

RECONSIDERING LAPITA ANCESTRY: EVIDENCE OF MATERIAL CHANGE
AND MIGRATION ON TUTUILA ISLAND, AMERICAN SAMOA

A Dissertation

by

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ABSTRACT

Recent advances in the archaeology of the Samoan Islands have forced us to reconsider the generally accepted phylogenetic model for the chronology of cultural change in prehistoric Samoa. In this dissertation I use new archaeological evidence from excavations at multi-component sites across the islands of American Samoa to measure the degree to which the archaeological record supports the accepted linguistics-based phylogenetic model for Samoan cultural transformation. Specifically, I focus on multi-component sites to assess the social implications of diachronic change in pottery production, obsidian use and basalt tool manufacture.

To expand our understanding of the chronology for cultural change in the Samoan Archipelago I study the chronology of site use and tool production at Vainu'u, 'Aoa, Aganoa and Matautia on Tutuila Island and offer recalibrated radiocarbon dates from To'aga on Ofu Island. The findings from these multi-component sites show that differences in traditions of stone tool production and raw material provisioning accompany the noted cessation of pottery production ca. 1,500-1,700 B.P. Two identifiable forms of technological organization, attributed to the Ceramic Period and Monument Building Period components, are separated in time by several centuries of reduced population density across the study area. Patterning in the chronology of site use and technological change provides support for a cultural hiatus with demographic decline in the Samoan Islands beginning ca. 1,500 B.P.

DEDICATION

To my dear friend Wilson Fitiao

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NOMENCLATURE

APS	Ancestral Polynesian Society
CHM	Cultural Hiatus Model
EEL	Early Eastern Lapita
LEL	Late Eastern Lapita
PPW	Polynesian Plain ware
MBP	Monument Building Period
B.P.	Before Present
Cal. B.P.	Calendar years before present

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1. INTRODUCTION

“The interface between pottery-using communities in Fiji and aceramic Polynesians who persistently declined to relearn the art, despite their own earlier history of pottery manufacture and use is not the least intriguing of the problems of cultural processes awaiting further study” (Davidson 1977:91).

The statement given above by Janet Davidson (1977) summarizes the current archaeological consensus for cultural transformation in the Samoan Islands: that the initial pottery-making colonizers of Samoa are the direct ancestors of later aceramic Polynesians. Did prehistoric Samoan Islanders really stop teaching the techniques of pottery production to their children, despite more than a thousand years of maintained practice? Rather than a gradual cultural loss and replacement of traditional knowledge, perhaps the archaeological record best represents two different populations who practiced different cultural frameworks for living on the same island chain over time. In this work I offer data in support of two separate colonization events within the Samoan Islands. This concept of two occupation periods challenges the current consensus for Polynesian cultural transformation, yet a reassessment of key changes in stone tool manufacture processes, raw material distribution networks and pottery production is

needed as new data fail to fit comfortably within the widely accepted model of cultural change.

1.1 BACKGROUND

1.1.1 An Interesting Pattern in Samoan Archaeology

An intriguing pattern exists within archaeological deposits across the Samoan Archipelago. Systematic excavation of archaeological deposits within the islands often reveals two separate prehistoric cultural activity surfaces separated by soils that indicate a significant gap in time between sustained occupation periods (Addison et al. 2005; Crews 2008; Eckert and Welch 2013; Green and Davidson 1969, 1974; Kirch and Green 2001; Reith and Hunt 2008 Smith 2002). Differences in the items made by islanders during these two periods of residence suggest that early traditions disappeared and were replaced with new technological approaches (Addison and Matisoo-Smith 2010; Addison and Morrison 2010; Eckert and Welch 2009; Eckert and Welch 2013; Smith 2002). The exact timing and scope of this material, and perhaps cultural, change remains under debate (Reith and Addison 2008). One major change, the disappearance of pottery ca. 1,500-1,700 B.P. (Smith 2002; Reith and Addison 2008) has led archaeologists to discuss prehistoric assemblages as belonging to either the “ceramic” or “aceramic” period.

Closer scrutiny of the material record shows a much wider scope of change accompanied the halt of pottery traditions (Smith 2002; Kirch and Green 2001; Welch 2013). By A.D. 500 pottery production falls from the archaeological record, the procurement and distribution of volcanic glass ceases and popular groundstone axe types are replaced outright. After a period of several centuries known as the Samoan Dark Ages ca. A.D. 500-1200 (Reith and Hunt 2008; Smith 2002; Poulsen 1976; Spennemann 1986), new tool forms and distribution networks appear alongside monumental architecture (Reith and Addison 2008).

Across the Samoan Archipelago (Figure 1.1), underneath the more recent archaeological layers attributed to the Samoan complex chiefdom rests the story of an earlier colonizing community that seems to have left the islands or become integrated within the cultural traditions of an intrusive colonizing population around 1,500 years ago. While opposed to the generally accepted model for the culture history of the Samoan Islands where an Ancestral Polynesian society formed the foundation for later Polynesian complex chiefdoms (Burley and Clark 2003:240), this apparent disconnect in residential occupation and the material manifestation of different cultural practices has become the focus of my current research. The ultimate goal of this work is to observe patterning in recently excavated sites to determine if the archaeology of Tutuila Island, American Samoa agrees with the generally accepted model for cultural change in the Samoan Archipelago.

The current consensus for the formation of Polynesian culture (Kirch and Green 2001) describes a sequence of gradual change from the initial Lapita settlers of Samoa

into a different kind of culture, a “Polynesian” cultural system (Kirch and Green 2001). A majority of researchers argue that recreated linguistic patterns correlate with parts of the archaeological record to suggest a change in cultural behavior on the Samoan Islands into an ancestral, or proto-Polynesian, way of life ca. 2400 B.P.. Polynesianists describe this transformed community as the Ancestral Polynesian Society (APS), a group of village communities that would form a chiefdom-level society in Samoa by ca. 1200 B.P. and would carry the transformed cultural suite to distant un-colonized archipelagos to the East (Kirch 1997).

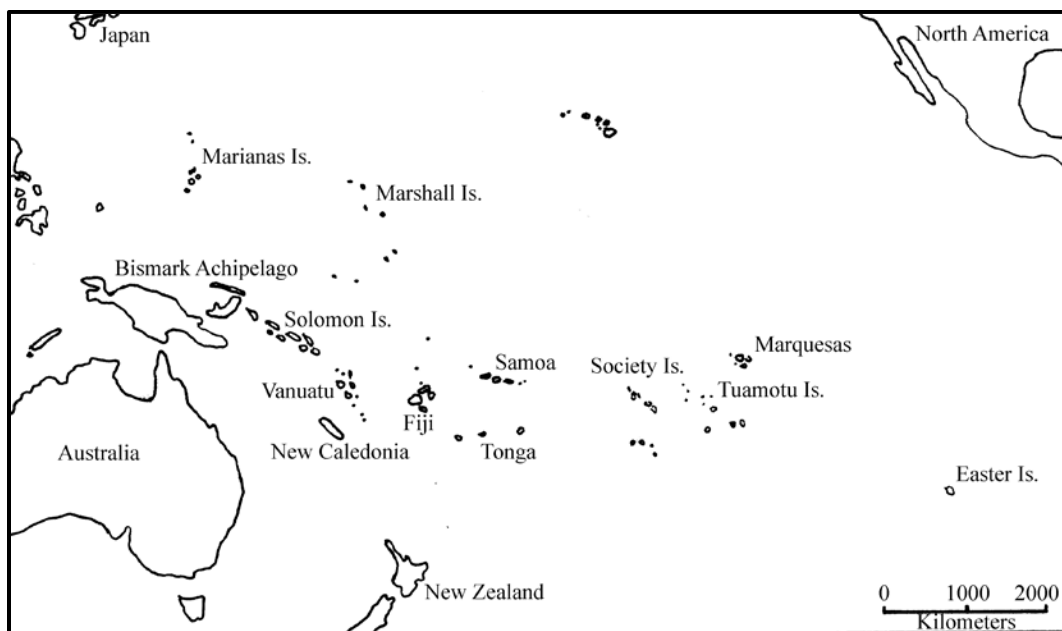


Figure 1.1: Map of island archipelagos discussed in text.

The archaeological community generally agrees that this phylogenetic/linguistic model (Kirch and Green 1992; 2001), with constant island occupation and gradual ancestor-descendent sociocultural change, best explains the large-scale differences evident in the archaeology of early and late Samoan deposits. This is to assume, however, that lexico-reconstruction is an appropriate framework to use in the interpretation of the archaeological record, and that the production of material goods necessarily changes at the same rate as linguistic patterns. Moreover, to this point archaeological investigations have failed to identify a suitable “type site” in Samoa that unequivocally displays material correlates for constant habitation and gradual cultural change from initial Late Eastern Lapita colonists toward a fully Polynesian cultural motif. This questioning of the consensus will be returned to in section 1.2 of the Introduction, after a description of the consensus presented here.

1.1.2 The Consensus Chronology

In the following section I outline the general consensus for the timing of cultural change in the Samoan Islands and the material remains that most agree these social changes produced. The dominant perspective for migration and cultural change in Samoa is the culmination of initial fieldwork by Roger Green, Janet Davidson and colleagues (1969, 1974), furthered by Kirch and Green (1992) and discussed in depth by Kirch and Green in their book *Hawaiiiki, Ancestral Polynesia* (2001). Recent works in support of this model come from Davidson (2012). This traditional model maintains that

the rise of an Ancestral Polynesian Society ca. 2400 B.P. is archaeologically visible and signals the formation of a Proto-Polynesian suite of behaviors that would inform the social and technological choices of later Monument Building Period communities. This line of thought has come to be known as a “Lapita-only model” (Addison and Matisoo-Smith 2010), as it suggests that Polynesians are the descendants of a transformed Lapita population and excludes the possibility of population intrusion.

Hypotheses about the manner in which Lapita ancestors managed to come to the Samoan Islands include ideas of rapid movement by Lapita peoples across Polynesia as an "Express Train" (Diamond 1988) or alternatively, a "Slow Boat" movement of Lapita populations with embedded time for interaction, integration and innovation towards a recognizable Polynesian conclusion (Green 1991, 2000; Oppenheimer and Richards 2001).

As ceramic traditions appear to have ceased across Western Polynesia at some point around 1,700-1,500 B.P. (Green and Davidson 1974; Kirch and Green 2001, Reith and Hunt 2008; Smith 2002) researchers of Polynesian prehistory identify two major behavioral periods: Ceramic Period and Aceramic Period. These two components are further subdivided into phases that follow inferred changes in behavioral traits. A brief description of the traditional chronology of cultural and material change in the Samoan Islands is provided below.

Early Eastern Lapita (ca. 3100-2700 B.P.)

The Early Eastern Lapita Period (EEL) represents the earliest settlement of the Samoan Archipelago and is identified archaeologically by the presence of dentate-stamped pottery, shell tools, flaked obsidian and plano-convex adze forms. This material assemblage differs stylistically from the archipelagos of Tonga and Fiji, primarily in manners of design elements and differential use of design fields. Overall, fewer design elements are employed, especially in comparison to Lapita designs of Fiji, New Caledonia, the Reef/Sana Cruise Islands and the Bismark Archipelago.

Established radiocarbon evidence from Mulifanua on Upolu Island indicates that initial colonization took place approximately 2800 B.P. (Jennings 1974; Jennings and Holmer 1980; Petchey 2001) and marks the earliest reliable radiocarbon dates encountered in the archipelago. While currently this is the only known dentate-stamped pottery-bearing site in the Archipelago, the sites of To'aga (Kirch and hunt 1993), Aganoa (Eckert et al. 2008; also see below) and 'Aoa (Clark and Michlovic 1996; Clark et al. 1997) offer radiocarbon dates that fall within the end of this timeframe but do not include dentate-stamped pottery. Other material traits of the Lapita material assemblage exist within the Samoan Islands, specifically plano-convex adze forms, shell bracelets and local procurement and use of obsidian. Several hypotheses exist as to why the Samoan sequence offers so little dentate-stamped pottery. Ideas include geomorphic change as an agent of site destruction, sea level change and submergence; stilt houses over lagoons as ephemeral archaeological signals, or the idea that decorated pots were

simply never made. Archaeological ideas of subsistence practices at this time are limited. Marine foraging is well expressed at early sites such as To'aga and Aganoa. Horticulture may have been part of the resource base, as attested by stone scrapers. At this time the earliest colonization sites show little evidence of intensive horticultural practice and are largely confined to coastal margins. Inland use of terrestrial resources appears to take place during the next century as populations spread across the landscape.

Late Eastern Lapita (ca. 2700-2300 B.P.)

The Late Eastern Lapita Period (LEL) is recognized as a period of cultural continuation derived from the Early Eastern Lapita tradition and is chiefly characterized by the absence of dentate- stamped vessels and an overall simplification of all decorative motifs. Additionally, there appears to have been a decrease in the diversity of vessel forms (Burley 1998; Green and Davidson 1974; Smith 2002). The simplified decoration evident at the coastal sites of Aganoa, To'aga, 'Aoa, Va 'oto and the highland site of Vainu'u typify the ceramic assemblages of this period (Eckert 2006, 2007, 2011; Eckert et al. 2008; Eckert and Welch 2013; Best 1992; Clark and Michlovic 1996; Clark et al. 1997; Kirch and Hunt 1993). Inland sites are increasingly common during this time period, as is evidence for the movement of stone tool resources between islands at the archipelago level. The site of To'aga on Ofu Island received stone tools from Tutuila, as did the western Islands of Savai'i and Upolu.

Current evidence suggests increased population during this time, signaled by a higher frequency of archaeological events within inland regions. Volcanic glass artifacts were moved between islands during this period and occur frequently across inland areas. Upland and highland sites suggest limited horticulture. Local production of pottery remained a common activity at residential and perhaps special-use sites. Decorative elements were reduced to surface finish and small modification on the rim of a few vessels. Multiple rim forms were produced, and local production of vessels led to a multitude of paste recipes.

Plano-convex adzes were still in vogue and are accompanied by rectangular and trapezoidal tool forms. Limited evidence from special-use areas suggests the production and use of basalt blades in association with cooking activities, although more work is needed to expand on this lithic approach.

Plainware Period (ca. 2300-1500+ B.P.)

During this period decorated sherds are exceptionally rare, and those that do exhibit decorative elements display simple patterns of cross hatching or angled lines along the rim. At this time, volcanic glass is still used as a lithic material alongside high-quality basalt. Triangular adze forms were not yet present and plano-convex adze morphologies had not yet disappeared from use (Smith 2002; Best et. al 1989; Green and Davidson 1974). Traditional models maintain that this period is significant because it is from this tradition that ensuing Polynesian cultures arose to later colonize the untouched

islands of the Eastern Pacific Ocean (Kirch and Green 2001). At this time, as the consensus model suggests, the Lapitoid/Melanesian traditions began a transformation towards an early proto-Polynesian behavioral motif.

Traditional archaeological models describe this derived tradition as “Ancestral Polynesian”. Successive generations stopped making pottery and manifested a distinctly Polynesian pattern of cultural behavior that was carried eastward to newly colonized archipelagos (Burley et al. 1995; Kirch 1997, 2000; Kirch and Green 2001; Pawley 1966; Pawley and Ross 1993; Shutler and Shutler 1975). In this regard the islands of Samoa are widely considered to be the Polynesian homeland; an essential time and place from which discrete social patterns emerged that are identifiable in later deposits elsewhere in the Pacific. The material culture during this time is argued to signify a cultural shift away from Lapita organization and more towards a recognizable ancestral population. Plano-convex adzes were still used, volcanic glass was still obtained and used, pottery was still locally produced and used in subsistence activities, shell ornaments still occurred at times and populations used inland areas for special-use sites and residential areas.

Dark Ages (ca. 1500 - 1000 B.P.)

