9N	Feature 64	N/A	Body	7.65
2012	119-29	38E/9N	Feature 64	N/A	Base	10.1
2012	119-30	38E/9N	Feature 64	N/A	Body	7.53
2012	119-31	38E/9N	Feature 64	N/A	Body	7.37
2012	107-1	38E/9N	IVc	12	Rim	10.32
2012	107-2	38E/9N	IVc	12	Body	8.64
2012	107-3	38E/9N	IVc	12	Body	7.49
2012	68-1	38E/9N	IVc	11	Base	10.46
2012	36-4	38E/9N	IV	9	Rim	10.46
2012	36-5	38E/9N	IV	9	Body	9.32
2012	36-6	38E/9N	IV	9	Body	7.96
2012	36-7	38E/9N	IV	9	Body	9.91
2012	36-8	38E/9N	IV	9	Body	9.84
2012	36-9	38E/9N	IV	9	Body	7.23
2012	36-10	38E/9N	IV	9	Body	6.8
2012	57-1	38E/9N	IVc	11	Body	8.1
2012	57-2	38E/9N	IVc	11	Body	7.81
2012	57-3	38E/9N	IVc	11	Rim	8.8
2012	57-4	38E/9N	IVc	11	Body	7.9
2012	57-5	38E/9N	IVc	11	Rim	9.65
2012	57-6	38E/9N	IVc	11	Body	9.3
2012	57-7	38E/9N	IVc	11	Body	12.18
2012	57-8	38E/9N	IVc	11	Body	8.49
2012	57-9	38E/9N	IVc	11	Body	8.43
2012	57-10	38E/9N	IVc	11	Body	10.24
2012	57-11	38E/9N	IVc	11	Body	9.92
2012	57-12	38E/9N	IVc	11	Body	8.82
2012	57-13	38E/9N	IVc	11	Rim	8.45
2012	57-14	38E/9N	IVc	11	Body	9.89
2012	57-15	38E/9N	IVc	11	Body	7.38
2012	57-16	38E/9N	IVc	11	Body	10.12
2012	57-17	38E/9N	IVc	11	Body	6
2012	57-18	38E/9N	IVc	11	Body	10.67
2012	57-19	38E/9N	IVc	11	Body	10.54
2012	57-20	38E/9N	IVc	11	Body	7.96
2012	57-21	38E/9N	IVc	11	Body	7.54
2012	57-22	38E/9N	IVc	11	Body	9.85
2012	57-23	38E/9N	IVc	11	Body	10.06
2012	57-24	38E/9N	IVc	11	Body	9.74
2012	65-1	38E/9N	IVc	11	Body	8.83
2012	73-1	38E/9N	IVc	11	Body	9.8
2012	73-2	38E/9N	IVc	11	Body	9.55
2012	114-1	38E/9N	V	N/A	Rim	11.99
2012	114-2	38E/9N	V	N/A	Body	10.23
2012	114-3	38E/9N	V	N/A	Rim	11.33
2012	114-4	38E/9N	V	N/A	Body	8.07
2012	142-1	38E/9N	V	N/A	Body	13.21
2012	142-2	38E/9N	V	N/A	Body	9.02
2012	142-3	38E/9N	V	N/A	Body	5.64
2012	31-1	38E/9N	IVb	7	Body	11.59
2012	31-2	38E/9N	IVb	7	Body	11.74
2012	32-3	38E/9N	IVb	7	Body	11.44

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	71-1.13	38E/9N	IVc	11	Body	8.27
2012	71-2.13	38E/9N	IVc	11	Body	10.42
2012	71-3.13	38E/9N	IVc	11	Body	10.55
2012	71-4.13	38E/9N	IVc	11	Body	10.72
2012	71-5.13	38E/9N	IVc	11	Body	10.18
2012	71-6.13	38E/9N	IVc	11	Body	10.12
2012	71-7.13	38E/9N	IVc	11	Body	10.71
2012	143-1	38E/9N	IV	N/A	Body	12.44
2012	144-1	38E/9N	V	N/A	Body	8.92
2012	144-2	38E/9N	V	N/A	Body	9.49
2012	64-1	38E/9N	IVc	11	Body	8.48
2012	7--1	38E/9N	III	5	Body	6.31
2012	9--1	38E/9N	III	5	Body	15.71
2012	9--2	38E/9N	III	5	Body	13.91
2012	112-1	38E/9N	Feature 66	N/A	Body	7.64
2012	112-2	38E/9N	Feature 66	N/A	Body	7.75
2012	62-1	38E/9N	IVc	11	Body	5.92
2012	20-1	38E/9N	Feature 62	N/A	Body	9.55
2012	20-2	38E/9N	Feature 62	N/A	Body	11.29
2012	20-3	38E/9N	Freature 62	N/A	Body	9.4
2012	20-4	38E/9N	Feature 62	N/A	Body	8.12
2012	20-5	38E/9N	Feature 62	N/A	Body	4.33
2012	11--5	38E/9N	III	5	Body	8.61
2012	134-1	38E/9N	V	13	Rim	9.85
2012	134-2	38E/9N	V	13	Body	6.87
2012	24-1	38E/9N	IV	6	Rim	9.03
2012	24-2	38E/9N	IV	6	Body	6.69
2012	24-3	38E/9N	IV	6	Body	9.64
2012	24-4	38E/9N	IV	6	Body	4.36
2012	132-1	38E/9N	Feature 65	N/A	Body	7.92
2012	132-2	38E/9N	Feature 65	N/A	Body	5.25
2012	11--1	38E/9N	III	5	Body	10.58
2012	11--2	38E/9N	III	5	Body	12.24
2012	11--3	38E/9N	III	5	Body	12.59
2012	11--4	38E/9N	III	5	Body	10.96
2012	2--1	38E/9N	II	2	Body	2.17
2012	2--2	38E/9N	II	2	Body	4.39
2012	2--3	38E/9N	II	2	Body	4.55
2012	35-1	38E/9N	IVb	9	Body	5.16
2012	35-2	38E/9N	IVb	9	Body	6.56
2012	35-3	38E/9N	IVb	9	Body	6.98
2012	35-4	38E/9N	IVb	9	Body	8.19
2012	104-1	38E/9N	IVc	12	Body	6.74
2012	104-2	38E/9N	IVc	12	Body	6.53
2012	104-3	38E/9N	IVc	12	Body	6.77
2012	104-4	38E/9N	IVc	12	Body	8.3
2012	104-5	38E/9N	IVc	12	Body	7.02
2012	117-1	38E/9N	Feature 65	N/A	Body	11.04
2012	117-2	38E/9N	Feature 65	N/A	Body	7.23
2012	117-3	38E/9N	Feature 65	N/A	Body	7.61
2012	117-4	38E/9N	Feature 65	N/A	Body	8.38
2012	117-5	38E/9N	Feature 65	N/A	Body	6.38
2012	117-6	38E/9N	Feature 65	N/A	Rim	7.66
2012	117-7	38E/9N	Feature 65	N/A	Body	11.24
2012	117-8	38E/9N	Feature 65	N/A	Body	11.78
2012	117-9	38E/9N	Feature 65	N/A	Rim	11.48
2012	117-10	38E/9N	Feature 65	N/A	Rim	10.25
2012	117-11	38E/9N	Feature 65	N/A	Body	8.69
2012	117-12	38E/9N	Feature 65	N/A	Body	9.4
2012	117-13	38E/9N	Feature 65	N/A	Body	9.16

