EXCAVATIONS AT VAINU'U (AS-32-016): A MULTI-COMPONENT HIGHLAND SITE NEAR TUAOLO VILLAGE, TUTUILA ISLAND, AMERICAN SAMOA

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Abstract

This report summarizes the archaeological studies at Vainu'u (AS-32-016), a multi-component site located on Tutuila Island, American Samoa. The primary concern of this research was to chronologically place the site so as to help determine its eligibility for the National Register of Historic Places. The site was mapped and excavated by a Texas A&M University archaeology crew in 2006 and 2007. The two archaeological field seasons resulted in extensive mapping of the site as well as the excavation of 23 1x1 meter pits. Radiocarbon evidence collected for this report indicates that Vainu'u was occupied during three prehistoric periods: the Late Eastern Lapita Period (2700 - 2300 B.P.), the Plain Ware Period (2300 - 1700+ B.P.), and the Monument Building Period (1000 - 250 B.P). Based on current evidence, we divide the occupation of Vainu'u into two prehistoric components. A cluster of seven radiocarbon samples date Component 1 from 2270 to 2440 B.P; this component is associated with the ceramic-bearing layer of the site. Based on a single radiocarbon date collected from within a posthole, Component 2 dates to ca. 650 B.P.; this component is associated with a large house foundation. Excavations at Vainu'u fundamentally change our understanding of highland occupation. In light of this research, we argue that Vainu'u should be considered for inclusion on the National Register of Historic Places under criterion *A: Property is associated with events that have made a significant contribution to the broad patterns of our history* and under criterion *D: Property has yielded, or is likely to yield, information important in prehistory or history*.

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Acknowledgments

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The 2007 crew

CHAPTER 1

INTRODUCTION

This report summarizes the results of the archaeological studies of Vainu’u (AS-32-016) -- a multi-component site located on Tutuila Island, American Samoa -- and interprets the site in light of our broader understanding of Samoan prehistory. First identified as a prehistoric site by David Herdrich, American Samoa territorial archaeologist, Vainu’u (Table 1.1) was then mapped and excavated by a Texas A&M University archaeology crew in 2006 and 2007. The two archaeological field seasons resulted in extensive mapping of the site as well as the excavation of 23 1x1 meter pits (4 in 2006 and 19 in 2007). Vainu'u is a significant discovery because it is the first ceramic-bearing highland site reported and excavated on the island.

Table 1.1. Basic Descriptives concerning Vainu’u

Site name:	Vainu’u
Site number:	AS-32-016
Other names:	Vai Nu’u, Pot Drop Knob, PDK
Descriptive Location:	road running between villages of Pava’ia’a and A’oloaufou, in vicinity of Tuaolo village, Western Tutuila Island, American Samoa
UTM References:	Zone 2 Easting 525532.06 Northing 8417607.40
Ownership:	Private
Historic Functions:	Subsistence Agricultural Field, Domestic Single Dwelling
Current Functions:	Subsistence Agricultural Field
Acreage of Site:	~8 acres

Project Background

An archaeological testing program was conducted on 27 August 2006 at Vainu'u to assess the site's eligibility for inclusion in the National Register of Historic Places. The results of the testing program indicated that Vainu'u was likely eligible, however, the radiocarbon dates collected were inconclusive as to the date of the site. Consequently, the American Samoa Historic Preservation Office requested that Dr. Suzanne L. Eckert (from the Department of Anthropology at Texas A&M University) prepare a research proposal. The data recovery plan was designed to acquire an accurate suite of radiocarbon dates to complete the National Register Nomination for the site and to gather additional data to more accurately characterize the site. for

Excavations were proposed that would determine the chronological extent and nature of cultural deposits at the site, interpret the geoarchaeological sequence, and quantitatively sample and characterize recovered cultural material. The work was conducted under the terms of contract CM-56408 issued by the American Samoa Government through the American Samoa Historic Preservation Office.

Between 1 November 2007 and 30 November 2007, Dr. Eckert directed a team of four archaeologists directed to conduct excavations at Vainu'u (Figure 1.1). The information obtained from this site contributes to a growing body of knowledge about the chronology, shifting settlement patterns, subsistence, and activities of Tutuila's earliest inhabitants; the production of pottery by these early settlers has resulted in this era of Samoan history being named the Polynesian Plain Ware period (Davidson 1979). The majority of previous work focused on this period on Tutuila Island has been at coastal sites (Clark and Michlovic 1996; Eckert 2006; Eckert and Pearl 2006). Fortunately, work at Vainu'u complements this earlier work by providing insight into a different dimension of the subsistence-settlement system of these early inhabitants: the use of Tutuila's highland environments.

The proposed project called for 20 1x1 meter test units to be excavated. Due to time constraints, depth of deposits, and weather conditions, the total area covered in 2007 was reduced to 19 excavation units with a volume of approximately 15 cubic meters. Five features were encountered including two probable house foundations, a possible burial, and two associated stone features that may be the remnants of prehistoric *umus* (stone fire hearths). Lithic debitage and ceramic sherds made up the majority of recovered cultural material. The field forms, data documentation, and artifacts are currently stored at the Department of Anthropology, Texas A&M University; final curation on-island will occur through negotiations with the American Samoa Historic Preservation Office.

This report contains seven chapters that summarize the results of the archaeological studies of Vainu'u. The environmental setting, a brief review of the culture history of Tutuila Island, and the results of the 2006 archaeological testing program are discussed in Chapter 1. Chapter 2 presents the research objectives that guided the 2007 excavation project. Chapters 3 through 6 are primarily descriptive in nature; these chapters provide summaries of the excavated features and gearchaeology of the site, as well as summarize analyses of the material culture recovered. The final chapter of this report, Chapter 7, provides a synthetic and interpretative overview of our research and compares Vainu'u to previously investigated contemporaneous sites.

Overall, Vainu'u is in very good condition. The two seasons of archaeological work found no evidence of looting, and found most features to be largely undisturbed. Although there are some modern features associated with agricultural activity on the surface, the earliest cultural deposits are deep enough to have been unaffected by such construction. Similarly, although the upper

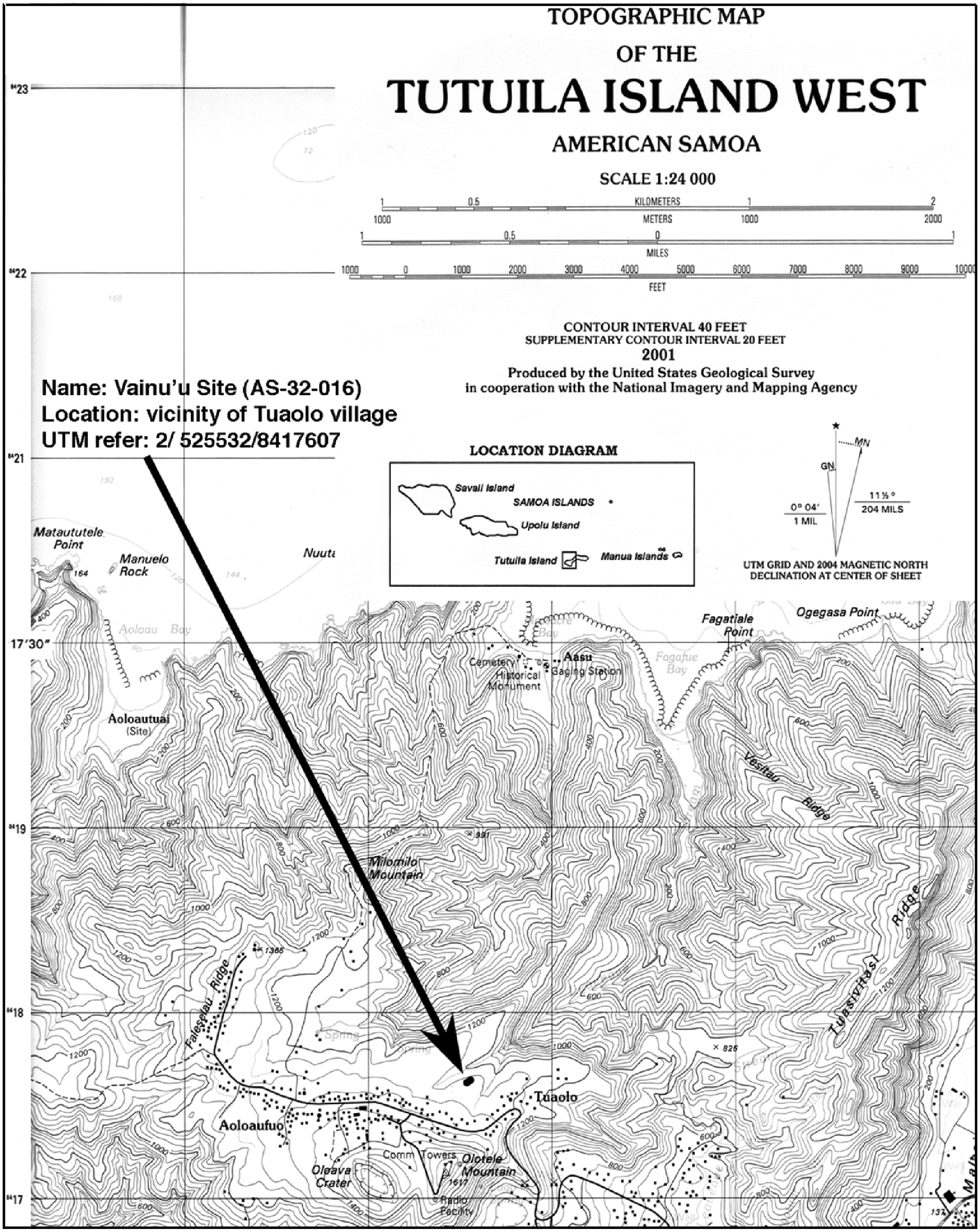

Figure 1.1. Project Location Map

30 centimeters of the site (Layer V as discussed in Chapter 4) shows evidence of post depositional disturbance by repeated planting and harvesting, much of the site is intact and has the potential of providing extensive information on at least three periods (Plain Ware Period, Monument Building Period, and Historic Period) of cultural activity on Tutuila Island.

Environmental Setting

Vainu'u is located on the island of Tutuila, American Samoa at approximately 1100 feet above sea level. The site is situated on a ridge (probably a combination of natural and manmade terracing) between the two forks of the Leaveave Stream. The site stretches northwest/southeast along an agricultural terrace. The ridge on which Vainu'u is located gently rises towards the south, but is otherwise fairly flat. The surface of the site is unremarkable, with a few pieces of ceramic sherds and chipped stone material scattered throughout the agricultural fields. Although surface material was not collected or recorded in a systematic way, artifacts appear to cluster in lower and higher density areas. There are no clear surface indicators to mark the site boundaries – no features or mounded areas. Although artifacts are scattered across the surface of the site, these artifact scatters do not correspond with the extent of the site as reflected in shovel pit testing or excavation.

Ecology

Typical of Pacific islands ecology, Samoan islands have a limited range of wild plant and animal species adapted to lagoon, marine, and terrestrial ecosystems (Green 1991). The introduction of domesticates by the earliest colonists, as well as over exploitation by these colonists, may have resulted in local extinction of wild species that were present early in Samoan prehistory but are no longer found on the islands (Steadman 1993a, 1993b).

As Vainu'u is located across active agricultural fields, the vegetation in the immediate area of the site consists primarily of cultigens. While vegetation acts to hold the soil together, it also acts as an agent of water infiltration which fuels subsurface flow. One of the main processes acting on the site and the landscape is water interception. Over time, humid conditions combined with lush vegetation act to modify the landscape: during the rainy season, soils will over saturate which results in runoff, erosion and deposition of sediments. In terms of site preservation, agricultural activity and vegetation growth can cause stratigraphic layers to be mixed as well as contribute to water infiltration. Striping the land of tropical forest for agricultural use can also be a problem for site preservation. Such activity allows for relatively high amounts of sheet runoff that can result in a mass wasting event. These events transport material – including artifacts -- from one location to another (Waters 1992).

At the time of recording in 2007, the main portion of the Vainu'u was covered in taro (*Colocasia esculenta*) plants. A major component of the Samoan diet, taro can grow very large with a root system that can grow up to several feet. Although taro grew along the ridge top where the site is situated, papaya, banana, breadfruit, coconut, tomatoes, maize and eggplant were also noted within the area.

Island Geology

The Samoan archipelago is comprised of six large volcanic islands and numerous small coral islands. The archipelago is located along the top of the Samoan Ridge. Volcanic islands have been formed as a result of the westward movement of the Pacific Plate over a "hot spot" of erupting magma; as a result, islands in the west are geologically older than islands in the east. As the islands moved away from the hot spot, volcanic activity ceased, volcanoes collapsed forming calderas, wind and water erosion cut into the landscape, and subsidence and coral reef formation changed the coastlines (Stice 1981).

Vainu'u is located on the island of Tutuila, American Samoa. Four of the island's main volcanoes and numerous secondary eruptions experienced peak activity during the late-Pliocene (McDougall 1985; Stearns 1944). This resulted in the formation of four of the island's five distinct volcanic series including Alofau, Olomoana, Pago, and Taputapu. Calderas of these volcanoes have been partially filled through later plutonic activity and erosion. Residents of Tutuila Island working at Vainu'u would easily have had access to basalts and clays from three of these series.

As volcanic activity decreased on Tutuila, deep valleys and high sea cliffs were cut into the landscape. Sea level rise ca. 20,000 BP filled some valleys and covered a barrier reef. A resurgence of volcanic activity during the early Holocene formed 'Aunu'u Island off the southeastern tip of Tutuila and added another 21 square kilometers of land to Tutuila known today as the Leone formation (Stearns 1944). Despite being formed in geologically close succession and from the same magma bed, the five volcanic formations (Figure 1.2) are mineralogically, chemically and morphologically diverse, partially due to the numerous dikes, plugs, and extra-caldera lavas that transect much of the island (Natland 1980; Stearns 1944). Further, reef activity continues to this day around Tutuila, with a fringing reef growing around much of the island.

Local volcanism directly affected the site formation at Vainu'u. As will be discussed further in Chapter 4, volcanism deposited a layer of cinder ash after the site's initial occupation. This eruption may have rendered the location impractical for cultural use for at least a few years. As described in Chapter 4, the lithostratigraphic layers have been identified as a silty clay loam that give way to sandy clay with volcanic gravels and two additional layers of well-graded volcanic gravels. During the site's earliest human presence, the stratigraphic sequence indicates that people were active upon a thin layer of sandy clay with ground vegetation and hardwoods (Layer III) overlying volcanic gravels (Layer II). Cultural activity is evidenced by fire hearths (*umu*) found resting on the interface of the lower volcanic soil (Layer III) and the higher welded ash and andisol (Layers IV and V, respectively).

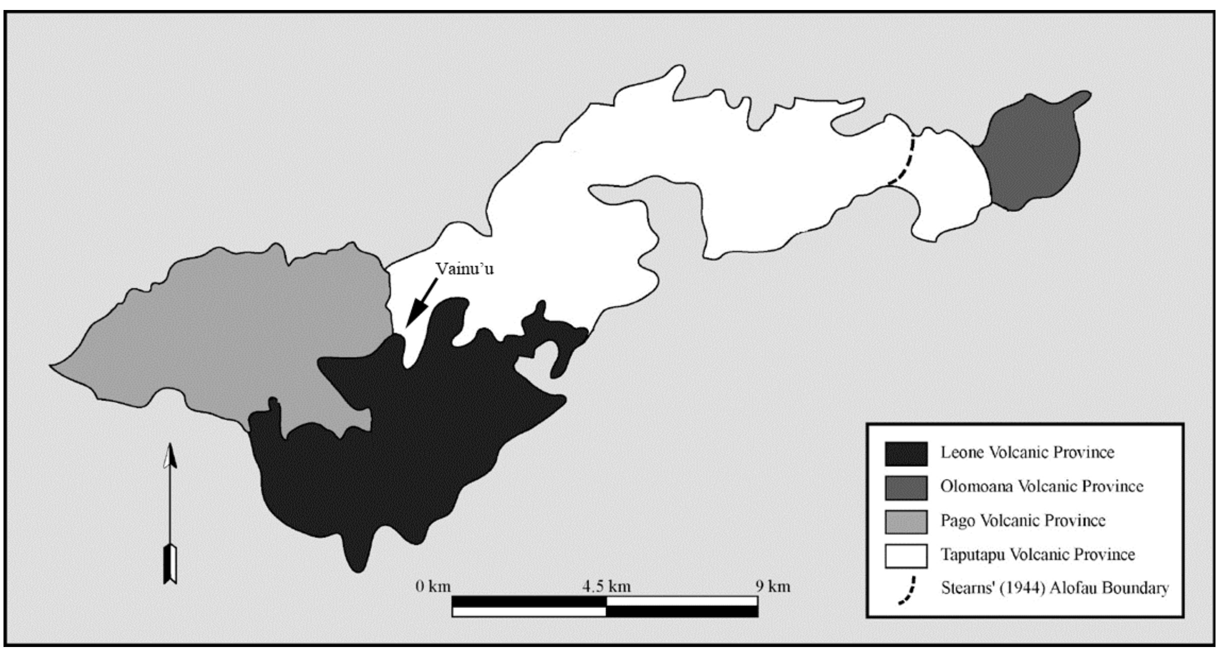

Figure 1.2. Tutuila showing location of Vainu'u in relation to the island's 5 major volcanic series

Geomorphology of Vainu'u

The geomorphology of the area surrounding Vainu'u is a major determinate of the site's preservation. Vianu'u is situated in an unstable area with a cycle of heavy rainfall, erosion and deposition. Once the prehistoric occupations were buried, post-depositional physiogenic, biogenic and chemical agents worked to modify and alter the archaeological debris and the spatial relationships between the remains. The landscape at Vianu'u has been altered both by cultural and natural processes.

Archaeological remains, in this case primarily lithic and ceramic material but also charcoal and stone features, were altered as a result of water percolating down along with biogenic and chemical agents. Floralturbation -- resulting from tree-throws or taro harvesting -- also aided in site distortion. As the land was stripped for agriculture, overland water flow increased which aided in sediment transport and could also have had a detrimental effect on cultural features. Post-depositional processes also resulted in degradation of certain artifact classes such as charcoal or shell, and may have also contributed to total or partial mixing of site layers.

Although Vainu'u is currently being used for agricultural activities, there is no denying that the site is surrounded by tropical forest and, most likely, was part of this forest at various points in time. The infiltration capacity and hydraulic conductivity of surface soils are relatively high in tropical forests and is supported by continual inputs of organic matter (Sidle et al. 2006).

Tropical forest soils experience a high rate of organic decomposition and sediment transport due to high annual precipitation. Rainwater that is intercepted by dense vegetation leaches through the soil, transporting clay particles downward as it flows underground towards nearby streams. When the ground becomes saturated as a result of significant rainfall, appreciable soil erosion is generated by overland flow. Over time, loosely compacted tropical soils are displaced by overland flow events, which expose mineral sediments and archaeological remains to further weathering processes (Sidle et al. 2006). High pore water pressures, a result of excessive precipitation, can develop and result in mass wasting events when shallow subsurface flow is combined with steep slopes and poorly consolidated soils that overlie relatively impermeable substrates (Sidle et al. 2006). Geomorphic processes such as these are constant across the Tutuilan landscape and act as vivid reminders of forces past and present that shaped the behavior of prehistoric inhabitants and the condition of resultant archaeological deposits.

Infiltration in a given area is dependant on slope angle, vegetation, how permeable the ground is, how much water is in the soil and how much water the soil can hold. Hortonian Overland Flow is the main process for sheet erosion and rill initiation on slope surfaces. Vainu'u is covered in vegetation with high water content. Vegetation such as the banana plant (*Musa paradisiaca*) aid in the interception of water. In general, one would expect to find more saturation in these conditions compared to those of temperate ones. The extent of surface erosion on forest hill slopes depends on the depth of the disturbance related to the depth of the soil organic horizons, as well as the spatial extent or connectivity of disturbances (Sidle et al. 2006). Due to thin organic horizons in the tropics, agriculture can often disturb soils and increase the risk of surface erosion that may eventually lead to a mass-wasting event (Sidle et al. 2006). It is evident that such events have occurred on the landscape near and around Vainu'u. A hilltop located southwest of the excavation units (across the road from the site property) exhibits signs of mass wasting (Figure 1.3). Overall, then, the ridgetop location of Vainu'u has left the site vulnerable to various geological processes than will need to be considered during geoarchaeological evaluation of the site's stratigraphy.

Figure 1.3. Slope southwest of Vainu'u excavation area. The white lines indicate the areas of potential mass wasting events (photo by Megan T. Hawkins)

Cultural Chronology

An international effort in the 1960s resulted in a Samoan cultural chronology (Table 1.2) that still carries great weight in the discipline (Burley et al. 1995; Davidson 1979; Green and Davidson [editors] 1969, 1974; Kirch 2000). Time periods are associated with specific material traits and settlement patterns. When this project began, we had no reason to exclude any of these periods as possibly being represented at Vainu'u. Evaluation of radiocarbon dates discussed in Chapter 4, as well as cultural components described for Vainu'u throughout this report, are considered in light of these established periods.

Table 1.2. Samoan Cultural Chronology (after Davidson 1979)

Period	Date Range	Material Traits
Ceramic Periods		
Early Eastern Lapita	3100 - 2700 B.P.	Initial settlements along coast; early Lapita decorated pottery
Late Eastern Lapita	2700 - 2300 B.P.	Coastal settlements; late Lapita decorated pottery
Plain Ware Period	2300 - 1700+ B.P.	Coastal and inland settlements; undecorated pottery
Aceramic Periods		
Dark Ages	1700+ - 1000 B.P.	Absence of pottery; triangular and trapezoidal-sectioned adzes
Monument Building	1000 - 250 B.P.	Inland settlements; monumental architecture including fortifications and star mounds
Historic	250 B.P. - present	Coastal settlements

Ceramic Periods

Early Eastern Lapita (3100 - 2700 B.P.). The Early Eastern Lapita Period marks the settlement of Samoa by seafaring groups identified archaeologically by a distinct artifact assemblage including dentate-stamped pottery; this distinct assemblage has come to be known as the Lapita Cultural Complex. The earliest site known on the Samoan archipelago is the Mulifanua ferry berth site, located just off the northwest coast of Upolu Island, Western Samoa (Petchey 2001, Jennings 1974). The most reliable radiocarbon dates for this site suggest an occupation of approximately 2800 years ago (Petchey 2001). Decoration on sherds from Mulifanua include dentate-stamping on and below the rim and is typical of Early Eastern Lapita decoration (Green 1974a); currently, this is the only dentate-stamped pottery bearing site in the archipelago. However, two other sites, To'aga (Kirch and Hunt 1993) and 'Aoa (Clark and Michlovic 1996; Clark et al. 1997), have provided Early Eastern Lapita period radiocarbon dates from American Samoa but no Lapita pottery.

Late Eastern Lapita (2700 - 2300 B.P.). The Late Eastern Lapita Period is viewed as a cultural continuation of the Early Eastern Lapita Period, and is characterized primarily by the lack of dentate-decorated pottery and an overall simplification of pottery decoration; in general, there appears to be less diversity in the artifact assemblage as a whole. The simplified decoration on sherds recovered from Aganoa, To'aga and 'Aoa is typical of this period (Green 1974a). When examined together, data from these three sites suggest the original ceramic chronology of Early and Late Eastern Lapita is appropriate for Samoa despite difficulties in applying this chronology elsewhere in Polynesia (Burley et al. 1999; Kirch 1988).

Plain Ware Period (2300 - 1700+ B.P.). This period is marked by a ceramic assemblage that consists almost entirely of undecorated sherds; where decoration does exist, it is usually simple patterns along the rim. The Plain Ware Period is significant because most Oceania archaeologists believe that it is from the culture of this period that all subsequent Polynesian culture springs. It is generally believed that during this period, Polynesian culture began to diverge from a Lapitoid/Melanesian pattern towards a more distinctively Polynesian pattern. The most widely accepted model of Polynesian cultural development (Burley et al. 1995; Clark 1996; Davidson 1979; Hiroa 1930; Irwin 1992; Kirch 1984, 2000; Kirch and Green 2001; Pawley 1966; Pawley and Ross 1993; Shutler and Shutler 1975) stipulates that ancestral Polynesians used the islands of western Polynesia as a gateway through which eastern Polynesia was settled during the late Plain Ware Period. Previous studies of Plain Ware sites have suggested that occupation during this period was focused primarily along the coast (Clark and Michlovic 1996, Green and Davidson [editors] 1969, 1974; Kirch and Hunt [editors] 1993; Kirch et al. 1990).

Aceramic Periods

Dark Ages (1700+ - 1000 B.P.). The date for the end of the Plain Ware Period, marked by the cessation of pottery production throughout Samoa, is debated: while the conventional view has been that pottery ceased to be produced at 1700 B.P. (Davidson 1979), Kirch and Hunt (1993) suggest an end date of 1200 B.P., and Clark and colleagues (Clark and Michlovic 1996; Clark et al. 1997) have argued that pottery was produced as recently as 400 years ago. This hole in our knowledge of Samoan cultural chronology has important implications for understanding the Dark Ages period. The term "Dark Ages" is Davidson's (1979:94-95) and refers to a dearth of archaeological evidence from this time and not to a cultural decline. However, the American Samoa Historic Preservation Office (2004) recently stated that the inability to adequately date the end of the Plain Ware Period may help explain why a "Dark Ages" was initially defined in the

Samoan cultural chronology. At the time the chronology was being outlined, pottery-bearing sites were all assumed to date to the earliest period of Samoan prehistory; charcoal was rarely collected from these sites to confirm this assumption. As a result, the "Dark Ages" requires further consideration and possible redefinition to determine if this Period is culturally meaningful and, if so, what material culture traits characterize it.

Monument Building Period (1000 - 250 B.P.). Most of the known prehistoric sites on Tutuila date to the Monument Building Period. According to oral tradition, villages on Tutuila were obligated to follow the rule of chiefs living on the island of 'Upolu (Krämer 2000: 424). This period was one of regular warfare, with the building of fortifications and defensible highland sites common. The building of star mounds on Tutuila probably reflects prestige building activities by chiefs of this period (Herdrich 1991). Historic records tell us that by European contact, Samoans had developed a diversity of organizational forms to deal with the production requirements of their chiefdomships. The complexity of their craft production organization is reflected in the archaeological record through evidence for specialized production of basalt adzes on Tutuila during this period; this evidence includes the massive quarry at Tatagamatau (Enright 2001), the hundreds of *foaga* (grinding surfaces) on the coast of Leone (Enright 2001) used to finish basalt adzes, and the distribution of Tutuila basalt adzes to locations as far as Fiji, the Manu'a Islands, Taumako, and Tokelau (Best et al. 1992).

Historic Period (250 B.P. - present). European contact was made in Samoa in 1722, but historic records describing Samoan culture are few until after 1840 (Davidson 1979). However, oral tradition from this period is rich in detail. Directly downstream of Vainu'u lies the coastal village of A'asu; beneath this modern village is the Massacre Bay site, which dates to the Historic Period (Pearl and Loiseau-Vonruff 2006). The building of fortifications ceased once Europeans began to missionize the islands.

In terms of craft production, historic Samoans recognized experts (whom ethnographers have labeled specialists) in canoe and house building, stone masonry, net making, tattooing, wood carving, feathered cloak production, and *kapa* making (Stair 1897). Some producers were organized into guilds, while others produced on the household level (Hiroa 1930; Kaeppler 1978; Krämer 1995; Mead 1930; Sahlins 1958; Turner 1884). There is record that some specialists were attached to a specific chief, however most specialization was not a full time task (Hiroa 1930; Mead 1930). Although most crafts appear to have been produced by Samoans for Samoans, residents of other archipelagos also sought Samoan products (Kaeppler 1978).

With the Tripartite Convention of 1899, the Samoan Islands were partitioned between the Eastern Islands which went to the United States and the Western Islands which went to Germany; Germany lost control of the islands to New Zealand in 1914; In 1962 these islands formed the country of the Independent State of Samoa. The United States has continued to control American Samoa, including Tutuila Island, since the Triparitite Convention. Throughout the first half of the 20th century, Tutuila Island served a Naval Station; as a result, historic military sites are found throughout the island. In 1951, governance of American Samoa was transferred to the Department of the Interior. In 1954, the fishery industry opened canneries in Pago Bay, impacting not only the economy of Samoa, but the archaeological record as well.

Today, as the island's population continues to grow and the infrastructure continues to be modernized, archaeological sites continue to be discovered and often destroyed in a short period of time. Despite the best efforts of the American Samoa Historic Preservation Office and American Samoa Power Authority's archaeology division, the resources continue to be too few to keep up with the excavation and reporting that needs to be done.

2006 Test Excavations Conducted at Vainu'u

Although from a distance Vainu'u is not distinctive, appearing to be no more than a group of ridge top agricultural fields, the surface of the site is lightly covered in ceramic and lithic artifacts. These artifacts appear to have been brought to the surface through agricultural activity. A testing program was conducted at the site to determine the nature, depth, density and integrity of surface and subsurface features and to assess the eligibility of Vainu'u for inclusion in the National Register of Historic Places.

The archaeological testing program was initiated by locating and pin-flagging artifact concentrations along the ridge. Diagnostic artifacts were also marked in this way. Subsequently, the site was gridded into 1 meter by 1 meter units with reference to a primary datum located in the center of the site as defined by the pin flags; the location of this datum could not be relocated in 2007 and is presumably lost on the ground. Surface visibility varied, with high visibility in recently planted agricultural fields and low visibility in overgrown fields and tropical forest areas. Visible cultural features, excavation units, shovel test pits, and the edge of the ridge were mapped with the aid of a Total Station. Due to time constraints and the diffuse nature of artifact scatters, not all of the surface material was collected or mapped. Four 1x1 meter excavation units were laid out near ceramic artifact concentrations and then excavated by hand; fourteen shovel test pits were also dug north, south, east and west of the 2006 excavation units to help determine the extent of the site boundary as well as plan future excavation strategy (Figure 1.4). Combined, surface mapping, excavation units, and shovel pits revealed only one surface feature but provided an excellent artifact assemblage for initial testing of the site.

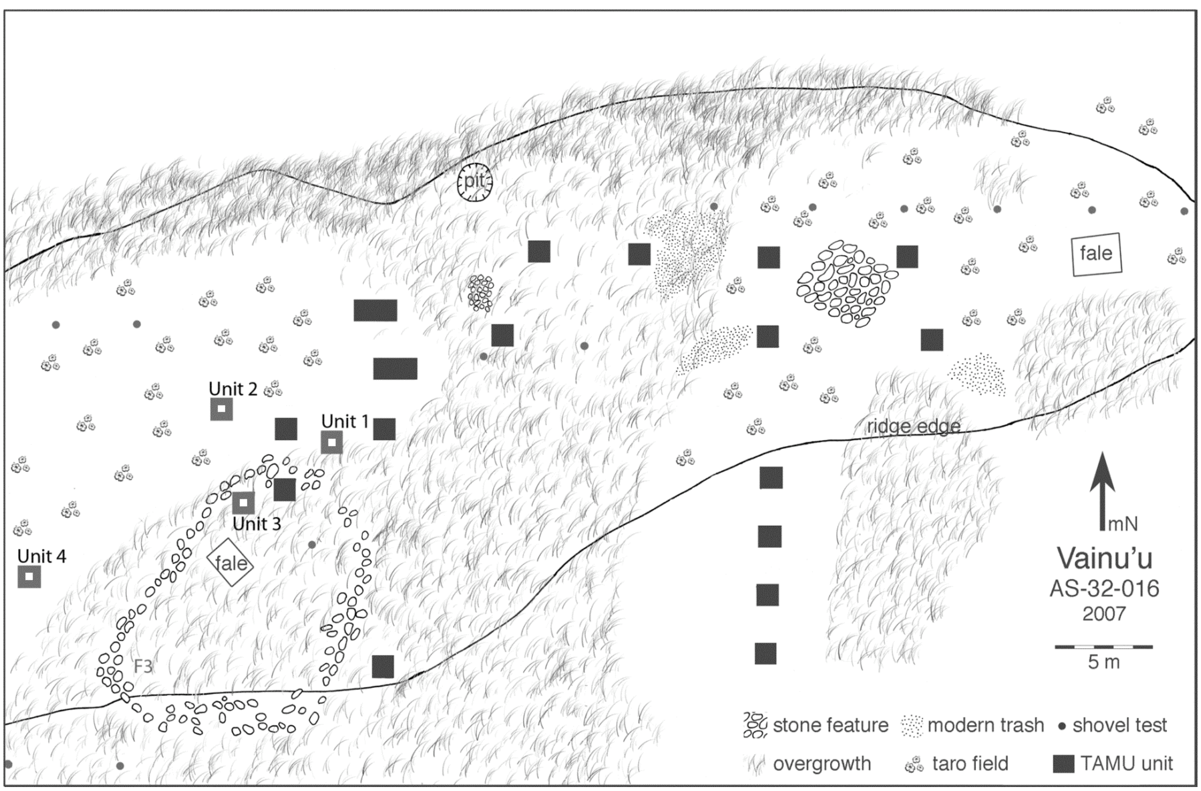

Figure 1.4. Vainu'u showing location of 2006 excavation units and shovel test pits

2006 Shovel Test Pits

Eight shovel test pits were dug during the 2006 test excavations; an additional 6 shovel test pits were dug by David Herdrich and Jonathon Bell in January 2007. These shovel test pits were used to help determine the extent of the site boundary as well as plan future excavation strategy. If no artifacts were recovered from the shovel test pit, it was assumed that it was outside the site boundaries. Both prehistoric and historic artifacts were recovered (Table 1.3).

Surface Features from 2006 Mapping

The only surface feature recorded during the 2006 testing was a pit. This pit is located along the north central portion of the ridge top. Measuring approximately 2 meters in diameter and 1 meter deep, the purpose and age of this pit is uncertain. It is possible that this feature is a *lua'i masi* or *masi* pit: a common historic Samoan technology used for breadfruit preservation and concealment (Cox 1980). These pits were used as a risk-reduction strategy against the threat of drought or invasion.

Cox (1980) describes the construction of a *masi* pit that he witnessed during his field work: a pit was dug measuring approximately 1 meter in diameter and depth, the pit was lined with banana and *Heliconia* leaves, filled with 10 mature breadfruit that had been peeled of their skins and quartered, and the *Heliconia* leaves were then folded over the breadfruit forming an airtight pocket. The pit was then sealed with a layer of soil and rocks.

Table 1.3. Summary of artifacts found in shovel test pits (dash represents untested)

STP#	Year	0-20 cmbs	20-40 cmbs	40-60 cmbs	60-80 cmbs
1	2006	bullet (WWII 30 cal) basalt flake	charcoal	--	--
2	2006	*no artifacts recovered*		--	-- --
3	2006	*no artifacts recovered*		--	-- --
4	2006	*no artifacts recovered*		--	-- --
5	2006		3 sherds	--	-- --
6	2006		2 sherds	--	-- --
7	2006	*no artifacts recovered*		--	-- --
8	2006	*no artifacts recovered*			
1a	2007			3 sherds	
2a	2007		glass & plastic	basalt flake	
3a	2007				2 sherds
4a	2007	1 sherd	4 sherds		
5a	2007	*no artifacts recovered*			
6a	2007	*no artifacts recovered*			

Based on Cox's description, it is possible that the pit recorded at Vainu'u is a *masi* pit. Although the size is larger than recorded by Cox, he states that pit size is entirely dependent upon the number of breadfruit to be preserved (1980: 182). Although no rocks were recorded around the pit, they may have either been missed in the dense foliage or been moved over time. Currently, without some type of palynological or residue analyses, the purpose of this surface feature will remain uncertain.

2006 Excavation Units

Four 1x1 meter units were excavated in 10 cm arbitrary levels, with a total volume of almost 2 cubic meters of fill removed and sifted through ¼ inch screen. No subsurface cultural features were exposed during 2006 testing. In terms of site soil matrix, all four units exposed a similar stratigraphic profile. Time constraints did not allow for scaled profiles to be drawn. However, notes and sketches of these profiles allowed us to determine that Vainu'u was situated primarily in a clay heavy area, with the upper 30 centimeters of the site having been modified for agricultural purposes. The excavation units were dominated by dark brown and brown clayey loam in the upper 20-30 centimeter levels, with reddish brown clay and volcanic gravels dominating deeper levels. Prehistoric cultural material was recovered from all 4 units.

Analysis of Artifacts Collected from Vainu'u during 2006 Testing

Analyses of ceramic and lithic artifacts from the 2006 test units provided some tantalizing patterns. Petrographic and technological analysis (Table 1.4) of the recovered 180 ceramic sherds suggested three important patterns (Robert 2007). First, diverse tempering material suggested pottery at this site was produced by multiple potters, possibly at multiple locations across the island. Second, the lack of soot and smudging on the vessels implied that they were used for storage and as serving vessels rather than for cooking. This finding contrasted with findings from coastal sites, where it has been argued that pottery was used for service and cooking (Eckert 2006, 2007; Eckert and Pearl 2006). Third, three sherds from Vainu'u – all probably from the same vessel -- display decoration (Figure 1.5). Ceramic decoration is not common in Samoan material culture and is associated with the earliest ceramic tradition of the Lapita Cultural Complex (Lapita 3100-2300 BP). Based upon this preliminary work, it became clear that further work at Vainu'u would provide a more complete understanding of Polynesian pottery in terms of chronology, production organization, and circulation.