The period of time between the cessation of pottery traditions and the rise of the complex chiefdom level society evident at European contact is often referred to as the Samoan "Dark Age" (Poulsen 1976; Spennemann 1986). The exact timing for the end of

the Plain Ware Period remains unclear. Most researchers agree on a date between 1,700-1,500 B.P., while Clark and colleagues argue for a later date, ca. 400 B.P.. After this period of time, between 1500 and 1000 B.P., traditional models suggest increased population and expansion of residential sites took place. An unfortunate fact for traditional models is that archaeological evidence of increased population or large-scale residential sites is notoriously elusive during this period of time (Davidson 1979:94-95; Green 2002:140). The lack of archaeological visibility has traditionally been seen as a result of the termination of ceramic manufacture, a characteristic that would make finding sites of this age difficult. Thirteen sites of this age have offered acceptable radiocarbon dates (Reith and Hunt 2008), however, and they illustrate a general trend of pottery cessation ca. 1500 B.P. followed by small-scale lithic production and ephemeral remains of cooking activity along coastal margins. From these results Reith and Hunt (2008:1918) note "The Dark Age period has been given considerable sociocultural significance that presently has little basis in the archaeological record"

Monument Building Period (ca. 1000-250 B.P.)

The majority of known prehistoric sites in Samoa dates to the Monument Building Period. This period was one of frequent warfare between villages, districts, islands and archipelagos. Archaeological signals of increased lithic production and internal and external warfare come in the form of defensible highland villages, fortifications, trenches and large basalt adze quarries (Best et. al 1989; Clark 1989; Clark

and Herdrich 1988). The construction of raised stone platforms and rayed mounds likely reflects prestige-driven building activities within villages under the direction of village and district level chiefs (Herdrich 1991). Prior to this time there is no archaeologically defined signal of prestige-driven building events. This could indicate a different concept of social organization between ceramic and aceramic periods. Alternatively this could be the result of later activity erasing prior archaeological remains.

Distribution networks are illustrated by the intensive production and distribution of basalt adzes from small industry workshops across Tutuila Island. The complexity of these social structures is represented in the ethnographic and archaeological record through evidence of specialized production activities in items such as stone adzes, fishnets, canoes, tattooing, as well as fishing lures and hooks.

On Tutuila Island, the massive adze production site of *Tataga matau* (transl: chipping of axes) and hundreds of grinding bowls (*foaga*) for the finishing stages nearby offer striking evidence of intensive production and distribution to islands as far as Fiji, Taumako and Tokelau (Best et al. 1992). By this point in time plano-convex adzes are no longer present in well-preserved archaeological contexts, nor are volcanic glass flakes. The advent of this aceramic, monumental architecture tradition also ushers the introduction of triangular adze forms (types VI and VII), which are absent during all phases of the Ceramic Period (Green and Davidson 1974; Smith 2002).

Historic Period (ca. 250 B.P. - present)

Contact with European sailors occurred in A.D. 1722, yet historic accounts of Samoan culture are sparse until after 1840 when missionary work began in earnest (Kramer 1903; Pearl 2007). The importance of defensible mountain top residence diminished as western influence sought to diminish local violence; yet, social friction remained ever present. By this time, and probably before, Samoans recognized the roles of craft specialists (*tufuga*). The skills and labor of some specialists were attached to specific chiefs (Hiroa 1930; Kramer 1903). The majority of craft specialization was not, however, a full-time task, as necessity required additional efforts in horticultural plots and the management of livestock. 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 Western islands in 1914 to New Zealand. In 1962 the Western Islands formed the independent nation of Samoa, which is occasionally referred to as Western Samoa by those living in American Samoa.

The generally agreed upon cultural timeline maintains that becoming Polynesian took place during a formative period of ceramic loss and language change. The transformed society would then, after a thousand years in relative isolation, burst from the Samoan archipelago to the islands in the East. At around ca. 1200 B.P. an archaeological definable Polynesian population would sail to the Marquesas, Hawaii and eventually New Zealand. The mental template of material culture and social

organization was draped across the newly colonized islands in a Polynesian behavioral motif, the Polynesian phylogenetic unit. In this way Polynesian identity is tied to Austronesian speaking Lapita ancestors. Those living in the Marquesas Islands are the descendants of those living in Fiji; those in Hawaii and other archipelagoes are similarly tied in ancestry to Lapita deposits in Samoa.

1.1.3 Who, or Rather What, is Lapita?

The term “Lapita” describes a suite of cultural traditions held by a widespread group of island communities across much of Oceania ca. 3,200 B.P. (Burley 1994; Clark 2006; Kirch and Green 2001; Smith 2002). Similarities in methods of tool production, obsidian use, and, of primary importance to most archaeologists, dentate-stamped pottery set assemblages apart as Lapita from earlier or later social identities (Anderson 2000; Best 1987; Burley et al. 1995; Golson 1971; Green 1974b; Smith 2002). Dentate-stamped pottery usually comprises only a small portion of the ceramic assemblage at a given site, typically around eleven percent (Smith 2002). Evidence for the origin of the Lapita Complex begins in Near Oceania 3,500 B.P. (Kirch 2000); however, the story of human occupation in Near Oceania extends well into the Pleistocene. The Near Oceanic Islands of the Bismarck and Solomon archipelagos show signs of continued human occupation from the Pleistocene (ca. 30,000 B.P.) to the late Holocene (ca. 4,000 B.P.) (Kirch 2000; Kirch and Green 1997). By 18,000-20,000 B.P. Near Oceanic, Non-Austronesian-speaking occupants had begun to procure and move obsidian materials up

to 350 km, with evidence of sea voyaging to the islands of New Britain and New Ireland (Green and Kirch, 1997). This practice of small-scale procurement and distribution carried on until approximately 4,000 B.P.

The Advent of the Lapita intrusion into Near Oceania coincides with the massive eruption of Mount Witori (W-K2 eruption event) on the island of New Britain approximately 3,600 B.P. (Kirch 2000; Torrence and Boyd 1997; Torrence and Summerhayes 1997). This eruption smothered vast regions of the Bismarck Archipelago in blankets of burning ash and was “One of the most massive eruptions to occur anywhere on earth during the time that modern humans have existed on the planet” (Spriggs 1997:76). Meters of volcanic ash interred obsidian procurement sites at Mopir (Kirch 2000) and scorched the landscape that had provided sustenance for millennia.

Geoarchaeological evidence from New Britain (Torrence and Boyd 1997; Torrence and Summerhayes 1997) shows that the W-K2 tephra (3,600 B.P.) created a discrete and intriguing stratigraphic marker separating different material signatures of human activity. Below the W-K2 ash (ca. 5,900-3,600 B.P.), cultural deposits include formally flaked obsidian tools that exhibit stemmed bases for hafting. These artifacts are non-existent above the W-K2 tephra boundary. An apparent shift in lithic-reduction practices occurs above the stratigraphic horizon. Stone tool technology in the later context is dominated by expedient (informal) technology in the form of un-retouched flake use. No signs of the pre-W-K2 stemmed tools are evident in the layers above the 3,600 year-old tephra (Kirch 2000:88).

The limited inter-island obsidian trade preceding the cataclysm shifted dramatically after the W-K2 event to a geographically widespread, complex and specialized trade network (Torrence and Summerhayes 1997). To further the case for the changing face of New Britain, the people that occupied the region before the eruption did not have a tradition of ceramic production. The layers above the tephra, however, offer a stark distinction on the north shore of New Britain where “a highly decorated style of pottery called Lapita makes a sudden appearance in the Willaumez Peninsula” (Torrence et al. in press). The expansion in obsidian trade and the primary instance of ceramics was coupled with changes to larger-scale, less-mobile settlements focused on the coastal margins. This population was a culturally distinct and varied Austronesian-speaking complex. The Lapita Complex mastered ocean navigation and through long distance ocean travel continued the settlement and provisioning of the Near Oceanic Islands.

Lapita Expansion: The World of Near Oceania

After the intrusion of Lapita into Near Oceania there is a period of a few centuries where no expansion occurred, ca. 3,500-3,200 B.P. (Kirch 2000). After this expansion hiatus, Lapita period seafaring pierced the boundary between Near and Remote Oceania as voyaging coursed south and east through the Santa Cruz Islands to the Reef Islands. At the same time other voyages encountered the Vanuatu Archipelago via the Banks Islands and soon thereafter occupied islands of the Loyalty group,

eventually pushing onward to meet the island of New Caledonia (ca. 3,100 B.P.). New Caledonia shows signs of sustained Lapita contact and settlement by ca. 2,800 B.P. (Frimigacci 1974, 1975). This new southern region of expansion across the Remote Oceania opened the door to the final frontier of Lapita oceanic expansion, the islands of Fiji, Uvea, Futuna, Tonga and finally Samoa. Oceanic voyaging settled Fiji shortly after New Caledonia at the turn of the first millennium B.C. (Anderson and Clark 1999). Further to the east, Niuaupolu, Tonga and Samoa were colonized certainly by 2,500 B.P., the oldest being Niuaupolu (3,200-1,800 B.P.) (Kirch 1988; Kirch and Green 2001).

Mulifanua on the Samoan Island of 'Upolu shows evidence of occupation at 3,000 B.P. and provides the best evidence of dentate-stamped ceramics within the Samoan Archipelago to date (Green and Davidson 1974; Leech and Green 1989). Systematic excavation at To'aga (Ofu Island) offers a date of ca. 3,000-2,500 B.P. (Kirch and Hunt eds. 1993) in conjunction with ceramic sherds, volcanic glass, early adzes and shell items. The earliest radiocarbon dates from Tutuila Island are from the coastal village of Aganoa (cal. 2,600 B.P. ± 40 at 1 sigma Beta-228302) which provides further evidence of initial occupation occurring well before the second half of the first millennium B.C. (Crews 2008; Kennedy and Moore 1999). Excavations by Clark and Miclovic at 'Aoa also shows evidence of occupation ca. 2,700 B.P. (Clark and Miclovic 1996; Clark and Wright 1995).

Until recently in Samoa, the earliest dates were relegated to sites dotting the coastal margin. Recent excavations at Vainu'u (AS-32-016), a highland ceramic site on

Tutuila, provide strong evidence of highland use by at least 2,300 B.P. (2350-2340 Cal B.P., Beta-240793). The site is presently interpreted as a non-residential site that was habitually visited for agriculture or the felling of timber for lowland residential structures or ship construction (Welch 2007). The Vainu'u assemblage contains an array of adze fragments, remnants of ceramic vessels with rim decoration as well as volcanic glass cores and flakes, all of which correlate well with the established Eastern/Late Eastern Lapita material assemblage (Welch 2007; Roberts 2007; Hawkins 2008; Eckert 2008).

Differences in settlement chronologies, linguistics, as well as the morphology and frequency of cultural materials have led to the dissection of the Lapita Complex range into Far Western, Western, Southern and Eastern Lapita provinces. Artifact assemblages and linguistics of Western Polynesian islands display differences to island groups to the west (Reef-Santa Cruz Islands) and south (New Caledonia and Loyalty Islands). As a result, the Bismarck Archipelago and surrounding islands account for the Far Western Lapita region; The Reef-Santa Cruz Islands and Vanuatu comprise the Western Lapita region. New Caledonia and the Loyalty Islands are members of the Southern Lapita Province. The Islands of Fiji and Western Polynesia constitute the Eastern Lapita province and signify the easternmost extent of Lapita seafaring (Kirch 2000; Sand 2001).

Material Culture of the Lapita Expansion

Lapita assemblages are characterized by dentate-stamped ceramics with a wide variety of globular and shouldered pots, as well as small dishes, flat serving vessels and cylindrical containers (Sand 2001). These decorated vessels show highly stylized patterns and employ a wide variety of design elements. Morphological variety in vessel forms and design elements decline over time across Oceania (Smith 2002). Many ceramic morphologies and attributes (cylindrical containers and most design elements) had vanished by the Eastern Lapita occupation of the Samoan Archipelago. Historically, researchers of the Pacific Islands based the identification of Lapita sites primarily on the existence of highly decorated ceramics (Smith 2002; Kirch 2000). Lapita ceramic assemblages however also contain large amounts of non-decorated ceramic plain ware and include characteristic non-ceramic artifacts (Sand 2001; Smith 2002).

While only a small fraction of systemic cultural materials are expressed in the Oceanic archaeological record (see Kirch and Green 2001:165), Lapita voyagers utilized a plethora of non-ceramic cultural materials. In most cases these perishable items are not preserved in the archaeological record of the Pacific. As a result, non-perishable materials, such as stone or ceramics, must be used to understand human interaction and change through time. Of the materials that survive, Lapita assemblages often include artifacts that display regional variations of plano-convex adze types fashioned from greenstone, andesite or basalt depending on local geology, one-piece shell fishhooks, tools and valuables of shell, flaked obsidian tools, echinoderm drills, and coral files.

The presence of plain ware pottery, complemented by associated diagnostic cultural materials such as shell tools and jewelry, obsidian flakes and early-type adzes (Green and Davidson 1979; Kirch 2000; Leach 1996) may still represent Late Eastern Lapita (LEL) occupation (Smith 2002:189).

Formalized tools, such as adzes, in an assemblage offer recurring and familiar attributes for study. The distribution and morphological change of these culturally defined objects show inter-group interaction and cultural evolution over the span of time. The early adze kit of Western Polynesia (Eastern Lapita) includes plano-convex adze forms (Type Va) along with triangular forms (Type Vb, VI, VII and possibly IX). Rectangular forms (Type III) are present as small adzes or chisels. Additionally, the reverse-trapezoidal type IV adzes are present in small numbers. At this time, Type I and II are also apparent in the assemblage and exhibit variable size (Green and Davidson 1969, 1974; Leach 1996; Kirch 2000). While some researchers stress the importance of plano-convex adze forms as markers of Eastern Lapita activity in Western Polynesia, it must be noted that the stone adze kit of Lapita voyagers was already diverse by the time of initial entrance into what would later become Polynesia. While plano-convex adzes are distinctly the product of initial occupants to the Polynesian Islands, many other forms existed and were employed regularly.

Obsidian procurement and trade featured dominantly in Lapita exchange systems throughout the regions of both Near and Remote Oceania (Green and Kirch 1997:23; Torrence 2011). Lapita occupants of the Willaumez peninsula of New Britain procured the glassy material from the Talasea source in quantities previously unknown to the

island and distributed across the known island universe, ranging from Eastern Indonesia (Bellwood and Koon 1989) to the Fijian Archipelago (Best 1987). This range of distribution comprises a distance of 6,500 km from one end to the other, a staggering distance across an open Pacific Ocean.

Green and Kirch (1997) illustrate that after Lapita's entrance in Near Oceania, the rise in procurement and distribution was not just a mere increase in procurement, but rather upon arrival Lapita populations incorporated the obsidian into a "complex, multi-nodal, multi-directional, decentralized" network (Green and Kirch 1997:27). This network mobilized a diverse suite of goods throughout the Lapita provinces. The initial settlements in Remote Oceania, those of the Santa Cruz, Reef and surrounding islands, show a distinct tradition of one-way trade and down-the-line exchange westward towards the homeland (Green and Kirch 1997). While trade was focused primarily towards the Near Oceanic homeland, localized trade is archaeologically evident within the Reef-Santa Cruz and Duff islands, with procurement of obsidian from the Banks Islands to the south as well as the movement of chert from Lakao (Duff Islands) to the Reefs (Green 1994).

As the range of Lapita expansions grew over the following centuries, obsidian procurement and trade became increasingly regionalized as the links between marginalized Eastern Lapita networks lost ties to the Far Western Lapita homeland. Green (1996) illustrated this trend, showing that the exchange systems beyond the Western Lapita province become less complex and more regionalized. With the

exception of isolated artifacts, it appears that major inter-archipelago trade fails to exist shortly after initial colonization.

The fact that inter-archipelago trade yields to local exchange systems is interpreted by Green and Kirch (1997) as the product of a colonization front that created localized, intra-archipelago exchange networks as it raced across the Pacific towards the un-colonized islands of Fiji, Tonga and Samoa. The populations that settled each island chain in effect repeated those cultural traits held by the Lapita complex in relative isolation, with only minor contact to down-the-line populations from the homeland or newer colonies. In this way, the regionalized trade network between Fiji, Tonga and Samoa took shape and constituted the eastern terminus of Lapita oceanic exploration.