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	117-14	38E/9N	Feature 65	N/A	Body	9.63
2012	117-15	38E/9N	Feature 65	N/A	Body	8.33
2012	117-16	38E/9N	Feature 65	N/A	Body	6.49
2012	117-17	38E/9N	Feature 65	N/A	Body	8.82
2012	117-18	38E/9N	Feature 65	N/A	Body	10.43
2012	117-19	38E/9N	Feature 65	N/A	Body	10.85
2012	117-20	38E/9N	Feature 65	N/A	Rim	9.51
2012	117-21	38E/9N	Feature 65	N/A	Body	8.28
2012	117-22	38E/9N	Feature 65	N/A	Body	9.01
2012	117-23	38E/9N	Feature 65	N/A	Body	9.27
2012	117-24	38E/9N	Feature 65	N/A	Body	8.77
2012	117-25	38E/9N	Feature 65	N/A	Body	7.18
2012	117-26	38E/9N	Feature 65	N/A	Body	6.24
2012	117-27	38E/9N	Feature 65	N/A	Body	7.03
2012	117-28	38E/9N	Feature 65	N/A	Body	8.42
2012	117-29	38E/9N	Feature 65	N/A	Body	9.26
2012	117-30	38E/9N	Feature 65	N/A	Body	7.25
2012	117-31	38E/9N	Feature 65	N/A	Body	7.88
2012	117-32	38E/9N	Feature 65	N/A	Body	10.95
2012	117-33	38E/9N	Feature 65	N/A	Body	8.03
2012	117-34	38E/9N	Feature 65	N/A	Body	10.35
2012	117-35	38E/9N	Feature 65	N/A	Body	10.08
2012	117-36	38E/9N	Feature 65	N/A	Body	9.82
2012	117-37	38E/9N	Feature 65	N/A	Body	7.79
2012	117-38	38E/9N	Feature 65	N/A	Body	7.57
2012	117-39	38E/9N	Feature 65	N/A	Body	7.87
2012	117-40	38E/9N	Feature 65	N/A	Body	11.25
2012	117-41	38E/9N	Feature 65	N/A	Body	13.95
2012	117-42	38E/9N	Feature 65	N/A	Body	9.18
2012	117-43	38E/9N	Feature 65	N/A	Body	9.1
2012	117-44	38E/9N	Feature 65	N/A	Body	10.37
2012	117-45	38E/9N	Feature 65	N/A	Body	9.5
2012	117-46	38E/9N	Feature 65	N/A	Rim	10.25
2012	117-47	38E/9N	Feature 65	N/A	Rim	10.83
2012	117-48	38E/9N	Feature 65	N/A	Body	6.36
2012	117-49	38E/9N	Feature 65	N/A	Body	9.59
2012	117-50	38E/9N	Feature 65	N/A	Body	9.56
2012	117-51	38E/9N	Feature 65	N/A	Body	7.4
2012	117-52	38E/9N	Feature 65	N/A	Body	8.47
2012	117-53	38E/9N	Feature 65	N/A	Body	7.87
2012	117-54	38E/9N	Feature 65	N/A	Body	11.34
2012	117-55	38E/9N	Feature 65	N/A	Body	13.89
2012	117-56	38E/9N	Feature 65	N/A	Body	9.52
2012	117-58	38E/9N	Feature 65	N/A	Body	8.98
2012	117-59	38E/9N	Feature 65	N/A	Body	13.53
2012	117-60	38E/9N	Feature 65	N/A	Body	4.7
2012	117-61	38E/9N	Feature 65	N/A	Body	8.58
2012	117-62	38E/9N	Feature 65	N/A	Body	9.2
2012	117-63	38E/9N	Feature 65	N/A	Body	9.2
2012	117-64	38E/9N	Feature 65	N/A	Body	7.31
2012	117-65	38E/9N	Feature 65	N/A	Body	7.6
2012	117-66	38E/9N	Feature 65	N/A	Body	7.91
2012	117-67	38E/9N	Feature 65	N/A	Rim	6.88
2012	117-68	38E/9N	Feature 65	N/A	Body	8.8
2012	117-69	38E/9N	Feature 65	N/A	Body	8.09
2012	117-70	38E/9N	Feature 65	N/A	Body	8.98
2012	135-1	38E/9N	Feature 69	N/A	Rim	8.45
2012	135-2	38E/9N	Feature 69	N/A	Body	8.18
2012	14-1	38E/9N	III	5	Body	19.45
2012	61-1	38E/9N	IVc	11	Body	7.68

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	61-2	38E/9N	IVc	11	Body	8.07
2012	69-1	38E/9N	N/A	N/A	Body	9.93
2012	76-1	38E/9N	N/A	N/A	Body	7.13
2012	27-1	38E/9N	IV	7	Body	11.84
2012	27-2	38E/9N	IV	7	Body	12.44
2012	27-3	38E/9N	IV	7	Body	12.42
2012	27-4	38E/9N	IV	7	Body	10.53
2012	27-5	38E/9N	IV	7	Body	5.82
2012	63-1	38E/9N	N/A	N/A	Body	1.71
2012	66-1	38E/9N	N/A	N/A	Body	8.35
2012	60-1	38E/9N	IVc	11	Body	11.74
2012	72-1	38E/9N	N/A	N/A	Body	10.22
2012	72-2	38E/9N	N/A	N/A	Body	9.58
2012	38-1	38E/9N	Wall Scrape	N/A	Body	8
2012	38-2	38E/9N	Wall Scrape	N/A	Body	10
2012	38-3	38E/9N	Wall Scrape	N/A	Body	11.88
2012	38-4	38E/9N	Wall Scrape	N/A	Body	5.08
2012	38-5	38E/9N	Wall Scrape	N/A	Body	8.6
2012	74-1	38E/9N	N/A	N/A	Body	12.73
2012	67-1	38E/9N	N/A	N/A	Body	8.12
2012	120-1	38E/9N	Feature 64	N/A	Body	7.92
2012	123-1	38E/9N	Feature 64	N/A	Body	4.6
2012	123-2	38E/9N	Feature 64	N/A	Body	5.25
2012	70-1	38E/9N	N/A	N/A	Body	10.63
2012	70-2	38E/9N	N/A	N/A	Body	10.49
2012	N/A	38E/9N	VI	N/A	Body	6.99
2012	43-1	38E/9N	IVb	10	Rim	11.88
2012	43-2	38E/9N	IVb	10	Rim	9.5
2012	43-3	38E/9N	IVb	10	Rim	10.57
2012	43-4	38E/9N	IVb	10	Body	6.8
2012	43-5	38E/9N	IVb	10	Body	7.31
2012	43-6	38E/9N	IVb	10	Body	6.06
2012	43-7	38E/9N	IVb	10	Body	8.12
2012	75-1	38E/9N	144CM BD	N/A	Body	7.12
2012	59-1	38E/9N	IVc	N/A	Body	2.78
2012	109-1	38E/9N	IVc	12	Base	10.25
2012	109-2	38E/9N	IVc	12	Neck	7.83
2012	109-3	38E/9N	IVc	12	Base	9.84
2012	109-4	38E/9N	IVc	12	Body	8.47
2012	109-5	38E/9N	IVc	12	Body	6.98
2012	109-6	38E/9N	IVc	12	Rim	10.43
2012	109-7	38E/9N	IVc	12	Base	10.52
2012	109-8	38E/9N	IVc	12	Base	9.82
2012	109-9	38E/9N	IVc	12	Body	8.91
2012	109-10	38E/9N	IVc	12	Neck	7.23
2012	109-11	38E/9N	IVc	12	Inconclusive	9.03
2012	109-12	38E/9N	IVc	12	Body	6.23
2012	109-13	38E/9N	IVc	12	Base	9.12
2012	109-14	38E/9N	IVc	12	Body	8.12
2012	109-15	38E/9N	IVc	12	Body	6.67
2012	109-16	38E/9N	IVc	12	Base	10.86
2012	109-17	38E/9N	IVc	12	Neck	8.61
2012	109-18	38E/9N	IVc	12	Body	8.57
2012	109-19	38E/9N	IVc	12	Base	9.95
2012	109-20	38E/9N	IVc	12	Body	7.18
2012	109-21	38E/9N	IVc	12	Body	7.42
2012	109-22	38E/9N	IVc	12	Base	9.48
2012	109-23	38E/9N	IVc	12	Base	9.3
2012	109-24	38E/9N	IVc	12	Body	8.1
2012	109-25	38E/9N	IVc	12	Rim	10.07