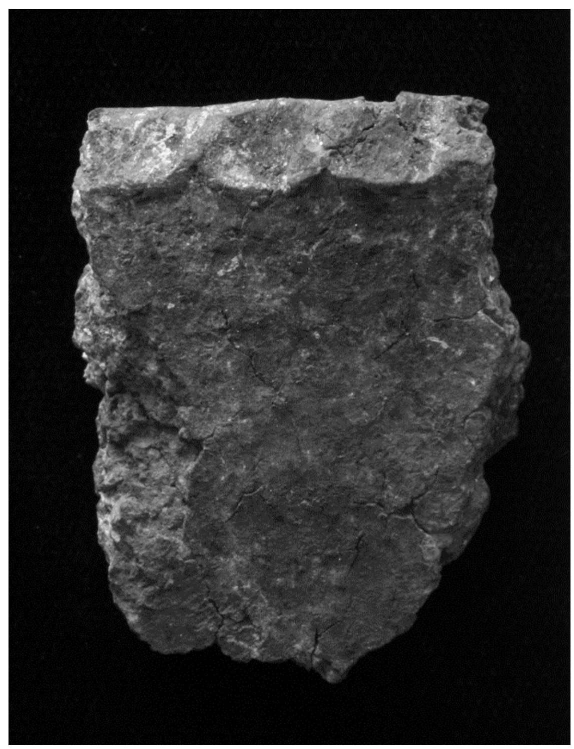

Figure 1.5. Decorated sherd recovered during 2006 excavations (photo by Charlotte Pevny)

Table 1.4. Summary of sherds recovered during 2006 excavations

Unit	Level	Thin 3 - 6 mm	Thick 7 - 13 mm	Rims	***Total***
site	surface	3	17	5 (3 decorated)	*23*
STP #5	20-40 cmbs		3		*3*
STP #6	20-40 cmbs		2		*2*
1	1	1			*1*
	2	3			*3*
	3	23	3		*26*
	4	15	2		*17*
	5	1			*1*
2	1	9			*9*
	2	32			*32*
	3	32		2	*32*
3		*no sherds recovered from this unit*			
4	1	2	24	2	*26*
	2		3	2	*3*
	3	2			*2*
	4	2			*2*
	5	1			*1*
	Total	*126*	*54*	*11*	*180*

The lithic component of Vainu'u also provided important data with interesting implications regarding the technological organization of lithic resources during ceramic and aceramic periods (Table 1.5). The 2006 excavations at Vainu'u yielded 286 lithic specimens including 1 adze and 4 adze fragments (Welch 2007). A lithic attribute analysis was conducted to examine basic stone tool technology, but also to provide insight into production activities and the intensity of production at Vainu'u. Welch (2007) interpreted the restricted flake size (1-3 cm) as reflecting only middle to late stage stone tool production (Figure 1.6). Further, using a combination of experimental archaeology and an expanded lithic flake typology, Welch argued that adzes, not other types of formal tools, were being produced. However, he also argued that the fine-grained blue basalt being worked was not immediately available in the vicinity of the site, but had to be transported to Vainu'u. He concluded that further analysis of the adzes from Vainu'u, such as residue analysis of breakage patterns, may provide a further understanding of the types of activities these tools were used for at the site. In summary, though, he argued that his preliminary analysis tells archaeologists that small-scale, late stage adze production occurred at Vainu'u. As with the pottery, it became clear that further lithic analyses with a larger sample size and better contextual control needed to be performed to support or refute these initial findings.

Initial Site Chronology

The prehistoric site of Vainu'u is a significant discovery because it is the first ceramic-bearing highland site reported and

Table 1.5. Summary of lithic material recovered during 2006 excavations

Unit	**Level**	**Volcanic Glass**	**Basalt Debitage**	**Adzes**	***Total***
site	surface			1 whole 2 fragments	*3*
STP #1	0-10 cmbs		1		*1*
1	2		6		*6*
	3	1	120		*121*
	4		82		*82*
	5		25		*25*
	6		7		*7*
2	1		1		*1*
	2		4		*4*
	3		3		*3*
3	1		1		*1*
	3			1 fragment	*1*
4	1		5	1 fragment	*6*
	2		9		*9*
	3		4		*4*
	4		6		*6*
	5		6		*6*
	Total	*1*	*280*	*5*	*286*

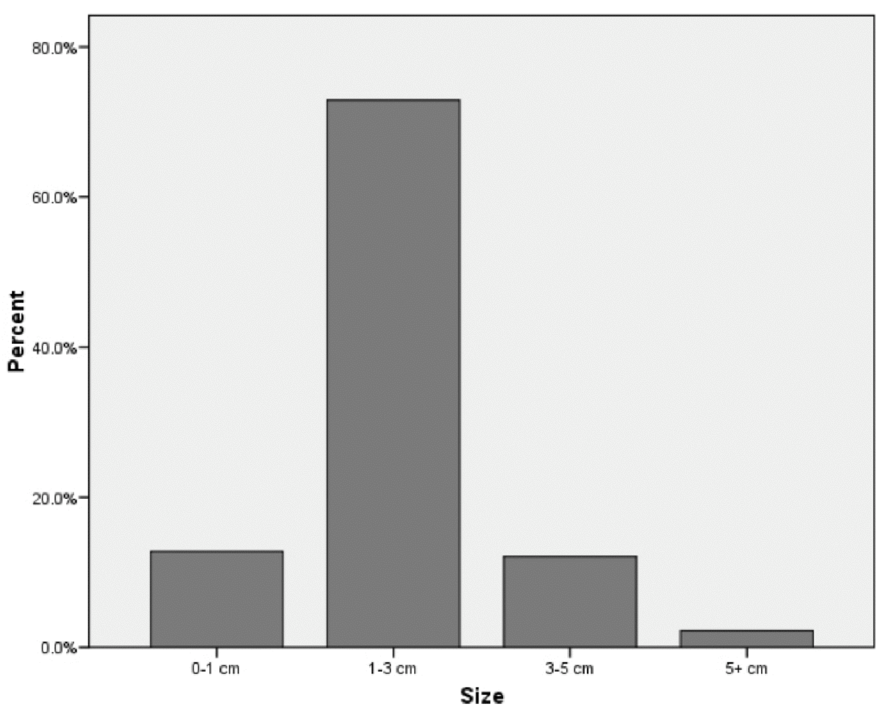

Figure 1.6. Debitage flakes from 2006 test excavations graphed by diameter (from Welch 2007)

excavated on Tutuila Island. Further, the site represents an anomalous archaeological signature. As we understood the ancestral Samoan cultural sequence prior to the discovery of Vainu'u, pottery ceased to be produced *prior* to occupation of the highlands (Davidson 1979). Unfortunately, due to a lack of appropriate datable material recovered during 2006 from well-controlled cultural contexts at Vainu'u, an absolute chronology of prehistoric activity, as well as details of any associated items of material culture was unclear. Was pottery produced longer than we suspected, as suggested by Clark and colleagues (1997), or were the highlands occupied earlier than originally believed? If preliminary ceramic and lithic studies were a good indicator, further excavation at Vainu'u had the potential of providing important data for understanding the Ancestral Samoan cultural sequence as well as important insights into production organization.

Excavation information gathered in 2006 offered little evidence to help place Vainu'u into the ancestral Samoan timeline. Although 4 samples were submitted for radiocarbon dating, only three dates were obtained, none of the dated material was identified to species, and the association of this material with the actual occupation of Vainu'u was weak (Table 1.6). The agreed upon chronology for Samoa tells us that ceramic bearing sites date to 3100-1700 BP. Sites on the early end of this date range often have decorated pottery, while ceramic bearing sites in general are associated with a relatively high amount of obsidian when compared to later sites. The presence of pottery (including 3 decorated sherds), one piece of obsidian, and one conventional radiocarbon date (1710 ± 40 B.P.) supported this earlier date range for Vainu'u.

However, the currently agreed upon chronology for Samoa also tells us that ceramic-bearing sites were all located along the coast. Previous research indicates that mountain settlements represent a major shift in settlement patterns that occurred approximately 1000 B.P., and that highland sites in general date to 1000-250 B.P. (Pearl 2004). Further, in a much debated study, Clark and colleagues (1997) have argued that pottery at 'Aoa dates to as late as 400 years ago. With this in mind, the presence of pottery at Vainu'u may not help date the site to an earlier time period, while two unconventional radiocarbon dates (150 ± 40 B.P. and 100 ± 40 B.P.) support a later occupation for the site. Test excavations at Vainu'u, then, made it clear that the site was significant because it not only pointed out the holes in our understanding of the ancestral Samoan timeline, but had the potential to provide data that would help fill those holes.

Summary and Recommendations

The eligibility of Vainu'u for inclusion in the National Register of Historic Places was evaluated by conducting a program of archaeological testing and preliminary mapping. The archaeological testing exposed no subsurface features. The preliminary analysis of the artifact assemblage indicated that Vainu'u was likely occupied during the Plain Ware Period. A later period of occupation may have dated to the Monument Building Period or early Historic Period. However, radiocarbon dates for the site were inclusive, and cross-dating using artifacts is notoriously inaccurate for this type of site (see Chapter 2).

Based on the initial testing, Vainu'u was determined to be significant for three reasons. First, the presence of pottery at this highland site has resulted in a modification of the known cultural sequence. Either pottery production dates later than most archaeologists suppose, or highland sites were occupied earlier than most archaeologists suppose. Second, further work at Vainu'u may provide archaeologists with valuable data in the on-going attempts to create a more accurate chronology for ancestral Samoa. Third, and finally, regardless of when this site fits into the timeline, Vainu'u provides the unique potential of understanding craft production and circulation in ancestral Samoan society. For example, it is possible that ceramic producing societies had some settlements, or at least special-use sites, in the mountains prior to 1000 B.P. Additionally, Vainu'u could provide a further understanding of social stratification on Tutuila and in Samoa. Data could contribute information about inter- and intra- island contact through migration and the exchange of portable artifacts as well as settlement patterns in prehistoric Samoa.

The construction of the proposed residential building would directly impact this site, which might be eligible for inclusion in the National Register of Historic Places. Consequently, an archaeological data recovery program was recommended to acquire an accurate suite of radiocarbon dates to complete the National Register Nomination for the site and to gather additional data to more accurately characterize the site for the National Register Nomination.

Table 1.6. Summary of radiocarbon dating from 2006 test excavations at Vainu'u. Data from Beta Analytic Radiocarbon Dating Laboratory (Hood 2007)

Beta#	Provenience	Material	C14 Age Years B.P.	C13:C12 Ratio	C13 Adjusted Age B.P.	1-sigma Calibrated Age B.P.	2-sigma Calibrated Age B.P.
228639	Unit 1 Level 2	charcoal	results indicate the material was living within the last 50 years				
228640	Unit 1 Level 3	charcoal	150 ± 40	-28.2 o/oo	100 ± 40	260-220 140-20 0-0	280-180 150-10 0-0
228641	Unit 1 Level 3	charcoal	210 ± 40	-28.6 o/oo	150 ± 40	280-250 230-170 150-130 110-70 40-0 0-0	290-0
228642	Unit 1 Level 4	charcoal	1780 ± 40	-29.0 o/oo	1710 ± 40	1690-1650 1640-1560	1710-1530

CHAPTER 2

RESEARCH DESIGN AND METHODS

The geographic location of Vainu'u (AS-32-016) prompted initial archaeological interest in this site, as it is the first ceramic-bearing site located in the highlands to be recorded and systematically excavated on Tutuila Island. This fact, combined with the very recent discovery of more ceramic bearing highland sites on the island (Bartek 2009; Welch 2009), is a reflection of the relatively undisturbed nature of highland Tutuila. The ephemeral nature of these sites, which exhibit minimal surface features due to deep deposition, were historically of little interest to Samoan archaeologists.

Vainu'u is an important addition to the suite of excavated ceramic era sites on Tutuila, such as 'Aoa and Aganoa, in that it complements the information gathered from excavations at coastal sites. Further, Vainu'u also has features and material culture associated with post-ceramic periods, providing the opportunity to investigate diachronic changes in economic activities and adaptive strategies at the same site. Examining the differences in material culture through time at Vainu'u, as well as between Vainu'u and other contemporary coastal sites, should provide a clearer understanding of the lifeways of ancestral Samoans than we currently have. With this in mind, four research issues guided our work.

Research Issues

Four basic research issues were considered in planning the excavation and artifact analysis at Vainu'u. The first three research issues include site-specific concerns, including the temporal placement of Vainu'u in the Samoan cultural chronology, the spatial and functional relationship between any features discovered at the site, and the type of adaptive strategies and economic pursuits engaged in by the occupants of the site. On the local and regional level, temporal placement of Vainu'u will help refine the Samoan cultural chronology in terms of how long pottery was produced as well as how early inhabitants of the island utilized in the highlands; work at Vainu'u may also help further evaluate two mutually exclusive models of cultural development proposed for Tutuila Island.

Chronological Placement of Vainu'u

The primary focus of this project was to develop a clear chronology for Vainu'u. As discussed in the previous chapter, the discovery of Vainu'u and its highland ceramic assemblage provides Samoan archaeologists with a chronological conundrum. At the time of the site's discovery, the understanding of the ancestral Samoan cultural sequence had pottery production occurring 3100-1700 BP, *prior* to occupation of the highlands (Davidson 1979); previously discovered ceramic-bearing sites have been located along the coast or in the foothills. The discovery of Vainu'u requires at least one of two possible changes in the cultural timeline. Either pottery was produced longer than suspected, as suggested by Clark and colleagues (1997); or the highlands were occupied earlier than originally believed (Pearl 2004). If preliminary ceramic and lithic studies are a good indicator, further excavation at Vainu'u has the potential of providing important data for understanding the Samoan cultural sequence as well as important insights into production organization. Chronological placement of Vainu'u in the Samoan cultural sequence, then, was the first research priority.

Prehistoric Polynesian sites have limited means by which to be dated. Two procedures commonly used in Samoan artifact dating include: 1) cross-dating, which is the establishment of a date at one site based upon the appearance of a particular artifact class or type at that site that has been well-dated at other sites; and 2) radiocarbon dating, in which organic material in association with artifacts or features is dated. Of these two methods, the latter is preferred in this study.

The only two artifacts classes that can be cross-dated in Samoa, adzes and pottery, have problems when considered in light of Vainu'u. The adze typology is problematic in that it was not designed as a dating method, and although specific adze types have a tendency to date to specific time periods, overall the Samoan adze typology in and of itself has failed as a dating technique. Pottery recovered from sites on Tutuila is even more problematic to use for cross-dating, in that the cessation of pottery production on the island is currently under debate, with some researchers arguing for production ceasing as early as 1700 B.P. (Davidson 1979), while others have argued for a date as late as 400 B.P. (Clark et al. 1997). Considering the issues surrounding the chronologies for both adzes and pottery on Tutuila, it was decided at the onset of this project that radiocarbon dating would be the best means to establish the timeline for Vainu'u.

Materials for radiocarbon dating are susceptible to geomorphologic and physical contamination, at times causing an incorrect association of items of material culture to calendar age (Bowman 1990). Due to contamination issues during and after deposition, as well as during archaeological recovery, careful sample selection controlled for these factors.

Only through an understanding and identification of the geomorphic forces active upon a site is it possible to critically assess the integrity of a stratigraphic profile. Vainu'u is located within a modern agricultural field, and so it can be assumed that the first 30-50 cm of the site has been repeatedly disturbed (Custer 1992), probably containing a mix of older and younger organic remains. With this in mind, samples were selected from below 40 cm. Further, we attempted to collect datable carbon samples that were in strong association with either cultural materials or geological layers.

Another problem with radiocarbon dating arises from using material recovered at Vainu'u as part of Eckert's broader research project attempting to develop a technique to date soot on Samoan pottery. In theory, soot provides an average date range for the different fuels that was used in forming the soot. However, radiocarbon dates from soot removed from pottery can be impacted by a carbon core and/or the presence of shell temper. Ceramic samples, therefore, were carefully selected to avoid the presence of these two potential contaminants.

Spatial and Functional Patterning

A second research goal at Vainu'u was to identify features that would help us interpret how the occupants of Vainu'u were using the site over space and time. Using ethnographic documentation and previous archaeological research on Tutuila, we developed an analytical model of features that we could potentially encounter during our excavations. The presence of such features, and their spatial and temporal relationships, would then help guide our interpretations.

1. Although house structures, or *fale*, rarely survive in Samoa, house platforms with associated postholes are often identifiable. House platforms can vary in height, but were commonly very low (Green 1974b) in prehistory and the early historic period. House platforms may be square or oval; they may consist of either a ring of curbstones with dirt fill or a complete stone pavement; postholes may be located only along the outer ring of stones or may also have a central placement; *ili'ili* may or may not be present. If excavations at Sasoa'a in Western Samoa are indicative, residential areas might be as small as 25 m^2 (Green 1974b). However, based on ethnographic comparisons, a complete residential area could encompass as much as 300 m^2 (Hiroa 1930).

2. Prepared surfaces, known as *ili'ili*, were made by leveling a house floor, platform surface, or terrace area and then covering it with a variety of available terrestrial or marine materials (Hiroa 1930: 68). Along coastal sites coral, water worn stones, shell, basalt gravel, or a combination of these materials were used to create *ili'ili*. At some inland sites, only basalt gravel or water worn stones were used. Although it is unclear how far back in time the use of *ili'ili* dates in Samoa, the later occupations of at least 4 prehistoric sites in Western Samoa show clear evidence of *ili'ili* (Davidson 1974: 156), while a possible *ili'ili* surface was identified at Aganoa with an associated date of ca. 2000 years ago (Eckert et al. 2008).

3. An *umu* is an above-ground stone oven used in traditional Samoan cooking (Hiroa 1930). Heat-treated stones (usually basalt cobbles) are heated in a fire, often using coconut charcoal as fuel. When the fire has burned down but the stones are still hot, traditional foods are placed on and around the stones and covered with banana and/or taro leaves (Krämer 1995). Modern *umu* building is done outside of residential areas, but the *umu* is often sheltered by a small ramada, called a *fale umu* (Hiroa 1930: 13), to protect it from rain. When the cooking is finished, the stones are unstacked as the food is removed, and often left in the immediate area of the *fale umu* for reuse in a future *umu*. As stones crack or weather through repeated firing, they are replaced with new heat-tested stones.

4. A *lua'I masi* or *masi* pit was a food production technology throughout historic Samoa used for the preservation and concealment of fermented breadfruit paste (Cox 1980). Although the pit that Cox (1980) witnessed being built during his fieldwork was approximately 1 meter in both depth and diameter, he notes that the size of any given pit is entirely based upon the amount of breadfruit to be preserved (1980: 182). Cox further notes that once the pit that he was observing was built

and filled, a layer of rocks and soil were placed on top to seal it.

5. Prehistoric Samoan burials appear to have been primarily in shallow graves on or near houses. Davidson (1974:158) argues that this practice probably extends far back into prehistory, and did not change to the historic practice of burial mounds until the missionary period. Hiroa (1930:322) noted that ethnographic Samoan "cairns of unworked stone were raised over the graves of the dead. Some of these erected over children and people of lesser importance are merely rectangular patches of larger stones loosely laid on the ground near the houses. . . . .for higher chiefs, the cairn is built up in loose rectangular piles that may be stepped".

6. Late in Samoan prehistory, fortifications (Davidson 1979) in the form of transverse trenches across ridges or other defensive earthworks constructed of either basalt boulders or soil were built. The construction of these features has been attributed to an increase in intra- and inter-island warfare during a period of increased chiefly competition and intensified food production. Probably the most famous example of fortifications on Tutuila is at Tataga-matau, a basalt quarry that appears to have been the focus of intense and specialized production of adzes for exchange throughout the South Pacific (Leach and Witter 1987, 1990).

7. Star mounds, *tia ave* or *tia seu lupe*, are late prehistoric period mounds usually built on ridges and composed either entirely of stone or of earthen fill with a stone facing (Herdrich 1991; Hiroa 1930). These mounds can be 1-14 courses tall, and have numerous projecting arms that average approximately 3 meters in length and width. These rayed earthen platforms were most likely built for the chiefly privilege of pigeon hunting; these structures, therefore, reflect the increased chiefly competition that appears to have developed late in Samoan prehistory.

As discussed in Chapter 2, the only feature identified during the 2006 test excavations of Vainu'u was a possible *masi* pit. It was hoped that clearing the surface of vegetation, systematic mapping, and careful excavation would expose more features that would help determine how occupants were using this site over space and time.

Adaptive Strategies, Economic Pursuits and Production Organization

As preliminary analysis of material from Vainu'u has not provided a clear temporal setting for the occupants of Vainu'u, the site could have been used as part of a variety of adaptive strategies or economic pursuits over time. A combination of feature and artifact analyses will be used to evaluate at least three lines of inquiry.

1. At any time in the Samoan cultural chronology, occupation of highland sites may have been permanent or periodic, residential or special use areas. Material culture from Vainu'u will be considered in light of these possibilities. If the site witnessed lengthy occupations by a relatively sedentary population, such an occupation should be reflected in the presence of house platforms as well as a variety of features such as postholes and *umus*, a broad suite of lithic and ceramic categories suggesting a wide range of residential activities, and potential evidence for the presence of lithic and ceramic material from other regions of the island. Periodic occupation, or shorter-term visitation for specific activities at Vainu'u

should be reflected in a much narrower range of features and material culture than if the site were a permanent residence. However, the characteristics of material correlates at special use sites are dependent upon the activities that occurred at the location as well as the frequency of site visitation and occupation duration. For example, if Vainu'u was only used for agricultural activities, a narrow range of features, ceramic artifacts, stone tools and debitage associated with planting and harvesting would be expected; however, if Vainu'u was only used for chiefly prestige building activities, an entirely different range of features and tools would be expected.

2. A number of economic pursuits could have taken place at Vainu'u over space or time. These pursuits can be separated into three broad categories: 1) subsistence-related activities such as farming, gathering, hunting or food production; 2) resource procurement such as tree-felling or stone material collection; and 3) craft production activities such as basket making, lithic tool production, or ceramic production. Evidence for some of these activities, such as cooking or stone tool production, may be found in the artifacts and features recovered at the site; however, evidence for other activities, such as basket making or tree-felling, may not be highly visible in the archaeological record and will require luck of preservation as well as more speculative interpretation from the material record.

3. By European contact, Samoan culture had developed a diversity of organizational forms to deal with their production requirements. Samoans recognized experts (whom ethnographers have labeled specialists) in canoe and house building, stone masonry, net making, tattooing, wood carving, feathered cloak production, and *kapa* making (Stair 1897). Some producers were organized into guilds, while others produced on the household level (Hiroa 1930; Kaeppler 1978; Krämer 1995; Mead 1930; Sahlins 1958; Turner 1884). There is record that some specialists were attached to a specific chief, however most specialization was not a full time task (Hiroa 1930; Mead 1930). This organizationally diverse array of craft production and circulation reflects the moment in time when ethnographers began to record such economic matters. However, it is only one moment in a cycle that began over 2000 years earlier with the settlement of the Samoan islands by the Lapita cultural complex. While it has been assumed that the Lapita colonists had craft specialists among them (Marshall 1985), and Samoans had various craft specialists at European contact (Kaeppler 1978), the nature of craft production for the 2000+ years of ancestral Samoan society remains largely unknown.

Ancestral Polynesians?

A final research issue to be considered with data from Vainu'u concerns the concept of Ancestral Polynesians in Samoa. Currently, there are two mutually exclusive models for the presence of an Ancestral Polynesian Society on Tutuila Island: the "cultural continuity" model, and the "cultural hiatus" model.

The first model, which can be considered the "consensus" or "cultural continuity" model, is based primarily on linguistic data combined with recognized changes in artifact assemblages. This model posits that the earliest potters on Tutuila were part of the Austronesian-speaking Eastern Lapita Cultural Complex.

By 2500 B.P., a cultural metamorphosis occurred in which a proto-Polynesian speaking people emerged. This linguistic shift is argued to be accompanied by the loss of decorated pottery and to reflect the formation of an Ancestral Polynesian Society in Western Polynesia (Kirch and Green 2001). The model illustrating continual cultural transformation allows for a hiatus in eastern expansion often referred to as “the long pause” (Kirch 2000: 232-233; Smith 2002) and suggests that initial entrance into Eastern Polynesia was by at least 1400 BP (Sheppard and Green 1991). This span of relative sedentism in the Polynesian Homeland of Samoa allowed ample time for the formation of the Ancestral Polynesian Society. Ceramic manufacture ceased as the island populations became increasingly sedentary and gradually moved towards a monument-building, complex chiefdom society, which becomes archaeologically distinct from previous assemblages by ca. 1,000 B.P. (Kirch 2000; Smith 2002; Kirch and Green 2001; Green and Davidson 1974). While distinct social and cultural shifts occurred, the “cultural continuity” model regards occupation as constant across the Samoan Archipelago; witnessing a gradual loss of pottery, volcanic glass use and plano-convex adze forms as society transitioned from Late Eastern Lapita to Ancestral Polynesians whom, through social evolution, became the distinctive aceramic Polynesian inhabitants.

The second model, the “cultural hiatus” model, is gleaned from recent research by Anita Smith (2002) and posits that the ceramic and aceramic periods reflect two different cultural groups inhabiting the island at different times. Smith suggests that there are no material correlates for the formation of an Ancestral Polynesian Society in Samoa at the proposed date of 2500 B.P. Additionally, Smith states that the ceramic producing inhabitants of Samoa were not at all ancestral to the monument-building society. She argues that the distinctive Samoan culture encountered at European contact became archaeologically apparent in combination with renewed voyaging attempts and the resultant interaction with the island archipelagoes of Eastern Polynesia. The “cultural hiatus” model, then, views the cessation of pottery production as the result of two temporally disparate occupations by two separate peoples.

Archaeological signatures of post-ceramic occupation are sparse on Tutuila Island between 1700 B.P. and 1000 B.P., a 700 year period commonly referred to as the “Dark Age” (Davidson 1979: 94-95). Understanding the nature of settlement on Tutuila Island during this period is critical to evaluating any models of cultural development for the island. Although we do not expect excavations at Vainu’u to solve the issue of whether or not Ancestral Polynesian Society was present on Tutuila, it is our intention that careful excavation of Vainu’u with numerous and well-provenienced radiocarbon dates will add to the growing database that will help resolve this issue.

Research Methods

Fieldwork was conduction during November 2007; Dr. Suzanne L. Eckert of Texas A&M University served as field supervisor; Daniel Welch, Andrew Roberts, and Megan Hawkins (all graduate students at TAMU) served as the field crew. Fieldwork was designed to recover data necessary to address the research issues outlined above. Vainu’u was mapped and manually excavated, and cultural material was recovered and analyzed using a variety of techniques. Data from both the site surface and excavated units were collected. The original scope of work during the 2007 field season called for 20 square meters to be excavated. Due to time constraints, depth of deposits, and weather conditions, the total area covered was reduced to 19 square feet with a volume of ca. 15 cubic meters. During the 2007 field season, five stone features were encountered which are described in the next chapter. Enough organic material was recovered for ten radiocarbon dates; the geoarchaeology and cultural chronology of the site are detailed in Chapter 4. Lithic and ceramic debitage made up the majority of recovered cultural material; analyses of these artifacts are discussed in Chapters 5 and 6.

Mapping

An initial pedestrian survey over the ridge top where Vainu'u is located resulted in the discovery of artifact concentrations, primarily in taro fields (Figure 2.1). To increase surface visibility prior to mapping or laying out excavation units, much of the non-agricultural surface vegetation along the ridge had to be manually stripped using machetes. A map of Vainu'u was completed that illustrates the position of each feature and excavation unit from both the 2006 and 2007 field seasons. This map was drawn with reference to a site datum, which was the primary reference point for both vertical and horizontal controls. The master map was drawn using the compass-and-tape method, and site datum elevation was determined by taking the average of 100 GPS elevations recorded for the datum over the course of the 2007 field season.

Excavation Methods

Excavations at Vainu'u used a variation of the locus-unit-level system of recording. The information refers all excavation to a master map of the site. The idea of the locus-unit-level system is to have a system wherein the labels assigned to the excavated volumes and artifacts are meaningful, rather than arbitrary (as is the case with the grid system), to the maximum extent possible. The locus-unit-level system seems most advantageous in contexts in which there is some surface visibility of artifact concentrations, house platforms, or other features.

A locus is a horizontal designation and may refer to a cultural or arbitrary (horizontal) division of a site. At Vainu'u, loci were assigned based upon artifact concentrations or cultural features visible on the surface. Five loci were designated (A, B, C, D, and E) over the course of the field season. A unit refers to a horizontal designation of space *within* a locus; each unit within a locus was assigned a number consecutively starting with 1 (Unit A1 is unit 1 in locus A, while Unit B1 is unit 1 in locus B). A level refers to the vertical position of the portion of the locus that is being excavated. The surface was *always* designated level 0 and the first excavated level was 1. The numbers increased as excavation proceeded down. Levels may be of two types, arbitrary or natural. Arbitrary levels were dug in specified depths (such as 10 cm) without reference to the natural. Natural levels correspond to naturally occurring strata that were observable in the profile.

After clearing the surface of vegetation using machetes, 1x1 meter units were laid out using compass-and-tape, surface collections were made within the unit, and excavations proceeded using primarily hand picks and trowels. All excavated material was screened through ¼" mesh. A photographic record was maintained, including documentation of all excavated levels and features to supply multiple lines of information for later analysis. Each excavation level was recorded on a separate form, including a plan view drawing. Profiles were drawn for all units while plan views and profiles were drawn for all features. Excavation results are presented in Chapter 3.

Ceramic and Lithic Analyses

Major artifact categories are based on type of material and include: basalt debitage and tools, obsidian flakes, and ceramic sherds. These materials comprised the vast majority of cultural material recovered from Vainu'u. As such, the analyses of these specific artifact classes became the focus of this research and included basic laboratory procedures focused on functional and technological attributes, as well as more specialized geochemical and chronometric dating studies. All analyses were designed to address the research issues outlined above. Although details of specific analyses are presented in Chapters 5 and 6, a broad overview of factors driving analyses of both ceramic and lithic material is presented here.

The primary focus of both the ceramic and lithic analyses was to identify: 1) when a artifacts were produced, 2) how tools, utilized flakes, and ceramic vessels were used, and 3) the geographic origin of items. The dates of production of artifacts were used to help provide a range of dates for the occupation of the site. As discussed above, cross-dating was determined to be a useless dating method at Vainu'u. Both ceramic and lithic artifacts were dated through their association with carbon material that was then radiocarbon dated. Further, three ceramic sherds were dated through radiocarbon dating of either the sooted material on the exterior of these sherds, or the food residue on the interior. How specific artifacts were used was determined primarily through selecting attributes related to function and production technology. Functional analyses were used to determine the range and intensity of activities performed at Vainu'u over space and time.

Finally, the geographic origin of artifacts was determined through geochemical and petrographic analyses. In some cases, these analyses could define the probable number of sources, but not determine the specific location of a source. Further, these analyses were able to address only on-island procurement

Figure 2.1. Facing west from Locus C at Vainu'u, showing taro field in foreground and thick vegetation in background

practices. Provenance studies were used to determine the extent that items from other portions of the island were moving into Vainu'u through a range of possible economic activities.

Summary

Nomination of Vainu'u to the National Register of Historic Places required far better chronological control than was obtained through the 2006 test excavations. Testing did indicate that important data relating to the ceramic period occupation of the island could be recovered from the site, including charcoal for radiocarbon dating. An excavation program was therefore planned and carried out.

Excavation methods and artifact analyses were structured to address four research issues relating to the site's chronology, spatial and functional patterning, adaptive strategies and economic pursuits of its occupants, and the concept of an Ancestral Polynesian Society on Tutuila Island. Five stone features, radiocarbon dated material, and excavated lithic and ceramic materials are used to address these issues in the following chapters.

CHAPTER 3

FINDINGS:

EXCAVATION SUMMARIES AND FEATURE DESCRIPTIONS

The 2007 archaeological investigations at Vainu'u resulted in the excavation of 19 1x1 meter units. Six cultural features were identified including two probable house foundations, one probable burial, two ovens, and postholes. This chapter summarizes the excavation units in terms of cultural material and features, while the next chapter provides descriptions of the natural layers and radiocarbon chronology at the site.

Locus and Unit Summaries

Locus A

Locus A (Figure 3.1) was located in a recently cleared agricultural field along the southeastern portion of the ridge (Figure 3.2) on which Vainu'u is located. This location was chosen for excavation due to a relatively high surface concentration of ceramic artifacts. So as to cover the entire artifact concentration, as well as understand the geological strata along this portion of the

Figure 3.1. Overview of Locus A, facing north from Unit A4. From back to front: Daniel Welch in Unit A1, Andrew Roberts in Unit A2, Megan Hawkins in Unit A3

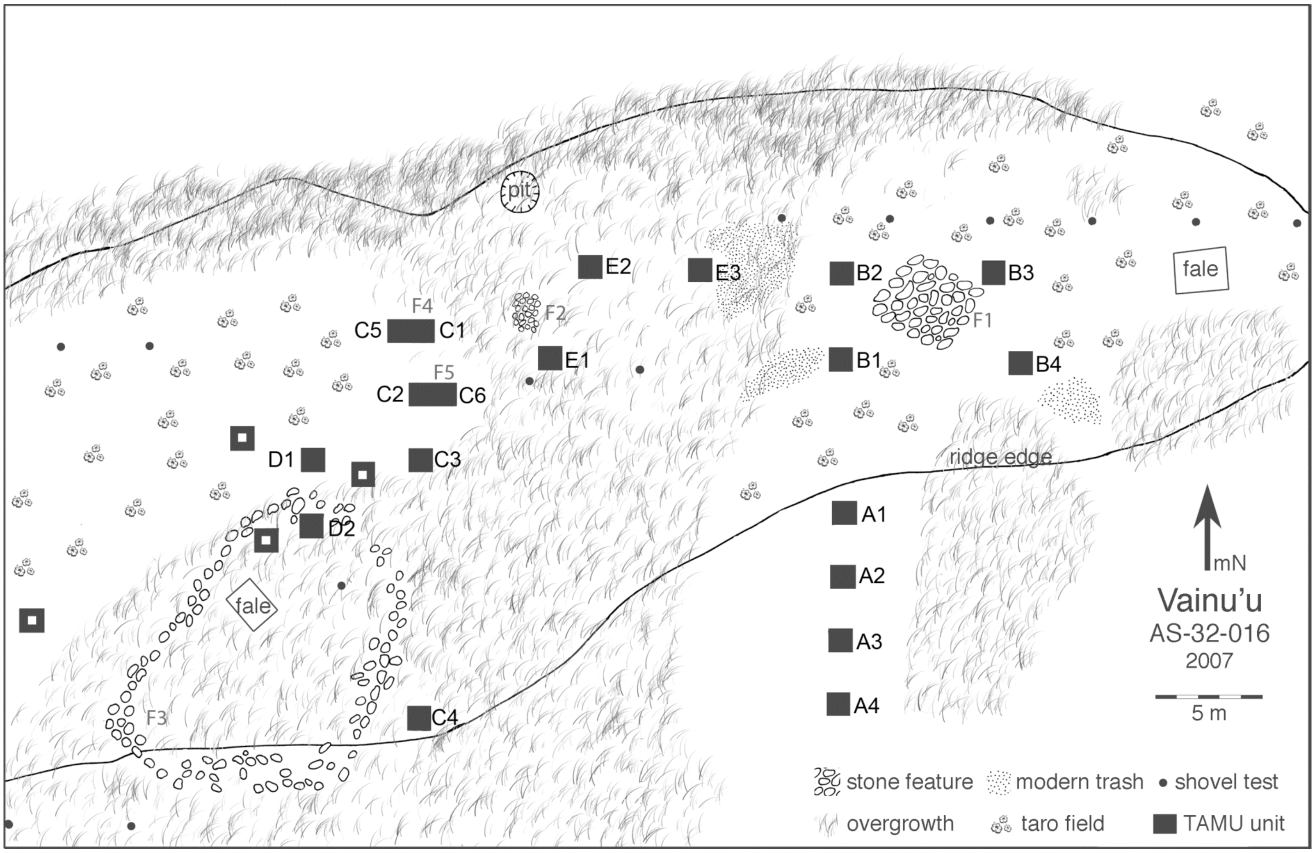

Figure 3.2. Vainu'u showing location of 2007 excavation units and cultural features

ridge, four units (Units A1, A2, A3, A4) were placed in a north-south line down the slope of the field (Figure 3.2).