1.1.4 Lapita Complex Continuum, or the Rise of an Ancestral Polynesian Society?

Lapita voyaging established the Eastern Lapita Province in Fiji ca. 3,200 B.P. (Davidson and Leach 1993), which almost immediately extended to Tonga (ca. 3,100-3,000 B.P.) (Poulsen 1987) and Samoa (ca. 3,000 B.P.) (Clark and Michlovic 1996; Crews 2008; Kennedy and Moore 1999; Kirch 1993).

The region of Tonga, Samoa, Futuna and Uvea became increasingly disconnected from island chains to the west, with some materials coming from Fiji through Tonga to the islands of Samoa. Several changes occurred in the ceramic tradition as populations left Fiji and settled the new islands of Western Polynesia. The highly stylized ceramic designs seen in Fiji had become less extravagant upon reaching the Uvean and Tongan

Islands. When compared to Tonga, further depletion in vessel form and design elements is apparent in those of the Samoan assemblage.

While dentate-stamped ceramics tend to decline from Fiji to Tonga and Samoa, volcanic glass, basaltic adzes, shell tools and jewelry, echinoderm and coral tools as well as plain ware ceramic vessels sees minor changes (Smith 2002). This reduced assemblage of ceramic forms and decoration, known as Polynesian Plainware (PPW), coupled with previously mentioned characteristic portable artifacts, continued until approximately A.D. 400-500 (Kirch and Green 2001). This date marks the beginning of a poorly understood portion of Samoan prehistory often referred to as the Samoan “Dark Ages” (Davidson 1979: 94-95; Reith and Hunt 2008) that persisted until ca. A.D. 1,200. After A.D. 1,200, stark changes occurred in the morphology and variety of material culture as well as settlement patterns and architecture in Samoa (Clark 1989; Green and Davidson 1974; Smith 2002).

Researchers offer two main models to explain the cultural materials exhibited in the archaeological record of Western Polynesia: The Consensus model, also known as the Lapita-Only model, and the Triple-I model. The “Consensus” model (Burley et al. 1995) expresses the commonly held sentiment among authors regarding Lapita contact and change over time. Most importantly, this model asserts that becoming Polynesian happened in Samoa and is the result of gradual change in the cultural practices brought by initial Lapita colonists. The term Lapita-Only describes the main tenet where initial Lapita traditions gradually transformed as the result of isolation into an Ancestral Polynesian Society and a later complex chiefdom. The model maintains that an Eastern

Lapita settlement occurred ca. 3,100-2,500 B.P., which brought with it the remnants of Lapita pottery, tool production and linguistics. Trade networks with the Fijian Islands waned by ca. 2,500-2,000 B.P. and led to the relative isolation of Tonga, Uvea, Futuna and Samoa, punctuated by some long distance trade from Fiji to Tonga and regular trade between Tonga and Samoa (Kirch and Green 2001). Over the next several hundred years (ca. 1,600 B.P. in Samoa and ca. 2000 B.P. in Tonga) a cultural shift towards a culturally definable Ancestral Polynesian Society (APS) occurred as the result of isolation from the homeland coupled with inter-island trade within Polynesia (Kirch 2001; Smith 2002).

A fully plain ware ceramic tradition accompanies a shift in linguistics to Proto-Polynesian from the Late Eastern Lapita precursor as a culturally distinct Ancestral Polynesian Society emerged (Kirch 2000; Kirch and Green 2001). In this regard, the archaeological sequence in Samoa transformed from Eastern Lapita almost immediately to that of a distinct Ancestral Polynesian Culture. This transformed ancestral group of communities began to engage in monument building practices and practiced a complex chiefdom form of social organization which would be transmitted to newly settled islands of Eastern Polynesia by ca. 1000 B.P.

The Triple-I model for Polynesian cultural transformation (Addison and Matisoo-Smith 2010) is a relatively new attempt at revising the Lapita-Only consensus. This model suggests that intrusion, interaction and integration, occurred within the Samoan Islands sometime after ca. 1500 B.P., and this served to transform the social organization and technological traditions held by resident pottery-making communities. Both models

maintain constant island occupation is evident in the archaeological record and that population density did not diminish significantly during the Samoan Dark Ages.

1.2 QUESTIONING THE CONSENSUS

1.2.1 Before *Hawaiiiki*, Ancestral Polynesia

Here I specifically focus on the formation of the phylogenetic model forwarded by Kirch and Green in their 1992 essay in *Current Anthropology*. This paper came nine years prior to their seminal work *Hawaiiiki, Ancestral Polynesia* (Kirch and Green 2001). What makes this paper especially interesting is the litany of comments that the paper drew to the contrary from authors such as Dannel, Dye, Gosden and Terrell. In their essay, Kirch and Green borrow from biology and use an evolutionary framework to provide a homologous link between late Samoan prehistoric remains and the early ceramic period assemblages. They used historical linguistics as an independent method of creating phylogenetic relationships between island groups. In order to bridge the gap between early and late records of Samoan prehistory, they recreate proto languages and trace the synthesized cognate shifts back in time to an ancestral language. This approach did not test the hypothesis of multiple cultures at work on the Samoan archaeological record and furthered the assumption that populations were not significantly changed through cultural intrusion. The argument was not based on radiometric dates *per se*, but rather radiometric dates were used as supplemental data in support of their model. Kirch

obtained the dates from earlier work by Green and colleagues and from his excavations at To'aga in the late 1980s.

The phylogenetic approach used by Kirch and Green (1992, 2001) is summarized as such:

- 1) Plot the distribution of related languages
- 2) Calculate the approximate time depth of linguistic differentiation. This was based on lexicostatistics and glottochronology and put the separation of Proto-Polynesian from Proto-Fijian around 3500 B.P. The split between the later Samoan and Tongan languages was then argued by Kirch and Green (2001) to have taken place between ca. 3500-2500 B.P.
- 3) Define the origin and history of migrations. This they do with linguistic models and archaeologically excavated materials not described in the 1992 text due to lack of space.
- 4) Reconstruct the material goods made by the proto culture from the linguistic reconstruction.
- 5) Test the linguistic reconstructions with archaeological data.
- 6) Test the reconstruction with physical anthropological data
- 7) Utilize ethnohistoric and ethnographic data to analyze archaeological cultural patterns

The lexico reconstructions of a proto language ultimately led to the concept of an “Ancestral Polynesian Society” (APS). The next step (number 5) was to test the

linguistic model with archaeological evidence from the Samoan islands to find a correlate for the synthetic linguistic changes from an ancestral language toward the language spoken at the time of European contact. Kirch coordinated these lexico reconstructions with archaeological evidence and suggested a change in material culture in the form of a shift from decorated pottery to a fully plainware assemblage fit the timeline for linguistic change ca. 2500 B.P. signified the rise of APS. Loosely defined changes in ceramics, stone tool morphology and other subsistence behaviors were also argued to have occurred in sequences that aligned with the reconstructed culture created through the manufactured linguistic pattern of divergence. Synchronic and diachronic differences in site function, rather than the formation of a proto-culture, could be a strong counter-argument for the variability in archaeological assemblages.

Another example of an archaeological correlate for the rise of APS was a shift from fine-tempered, thin-walled vessels toward thicker vessels with coarser temper. Archaeological investigations since have failed to identify this change as a solid temporal marker, but rather excavations find the two to appear synchronically which suggests differential use between the two morphologies. The findings of the lexical reconstruction and material correlates were expanded upon with a robust list of lexical reconstructions and material correlates of an Ancestral Polynesian Society within the Samoan Islands in the book *Hawaiiiki* (2001). The result of these works sets the Samoan Islands apart as the ancestral homeland from which colonists would later migrate towards the islands of Eastern Polynesia. In this regard, initial pottery-producing populations that settled Samoa via Fiji and Tonga are the ancestors of all Polynesians.

The work by Kirch and Green was not an instant success by any means. In what has become a forgotten literary battlefield, the comments contained within the 1992 *Current Anthropology* article offer scathing reviews in which R.C. Dunnell criticized the authors for their Lamarkian and essentialist standpoint in which confused cultural and scientific evolution as they created APS as an empirical “society” out of thin air. In this critique Dunnell warns that archaeologists have forgotten the separation of biological evolution and cultural transformation and are now using popular theoretical perspectives to fit their facts. In the same round of comments Chris Gosden asks why use an evolutionary framework at all? Gosden is concerned at the use of linguistics to create homology over analogy and that Kirch and Green have failed to look at the archaeological record as the starting point, but rather used the material record to satisfy a linguistically reconstructed “society”. John Terrell goes as far as to say that Kirch and Green have simply over-exaggerated their success in lexical reconstruction and the association of an identifiable Ancestral Polynesian Society. Other authors were in support of Kirch and Green, with Bellwood calling the approach the “essence of sound common sense”.

Attempts to refine our models for cultural change via new primary data should remain at the forefront of our research endeavors in the Samoan Archipelago, and Polynesian archaeology at large. Time has covered the traces of deep contention. The phylogenetic model that was so hotly contested became the singular understanding of cultural change that the majority of archaeologists use to frame their questions. Perhaps Kirch and Green were correct. Maybe the linguistically recreated society indeed can be

traced back in time and the entire archipelago changed their material culture because they started speaking differently. Regardless, the singular hypothesis became gospel from the early 1990s through the 2010 and has only recently received a new wave of critical assessment.

1.2.2 Recent Arguments against an Ancestral Polynesian Society

In the last few years, with prompting from Anita Smith (2002), archaeologists have begun to test the Consensus model. Specifically, Smith argued that the material culture evident in the Samoan archaeological record does not exhibit the signals of social transformation towards an Ancestral Polynesian cultural tradition at the date of ca. 2,400 B.P. proposed by Kirch and colleagues (e.g., Kirch and Green 2001). Rieth and Hunt (2008) assessed the radiocarbon chronology of the Samoan islands to refine the number of usable dates. From their work they found that minimal evidence of any human activity exists during the period of time in which the Ancestral Polynesian Society was modeled to have blossomed. So not only do we not have a strong signal of a widespread switch from decoration to plainware at 2500 B.P. to signal the advent of APS, but we barely have any evidence at all of occupation for 300 years prior to the advent of the Monument Building period.

Addison and Matisoo-Smith (2010) provide a genetics-based model and suggest that the inhabitants of Samoa ca. 2700-1500 B.P. would have been genetically and phenotypically similar to other Lapita voyagers in Remote Oceania, appearing much like

present populations in Vanuatu, New Caledonia and Fiji (Addison and Matisoo-Smith 2010). This stretches the timeline of Lapita by eliminating the rise of an ancestral proto-Polynesian culture. Pottery-producing populations would have had mtDNA lineages affiliated with haplogroups P, Q, M and perhaps B4 with Y chromosomes of the C2, K-M9*, M1* and O3* types (Addison and Matisoo-Smith 2010:7-8).

Around 1500 B.P., biological evidence, as argued, indicates the admixture of a new population with typically Asian-derived physical characteristics. At this point the introduction of Asian-derived mtDNA lineages occurred and brought the current Polynesian motif and Y chromosome of the O3-M324 lineage. The newly arrived population was also responsible for the introduction of commensal animals and plants that do not appear prior to 1500 B.P. (Addison and Matisoo-Smith 2010; Smith 2002). Ultimately this interpretation suggests an early Polynesian population formed shortly after 1500 B.P. as the result of intrusion, integration and innovation via interaction with populations originating from Micronesia. The timing of this event has interesting implications for the seemingly explosive colonization events across Eastern Polynesia ca. 1300 B.P. and warrants additional attention.

Still, the proponents of the phylogenetic model have met this contrary viewpoint of multiple discrete occupations with sharp criticism. Janet Davidson (2012) published a revision of her 1977 synthesis of Samoan archaeology in response to recent ideas of population admixture (Addison and Matisoo-Smith 2010) and maintains that Samoa shows no signals of cultural integration with outside populations. Her argument is based

on similarities in material culture across time and is drawn from thoughts created during the wave of phylogenetic model building in the late 1970s and early 1990s.

The debate continues as to where modern Polynesian culture started, where Polynesian identity took root, and how it spread. I choose to employ multiple working hypotheses in an endeavor to balance the data against the models at hand while creating additional scenarios to test the archaeological data. My approach works outside of the boundaries placed on Polynesian origins and identity by the phylogenetic model, as new ceramic data to the contrary appears to contradict a correlation between plainware assemblages and the formation of an Ancestral Polynesian Society. My approach starts with the archaeological record and offers new data for old questions of cultural transformation in the Samoan Islands.

This dissertation focuses specifically on components of pottery, obsidian and basalt assemblages between the Ceramic and Aceramic periods. By assessing patterns in the chronology of craft production we may gain a better image of population movement and cultural identity. My investigations use the period of reduced occupation during the Dark Age as a benchmark to test changes in political configuration, discrepancies in material procurement and distribution, and potential large-scale population shifts as the result of natural disasters. The result of this work paints a picture of two cultural traditions in the Samoan Islands that are separated in time and do not share a direct ancestor-descendant relationship.

1.2.3 Rejecting the Dominant Paradigm

Archaeological field methods and the theoretical underpinnings from which we may draw our logical inferences change as a function of time. Available technology and popular theoretical directives will continue to change within our discipline as we attempt to clarify our understandings of prehistoric social and environmental relationships. Understanding that our discipline evolves as we seek evidence of change in others, we must challenge ourselves to critically assess our own analytical past, reframe questions, test alternate hypotheses and evaluate the lines of thought that create contemporary knowledge.

By operating under a single hypothesis we risk the danger of becoming overly attached to our hopeful conclusion. The momentum of one's effort becomes focused on seeing a singular argument toward the logical conclusion, when in fact several perfectly valid explanations likely exist. Hypotheses become facts used by subsequent generations, and data are collected and interpreted within a framework that may never have been adequately tested. The creation and testing of multiple working hypotheses (Chamberlin 1897) provide a measure of restraint on this cycle as the approach alleviates the tendency to become dogmatically protective of a single hypothesis. Several different hypotheses may explain the disappearance of pottery in the Samoan Islands. Perhaps the change in ceramic production was the result of cultural drift. In this scenario, during a period of decreased population (Kirch 1984:102), the cost of ceramic production may have outweighed the social functions and subsistence needs and was never reintroduced.

While often unpopular at first, and while respecting the pioneering work of initial archaeological forays and inference, it is critical to continually reassess our interpretive framework as new information arises.

The current consensus for the peopling of Polynesia, and specifically the cultural changes that occurred in the Samoan archipelago, has received minimal attempts at revision since the original chronology was outlined in the late 1960s (Green and Davidson 1969, 1974). The timidity for reassessment and revision is perhaps a product of respect for early archaeologists, as new researchers feel they should not step on the toes of archaeologists that have indeed produced some very valuable work. The material remains of prehistoric life in the islands have been interpreted through a single viewpoint, a perspective that maintains becoming Polynesian happened in Samoa as the result of gradual change within an original Lapita founding population (Kirch and Green 2001). The consensus framework offers certain valuable understandings yet should not be seen as the only answer until alternate big-picture hypotheses regarding the timing and cause of different cultural traditions apparent in the archaeological record of the Samoan Islands have been tested. In the following pages I offer evidence in support of an alternative hypothesis: Polynesian cultural traditions in the Samoan Islands ca. 1200-250 B.P. are not derived from initial Lapita-period settlers or an Ancestral Polynesian Society ca. 2800-1500 B.P.. Rather, multi-component archaeological sites attest to two separate colonization events and suggest a case of population replacement in the Samoan Islands. To assess the potential that two discrete populations may have lived across the Samoan Islands I observe patterning in lithic technological organization, ceramic craft

production and the geoarchaeological record of site occupation at multi-component archaeological sites.