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	109-26	38E/9N	IVc	12	Body	7.6
2012	109-27	38E/9N	IVc	12	Body	7.79
2012	109-28	38E/9N	IVc	12	Base	10.08
2012	109-29	38E/9N	IVc	12	Body	8.85
2012	109-30	38E/9N	IVc	12	Base	9.31
2012	109-31	38E/9N	IVc	12	Base	10.01
2012	109-32	38E/9N	IVc	12	Neck	9.21
2012	109-33	38E/9N	IVc	12	Rim	9.11
2012	109-34	38E/9N	IVc	12	Base	9.78
2012	109-35	38E/9N	IVc	12	Base	9.23
2012	109-36	38E/9N	IVc	12	Body	8.54
2012	119-1	38E/9N	Feature 64	N/A	Body	9.74
2012	119-2	38E/9N	Feature 64	N/A	Body	9.5
2012	119-3	38E/9N	Feature 64	N/A	Body	7.49
2012	119-4	38E/9N	Feature 64	N/A	Base	10.16
2012	119-5	38E/9N	Feature 64	N/A	Body	8.27
2012	119-6	38E/9N	Feature 64	N/A	Body	9
2012	119-7	38E/9N	Feature 64	N/A	Body	6.21
2012	119-8	38E/9N	Feature 64	N/A	Body	4.14
2012	119-9	38E/9N	Feature 64	N/A	Body	5.58
2012	119-10	38E/9N	Feature 64	N/A	Neck	9.4
2012	119-11	38E/9N	Feature 64	N/A	Body	8.88
2012	119-12	38E/9N	Feature 64	N/A	Body	6.62
2012	119-13	38E/9N	Feature 64	N/A	Body	9.09
2012	119-14	38E/9N	Feature 64	N/A	Body	8.89
2012	119-15	38E/9N	Feature 64	N/A	Body	8.04
2012	119-16	38E/9N	Feature 64	N/A	Body	7.34
2012	119-17	38E/9N	Feature 64	N/A	Base	10.17
2012	119-18	38E/9N	Feature 64	N/A	Body	7.34
2012	119-19	38E/9N	Feature 64	N/A	Rim	9.63
2012	119-20	38E/9N	Feature 64	N/A	Body	7.11
2012	119-21	38E/9N	Feature 64	N/A	Body	8.85
2012	119-22	38E/9N	Feature 64	N/A	Body	9.08
2012	119-23	38E/9N	Feature 64	N/A	Base	10.22
2012	119-24	38E/9N	Feature 64	N/A	Body	8.63
2012	119-25	38E/9N	Feature 64	N/A	Body	5.49
2012	119-26	38E/9N	Feature 64	N/A	Body	5.42
2012	119-27	38E/9N	Feature 64	N/A	Body	8.17
2012	119-28	38E/9N	Feature 64	N/A	Body	7.65
2012	119-29	38E/9N	Feature 64	N/A	Base	10.1
2012	119-30	38E/9N	Feature 64	N/A	Body	7.53
2012	119-31	38E/9N	Feature 64	N/A	Body	7.37
2012	107-1	38E/9N	IVc	12	Rim	10.32
2012	107-2	38E/9N	IVc	12	Body	8.64
2012	107-3	38E/9N	IVc	12	Body	7.49
2012	68-1	38E/9N	IVc	11	Base	10.46
2012	36-4	38E/9N	IV	9	Rim	10.46
2012	36-5	38E/9N	IV	9	Body	9.32
2012	36-6	38E/9N	IV	9	Body	7.96
2012	36-7	38E/9N	IV	9	Body	9.91
2012	36-8	38E/9N	IV	9	Body	9.84
2012	36-9	38E/9N	IV	9	Body	7.23
2012	36-10	38E/9N	IV	9	Body	6.8
2012	57-1	38E/9N	IVc	11	Body	8.1
2012	57-2	38E/9N	IVc	11	Body	7.81
2012	57-3	38E/9N	IVc	11	Rim	8.8
2012	57-4	38E/9N	IVc	11	Body	7.9
2012	57-5	38E/9N	IVc	11	Rim	9.65
2012	57-6	38E/9N	IVc	11	Body	9.3
2012	57-7	38E/9N	IVc	11	Body	12.18

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	57-8	38E/9N	IVc	11	Body	8.49
2012	57-9	38E/9N	IVc	11	Body	8.43
2012	57-10	38E/9N	IVc	11	Body	10.24
2012	57-11	38E/9N	IVc	11	Body	9.92
2012	57-12	38E/9N	IVc	11	Body	8.82
2012	57-13	38E/9N	IVc	11	Rim	8.45
2012	57-14	38E/9N	IVc	11	Body	9.89
2012	57-15	38E/9N	IVc	11	Body	7.38
2012	57-16	38E/9N	IVc	11	Body	10.12
2012	57-17	38E/9N	IVc	11	Body	6
2012	57-18	38E/9N	IVc	11	Body	10.67
2012	57-19	38E/9N	IVc	11	Body	10.54
2012	57-20	38E/9N	IVc	11	Body	7.96
2012	57-21	38E/9N	IVc	11	Body	7.54
2012	57-22	38E/9N	IVc	11	Body	9.85
2012	57-23	38E/9N	IVc	11	Body	10.06
2012	57-24	38E/9N	IVc	11	Body	9.74
2012	65-1	38E/9N	IVc	11	Body	8.83
2012	73-1	38E/9N	IVc	11	Body	9.8
2012	73-2	38E/9N	IVc	11	Body	9.55
2012	114-1	38E/9N	V	N/A	Rim	11.99
2012	114-2	38E/9N	V	N/A	Body	10.23
2012	114-3	38E/9N	V	N/A	Rim	11.33
2012	114-4	38E/9N	V	N/A	Body	8.07
2012	142-1	38E/9N	V	N/A	Body	13.21
2012	142-2	38E/9N	V	N/A	Body	9.02
2012	142-3	38E/9N	V	N/A	Body	5.64
2012	31-1	38E/9N	IVb	7	Body	11.59
2012	31-2	38E/9N	IVb	7	Body	11.74
2012	32-3	38E/9N	IVb	7	Body	11.44
2012	71-1.13	38E/9N	IVc	11	Body	8.27
2012	71-2.13	38E/9N	IVc	11	Body	10.42
2012	71-3.13	38E/9N	IVc	11	Body	10.55
2012	71-4.13	38E/9N	IVc	11	Body	10.72
2012	71-5.13	38E/9N	IVc	11	Body	10.18
2012	71-6.13	38E/9N	IVc	11	Body	10.12
2012	71-7.13	38E/9N	IVc	11	Body	10.71
2012	144-1	38E/9N	V	N/A	Body	8.92
2012	144-2	38E/9N	V	N/A	Body	9.49
2012	64-1	38E/9N	IVc	11	Body	8.48
2012	7--1	38E/9N	III	5	Body	6.31
2012	9--1	38E/9N	III	5	Body	15.71
2012	9--2	38E/9N	III	5	Body	13.91
2012	112-1	38E/9N	Feature 66	N/A	Body	7.64
2012	112-2	38E/9N	Feature 66	N/A	Body	7.75
2012	62-1	38E/9N	IVc	11	Body	5.92
2012	20-1	38E/9N	Feature 62	N/A	Body	9.55
2012	20-2	38E/9N	Feature 62	N/A	Body	11.29
2012	20-3	38E/9N	Freature 62	N/A	Body	9.4
2012	20-4	38E/9N	Feature 62	N/A	Body	8.12
2012	20-5	38E/9N	Feature 62	N/A	Body	4.33
2012	11--5	38E/9N	III	5	Body	8.61
2012	24-1	38E/9N	IV	6	Rim	9.03
2012	24-2	38E/9N	IV	6	Body	6.69
2012	24-3	38E/9N	IV	6	Body	9.64
2012	24-4	38E/9N	IV	6	Body	4.36
2012	132-1	38E/9N	Feature 65	N/A	Body	7.92
2012	132-2	38E/9N	Feature 65	N/A	Body	5.25
2012	11--1	38E/9N	III	5	Body	10.58
2012	11--2	38E/9N	III	5	Body	12.24