Unit A1: The most northern unit in Locus A, Unit A1 was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 62 centimeters below surface (cmbs) (1260.93 feet above mean sea level [ft AMSL]) in the northern portion of the unit. Layers II, III, IV, V, and O, as described in Chapter 4, were identified in this unit. During excavation of Level 3, at approximately 21-26 cmbs (1262.26-1262.07 ft AMSL), a solid mass of welded cinder (Layer IV, see Chapter 4) was encountered in the southern portion of the unit and could no longer be excavated (see Chapter 4). This unit had a very low artifact concentration (< 10 artifacts). Although darker areas of soil were noted throughout excavation of this unit, no patterns emerged to identify these "stains" as cultural. Unit A1 contained no features.

Unit A2: This unit was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 57 cmbs (1260.13 ft AMSL). Layers II, III, V, and O were identified in this unit. This unit had a low artifact concentration (11-50 artifacts) including historic material in the first 10 cmbs, prehistoric pottery, basalt flakes, and volcanic glass; highest density of prehistoric material was recovered in Levels 2 and 3. Unit A2 contained no stains or features.

Unit A3: This unit was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 41 cmbs (1259.64 ft AMSL). Layers II, III, V, and O were identified. This unit had a very low artifact concentration (< 10 artifacts) of volcanic glass and pottery. In Level 2, a dark brown stain was identified as the probable remains a tree root; Unit A3 contained no features.

Unit A4: This unit was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 46 cmbs (1258.46 ft AMSL) Layers II, III, V, and O were identified in this unit. No artifacts were recovered from Unit A4 and no stains nor features were identified (in the words of the excavator "nothing, just nothing").

Locus B

Locus B (Figure 3.2) was located in such a way as to contain Feature 1 (described below) and a possible associated ceramic and lithic artifact scatter (Figure 3.3). Excavations in this locus were performed with the goals of determining 1) the extent and age of Feature 1 and 2) the depth of the artifact scatter. Four units (Units B1, B2, B3, and B4) were placed around Feature 1 so as to fulfill these two goals without destroying the feature.

Unit B1: Unit B1 was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 56 cmbs (1262.69 ft AMSL). Layers II, III, IV, V, and O, as described in Chapter 4, were identified. This unit had a low artifact concentration (10-50 artifacts) consisting almost entirely of ceramic sherds recovered at 21-29 cmbs (1263.84-1263.58 ft AMSL) and described as being below "a laminated volcanic layer". This layer corresponds to the welded cinder identified in Unit A1 (Layer IV, see Chapter 4). Although darker areas of soil and some unaligned cobbles were noted throughout excavation of this unit, no patterns emerged to identify these occurrences as the result cultural activity. Unit B1 contained no features.

Figure 3.3. Overview of Locus B. Suzanne Eckert standing on southwest corner of Feature 1

Unit B2: This unit was a 1x1 meter unit excavated in arbitrary levels to a depth of 91 cmbs (1261.84 ft AMSL) in the northeast quadrant of the unit. Levels 1-6 were 10 cm arbitrary levels that contained the entire 1x1 meter area of the unit; Level 7 was a 30 cm arbitrary level that excavated the northeast quadrant of the unit to ascertain that the volcanic gravels (Layer II in Chapter 4) did not cap another cultural component (Figure 3.4). Although Layers II, III, V, and O were identified in this unit, not enough area was excavated to provide a clear understanding of the depositional processes recorded in the profile. Although historic trash was noted on the surface, this unit had a very low artifact concentration (<10 artifacts), with only a few ceramic sherds being recovered. Unit B2 contained no stains or features.

Unit B3: This unit was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 81 cmbs (1261.48 ft AMSL). Layers II, III, IV, V, and O were identified. A high concentration of historic trash was noted in Level 1, and included soda pop tops, plastic, clear glass, nails, and bathroom tiles; basalt flakes were also collected from Level 1. Below Level 1, no historic artifacts were encountered and this unit had a low artifact concentration (10-50 artifacts) of prehistoric artifacts including pottery, basalt flakes and tools, and volcanic glass. Unit B3 contained no stains or features.

Unit B4: Unit B4 was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 61 cmbs (1261.84 ft AMSL). Layers II, III, V, and O were identified in this unit. A high concentration of historic glass was recorded in Levels 1 and 2; Below Level 1, a low artifact concentration (10-50 artifacts) of prehistoric artifacts including pottery, basalt flakes and volcanic glass was recovered. Unit B4 contained no stains or features.

Figure 3.4. Unit B2, Level 7 showing culturally sterile volcanic gravels

Locus C

Locus C (Figure 3.2) was located along the eastern edge of a taro field on top of the ridge on which Vainu'u is located (Figure 3.5); portions of the locus had to be cleared of grass and other vegetation. This location was chosen for excavation because it displayed the highest concentration of ceramic artifacts on the site. So as to cover the entire artifact concentration, as well as understand the geological strata along this portion of the ridge, four units (Units C1, C2, C3, C4) were placed in a north-south line across the ridge top. Unit C4 was also located along the eastern edge of Feature 3, and so recovered data could also be used to help evaluate the goals outlined below for Locus D. Units C5 and C6 were opened to expose more of Features 5 and 6 (described below).

Unit C1 and C5: Unit C1 was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 69 cmbs (1285.99 ft AMSL); Unit C5 was a 1x1 meter unit that extended west from Unit C1 and then excavated in 10 cm arbitrary levels to a depth of 65 cmbs (1286.01 ft AMSL). Layers II, III, V, and O, as described in Chapter 4, were identified in both units. A very low concentration of historic artifacts was noted in Level 2 of Unit C5; overall, a low artifact concentration (10-50 artifacts) of prehistoric artifacts including pottery, basalt flakes and volcanic glass was encountered, mostly in association with Feature 4 (described below). Feature 4, consisting of a rough oval of burned rocks and soil as well as a posthole, was first encountered at 22 cmbs (1287.42 ft AMSL) and continued to 45 cmbs (1286.18 ft AMSL). Charcoal samples for radiocarbon dating were collected from this feature (see Chapter 4).

Figure 3.5. Photo of Locus C at Vainu'u, facing northeast from fale

Unit C2 and C6: Unit C2 was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 59 cmbs (1286.65 ft AMSL); Unit C6 was a 1x1 meter unit that extended east from Unit C2 and then excavated in 10 cm arbitrary levels to a depth of 59 cmbs (1286.65 ft AMSL). Layers II, III, V, and O were identified in both units. A low artifact concentration (10-50 artifacts) of prehistoric artifacts -- including pottery, basalt flakes, basalt tools and volcanic glass -- was encountered, mostly in association with Feature 5 (described below). Feature 5, consisting of loosely stack burned rocks, was first encountered at 26 cmbs (1287.49 ft AMSL) and continued to 64 cmbs (1286.74 ft AMSL). Charcoal samples for radiocarbon dating were collected from this feature (see Chapter 4).

Unit C3: This unit was a 1x1 meter unit excavated in arbitrary levels to a depth of 148 cmbs (1283.81 ft AMSL). Levels 1-5 were 10 cm arbitrary levels; Level 6 was a 100 cm arbitrary level that was excavated into the sterile strata to ascertain that these volcanic gravels (Layer I in Chapter 4) did not cap another cultural component (Figure 3.6). Layers I, II, III, V, and O were identified in this unit. A low artifact concentration (10-50 artifacts) of prehistoric artifacts -- including pottery and basalt flakes -- was collected in the first four levels. Charcoal samples for radiocarbon dating were collected from this feature (see Chapter 4). No stains or features were recorded in this unit.

Unit C4: Unit C4 was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 57 cmbs (1285.02 ft AMSL). Layers II, III, V, and O, as described in Chapter 4, were identified in this unit. A low artifact concentration (10-50 artifacts) of prehistoric artifacts including pottery and basalt flakes was encountered throughout the first five

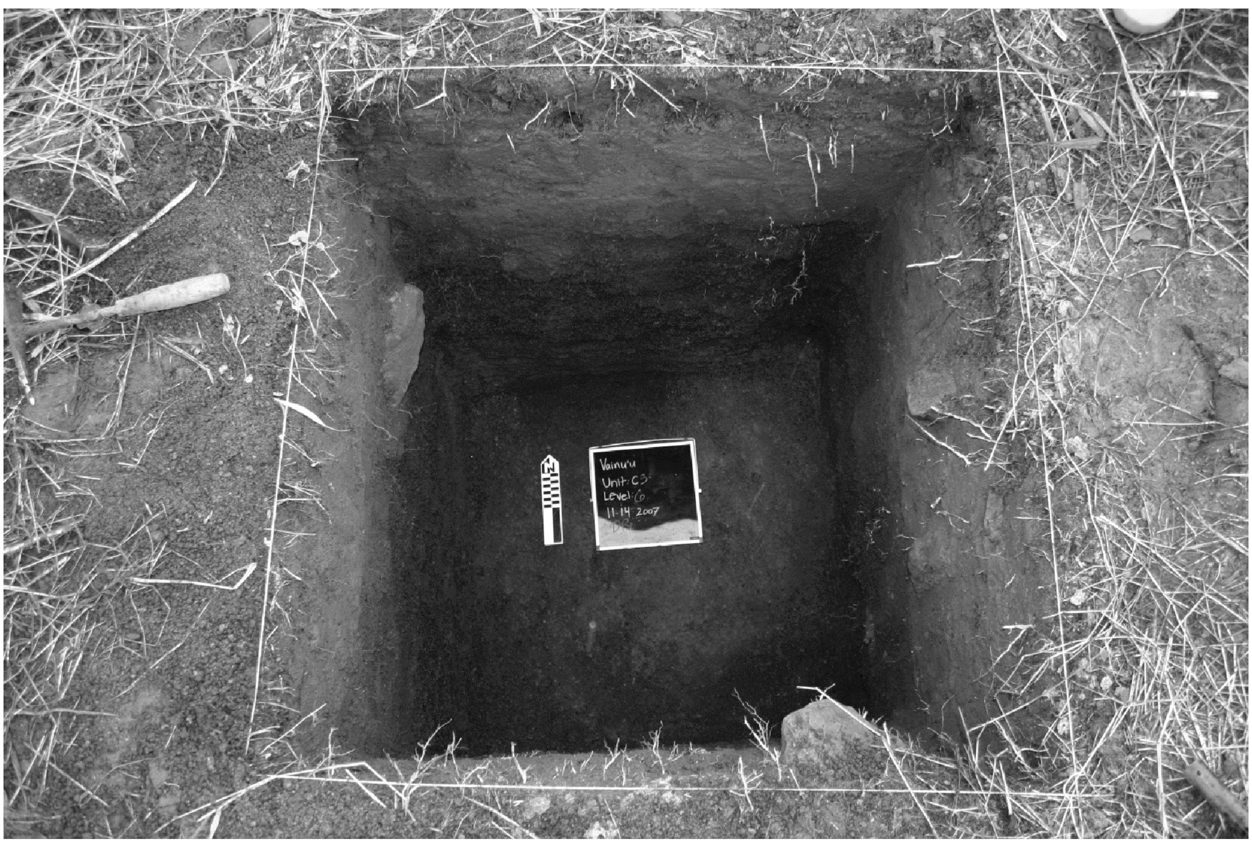

Figure 3.6. Unit C3, Level 6 showing culturally sterile volcanic gravels

levels. In the southwest corner of the unit, a possible thermal feature, consisting of 5 burned rocks and light charcoal staining, was first encountered at 30 cmbs and continued to 39 cmbs (1285.92-1285.62 ft AMSL). No charcoal samples were recoverable for dating. The nature of this possible feature remains unclear, as time did not permit extending excavations into adjoining units.

Locus D

Locus D (Figure 3.2) was located along the northern edge of Feature 3 (described below), a partially buried stone feature associated with a surface lithic scatter (Figure 3.7). Excavations in this locus were performed with the goals of 1) determining the depth and age of the stone feature and 2) determining the depth and nature of the lithic scatter. Unfortunately, time permitted only two units (Units D1 and D2) to be excavated in an attempt to fulfill these goals; however, data from Unit C4 will also be considered when interpreting this feature.

Unit D1: This unit was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 52 cmbs (1286.81 ft AMSL). Layers II, III, V, and O, as described in Chapter 4, were identified. This unit had a very low artifact concentration (<10 artifacts) of lithic flakes and pottery; however, a high concentration of fire-reddened rock was noted in Level 1 and light charcoal flecking was noted throughout Levels 2, 3, and 4. No charcoal was recoverable for radiocarbon dating. Unit D1 contained no stains or features.

Figure 3.7. Locus D at Vainu'u, facing northwest from Unit C4; Suzanne Eckert in fale *at left, Megan Hawkins at right*

Unit D2: Unit D2 was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 59 cmbs (1223.31 ft AMSL). Layers II, III, V, and O were identified in this unit. A low artifact concentration (10-50 artifacts) of prehistoric artifacts -- including mostly basalt flakes and tool fragments -- was encountered throughout the first 5 levels. In Levels 3-5, five circular stains of similar diameter were recorded (Feature 6); these stains were interpreted as postholes associated with Feature 3. A charcoal sample for radiocarbon dating was collected from Level 5 in association with these postholes in an attempt to date Features 3 and 6 (see Chapter 4).

Locus E

Locus E (Figure 3.2) was located along the central portion of the ridge. A relatively high density of pottery was observed on the surface during the clearing of high grass and vegetation around Feature 2. This location was chosen for excavation due to this artifact scatter, not as a means to better interpret Feature 2 (see below). Three units (Units E1, E2, and E3) were placed within the loci in an attempt to sample across the entire artifact concentration.

Unit E1: Unit E1 was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 52 cmbs (1306.5 ft AMSL). Layer II, as described in Chapter 4, was identifiable in this unit, but evidence of other layers is absent due to probable heavy cultural disturbance. Historic artifacts, mostly clear glass but also nails, were observed in Levels 1-4 of the unit; a low artifact concentration (10-50 artifacts) of prehistoric artifacts -- including pottery, basalt flakes and volcanic glass -- was encountered throughout the first four levels as well. In the northeast corner of the unit, a dark gray stain was observed at 40 cmbs

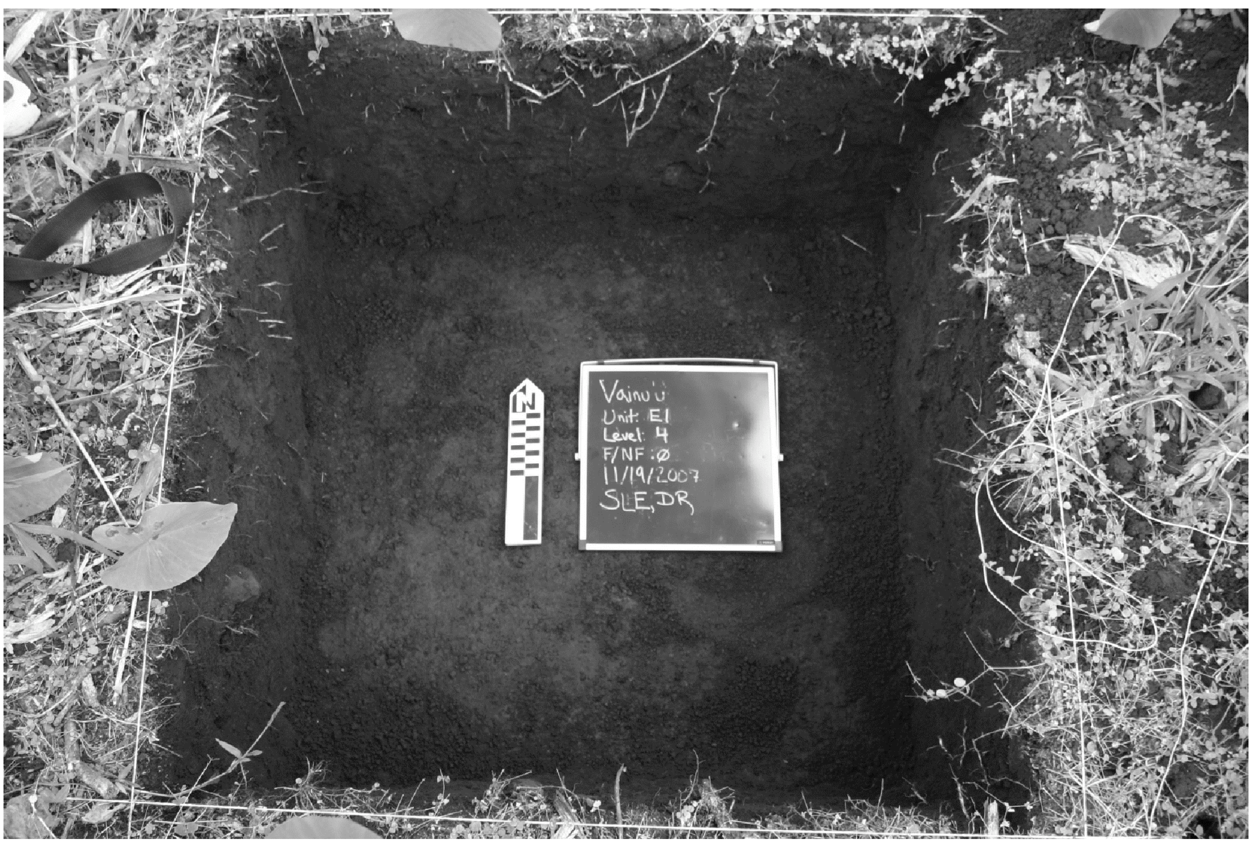

Figure 3.8. Unit E1, Level 4. Note dark stain in northeast corner

but the nature of this stain remains unclear (Figure 3.8). No charcoal samples were recoverable for dating. Unit E1 contained no features.

Unit E2: Unit E2 was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 60 cmbs (1305.53 ft AMSL). Layer II was identifiable in this unit, but evidence of other layers is absent due to probable heavy cultural disturbance. Historic artifacts, mostly clear glass and plastic but also nails, were observed in the first three levels of the unit; a low artifact concentration (10-50 artifacts) of prehistoric artifacts -- including pottery, basalt flakes and volcanic glass -- was also recovered throughout the first three levels. Although soil was mottled throughout the first five levels, Unit E2 had no clearly defined stains or features.

Unit E3: This unit was a 1x1 meter unit excavated in 10 cm arbitrary levels to a depth of 49 cmbs (1305.59 ft AMSL). Layer II was identifiable in this unit, but evidence of other layers is absent due to probable heavy cultural disturbance. Historic artifacts, including clear glass and plastic, were observed in the first two levels of the unit; a low artifact concentration (10-50 artifacts) of prehistoric artifacts -- including pottery, basalt flakes and volcanic glass -- was encountered throughout the first three levels of excavation. Soil was very homogenous throughout excavation; no stains or features were observed.

Feature Descriptions

Feature 1

Feature 1, the most eastern feature, is a rectangular placement of large (up to 1 meter in length) naturally-rounded basalt boulders laid out to create a flat surface (Figure 3.3 and 3.9). This feature is approximately 21 square meters (~4.25 x 5.00 meters) and aligned east-west along the ridge. Once cleared of vegetation, Feature 1 was highly visible, having suffered little in the way of disturbance either through erosion or soil deposition. Local villagers state that Feature 1 served as a house foundation and was built in the early 1970s; if so, modern surface trash found immediately to the northeast and southwest may be associated midden. Four excavation units (B1, B2, B3, and B4) placed around this feature revealed that the historic trash has a depth of approximately 20-30 cms. Historic artifacts identified included a range of residential items such as clear glass, nails, plastic, bathroom tiles, and soda pop tops; all items were consistent with this feature being a house foundation. Excavations also helped determine that Feature 1 is not partially buried; what is observable on the surface is the entire feature. There is no evidence that this house feature was built or used prior to the early 1970s date offered by local residents. Ceramic and lithic material recovered from 30-40 cms below surface suggests that the ceramic period component of is, in part, buried beneath Feature 1 but is not associated with it.

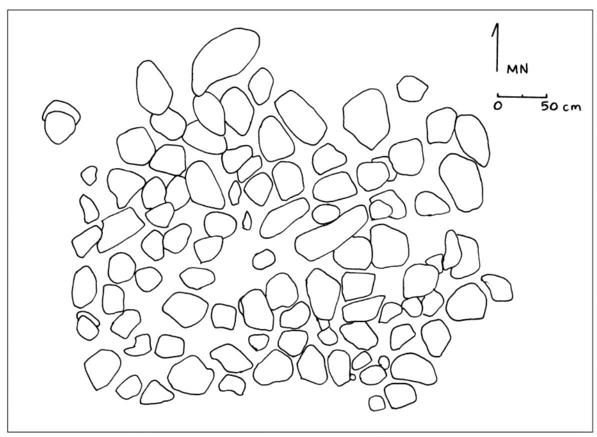

Figure 3.9. Drawing of Feature 1 (also see Figure 3.3 above)

Feature 2

Feature 2, located in the center of the site, is the smallest of the surface features (Figure 3.10). Aligned north-south, this feature is a low pile of moderate size basalt boulders. Its size (approximately 1.5 x 2 meters) and shape (rectangular)

Figure 3.10. Feature 2, a possible Historic Period burial

suggest that it is a historic grave, possibly associated with Feature 1, although local villagers did not identify it as such. Due to the suspected nature and age of Feature 2, no further investigations involving this feature were pursued.

Features 3 and 6

Feature 3 is the largest of the stone features identified at Vainu'u (Figures 3.11 and 3.12). Although visible on the surface, this feature has been partially buried through natural soil deposition (see Chapter 4). The extent of the feature was determined through clearing of vegetation, stone chasing and excavation (Units C4, D1, and D2). This approximately rectangular feature is aligned northeast-southwest along the ridge and is about 180 square meters in size (15 x 12 meters). The exact extent and shape of the southern edge is unknown as many of the stones in this area have begun to erode down the southern slope of the ridge. Feature 2's size, shape, and composition suggest that it served as a house platform. Data from the excavation units placed along the eastern (Unit C4) and northern (Units D1 and D2) portions of Feature 3 suggest that it stood only a single course of stones high. Fire-reddened rocks and charcoal flecking in the upper levels of Units C4 and D1 suggest the presence of ovens or other firing features in association with Feature 3; the five postholes (Feature 6) identified in Unit D2 are associated with this house platform. The vast majority of cultural material associated with Feature 3 is basalt debitage (see Chapter 5). A single piece of charcoal from Feature 6 radiocarbon dated to 650 ± 40 B.P. (conventional radiocarbon date, Beta

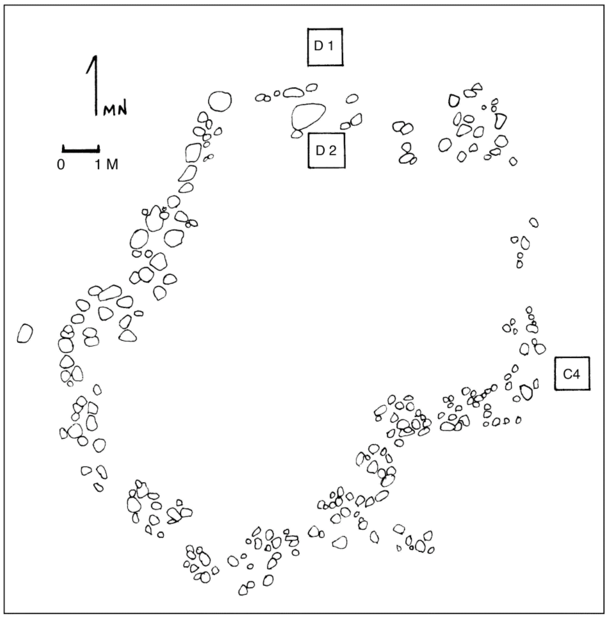

Figure 3.11. Drawing of Feature 3

Figure 3.12. A portion of the northern edge of Feature 3

#240798, see Chapter 4). This date, combined with the associated material culture, suggests that Features 3 and 6 were both part of a Monument Building Period house foundation.

Features 4 and 5

Features 4 and 5, located on average 41 cms below the surface in Locus C, are about 3 meters apart; however, the similarities in depth, associated artifacts, and radiocarbon dates suggest they are associated features and probably served similar functions. As such, they are discussed together. Feature 4, found in Units C1 and C5, is located 32-45 cmbs (1287.42-1286.18 ft AMSL); this roughly circular pile of stones measured approximately 90 cm in diameter (Figure 3.13).

Feature 5, found in Units C2 and C6, is located 26-64 cmbs (1287.49-1286.74 ft AMSL); this roughly oval pile of stones measured approximately 110 cm across at its widest. Additionally, the stones in Feature 5 appear to have been stacked or discarded near a post, as evidenced by their circular placement around a posthole (Figure 3.14 and 3.15). Stones making up both features were a bit larger than fist size, showed signs of heat stress (fired-reddened and occasionally cracked), and were surrounded by soot and ash; these characteristics are typical of an *umu*, or Samoan cooking oven.

Comparison of Features 4 and 5 with modern *umus* (Figures 3.16 and 3.17) show similarity in selection of stone size and feature shape. Although Features 4 and 5 are smaller in dimension, this may be due to the amount of food being prepared and not to function. Modern *umus* are normally covered by a *fale* to protect the ovens from rain; the posthole in Feature 4 may have been part of an analogous structure (also see Figure 3.18 background). Although we are not suggesting that direct ancestors of modern Samoans made Features 4 and 5, we are suggesting that this type of feature

Figure 3.13. Coming down on top of Feature 4

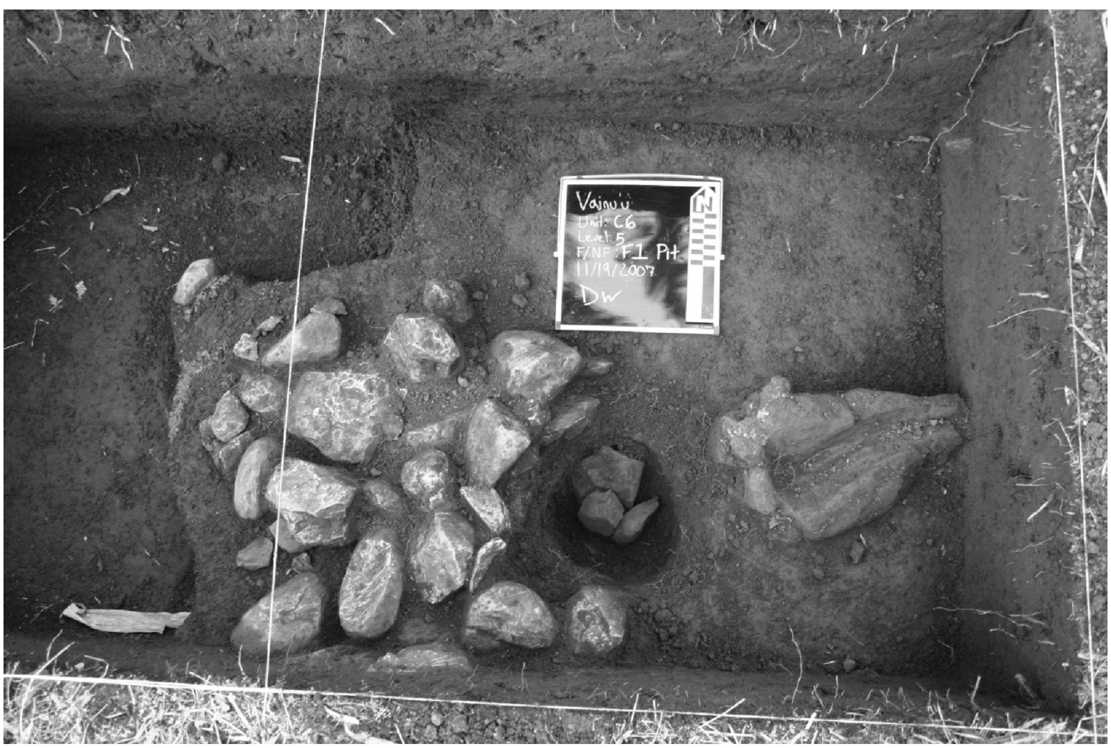

Figure 3.14. Feature 5 showing excavated posthole

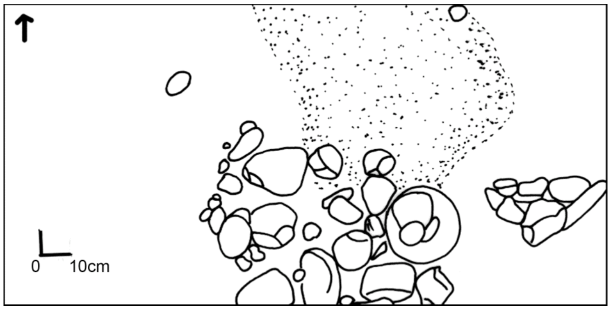

Figure 3.15 Drawing of Feature 5

has a long history in the South Pacific and was probably brought to the island by the earliest inhabitants. Artifacts associated with these two features include undecorated pottery sherds (see Chapter 6), volcanic glass (see Chapter 5), and basalt flakes and blades (see Chapter 5). Six radiocarbon dates associated with these features date them to approximately 2300-2400 years ago (see Chapter 4). Currently, Features 4 and 5 are the oldest highland cultural features recorded on Tutuila Island.

Figure 3.16. Modern umu *(photo by David Herdrich). Note size and shape of stones*

Figure 3.17. Modern umu *(photo by David Herdrich). Note stones stacked against farthest post*

Summary

The 2007 field season at Vainu'u resulted in the excavation of 19 units and the identification of six features. These features reflect various cultural activities over time at Vainu'u, including cooking during the earliest use of the site and residential occupation late in the prehistoric period. Analysis of cultural material associated with these features, described in Chapters 5 and 6, provide further data to interpret these features. In the final chapter of this report, these excavation results and feature descriptions, combined with radiocarbon dates and artifact analyses, are used to address the four research issues outlined in Chapter 2.

CHAPTER 4

FINDINGS:

SITE STRATIGRAPHY, GEOLOGICAL PROCESSES, AND CHRONOLOGY

The 2007 archaeological investigations at Vainu'u resulted in a maximum depth of 148 cmbs (1283.81 ft AMSL) (see Unit C3 in Chapter 3). Further, excavation units covered a maximum distance of 45 meters east-west across the ridge, and 20 meters north-south. These data, combined with ten radiocarbon samples dated from the 2007 season, are used in this chapter to reconstruct the site's natural stratigraphy and how this stratigraphy relates to cultural deposits across space and time.

Site Stratigraphy

Examination of unit profiles show that five stratigraphic layers are present across the site (Table 4.1), all of which originated as volcanic ejecta (Nakamura 1984:52). Layer O, the uppermost sediment, is composed of a thin organic Ap horizon (OL/OH) with an average depth of 5 cm (Figure 4.1). The thin organic stain of Layer 0 transitions into Layer V, a Bw horizon composed of dark brown lean clay (CL) that ranges in thickness from 10 to 25 cm across the site. Both Layer O and V are laterally continuous (Figures 4.2) and formed as the most recent volcanic event deposited a layer of ash upon Layer IV.

Layer IV is discontinuous across the site (Figures 4.2) and is composed of welded ash (Cm) approximately 3 to 5 cm thick. The siliceous material is physically root-restrictive where intact and must be broken with a hand pick when fully intact. Inspection of portions of the welded ash yielded casts of deciduous foliage trapped within several of the laminated clasts. This finding points toward some level of landscape stability prior to the addition of Layer IV. The superheated blanket of ash that created Layer IV, most likely the result of pyroclastic flow, would have destroyed the natural environment upon deposition. The once active cultural surface of Layer III below the welded ash would have been rendered devoid of any living foliage for some time.

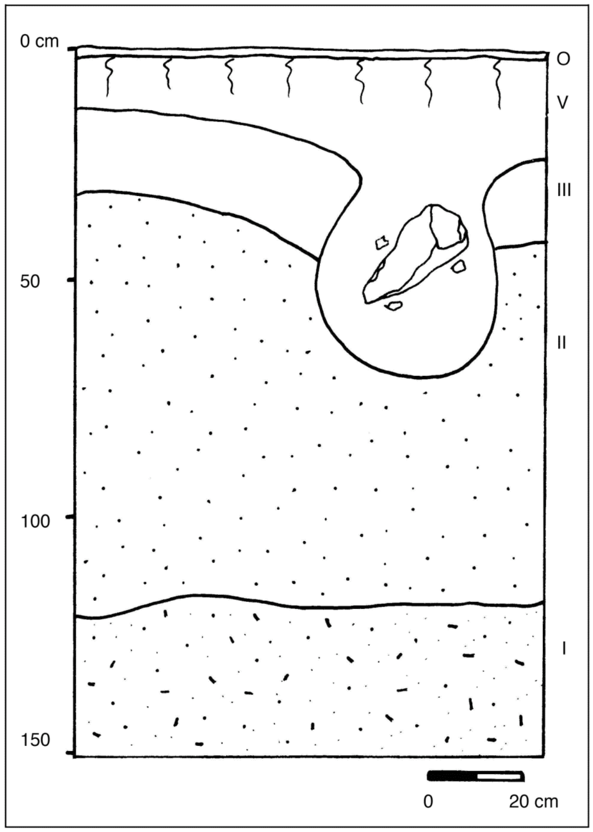

Figure 4.1. Unit C3 west wall profile

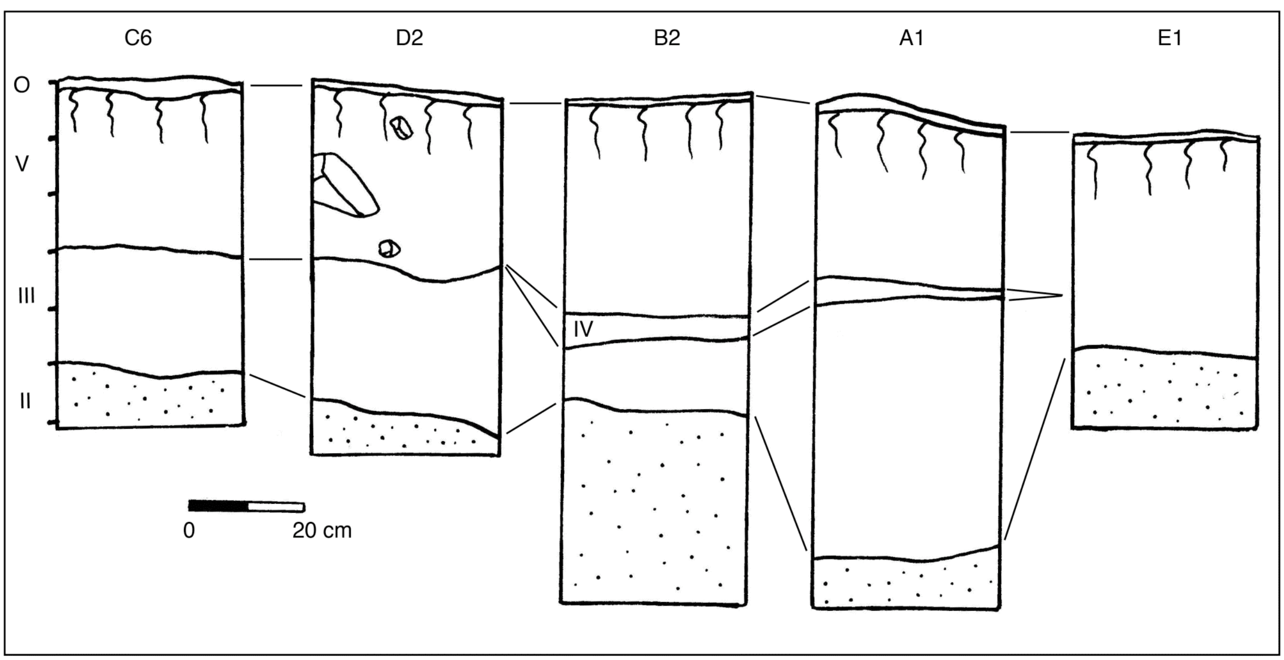

Figure 4.2. Stratigraphic cross correlations showing presence and absence of Layer IV

Layer III is composed of fat clay with gravels (CH). The layer ranges from 10 to 45 cm in thickness. This stratigraphic unit is also the product of weathered volcanic ash that exhibits variable thickness yet is distinct and continuous across the site (Figure 4.2). The surface of Layer III is a buried cultural horizon associated with Plain Ware Period activity (Figure 4.3). Soil formation is weak (2BC), yet the stratigraphic profile illustrates that landscape stability was constant long enough for a small degree of clay translocation within the layer before burial by Layers IV and V. Due to the fact that the welded ash of Layer IV is not continuous, Layer V often rests directly above Layer III (Figure 4.1), creating a paraconformity in the stratigraphic record in certain areas of the site.

Layer II consists of dark reddish brown clayey gravels and is approximately 85 cm thick. The lower boundary of this stratigraphic layer was encountered only within the deepest unit (C3) at a depth of 120 cmbs (Figure 4.1). The volcanic gravels are angular, well sorted and exhibit siliceous, vesicular structure. This depositional unit is devoid of artifacts in primary context. Minimal artifacts do exist within the sediment unit, yet their location is the result of gradual downward movement beyond contact of the cultural horizon of Layer III above. Excavation often halted upon encountering this culturally sterile layer, yet excavation in Unit C3 continued past this layer to ascertain that a cultural layer did not lie beneath it.

Layer I is culturally sterile and made of angular well-graded gravels (GW) of volcanic origin. The lowest limit of this sediment package was not met, excavation halted at 35 cm depth within the layer. Small (<0.25 cm) particles of ash-derived clay are interspersed in very limited amounts within the grain-supported matrix of Layer I.