In the remaining portion of the introduction I examine the history of archaeological thought in the study of prehistoric Samoa. Section 1 offers new evidence from the highland site of Vainu'u on Tutuila Island, American Samoa. The findings from this multi-component site illustrate that large-scale environmental change occurred ca. 1500 B.P. and that material correlates of two cultural traditions are readily apparent below and above a deposit formed by late Holocene volcanism. Section 2 offers new evidence from the coastal site of 'Aoa in opposition of a late chronology of pottery production on Tutuila Island and furthers the argument that the Ceramic period practices of obsidian distribution and ceramic production were not culturally transmitted to later Monument Building Period communities. This distinction is valuable as 'Aoa was previously the only site to suggest a link in material culture between pottery-making communities and the later Polynesian cultural motif expressed during the Monument Building Period. In Section 3 I illustrate that obsidian distribution networks cease to operate synchronically with the cessation of pottery production on the heels of a string of volcanic eruptions ca. 1500 B.P.. The disappearance of subsistence-related craft products and distribution networks across the Archipelago ca. 1500 B.P. suggests a large-scale decline in population density, likely as the result of diminished resources due to catastrophic volcanic eruptions. Upon renewed occupation, ca. 1250 B.P., the early cultural identity perpetuated by initial occupants through pottery production and obsidian distribution was absent, which suggests new sociocultural values were brought

to the Archipelago by the later colonizing population. The concluding section recounts the research problem and the findings of this study in support of a cultural hiatus model for the Samoan Islands.

1.2.4 New Archaeological Assemblages that Do Not Fit the Consensus Model

When I began my archaeological work in Samoa during the summer of 2005 I had no reason to doubt the current literature and the phylogenetic model for Polynesian cultural transformation. However, my confidence in the general consensus for cultural change was challenged during the 2006 field season at Aganoa, a prehistoric village on the eastern coast of Tutuila Island.

The patterning of artifact assemblages at this multi-component site did not seem to adhere to the core tenets of the phylogenetic model. For instance, the pottery assemblage did not fit the patterned changes touted in the dominant literature. There was a long gap in residential occupation, and any signals to indicate that the initial population was ancestral to the later community were absent. There were what appeared to be two very different forms of making a living at that site separated by several centuries with no cultural activity in between. Far from the gradual transformation of a ceramic-making community into a monument-building complex chiefdom, the excavations at Aganoa presented a confusing dilemma where new data were not fitting smoothly into the dominant paradigm.

To expand our understanding of this problem, I took part in further excavations under the direction of Dr. Suzanne Eckert to investigate other multi-component sites and evaluate the success of the phylogenetic model. Initially this was an attempt to find concrete evidence of a cultural link between Lapita colonists and monument-building Polynesians. New excavations were carried out at Vainu'u, Matautia and 'Aoa on Tutuila Island, American Samoa. Two stratified archaeological components separated by a catastrophic volcanic event were present at Vainu'u and Matautia. The items of material culture recovered within the discrete deposits appeared to illustrate unique technological choices in tool manufacture and raw material procurement (Eckert and Welch 2013). Each respective archaeological component produced discrete differences in tool forms without a definable signal of a community in between that was “transforming” from pottery makers to aceramic monument builders. Excavation at 'Aoa illustrated widespread geomorphic change had restructured the initial spatial arrangement of archaeological deposits. At 'Aoa, post-depositional artifact transport by cyclical erosional events made assigning behavioral interpretations extremely problematic and made any confident interpretations regarding the chronology of cultural change impossible.

The archaeological findings from excavation at these sites do not fit comfortably within the phylogenetic/linguistic model for Polynesian cultural transformation and require new ways of thinking to explain patterns of change in the Samoan Islands. Rather than attempt to force the new archaeological information into a mold founded on lexico-reconstruction, in this study I choose to observe patterning present in the

archaeological record first and foremost, and supply an interpretation outside of an adherence to the traditional culture history model. This dissertation describes the discrepancies produced from recent fieldwork and provides an alternative model for the behaviors that created such change.

Recently, Smith (2002) questioned the consensus model for Samoan cultural transformation forwarded by Kirch and Green (1992; 2001). Specifically, she asked whether or not an ancestral Polynesian Society is actually definable within the archaeological record ca. 2400 B.P.. Her findings suggest that there is not sufficient archaeological evidence to support a cultural transformation at 2400 B.P. toward a new, “proto-Polynesian” way of life. Smith notes that general continuity in cultural practices existed until ca. 1000 B.P. when widespread distribution networks and monument building practices indicate the complex chiefdom-level form of political organization began. The implications of her work force us to reconsider the culture history of Samoa and especially the level of cultural affinity between initial settlers and later Polynesians. Could it be that the widely accepted viewpoint of Lapita ancestry in the Samoan Islands is in error? Perhaps Samoan culture history is best seen as including two major colonizing events rather than gradual transformation stemming from a single ancestral population.

1.2.5 An Alternative Viewpoint on Ancestral Polynesia

Smith (2002) proposes an alternative model for the evolution of Polynesian culture. She suggests that there is minimal archaeological evidence to support the link between the changing linguistics from Pre-Polynesian to Proto-Polynesian and that the archaeological record does not offer a signal of the formation of a recognizable ancestral phase. She states that chronometric data from Samoan ceramic-bearing sites (Clark and Michlovic 1996; Kirch and Hunt 1993; Kirch and Green 2001) do not show a regression through time from Lapita to Polynesian Plainware, and therefore archaeologically there is no material correlate for the “Consensus” model of cultural change. Smith argues that Archaeology “can only ever play a confirmatory role in the linguistic model” and that researchers must avoid framing archaeological conclusions surrounding the model of Lapita dispersal and the evolution of APS based on terms of another discipline (linguistics) (Smith 2002:7).

Smith suggests that a cultural continuum from Late Eastern Lapita to plain ware traditions is apparent and that archaeological evidence cannot provide definitive material implications for a shift to a distinct Ancestral Polynesian Society. She reinforces the fact that the Lapita ceramic assemblage was never entirely composed of dentate-stamped vessels; rather that it only comprised a small, non-utilitarian percentage of approximately 11%. From this, she argues that Polynesian Plainware is not archaeologically distinct from Late Eastern Lapita on the basis that plain ware assemblages show minimal variation over time, are often synchronic with LEL dates and

remain in conjunction with the prior suite of non-ceramic material elements of LEL assemblages.

The timeline of Smith's model has simple dentate-stamped vessels and additional Eastern Lapita artifacts occurring in Western Polynesia during the "Colonization Period" (ca. 3,000 B.P.). The ceramic design elements of initial settlement become minimal, with the apparent loss of decoration and the shift to a fully plainware ceramic tradition following soon after. Adze morphology changed, where plano-convex adzes were replaced by triangular forms and a reduced number of shell ornaments and shell tools types occurred during the "Post-Colonization Period" (ca. 2,600-1,000 B.P.).

A proposed Mound Building Period extends from ca. 1,000 B.P. to the Historic Period (Smith 2002:182) during which some use of plain ware ceramics still existed (contested by this author in Chapter 3). This mid-to-late phase in Polynesian prehistory saw the disappearance of plano-convex (type V) adzes (Green and Davidson 1974) and an expansion of adze morphologies including rectangular types (type III) and the predominance of quadrangular type I.

While I contest certain aspects of this model (i.e., the use of ceramic after 1,500 B.P.), the model does show, in many regards, that the previously accepted model for Polynesian origins requires further scrutiny. Smith shows that the material culture evident in the archaeological record of the Polynesian Islands may not in fact display the cultural distinctions necessary to maintain the discrete cultural phases given in the "consensus" model (Smith 2002:189). In this regard, she argues the possibility that the Eastern Lapita voyagers who initially colonized Tonga and Samoa continued occupy the

islands using plainware ceramics, without the rise of an archaeologically distinct Ancestral Polynesian Society.

1.2.6 Framing the Research

In the following sections I illustrate the history of archaeological methodology and anthropological thought of early Polynesianists. I outline the current consensus for cultural change and the material correlates that support traditional standpoints, and to this I offer a general assessment and critique. Second, I survey previous works in Western Polynesia that pertain to our understanding of material change in the Samoan Archipelago. Last, I survey recent advances in archaeological methods and discuss the new wave of scientific inquiry into Samoan prehistory as it offers a potential revision to concepts of the Polynesian Homeland, Lapita ancestry and Polynesian identity.

The earliest archaeological datasets for Samoa come from the work compiled by Green, Davidson and colleagues (Green and Davidson 1969, 1974) as part of the Programme of Polynesian Culture History. The findings from excavations on Upolu and Savai'i were compiled into two volumes edited by Green and Davidson (1969, 1974) and encompass a substantial amount of time, money, effort and skill. The radiocarbon dates provided within these seminal works formed the initial chronology and dataset that would carry archaeological sentiments into the coming decades. From their work they realized that there was an apparent disappearance of pottery within stratified deposits. This disjunction led to the idea of “ceramic” and “aceramic” periods of prehistoric

behavior within the Samoan Islands. A study of stone adze morphology was used to infer continuity over time; however, where new forms were seen as the product of local innovations and morphological evolution through experimentation over time Green and Davidson 1974:260).

The resulting culture history described continuous change within a pottery-producing society that entered an uncolonized Samoa, ca. 2900 B.P. The traditions of the founding population transformed into an Ancestral Polynesian population at some point around 2400 B.P. (Kirch and Green 2001, 1992). Lapita descendants halted ceramic production around ca. 1,500-1,700 B.P., with significant intensification in social stratification occurring by 1000 B.P. as political structures evolved into the complex chiefdom witnessed at European contact ca. 250 B.P. The fieldwork conducted by Green and colleagues remains a significant and impressive venture that produced a huge corpus of information. The conclusions drawn from this pioneering work would lead to the Phylogenetic framework forwarded by Kirch and Green (1992, 2001) which forms the backbone of the currently accepted archaeological chronology for Polynesian migration, cultural transformation and western concepts of Polynesian identity.

Davidson (1977) discussed the current direction of archaeological thought regarding the similarities and differences in Fiji, Tonga and Samoa. Her 1977 paper was a summary of findings and generalized trends in analyzed materials in support of a ceramic-making population that forgot how to make pottery and changed into modern day Samoans. Unfortunately no specific data were presented in that paper. To be fair, her work had been presented in two volumes prior; she was simply placing a bow on top

of the package (she would later re-write this article in 2012 in response to new hypotheses about Samoan cultural transformation). In 1977, in no uncertain terms she admitted that the data they produced over the last 20 years were still inadequate and could only offer low resolution info on broadly based questions. Davidson continues to illustrate that little is known about Polynesian prehistory, but that certainly continuity is assured and that there is no evidence of significant cultural intrusion from other archipelagos (Davidson 2012).

A potential failure in argumentative logic is illustrated in the accepted standpoint regarding cultural transmission and continuous habitation of the Samoan Islands. In the phylogenetic model, the noted change in pottery production to a fully plain ware tradition is used as a signal for the formation of an Ancestral Polynesian Society ca. 2400 B.P.. However, the proposed descendant population (Monument Building Period) never made pottery, so the use of this archaeological material to link ancestors and descendants is problematic (Smith 2002). An additional example of problematic arguments for continuity is exemplified as such: 1) inter-island relationships must have happened then because they happen now and result in the transfer of perishable goods; 2) the signs of prehistoric inter-island interaction between different culture groups are gone due to the fact that perishable items do not survive in the archaeological record; 3) there is no surviving evidence of intrusion whatsoever so cultural transformation occurred without significant intrusion (Davidson 2012).

The problem here is that if perishable items are claimed to be the only measure of inter-island interaction, yet have not survived within the archaeological record, then how

have we any possible measure of interaction or intrusion? This “straw man” argument presents an unfalsifiable line of thought and excludes alternative hypotheses for cultural change. Until recently, and still in large part, researchers believed without a level of significant skepticism that generalized cultural continuity existed in western Polynesia. This line of reasoning relies on two points: a beginning and an end, initial colonists and communities that existed at European contact. With a beginning and an end population identified, research focused on drawing a line between the two archaeological components to illustrate a picture of cultural evolution. This brings us to the next wave of anthropological thought in Western Polynesia that occurred in the early 1990s to explain cultural transformation in Samoa.

1.2.7 Moving Forward

What would happen if we reinvigorate the notion of several working hypotheses? For this study I will test the following hypotheses: A) stratified archaeological remains do not present evidence for continual occupation and gradual cultural transformation between the Ceramic and Aceramic periods in the Samoan Islands (Cultural Hiatus Model); and B) stratified archaeological deposits show a sequence of gradual cultural transformation from Late Eastern Lapita communities toward an Aceramic complex chiefdom-level society (Lapita-Only Consensus Model). Further, I observe patterning in site occupation duration and presence/absence of pottery, volcanic glass and basalt tools to test the following hypotheses: C) large-scale change in assemblage diversity and form

is the result of cultural drift and D) change in assemblage diversity and form is the result of cultural replacement.

Change in material culture through cultural drift takes place as small errors and innovations allows a cultural group to transform from within and is not the result of significant outside intrusion of new technologies (Eggan 196; Hosfield 2009; Koerper and Stickel 1980). Punctuated occupation, signaled by decolonization, occupation hiatuses and new items of material culture upon recolonization would support a hypothesis of population replacement (Addison and Matisoo-Smith 2010; Barrientos and Perez 2005; Cronin and Neall 2000; Kononenko et al. 2010). How might new tests help to reinterpret our understanding of Samoan population dynamics, Polynesian ancestry and current identity? Will a Polynesian proto-culture be identifiable if we start with archaeology first rather than a linguistic model?

The work of Smith (2002) began to ask these questions of the early Samoan archaeological record ca. 2700-2400 B.P.. Smith questions the dominant, linguistics-based paradigm that a shift to a plainware assemblage aligns with the recreated linguistic (and therefore cultural) transition from Lapita groups to a population ancestral to later Polynesians. Smith argues that the archaeological record of Polynesia at large, including Samoa, says something very different from the linguistic phylogenetic model. In reference to Samoa, Smith notes that two fully plainware sites from Tutuila Island are of similar age to Lapita deposits elsewhere and date to the earliest occupation of the Samoan archipelago. The significance of this pattern is that it does not conform to the linear progression of early Lapita with decorative motifs trending toward Late Eastern

Lapita traditions with decreased decoration and then a fully plainware “ancestral” signature ca. 2500 B.P. Additional findings from sites such as Aganoa (Eckert and James 2011) supplement this important observation and show that fully plainware assemblages were produced concurrently on Samoa while dentate-stamped vessels were produced on the islands of Tonga and Fiji. This fact forces us to reconsider what Lapita identity even means to Samoan archaeology.

With the new understanding that there were sites with fully plainware assemblages synchronic with other diagnostically Lapita sites, we are able to field questions of variability in synchronic pottery production traditions. The significance of finding fully plainware assemblages that date to ca. 2700 B.P is that the materials offer contradictory evidence to the sequence of stylistic devolution over time from decorated “Lapita” to a plainware “Ancestral Polynesia”. If the two traditions can occur coevally and are not in fact separated by the ca. 200 years that it took for the formation of an ancestral society, what are we left with? The production of plainware simply may have been the result of technological choices and cannot serve as a landmark of cultural change ca. 2500 B.P. The meaning and identity tied to Lapita designs on other islands may not have held the same level of significance for pottery-making populations living in the Samoan Islands.

This simple finding of synchronic variability in material culture poses a significant challenge to the foundation of the linear cultural evolution framework of the Phylogenetic model. What other large-scale findings exist to challenge the dominant viewpoint of cultural transformation in the Samoan Islands? With the knowledge that

fully plainware assemblages are not relegated to a specific sequence within the Ceramic Period, a problem seems to arise in conventional knowledge that a transition from decorated traditions to plain ware traditions denotes the rise of an Ancestral proto-culture. This seemingly simple finding directly challenges the landmark trait of the rise of an ancestral cultural motif and calls into question the linear evolution of Lapita-Ancestral Polynesian-Polynesian identity as maintained by the phylogenetic model.

The contradictory ceramic evidence has an affect at a larger scale. With recent revisions to the chronology for first peopling of Eastern Polynesia, Specifically Hawaii at ca. 1260 B.P. and the Marquesas post 1400 B.P., the timing for migrations and cultural change within Polynesia as a whole seems to take on a different shape. The monument building period in Samoa ca, 1200 B.P., falls so close to the colonization of Hawaii and the Marquesas that the events become almost chronologically indistinguishable. But, if becoming Polynesian did not happen in Samoa via an ancestral Polynesian population derived from Lapita ancestry, then where did it all come from? To some, not all, the archaeology of Western Polynesia suggests that Polynesian identity did not form in Samoa via a transformed Lapita community, but rather arose after ca. 1,500 B.P. as the result of population intrusion from Oceanic islands to the North (Addison and Matisoo-Smith 2010).