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	11--3	38E/9N	III	5	Body	12.59
2012	11--4	38E/9N	III	5	Body	10.96
2012	2--1	38E/9N	II	2	Body	2.17
2012	2--2	38E/9N	II	2	Body	4.39
2012	2--3	38E/9N	II	2	Body	4.55
2012	35-1	38E/9N	IVb	9	Body	5.16
2012	35-2	38E/9N	IVb	9	Body	6.56
2012	35-3	38E/9N	IVb	9	Body	6.98
2012	35-4	38E/9N	IVb	9	Body	8.19
2012	104-1	38E/9N	IVc	12	Body	6.74
2012	104-2	38E/9N	IVc	12	Body	6.53
2012	104-3	38E/9N	IVc	12	Body	6.77
2012	104-4	38E/9N	IVc	12	Body	8.3
2012	104-5	38E/9N	IVc	12	Body	7.02
2012	117-1	38E/9N	Feature 65	N/A	Body	11.04
2012	117-2	38E/9N	Feature 65	N/A	Body	7.23
2012	117-3	38E/9N	Feature 65	N/A	Body	7.61
2012	117-4	38E/9N	Feature 65	N/A	Body	8.38
2012	117-5	38E/9N	Feature 65	N/A	Body	6.38
2012	117-6	38E/9N	Feature 65	N/A	Rim	7.66
2012	117-7	38E/9N	Feature 65	N/A	Body	11.24
2012	117-8	38E/9N	Feature 65	N/A	Body	11.78
2012	117-9	38E/9N	Feature 65	N/A	Rim	11.48
2012	117-10	38E/9N	Feature 65	N/A	Rim	10.25
2012	117-11	38E/9N	Feature 65	N/A	Body	8.69
2012	117-12	38E/9N	Feature 65	N/A	Body	9.4
2012	117-13	38E/9N	Feature 65	N/A	Body	9.16
2012	117-14	38E/9N	Feature 65	N/A	Body	9.63
2012	117-15	38E/9N	Feature 65	N/A	Body	8.33
2012	117-16	38E/9N	Feature 65	N/A	Body	6.49
2012	117-17	38E/9N	Feature 65	N/A	Body	8.82
2012	117-18	38E/9N	Feature 65	N/A	Body	10.43
2012	117-19	38E/9N	Feature 65	N/A	Body	10.85
2012	117-20	38E/9N	Feature 65	N/A	Rim	9.51
2012	117-21	38E/9N	Feature 65	N/A	Body	8.28
2012	117-22	38E/9N	Feature 65	N/A	Body	9.01
2012	117-23	38E/9N	Feature 65	N/A	Body	9.27
2012	117-24	38E/9N	Feature 65	N/A	Body	8.77
2012	117-25	38E/9N	Feature 65	N/A	Body	7.18
2012	117-26	38E/9N	Feature 65	N/A	Body	6.24
2012	117-27	38E/9N	Feature 65	N/A	Body	7.03
2012	117-28	38E/9N	Feature 65	N/A	Body	8.42
2012	117-29	38E/9N	Feature 65	N/A	Body	9.26
2012	117-30	38E/9N	Feature 65	N/A	Body	7.25
2012	117-31	38E/9N	Feature 65	N/A	Body	7.88
2012	117-32	38E/9N	Feature 65	N/A	Body	10.95
2012	117-33	38E/9N	Feature 65	N/A	Body	8.03
2012	117-34	38E/9N	Feature 65	N/A	Body	10.35
2012	117-35	38E/9N	Feature 65	N/A	Body	10.08
2012	117-36	38E/9N	Feature 65	N/A	Body	9.82
2012	117-37	38E/9N	Feature 65	N/A	Body	7.79
2012	117-38	38E/9N	Feature 65	N/A	Body	7.57
2012	117-39	38E/9N	Feature 65	N/A	Body	7.87
2012	117-40	38E/9N	Feature 65	N/A	Body	11.25
2012	117-41	38E/9N	Feature 65	N/A	Body	13.95
2012	117-42	38E/9N	Feature 65	N/A	Body	9.18
2012	117-44	38E/9N	Feature 65	N/A	Body	10.37
2012	117-45	38E/9N	Feature 65	N/A	Body	9.5
2012	117-46	38E/9N	Feature 65	N/A	Rim	10.25
2012	117-47	38E/9N	Feature 65	N/A	Rim	10.83

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	117-48	38E/9N	Feature 65	N/A	Body	6.36
2012	117-49	38E/9N	Feature 65	N/A	Body	9.59
2012	117-50	38E/9N	Feature 65	N/A	Body	9.56
2012	117-51	38E/9N	Feature 65	N/A	Body	7.4
2012	117-52	38E/9N	Feature 65	N/A	Body	8.47
2012	117-53	38E/9N	Feature 65	N/A	Body	7.87
2012	117-54	38E/9N	Feature 65	N/A	Body	11.34
2012	117-55	38E/9N	Feature 65	N/A	Body	13.89
2012	117-56	38E/9N	Feature 65	N/A	Body	9.52
2012	117-58	38E/9N	Feature 65	N/A	Body	8.98
2012	117-59	38E/9N	Feature 65	N/A	Body	13.53
2012	117-60	38E/9N	Feature 65	N/A	Body	4.7
2012	117-61	38E/9N	Feature 65	N/A	Body	8.58
2012	117-62	38E/9N	Feature 65	N/A	Body	9.2
2012	117-63	38E/9N	Feature 65	N/A	Body	9.2
2012	117-64	38E/9N	Feature 65	N/A	Body	7.31
2012	117-65	38E/9N	Feature 65	N/A	Body	7.6
2012	117-66	38E/9N	Feature 65	N/A	Body	7.91
2012	117-67	38E/9N	Feature 65	N/A	Rim	6.88
2012	117-68	38E/9N	Feature 65	N/A	Body	8.8
2012	117-69	38E/9N	Feature 65	N/A	Body	8.09
2012	117-70	38E/9N	Feature 65	N/A	Body	8.98
2012	135-1	38E/9N	Feature 69	N/A	Rim	8.45
2012	135-2	38E/9N	Feature 69	N/A	Body	8.18
2012	14-1	38E/9N	III	5	Body	19.45
2012	61-1	38E/9N	IVc	11	Body	7.68
2012	61-2	38E/9N	IVc	11	Body	8.07
2012	69-1	38E/9N	N/A	N/A	Body	9.93
2012	76-1	38E/9N	N/A	N/A	Body	7.13
2012	27-1	38E/9N	IV	7	Body	11.84
2012	27-2	38E/9N	IV	7	Body	12.44
2012	27-3	38E/9N	IV	7	Body	12.42
2012	27-4	38E/9N	IV	7	Body	10.53
2012	27-5	38E/9N	IV	7	Body	5.82
2012	63-1	38E/9N	N/A	N/A	Body	1.71
2012	66-1	38E/9N	N/A	N/A	Body	8.35
2012	60-1	38E/9N	IVc	11	Body	11.74
2012	72-1	38E/9N	N/A	N/A	Body	10.22
2012	72-2	38E/9N	N/A	N/A	Body	9.58
2012	38-1	38E/9N	Wall Scrape	N/A	Body	8
2012	38-2	38E/9N	Wall Scrape	N/A	Body	10
2012	38-3	38E/9N	Wall Scrape	N/A	Body	11.88
2012	38-4	38E/9N	Wall Scrape	N/A	Body	5.08
2012	38-5	38E/9N	Wall Scrape	N/A	Body	8.6
2012	74-1	38E/9N	N/A	N/A	Body	12.73
2012	67-1	38E/9N	N/A	N/A	Body	8.12
2012	120-1	38E/9N	Feature 64	N/A	Body	7.92
2012	123-1	38E/9N	Feature 64	N/A	Body	4.6
2012	123-2	38E/9N	Feature 64	N/A	Body	5.25
2012	70-1	38E/9N	N/A	N/A	Body	10.63
2012	70-2	38E/9N	N/A	N/A	Body	10.49
2012	N/A	38E/9N	VI	N/A	Body	6.99
2012	75-1	38E/9N	144CM BD	N/A	Body	7.12
2012	59-1	38E/9N	IVc	N/A	Body	2.78
2012	109-1	38E/9N	IVc	12	Base	10.25
2012	109-2	38E/9N	IVc	12	Neck	7.83
2012	109-3	38E/9N	IVc	12	Base	9.84
2012	109-4	38E/9N	IVc	12	Body	8.47
2012	109-5	38E/9N	IVc	12	Body	6.98
2012	109-6	38E/9N	IVc	12	Rim	10.43