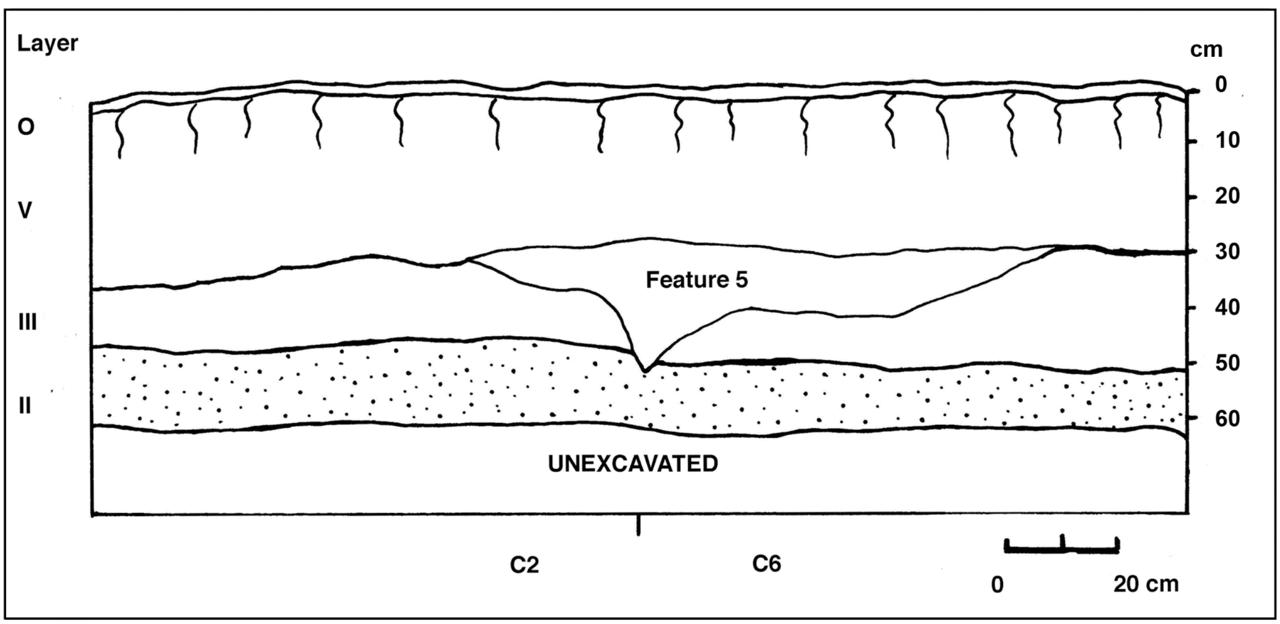

Figure 4.3. Unit C2 and C6 north wall profile. Note contact of Feature 5 on Layer III

Table 4.1. Summary of Stratigraphic Layers described for Vainu'u

Layer	Thickness	Texture	Color	Horizon	Associated Cultural Material
O	5 cm	Organic soil, small spheriodal granular ped structure (OL/OH)	7.5YR 2/0 Black	Ap	recent debris, lithic artifacts, features
V	10-25 cm	Andisol, lean clay (CL)	10YR 3/3 Dark Brown	Bw	recent debris, lithic artifacts, features
IV	3-5 cm	Discontinuous welded ash	5YR 3/3 Dark Reddish Brown	Cm	culturally sterile, no artifacts
III	10-45 cm	Fat clay with gravels (CH)	10 YR 3/4 Dark Yellowish Brown	2BC	ceramic artifacts, lithic artifacts, features
II	85 cm	Clayey gravels (GC)	5YR 3/2 Dark Reddish Brown	2C	culturally sterile, few artifacts
I	>35 cm	Well graded gravels (GW)	7.5YR 4/6 Strong Brown	3C	culturally sterile, no artifacts

Building a Chronology for Vainu'u

Seven charcoal samples and three ceramic samples were submitted to Beta Analytic Radiocarbon Dating Laboratory for dating (see Appendix A for Beta Laboratory data result sheets). All ten samples were pretreated through a series of acid/alkali/acid washes to eliminate carbonates, remove mechanical contaminants, and remove secondary organic material; each sample was then submitted to accelerator mass spectrometry (AMS) radiocarbon dating (Table 4.2).

Discussion of the Radiocarbon Dates

The ten radiocarbon dates collected from the 2007 field season suggest that Vainu'u was occupied during three of the prehistoric periods identified in Chapter 1: the Late Eastern Lapita Period (2700-2300 B.P.), the Plain Ware Period (2300-1700+ B.P.) and the Monument Building Period (1000 to 250 B.P). Although datable samples were not recovered from all layers, features, or units, enough dates were recovered to divide Vainu'u into two prehistoric components and to discuss specific features and layers associated with these components. These components will also be used in the next chapters to discuss changes through time in material culture.

Component 1: Component 1 dates to the Late Eastern Lapita Period/Plain Ware Period transition; seven radiocarbon samples (Beta #s 240791, 240792, 240793, 240795, 240796, 240797, 240800) comfortably date this component from 2270 to 2440 B.P. (C13 adjusted age). Stratigraphically, this component is associated with Layer III; culturally, this component is associated with Features 4 and 5. Feature 4 has three radiocarbon samples that, when combined, date from 2240 to 2300 B.P.; Feature 5 has four radiocarbon samples that, when combined, date from 2240 to 2440 B.P. This indicates that these features are contemporaneous, and may even be part of the same *umu*. The only *in situ* pottery and volcanic glass were recovered from Component 1 contexts.

Table 4.2. Summary of radiocarbon dating from 2007 excavations at Vainu'u. Data from Beta Analytic Radiocarbon Dating Laboratory (Hood 2008)

Beta#	Provenience	Material	C14 Age Years B.P.	C13:C12 Ratio	C13 Adjusted Age B.P.	1-sigma Calibrated Age B.P.	2-sigma Calibrated Age B.P.
240791	Unit B4 Level 4 Layer III	soot on sherd	2440 ± 40	-24.9 o/oo	2440 ± 40	2690-2640 2610-2590 2500-2360	2710-2350
240792	Unit C2 Level 4 Feature 4 Layer III	charcoal	2340 ± 40	-27.5 o/oo	2300 ± 40	2350-2320	2360-2300 2240-2180
240793	Unit C1 Level 5 Feature 5 Layer III	charcoal	2380 ± 40	-27.9 o/oo	2330 ± 40	2350-2340	2360-2320
240794	Unit C6 Level 4 Feature 4 Layer III	soot on sherd	1400 ± 40	-19.9 o/oo	1480 ± 40	1400-1330	1420-1300
240795	Unit C2 Level 5 Feature 4 Layer III	charcoal	2290 ± 40	-28.0 o/oo	2240 ± 40	2330-2300 2260-2160	2340-2150
240796	Unit C6 Level 4 Feature 4 Layer III	charcoal	2320 ± 40	-28.3 o/oo	2270 ± 40	2340-2310 2230-2200	2350-2290 2270-2160
240797	Unit C5 Level 5 Feature 5 Layer III	charcoal	2370 ± 40	-27.8 o/oo	2320 ± 40	2350-2330	2360-2310
240798	Unit D2 Level 5 Feature 6	charcoal	660 ± 40	-25.9 o/oo	650 ± 40	660-630 600-560	670-550
240799	Unit C5 Level 6 Feature 5 Layer III	charcoal	2280 ± 40	-27.3 o/oo	2240 ± 40	2330-2300 2260-2160	2340-2150
240800	Unit C5 Level 7 Feature 5 Layer III	soot on sherd	2440 ± 40	-25.3 o/oo	2440 ± 40	2690-2640 2610-2590 2500-2360	2710-2350

The Problem of Beta #240794: There is one sample recovered from Feature 4 that appears to be an outlier from the cluster of seven dates discussed above for Component 1. Beta #240794, soot residue taken from the exterior of a sherd, dates to 1480 ± 40 B.P. (C13 adjusted age). After checking to make sure this sherd was from a good context and had no obvious source of contamination, we contacted Ron Hatfield, Deputy Director and Quality Manager at Beta Analytic Inc. We asked him if there was some explanation from his laboratory notes that may help to explain this sample's more recent date when compared to other samples collected from the same Feature 4 context. Obvious contaminants (carbon core, shell temper, food residue) were ruled out. However, Hatfield noted that the "one odd thing I keep coming back too however is the very different C13/12 ratio of ca. -19 o/oo for Beta-240794 which yielded the odd date vs. the -24 to -25 o/oo of the others that yielded very reasonable and reproducible dates. The residue dated for this sherd is clearly different chemically than that of the others" (Hatfield, personal communication). Hatfield suggests that humic acids present in the sediments *may* have been a source of contaminants, but that is not at all clear from the analysis. Overall, then, until a satisfactory explanation can be provided for the chemical difference between Beta #240794 and the other samples from Feature 4, this sample remains an outlier and is currently not taken into consideration when creating the chronology for Vainu'u.

Component 2: Component 2 dates to the Monument Building Period; one radiocarbon sample (Beta #240798) dates this component to 650 ± 40 B.P. (C13 adjusted age). Stratigraphically, this component is associated with Layer V; culturally, this component is associated with a large rectangular house foundation (Feature 3) and associated postholes (Feature 6). The radiocarbon sample dating this component was obtained from Unit D2, which rests within the interior of the large basalt boulder house outline (Feature 3). The charred material came from within a posthole feature (Feature 6) encountered *in situ* during excavation. The columnar posthole stains are directly adjacent to the basalt curbstones and were likely support poles for this feature's wooden superstructure. Lithic tools and debitage associated with this component are discussed in the next chapter.

Based on this current chronometric information, it appears that an appreciable time gap exists at Vainu'u between instances of habitual site visitation. Chronological time gaps are evident in the archaeological record at other sites in American Samoa, specifically the coastal site of Aganoa on Tutuila (Moore and Kennedy 2003; Eckert et al. 2008; Crews 2008) and To'aga on nearby Ofu (Kirch and Hunt [editors] 1993). The current chronological information and material correlates fit well within the current archaeological assessment of cultural change on Tutuila. No confounding stratigraphic or chronological evidence exists in primary context at Vainu'u to warrant a reassessment of associated dates for cultural activity on site during either component of site use.

Late Holocene Volcanism and Component 1 at Vainu'u

The depositional history of Vainu'u provides significant information regarding late Holocene volcanism that no doubt forced a shift in mobility patterns across the entire highland range. The weak soil of Layer III that saw ceramic period activity overlies a thick deposit of culturally sterile volcanic gravels (Layer V). The earliest chronometric date for cultural activity upon the Layer III andisol comes from a direct measurement in the form of Beta# 240800, a sooted sherd from Feature 5 which provided a date of 2440 ± 40 B.P. (C13 adjusted age). The latest date associated with cultural activity within Layer III also comes from Feature 5, a charcoal sample

(Beta# 240799) with a date of 2280 ± 40 (C13 adjusted age). The materials for chronometric dating were recovered in direct association with cooking features, including charcoal and sooted pottery. A minimal amount of post-depositional disturbance was noted for both Features 4 and 5; yet two age samples are inverted in respects to their vertical location (Beta# 240795; Beta# 240799). The fact that the dated materials were obtained from a once-active cooking feature -- specifically the ash deposit -- suggests that the younger carbon became inverted as ash was moved away from the heated stone area and covered by prehistoric visitors to the site. Indeed, the cooking stones in Feature 5 have been removed from the charred area, which is present to the north of the stone pile. Small-scale vertical movement of charcoal and ceramic sherds in an area of high activity such as cooking features is hardly surprising. The dates recovered from the hearths cluster well and show that upland activity took place during the ceramic period for approximately 160 years prior to site abandonment due to the introduction of Layers IV and V.

An exact date for the volcanic eruption that deposited Layers IV and V upon the Component 1 living surface is unknown at this time. Two volcanic craters, Olovalu and Oloava, are within close proximity to the region capped in ash. Volcanic activity by one, or both, of these extinct cinder cones is a possible cause for Layers IV and V deposition. Volcanic activity covered Layer III after ca. 2,280 B.P. (Beta# 240800) and far before the next youngest radiocarbon date collected from the site in direct association with cultural activity upon Layer V at 660 ± 40 (Beta# 240798). The rate of soil transformation is relatively quick in tropical environments, due to elevated leaching rates from high interception of precipitation by dense undergrowth. Yet, while clay translocation is relatively rapid, an appreciable amount of time must lapse between deposition of ejected ash and the formation of soil structures and leaching profiles. It is likely that the volcanic event occurred during the centuries that still saw the production and trade of ceramic vessels, which ceases to appear in the archaeological record by ca. 1,700 B.P. (Kirch and Green 2001; Smith 2002).

The socio-cultural implications of this volcanic activity, which may have been impressively catastrophic, are unclear at present. Further archaeological investigation across the affected landscape would offer information regarding adaptive strategies to the depleted natural resources. Such investigations would also inform on how the geographic extent of the ca. 2,280 B. P. pyroclastic event as well as the depth of the resulting blanket of ash. Additional excavation in the surrounding local may also provide evidence of ceramic period activity near Vainu'u after 2,280 B.P. Yet, at present 2,280 B.P. serves as the final indication of early period involvement at the site.

Summary

Stratigraphic analysis and radiocarbon dating indicate that there were two prehistoric cultural components at Vainu'u: Component 1, a ceramic period component, dates to 2270 to 2440 B.P. and has two associated *umus*. Component 2, an aceramic period component, dates to ca. 650 B.P. and is associated with a large basalt *fale*. Stratigraphic evidence indicates that these components were not only divided by a 1500+ year time gap, but that at least one volcanic eruption affected the site, rendering the ridge useless for cultural activity for some undetermined amount of time. Artifact analyses, discussed in the next two chapters, provide insight into the similarities and differences in the cultural activities that occurred on the ridge between Component 1 and 2.

CHAPTER 5

FINDINGS:

LITHIC ANALYSES

The Vainu'u lithic collection from both the 2006 and 2007 excavations, analyzed and described here by Welch, consists of 718 basalt artifacts. The 2006 test excavations recovered seven tool fragments; the 2007 excavations recovered 20 tools and tool fragments. Excavations failed to recover any flaked basalt cores. Stratigraphic provenience of the flakes and few tool fragments recovered during the 2006 test excavations is not as detailed as that which is available from the 2007 excavations. As a result, the 2006 data are described in brief; focus is on the higher resolution information available from the 2007 excavations.

Of the 20 tools recovered during 2007, eight are complete specimens. Component 1 yielded a total of six tools, three of which are complete. Component 2 offered 13 tools: five are complete, seven are fragments and one specimen has evidence of reworking after breakage. This chapter addresses technological elements in the organization of basalt adze use including frequency and function of adze types, (Green and Davidson [editors] 1969, 1974) as well as retouch and reuse as interpreted through associated debitage.

The results presented in Chapter 4 indicate that Vainu'u witnessed two discrete components, each of which had its own lithic signature. Initial activity occurred on site during the ceramic period ca. 2,600-2,200 B.P. (Table 4.2); this component is associated with volcanic glass flakes, evidence of basalt adze retouch and use, and a limited number of basalt blades. Longer-term site use took place by aceramic inhabitants within the last 600 years; the pattern of lithic use during this period is one of a wider variety of tools that underwent less retouch than in the previous component.

Initial visitors to the highland site employed more intensive retouch of adzes in relation to the later aceramic occupants, evidenced by a higher frequency of adze-related debitage coupled with fewer tools in Layer III (Component 1) and minimal debitage and more tools in Layer V (Component 2). The findings outlined in this chapter suggest that ceramic using visitors to the site utilized a relatively small toolkit to complete tasks during short-term site visitation, reshaping and recycling lithic material as needed. Conversely, Monument Building Period occupants employed a relatively larger on-site toolkit, which is interpreted as evidence for longer-term site occupation and a wider variety of on-site tasks associated with residential activity.

Methodology

Basalt and volcanic glass debitage from 2006 and 2007 underwent analysis that studied varying attributes of flake platform and termination, as well as aggregate values of flake size and weight. Flakes are considered complete in this study if a striking platform is present. Flakes lacking a platform are regarded as flake fragments indicative of fracture upon application of force during detachment. Breakage over time as the result of trampling or agricultural practices may also be responsible for some degree of flake breakage. This analysis studies the attributes evident in the debitage by temporal components as outlined in the previous chapter. This allows for comparison across time to illustrate differences between ceramic and aceramic lithic assemblages.

This analysis recorded flake attributes using a decimal coding system (see Appendix B for code sheet and lithic artifact inventory). All statistics were done using SPSS 11 for Mac. Coding of attributes during analysis allows for objectivity in description, regulating observations to well-defined categories that may be employed between sites to determine further behavioral patterns in the organization of lithic technology across the Samoan Islands. Changes or stases evident in the Vainu'u collection inform patterns of tool use, site use, raw material availability and procurement practices as well as scale of activity at the site across time.

Aggregate analysis focused on flake size and weight to determine possible spatial or temporal shifts in flake removal practices. Changes in the frequencies of flake size over time would suggest differing stages of tool reduction, which is the possible product of changes in raw material availability, site occupation duration or average tool sizes used. Stases in the distribution of flake size across time is indicative of continuity in raw material availability, site function and/or tool use and retouch practices as well as site occupation span and the spectrum of tool morphology and size employed.

Basalt Artifacts

The majority of lithic raw material recovered from Vainu'u consists of high and low quality basalts. The quality of basalt is determined by flaking quality and the degree to which flakes may be predictably and consistently driven from a specimen. The evaluation of lithic quality is based upon grain-size data gathered using a 50x stereomicroscope to determine the probable behavior of each raw material utilized at Vainu'u. Knowledge of the technical characteristics of lithic raw materials -- the way siliceous stones flake during percussion -- provides a valuable understanding of reasons why prehistoric inhabitants on Tutuila Island pursued unique material types from specific locations across the landscape.

Basalt Adzes and Flake Tools

The presence of adzes at a given site offers information regarding intensity or duration of site use, as well as clues as to what stages of woodworking took place. If only small adzes and chisels are found, it may be ascertained that woodworking was in the later stages of completion. Conversely, if a wide range of adze morphologies is represented, one may conclude that prehistoric occupants manipulated timber resources across a larger chain of operation which prepares tool users for both preconceived and unexpected tasks.

Several adzes from Vainu'u show signs of end-shock damage on the bevel

(Figure 5.1). These flake scars indicate the possibility of flaws in the raw material, over exertion by user, accidental force upon hard objects or an incorrect angle of cutting edge upon impact.

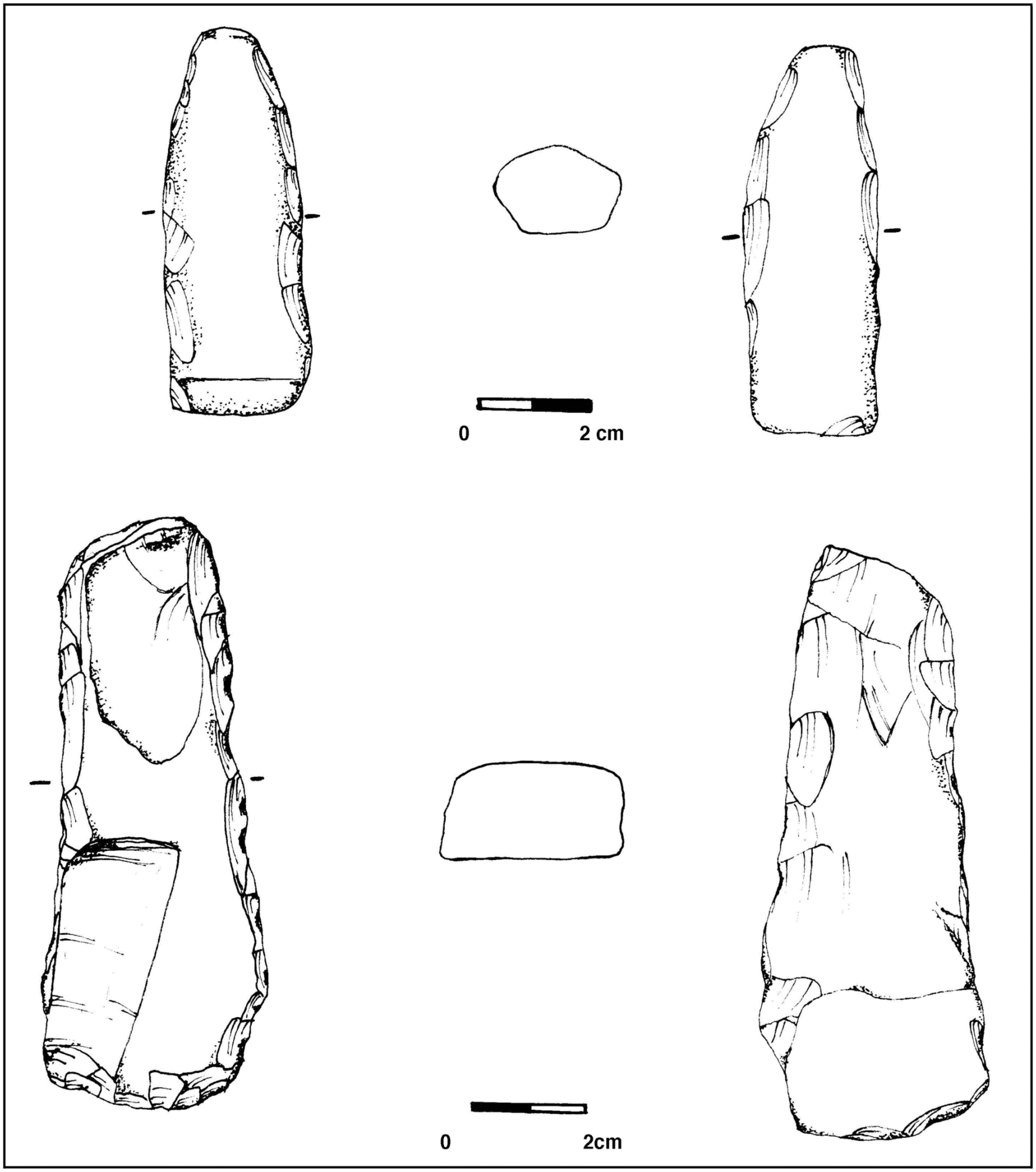

Figure 5.1.
Basalt adzes recovered from Vainu'u. Top: Specimen V030 recovered from Unit B3, Layer III (Component 1). Bottom: Specimen V043 recovered from Unit C2 Layer V (Component 2)

While the 2006 excavations did not yield any flake tools, the larger scale of the 2007 field season produced a total of six flake tools (Figure 5.2). Of these tools, two are expediently utilized basalt flakes. One of these expedient tools is created on a flake removed from an adze during late-stage shaping. The morphology of the remaining four tools suggests scraping activities took place on site. Three tools fall under the flake tool classification developed by Jeffrey Clark as Class 1a scrapers (Clark 1992; Clark and Herdrich 1988). One of these Class 1a scrapers shows signs of additional flaking at the proximal margins to accommodate hafting. Two scraping tools are not made from high quality basalt, but rather are created on thin tabular pieces of volcanic rock. The raw material is thin (12 mm) and has cortex on both faces. It may be confidently stated that this material is geologically different from that of the basalt adzes at Vainu'u.

The presence of flake tools at Vainu'u does not change the initial interpretation of the site as an upland resource procurement location. It does however expand the scope of activity on site, illustrating that small-scale domestic activities most likely took place. Prehistoric peoples at Vainu'u may have used flake tools in conjunction with earth oven cooking during resource collection.

There is no significant difference in the condition (broken vs. whole) of discarded tools between temporal component ($\chi^2 = 1.495$; $df = 4$; $p = 0.828$) (Table 5.1). This suggests that the ways in which visitors to the site implemented tools upon the environment changed minimally over time. A significant difference in tool breakage between layers may indicate poor raw material characteristics, repeated miscalculation in angle of contact between tool and wood or preferential differences in the hardness of wood resources over time. The fact that no significant difference in tool damage exists implies that tool users during both temporal components of site use were familiar with the material restrictions of stone tools and applied their skills accordingly.

However, there is a significant difference in tool condition between tool types ($\chi^2 = 10.00$; $df = 4$; $p = 0.040$). Adzes at Vainu'u have a much higher instance of breakage than flake tools. This difference in patterns of tool breakage is most likely a function of the repeated high impact and compression that hafted adzes endured versus the more subtle wear and tear that was applied to scraping tools.

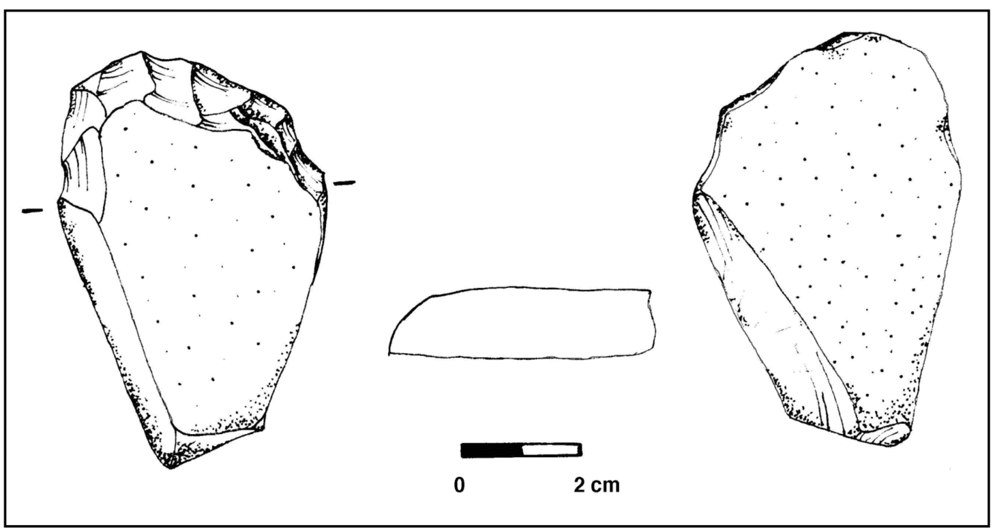

Figure 5.2. Scraper recovered from Vainu'u. Specimen V048 recovered from Unit C3 Layer V (Component 2)

Table 5.1. Condition of basalt tools by stratigraphic layer

Condition	**Layer III (Component 1)**	**Layer V (Component 2)**	**Disturbed contexts**	***Total***
Complete	3	5	0	*8*
Fragment	3	7	1	*11*
Reworked Fragment	0	1	0	*1*
Total	*6*	*13*	*1*	*20*

Table 5.2. Type of basalt tools by stratigraphic layer

Tool Type	**Layer III (Component 1)**	**Layer V (Component 2)**	**Disturbed contexts**	***Total***
Adze	4	10	1	*15*
Expedient flake tool	1			*1*
Formal flake tool	1	3		*4*
Total	*6*	*13*	*1*	*20*

Differing ratios of discarded tool type between Layer III and Layer V may suggest changing site functions between Component 1 and Component 2 occupation. While more adzes were recovered from Component 2, no significant relationship exists in discarded tool types between cultural components ($\chi^2 = 2.77$; $df = 4$; $p = 0.596$) (Table 5.2). This constant pattern indicates minimal variation in tool use practices over time. The aceramic component yielded a slightly higher number of tools, yet the differences in tool type and tool count do not suggest changing site function. Rather, the higher frequency of tool use and discard in the aceramic period is indicative of increased site occupation span and a higher occurrence of tool discard upon damage or breakage. Uncertainty regarding the range of tasks increases with lengthened occupation duration (Rasic and Andrefsky 2001). Increased task variability was often countered by maintaining access to a wider range of individual tool types or by employing specialized multifunction items (Rasic and Andrefsky 2001). This dynamic of lithic technological organization appears to be well expressed throughout time at Vainu'u.

Basalt Blade Technology

Basalt blade technology is identified in the Component 1 lithic assemblage at Vainu'u (Figure 5.3). One blade is complete, exhibiting an isolated platform, single longitudinal dorsal ridge and a feathered termination. Four medial, proximal and distal fragments are also present and are morphologically distinct from other flakes on site. The morphological difference indicates that these flakes were the product of removal from a flake core rather than being a random byproduct of adze manufacture. Laminar ridges on the dorsal face indicate that other flakes were removed in a similar fashion prior to the detachment of the blades in the collection. The fact that Component 1 inhabitants employed prepared-core blade technology at Vainu'u in no way suggests that Vainu'u was a workshop for blade production, but rather that those utilizing the area at one time knew the benefits of isolating striking platforms to produce long thin flakes that maximized usable surface area along each flake margin.

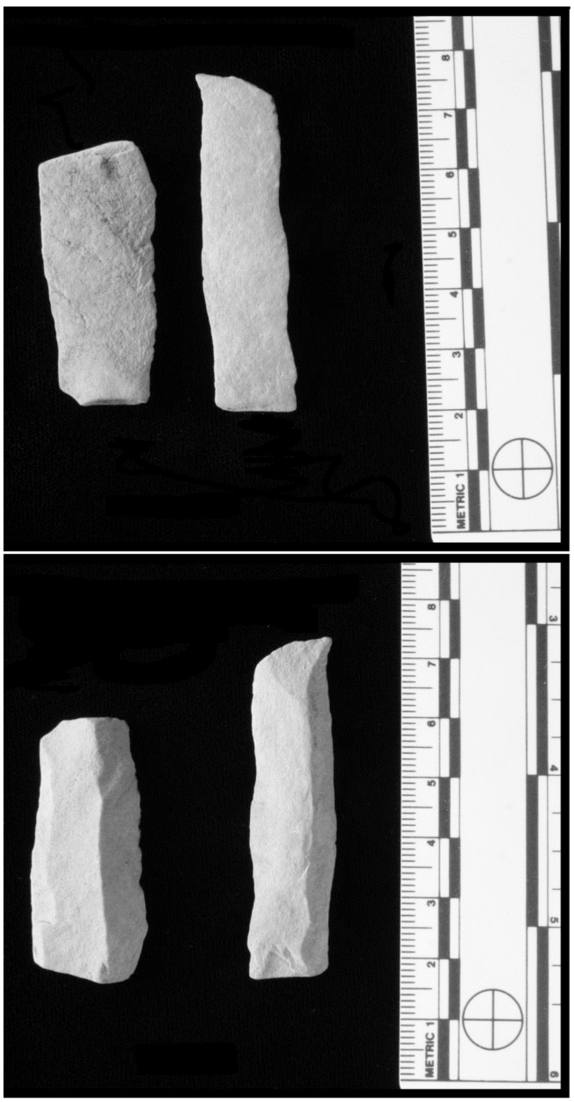

Figure 5.3. Basalt blades recovered from Unit C1 Layer III (Component 1). Top: ventral face. Bottom: dorsal face (photos by Charlotte Pevny)

Basalt Flake Debitage

The basalt flakes collected during excavation lend an attractive opportunity to study the dynamics of late-stage shaping and retouch of ground stone tools, specifically Samoan adzes. Upon inspection, the collection proves to be restricted to flakes rarely larger than 5 cm in diameter. This restriction in size suggests a non-local source of raw material. Correspondingly, intensive ground survey around Vainu'u in 2008 failed to locate a basalt procurement site within the 2 km survey diameter. Large-scale procurement of basalt resources may have taken place above the coastal village of Fagasa on the nearby northern coast, but systematic archaeological survey has yet to locate such a site. The closest known source of basalt provisioning is the Tataga Matau quarry on the western end of the island (Best et al. 1989). Of the 888 basalt flakes encountered from Vainu'u, only ten appear to be the product of core reduction to produce flake blanks as opposed to the shaping of adzes. In other words, adze-related flakes comprise approximately 98.9% of the excavated debitage.

<u>*Morphological Restrictions in Flake Type:*</u> The morphologies of the flakes in the 2007 Vainu'u lithic assemblage are surprisingly similar to one another. The majority of the flakes fall into three discrete categories: 1) flakes removed during the shaping of adze shoulders (sides); 2) flakes removed from the top or bottom to thin an adze for a new haft, to remove imperfection on the top or bottom of the adze, or to thin bulbs of percussion; and 3) small unclassifiable chips, most likely the product of final-stage shaping of adze shoulders as well as the top and bottom of an adze.

The first category is readily recognized by a feathered, overhanging termination with a transverse line on the dorsal face. These flakes were created through removal from the shoulder edges on quadrangular adzes. It is possible that these flakes may be derived from trilateral adze reduction methods. However, based on experimental shaping and type collections, flaking rarely reaches from margin to margin during the trilateral method of production.

The second category is slightly less discrete. These flakes show a flat platform with signs of adjacent, previously removed flakes. Flakes from this category were removed during the thinning of the tool and rarely reached the opposite margin. They often have feathered or stepped terminations and are wide and thin in shape. Narrow thick flakes with stepped terminations and well-isolated platforms were also produced during top and bottom shaping.

The third category is comprised of ambiguous basalt chips, usually under 2 cm in diameter that exhibit no diagnostic attributes indicative of detachment location. These flakes are too small to be flake blanks taken from a core for use in tool production. As a result of their restricted morphology, and consistent production during experimental replication of adzes, flakes in this category are confidently attributed to late-stage adze shaping. Experimental recreations of several adze types on Tutuila basalt created all three categories, with the highest percentage of the flakes falling into this third category.

Debitage Analysis: Debitage collected from Vainu'u is predominantly restricted to flakes under 5 cm in diameter. The ceramic component contains a substantially higher frequency of smaller flakes, indicative of more intensive tool retouch in relation to the overlying aceramic component. Flakes 1-3 cm in diameter are predominant at the site. Component 1 (Layer III) exhibits a higher percentage of flakes 1-3 cm in diameter (N = 274) relative to Component 2 (Layer V) deposits (N = 38). Significant patterning is evident in flake size by cultural layer ($\chi^2 = 27.353$, $df = 6$, $p = 0.000$). The distribution of flake size in Component 2, while primarily restricted to flakes below 5 cm in diameter, is more evenly represented than flakes present in Component 1.

The higher frequency of small flakes detached from adzes during Component 1 at Vainu'u may be a technological correlate, the product of metrically smaller tools. Tools recovered from the site do suggest size and form differentiation over time (Figure 5.4), only in that the smallest formal tools were recovered from the earliest cultural layer while the largest formal tools were present on the surface. This observation in tool size should not be viewed as an island-wide trend, as the recovered tool sample size is small and is most likely the result of varying site function and shifting target resources over the last two thousand years. The debitage from Vainu'u suggests that Component 1 occupants employed more intensive retouch practices relative to tool retouch performed by Component 2 occupants.

The larger number of formal tools from Component 2 (Layer V) and the higher frequency of late-stage retouch during Component 1 (Layer III) suggests that the later aceramic occupants experienced less pressure to fix broken tools or to modify the shape of adzes for new uses, while ceramic period occupants adapted to a restricted availability of new tools by engaging in a higher relative degree of tool curation (Davis and Shea 1998; Andresky 2008). This is not to say that retouch and reuse did not take place during the Monument Building period at Vainu'u; associated tools suggest that reshaping broken adzes took place to produce a nearly even distribution of flakes sized 1-5 cm in diameter.