In the following sections I focus on ceramic and lithic technology, specifically the timing of change in volcanic glass distribution networks and pottery production. Evidence of site abandonment and technological change upon reoccupation at the archaeological sites under study prompt a new model for the chronology of cultural

change in the Samoan Islands that includes demographic decline ca. 1500 B.P. with renewed large-scale activity as the result of intrusion beginning ca. 1200 B.P. This model breaks the ancestral link between Lapita populations and Polynesians as argued by the Lapita-Only Model and suggests population decline occurred prior to the intrusion, interaction and integration aspect of the Triple I Model.

2. A COMMANDING VIEW OF THE PACIFIC: HIGHLAND LAND USE AS VIEWED FROM VAINU'U, A MULTI-COMPONENT SITE ON TUTUILA ISLAND, AMERICAN SAMOA*

We discuss recent findings from Vainu'u (AS-32-016), a multi-component highland site on Tutuila Island, American Samoa. Vainu'u is of interest for three reasons. First, as the earliest recorded highland site in the Samoan archipelago, this site changes our understanding of the Samoan cultural chronology. Second, as a ceramic bearing site, material culture recovered from Vainu'u complements assemblages recovered from lowland and coastal sites. Third, the post-ceramic occupation observed at Vainu'u provides interesting insights into residential occupation during the Monument Building Period. Although excavations at Vainu'u were successful in terms of broadening our understanding of precontact culture on Tutuila Island, there is still much to be learned at this and other recently discovered highland sites.

2.1 INTRODUCTION

In this paper, we examine the occupation of Vainu'u (AS- 32-016) - a multicomponent site located on Tutuila Island, American Samoa -- and interpret the site

* Reprinted with permission from "A Commanding View of the Pacific: Highland Land Use as Viewed from Vainu'u, a Multi-Component Site on Tutuila Island, American Samoa" by Suzanne Eckert and Daniel R. Welch, 2013. *Archaeology in Oceania* 48(1):13-25. Copyright 2013 by John Wiley and Sons, Inc.

in light of our broader understanding of Samoan prehistory. Archaeological work at Vainu'u is of interest for at least three reasons. First, as the earliest recorded highland site in the Samoan archipelago, this site changes our understanding of the Samoan cultural chronology. Evidence from Vainu'u shows that the highlands were being occupied, at least for resource procurement and possibly for residency, as early as 2270 B.P.. Vainu'u is also the first ceramic-bearing site located in the highlands (Figure 2.1) to be recorded and systematically excavated in the Samoan archipelago.

At the time of Vainu'u's discovery, the understanding of ancestral Samoan cultural sequence had pottery production occurring 3100-1700 B.P., *prior* to residential settlement of the highlands (Davidson 1969, 1974, 1979; Pearl 2004); previously recorded ceramic bearing sites had all been located along the coast or in the foothills. Second, as a ceramic-bearing highland site, material culture recovered from Vainu'u provides an important complement to the assemblages recovered from excavations at lowland and coastal sites. Our evidence suggests that cultural activities practiced at Vainu'u were somewhat different than those practiced at coastal sites. As such, more archaeological work needs to be done at ceramic period highland sites so as to be able to understand the full range of behaviors practiced by the earliest settlers of Tutuila Island.

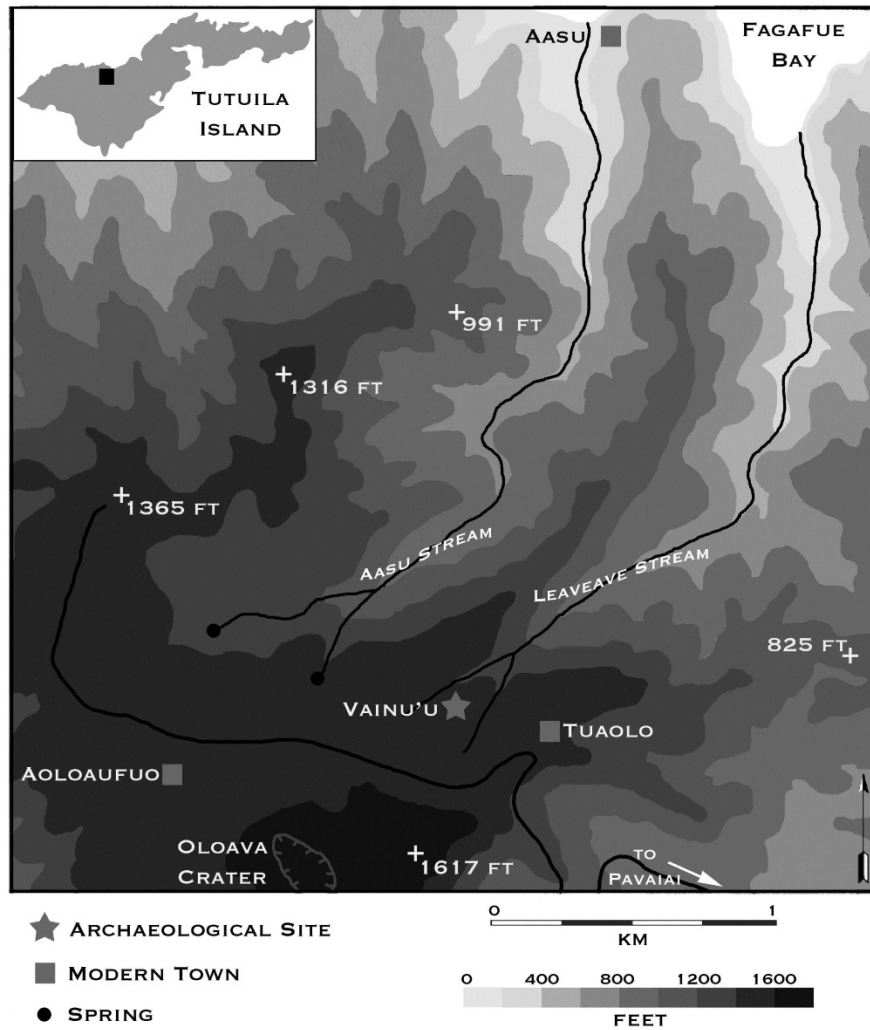


Figure 2.1: Topographic map showing Vainu'u and environs

Third, and finally, the post-ceramic occupation at Vainu'u provides interesting insights into residency during the Monument Building Period. Unlike the larger, more well-known archaeological sites of this period, residents of Vainu'u do not appear to have been at the center of any prestige building or production specialization activities. Examining Monument Building Period sites that were not politically central, as seems to

be the case at Vainu'u, has the potential to provide important data to help explain how social complexity developed, was organized, and was maintained in late period Samoan prehistory. Interpretation of such data provides a clearer understanding of the lifeways of ancestral Samoans than we currently have.

2.2 VAINU'U AND ITS CULTURAL SETTING

Vainu'u is located at approximately 335 meters above sea level on a ridge between two forks of the Leaveave Stream. First identified as a prehistoric site by David Herdrich, American Samoa territorial archaeologist, Vainu'u was mapped and excavated by a Texas A&M University archaeology crew in 2006 and 2007 (Eckert and Welch 2009). Combined, the 2006 testing and the 2007 archaeological investigations at Vainu'u resulted in the excavation of 23 1x1 meter units with a volume of ca. 17 cubic meters as well as 14 shovel test pits (Figure 2.2).

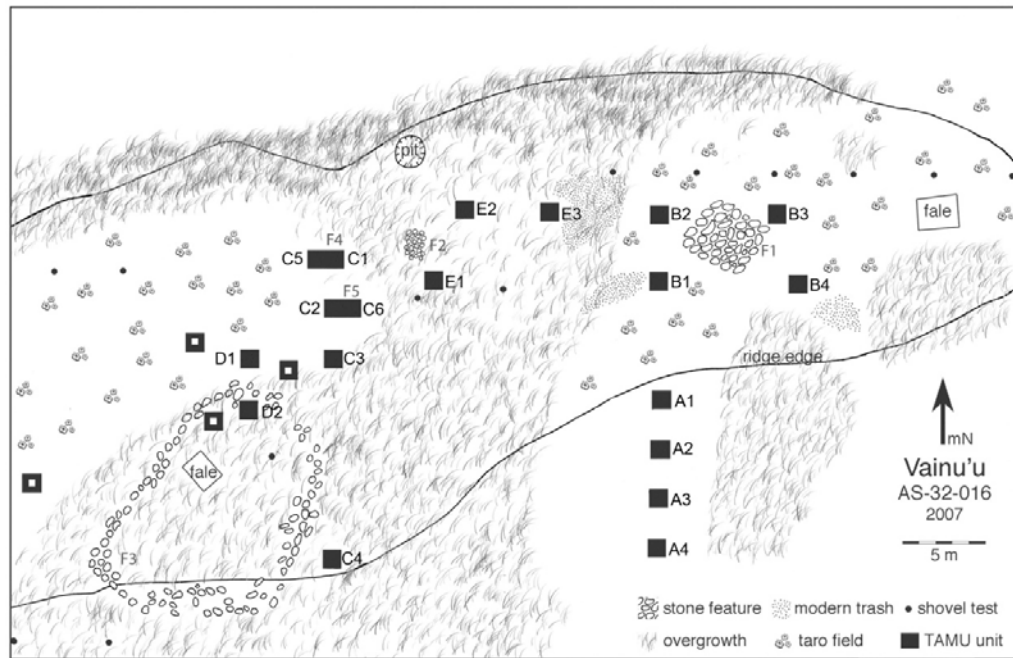


Figure 2.2: Vainu'u showing location of 2007 excavation units and cultural features

The material culture recovered includes 718 basalt artifacts, 24 volcanic glass artifacts, and 755 ceramic sherds. Only a subset of artifacts could be assigned to stratigraphic layers (Table 2.1); we focus on this subset to interpret cultural activity during each component.

The majority of artifacts could not be assigned to a stratigraphic layer because these artifacts were surface finds, were recovered from four excavations units where stratigraphy was not well recorded, or were recovered from three excavation units disturbed by historic activity. In addition to artifacts, a total of seven cultural features were identified (Table 2.2).

The radiocarbon dates discussed below allow us to place Vainu'u within the established Samoan chronology (Addison et al. 2008; Burley et al. 1995; Davidson 1969, 1979; Green and Davidson [editors] 1969, 1974; Kirch 2000) that associates time periods with specific material traits and settlement patterns (Table 2.3). Vainu'u is multi-component, with Component I dating to the Late Eastern Lapita Period/Plain Ware Period transition and Component II dating to the Monument Building Period. The Late Eastern Lapita Period (2700 - 2300 B.P.) is characterized primarily by the lack of dentate-stamped pottery and an overall simplification of pottery decoration when compared to the Early Eastern Lapita Period. The Plain Ware Period (2300 - 1700+ B.P.) is characterized by a ceramic assemblage that consists almost entirely of undecorated sherds; where decoration does exist, it is usually simple patterns along the rim.

Table 2.1. Summary of artifacts that can be assigned to a stratigraphic layer.

	Component (features)	Thin pottery	Thick pottery	Volcanic glass	Basalt flakes	Adzes	Basalt scrapers	Basalt blades
O		14	6	4	2	3		
V	Component 2 (F3 house foundation, F6 postholes)	25	6		63	8	3	
IV								
III	Component 1 (F4 and F5 stone ovens)	260	55	24	333	4	2	5
II					12			
I								
Total		299	67	28	410	15	5	5

Table 2.2: 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 <i>masi</i> pit
House platform (Feature 1)	Surface	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
<i>Umu</i> (Feature 4)	Units C1 and C5 32-45 cmbs	round 90 cm diameter	Component 1	fired rocks with charcoal and ash
<i>Umu</i> (Feature 5)	Units C2 and C6 26-64 cmbs	oval 110 cm at widest	Component 1	fired rocks with charcoal and ash
5 Postholes (Feature 6)	Unit D2 ~29-49 cmbs	each ~8 cm diameter	Component 2	Located on north edge of Feature 3

Table 2.3: Samoan cultural chronology.

Period	Time Period	Material Traits
<i>Aceramic Periods</i>		
Early Historic	250 - 112 B.P.	increase in coastal settlements
Monument Building	1000 - 250 B.P.	highland settlements; monumental architecture including fortifications and star mounds
Dark Ages	1700+ - 1000 B.P.	absence of pottery and volcanic glass; triangular and trapezoidal-sectioned adzes
<i>Ceramic Periods</i>		
Plain Ware Period	2300 - 1700+ B.P.	coastal and inland settlements; undecorated pottery
Late Eastern Lapita	2700 - 2300 B.P.	coastal settlements; late Lapita decorated pottery (designs simplified)
Early Eastern Lapita	3100 - 2700 B.P.	initial settlement(s?) along coast; early Lapita decorated pottery (dentate stamped)

Commonly known as the Polynesian Plain Ware Period, it is generally believed that during this period, Polynesian culture began to diverge from a Lapitoid/Melanesian pattern towards a more distinctively Polynesian pattern (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). However, this cultural continuity has yet to be established archaeologically (Smith 2002). As such, the term “Plain Ware Period” is used here, so as avoid untested cultural affiliations. Previous studies of Plain Ware Period sites have suggested that occupation during this period was focused along the coast (Clark and Michlovic 1996; Green and Davidson [editors] 1969, 1974; Kirch and Hunt [editors] 1993; Kirch et al. 1990).

Most of the known prehistoric sites on Tutuila island date to the Monument Building Period (1000 – 250 B.P.). Previous research indicates that a major settlement shift from the coasts and lowlands to the highlands occurred at approximately 700 B.P. (Pearl 2004). This period was one of regular warfare, with the building of fortifications and defensible villages common. The building of earthen mounds, especially rayed platforms, probably reflects prestige-building activities by chiefs (Herdrich 1991). Complex craft production organization is reflected in the archaeological record through evidence for specialized production of basalt adzes on Tutuila Island during this period (Best et al. 1992; Enright 2001).

2.3 BUILDING A CHRONOLOGY FOR VAINU'U

One of the most interesting aspects surrounding the discovery of Vainu'u and its highland ceramic assemblage was its potential to help refine the prehistoric timeline. As hoped, excavations provided ten radiocarbon samples from solid cultural contexts that have allowed us to confidently place the site within the ancestral Samoan cultural sequence. However, site stratigraphy and integrity need to be considered prior to a discussion of chronology building and cultural interpretation. Unfortunately, site stratigraphy cannot be reconstructed for seven of the 23 excavation units. Due to weather and time constraints, complete sediment data were not collected for the four units excavated in 2006. Also, the three units in Locus E were so heavily disturbed by historic cultural activity that stratigraphic layers were completely mixed (Figure 2.2). Very limited to no disturbance was evident in Loci A, B, C, and D after the first 30-40 cm below surface. As such, site stratigraphy, chronology building, and cultural interpretations relied on data recovered from these 16 units placed within these loci.

2.3.1 Description of Site Stratigraphy

Five stratigraphic layers are present across the site (Table 2.4), all of which originated as volcanic ejecta (Nakamura 1984:52). The thin organic stain of Layer O, the uppermost soil horizon, transitions into Layer V; Layers O and V are laterally continuous. These layers originally formed as the most recent volcanic event deposited a

lens of ash upon Layer IV. Layer IV is discontinuous across the site and is composed of welded ash; this 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 laminated clasts formed by pyroclastic flow. 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 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.

Layer III is composed of sandy clay loam with gravels and is the product of weathered volcanic ash and cinders. This layer exhibits variable thickness yet is distinct and continuous across the site. The surface of Layer III is a buried cultural horizon associated with ceramic artifacts. Soil formation is weak, 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, creating a paraconformity in the stratigraphic record in certain areas of the site. Layer II consists of dark reddish brown clayey gravels.

Table 2.4: Summary of stratigraphic layers described for Vainu'u.

Layer	Thickness	Texture	Color	Horizon	Associated Cultural Material
O	5 cm	Organic soil, small spheroidal 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)	5 YR 3/2 dark reddish brown	2C	few lithic artifacts
I	>35 cm	Well graded gravels (GW)	7.5YR 4/6 strong brown	3C	culturally sterile, no artifacts

The volcanic gravels are angular, well sorted and exhibit siliceous, vesicular structure. This depositional unit is devoid of artifacts in primary context. A few small artifacts were recovered, yet their location is most likely the result of gradual downward movement from the cultural horizon in Layer III. Layer I is culturally sterile and made of angular well-graded gravels of volcanic origin. The lowest limit of this sediment package was not met, with the deepest excavations ending at a depth of 35 cm 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.