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	109-7	38E/9N	IVc	12	Base	10.52
2012	109-8	38E/9N	IVc	12	Base	9.82
2012	109-9	38E/9N	IVc	12	Body	8.91
2012	109-10	38E/9N	IVc	12	Neck	7.23
2012	109-11	38E/9N	IVc	12	Inconclusive	9.03
2012	109-12	38E/9N	IVc	12	Body	6.23
2012	109-13	38E/9N	IVc	12	Base	9.12
2012	109-14	38E/9N	IVc	12	Body	8.12
2012	109-15	38E/9N	IVc	12	Body	6.67
2012	109-16	38E/9N	IVc	12	Base	10.86
2012	109-17	38E/9N	IVc	12	Neck	8.61
2012	109-18	38E/9N	IVc	12	Body	8.57
2012	109-19	38E/9N	IVc	12	Base	9.95
2012	109-20	38E/9N	IVc	12	Body	7.18
2012	109-21	38E/9N	IVc	12	Body	7.42
2012	109-22	38E/9N	IVc	12	Base	9.48
2012	109-23	38E/9N	IVc	12	Base	9.3
2012	109-24	38E/9N	IVc	12	Body	8.1
2012	109-25	38E/9N	IVc	12	Rim	10.07
2012	109-26	38E/9N	IVc	12	Body	7.6
2012	109-27	38E/9N	IVc	12	Body	7.79
2012	109-28	38E/9N	IVc	12	Base	10.08
2012	109-29	38E/9N	IVc	12	Body	8.85
2012	109-30	38E/9N	IVc	12	Base	9.31
2012	109-31	38E/9N	IVc	12	Base	10.01
2012	109-32	38E/9N	IVc	12	Neck	9.21
2012	109-33	38E/9N	IVc	12	Rim	9.11
2012	109-34	38E/9N	IVc	12	Base	9.78
2012	109-35	38E/9N	IVc	12	Base	9.23
2012	109-36	38E/9N	IVc	12	Body	8.54
2012	64-1	39E/9N	V	2	Body	10.88
2012	64-2	39E/9N	V	2	Body	8.74
2012	64-3	39E/9N	V	2	Body	11.72
2012	67-1	39E/9N	V	2	Body	19.95
2012	67-2	39E/9N	V	5	Base	21.04
2012	67-3	39E/9N	V	5	Base	22.35
2012	43-1	39E/9N	IV	2	Body	10.48
2012	43-2	39E/9N	IV	2	Body	N/A
2012	44-1	39E/9N	IV	2	Body	10.99
2012	44-2	39E/9N	IV	2	Body	10.92
2012	44-3	39E/9N	IV	2	Body	10.85
2012	44-4	39E/9N	IV	2	Body	11.33
2012	44-5	39E/9N	IV	2	Body	10.88
2012	44-6	39E/9N	IV	2	Body	11.73
2012	44-7	39E/9N	IV	2	Body	10.7
2012	44-8	39E/9N	IV	N/A	Shatter	N/A
2012	20-1	39E/9N	III	2	Body	12.47
2012	35-1	39E/9N	IV	2	Body	14.58
2012	35-2	39E/9N	IV	2	Body	15.21
2012	164-1	39E/9N	Feature 74/LVI interface SW corner	1	Rim	8.82
2012	164-2	39E/9N	Feature 74/LVI interface SW corner	glued to 164-1	glued to Rim6Carination-Rim	N/A
2012	164-3	39E/9N	Feature 74/LVI interface SW corner	1	Rim	9.36
2012	164-4	39E/9N	Feature 74/LVI interface SW	2	Body	9.04

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	164-5	39E/9N	Feature 74/LVI interface SW corner	2	Body	8.87
2012	164-6	39E/9N	Feature 74/LVI interface SW corner	2	Body	8.63
2012	164-7	39E/9N	Feature 74/LVI interface SW corner	2	Body	8.89
2012	164-8	39E/9N	Feature 74/LVI interface SW corner	2	Body	8.53
2012	194-9	39E/9N	Feature 74/LVI interface SW corner	2	Body	8.56
2012	164-10	39E/9N	Feature 74/LVI interface SW corner	glued to 164-1	Rim	N/A
2012	164-11	39E/9N	Feature 74/LVI interface SW corner	2	Body	7.84
2012	164-12	39E/9N	Feature 74/LVI interface SW corner	2	Body	8.61
2012	164-13	39E/9N	Feature 74/LVI interface SW corner	N/A	Shatter	N/A
2012	54-1	39E/9N	Feature 68/43cm from S/35cm from W	5	Base	17.39
2012	54-2	39E/9N	Feature 68/43cm from S/35cm from W	N/A	Shatter	N/A
2012	91-1	39E/9N	Feature 75	2	Body	11.07
2012	91-2	39E/9N	Feature 75	2	Body	7.87
2012	91-3	39E/9N	Feature 75	2	Body	7.56
2012	91-4	39E/9N	Feature 75	2	Body	6.66
2012	91-5	39E/9N	Feature 75	2	Body	6.93
2012	91-6	39E/9N	Feature 75	2	Body	6.62
2012	91-7	39E/9N	Feature 75	5	Base	10.67
2012	91-8	39E/9N	Feature 75	2	Body	7.53
2012	91-9	39E/9N	Feature 75	2	Body	7.62
2012	91-10	39E/9N	Feature 75	N/A	Shatter	N/A
2012	71-1	39E/9N	LV	2	Body	17.88
2012	71-2	39E/9N	LV	N/A	Shatter	N/A
2012	131-1	39E/9N	Feature 69	2	Body	7.56
2012	131-2	39E/9N	Feature 69	2	Body	5.99
2012	131-3	39E/9N	Feature 69	1	Rim	9.21
2012	131-4	39E/9N	Feature 69	N/A	Shatter	N/A
2012	85-1	39E/9N	VI	2	Body	9.99
2012	85-2	39E/9N	VI	2	Body	6.94
2012	85-3	39E/9N	VI	2	Body	7.34
2012	85-4	39E/9N	VI	2	Body	7.44
2012	85-5	39E/9N	VI	2	Body	7.52
2012	85-6	39E/9N	VI	2	Body	6.62
2012	85-7	39E/9N	VI	2	Body	7.15
2012	85-8	39E/9N	VI	1	Rim	9.06
2012	85-9	39E/9N	VI	1	Rim	11.45
2012	85-10	39E/9N	VI	1	Rim	9.42
2012	85-11	39E/9N	VI	2	Body	8.57
2012	85-12	39E/9N	VI	2	Body	7.22

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	85-13	39E/9N	VI	2	Body	6.05
2012	85-14	39E/9N	VI	2	Body	8.53
2012	85-15	39E/9N	VI	2	Body	7.44
2012	85-16	39E/9N	VI	2	Body	7.98
2012	85-17	39E/9N	VI	2	Body	8.4
2012	85-18	39E/9N	VI	2	Body	11.64
2012	85-19	39E/9N	VI	2	Body	11.43
2012	85-20	39E/9N	VI	2	Body	9.04
2012	85-21	39E/9N	VI	2	Body	10.07
2012	85-22	39E/9N	VI	2	Body	9.69
2012	85-23	39E/9N	VI	2	Body	7.4
2012	85-24	39E/9N	VI	2	Body	7.56
2012	85-25	39E/9N	VI	N/A	Shatter	N/A
2012	56-1	39E/9N	Feature 68	2	Body	12.02
2012	56-2	39E/9N	Feature 68	2	Body	12.01
2012	56-3	39E/9N	Feature 68	N/A	Shatter	N/A
2012	132-1	39E/9N	Feature 69	2	Body	15.57
2012	132-2	39E/9N	Feature 69	2	Body	7.94
2012	132-3	39E/9N	Feature 69	2	Body	8
2012	132-4	39E/9N	Feature 69	2	Body	5.26
2012	132-5	39E/9N	Feature 69	2	Body	9.37
2012	132-6	39E/9N	Feature 69	N/A	Shatter	N/A
2012	43-1	39E/9N	IV	2	Body	4.68
2012	67-1	39E/9N	V	2	Body	7.01
2012	6--1	39E/9N	IIb	2	Body	8.85
2012	26-1	39E/9N	IV	2	Body	10.93
2012	26-2	39E/9N	IV	2	Body	10.95
2012	26-3	39E/9N	IV	2	Body	7.2
2012	26-4	39E/9N	IV	2	Body	10.18
2012	26-5	39E/9N	IV	2	Body	12.43
2012	26-6	39E/9N	IV	1	Rim	14.33
2012	26-7	39E/9N	IV	2	Body	12.23
2012	26-8	39E/9N	IV	2	Body	10.39
2012	26-9	39E/9N	IV	N/A	Shatter	N/A
2012	26-10	39E/9N	IV	N/A	Shatter	N/A
2012	26-11	39E/9N	IV	N/A	Shatter	N/A
2012	26-12	39E/9N	IV	N/A	Shatter	N/A
2012	26-13	39E/9N	IV	N/A	Shatter	N/A
2012	26-14	39E/9N	IV	N/A	Shatter	N/A
2012	34-1	39E/9N	IV	5	Base	13.6
2012	46-1	39E/9N	IV	1	Rim	10.61
2012	15-1	39E/9N	III	2	Body	10.12
2012	15-2	39E/9N	III	2	Body	12.76
2012	83-1	39E/9N	Vc	2	Body	6.6
2012	83-2	39E/9N	Vc	2	Body	6.82
2012	83-3	39E/9N	Vc	2	Body	6.44
2012	83-4	39E/9N	Vc	2	Body	6.38
2012	83-5	39E/9N	Vc	5	Base	13.24
2012	83-6	39E/9N	Vc	2	Body	6.65
2012	83-7	39E/9N	Vc	2	Body	5.79
2012	83-8	39E/9N	Vc	2	Body	6.48
2012	83-9	39E/9N	Vc	2	Body	6.82
2012	83-10	39E/9N	Vc	2	Body	6.26
2012	83-11	39E/9N	Vc	1	Rim	6.66
2012	83-12	39E/9N	Vc	1	Rim	N/A
2012	83-13	39E/9N	Vc	N/A	Shatter	N/A
2012	87-1	39E/9N	Feature 74	2	Body	7.99
2012	87-2	39E/9N	Feature 74	2	Body	8.33
2012	87-3	39E/9N	Feature 74	2	Body	7.16
2012	87-4	39E/9N	Feature 74	2	Body	7.46