The medium sized flakes in the collection (3-5 cm) are present in larger numbers in Layer V associated with Component 2 activity. This may be related to the observation that larger tools were utilized at the site during the later occupation span. As a result of larger tools and less extensive tool curation, the size distribution of retouch flakes are accordingly larger than the earlier deposits containing the remains of tools that saw more intensive reshaping or retouch. The significant patterning in flake size and technological

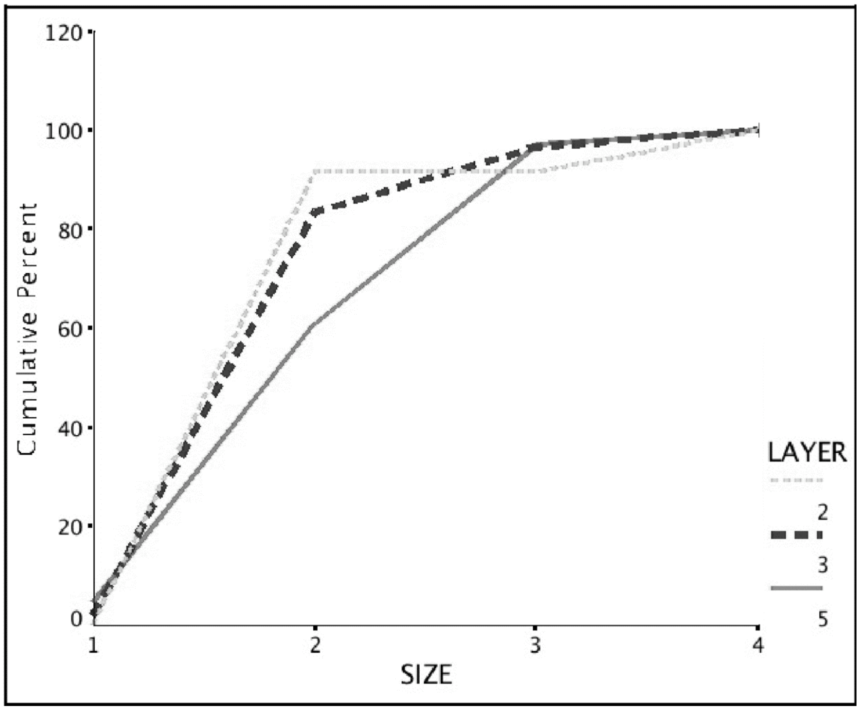

Figure 5.4. Size of flakes graphed by temporal layer

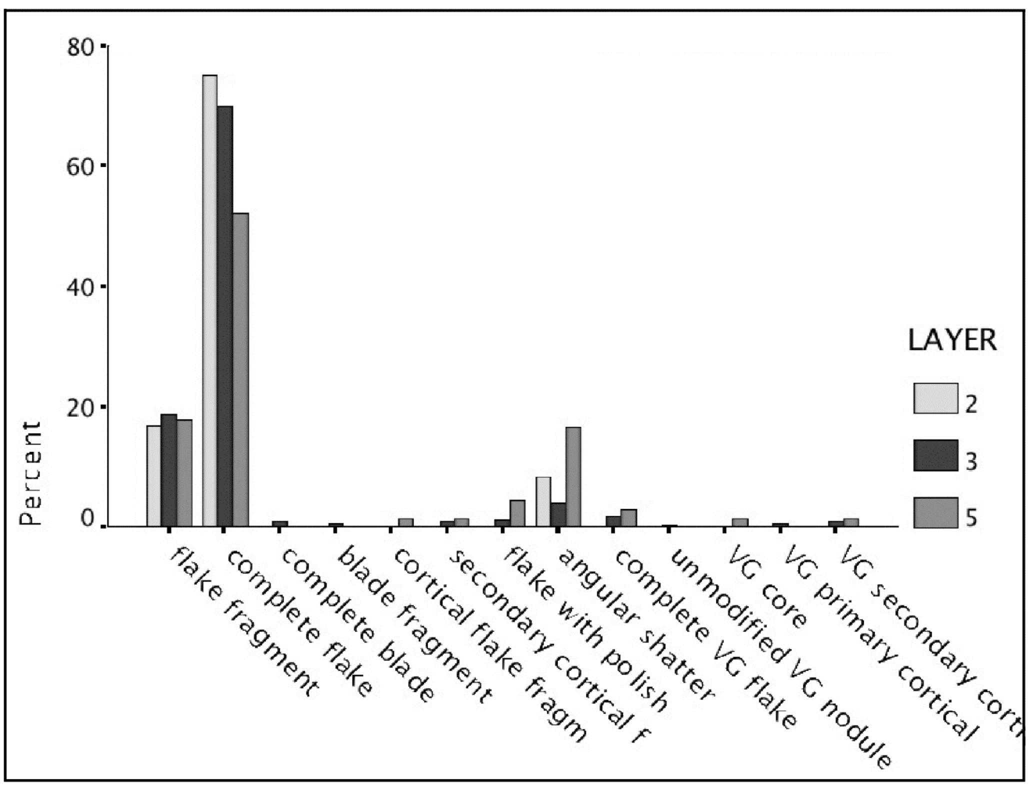

Figure 5.5. Flake type graphed by temporal layer

attributes suggest that flakes were struck from objective pieces in several similar progressions (Best et al. 1989; Welch 2007). Refit analyses of recreated adzes suggest that the flakes at Vainu'u originated primarily during adze reshaping for a new hafting element or for extended utility after breakage.

Significant differences exist in the distribution of flake type by layer (χ^2 = 23.238, *df* = 8, *p* = 0.003). Excavations within Layer III (Component 1) yielded 302 non-cortical flakes, while the above Layer V (Component 2) contained only 47 non-cortical flakes and 2 cortical flakes (Figure 5.5). The instance of angular shatter between cultural layers shows no significant difference (N = 14 from Layer III; N = 11 from Layer V). Volcanic glass flakes and cores are relegated to ceramic bearing deposits (N = 15), although some debitage exist in the upper layers (N = 9). Volcanic glass debitage in Layer V is attributed to rodent activity and agricultural disturbance in certain portions of the site.

When identifying relationships in debitage type by cultural layer, complete basalt flakes are the predominant artifact in all layers (Figure 5.5). The non-cultural sediment Layer II is composed of volcanic cinders and rests below the ceramic bearing activity surface. The flakes encountered in this layer are the result of sinking over time into stratigraphic deposits below the active cultural surface of Layer III (Schiffer 1987). Blades and blade fragments exist only within Layer III, indicating that, like volcanic glass, blades are a part of the ceramic period lithic tradition that is not evident in primary contexts during the later aceramic times.

Lithic Assemblage of Component 1 Cooking Features

Comparison of the stone tools and debitage associated with the earth ovens (Features 4 and 5) offers information regarding flake removal practices at two discrete locations that shared similar cooking practices (Figure 5.6). The cooking features contain significantly different proportions of associated debitage types (χ^2 = 116.5; *df* = 24; *p* = 0.000). Complete flakes are the most frequent item associated with both features. While Feature 5 shows a higher relative number of complete flakes (N = 170) when compared to Feature 4 (N = 54), Feature 4 exhibits the higher percentage of complete flakes. Feature 4 debitage was composed of approximately 80% complete flakes, while Feature 5 debitage was composed of a nearly even incidence of complete and broken flakes (47% complete).

At first appearance, the high ratio of complete to broken flakes in Feature 4 and the nearly equal balance of broken and whole flakes in Feature 5 would seem to indicate differing levels of experience in the removal of usable flakes. The morphology of the flakes do not suggest the production of flake blanks for retouch but rather the vast majority of flakes accumulated upon the prehistoric cultural surface as adzes were reshaped. Differential experience or skill by knappers is a valid material correlate in many instances when discussing the detachment of flakes that are expressly intended for retouch, or at production workshops where minimal morphological variability is a proxy measure of craft experience (Allan et al. 1997). Yet, the factors that affect flake morphology are numerous, including the behavioral characteristics of the lithic raw material, angle of percussive force as well as hammer type and application load. These physical and technological factors in concert affect the morphological attributes of each detached piece.

A controlled assessment of the differing frequencies is possible however when the factors that affect breakage are similar. The raw material in Features 4 and 5 is of similar fine grain quality, the hammer type is unknown, yet was most likely a hard hammer percussor (Best et al. 1989). As a result, at Features 4 and 5 the application load and striking angle applied to each objective piece are the main technological variables controlling flake behavior during reduction. With this understanding, if the cause of breakage was in fact technological, the probable reason for the significantly higher frequency of fragmented flakes in Feature 5 was routine application of force that exceeded the performance qualities of the raw material.

Other causes of the differential flake breakage between cooking features are plausible. If flakes were within areas of relatively high cultural activity, trampling and breakage from heat stones and thermal shock was likely to inflate signals of flake breakage. The flakes in Feature 5 may have seen more trampling or may have been in the discard zone for thrown cooking stones and as a result exhibit a higher breakage frequency in relation to the Feature 4 oven, which may have not seen the same degree of repeat use.

Basalt blades are rare on Tutuila Island; yet a few blades exist in direct association with both hearths at Vainu'u (Figure 5.3). Feature 4 contained two complete blades, while Feature 5 yielded one complete blade and two medial fragments. Basalt blade technology on Tutuila Island is poorly expressed and does no appear to be a widespread method of flake removal. While blade production during the ceramic period was limited, the technological method was known and used on occasion to produce repeated flakes whose lengths are more than twice the width with small flat platforms, coupled with feathered terminations and diffuse bulbs of percussion.

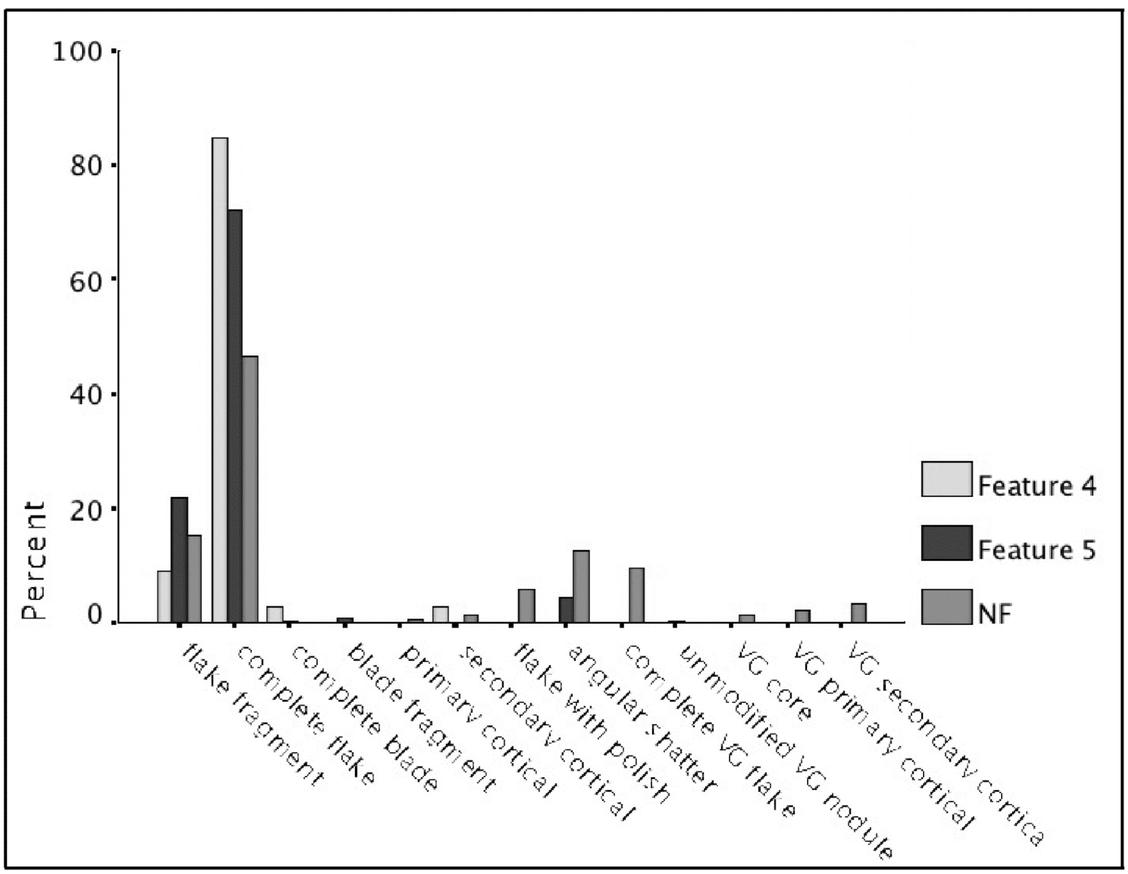

Figure 5.6. Component 1 flake type graphed by feature

Volcanic Glass Artifacts

Volcanic glass, as an artifact of material culture, is associated with the ceramic period of occupation on Tutuila Island ca. 3,000-1,700 B.P. (Clark and Micklovic 1996; Clark and Wright 1995; Green and Davidson [editors] 1969, 1974; Kirch 2000; Kirch and Green 2001; Smith 2002; Welch 2008). The lustrous material may be viewed as an essential trade good during the ceramic-making period for use as a multi-purpose razorblade. These artifacts are evident in Lapita assemblages spanning the Pacific Ocean and tie the early occupants of Tutuila to the Eastern Lapita Voyaging Complex (Jennings 1979; Sheppard et al. 1989; Smith 2002; Green and Davidson [editors] 1969, 1974; Kirch 2000; Kirch and Green 2001). Procurement and trade of the gravel-sized nodules added to the ways in which islands and archipelagoes maintained social connections across vast oceanic distances as the reach of Lapita voyaging stalled ca. 2,700 B.P. (Kirch and Green 2001). The small flakes and nodules of dark glass are not archaeologically evident in primary contexts dating the aceramic periods (Smith 2002; Green and Davidson [editors] 1969, 1974; Kirch 2000; Kirch and Green 2001). A discontinuation in procurement practices, trade and use of this material ca. 1,700 B.P. (Smith 2002, Kirch and Green 2001) suggest that volcanic glass artifacts are reliable chronological markers, specific to the ceramic periods. Reliable radiocarbon data from Vainu'u provides additional support for this relative method of dating.

While the exchange of volcanic glass may have functioned socially to maintain trade networks and social cohesion within the islands, prehistoric occupants on Tutuila treated volcanic glass flakes, cores, unmodified nodules and tools as utilitarian items, discarding the material as necessary. The use of volcanic glass as tools, rather than as non-utilitarian items of prestige, is supported at Vainu'u by the discarded flakes recovered from Layer III that exhibit no spatial patterning across the site or morphological preference. Additional support for volcanic glass as an expedient razor for delicate tasks comes from the coastal site of Aganoa, where exhausted cores and flakes accompany potsherds and the remains of marine resources in a ceramic period trash midden (Welch 2008).

To further understand ceramic period distribution of volcanic glass resources, all artifacts that met sample requirements were to undergo a nondestructive geochemical analysis using energy-dispersive X-ray fluorescence (EDXRF). It was hoped that such an analysis would have provided geochemical data to illustrate the number of raw material sources employed by those that utilized the highland site. Unfortunately, due to the small nature of the volcanic glass flakes from Vainu'u, only one specimen met the size requirements for the EDXRF instrument at the Center for Chemical Characterization at Texas A&M University (Shackley [editor] 1998). Artifacts that do no adequately cover the rotating aperture during exposure to X-rays fail to yield reliable elemental concentrations. The one specimen that fit methodological requirements is geochemically similar to the volcanic glass recovered from 'Aoa (Clark and Wright 1995).

Volcanic glass is nearly absent in association with the Component 1 cooking features, the only associated item is a small nodule within Feature 5. The absence of volcanic glass flakes at the cooking features does not necessarily imply that the sharp flakes were not utilized in ceramic period cooking practices. Rather, if the glassy flakes were used in cooking practices they were either 1) carried away from the cooking site or 2) the 1/4-inch screen size used during excavations failed to collect all micro debitage. Excavations recovered 24 volcanic glass artifacts from the surrounding non-feature excavations. Volcanic glass flakes of all sizes were identified and collected during excavation above and below Features 4 and 5, suggesting that the flakes were produced and utilized at a location slightly removed from the cooking location and was not discarded directly within the cooking zone. One functional explanation of this is that the siliceous material may explode when heated if discarded among the basalt cooking stones. This material characteristic would regulate a low relative percentage of volcanic glass artifacts in direct association with cooking stones and higher percentages in extraneous zones of habitual material discard.

Non-cortical flakes are the predominant volcanic glass item at Vainu'u (n= 13) (Figure 5.7). Secondary and primary cortical flakes are next in abundance and adhere to normal trends in cortical flakes relative to non-cortical flakes. This relationship is due to the fact that a larger volume of non-cortical material exists within objective pieces and therefore more non-cortical surface area is produced during knapping events (Andresky 2005). Two volcanic glass cores were recovered. The flaking scars remaining on these cores conform to current archaeological knowledge of volcanic glass flaking practices on Tutuila. Flakes are removed from cores through a combination of bipolar and hand-held methods. Bipolar reduction of small cores is an adaptive strategy to the small material package size (Welch 2008). Initial flake removal may have been relegated to hand-held percussion in order to reduce crushing of valued cutting edge. A bipolar method of flake removal using a hard hammer and bottom anvil to amplify percussive force was employed once cores became too small for hand held reduction.

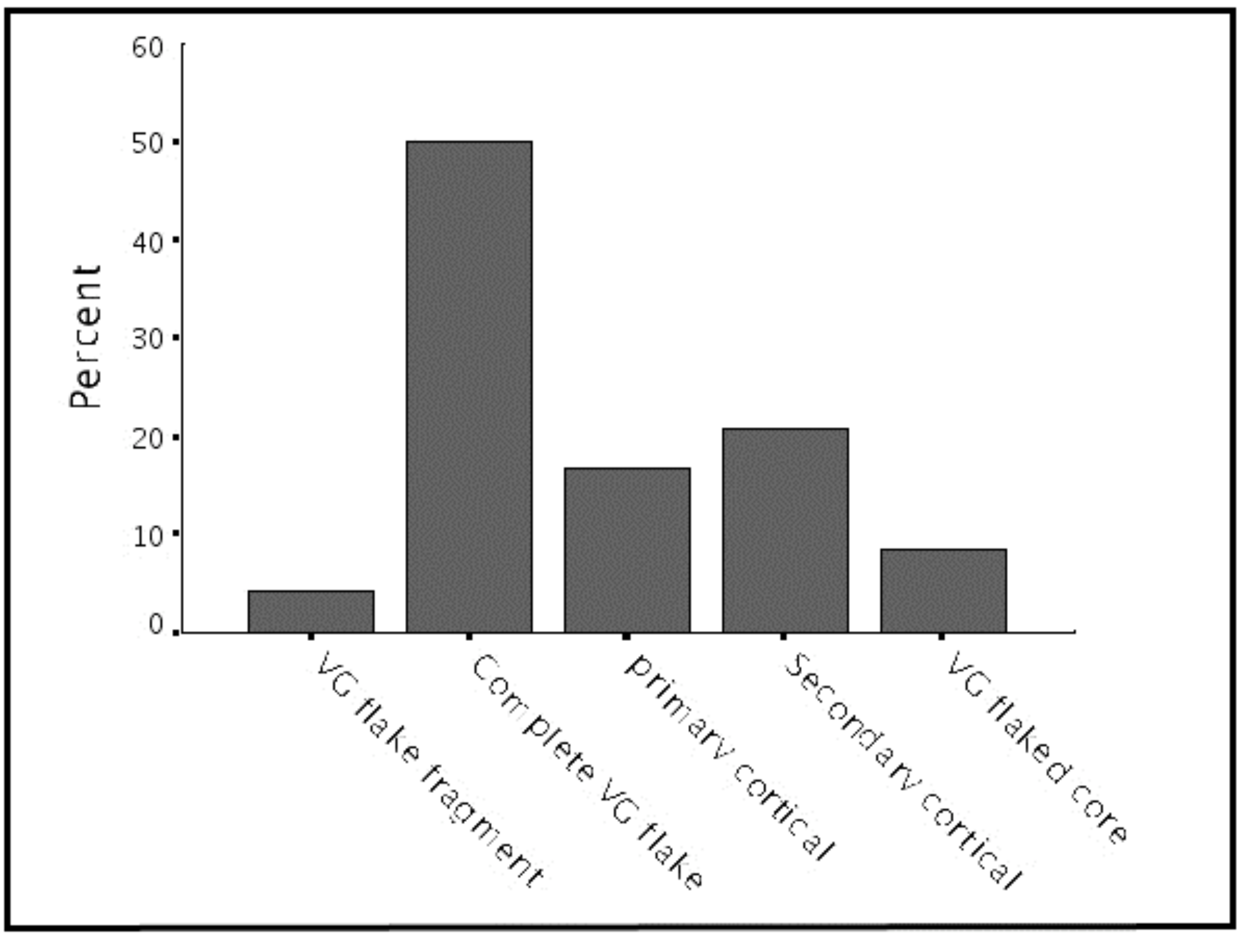

Figure 5.7. Percent of Volcanic flake types recovered from Vainu'u.

Table 5.3. Size distribution of volcanic glass artifact types

Size	**Non-cortical flake**	**Cortical flake**	**Core**	***Total***
<1 cm	9	3	0	*12*
1-3 cm	4	6	2	*12*
Total	*13*	*9*	*2*	*24*

The size of volcanic glass flakes at Vainu'u is restricted to flakes under 3 cm in diameter (Table 5.3). This size characteristic is repeated across volcanic glass-bearing sites on Tutuila Island (Green and Davidson [editors] 1969, 1974; Clark and Miclovic 1996; Clark and Wright 1995; Welch 2008). An equal flake size distribution exists in the small sample, a larger sample size may illustrate the presence of more flakes under 1 cm in diameter due to increased late stage flaking. The flake size relationships seen at Vainu'u suggest a slightly different technological approach to flake production than employed at the contemporaneous coastal sites of Aganoa and 'Aoa. This unique technological distinction is evidenced by the relationship of flake termination and platform, notably the relatively small frequency of bipolar flakes at Vainu'u when compared to assemblages at other Tutuilan sites.

The attributes of flake platform and termination inform technological methods of flake removal. If a significant majority of the small flakes exhibit crushed ends, due to bipolar reduction, it may be assumed that cores were simply too small for less destructive hand-held methods of flake removal. Conversely, flakes that show flat platforms and feathered terminations suggest that raw material size was initially large enough for hand-held percussion which would supply a larger proportion of uncrushed, usable cutting edge. Flake attributes at Vainu'u show that smooth platforms and feathered terminations are dominant in the excavated collection (Table 5.4). While the sample size is small, significant patterning exists between platform and termination attributes (χ^2 = 13.640; df = 6; p = 0.034). This relationship may indicate that 1) volcanic glass nodules were larger than those at 'Aoa and Aganoa (Clark and Micklovik 1996; Clark and Wright 1995; Welch 2008) or that 2) the volume of volcanic glass carried to Vainu'u met utility requirements to such a degree that extended reduction using bipolar methods was not necessary. The latter implication is the most probable cause for the low appearance of crushed platforms, principally because volcanic glass cores are all but absent at Vainu'u. This pattern indicates that, while utilized flakes may have been discarded, the cores were expended elsewhere where the instance of crushing due to bipolar reduction would be well exhibited.

Table 5.4. Platform termination of volcanic glass artifact types

Platform	**Termination**				***Total***
	feathered	**stepped**	**hinged**	**crushed**	
cortex	2				*2*
smooth	14	1	1		*16*
crushed	1			2	*3*
Total	*17*	*1*	*1*	*2*	*21*

Table 5.5. Volcanic glass artifact types by stratigraphic layer

Type	**Layer III (Component 1)**	**Layer V (Component 2)**	***Total***
Non-cortical flake	7	6	*13*
Cortical flake	8	1	*9*
Core		2	*2*
Total	*15*	*9*	*24*

Significant patterning also exists in the vertical distribution of volcanic glass artifacts regardless of sporadic post-depositional disturbance in the upper layer ($\chi^2 = 6.423$; $df = 2$; $p = 0.040$) (Table 5.5). While some mixing has admittedly occurred, significant relationships and associative ties to ceramic material show that volcanic glass artifacts are systemic to Layer III but not to Layer V.

Discussion and Conclusion

During Component 1 use of Vainu'u, visitors to this highland site employed higher levels of tool curation in the form of intensive retouch and reshaping than did later Component 2 occupants. Less intensive natural resource collection coupled with a heightened pressure to reshape and reuse tools in the early period is the most likely cause for the low instance of tool abandonment expressed during the ceramic period. Conversely, fewer adze related flakes are present in the Component 2, coupled with slightly more discarded tools. These material correlates suggest that less retouch took place due to a more numerous collection of adzes on site in later years. The larger stock and wider morphological range would have enabled prehistoric occupants to spend less time reshaping tools to fit new functional demands. Secondly, a larger on-site tool kit decreased the pressure to repair and recycle damaged tools.

While the Component 2 behavior of tool replacement, rather than the reshaping witnessed during Component 1, required more initial investment, less time would be spent maintaining tools. One functional benefit of this method of technological organization is that minimal time is lost due to broken tools, lending more time to exploiting resources and shaping wooden items. In other words, access to distant stone resources was less of a controlling factor upon inhabitants at Vainu'u during Component 2, likely due to an increased collection of tools to equip longer-term occupation spans as well as more complex social networks developed during the rise of chiefdoms on the island. The large stone outline of a prehistoric house foundation (Feature 3) credits the hypothesis of increased site occupation duration during the latter prehistoric years.

The relatively high number of adzes recovered during excavation suggests that one common cultural activity on site was the felling of trees; however the site was probably host to a multitude of small-scale activities that left no material manifestation. The overwhelming predominance of adze flakes, especially present in the Component 1 deposits (Layer III), suggests tool reshaping to fulfill the requirements of the task at hand as adzes lost their edge. Polish on a number of basalt flakes removed from the sides of adzes indicates intentional removal for reshaping or rejuvenation purposes. The basalt flakes from the site suggest that late-stage shaping of adzes was the most commonly exercised practice, not core reduction, blank production, or preform shaping. The collection does not suggest an adze workshop, primarily due to the small number and size of flakes.

The flake tools from the site indicate that scraping activities also took place and were most likely associated with food preparation. Although the scrapers were not recovered in direct association, excavated earthen ovens dating to ca. 2,300-2,400 B.P. provide evidence that cooking did take place on site. At this time, the lithic materials available from Vainu'u suggest cultural activity surrounding the upland felling of trees, which was accomplished through the use and re-use of a wide range of adze morphologies. Additionally, small-scale food processing and cooking occurred, most likely with the aid of the formal and expedient flake tools recovered during excavation.

CHAPTER 6

FINDINGS:

CERAMIC ANALYSES

The Vainu'u ceramic assemblage, analyzed and described here by Eckert, consists of 755 sherds (183 from the 2006 excavations; 572 from the 2007 excavations). Along with addressing the research issues outlined in Chapter 1, the ceramic analysis was designed to characterize sherds in a way that would make this analysis comparable to published collections from other western Polynesian sites. All 755 sherds from Vainu'u are Polynesian Plain Ware (Green 1974c); however we maintain that this name is somewhat of a misnomer, as it assumes continuity between the pottery producing peoples of Samoa's earliest occupation with later Polynesian residents. This cultural continuity has yet to be established (Smith 2002). As such, the term "Plain Ware" is used here, so as avoid untested cultural affiliations.

Attribute Analysis

After assigning a unique ID number to each sherd, 11 attributes were recorded. These attributes include provenience, body part, sherd thickness, sherd size, weight, temper, temper size, paste color, rim form, sooting, and surface modification (see Appendix C for code sheet and ceramic artifact inventory). This section summarizes the 11 attributes recorded for each sherd from the Vainu'u site, before moving onto a more detailed discussion of petrographic and geochemical data analyzed from a subset of this assemblage.

The sherd ID number (as written on each sherd) and provenience were recorded allowing us to relate each sherd specimen back to its original excavation context. Pottery was recovered from surface contexts (N = 38), shovel test pits (N = 9), unit fill (N = 696), and in association with Features 4 and 5 (N = 30). Although sherds were recovered primarily from Layer III, some ceramic material was also recovered from Layers V and O; at this time, due to low density of sherds as well as no ceramic artifacts found in primary context in these layers, we maintain that the sherds in these upper layers are a result of agricultural disturbance (Chapter 4). With this in mind, we argue that pottery is associated only with

Component 1. As such, the analysis here focuses primarily on sherds recovered from the 2007 excavations in Layer III.

The size (measured in 1, 3, and 5 cm^2 increments) and weight (in grams) of each sherd were also measured. The vast majority of sherds fell between 1-3 cm^2 (N = 658); a few sherds were 5-7 cm^2 in size (N = 84); and a few sherds were <1 cm^2 (N= 31). Due to the difficulty in recording a range of attributes accurately on small sherds, samples falling into this latter size range were removed from further analysis.

Body thickness was recorded (measured in mm) in the hopes that, combined with chronological data, changes in thickness over time could be examined. This was of interest because Green (1974) had observed that the production of thin ware appeared to decline over time in relation to thick ware at numerous sites in Western Samoa. Since Green's initial observation, some studies have confirmed this trend (Clark and Herdrich 1988; Kirch and Hunt 1993; Moore and Kennedy 2003: 103-110), while other studies have found no evidence to support this temporal pattern (Jennings and Holmer 1980; Eckert and Pearl 2006). Unfortunately, this trend currently cannot be examined at Vainu'u; the pottery dates only to Component 1, and we do not have the stratigraphic control within this component to examine changes in the ceramic assemblage over time. The Vainu'u data do confirm the existence of two wares based upon thickness, temper size, and paste color: thick ware (26% of assemblage) normally has a light brown paste, very coarse sized olivine basalt temper, and averages 11.9 ± 0.5 mm in thickness; thin ware (74%) normally has a dark reddish brown paste, medium to coarse sized basalt temper, and averages 7.8 ± 1.2 mm in thickness.

Vessel part was recorded for each sherd as either a rim or body sherd. A total of 461 body sherds and 33 rim sherds were recorded for the 2007 excavated material from Layer III. Two sets of rim sherds refit. The remainder of the rim assemblage sherds are different enough in terms of form, thickness, paste color, and temper as to be from separate vessels; with this in mind, the minimum number of vessels represented by this ceramic assemblage is 31. Three additional attributes were recorded for rim sherds only (Figure 6.1): rim profile, lip cross section, and rim form. Rim profile refers to the degree of exterior or interior rim thickening relative to body thickness. Of the rim sherds that were large enough to record profile (N = 29), two were thickened (both interior and exterior sides expand), 15 were parallel (no thinning or thickening), 12 had a thickened interior, none had a thickened exterior, and two had unusual form. By far, the most common lip cross section was square (N = 23).

Only four sherds had any observed surface modification, consisting of striations interpreted as evidence of wiping during the production process. Lack of surface modification is, at least partially, a result of the high-degree of weathering evidenced on these relatively soft ceramic artifacts. About a quarter of the ceramic assemblage (N = 108) was recorded as being sooted. The majority of sooted sherds (N = 86) were thin ware as described above. This suggests that thick and thin ware may have a functional difference; thin ware being preferred for, but not limited to, cooking activities.

Temper, temper size, and paste color were recorded for most sherds. These data provide information on production technology and technological style. Three temper-paste combinations were identified using a binocular microscope, and then tempers were more thoroughly described with the petrographic analysis discussed below. The most common (N = 345) temper-paste combination consists of a reddish brown to dark reddish brown (Munsell Color Chart Hue 5YR Value 3-5 Chroma 3-4) paste with fine-grained basalt temper that appears as black inclusions under a binocular microscope. This temper ranged in size from medium (0.25 - 0.50 mm) to coarse grain (0.5 - 1.0 mm). The second most common (N = 144) temper-paste combination consists of a normally

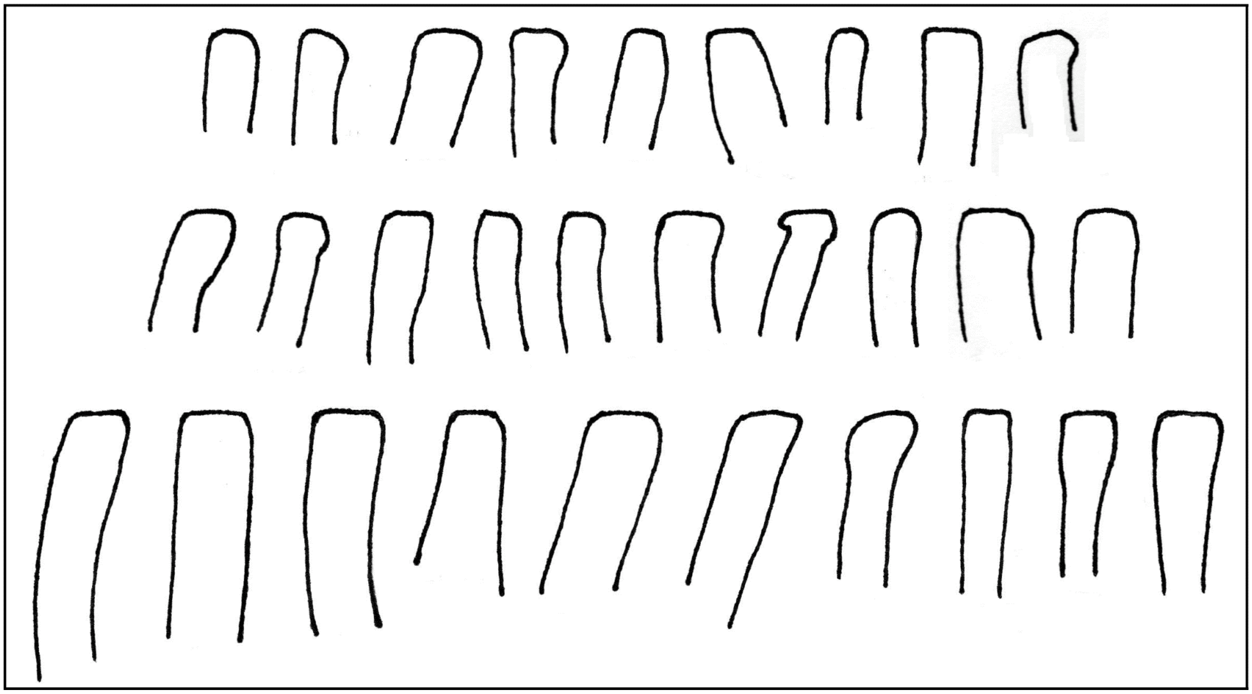

Figure 6.1. Rim forms recorded on pottery recovered from Vainu'u

light brown (Munsell Color Chart Hue 7.5YR Value 6 Chroma 3-4) paste with olivine basalt temper that appears as dark gray to red inclusions under a binocular microscope. This temper ranged in size from coarse (0.5 - 1.0 mm) to very coarse grain (1.0 - 2.0 mm). The third, and by far the least common (N = 5), temper-paste combination consists of a dark reddish brown (Munsell Color Chart Hue 5YR Value 3 Chroma 3-4) paste with beach sand temper of medium grain size (0.25 - 0.50 mm). The brown color of the paste suggests that all pottery recovered from this site was fired in an oxidizing atmosphere. To explore production provenance, a petrographic analysis of the tempers combined with a geochemical analysis of the pastes was performed.

Petrographic Analysis

This report presents the results of a detailed analysis of 20 petrographic thin sections made from Plain Ware pottery, and a more cursory examination of numerous comparative rock and ceramic thin sections. The sherds from which these thin sections were made were collected from both surface and excavation contexts during both the 2006 and 2007 field seasons.

Although potters working at Vainu'u would mostly likely have had access to clays and rocks from throughout the island, the expedient nature of Plain Ware on Tutuila along with the difficulty of carrying clays up and down steep paths, allowed us to initially assume that potters were relying mostly on local materials. However, this was an assumption that needed to be tested. We also wanted to examine whether or not pottery from other regions of the island, or from other islands, was being brought to Vainu'u. With this in mind, a brief description of the local volcanic material is provided.

Occupants of Vainu'u would have had easy access to material from the western portion of the Taputapu volcanics and the eastern portion of the Pago volcanics. These two volcanic series meet in Massacre Bay (Stearns 1944: 1306), located on the northern coastline below the ridge on which Vainu'u sits. Occupants of Vainu'u may also have had easy access to the northern portion of the Leone volcanics. Unfortunately, these three volcanics are all dominated by olivine basalts (Stearns 1944; MacDonald 1944). However, because some variation exists between these volcanic series – especially eight quartz trachyte plugs that have been petrographically described (MacDonald 1944) – the hope was that a petrographic analysis would allow for the tracing of at least some pottery to its production provenance on island. Further, any pottery with marine material may safely be argued to have been produced at coastal sites.

Methodology

Petrographic samples were prepared by National Petrographic Service, Inc. in Houston, Texas. The method of sample preparation followed standard procedure for petrographic thin sections out of ceramic material (Habicht-Mauche 1993). An approximately 5 mm thick slice was removed from the edge of each ceramic sherd using a circular saw. Each ceramic slice was infused with an epoxy and allowed to solidify. The cut edge of each sample was then ground flat, mounted on a standard petrographic slide, and ground down to a uniform thickness of 0.03 mm. Each sample was polished to remove any surface scratches and was then ready for petrographic analysis.

Using a standard petrographic (polarizing) microscope in the ceramic laboratory of the Department of Anthropology, Texas A&M University, 20 Plain Ware petrographic samples were examined for general characteristics and then performed a point count sampling. General characteristics recorded included paste matrix color and texture as well as sorting of non-plastic inclusions. For the point count sampling, a 0.5 mm micrometer grid overlay was placed over each slide. One hundred intersection points on the grid were then analyzed. Information recorded for each point included whether or not the point sampled the paste matrix, a void, or a non-plastic inclusion. The following information was recorded for all non-plastic inclusions: mineral or lithic identification, size, and angularity.

I compared data from the point count sampling of each thin section to determine the range and proportion of mineralogically distinct temper types represented in the thin section assemblage. The specific mineral and lithic inclusions were compared with both the known distribution of geological resources (Stearns 1944; MacDonald 1944; McDougall 1985), written descriptions of temper types (Dickinson 1969, 1974, 1976, 1993; 2006; Dickinson and Shutler 2000), and petrographic slides of both ceramic and lithic samples from private collection (Eckert's thin sections from Aganoa and the Ulu Tree site) to determine possible source areas. The petrographic analysis confirmed the three broad temper types identified in the binocular analysis discussed above and all three types conform to Dickinson's Oceanic basalt temper class (Dickinson 2006).