2.3.2 Radiocarbon Dates

Seven charcoal samples and three ceramic samples were submitted to Beta Analytic Radiocarbon Dating Laboratory for accelerator mass spectrometry (AMS) radiocarbon dating (Hood 2008) (Table 2.5). Vainu'u is located within a modern horticultural field, and so it can be assumed that much of 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, charcoal samples for radiocarbon dating were selected from below 40 cm. We also attempted to collect datable charcoal samples that were in clear association with either cultural features or stratigraphic layers. We also used sooted ceramic material for radiocarbon dating, which has problems unique to this material class. In theory, soot provides an average date range for the different fuels that were used in forming the soot and so recovered context is not as vital as with dispersed

charcoal. However, a carbon core and/or the presence of shell temper can impact a radiocarbon date obtained from surface soot. Ceramic samples, therefore, were carefully selected to avoid the presence of these two potential contaminants. 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 (Table 2.6).

Table 2.5: Summary of radiocarbon dates from 2007 excavations at Vainu'u.

Beta#	Provenience	Material	C14 age years B.P.	C13:C12 ratio	C13 adjusted age B.P.	1-sigma calB.P.	2-sigma calB.P.
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
240791	Unit B4 Level 4 Layer III 61 cmbs 385.39 masl	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 49 cmbs 387.33 masl	charcoal	2340 ± 40	-27.5 o/oo	2300 ± 40	2350- 2320	2360- 2300 2240- 2180

"Vcdrg" 407"Eqpvkpwgf

Beta#	Provenience	Material	C14 age years B.P.	C13:C12 ratio	C13 adjusted age B.P.	1 -sigma calB.P.	2-sigma calB.P.
240793	Unit C1 Level 5 Feature 5 Layer III 57 cmbs 387.26 masl	charcoal	2380 ± 40	-27.9 o/oo	2330 ± 40	2350- 2340	2360- 2320
240794	Unit C6 Level 4 Feature 4 Layer III 45 cmbs 387.37 masl	soot on sherd	1400 ± 40	19.9 o/oo	1480 ± 40	1400- 1330	1420- 1300
240795	Unit C2 Level 5 Feature 4 Layer III 55 cmbs 387.27 masl	charcoal	2290 ± 40	-28.0 o/o	2240 ± 40	2330- 2300 2260- 2160	2340- 2150
240796	Unit C6 Level 4 Feature 4 Layer III 42 cmbs 387.41 masl	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 50 cmbs 387.33 masl	charcoal	2370 ± 40	-27.8 o/oo	2320 ± 40	2350- 2330	2360- 2310
240798	Unit D2 Level 5 Feature 6 Layer V 49 cmbs 388.74 masl	charcoal	660 ± 40	25.9 o/oo	650 ± 40	660-630 600-560	670-550
240799	Unit C5 Level 6 Feature 5	charcoal	2380 ± 40	-27.9 o/oo	2330 ± 40	2330- 2300 2260-	2340- 2150

Table 2.5 Eqpwpwgf

Beta#	Provenience	Material	C14 age years B.P.	C13:C12 ratio	C13 adjusted age B.P.	1-sigma calB.P.	2-sigma calB.P.
	Layer III 56 cmbs 387.27 masl					2160	
240800	Unit C5 Level 7 Feature 5 Layer 3 63 cmbs 387.20 masl	soot on sherd	2440 ± 40	-25.3 o/oo	2440 ± 40	2690- 2640 2610- 2590 2500- 2360	2710- 2350

Component I dates to the Late Eastern Lapita Period/Plain Ware Period transition; eight radiocarbon samples (Beta-240791, 240792, 240793, 240795, 240796, 240797, 240800, 240799) 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, moreover, are the oldest highland cultural features recorded on Tutuila Island. There is one sample recovered from feature 4 that is an outlier from the cluster of seven dates discussed above. 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. After ruling out obvious contaminants (carbon core, shell temper, food residue), 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 soil *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 is considered an outlier and is currently not taken into consideration when creating the chronology for Vainu’u.

Component II 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 charred material recovered from within Feature 6 and encountered *in situ* during excavation. The columnar posthole stains are directly adjacent to basalt curbstones and were likely support poles for Feature 3's wooden superstructure. Stratigraphic evidence indicates that these two components were not only divided by a +1500 year time gap, but that at least one volcanic eruption occurred during this time gap as indicated by Layer IV discussed above. This eruption probably rendered the ridge useless for cultural activity for an undetermined amount of time. Chronological time gaps are evident in the archaeological record at other sites in American Samoa, specifically at the coastal site of Aganoa (Crews 2008; Moore and Kennedy 2003) on Tutuila island, at the inland sites of Pava'ia'i and Faleniu (Addison and Asaua 2006) on Tutuila Island, and at To'aga on nearby Ofu Island (Kirch and Hunt [editors] 1993). The chronological information and material correlates from Vainu'u, then, fit well within the current archaeological assessment of cultural change on Tutuila Island.

Table 2.6: Vainu'u components placed within the Samoan cultural chronology.

Period	Vainu'u Component	Materials
Early Historic 250 - 112 B.P.		
Monument Building 1000 - 250 B.P.	Component II ca. 650 BP	house foundation (feature 3), postholes (Feature 6), large triangular adzes, basalt scraping tools
Dark Ages 1700+ - 1000 B.P.		
Plain Ware Period 2300 - 1700+ B.P.	Component I 2270 - 2440 BP	cooking features (features 4 and 5), pottery, volcanic glass, basalt blades, basalt scraping tools
Late Eastern Lapita 2700 - 2300 B.P.		
Early Eastern Lapita 3100 - 2700 B.P.		

2.4 PERIODIC USE OF THE HIGHLANDS DURING THE PLAIN WARE PERIOD

2.4.1 Component I Material Culture Recovered from Vainu'u

During Component I, a visitor to Vainu'u would have been standing on a young yet stable volcanic soil that would have allowed for the typical suite of highland plant growth. This period is early enough in Samoan prehistory that now extinct species of birds may have still wandered the island (Steadman 1993a, 1993b), and horticulture probably did not yet dominate the landscape.

Two roughly circular stone features, features 4 and 5 (Figures 2.3 and 2.4), were located on average 50 cms below the surface and uncovered about three meters apart, and are associated with Component I. The similarities in depth, associated artifacts, and radiocarbon dates suggest they are associated features and probably served similar functions (Table 2.2). 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. 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 2.4). These characteristics are typical of an *umu*, or Samoan cooking oven.

Comparison of these two features with modern *umus* shows similarity in selection of stone size and feature shape (Eckert and Welch 2009). 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. We are not suggesting that direct ancestors of

modern Samoans made features 4 and 5, as we have yet to see convincing evidence that there was *not* a cultural hiatus between the ceramic and aceramic periods on Tutuila Island (Table 2.3). We are suggesting that this type of feature has a long history in the South Pacific and would probably have been brought to the island by the earliest inhabitants. Artifacts associated with these two features include undecorated pottery sherds, basalt blades, and flakes.

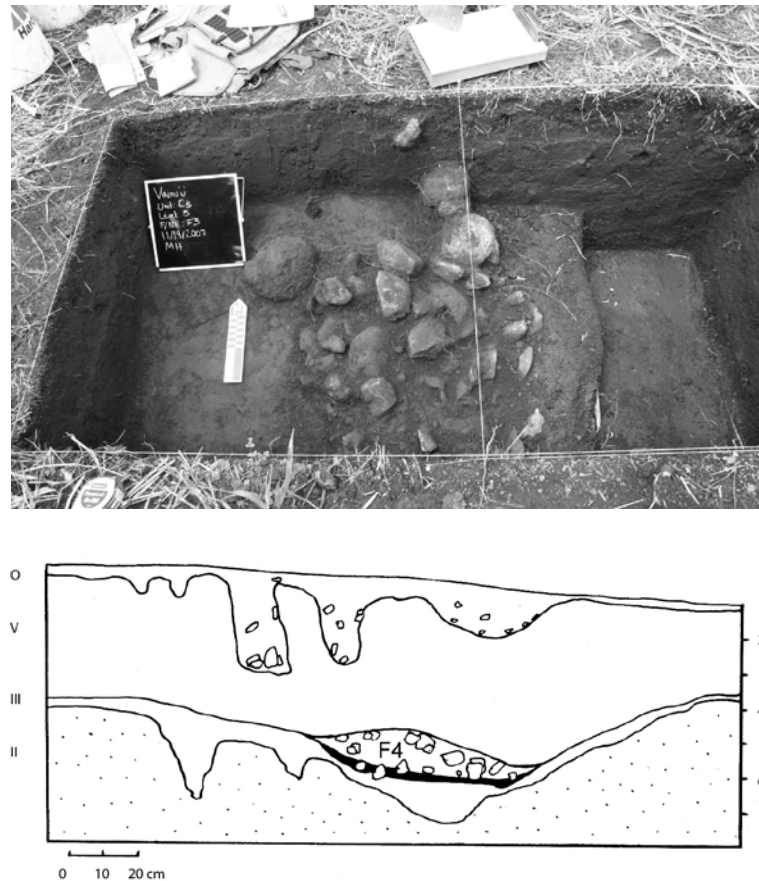


Figure 2.3: Feature 4 during excavation. Below: Feature 4 shown in north wall profile of units C1 and C5 with black representing the charcoal stain; stratigraphic layer indicated on left and cm below surface indicated on right.

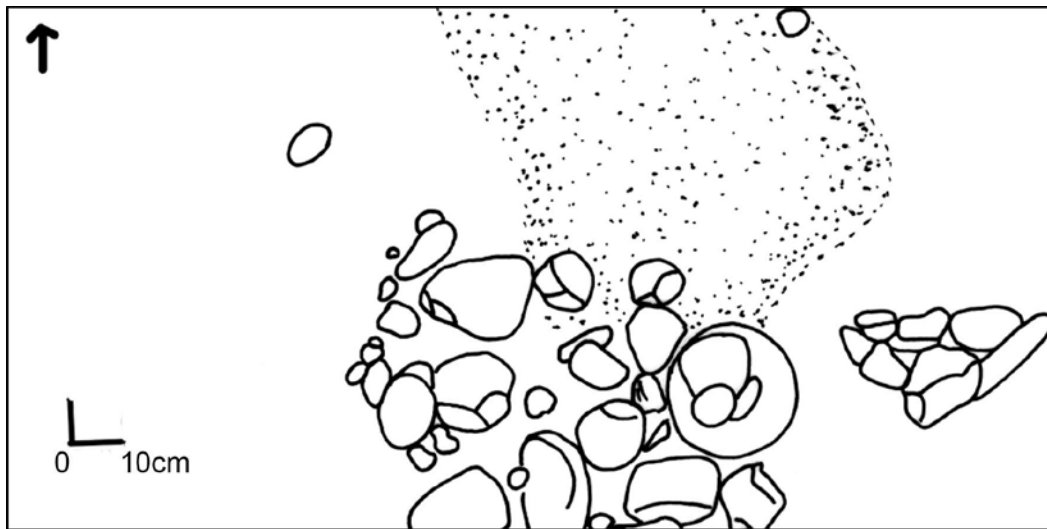


Figure 2.4: Feature 5 during excavation showing posthole. Below: Composite drawing of Feature 5 showing fired rocks, posthole, and charcoal and ash stain.

Although ceramic sherds were recovered primarily from Layer III associated with Component I (N = 315), some ceramic material was also recovered from layers V (N = 31) and O (N = 20). At this time, we assume that the low density of sherds recovered from these upper layers was probably originally associated with Component I based on three lines of reasoning. First, although basalt artifacts were recovered, no ceramic artifacts were found associated *in situ* with features in layers V and O. Third, portions of both Layer III (where sherds were recovered *in situ* as well as in stratigraphic fill) and Layer V (where sherds were recovered only in stratigraphic fill) are shallow enough to be in the “plow zone” (Custer 1992) and show evidence of post-depositional disturbance such as root growth; some sherds originally in Layer III could have been pulled into higher layers through this disturbance. Third and finally, Addison and colleague’s (2008) recent consideration of the ceramic chronology on Tutuila Island argues for an end date of no later than 1200 B.P., which is almost 600 years earlier than our dates for undisturbed features in Layer V.

At this time, there is no compelling evidence to suggest that pottery recovered from Vainu’u dates later than Component I. Attribute analyses of ceramic sherds reveal a pottery assemblage that is consistent with the Late Eastern Lapita/Plain Ware transition as it is currently understood (Addison et al. 2008) on Tutuila Island (Figure 2.5). Only seven sherds had any observed surface modification. Three sherds, all probably from the same vessel, display decoration (Figure 2.6). Four other sherds have striations interpreted as evidence of wiping during the production process.

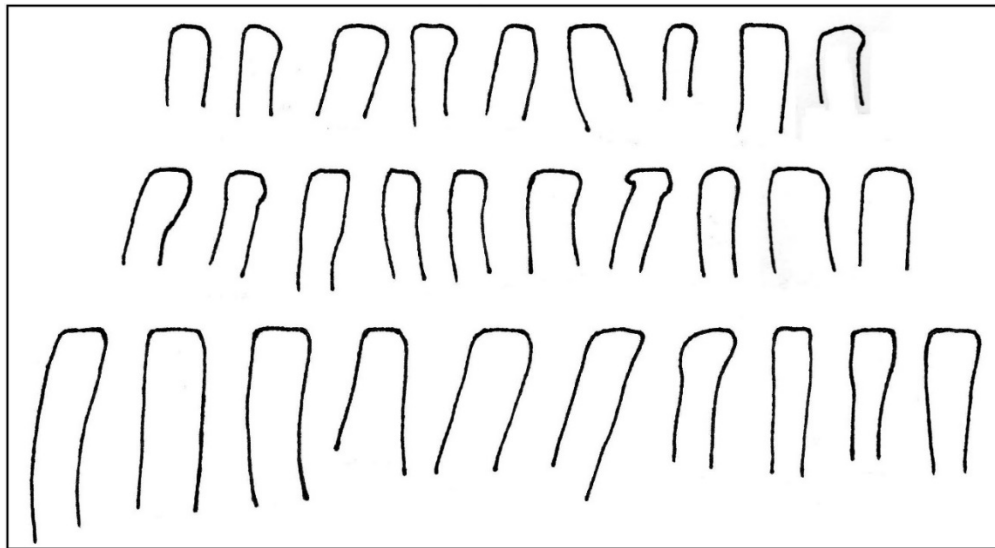


Figure 2.5. Rim forms recorded on pottery recovered from Vainu'u.

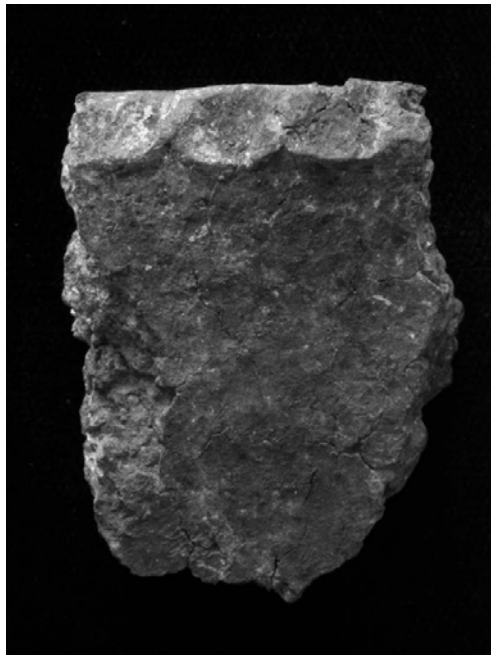


Figure 2.6. Decorated sherd recovered during 2006 excavations. (photo: Charlotte Pevny).