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	87-5	39E/9N	Feature 74	2	Body	9.6
2012	87-6	39E/9N	Feature 74	2	Body	8.22
2012	87-7	39E/9N	Feature 74	2	Body	6.55
2012	87-8	39E/9N	Feature 74	2	Body	6.15
2012	87-9	39E/9N	Feature 74	2	Body	9.81
2012	87-10	39E/9N	Feature 74	2	Body	7.26
2012	87-11	39E/9N	Feature 74	5	Base	16.4
2012	87-12	39E/9N	Feature 74	2	Body	8.35
2012	87-13	39E/9N	Feature 74	2	Body	14.67
2012	87-14	39E/9N	Feature 74	2	Body	11.03
2012	87-15	39E/9N	Feature 74	2	Body	8.79
2012	87-16	39E/9N	Feature 74	2	Body	9.54
2012	87-17	39E/9N	Feature 74	2	Body	8.43
2012	87-18	39E/9N	Feature 74	2	Body	9.1
2012	87-19	39E/9N	Feature 74	2	Body	7.45
2012	87-20	39E/9N	Feature 74	2	Body	9.76
2012	87-21	39E/9N	Feature 74	2	Body	8.43
2012	87-22	39E/9N	Feature 74	2	Body	8.61
2012	87-23	39E/9N	Feature 74	2	Body	9.02
2012	87-24	39E/9N	Feature 74	2	Body	7.31
2012	87-25	39E/9N	Feature 74	2	Body	8.35
2012	87-26	39E/9N	Feature 74	2	Body	6.58
2012	87-27	39E/9N	Feature 74	2	Body	6.1
2012	87-28	39E/9N	Feature 74	2	Body	8.25
2012	87-29	39E/9N	Feature 74	2	Body	7.6
2012	87-30	39E/9N	Feature 74	2	Body	7.03
2012	87-31	39E/9N	Feature 74	2	Body	10.19
2012	87-32	39E/9N	Feature 74	2	Body	6.91
2012	87-33	39E/9N	Feature 74	1	Rim	8.62
2012	87-34	39E/9N	Feature 74	1	Rim	10.72
2012	87-35	39E/9N	Feature 74	2	Body	7.95
2012	87-36	39E/9N	Feature 74	2	Body	9.42
2012	87-37	39E/9N	Feature 74	2	Body	8.24
2012	87-38	39E/9N	Feature 74	2	Body	9.57
2012	87-39	39E/9N	Feature 74	2	Body	9.51
2012	87-40	39E/9N	Feature 74	2	Body	7.08
2012	87-41	39E/9N	Feature 74	2	Body	7.37
2012	87-42	39E/9N	Feature 74	2	Body	7.68
2012	87-43	39E/9N	Feature 74	5	Base	12.59
2012	87-44	39E/9N	Feature 74	2	Body	8.34
2012	87-45	39E/9N	Feature 74	2	Body	8.53
2012	87-46	39E/9N	Feature 74	N/A	Shatter	N/A
2012	106-1	39E/9N	VI	1	Base	14.1
2012	106-2	39E/9N	VI	1	Body	8.56
2012	106-3	39E/9N	VI	2	Body	8.41
2012	106-4	39E/9N	VI	2	Rim	8.67
2012	106-5	39E/9N	VI	2	Rim	8.71
2012	106-6	39E/9N	VI	2	Base	11.83
2012	106-7	39E/9N	VI	2	Shatter	N/A
2012	106-8	39E/9N	VI	2	Rim	11.51
2012	106-9	39E/9N	VI	2	Rim	11.51
2012	106-10	39E/9N	VI	2	Body	9.23
2012	106-11	39E/9N	VI	2	Body	9.07
2012	106-12	39E/9N	VI	2	Body	11.36
2012	106-13	39E/9N	VI	2	Body	8.32
2012	106-14	39E/9N	VI	2	Body	8.73
2012	106-15	39E/9N	VI	2	Body	9.65
2012	106-16	39E/9N	VI	1	Body	11.88
2012	106-17	39E/9N	VI	2	Body	8.25
2012	106-18	39E/9N	VI	2	Body	7.67

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	106-19	39E/9N	VI	2	Body	7.12
2012	106-20	39E/9N	VI	2	Body	7.14
2012	106-21	39E/9N	VI	2	Body	8.18
2012	106-22	39E/9N	VI	2	Body	11.67
2012	106-23	39E/9N	VI	2	Rim	11.37
2012	106-24	39E/9N	VI	2	Body	10.95
2012	106-25	39E/9N	VI	N/A	Body	14.37
2012	97-1	39E/9N	VI	2	Body	10.61
2012	97-2	39E/9N	VI	2	Body	10.29
2012	97-3	39E/9N	VI	2	Body	11.65
2012	97-4	39E/9N	VI	2	Body	10.79
2012	97-5	39E/9N	VI	2	Body	10.48
2012	97-6	39E/9N	VI	2	Body	10.21
2012	97-7	39E/9N	VI	2	Shatter	N/A
2012	97-8	39E/9N	VI	2	Body	6.39
2012	97-9	39E/9N	VI	2	Body	7.63
2012	97-10	39E/9N	VI	2	Body	8.82
2012	97-11	39E/9N	VI	2	Body	10.97
2012	97-12	39E/9N	VI	1	Body	8.16
2012	97-13	39E/9N	VI	2	Body	7.27
2012	106-1	39E/9N	VI	15	Body	6.08
2012	106-2	39E/9N	VI	15	Neck	7.35
2012	106-3	39E/9N	VI	15	Body	7.58
2012	106-4	39E/9N	VI	15	Body	7.75
2012	106-5	39E/9N	VI	15	Rim	10.29
2012	106-6	39E/9N	VI	15	Body	6.2
2012	106-7	39E/9N	VI	15	Body	8.22
2012	106-8	39E/9N	VI	15	Body	9.1
2012	106-9	39E/9N	VI	15	Body	7.27
2012	106-10	39E/9N	VI	15	Body	6.43
2012	106-11	39E/9N	VI	15	Body	7.05
2012	106-12	39E/9N	VI	15	Body	8.37
2012	106-13	39E/9N	VI	15	Rim	9.22
2012	106-14	39E/9N	VI	15	Rim	8.06
2012	106-15	39E/9N	VI	15	Rim	8.18
2012	106-16	39E/9N	VI	15	Rim	8.66
2012	106-17	39E/9N	VI	15	Shatter	N/A
2012	47-1	39E/9N	Feature 68	N/A	Rim	15.14
2012	47-2	39E/9N	Feature 68	N/A	Body	12.65
2012	47-3	39E/9N	Feature 68	N/A	Body	14.22
2012	47-4	39E/9N	Feature 68	N/A	Body	10.45
2012	47-5	39E/9N	Feature 68	N/A	Body	9.45
2012	47-6	39E/9N	Feature 68	N/A	Body	10.73
2012	47-7	39E/9N	Feature 68	N/A	Body	12.61
2012	47-8	39E/9N	Feature 68	N/A	Shatter	N/A
2012	64-1	39E/9N	V	8	Body	6.81
2012	64-2	39E/9N	V	8	Body	7.54
2012	64-3	39E/9N	V	8	Body	6.64
2012	64-4	39E/9N	V	8	Body	6.34
2012	64-5	39E/9N	V	8	Body	10.23
2012	64-6	39E/9N	V	8	Body	7.22
2012	64-7	39E/9N	V	8	Body	10.08
2012	64-8	39E/9N	V	8	Shatter	N/A
2012	91-1	39E/9N 40E/9N	Feature 75	NA	Body	7.57
2012	91-2	39E/9N 40E/9N	Feature 75	NA	Body	12.44
2012	91-3	39E/9N 40E/9N	Feature 75	NA	Body	8.55