The Temper Groups

<u>*Temper Group I – olivine-poor basalt:*</u> 55% (N = 11) of the petrographic samples examined in this study are classified as Temper Group I: olivine-poor basalt (Figure 6.2). In ceramic hand samples, this temper type appears through a binocular microscope as angular pieces of black rock. In thin section, olivine-poor basalt normally has an intergranular to intersertal texture and is composed primarily of plagioclase and monoclinic pyroxene. Samples are too small to identify the minerals further. Rock inclusions are normally angular, fresh pieces with little to no altering of minerals; this corresponds with Dickinson's observation that sites in Samoa and American Samoa, unlike many other Oceanic potting traditions, has crushed rock temper (Dickinson 2006: 21). Unfortunately, olivine-poor basalt is common to all five volcanic series on Tutuila

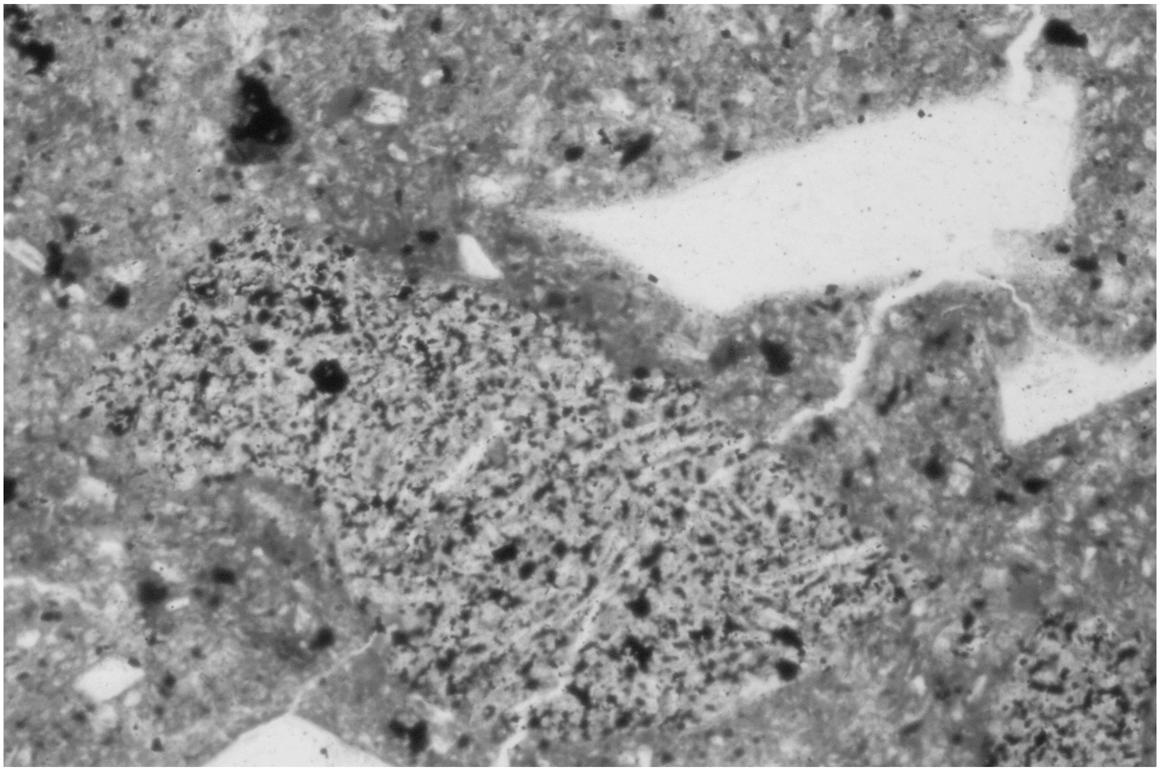

Figure 6.2. Olivine-poor basalt temper in thin section

Island (MacDonald 1944), and so production provenance of pottery with this temper type cannot be traced to a specific island location through petrography.

Temper Group II – olivine basalt: 40% (N = 8) of the petrographic samples examined in this study were classified as Temper Group II: olivine basalt (Figure 6.3). In ceramic hand samples, this temper type appears through a binocular microscope as angular pieces of dark gray to red rock. In this section, olivine basalt has a porphyritic texture, with large phenocrysts of olivine in an intergranular to intersertal groundmass composed of primarily plogioclase and pyroxenes. Most of the olivine has alteration rinds of iddingsite. As with the olivine-poor basalt described above, rock inclusions are normally angular indicating manual addition of this temper type to clay prior to production. Unfortunately, olivine basalt is the most common rock found in all five volcanic series on Tutuila Island (MacDonald 1944), making it impossible to trace production provenance of pottery with this temper type to a specific local on Tutuila Island using petrography.

Temper Group III – beach sands: 5% (N = 1) of the petrographic samples examined in this study are classified as Temper Group III: beach sand (Figure 6.4). In ceramic hand samples, this temper type appears as well-sorted, mostly rounded inclusions ranging in color from white to buff to red to black. The darker inclusions are volcanic in origin, and in thin section appear as small pieces of the olivine-poor basalt described above. Lighter colored inclusions were identified as feldspars and calcareous material. Some of the latter have textures indicative of marine shell and coral. Although it is safe to argue that beach sand temper is indicative of production along the coast of Tutuila, which village along the coast currently cannot be determined through petrographic analysis.

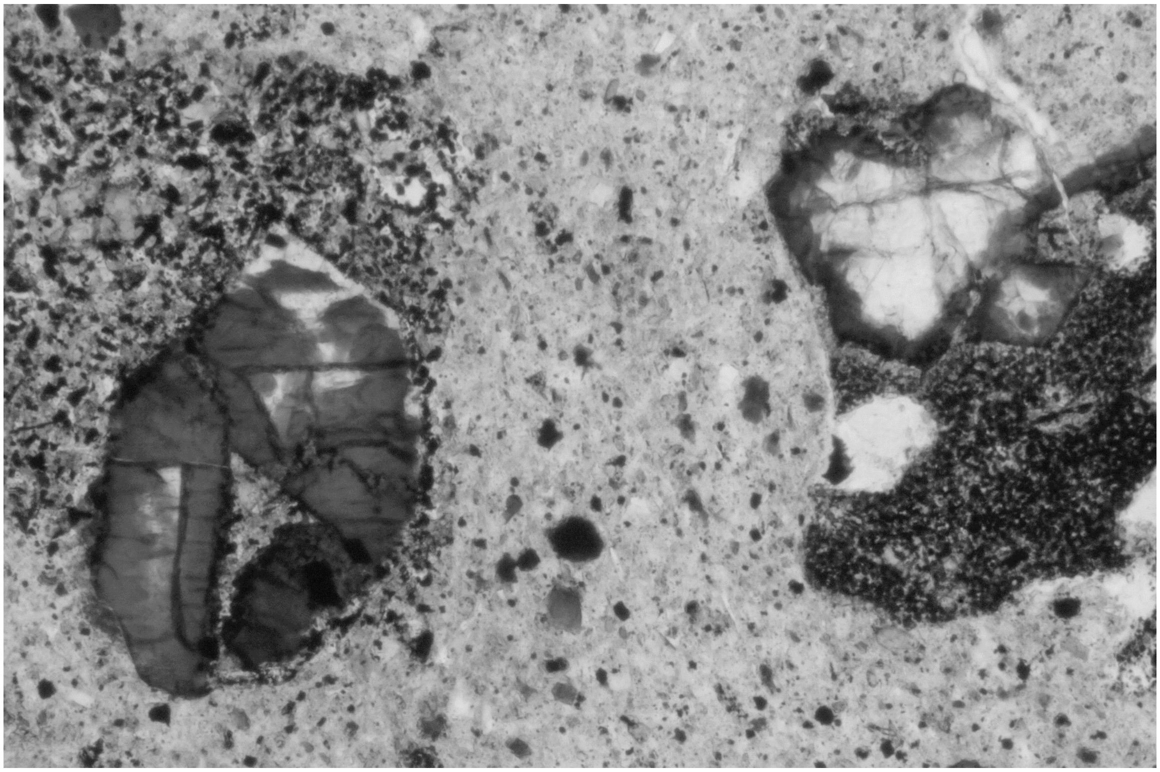

Figure 6.3. Olivine basalt temper in thin section

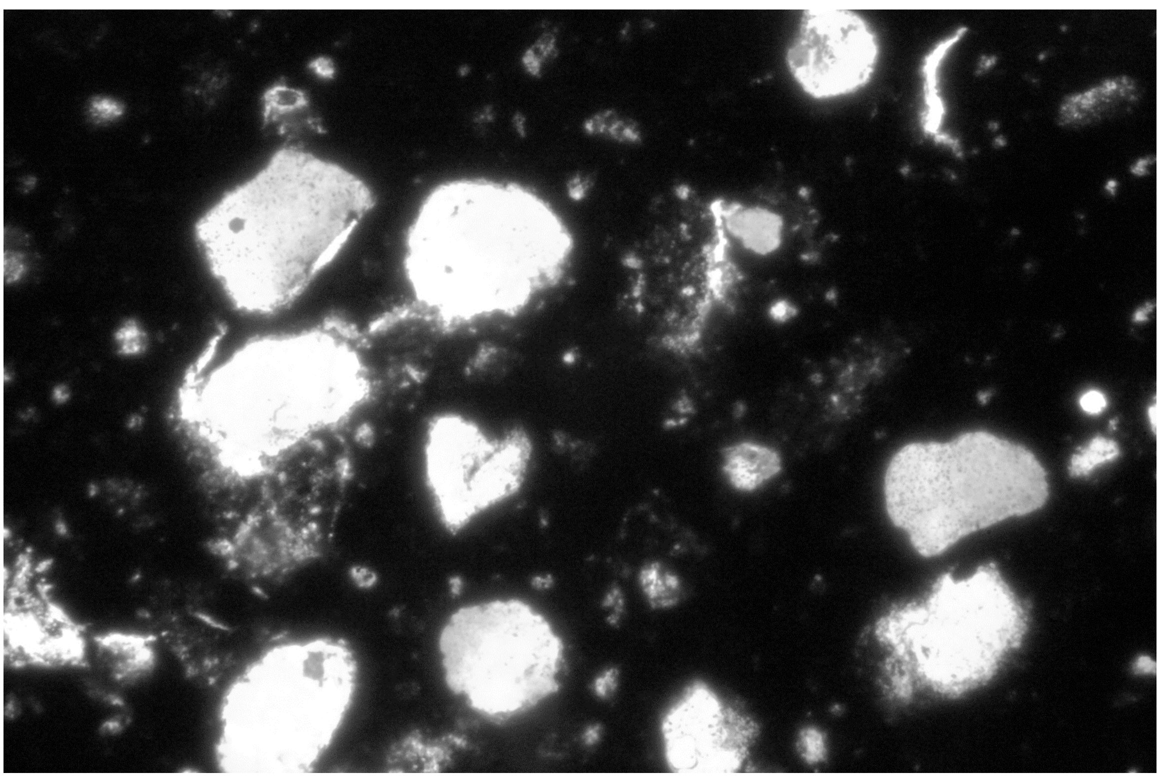

Figure 6.4. Beach sand temper in thin section

Discussion

One of the primary concerns of most published research focused on pottery in Samoa is a petrographic analysis of temper. The primary tempers reported from To'aga, (Dickenson 1993), 'Aoa (Clark and Michlovic 1996), Vailele (Dickenson 1969), and Falefa (Dickenson 1969) were some type of igneous rock or beach sand. Compared to these reports, no unusual patterns were found in the petrographic analysis of temper in sherds from Vainu'u. The analysis confirmed the binocular identification of three temper types at Vainu'u, all of which point to on-island production. Although one temper type indicates production in a coastal setting, overall the production provenance of pottery from Vainu'u could not be determined to a specific volcanic series. As a result, geochemistry was turned to in an attempt to narrow down the range of possible production provenances.

Geochemical Analysis

Geochemical work on basalts and clays has successfully differentiated volcanic series on Tutuila Island. Specifically, Johnson and colleagues (2007) found that basalt rock samples collected from known prehistoric quarries on island differentiated by quarry using Instrumental Neutron Activation Anaysis (INNA). James and Eckert (2009) found that clay samples collected from across the island differentiated by volcanic series using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS). As such, an LA-ICP-MS analysis was done on 80 sherds collected from Vainu'u during both the 2006 (N = 27 sherds) and 2007 (N = 53 sherds) field seasons in a further attempt to determine pottery production provenances on Tutuila. LA-ICP-MS was determined to be an appropriate method for this report because 1) it is relatively non-destructive, 2) it was successfully used to distinguish ceramic tiles made from Tutuila clays by volcanic series (James and Eckert 2009), and 3) it is relatively quick and easy compared to INAA.

Methodology

The 80 analyzed sherds were selected from excavated contexts only. Stratified random sampling was used in order to sample material from each paste and temper category defined in the binocular analysis discussed above. LA-ICP-MS analyses were conducted on a Perkin Elmer Elan DRCII housed at the Center for Chemical Characterization, Department of Chemistry, Texas A&M University. A New Wave UP-213 laser ablation system with associated software was used for sample induction.

Each ceramic sample had a fresh paste surface exposed; the sample was then placed in the induction chamber with the freshly exposed surface mounted towards the laser system. Prior to the analyses, the following parameters were set: the diameter of the laser beam was adjusted to 30 μm; each pass of the laser over the sample would remove 5 mm of material; the repetition rate of the laser was set to 10 Hz; and the maximum energy of the beam was set to 70%. Ablation rasters were set so that only paste matrix was sampled. After an initial pass to remove possible surface contaminants, two ablation passes were needed to generate abundance data for the 39 elements.

At the start of each day of analyses, a series of standards were analyzed: NIST standard SRM 610, NIST standard SRM 612, Glass Buttes obsidian, Pachuca obsidian, and MURR's Ohio Red Clay. A blank was run prior to each batch of 10 ceramic samples. The blank runs and standards were used to calibrate data using the Gratuze approach (Speakman and Neff 2005; Neff 2003: Gratuze 1999). Experiments using a wide range of materials, including ceramic, have shown that this approach yields results in reasonable agreement with data generated by other geochemical techniques.

The Analysis

Compositional variation was examined through principal components analysis and bivariate plots of various elements. This allowed for exploration of groupings based upon multivariate analyses as well as understand which elements drove these groupings. Results divide the sherds from Vainu'u into two main compositional groups, and these groupings are driven by the elements Al, Co, Cr, Fe, Ni, Ti, and V.

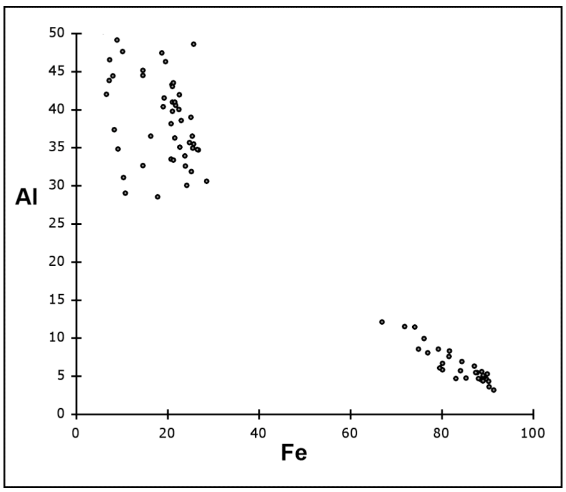

Figure 6.5. LA-ICP-MS analysis on sherds from Vainu'u plotted by Fe and Al

Two bivariate plots (Figures 6.5 and 6.6) serve to show the consistency of these compositional groups across multiple elements. These findings are in line with LA-ICP-MS analyses performed on sherds from other Tutuila sites (James and Eckert 2008), which found that group separation was driven by basically the same elements. The groups can be identified visually: sherds with relatively high Fe have the reddish brown to dark reddish brown (Munsell Color Chart Hue 5YR Value 3-5 Chroma 3-4) paste discussed above in the attribute analysis, while sherds with relatively low Fe have the light brown (Munsell Color Chart Hue 7.5YR Value 6 Chroma 3-4) paste.

Comparison of LA-ICP-MS data from the Vainu'u sherds to sherds recovered from coastal sites suggest that pottery at Vainu'u was being produced from a different suite of clays (Figure 6.7). Comparison of these data to ceramic tiles made from clays collected from three volcanic series --

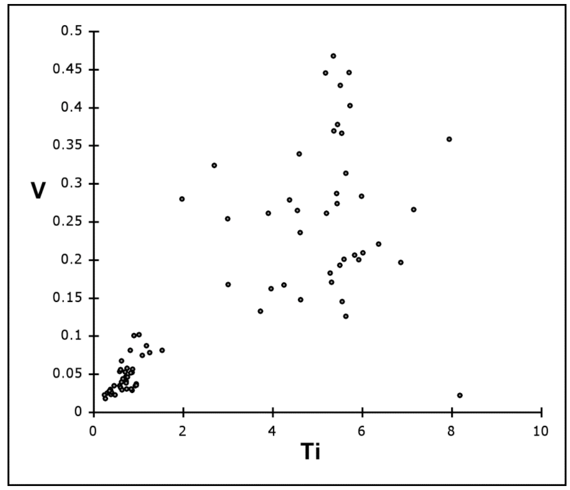

Figure 6.6. LA-ICP-MS analysis plotted by Ti and V; note outliers on far right

Olomoana, Pago, and Leone -- on Tutuila suggest that at least some pottery from coastal sites was produced from these clays, while pottery from Vainu'u was not. The two volcanic series not sampled – Pago and Taputapu -- are the two closest to Vainu'u. So, although unconfirmed with matching clays, the LA-ICP-MS data suggest that Vainu'u potters were using clays from one or both of these two sources. Further, at least two outlier sherds from Vainu'u do not group with the two primary compositional clusters (Figure 6.6). These two sherds clearly group with coastal sites (Figure 6.7) and may have been moved into Vainu'u from the coast. This agrees with the above finding that a few sherds are tempered with shell and were probably produced along the coasts. Finally, although two compositional groups are clearly defined by the LA-ICP-MS data from Vainu'u, sherds recovered from other sites do not belong to these groups, suggesting that pottery produced at Vainu'u was not leaving the site.

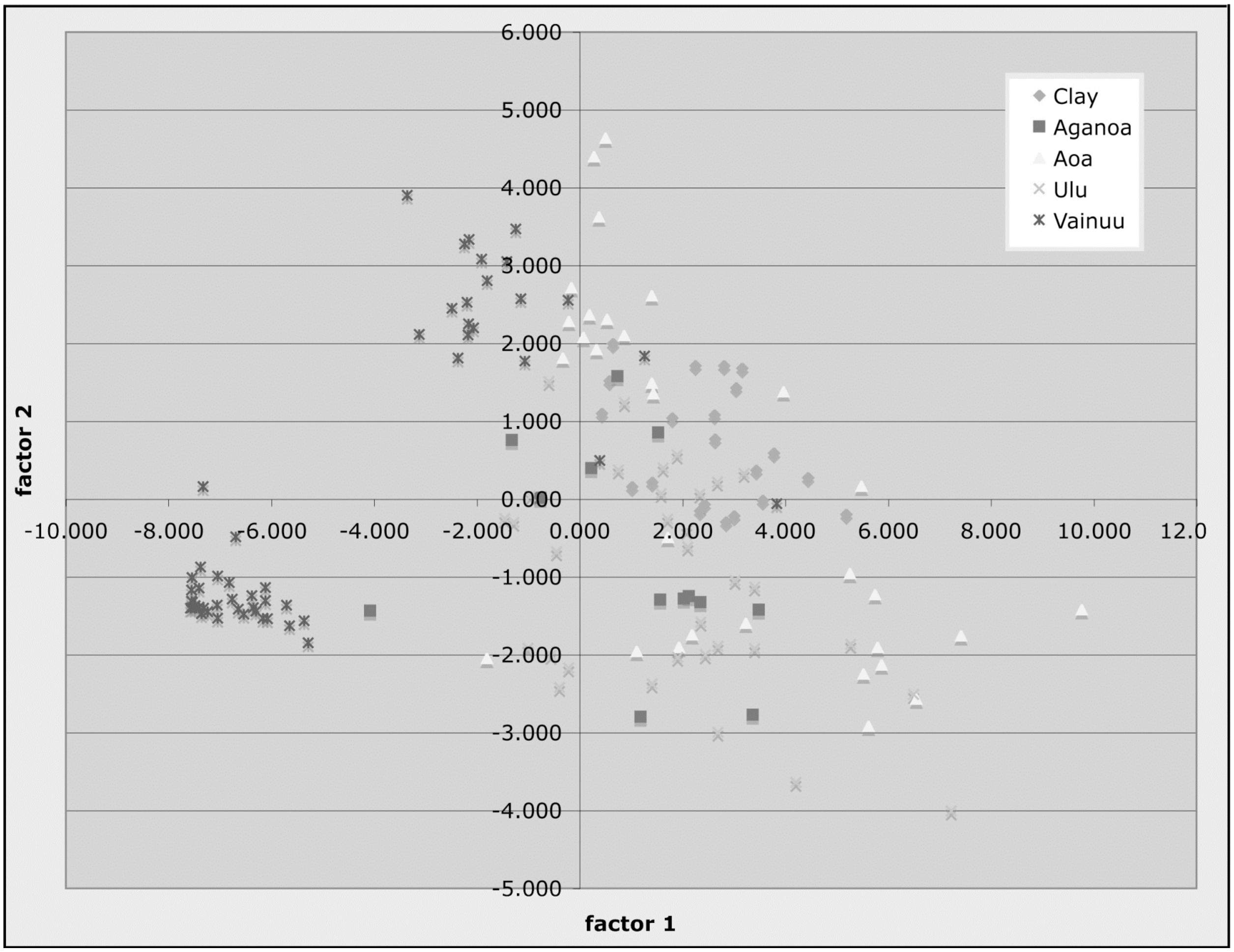

Figure 6.7. First two components of PCA results on LA-ICP-MS data from Tutuila clays and sherds (from James and Eckert 2009)

Summary

Ceramic analyses were undertaken with the hope of characterizing the Vainu'u ceramic assemblage in such a way as to be+ comparable to published collections from other western Polynesian sites. Overall, the combined analyses point to at least three findings that help to address the research issues outlined in Chapter 2. First, pottery at Vainu'u was used for cooking, as well as for service and/or storage. Second, pottery recovered from Vainu'u was overwhelmingly of local production. Third, and finally, pottery produced at Vainu'u does not appear to have been moved to coastal sites.

CHAPTER 7

SYNTHESIS AND CONCLUSIONS

In Chapter 2, we outlined four research issues that provided the framework for our excavations at Vainu'u. Surface maps, excavated features and material culture recovered from the site provided sufficient data to begin to address each of these issues. While we were able to gain answers to some of our research questions to a degree we had not thought possible at the onset of the project, answers to other questions remained more allusive than we had hoped and will require further work at Vainu'u and similar sites.

Chronological Placement of Vainu'u

The primary concern of our research at Vainu'u was to chronologically place the site so as to help determine the site's eligibility to the National Register of Historic places. One of the most interesting aspects surrounding the discovery of Vainu'u was that it did not fit into the agreed upon ancestral Samoan cultural sequence, which had pottery production occurring 3100-1700 B.P., *prior* to occupation of the highlands (Davidson 1979). The discovery of Vainu'u required one of two possible changes in the cultural timeline: either pottery was produced longer than suspected, or the highlands were occupied earlier than originally believed. As hoped, excavations at Vainu'u provided ten samples from solid cultural contexts that allow us to confidently place the site within the Samoan cultural sequence (Table 7.1).

Radiocarbon evidence collected for this report indicates that Vainu'u was occupied during three prehistoric periods: the Late Eastern Lapita Period (2700-2300 B.P.), the Plain Ware Period (2300-1700+ B.P.), and the Monument Building Period (1000 to 250 B.P). Based on current evidence, we divide the occupation of Vainu'u into two prehistoric components. A cluster of seven radiocarbon samples date Component 1 from 2270 to 2440 B.P; this component is associated with the ceramic-bearing layer of the site (Table 7.1). Based on a single radiocarbon date collected from within a posthole, Component 2 dates to ca. 650 B.P.; this component is associated with a large house foundation.

These findings indicate that our understanding of the Samoan cultural chronology needs to be changed in the

Table 7.1. Vainu'u Temporal Components placed within the Samoan Cultural Chronology (after Davidson 1979)

Period	Vainu'u Component	Cultural Material at Vainu'u
Early Eastern Lapita 3100 - 2700 B.P.		
Late Eastern Lapita 2700 - 2300 B.P.	Component 1 2270 - 2440 B.P.	cooking features (Features 4 and 5), pottery, volcanic glass, basalt blades, basalt scraping tools
Plain Ware Period 2300 - 1700+ B.P.		
Dark Ages 1700+ - 1000 B.P.		
Monument Building 1000 - 250 B.P.	Component 2 ca. 650 B.P.	house foundation (Feature 3), postholes (Feature 6), large triangular adzes, basalt scraping tools
Historic 250 B.P. - present		

following way: people were in the highlands during the earliest occupation of Tutuila. Pearl (2004) suggests that highland residency happened late in Samoan prehistory, but does not deny the possibility of early special use sites for the procurement of highland resources. Evidence from Vainu'u does not necessarily dispute this argument, in that no residential foundations were found; the presence of cooking ovens do not necessarily reflect long-term residential activities. That the earliest residents of the island were in the highlands, probably procuring specific resources, does not come as a surprise. A question that this report raises but does not answer is: how extensive and intensive was early highland occupancy? This question can only be answered through discovery, excavation, and dating of more ceramic period highland sites across the island.

Spatial and Functional Patterning

Our second research goal at Vainu'u -- to identify features that would help in our interpretations of the site – used an analytical model of features based on ethnographic documentation and previous archaeological research. This analytical model included: house platforms (including associated postholes), *ili'ili*, *umu, masi* pit, burials, fortifications, and star mounds. Over the course of the 2006 and 2007 excavations and mapping, seven features were identified (Table 7.2). We can be confident that large features – such as star mounds or fortifications – are not present at Vainu'u based on the 2007 field season. Such confidence cannot be stated about smaller features, including small house foundations. We were unable to clear all of the thick vegetation along the ridge on which Vainu'u sits, and as such, some smaller features may have gone undetected. Similarly, buried features not touched by our excavation units would have gone unrecorded.

Adaptive Strategies and Economic Pursuits

The third research goal outlined for Vainu'u was to use a combination of feature and artifact analyses to evaluate three lines

Table 7.2. Summary of cultural features identified at Vainu'u during 2006 and 2007

Feature	Location	Dimensions	Time period	Comments
Pit (no feature #)	surface	2 m diameter 1 m depth	Historic?	possible *masi* pit
House platform (feature 1)	surface	rough oval 4.25 x 5.00 m aligned east-west	Modern (within last 50 years)	complete stone pavement
Burial? (feature 2)	surface and partially buried?	rectangle 1.5 x 2 m aligned north-south	Historic?	low pile of stones
House platform (feature 3)	surface and partially buried	rough rectangle 15 x 12 m aligned northeast-southwest	Component 2	curbstones with dirt fill
Umu (feature 4)	Units C1 and C5 32-45 cmbs	90 cm diameter	Component 1	fired rocks
Umu (feature 5)	Units C2 and C6 26-64 cmbs	rough oval 110 cm at widest	Component 1	fired rocks with posthole
5 Postholes (feature 6)	Unit D2 ~29-49 cmbs	each ~8 cm diameter	Component 2	located on north edge of Feature 3

of inquiry concerning the adaptive strategies and economic pursuits performed at the site in prehistory. First, at any given time period, we were interested in whether or not the occupation of Vainu'u was permanent or periodic, residential or special use. Second, we were concerned with the economic pursuits that took place at Vainu'u in terms of three broad categories: subsistence, resource procurement, and craft production. Third, and finally, we hoped that evidence from Vainu'u would inform on the organization of craft production. As these three lines of inquiry are interrelated, and rely on the same suite of data, they are considered here as an integrated discussion.

Component 1

During Component 1, a visitor to Vainu'u would have been standing on a weak, yet stable, soil that would have allowed for the typical suite of highland plant growth. This component is early enough in Samoan prehistory that now extinct species of birds may have still wandered the island, and horticulture probably did not yet dominate the landscape. Cooking ovens and sooted pottery associated with this earliest component indicate that food production was taking place; however, what was being cooked is unknown. Whether this cooking was related to specific special-use activities or with long-term residency also remains unclear. The posthole found in association with one oven, as well as the scattering of pottery across the entire ridge, indicates either repeated use of the site for some special-activity pursuit or long-term residency associated with an as yet unidentified living structure. Currently, we favor the first interpretation based on the lack of evidence for a Component 1 residential structure and the limited range of features and artifact classes defined in the

Component 1 assemblage when compared to other sites. We would not be overly surprised, however, if a ceramic period living structure were discovered at Vainu'u, or at a similar highland site.

No indication of actual pottery production is evidenced at Vainu'u; petrographic and geochemical data suggest that the pottery recovered was produced from limited sources when compared to ceramic period coastal sites. We argue that these limited sources were local, and that pottery at Vainu'u was being produced for on-site use. This makes particular sense if Vainu'u were a special activity site used repeatedly over time. A potter would make her wares, and leave them in the highland location for future use, rather than carry the heavy and easily broken vessels up and down steep paths. Further, if Vainu'u was a special use site, then the types of activities where vessels would have moved between villages – feasts, life cycle events, exchange – would not have taken place there. However, these interpretations are currently speculative. What is evidenced is that Vainu'u pottery does not reflect participation in a network of villages across the island; pottery was not being moved back and forth from Vainu'u to sites along the coast.

The basalt blades, basalt flakes, and volcanic glass artifacts recovered from Component 1 deposits suggest that whatever cooking, procurement, or production activities included at Vainu'u required some amount of scraping. The presence of adzes and adze fragments point to some form of woodwork. Although there is no evidence for adze production at Vainu'u, retouch flakes suggest that adzes were regularly being reworked for the task at hand. The lack of exhausted basalt cores and primary flakes indicate that basalt adzes were being brought to the site in finished form, while the lack of volcanic glass cores may indicate that this rare material was being moved to and from the site.

Both these findings point towards short-term use of Vainu'u during Component 1, with easily carried tools and materials being transported back and forth as need required.

Although speculative, one interpretation of the Component 1 lithic assemblage is that early occupants of Vainu'u worked in this location to fell trees and begin at least initial woodworking. If wood workers were spending a few days at Vainu'u on a semi-regular basis, then some meals may have been prepared on site using pottery and stone ovens. The ceramic vessels and fire-seasoned stones would have then been left on the ridge for the next woodworking session.

Component 2

During Component 2, a visitor to Vainu'u would have been presented with a different landscape. After at least one volcanic eruption that covered the ridge in a layer of welded ash, the modern day soil layer had begun to develop. Horticulture now dominated the subsistence practices of the island's residents, and the ridge on which Vainu'u sits may already have been at least partially terraced for local gardens. Chances are, however, that wild vegetation was still also readily available. At least one family chose to build a house structure on the ridge, a location that provided an excellent view of the Pacific Ocean to both the north and south.

These occupants of the ridge had a different tool kit than their Component 1 counterparts: gone were basalt blades, gone were volcanic glass artifacts, gone were ceramic vessels. But the lithic assemblage was still dominated by scrapers, adzes, and retouch flakes, suggesting that woodworking was still at least one of the activities being done on the ridge.

Although the lithic analyses do not provide specifics on what activities were happening at Vainu'u during Component 2, they do provide evidence for what was *not* occurring. Component 2 dates to the Monument Building Period, a time of intense craft production on Tutuila, including the specialized production of basalt adzes for inter-island and inter-archipelago trade; however, there is no evidence that the residents of Vainu'u were participating in specialized production of any kind. The lithic assemblage does not have the high density expected of a lithic workshop (Winterhoff 2007), nor the high frequency of a narrow range of tool types expected if these tools were being used in the intense production of a perishable craft. This is not to say that residents of Vainu'u did not have access to specialized goods. Some of the basalt tools in the Component 2 assemblage are made from the fine-grained, high quality basalt associated with specialized production during this time. What social networks the residents of Vainu'u participated in to have access to these presumably controlled goods is not at all clear, but it does suggest that they were tied into the island's social and political landscapes.

Ancestral Polynesian?

The fourth, and final, research issue we hoped to address with Vainu'u centered on the concept of Ancestral Polynesians in Samoa; specifically, we hoped for data that would help evaluate the "cultural continuity" model and the "cultural hiatus" model. The "cultural continuity" model posits that occupation across Samoa was constant, with distinct social and cultural shifts occurring slowly over time so that the modern Polynesian inhabitants are directly descended from the Late Eastern Lapita inhabitants of 2500 years ago. The "cultural hiatus" model, on the other hand, posits that the ceramic and aceramic periods reflect two different cultural groups inhabiting the island at different times. Although Vainu'u adds to our growing body of well-dated sites that will eventually help evaluate these two models more thoroughly, currently we are no closer to understanding which model better reflects cultural developments on Tutuila.

There are two well-defined prehistoric cultural components identified at Vainu'u; these two components are separated by a time gap of over 1000 years and at least one volcanic explosion. Chronological time gaps are evident in the archaeological record at other sites in American Samoa, such as the coastal site of Aganoa on Tutuila (Eckert et al. 2008) and To'aga on nearby Ofu (Kirch and Hunt 1993). Davidson's (1979) "Dark Age" did not refer to a cultural back slide, after all, but to the very real lack of a good archaeological signature for cultural occupation between 1700 and 1000 B.P. The current chronological information from Vainu'u, then, fits well within the current archaeological assessment of cultural change on Tutuila. No confounding stratigraphic or chronological evidence exists in primary context at Vainu'u to warrant a reassessment of associated dates for cultural activity on site during either component of site use. Simply put, there is an appreciable time gap at Vainu'u between instances of habitual site visitation and this would appear, on first blush, to support the "cultural hiatus" model.

But the situation is not that simple. A true hiatus should be evident in the material culture, especially if that material culture were the tool kits for two different cultural groups. On the one hand, Component 1 has a very different material culture than Component 2: the former being characterized by volcanic glass artifacts, basalt blades, and pottery, while the latter is characterized by a lack of these items. On the other hand, the basalt artifacts that are present in Component 2 – basalt scrappers, adzes, adze retouch flakes – do not look significantly different from the same items found in the Component 1 assemblage. What needs to be known is if the Component 2 assemblage reflects specific Samoan developments, or if this assemblage reflects broader Polynesian developments. Our work at Vainu'u does not offer the data necessary to resolve this issue; what our work does offer is to add to the growing database of systematic excavation data and well-provenienced radiocarbon dates that will help to someday resolve this issue.

Comparison of Vainu'u with other Prehistoric Samoan Sites

Ceramic Periods

Few prehistoric ceramic sites in American Samoa have been as intensively investigated as Vainu'u in the last three decades. Those that have are been systematically excavated and reported have all been located along the coast or in the foothills. Prominent among these investigations are excavations at 'Aoa (Clark 1993; Clark et al. 1997; Clark and Michlovic 1996; Clark and Wright 1995), Aganoa (Moore and Kennedy 2003; Eckert et al. 2008; Crews 2008; Welch 2008) and To'aga (Kirch and Hunt [editors] 1993), each of which produced radiocarbon dates placing occupancy as roughly contemporaneous with ceramic period use of Vainu'u.

The site of 'Aoa (AS-21-5), located in 'Aoa Valley on the north coast of eastern Tutuila, was excavated under the direction of Jeffrey Clark in the early 1990s (Clark and Michlovic 1996). Two ceramic components were recognized: an upper component radiocarbon dated to 550 – 300 B.P., and a lower component radiocarbon dated to 3455 – 2195 B.P. (Clark 1993; Clark and Michlovic 1996). We focus our comparison on the lower component, as it is the one contemporaneous with Vainu'u. Aganoa (AS-22-43) is located in a small cove along the south coast of eastern Tutuila Island. First identified and tested by Moore and Kennedy (2003), the site was then extensively excavated by a Texas A&M University archaeology crew in 2006 (Eckert et al. 2008). The 2006 field season identified a cultural surface, containing ceramic artifacts, with an associated radiocarbon date of 2570 +/- 40 BP (conventional radiocarbon date). To'aga (AS-13-1) is located on the southeast shore of Ofu Island in the Manu'a Group (Kirch and Hunt [editors] 1993). The site was excavated in 1987 and 1989 by Kirch and Hunt, and identified a ceramic-bearing cultural component of continued occupation dating from 3200 -1900 B.P. (Kirch 1993a).

When compared with these three sites, the stone ovens identified at Vainu'u clearly represent one type in a range of firing features associated with ceramic component sites in American Samoa. Although no features were identified with the lower ceramic component at 'Aoa (Clark and Michlovic 1996), firing features were identified at both Aganoa and To'aga. The ceramic cultural surface excavated at Aganoa contained firing features as indicated by rings of basalt cobbles, ash piles and burnt soils; the ceramic bearing layers at To'aga contained multiple instances of ash lenses and oven stones. Although no unique features were identified at Vainu'u, features not present at Vainu'u were identified at Aganoa and To'aga in association with pottery: an *ili'ili* surface and shell midden were identified at Aganoa; while shell middens, pits, and postholes were identified at To'aga.

Vainu'u has a similar ceramic assemblage to 'Aoa, Aganoa, and To'aga. All four sites have both thin and thick ware. The sherds at each site display a variety of tempers and pastes pointing towards mostly localized production. Some vessels at each site have evidence that they were used for cooking (sooted vessels at Aganoa and Vainu'u, carbonized residues at To'aga [Hunt and Erkelens 1993: 137], and blackened surfaces at 'Aoa [Clark and Michlovic 1996: 161]). Rim forms at all four sites represent primarily wide-mouthed vessels. The general consensus of researchers at each site is that pottery vessels were probably used in a variety of ways including to store, cook, and serve food items.