The Vainu'u ceramic data confirm the existence of two plain wares as suggested by Green (1974) based upon thickness, temper size, and paste color. Thick ware (26% of total site assemblage; N = 193) at Vainu'u normally has a light brown paste, very coarse-sized olivine basalt temper, and averages 11.9 ± 0.5 mm in thickness. Thin ware (74% of total site assemblage; N = 557) normally has a dark reddish brown paste, medium to coarse-sized basalt temper, and averages 7.8 ± 1.2 mm in thickness. About a quarter of the total ceramic assemblage was sooted (N = 179). Most (80%) of the sooted sherds were thin ware. This suggests that thick and thin wares may have had a functional difference, thin ware being preferred for, but not limited to, cooking activities. Basalt blades are of special interest, as they are rare on Tutuila Island.

The five blades and blade fragments recovered from Vainu'u were all found in direct association with the Component I *umus* (Figure 2.7). These flakes were the product of removal from a flaked 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 I inhabitants employed core and 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. Component I yielded a total of six basalt tools: three complete adzes, one adze fragment, and two scrapers. The lack of exhausted basalt cores and primary flakes indicate that basalt adzes were being brought to the site in finished form. Significant patterning is

evident in flake size by time period ($X^2 = 27.353$, $df = 6$, $p = 0.000$), with Component I containing a substantially higher frequency ($N = 274$) of smaller flakes (<3 cm in diameter) than Component II ($N = 38$). Significant differences also exist in the distribution of flake type by time period ($X^2 = 23.238$, $df = 8$, $p = 0.003$).

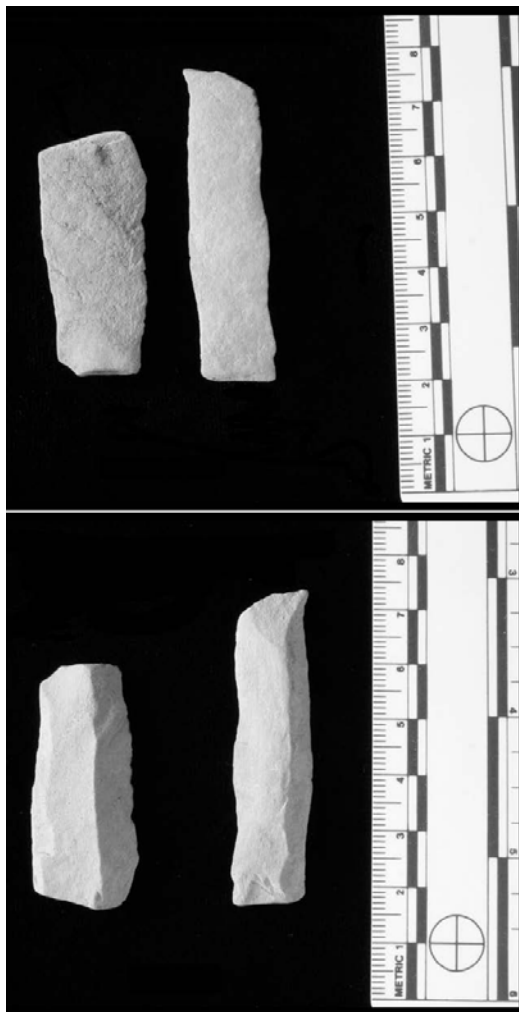


Figure 2.7: Basalt blades recovered from Component I. (photo by Charlot Pevney)

Component I yielded 302 non-cortical flakes, while Component II contained only 47 non-cortical flakes and two cortical flakes. Combined, these findings are indicative of more intensive tool retouch during Component I when compared with Component II. Excavations recovered 24 volcanic glass artifacts in Component I; however, only one of these artifacts was found in association with the *umus*. This suggests that volcanic glass was associated with activities other than cooking on the site. Non-cortical flakes are the predominant volcanic glass artefact ($N = 13$). Secondary and primary cortical flakes are next in abundance, with only two volcanic glass cores recovered. Flakes were removed from cores through a combination of bipolar and hand-held methods. While the sample size is small, the collection includes very few flakes with definite attributes of bipolar flake production. Significant patterning exists between flake platform and termination attributes ($X^2 = 13.640$; $df = 6$; $p = 0.034$), where flakes exhibit predominantly smooth platforms and feathered terminations. This relationship may indicate 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. As such, while utilized flakes may have been discarded, the cores were expended elsewhere.

Interpretation of Component I

We interpret the lack of residential features but presence of cooking ovens during Component I as evidence of short-term, repeated use of Vainu'u during this time. The two *umus* and sooted pottery associated with this earliest component indicate that food

production was taking place; however, what was being cooked is unknown. The posthole found in association with Feature 5, 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 I residential structure and the limited range of features and artefact classes defined in the Component I assemblage when compared to other sites discussed below. The low frequency of exhausted stone tools, early stage reduction flakes, and cores, suggests that easily carried tools and materials (including basalt adzes and volcanic glass) were transported back and forth from Vainu'u as need required. If people were spending a few days at Vainu'u on a semi-regular basis to fell trees or in pursuit of some other activity, then meals may have been prepared on site using pottery and stone ovens. The ceramic vessels and fire-seasoned oven stones would have then been left on the ridge for the next working session.

Comparison with Other Ceramic-Bearing Sites

Two ceramic-bearing coastal sites in American Samoa have produced *in situ* radiocarbon dates placing residency as roughly contemporaneous with Component I activity at Vainu'u: Aganoa and To'aga. Aganoa (AS-22-43) is located in a small cove along the south coast of eastern Tutuila Island (Eckert et al. 2008; Crews 2008; Moore and Kennedy 2003; Welch 2008) and has a cultural surface, containing ceramic artifacts,

with an associated radiocarbon date of 2570 ± 40 B.P. (C13 adjusted age). To'aga (AS-13-1) is located on the southeast shore of Ofu Island (Kirch and Hunt [editors] 1993) and has a buried ceramic-bearing cultural component of continued occupation dating from 3200 -1900 B.P. (Kirch 1993a).

When compared with these two 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. 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 associated with possible residential structures were identified at To'aga. The ceramic assemblages from all three sites consist of both thin and thick ware. 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 including sooted vessels at Aganoa (Eckert 2006) and Vainu'u, and carbonized residues at To'aga (Hunt and Erkelens 1993:137). Rim forms recovered from the three sites represent primarily wide-mouthed vessels. The general consensus of researchers 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 sites, there are also some obvious differences. The Component I lithic assemblage at Vainu'u is characterized by basalt blades, basalt scraping tools, volcanic glass, and adzes. Aganoa contained adzes and adze fragments, basalt flake tools identified as scrapers and gravers, and volcanic glass (Crews 2008). Even though both Vainu'u and Aganoa have substantial lithic assemblages, no basalt blades were identified at the coastal site, while no gravers were identified at Vainu'u. To'aga, on the other hand, has a much smaller lithic assemblage when compared to the sites on Tutuila Island. To'aga's assemblage includes a few flakes, awl-like tools, and 3 adzes; very few pieces of volcanic glass were found and those that were recovered were assumed to be natural (Kirch 1993b).

One obvious difference underlying the lithic assemblages is the range and types of activities that were taking place at each site. The presence of adzes at all three sites probably indicates that woodworking was occurring at each location; however, the differences in adze forms and other lithic tools may indicate differences in the nature of the woodworking. 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. A second possible reason for the differences in the lithic assemblage at each site is differences in access to shell. Material from Aganoa and To'aga indicated that a variety of tools – including abraders, fishhooks, 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 I 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 three 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 artefact types. However, differences may also have a temporal component. Other than evidence from To'aga that thick pottery increases in frequency over time (Kirch and Hunt 1993), we do not have a clear understanding of how most material culture changed over the approximately 1000 years considered here.

2.5 A NICE VIEW DURING THE MONUMENT BUILDING PERIOD

2.5.1 Component II Material Culture Recovered from Vainu'u

During Component II, a visitor to Vainu'u would have been presented with a different landscape than 1500 years earlier during Component I. 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. As evidenced by Features 3 and 6, at least one family chose to build a house structure on the ridge. Feature 3 is the largest of the stone features identified at Vainu'u (Figure 2.2). This approximately rectangular feature is aligned northeast-southwest along the ridge and is about 180 square meters in size (15 x 12 meters). Its size, shape, and composition suggest that it served as a house platform. Data from the excavation units placed along the eastern and northern portions of Feature 3 show that it stood only a single course of stones high. Fire-reddened rocks and charcoal flecking in the upper levels of these units suggest the presence of ovens or other firing features in association with Feature 3. Feature 6 consists of five postholes found in association with Feature 3. As discussed above, a single piece of charcoal from Feature 6 radiocarbon dated to 650 ± 40 B.P. (C13 adjusted age, Beta #240798). This date, combined with the associated material culture, suggests that features 3 and 6 were both part of a Monument Building Period house foundation.

The occupants of this ridgetop residency had a different tool kit than their Component I counterparts: gone were basalt blades, volcanic glass, and ceramic vessels. The lithic assemblage (Figures 2.8 and 2.9) however was still dominated by scrapers, adzes, and retouched flakes. Component II yielded a total of eight adzes and adze fragments and three basalt scrapers. The medium-sized flakes in the collection (3-5 cm) are present in a much higher frequency in Component II than Component I. This may be related to the observation that larger tools were utilized at the site during this later occupation.

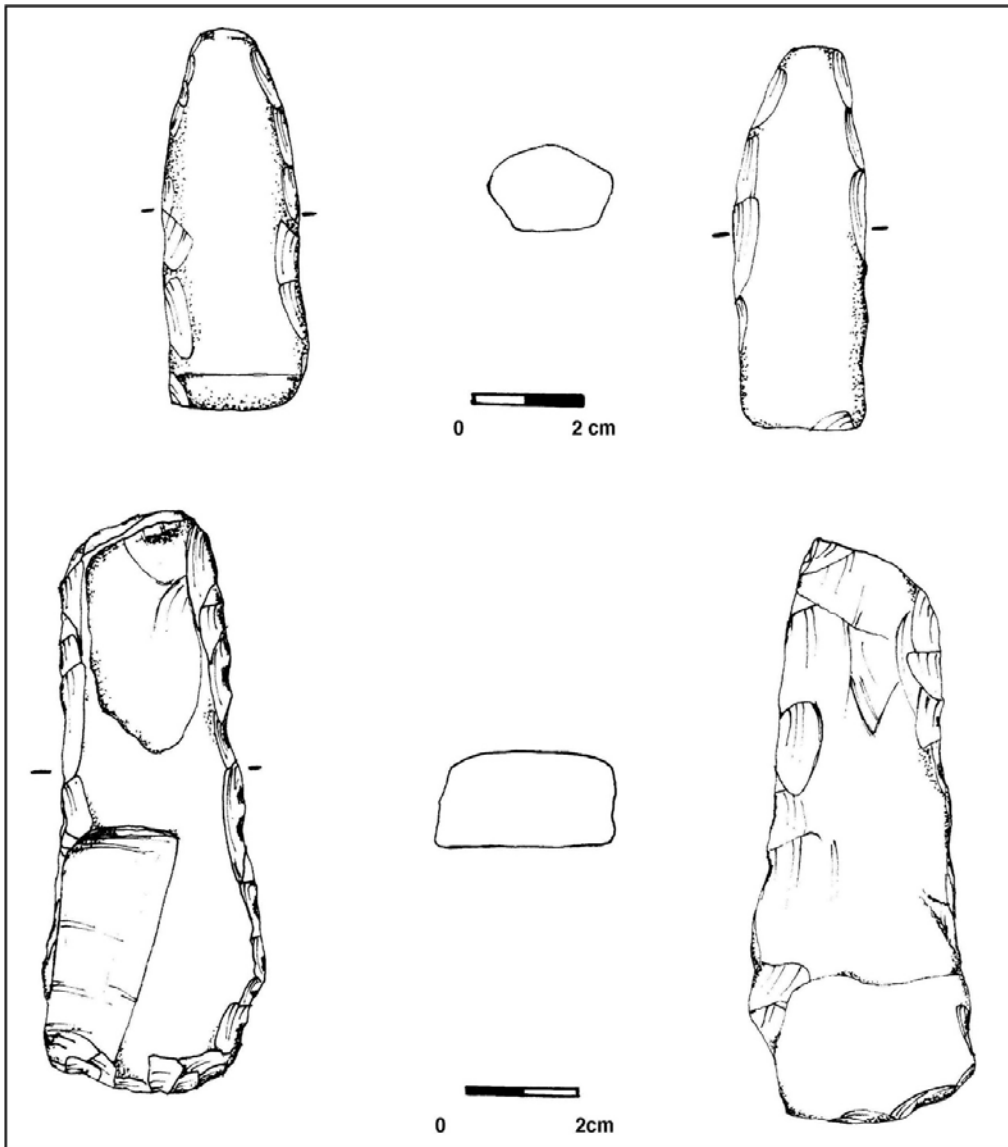


Figure 2.8: Basalt adzes recovered from Vainu'u. Top: Specimen V030 recovered from Unit B3, Layer III (Component I). Bottom: Specimen V043 recovered from Unit C2 Layer 5 (Component II).

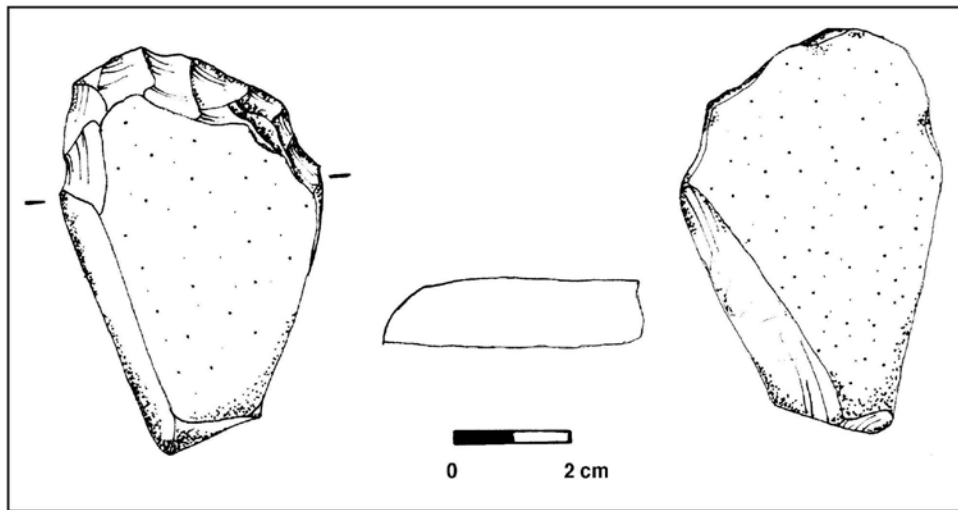


Figure 2.9: Basalt scraper recovered from Vainu'u. Specimen V048 recovered from Unit C3 Layer V (Component II).

Interpretation of Component II

Although the features and lithic analyses do not provide specifics on what activities were happening at Vainu'u during Component II, they do provide evidence for what was not occurring. The Monument Building Period was a time of intense craft production on Tutuila Island, including the specialized production of basalt adzes for inter-island and inter-archipelago trade (Best et al. 1992; Enright 2001); 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 II 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.

Comparison with Other Monument Building Period Sites

Component II at Vainu'u dates 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 extensive archaeological investigations on Tutuila Island due to the high visibility of sites, the rich oral traditions that exist to help in interpretations (Henry 1980; Stuebel 1896), and the social complexity of the period that resulted in production intensification and exchange between archipelagos (Best et al. 1992). In his study of building a chronology for the mountain settlements, Pearl (2004) focused specifically on three highland residential sites due to their size and preservation. Because of the chronology Pearl established for these sites, they are used here for comparison.

Lefutu (AS-21-02) is located on a ridge overlooking the most eastern coastline of Tutuila Island. 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, is probably the largest highland site on Tutuila Island (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 B.P., exactly at the time Component II of Vainu'u was occupied.

Unfortunately, it is meaningless to directly compare the Component II 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, but their construction sequences are 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 locations of the three large sites do 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 coasts of the island. While each larger 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.

2.6 CONCLUSIONS

Our work at Vainu'u has important implications for the interpretation of ancestral Samoan lifeways. Our findings indicate that people were in the highlands during the earliest occupation of Tutuila Island. Pearl (2004) argues that highland residency happened late in Samoan prehistory. Evidence from Vainu'u does not dispute this argument, in that no residential foundations were found; the presence of cooking ovens does 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 our research raises but does not answer is: how extensive and intensive was early highland activity? This question can only be answered through discovery, excavation, and dating of more ceramic period highland sites across the island.