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	91-4	39E/9N 40E/9N	Feature 75	NA	Rim	10.35
2012	91-5	39E/9N 40E/9N	Feature 75	NA	Body	6.48
2012	91-6	39E/9N 40E/9N	Feature 75	NA	Body	6.81
2012	91-7	39E/9N 40E/9N	Feature 75	NA	Body	6.18
2012	91-8	39E/9N 40E/9N	Feature 75	NA	Body	6.53
2012	91-9	39E/9N 40E/9N	Feature 75	NA	Body	7.31
2012	91-10	39E/9N 40E/9N	Feature 75	NA	Body	6.53
2012	91-11	39E/9N 40E/9N	Feature 75	NA	Body	11.93
2012	91-12	39E/9N 40E/9N	Feature 75	NA	Body	8.7
2012	91-13	39E/9N 40E/9N	Feature 75	NA	Body	6.07
2012	91-14	39E/9N 40E/9N	Feature 75	NA	Body	6.66
2012	91-15	39E/9N 40E/9N	Feature 75	NA	Body	7.04
2012	91-16	39E/9N 40E/9N	Feature 75	NA	Body	7.17
2012	91-17	39E/9N 40E/9N	Feature 75	NA	Body	11.98
2012	91-18	39E/9N 40E/9N	Feature 75	NA	Body	6.93
2012	91-19	39E/9N 40E/9N	Feature 75	NA	Body	7.69
2012	91-20	39E/9N 40E/9N	Feature 75	NA	Body	6.77
2012	91-21	39E/9N 40E/9N	Feature 75	NA	Shatter	N/A
2012	49-1	40E/9N	Feature 70	2	Body	6.69
2012	49-2	40E/9N	Feature 70	2	Body	6.73
2012	49-3	40E/9N	Feature 70	2	Body	7.78
2012	49-4	40E/9N	Feature 70	2	Body	8.47
2012	49-5	40E/9N	Feature 70	2	Body	11.84
2012	49-6	40E/9N	Feature 70	2	Body	6.98
2012	49-7	40E/9N	Feature 70	2	Body	5.93
2012	49-8	40E/9N	Feature 70	2	Body	10.8
2012	49-9	40E/9N	Feature 70	2	Body	8.59
2012	49-10	40E/9N	Feature 70	2	Body	7.91
2012	49-11	40E/9N	Feature 70	2	Body	8.19
2012	49-12	40E/9N	Feature 70	4	Carination	6.07
2012	49-13	40E/9N	Feature 70	2	Body	8.05
2012	49-14	40E/9N	Feature 70	2	Body	8.36
2012	49-15	40E/9N	Feature 70	2	Body	8.35
2012	49-16	40E/9N	Feature 70	2	Body	5.99
2012	49-17	40E/9N	Feature 70	2	Body	6.58
2012	49-18	40E/9N	Feature 70	2	Body	6.74
2012	49-19	40E/9N	Feature 70	2	Body	6.94
2012	49-20	40E/9N	Feature 70	2	Body	4.67
2012	49-21	40E/9N	Feature 70	2	Body	10.65
2012	49-22	40E/9N	Feature 70	2	Body	8.35
2012	49-23	40E/9N	Feature 70	2	Body	6.19
2012	49-24	40E/9N	Feature 70	2	Body	7.14

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	49-25	40E/9N	Feature 70	2	Body	4.16
2012	49-26	40E/9N	Feature 70	2	Body	3.19
2012	49-27	40E/9N	Feature 70	2	Body	9.6
2012	49-28	40E/9N	Feature 70	2	Body	4.72
2012	49-29	40E/9N	Feature 70	N/A	Shatter	N/A
2012	49-30	40E/9N	Feature 70	N/A	Shatter	N/A
2012	49-31	40E/9N	Feature 70	1	Rim	N/A
2012	55-1	40E/9N	LIV/l-7 61cm from N in East Wall	5	Base	14.25
2012	55-2	40E/9N	LIV/l-7 61cm from N in East Wall	N/A	Shatter	N/A
2012	86-1	40E/9N	VI	2	Body	6.66
2012	86-2	40E/9N	VI	2	Body	6.76
2012	86-3	40E/9N	VI	2	Body	7.06
2012	86-4	40E/9N	VI	2	Body	7.5
2012	86-5	40E/9N	VI	2	Body	7.35
2012	86-6	40E/9N	VI	N/A	Shatter	N/A
2012	86-7	40E/9N	VI	2	Body	10.35
2012	86-8	40E/9N	VI	2	Body	10.23
2012	86-9	40E/9N	VI	1	Rim	11.37
2012	86-10	40E/9N	VI	1	Rim	10.58
2012	86-11	40E/9N	VI	2	Body	7.91
2012	86-12	40E/9N	VI	N/A	Shatter	N/A
2012	88-1	40E/9N	Feature 74	2	Body	11.28
2012	88-2	40E/9N	Feature 74	2	Body	12.79
2012	88-3	40E/9N	Feature 74	2	Body	11.25
2012	88-4	40E/9N	Feature 74	2	Body	11
2012	88-5	40E/9N	Feature 74	2	Body	7.33
2012	88-6	40E/9N	Feature 74	5	Base	14.94
2012	88-7	40E/9N	Feature 74	2	Body	9.33
2012	88-8	40E/9N	Feature 74	2	Body	9.03
2012	88-9	40E/9N	Feature 74	2	Body	6.64
2012	88-10	40E/9N	Feature 74	2	Body	7.33
2012	88-11	40E/9N	Feature 74	2	Body	8.56
2012	88-12	40E/9N	Feature 74	2	Body	10.36
2012	88-13	40E/9N	Feature 74	2	Body	6.88
2012	88-14	40E/9N	Feature 74	2	Body	8.98
2012	88-15	40E/9N	Feature 74	2	Body	11.13
2012	88-16	40E/9N	Feature 74	1	Rim	8.93
2012	88-17	40E/9N	Feature 74	2	Body	8.43
2012	88-18	40E/9N	Feature 74	2	Body	9.1
2012	88-19	40E/9N	Feature 74	2	Body	6.19
2012	88-20	40E/9N	Feature 74	2	Body	11.52
2012	88-21	40E/9N	Feature 74	2	Body	11.7
2012	88-22	40E/9N	Feature 74	2	Body	8.69
2012	88-23	40E/9N	Feature 74	2	Body	10.12
2012	88-24	40E/9N	Feature 74	2	Body	8.93
2012	88-25	40E/9N	Feature 74	2	Body	6.76
2012	88-26	40E/9N	Feature 74	2	Body	10.03
2012	88-27	40E/9N	Feature 74	2	Body	6.2
2012	88-28	40E/9N	Feature 74	2	Body	8.9
2012	88-29	40E/9N	Feature 74	2	Body	6.54
2012	88-30	40E/9N	Feature 74	2	Body	10.04
2012	88-31	40E/9N	Feature 74	2	Body	6.93
2012	88-32	40E/9N	Feature 74	2	Body	9.42
2012	88-33	40E/9N	Feature 74	2	Body	6.13
2012	88-34	40E/9N	Feature 74	2	Body	7.66
2012	88-35	40E/9N	Feature 74	2	Body	9.34