Although there are some similarities between the lithic assemblages from these four sites, there are also some obvious differences. Vainu'u's Component 1 lithic assemblage is characterized by basalt blades, basalt scraping tools, volcanic glass, and adzes so weathered and broken as to be unidentifiable to type. Aganoa and 'Aoa have adzes and adze fragments (as well as 12 adze preforms at 'Aoa), basalt flake tools identified as scrapers and gravers, and volcanic glass. Even though all three sites have a substantial lithic assemblage, no basalt blades were identified at the coastal sites, while no gravers were identified at Vainu'u. To'aga, on the other hand, has a much smaller basalt assemblage when compared to the Tutuila sites. To'aga's assemblage includes a few flakes, awl-like tools, and 3 adzes; very few pieces of volcanic glass were found and what was recovered was assumed to be natural (Kirch 1993b).

One obvious difference underlying the lithic assemblages at each site is the range and type of activities that were taking place at each site (or at least, in the locales excavated at each site). Although specific activities cannot be stated with any certainty, differences in the tool kit of each site may reflect differences in types of activities. The presence of adzes at all four sites may indicate wood working was occurring at each location; however there are many steps in the woodworking process, and many different types of items that can be made through woodworking. The tools used to hollow out a wooden boat, for example, are not the same as the tools used to put the finishing touches on a wooden bowl. There is a second possible reason for the differences in the lithic assemblage at each site: easy access to shell at the coastal sites. Although few shell artifacts were preserved at 'Aoa, material from Aganoa and To'aga indicated that a variety of tools – including abraders, fish hooks, and scrapers – were made from shell. Shell and lithic scrapers may reflect different scraping needs, personal preference, or use of the closest available resource as the need for a scraper arose.

To summarize, Component 1 at Vainu'u falls well within the range of variability in terms of material culture when compared to roughly contemporaneous coastal sites. Differences between the four sites considered may be the result of either functional or temporal factors. If Vainu'u was a special use site while the coastal sites were permanent settlements, this could account for variability in features and artifact types. However, differences may also have a temporal component. Other than the evidence from To'aga and 'Aoa that thicker pottery increases in frequency over time, we still do not have a clear understanding of how most material culture changed over the approximately 1000 years considered here. For example, the basalt blades at Vainu'u may indicate time as well as function; or specific types of features may be restricted to specific periods not yet identified by archaeologists. Tighter chronological control has always been, and will continue to be, the best way to determine how much of a factor time is when considering the differences between sites.

Aceramic Periods

Component 2 at Vainu'u dates squarely within the Monument Building Period, a time period in which there was intensive residency in the Tutuila highlands (Pearl 2004). This period has probably witnessed the most intensive archaeological investigations on Tutuila island due to the high visibility of sites, the rich oral traditions that exist to help in interpretations, and the social complexity of the period that resulted in production intensification and exchange between archipelagos. In his study of building a chronology for the mountain settlements, Pearl (2004) focused specifically on three highland sites due to their size and preservation. Because of the chronology Pearl established for these sites, they are used here for comparison with Vainu'u.

Lefutu (AS-21-02) is located on a ridge overlooking the most eastern coastline of Tutuila. Despite prior claims that the site served as a defensive outpost (Frost 1976, 1978), extensive mapping (Clark and Herdrich 1988) of the site's surface features has led to the reinterpretation that this highland site was a residential village. Old Vatia (AS-24-02), located on Faiga Ridge overlooking the north-central coast of Tutuila, is probably the largest highland site on Tutuila (Clark and Herdrich 1988). Levaga Village (AS-25-27), located approximately 1.5 km southwest of Old Vatia and at a slightly higher elevation, also overlooks the northern coast. Both Old Vatia and Levaga Village have been interpreted as primarily residential complexes. Pearl (2004) has estimated that all three villages were established between 680 and 640 years ago, exactly at the time we believe Component 2 of Vainu'u was occupied.

Unfortunately, it is meaningless to directly compare the Component 2 features and material culture of Vainu'u with Lefutu, Old Vatia, and Levaga Village. These latter three sites continued to be occupied for a few centuries, and their construction sequences are still not understood (Pearl 2004). We do not know if these three sites were established as the large villages that we see on the ground today, or if they began as one or two residential units that eventually expanded into the largest highland villages on the island.

What we can say with certainty is that Vainu'u never obtained the village size of Lefutu, Old Vatia, or Levaga Village. Geographically, the location of the three large sites does not seem to have an advantage over Vainu'u. While each large village holds a commanding view of a coast, Vainu'u holds a commanding view of both the north and south Pacific; while each large site is spread over a ridge, Vainu'u is located on a ridge that would have allowed for continued expansion. There are other geographic factors that may have played a role in why some locations were chosen for expansion while others were not. Specifically, proximity to controllable resources important to the developing social order may have played a role in which villages grew. Politics may also have been important; the social and political dynamics of chiefs vying for power may have played a role in which ridge top sites developed and expanded and which did not. These various scenarios are testable, as more data from both small and large highland sites are collected.

National Register of Historic Places Recommendations

The primary purpose of this report was to collect data that would help assess Vainu'u with reference to eligibility criteria for inclusion on the National Register of Historic Places. We argue, for the following reasons, that Vainu'u is eligible and, as such, have already submitted a nomination (Eckert and Hawkins 2008) to ASHPO for consideration. Vainu'u should be considered for inclusion on the National Register of Historic Places under criterion *A: Property is associated with events that have made a significant contribution to the broad patterns of our history* and under criterion *D: Property has yielded, or is likely to yield, information important in prehistory or history*.

Vainu'u represents several time periods of ancestral Samoan society, including the earliest known highland occupation. The site has produced numerous datable charcoal samples, allowing archaeologists to create a more accurate chronology for ancestral Samoan society than currently exists. Specifically, ten radiocarbon dates have been recovered from good cultural contexts at Vainu'u and suggest the site had at least two prehistoric components. Component 1, dating from 2270 to 2440 B.P., places the earliest use of Vainu'u at the Late Eastern Lapita Period/Plain Ware Period transition. Component 2, dating to ca. 650 B.P., places occupants living at Vainu'u during the Monument Building Period. Although we are confident of dates associated with the various occupations at Vainu'u, further excavation needs to be done to understand how the various recovered features are related to the use of highland resources over time.

As the first ceramic-bearing highland site reported and excavated on Tutuila Island, Vainu'u has changed our understanding of the ancestral Samoan timeline. Prior to excavations at this site, the agreed upon cultural sequence had pottery production ceasing *prior* to highland occupation. With the excavation of datable material from Vainu'u, we now know that the highlands were occupied earlier than originally believed. However, we still do not know the exact nature of Vainu'u and other early highland sites: did early residents of Tutuila only make temporary camps in the highlands while collecting specific resources, or did they also build more permanent residential sites? Currently, we do not have enough excavation data to answer these questions. Further work at Vainu'u has the potential of providing more data to help clarify how early occupants of the island used their highland resources. Artifacts found *in situ* and in association with features provide great potential in helping archaeologists understand craft production and circulation in ancestral Samoan society. As this report attests, analyses of lithic and ceramic artifacts from Vainu'u have already provided some tantalizing finds that substantially expand our current knowledge of early production on the island.

Conclusions

In summary, although within the range of variability of previously excavated sites in American Samoa, the material culture of Vainu'u differs from these sites in some important ways as well. These differences can be explained in terms of at least three factors. Functional factors (permanent settlements versus temporary use, procurement of highland versus coastal resources) may account for differences observed between the Component 1 occupation of Vainu'u and contemporary coastal sites. While either political factors (the proximity Vainu'u residents had to high chiefs) or geographic factors (proximity to certain resources such as fine-grained basalt) may account for differences observed between Component 2 residency of Vainu'u and contemporary highland sites.

We have envisioned the early occupants of Vainu'u as a group of woodworkers who used the ridge regularly, but intermittently, as an activity area. We have described later occupants of the ridge as having built a house and living there on a more permanent basis than the previous occupants. Although these latter occupants were clearly tied into social networks across the island, they do not appear to have been at the center of any prestige building or production specialization activities. Of course, this is just one of a number of possible scenarios; a scenario we think is most likely based on current available data, but one that is still fairly speculative. The information recovered from Vainu'u provides a glimpse of the past, suggesting that life on the ridge changed over time. Although the 2007 excavations at Vainu'u were at least partially successful in terms of addressing each of the research goals outlined at the beginning of the project, there is still much to be learned at this and similar highland sites.

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APPENDIX A

RADIOCARBON REPORTS FROM BETA ANALYTIC, INC.

FROM: Darden Hood, Director (mailto:mailto:dhood@radiocarbon.com)
(This is a copy of the letter being mailed. Invoices/receipts follow only by mail.)

April 10, 2007

Mr. John Enright
American Samoa Historic Preservation Office
Executive Offices of the Governor
Pago Pago 96799
American Somoa

RE: Radiocarbon Dating Results For Samples PDK09, PDK20, PDK21, PDK23

Dear Mr. Enright:

Enclosed are the radiocarbon dating results for four samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. The report sheet contains the dating result, method used, material type, applied pretreatment and two-sigma calendar calibration result (where applicable) for each sample.

You will notice that Beta-228639 (PDK09) is reported with the units “pMC” rather than BP. “pMC” stands for "percent modern carbon". Results are reported in the pMC format when the analyzed material had more ^{14}C than did the modern (AD 1950) reference standard. The source of this "extra" ^{14}C in the atmosphere is thermo-nuclear bomb testing which on-set in the 1950s. Its presence generally indicates the material analyzed was part of a system that was respiring carbon after the on-set of the testing (AD 1950s). On occasion, the two sigma lower limit will extend into the time region before this "bomb-carbon" onset (i.e. less than 100 pMC). In those cases, there is some probability for 18th, 19th, or 20th century antiquity.

We analyzed these samples on a sole priority basis. No students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

Information pages are enclosed with the mailed copy of this report. They should answer most of questions you may have. If they do not, or if you have specific questions about the analyses, please do not hesitate to contact us.   Someone is always available to answer your questions.

Thank you for prepaying the analyses. As always, if you have any questions or would like to discuss the results, don’t hesitate to contact me.

Sincerely,

Darden Hood

Mr. John Enright	Report Date: 4/10/2007
American Samoa Historic Preservation Office	Material Received: 3/9/2007

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 228639	133.1 +/- 0.5 pMC	-27.8 o/oo	133.8 +/- 0.5 pMC

SAMPLE : PDK09
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
COMMENT: reported result indicates an age of post 0 BP and has been reported as a % of the modern reference standard, indicating the material was living within the last 50 years.

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 228640	150 +/- 40 BP	-28.2 o/oo	100 +/- 40 BP

SAMPLE : PDK20
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1670 to 1770 (Cal BP 280 to 180) AND Cal AD 1800 to 1940 (Cal BP 150 to 10)
Cal AD 1950 to 1960 (Cal BP 0 to 0)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 228641	210 +/- 40 BP	-28.6 o/oo	150 +/- 40 BP

SAMPLE : PDK21
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1660 to 1960 (Cal BP 290 to 0)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 228642	1780 +/- 40 BP	-29.0 o/oo	1710 +/- 40 BP

SAMPLE : PDK23
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 240 to 420 (Cal BP 1710 to 1530)

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-28.2:lab. mult=1)

Laboratory number: **Beta-228640**

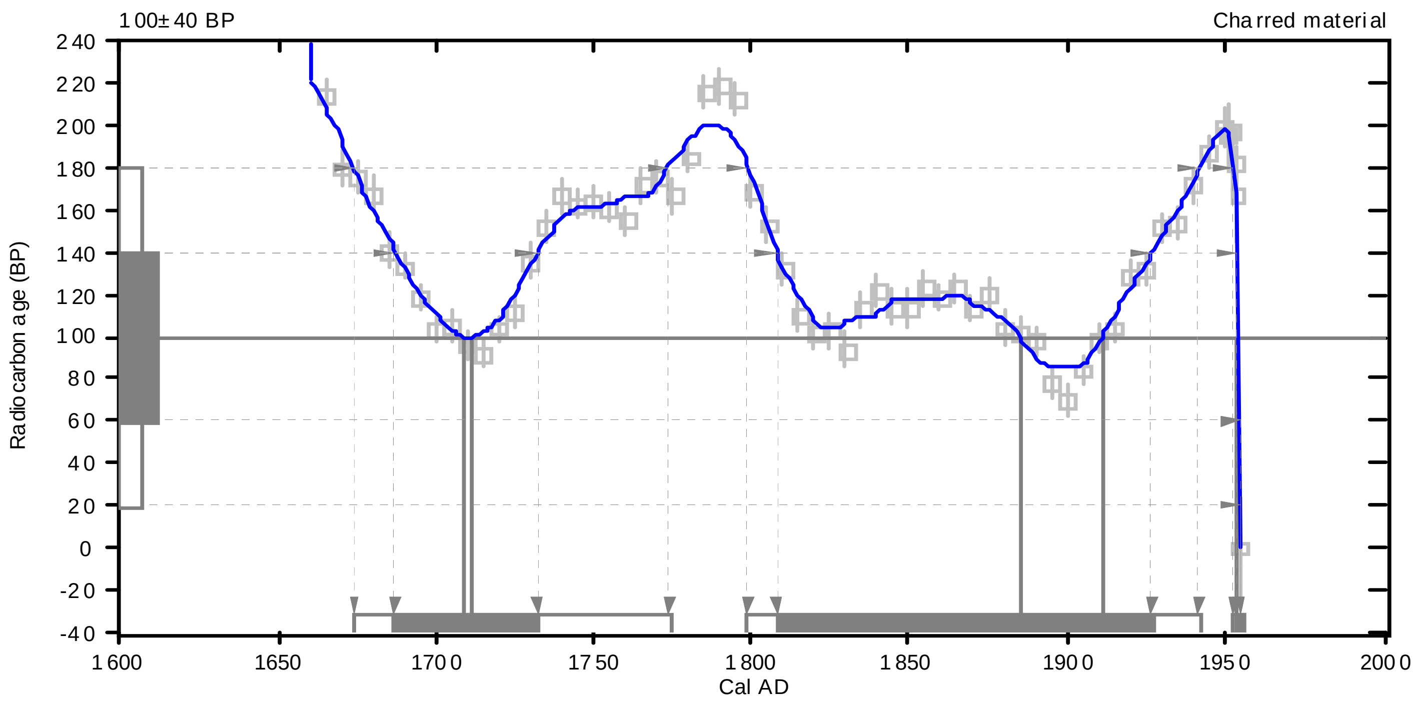
Conventional radiocarbon age: **100±40 BP**

2 Sigma calibrated results: **Cal AD 1670 to 1770 (Cal BP 280 to 180) and**
(95% probability) **Cal AD 1800 to 1940 (Cal BP 150 to 10) and**
Cal AD 1950 to 1960 (Cal BP 0 to 0)

Intercept data

Intercepts of radiocarbon age
with calibration curve: Cal AD 1710 (Cal BP 240) and
Cal AD 1710 (Cal BP 240) and
Cal AD 1880 (Cal BP 60) and
Cal AD 1910 (Cal BP 40) and
Cal AD 1950 (Cal BP 0)

1 Sigma calibrated results: Cal AD 1690 to 1730 (Cal BP 260 to 220) and
(68% probability) Cal AD 1810 to 1930 (Cal BP 140 to 20) and
Cal AD 1950 to 1960 (Cal BP 0 to 0)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-28.6:lab. mult=1)

Laboratory number: **Beta-228641**

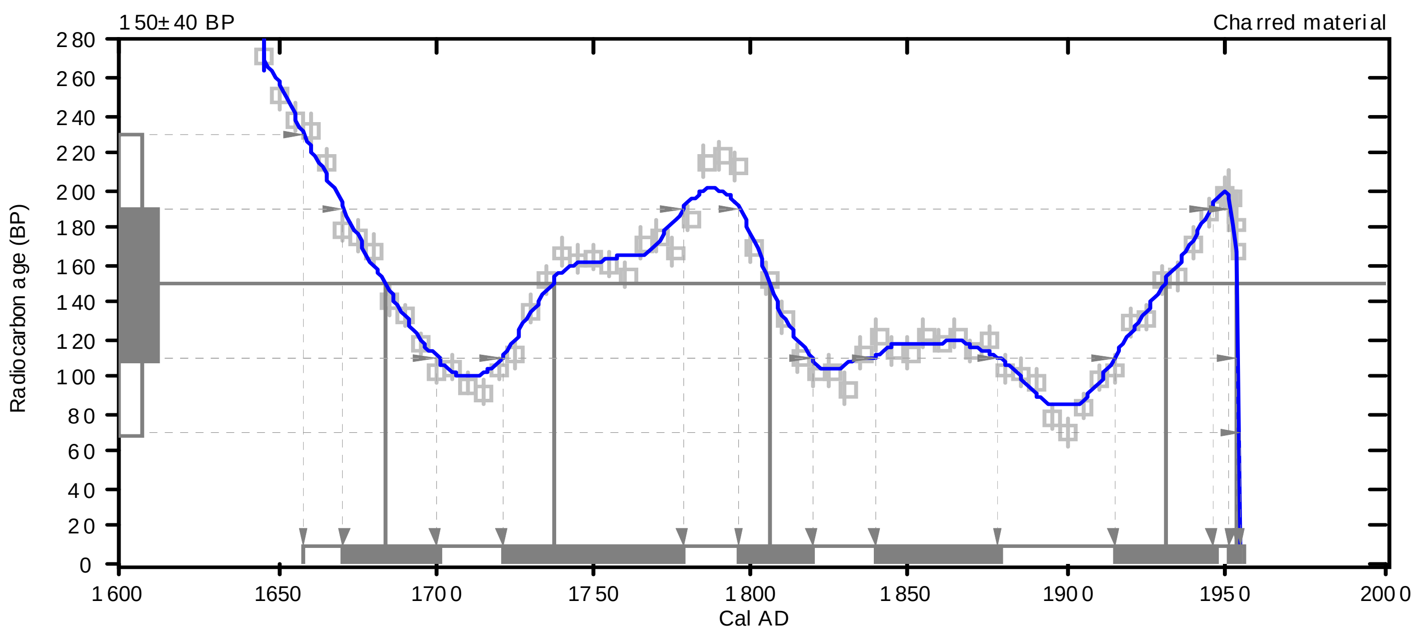
Conventional radiocarbon age: **150±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1660 to 1960 (Cal BP 290 to 0)**

Intercept data

Intercepts of radiocarbon age with calibration curve:
Cal AD 1680 (Cal BP 270) and
Cal AD 1740 (Cal BP 210) and
Cal AD 1810 (Cal BP 140) and
Cal AD 1930 (Cal BP 20) and
Cal AD 1950 (Cal BP 0)

1 Sigma calibrated results: (68% probability)
Cal AD 1670 to 1700 (Cal BP 280 to 250) and
Cal AD 1720 to 1780 (Cal BP 230 to 170) and
Cal AD 1800 to 1820 (Cal BP 150 to 130) and
Cal AD 1840 to 1880 (Cal BP 110 to 70) and
Cal AD 1920 to 1950 (Cal BP 40 to 0) and
Cal AD 1950 to 1950 (Cal BP 0 to 0)



References:
Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-29:lab. mult=1)

Laboratory number: **Beta-228642**

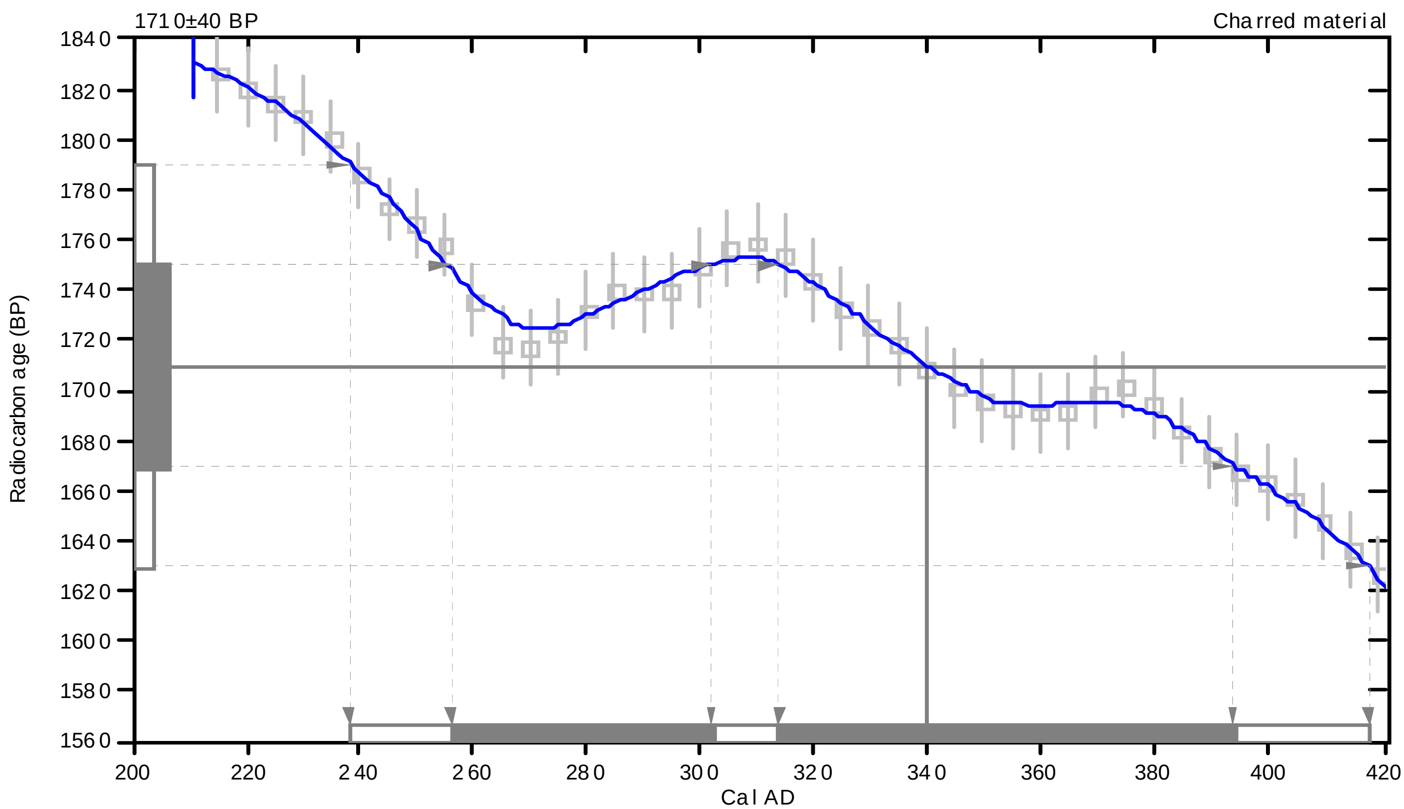
Conventional radiocarbon age: **1710±40 BP**

2 Sigma calibrated result: **Cal AD 240 to 420 (Cal BP 1710 to 1530)**
(95% probability)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 340 (Cal BP 1610)

1 Sigma calibrated results: Cal AD 260 to 300 (Cal BP 1690 to 1650) and
(68% probability) Cal AD 310 to 390 (Cal BP 1640 to 1560)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

FROM: Darden Hood, Director (mailto:mailto:dhood@radiocarbon.com)
(This is a copy of the letter being mailed. Invoices/receipts follow only by mail.)

March 3, 2008

Dr. Suzanne Eckert
Texas A & M University
Department of Anthropology
4352 TAMU
College Station, TX 77843
USA

RE: Radiocarbon Dating Results For Samples V037, V058, V060, V071, V081, V084, V091, V093, V103, V107

Dear Dr. Eckert:

Enclosed are the radiocarbon dating results for ten samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

The cost of analysis was previously invoiced. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood

Dr. Suzanne Eckert | Report Date: 3/3/2008

Texas A & M University | Material Received: 2/4/2008

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240791	2440 +/- 40 BP	-24.9 o/oo	2440 +/- 40 BP

SAMPLE : V037
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (carbon residue): acid washes
2 SIGMA CALIBRATION : Cal BC 760 to 400 (Cal BP 2710 to 2350)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240792	2340 +/- 40 BP	-27.5 o/oo	2300 +/- 40 BP

SAMPLE : V058
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 410 to 360 (Cal BP 2360 to 2300) AND Cal BC 290 to 240 (Cal BP 2240 to 2180)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240793	2380 +/- 40 BP	-27.9 o/oo	2330 +/- 40 BP

SAMPLE : V060
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 410 to 370 (Cal BP 2360 to 2320)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240794	1400 +/- 40 BP	-19.9 o/oo	1480 +/- 40 BP

SAMPLE : V071
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (carbon residue): acid washes
2 SIGMA CALIBRATION : Cal AD 540 to 650 (Cal BP 1420 to 1300)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240795	2290 +/- 40 BP	-28.0 o/oo	2240 +/- 40 BP

SAMPLE : V081
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 390 to 200 (Cal BP 2340 to 2150)

Dr. Suzanne Eckert

Report Date: 3/3/2008

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240796	2320 +/- 40 BP	-28.3 o/oo	2270 +/- 40 BP

SAMPLE : V084
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 400 to 340 (Cal BP 2350 to 2290) AND Cal BC 320 to 210 (Cal BP 2270 to 2160)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240797	2370 +/- 40 BP	-27.8 o/oo	2320 +/- 40 BP

SAMPLE : V091
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 410 to 360 (Cal BP 2360 to 2310)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240798	660 +/- 40 BP	-25.9 o/oo	650 +/- 40 BP

SAMPLE : V093
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1280 to 1400 (Cal BP 670 to 550)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240799	2280 +/- 40 BP	-27.3 o/oo	2240 +/- 40 BP

SAMPLE : V103
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 390 to 200 (Cal BP 2340 to 2150)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 240800	2440 +/- 40 BP	-25.3 o/oo	2440 +/- 40 BP

SAMPLE : V107
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (carbon residue from sherd): acid washes
2 SIGMA CALIBRATION : Cal BC 760 to 400 (Cal BP 2710 to 2350)

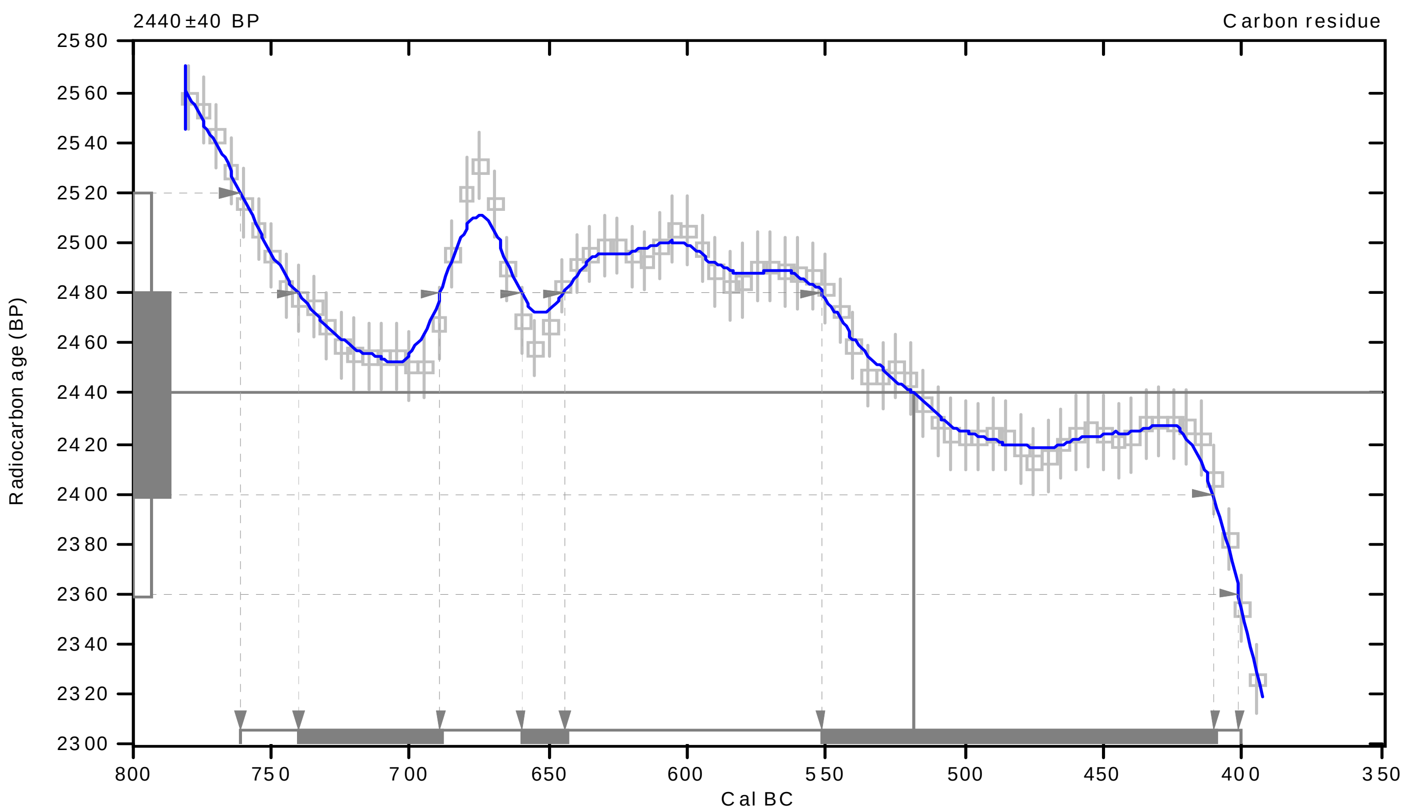
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.9:lab. mult=1)

Laboratory number:	**Beta-240791**
Conventional radiocarbon age:	**2440±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 760 to 400 (Cal BP 2710 to 2350)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 520 (Cal BP 2470)
1 Sigma calibrated results: (68% probability)	Cal BC 740 to 690 (Cal BP 2690 to 2640) and Cal BC 660 to 640 (Cal BP 2610 to 2590) and Cal BC 550 to 410 (Cal BP 2500 to 2360)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.5:lab. mult=1)

Laboratory number: **Beta-240792**

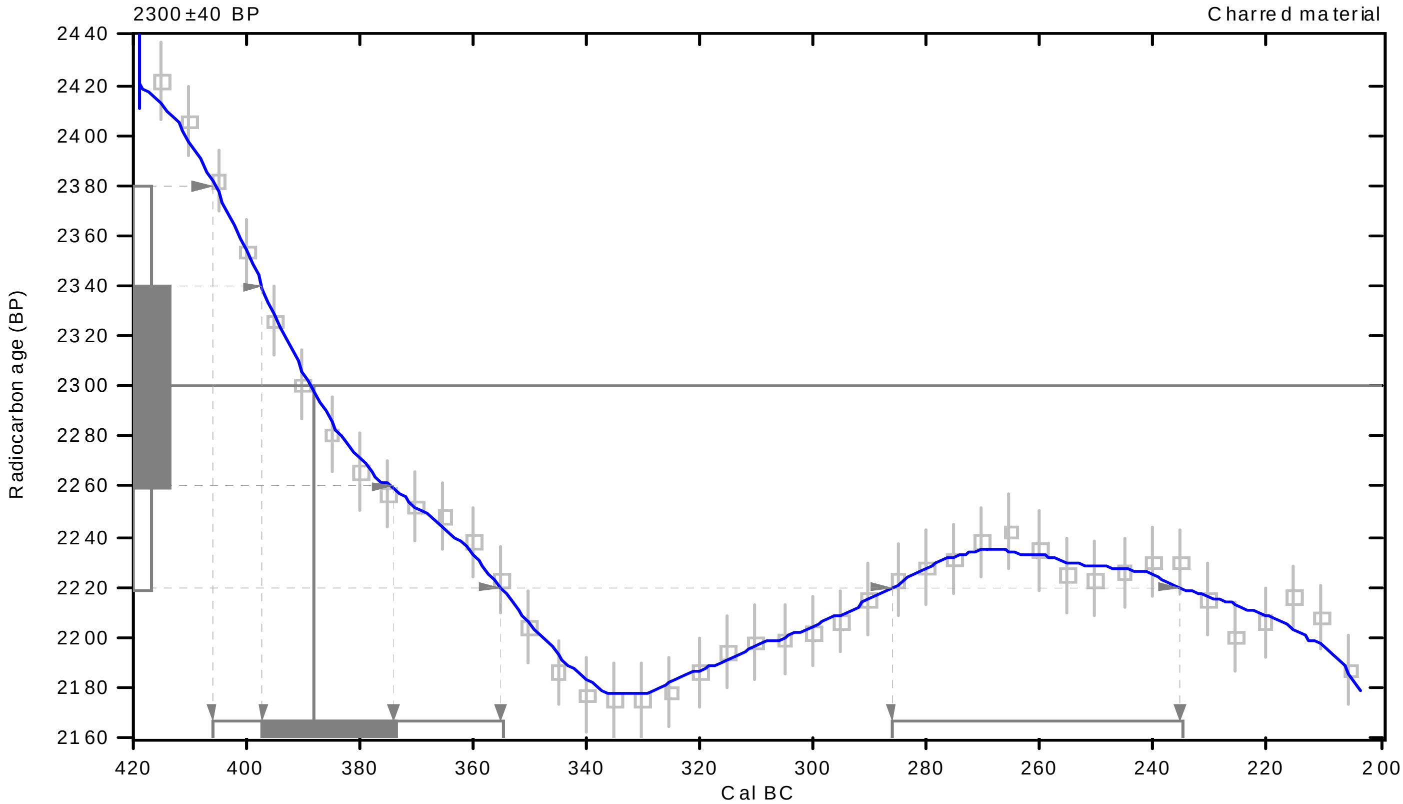
Conventional radiocarbon age: **2300±40 BP**

2 Sigma calibrated results: (95% probability) **Cal BC 410 to 360 (Cal BP 2360 to 2300) and Cal BC 290 to 240 (Cal BP 2240 to 2180)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 390 (Cal BP 2340)

1 Sigma calibrated result: (68% probability) Cal BC 400 to 370 (Cal BP 2350 to 2320)



References:

Database used
INTCAL04
Calibration Database
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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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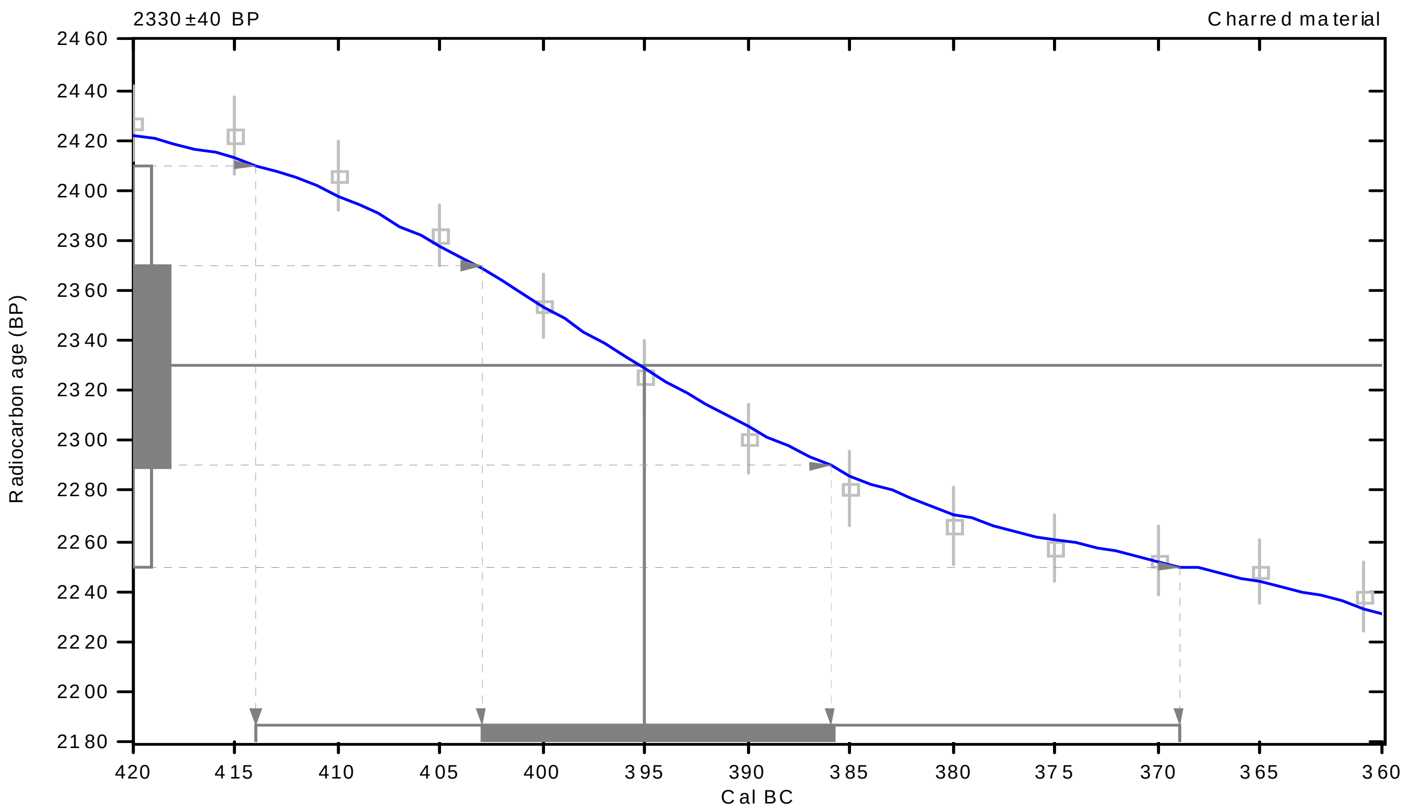
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.9:lab. mult=1)

Laboratory number:	**Beta-240793**
Conventional radiocarbon age:	**2330±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 410 to 370 (Cal BP 2360 to 2320)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 400 (Cal BP 2340)
1 Sigma calibrated result: (68% probability)	Cal BC 400 to 390 (Cal BP 2350 to 2340)



References:

Database used

INTCAL04

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-19.9:lab. mult=1)

Laboratory number: **Beta-240794**

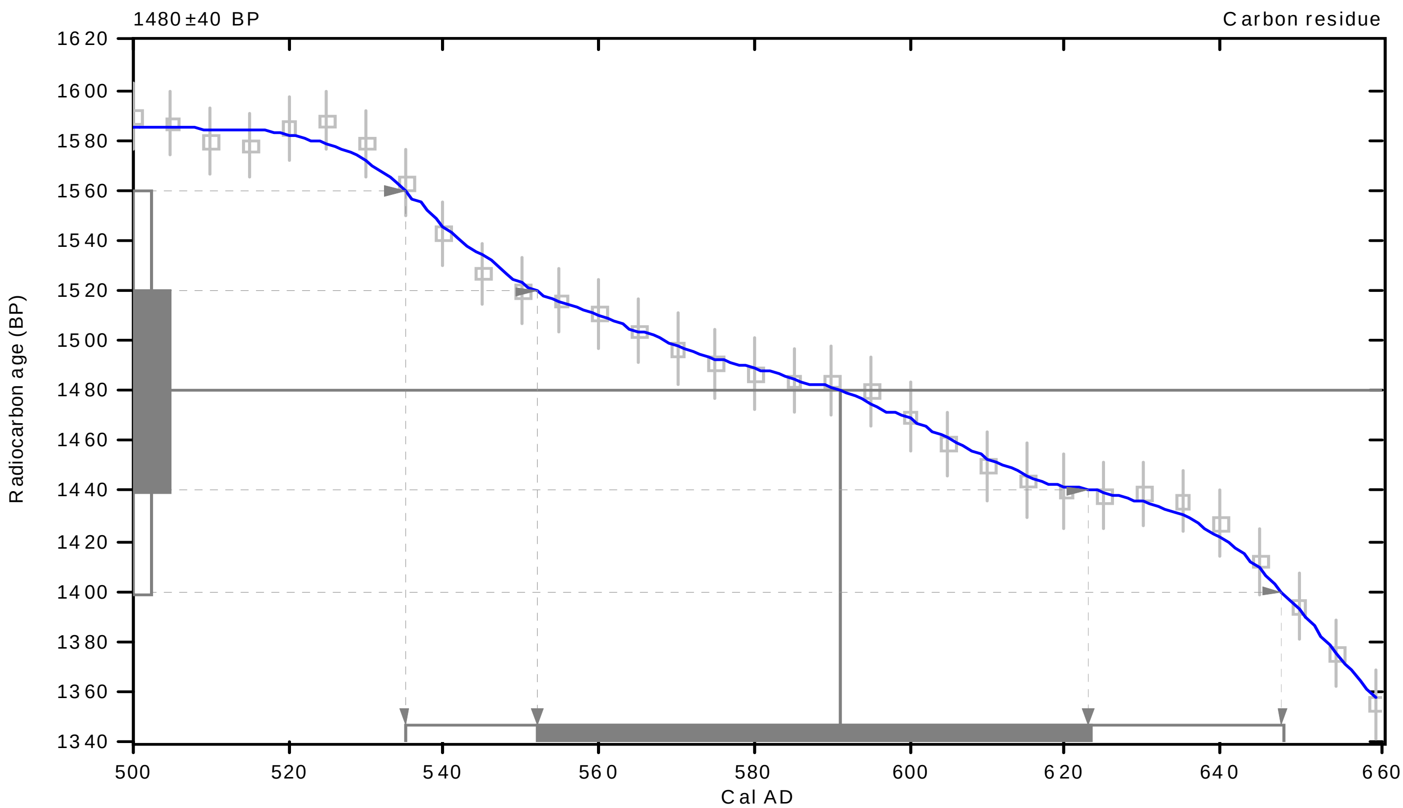
Conventional radiocarbon age: **1480±40 BP**

2 Sigma calibrated result: **Cal AD 540 to 650 (Cal BP 1420 to 1300)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 590 (Cal BP 1360)

1 Sigma calibrated result: Cal AD 550 to 620 (Cal BP 1400 to 1330)
(68% probability)



References:

Database used
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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-28:lab. mult=1)

Laboratory number: **Beta-240795**

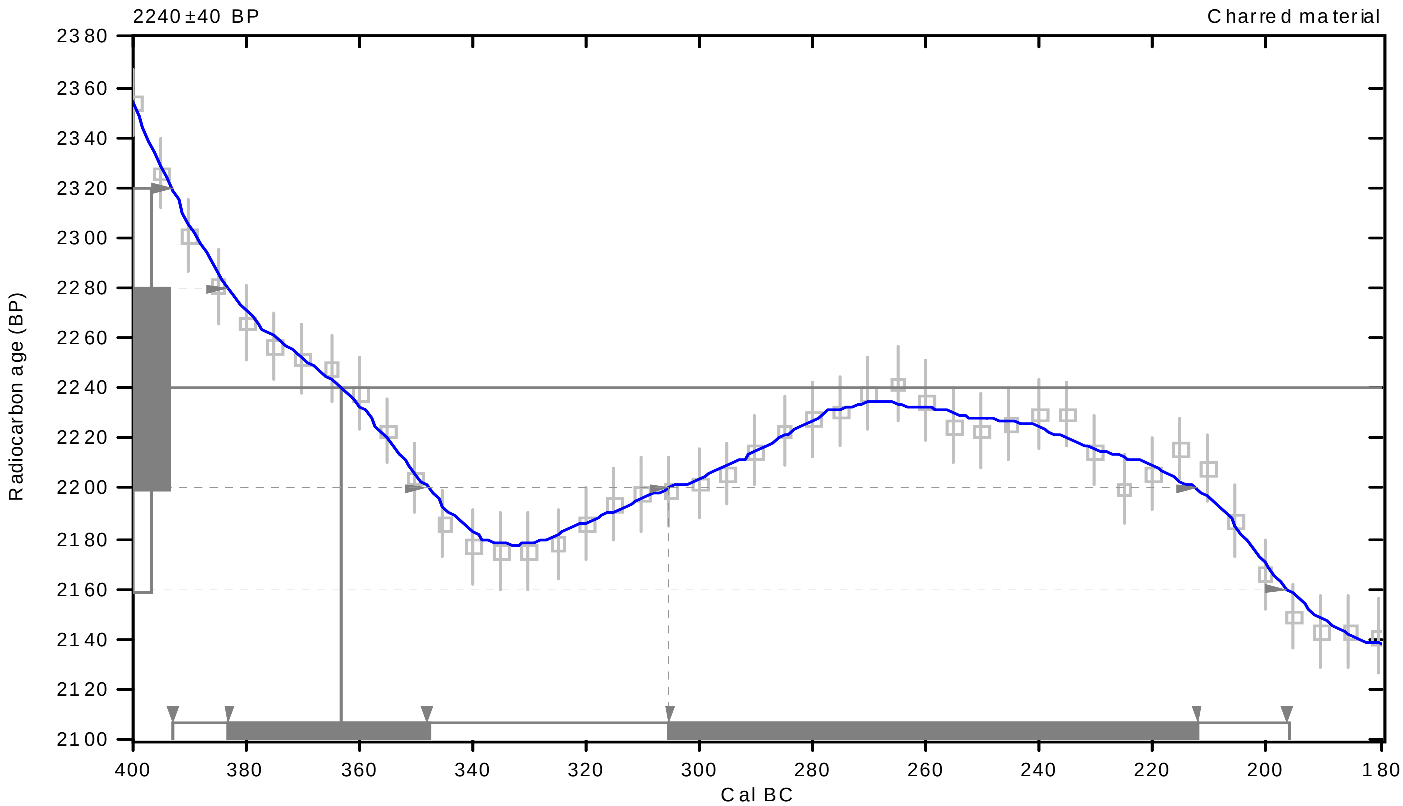
Conventional radiocarbon age: **2240±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 390 to 200 (Cal BP 2340 to 2150)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 360 (Cal BP 2310)

1 Sigma calibrated results: (68% probability) Cal BC 380 to 350 (Cal BP 2330 to 2300) and Cal BC 300 to 210 (Cal BP 2260 to 2160)



References:

Database used

INTCAL04

Calibration Database

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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

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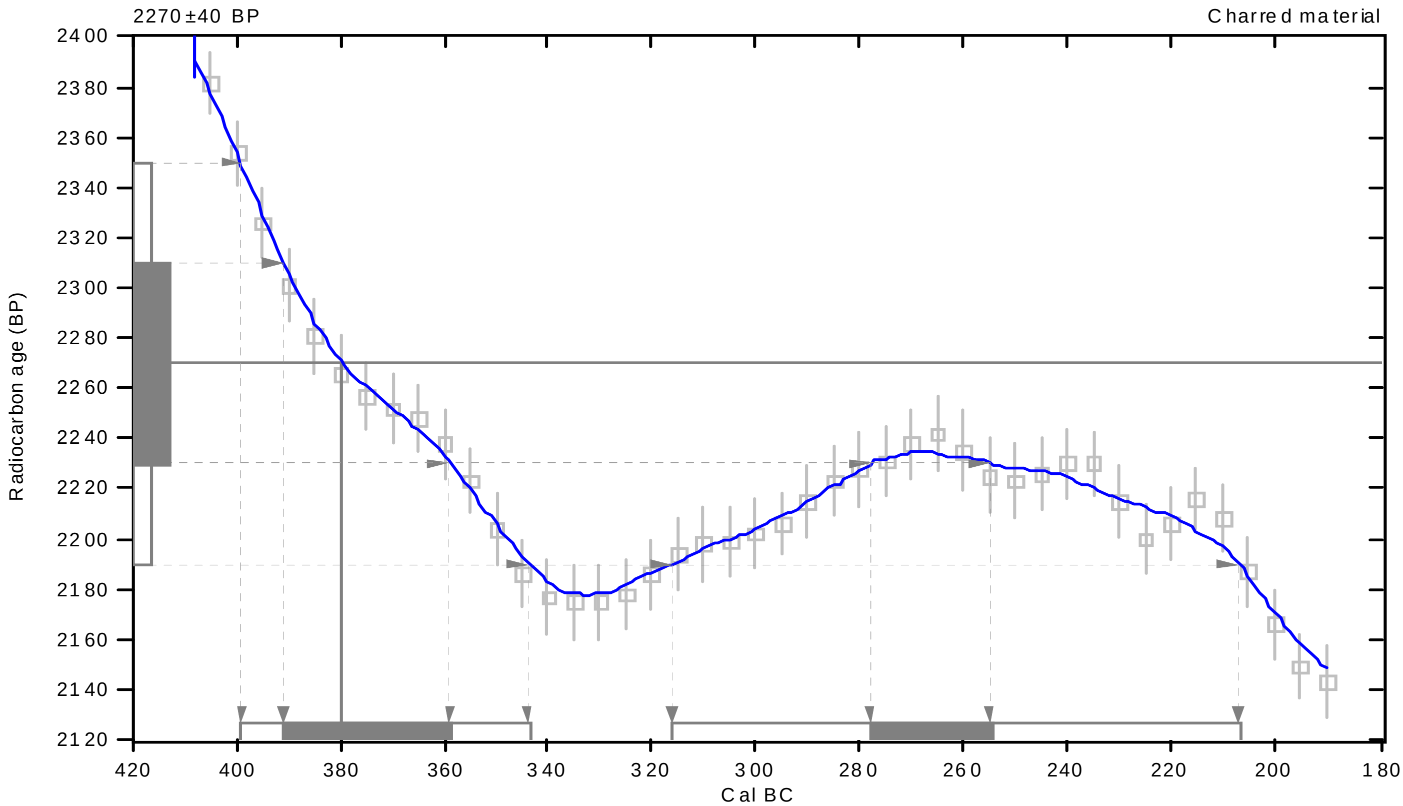
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-28.3:lab. mult=1)

Laboratory number:	**Beta-240796**
Conventional radiocarbon age:	**2270±40 BP**
2 Sigma calibrated results: (95% probability)	**Cal BC 400 to 340 (Cal BP 2350 to 2290) and Cal BC 320 to 210 (Cal BP 2270 to 2160)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 380 (Cal BP 2330)
1 Sigma calibrated results: (68% probability)	Cal BC 390 to 360 (Cal BP 2340 to 2310) and Cal BC 280 to 260 (Cal BP 2230 to 2200)



References:

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.8:lab. mult=1)

Laboratory number: **Beta-240797**

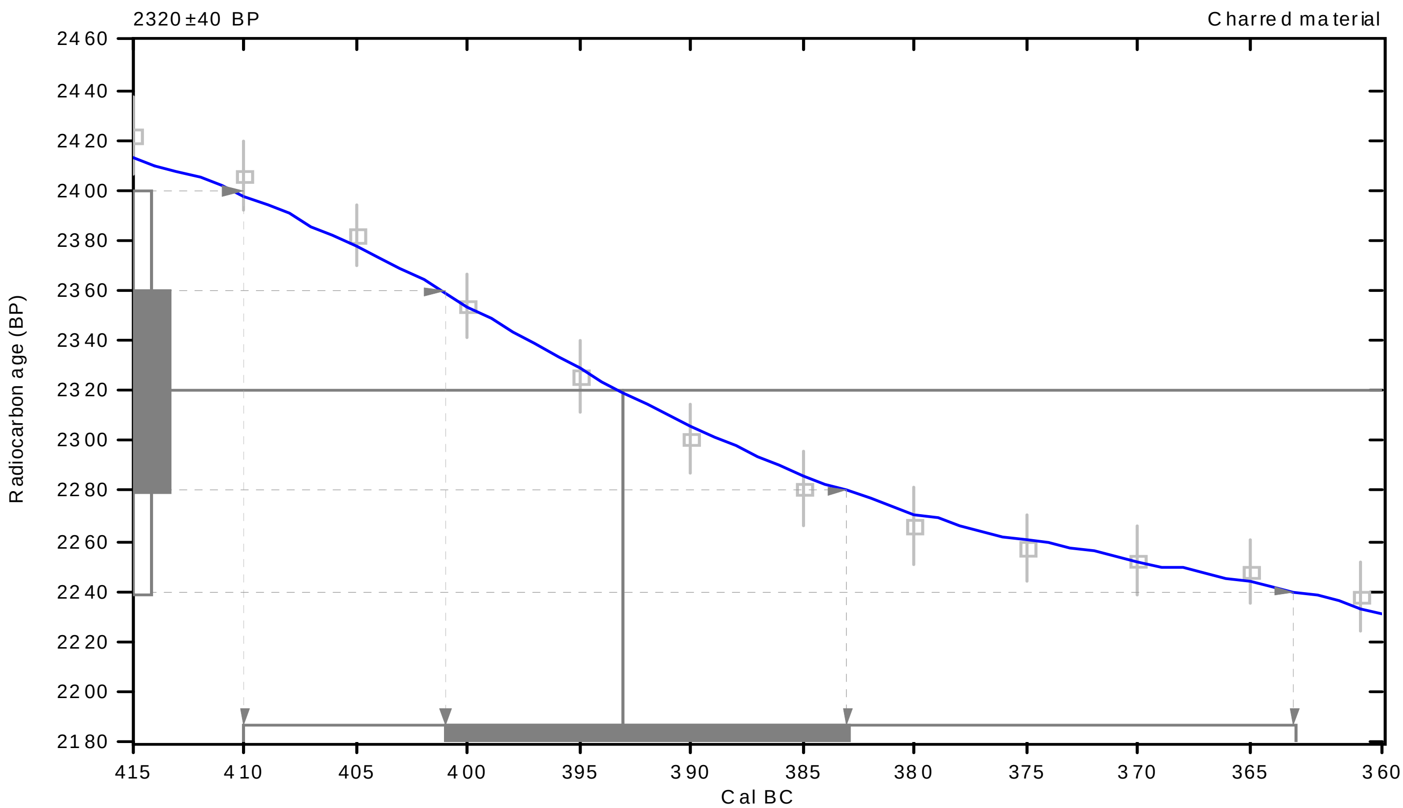
Conventional radiocarbon age: **2320±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 410 to 360 (Cal BP 2360 to 2310)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 390 (Cal BP 2340)

1 Sigma calibrated result: (68% probability) Cal BC 400 to 380 (Cal BP 2350 to 2330)



References:

Database used

INTCAL04

Calibration Database

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.9:lab. mult=1)

Laboratory number: **Beta-240798**

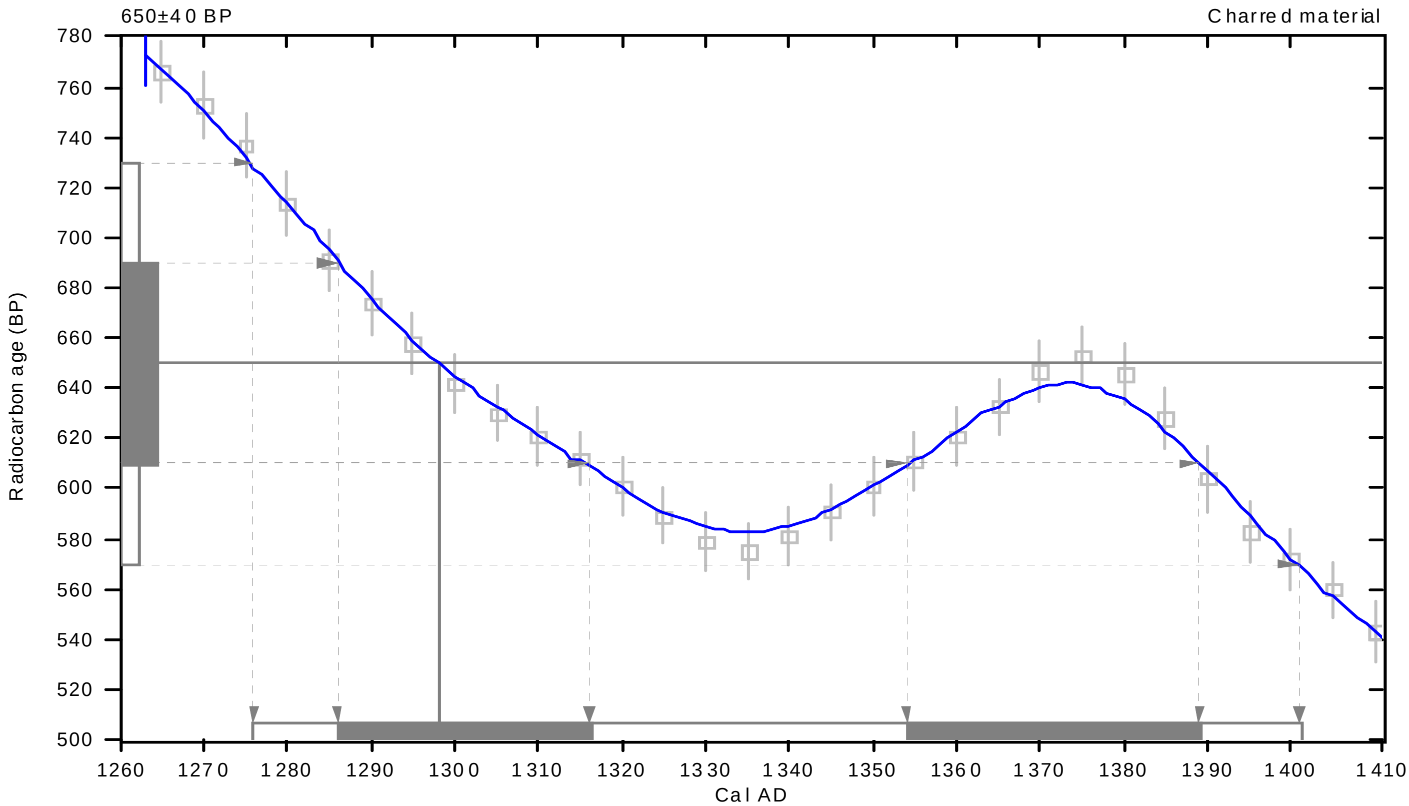
Conventional radiocarbon age: **650±40 BP**

2 Sigma calibrated result: (95% probability) **Cal AD 1280 to 1400 (Cal BP 670 to 550)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1300 (Cal BP 650)

1 Sigma calibrated results: (68% probability) Cal AD 1290 to 1320 (Cal BP 660 to 630) and Cal AD 1350 to 1390 (Cal BP 600 to 560)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

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A Simplified Approach to Calibrating C14 Dates

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.3:lab. mult=1)

Laboratory number: **Beta-240799**

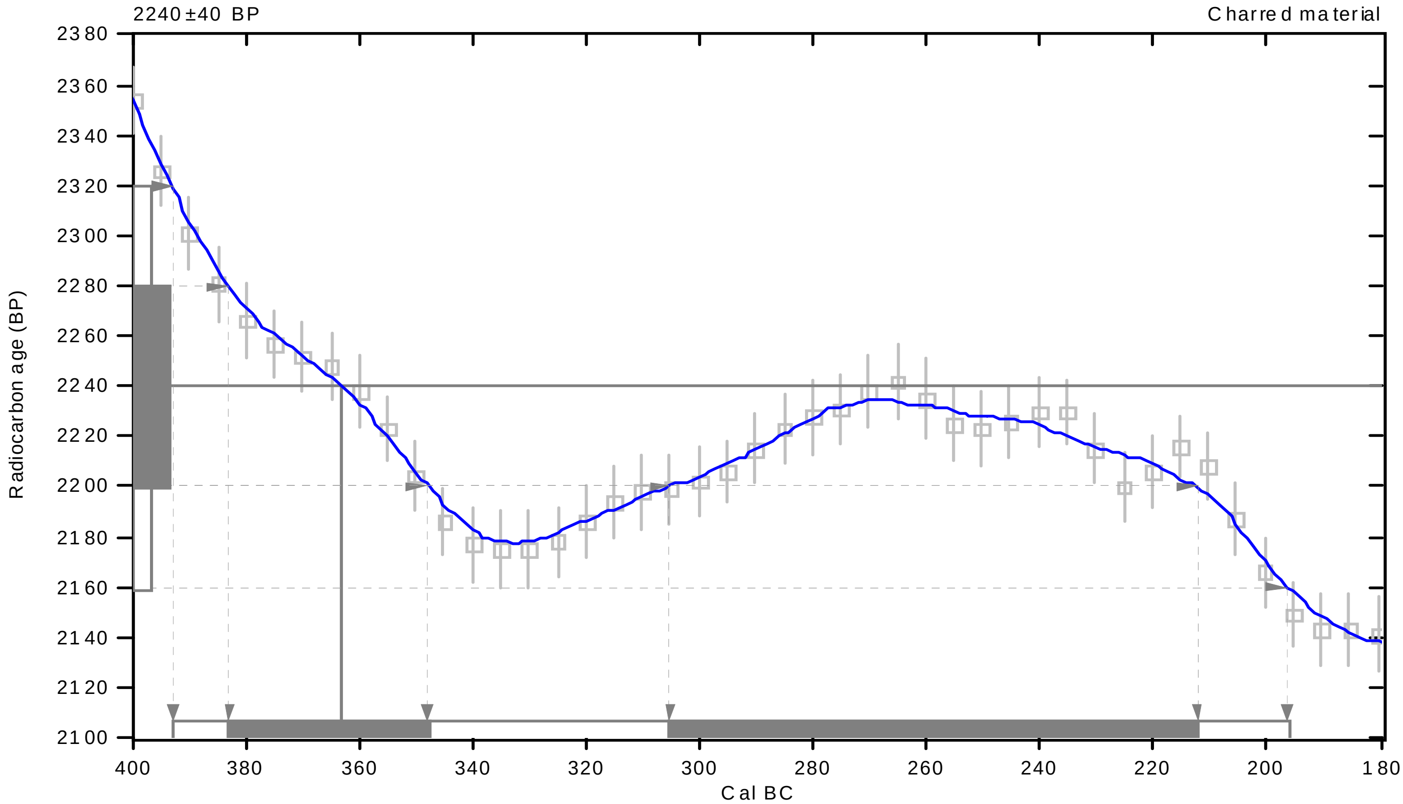
Conventional radiocarbon age: **2240±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 390 to 200 (Cal BP 2340 to 2150)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 360 (Cal BP 2310)

1 Sigma calibrated results: (68% probability) Cal BC 380 to 350 (Cal BP 2330 to 2300) and Cal BC 300 to 210 (Cal BP 2260 to 2160)



References:

Database used
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IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.3:lab. mult=1)

Laboratory number: **Beta-240800**

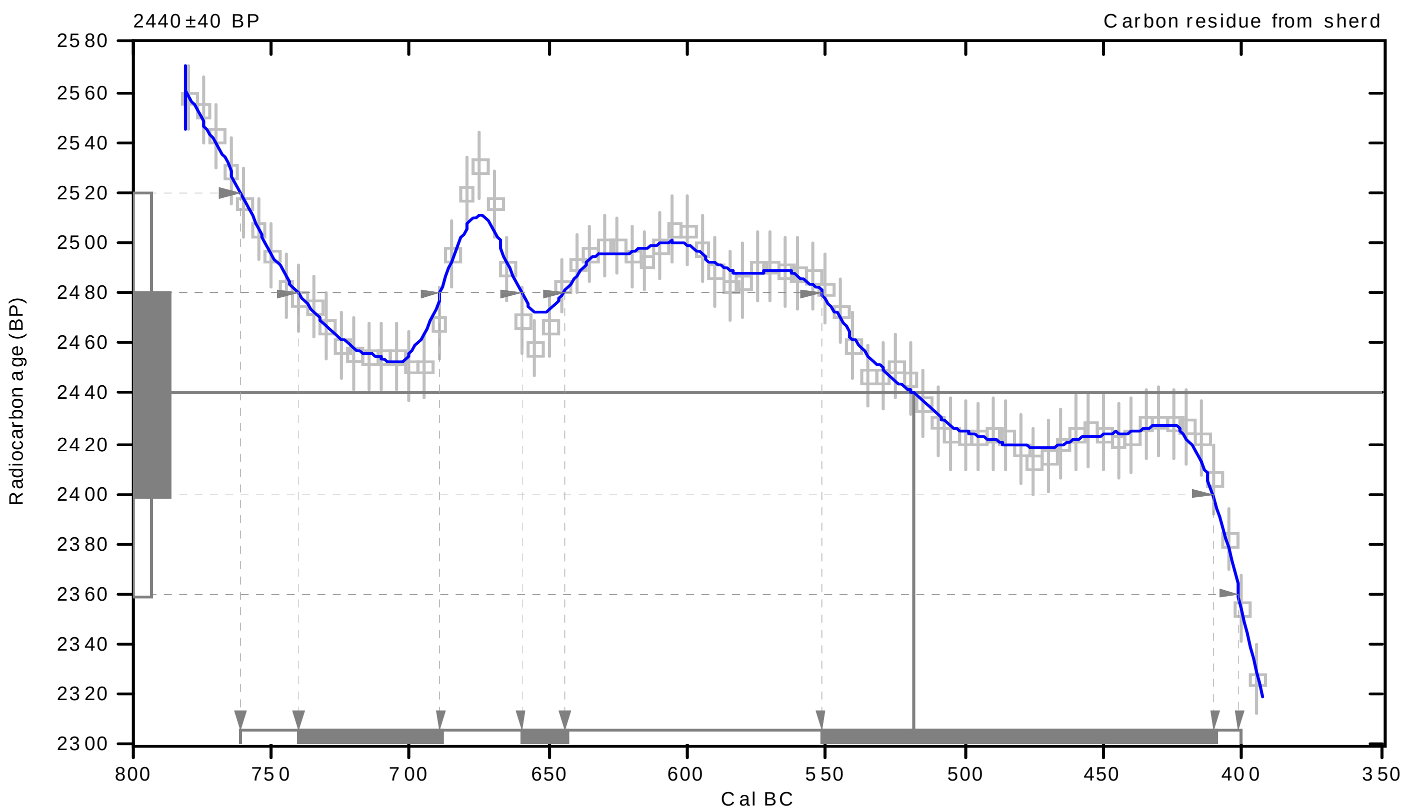
Conventional radiocarbon age: **2440±40 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 760 to 400 (Cal BP 2710 to 2350)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 520 (Cal BP 2470)

1 Sigma calibrated results: (68% probability) Cal BC 740 to 690 (Cal BP 2690 to 2640) and
Cal BC 660 to 640 (Cal BP 2610 to 2590) and
Cal BC 550 to 410 (Cal BP 2500 to 2360)



References:

Database used
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Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
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APPENDIX B

LITHIC ATTRIBUTE ANALYSIS CODE SHEET AND INVENTORY OF LITHIC ARTIFACTS

Lithic Attribute Analysis Code Sheet

Variable	*Code*	*Attribute*
Class	***1***	flake
	2	cortical flake
	3	retouch chip
	4	angular shatter
Type	***1.0***	flake fragment
	1.1	complete flake
	1.2	complete blade
	1.3	blade fragment
	2.0	cortical spall fragment
	2.1	secondary cortical spall
	3.3	retouch chip with polish
	4.0	angular shatter
	8.1	complete volcanic glass flake
	8.2	unmodified volcanic glass nodule
	8.3	volcanic glass flaked core
	8.4	primary volcanic glass cortical flake
	8.5	secondary volcanic glass cortical flake
Condition	***1***	whole
	2	fragment
Platform	***1***	cortex
	2	smooth
	3	complex
	4	crushed
Termination	***1***	feathered
	2	stepped
	3	hinged
	4	crushed
Size	***1***	< 1 cm diameter
	2	1.1 - 3 cm diameter
	3	3.1 - 5 cm diameter
	4	> 5 cm diameter
Flake Origin	***1***	adze side shaping
	2	adze top/bottom thinning
	3	unknown/indeterminate
	4	core removal

Summary of lithic artifacts recovered during 2007 excavations

Unit	Level/Layer	Volcanic Glass	Basalt Debitage	Adzes	Flake Tools	*Total*
site	surface		2	3		*5*
A1	2/V				1	*1*
A2	2/V	1				*1*
A2	2/III		2			*2*
A2	3/III	1	1			*2*
A2	4/III	5				*5*
A3	4/III	1				*1*
A3	5/III	1				*1*
B1	1/V		1			*1*
B1	2/V		1			*1*
B1	4/III		1			*1*
B2	1/V		1			*1*
B3	1/V		3			*3*
B3	2/III		1			*1*
B3	3/III	1		1		*2*
B3	4/III	1	2			*3*
B3	5/III		1			*1*
B4	1/V		1			*1*
B4	2/V	1				*1*
B4	3/III		3			*3*
C1	3/III		5			*5*
C1	4/III		9			*19*
C1	5/III		17			*17*
C1	6/III		9			*9*
C2	1/V			2		*2*
C2	2/V	1	4			*5*
C2	3/III		11			*11*
C2	4/III		37		1	*38*
C2	5/III	1	3			*4*
C3	1/V		5	1	1	*7*
C3	2/V		2			*2*
C3	3/III		6			*6*
C4	1/V		1			*1*
C4	2/V		7	1		*8*
C4	3/III		4			*4*
C4	5/III	1				*1*
C5	1/V		7			*7*
C5	2/V		6			*6*
C5	3/III		4			*4*
C5	4/III		9	1		*10*

Summary of lithic artifacts recovered during 2007 excavations (continued)

Unit	Level/Layer	Volcanic Glass	Basalt Debitage	Adzes	Flake Tools	***Total***
C5	5/III		7			*7*
C5	6/III		5			*5*
C5	7/II		1			*1*
C6	1/V		4			*4*
C6	2/V	1	10			*11*
C6	3/III		61	1		*62*
C6	4/III		99			*99*
C6	5/III		24			*24*
C6	6/II		10			*10*
D1	1/V		4			*4*
D2	1/V		5	2		*7*
D2	2/V		1	1	1	*3*
D2	2/III				1	*1*
D2	3/III		2	1		*3*
D2	5/II		1			*1*
E1	2/disturbed	2	1			*3*
E1	3/disturbed	1		1		*2*
E2	1/disturbed		1			*1*
E2	2/disturbed	1				*1*
E2	3/disturbed	1				*1*
E3	1/disturbed		1			*1*
E3	3/distrubed	1				*1*
Total		*22*	*413*	*15*	*5*	*455*

APPENDIX C

CERAMIC ATTRIBUTE ANALYSIS CODE SHEET AND INVENTORY OF CERAMIC ARTIFACTS

Ceramic Attribute Analysis Code Sheet

Variable	***Code***	***Attribute***
Lot	***1+***	sequential number assigned to each sherd
Provenience		site, locus, unit, level
Body Part	***0***	indeterminate
	1	rim
	2	neck
	3	body
	4	hande
	5	rim and neck
	6	neck and body
	7	body and handle
	25	other: note in comments
	99	complete vessel
Thickness		widest portion of sherd measured in mm
Size	***1***	< 1 square cm
	2	1.1 - 2 square cm
	4	2.1 - 4 square cm
	6	4.1 - 6 square cm
Weight		measured in gms
Temper	***1***	black and red angular inclusions
	2	gray and black angular inclusions
	3	multiple colors, rounded to subrounded, inclusions
Temper Size	***1***	very coarse (1 - 2 mm)
	2	coarse (0.5 - 1 mm)
	3	medium (0.25 - 0.5 mm)
	4	fine (0.12 - 0.25 mm)
Paste Color		hue-value-chroma from Munsell Soil Color Charts recorded on most oxided portion of paste
Rim Profile	***0***	indeterminate
	1	parallel
	5	thickened
	6	thickened interior
	7	thickened exterior
	25	other: note in comments
Lip Cross Section	***0***	indeterminate
	1	round
	5	square
	25	other: note in comments

Ceramic Attribute Analysis Code Sheet (continued)

Rim Form		rim form drawn
Sooting	***0***	indeterminate
	1	present on exterior only
	2	present on interior only
	3	present on both surfaces
	4	present on edge or edges only
	99	none
Surface Modification	***0***	indeterminate
	1	rough
	2	scraped/wiped
	3	smoothed
	4	polished
	5	slipped
	6	smudged
	7	fugitive red
	10	decorated: discuss in comments
	25	other: note in comments
	99	none

Summary of ceramic artifacts recovered during 2007 excavations

Unit	Level/Layer	Thin	Thick	Rims	*Total*
site	surface	14	6	5	*19*
A1	3	6			*6*
A2	1	1			*1*
A2	2	1			*1*
A2	3	1			*1*
A2	4/III	17	3	4	*20*
A2	5/III	6		1	*6*
A3	4	2			*2*
B1	1		1		*1*
B1	3	2			*2*
B1	4/III	13	12	1	*25*
B1	5/III	7	7	2	*14*
B2	1		1		*1*
B2	2	1	2		*3*
B2	3/III	2	1	1	*3*
B2	4		1		*1*
B3	2		1		*1*
B3	3	14	3		*17*
B3	4/III	78	9	2	*86*
B3	5	11	2		*13*
B3	6	13			*13*
B3	7	3			*3*
B4	2	6	1	1	*7*
B4	3/III	6	13	3	*19*
B4	4/III	2	2	2	*4*
B4	5	1			*1*
C1	2	1			*1*
C1	4	4			*4*
C1	6	1			*1*
C2	3	3			*3*
C2	4	6			*6*
C2	5/III (Feature 5)	1			*1*
C3	1	4			*4*
C3	2	3	1		*4*
C3	3	7	1		*8*
C3	4	1			*1*
C4	2	1			*1*
C4	4/III	1	4	2	*5*
C4	5	1			*1*

Summary of ceramic artifacts recovered during 2007 excavations (continued)

Unit	Level/Layer	Thin	Thick	Rims	***Total***
C5	1	1			*1*
C5	2	2	2	2	*4*
C5	3	2	1		*3*
C5	4/III	23	2	1	*25*
C5	5		1		*1*
C5	6	2			*2*
C5	6/III (Feature 4)	3			*3*
C6	3	8			*8*
C6	4/III (Feature 5)	9			*9*
D1	2	1			*1*
D2	3/III	8		1	*8*
E1	1	2	1	1	*3*
E1	2	6	8		*14*
E1	3		4		*4*
E1	4	2	2		*4*
E2	1	9	8	1	*17*
E2	2	14	12	2	*26*
E2	3	27	8	1	*35*
E2	4	4	7		*11*
E2	5	1			*1*
E3	1	3	6		*9*
E3	2	24	7	2	*31*
E3	3	17	7	2	*24*
E3	4	12	5	1	*17*
Total		*420*	*152*	*38*	*572*