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	88-36	40E/9N	Feature 74	2	Body	8.91
2012	88-37	40E/9N	Feature 74	2	Body	6.1
2012	88-38	40E/9N	Feature 74	2	Body	6.37
2012	88-39	40E/9N	Feature 74	2	Body	7.4
2012	88-40	40E/9N	Feature 74	2	Body	8.44
2012	88-41	40E/9N	Feature 74	2	Body	9.34
2012	88-42	40E/9N	Feature 74	2	Body	6.19
2012	88-43	40E/9N	Feature 74	2	Body	7.29
2012	88-44	40E/9N	Feature 74	2	Body	10.37
2012	88-45	40E/9N	Feature 74	2	Body	8.74
2012	88-46	40E/9N	Feature 74	2	Body	9.1
2012	88-47	40E/9N	Feature 74	2	Body	7.5
2012	88-48	40E/9N	Feature 74	2	Body	6.39
2012	88-49	40E/9N	Feature 74	2	Body	8.39
2012	88-50	40E/9N	Feature 74	1	Rim	9.89
2012	88-51	40E/9N	Feature 74	1	Rim	6.7
2012	88-52	40E/9N	Feature 74	1	Rim	10.5
2012	88-53	40E/9N	Feature 74	1	Rim	8.47
2012	88-54	40E/9N	Feature 74	1	Rim	7.6
2012	88-55	40E/9N	Feature 74	1	Rim	7.17
2012	88-56	40E/9N	Feature 74	1	Rim	6.99
2012	88-57	40E/9N	Feature 74	1	Rim	7.33
2012	88-58	40E/9N	Feature 74	1	Rim	7.99
2012	88-59	40E/9N	Feature 74	1	Rim	7.83
2012	88-60	40E/9N	Feature 74	1	Rim	9.09
2012	88-61	40E/9N	Feature 74	1	Rim	7.06
2012	88-62	40E/9N	Feature 74	1	Rim	6.84
2012	88-63	40E/9N	Feature 74	N/A	Shatter	N/A
2012	65-1	40E/9N	IV	5	Base	13.78
2012	31-1	40E/9N	IV	2	Body	9.79
2012	38-1	40E/9N	IV	1	Rim	11.49
2012	41-1	40E/9N	IV	2	Body	11.94
2012	41-2	40E/9N	IV	2	Body	7.58
2012	41-3	40E/9N	IV	1	Rim	7.65
2012	41-4	40E/9N	IV	2	Body	11.81
2012	41-5	40E/9N	IV	2	Body	10.25
2012	41-6	40E/9N	IV	2	Body	8.88
2012	41-7	40E/9N	IV	3	Neck	9.11
2012	41-8	40E/9N	IV	2	Body	6.58
2012	41-9	40E/9N	IV	2	Body	7.98
2012	41-10	40E/9N	IV	2	Body	9.01
2012	41-11	40E/9N	IV	2	Body	8.46
2012	41-12	40E/9N	IV	2	Body	5.57
2012	41-13	40E/9N	IV	2	Body	8.05
2012	41-14	40E/9N	IV	2	Body	6.13
2012	41-15	40E/9N	IV	2	Body	6.04
2012	41-16	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-17	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-18	40E/9N	IV	2	Body	6.8
2012	41-19	40E/9N	IV	2	Body	6.18
2012	41-20	40E/9N	IV	2	Body	5.26
2012	41-21	40E/9N	IV	2	Body	10.25
2012	41-22	40E/9N	IV	2	Body	7.54
2012	41-23	40E/9N	IV	2	Body	5.58
2012	41-24	40E/9N	IV	2	Body	6.28
2012	41-25	40E/9N	IV	3	Neck	8.17
2012	41-26	40E/9N	IV	1	Rim	6.59
2012	41-27	40E/9N	IV	2	Body	N/A
2012	41-28	40E/9N	IV	2	Body	5.84
2012	41-29	40E/9N	IV	2	Body	4.65

Table D3. Va‘oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	41-30	40E/9N	IV	2	Body	6
2012	41-31	40E/9N	IV	2	Body	7.3
2012	41-32	40E/9N	IV	2	Body	6.29
2012	41-33	40E/9N	IV	2	Body	8.21
2012	41-34	40E/9N	IV	2	Body	7.55
2012	41-35	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-36	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-37	40E/9N	IV	2	Body	5.77
2012	41-38	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-39	40E/9N	IV	2	Body	5.19
2012	41-40	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-41	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-42	40E/9N	IV	N/A	Shatter	N/A
2012	41-43	40E/9N	IV	N/A	Shatter	N/A
2012	41-44	40E/9N	IV	N/A	Shatter	N/A
2012	41-45	40E/9N	IV	2	Body	7.58
2012	41-46	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-47	40E/9N	IV	3	Neck	7.99
2012	41-48	40E/9N	IV	2	Body	7.28
2012	41-49	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-50	40E/9N	IV	2	Body	5.42
2012	41-51	40E/9N	IV	N/A	Inconclusive	N/A
2012	41-52	40E/9N	IV	N/A	Shatter	N/A
2012	41-53	40E/9N	IV	2	Body	5.78
2012	41-54	40E/9N	IV	2	Body	4.17
2012	41-55	40E/9N	IV	2	Body	6.26
2012	41-56	40E/9N	IV	2	Body	8.32
2012	41-57	40E/9N	IV	2	Body	5.05
2012	41-58	40E/9N	IV	2	Body	5.01
2012	41-59	40E/9N	IV	2	Body	8.46
2012	41-60	40E/9N	IV	1	Rim	7.45
2012	41-61	40E/9N	IV	2	Body	8.86
2012	41-62	40E/9N	IV	2	Body	6.07
2012	41-63	40E/9N	IV	2	Body	6.24
2012	57-1	40E/9N	IV	2	Body	14.46
2012	62-1A	40E/9N	IV	1	Rim	7.5
2012	62-1B	40E/9N	IV	2	Body	7.24
2012	62-1C	40E/9N	IV	2	Body	7.36
2012	62-2	40E/9N	IV	5	Base	14.35
2012	62-3	40E/9N	IV	5	Base	11.06
2012	62-4	40E/9N	IV	1	Rim	10.46
2012	62-5	40E/9N	V	N/A	Shatter	N/A
2012	52-1	40E/9N	Feature 70	3	Neck	13.82
2012	42-1	40E/9N	IV	1	Rim	11.7
2012	42-2	40E/9N	IV	2	Body	9.48
2012	42-3	40E/9N	IV	3	Neck	11.62
2012	42-4	40E/9N	IV	N/A	Shatter	N/A
2012	29-1	40E/9N	IV	2	Body	12.02
2012	29-2	40E/9N	IV	5	Base	11.06
2012	29-3	40E/9N	IV	2	Body	11.4
2012	29-4	40E/9N	IV	5	Base	12.57
2012	29-5	40E/9N	IV	5	Base	3.05
2012	26-6	40E/9N	IV	5	Base	13.44
2012	29-7	40E/9N	IV	3	Neck	10.13
2012	29-8	40E/9N	IV	5	Base	11.66
2012	29-9	40E/9N	IV	N/A	Shatter	N/A
2012	92-1	40E/9N	Feature 76	2	Body	8.02
2012	88-1	40E/9N	Feature 74	2	Body	7.91
2012	88-2	40E/9N	Feature 74	2	Body	10.34
2012	88-3	40E/9N	Feature 74	2	Body	7.78

Table D3. Va'oto sherds examined through physical analysis (continued).

Excavation Year	Catalog #	Unit	Layer	Level	Sherd Form	Avg Thickness (mm)
2012	88-4	40E/9N	Feature 74	2	Body	7.18
2012	88-5	40E/9N	Feature 74	1	Rim	11.65
2012	88-6	40E/9N	Feature 74	1	Rim	10.12
2012	88-7	40E/9N	Feature 74	1	Rim	9.98
2012	88-8	40E/9N	Feature 74	N/A	Shatter	N/A
2012	113-1	40E/9N	IV WALL CLEANING	N/A	Body	10.21
2012	22-1	40E/9N	III	5	Shatter	N/A