Our findings also indicate that, 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. These differences can be explained in terms of at least three possible factors. Functional factors, such as permanent settlements versus temporary use or procurement of highland versus coastal resources, may account for differences observed between the Component I occupation of Vainu'u and contemporary coastal sites. Differences observed between Component II residency of Vainu'u and contemporary highland sites may be explained by either political factors such as proximity to high chiefs or geographic factors such as proximity to fine grained basalt or other natural resources.

We have envisioned the early occupants of Vainu'u as a group of workers 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 to 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.

Our work also leads to more questions about prehistoric Samoa, the answers to which are beyond the scope of this paper. The information recovered from Vainu'u provides a glimpse of the past, suggesting that life on the ridge changed over time. Although the excavations at Vainu'u were successful in terms of broadening our

understanding of precontact culture on Tutuila Island, there is still much to be learned at this and other recently discovered highland sites (Bartek 2009; Welch 2009).

3. TESTING A LATE CHRONOLOGY FOR CERAMIC PERIOD TRADITIONS AT 'AOA, TUTUILA ISLAND, AMERICAN SAMOA*

The chronology for the decline of pottery production in the Samoan Islands remains uncertain. Specifically, archaeologists working in the Samoan Islands debate whether other items of material culture and associated distribution networks disappeared alongside ceramic technology. A majority of archaeological evidence suggests pottery traditions were no longer present in the Samoan Islands by ca. 1,500 B.P.. However, previous archaeological work at the coastal site of 'Aoa on Tutuila Island, American Samoa, suggests that one residential group retained traditions of pottery production and obsidian use until as late as ca. 400 cal yr B.P.. As the phylogenetic model for cultural change in the Samoan Islands suggests the cessation of pottery took place gradually within an Ancestral Polynesian Society, a community that retained traditional knowledge for one thousand years longer than neighboring villages is of special interest.

Previous work within the 'Aoa valley indicates that the stratigraphic placement of late radiocarbon dates, volcanic glass flakes and pottery sherds at this site may be the result of downslope superpositioning. A secondary deposit containing late period radiocarbon, volcanic glass and pottery would therefore provide a reorganized image of systemic patterns and cannot serve as evidence for production into the Monument Building Period. As such, this study compares the morphology of pottery fragments and the provenience of radiocarbon dates from the coastal site of 'Aoa Locality 2 and the

*For submission to *Geoarchaeology: An International Journal*

highland site of Vainu'u to test for significant post depositional movement of ceramic period artifacts and datable charcoal. The findings of this study show that pottery production and volcanic glass procurement did not extend until ca. 400 B.P. at 'Aoa as previously argued in the archaeological literature of the Samoan Islands.

3.1 INTRODUCTION

Archaeological debate exists as to the timing and impetus for the noted cessation of pottery production in the Samoan Islands (Clark and Wright 1995; Clark and Michlovic 1996; Clark et al. 1997; Davidson 2012; Green and Davidson 1976; Irwin 1981; Kirch and Green 2001; Smith 2002; Welch 2013b;). The generally held consensus (Smith 2002:14) suggests that Lapita pottery traditions entered the islands of Samoa ca. 2700 B.P. and ceased at some point around ca. 1,500-1700 B.P. as production technology gradually simplified towards plainware and was ultimately abandoned (Kirch 1984: 48-51; Kirch and Green 2001; Green and Davidson 1974; Irwin 1981; Clark 2006). The disappearance of pottery traditions in the Samoan Islands may reflect a shift in cooking practices, economic decisions or changes in ideology within a population ancestral to later Polynesians (Davidson 2012; Irwin 1981; Kirch 1984:51; Kirch and Green 2001). Alternatively this pattern may signal a cultural replacement by a population that in fact never made pottery (Addison and Matisoo-Smith 2010; Welch 2013).

The focus of this paper is to specifically address the chronology for ceramic production and volcanic glass provisioning provided from previous excavations at 'Aoa on Tutuila Island, American Samoa (Clark et al. 1997; Clark and Michlovic 1996; Clark and Wright 1995), from which it was suggested that ceramic production remained in practice at that location until as late as 400 B.P.. Recent arguments against a late chronology of pottery production (Addison et al. 2008:109) question the stratigraphic integrity of the deposits at 'Aoa and call for additional archaeological inquiry. As this debate ultimately seeks to define the chronology of material and cultural change, recent information regarding this question should remain at the forefront of archaeological investigation in the region. If pottery and volcanic glass were indeed used at 'Aoa for a thousand years longer than other residential areas, this would suggest that Monument Building Period residents at 'Aoa (ca. 1000-250 B.P.) maintained the traditions of earlier pottery making peoples within a larger cultural system where pottery had no role.

Further, as 'Aoa is the only site to suggest late pottery production, continued traditions of ceramic manufacture at this site until ca. 400 B.P.. would indicate that Ancestral Polynesian traditions and aceramic Polynesian cultural traditions coexisted without pottery distribution to other residences for one thousand years. To add new information to the debate, archaeological investigations were carried out by the author and field crew in 2009 at 'Aoa Locality 2. An alternative hypothesis is tested in this study with new data from 'Aoa that questions whether post depositional processes may have restructured the stratigraphic relationships of pottery, volcanic glass, and charcoal

such that archaeological deposits at 'Aoa are not actually indicative of a late chronology for pottery production and volcanic glass use on Tutuila Island.

Every archaeological site is disturbed to some degree (Nash 1987:193; Shiffer 1972). As such, this study surveys the vertical patterning of radiocarbon dates, depositional history of sediments and the weathered nature of the ceramic assemblage to identify signals of significant post-depositional mixing of pottery sherds and datable charcoal at 'Aoa Locality 2. I illustrate that items of material culture from an earlier pottery-making group have become vertically mixed through natural processes and now rest alongside other artifacts and dispersed charcoal burned by individuals living in the aceramic period.

I use a method for observing sherd roundness measures provided by Allen (1989) alongside the fundamentals of alluvial sherd abrasion (Shackley 1978; Shiffer and Skibo 1989; Skibo and Shiffer 1987; Skibo 1987) to illustrate inter-assemblage differences in ceramic sherd roundness as it reflects different post-depositional histories of artifact transport. Sherd roundness measures are compared between the toeslope environment of 'Aoa (Clark and Michlovic 1996) and the highland ridgetop site of Vainu'u (Eckert and Welch 2013) to identify significant differences in sherd morphology due to topography-associated alluvial abrasion at 'Aoa. The results offer a promising way to assess the stratigraphic integrity between multi-component deposits and helps to refine the chronology of pottery production within the Samoan Islands.

3.1.1 Geographic and Cultural Setting

Archaeologists separate the prehistoric record of the Samoan Islands (Figure 3.1) into two main periods based on the presence of ceramic technology and monument building practices. The Ceramic Period begins with initial island colonization by Lapita voyagers ca. 2800 B.P. (Eckert et al. 2008; Crews 2008; Jennings 1974; Kirch and Hunt 1993; Petchy 2001; Smith 2002; Welch 2008) and ends with the cessation of pottery traditions ca. 1500 B.P.. As discussed above, the exact timing is debated yet is beginning to look to be around 1500 B.P. (Addison et al. 2008; Addison and Matisoo-Smith 2010; Reith and Hunt 2008; Smith 2002). A later Monument Building Period follows ca. 1000-250 cal yr B.P. and is characterized by a lack of pottery production and the rise of monumental architecture organized through complex chiefdoms (Kirch 1984; Kirch and Green 2001; Pearl 2004; Smith 2002).

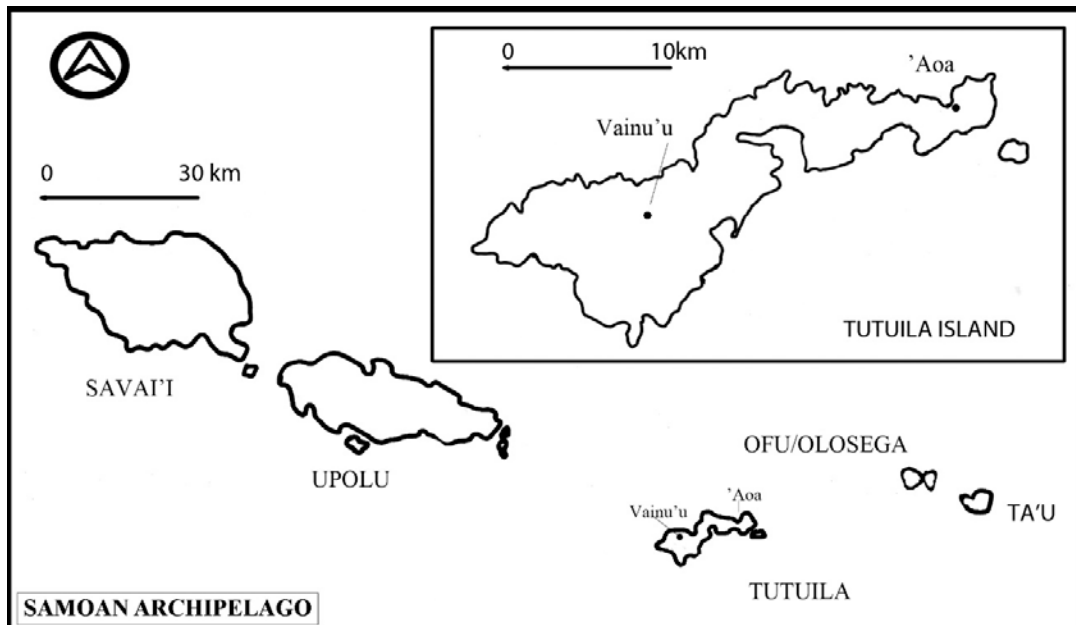


Figure 3.1: Map of Samoan Islands showing locations of Vainu'u and 'Aoa.

These two main behavioral periods are separated in time by a 300-500 year “Samoan Dark Age” during which archaeological evidence of residential activity is exceedingly sparse (Poulsen 1976; Spennemann 1986). Some have argued this scarcity is due to a lack of excavation (Kirch and Green 2001; Reith and Hunt 2008; Davidson 2012) while others argue it reflects a possible occupation hiatus (Welch 2013).

Excavations at 'Aoa (Figure 3.2) have provided radiocarbon dates on dispersed charcoal that date to the ceramic and aceramic periods (Clark and Wright 1995; Clark and Miclovic 1996; Clark et al. 1997). The majority of excavation at 'Aoa has taken place at Locality 2, along the eastern shore of the 'Aoa valley where the valley toeslope covers a relic shoreline of an infilled lagoon which formed as sea levels dropped ca. cal yr 3000 B.P. (Clark and Michlovic 1996). The archaeological deposits are contained

within colluvial and alluvial soils derived from the valley slope above. In response to falling sea levels and shoreline regression, clastic sediments prograded and covered the original coastal margin occupied by initial colonist to the area ca. 2,800 B.P. (Clark and Michlovic 1996).

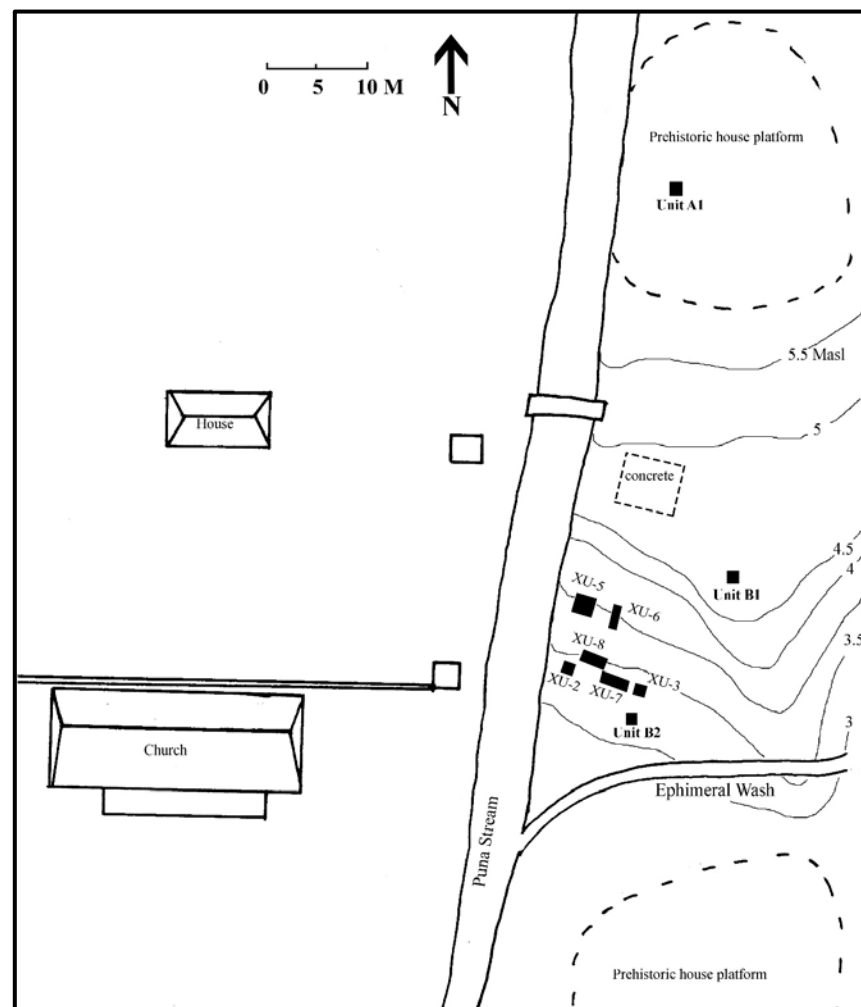


Figure 3.2: Map of 'Aoa Locality 2 and 2009 TAMU test excavation units. Unit A1, Unit B1, and Unit B2 were carried out in this study. Previous excavation units (XU) from (Clark and Michlovic 1996).

Observations of vertical change in soil textures during excavation undertaken in 2009 correlates well with previous work in the area and shows that Locality 2 exhibits alternating layers of gravelly and fine textures within three buried soil units which suggest cyclical high and low energy colluvial and alluvial deposition has occurred (Clark and Michlovic 1996:155; Field and Banning 1998). New excavations within Unit A1 illustrate that grain supported layers of gravels and cobbles form wavy contacts with buried A horizons and indicate erosion and gravel fan formation prior to subsequent lower intensity deposition of fine grain sediments. Cultural artifacts are present in various frequencies throughout the profile and are not exclusive to buried A horizons. The modern day surface is used for small-scale horticulture and shows evidence of rill erosion and recent deposition of coarse and fine grained sediments along the toeslope. The remains of Monument Building Period residential structures are present in various states of condition across the present surface.

The site of Vainu'u, used as a site for control features, is located in the western highlands of Tutuila Island. This site is a good candidate to offer in-situ, undisturbed features with associated artifacts as Ceramic Period features were covered rapidly with ash during a volcanic event ca. 1500 B.P. and show no sedimentary evidence of disturbance by flowing water (Eckert and Welch 2013). This discrete Ceramic Period component, including two hot rock cooking features ca. 2400-2200 B.P., offers high resolution information regarding stone tool use, cooking practices and ceramic technology during this period of time (Eckert and Welch 2009; Eckert and Welch 2013). A Monument Building Period component ca. 650 B.P. is also present upon the current

surface at this location. Multi-component deposits such as that seen at Vainu'u offer a unique avenue for the study of technological change over time and land use practices in response to late Holocene volcanism (Welch 2013). Geoarchaeological evidence collected from the 2009 season at 'Aoa and excavations at Vainu'u offer the opportunity to assess post-depositional influences on artifact provenience and understand the potential for late pottery production on Tutuila Island

3.2 METHODS AND MATERIALS

The Wadell Projection of Roundness (Wadell 1932) supplies an index of roundness for a single grain in a given plain of measurement. Roundness is given by the ratio of the radius of curvature of the individual corners to the radius of the maximum-size circle inscribed within the outline of a grain (Allen 1989; Boggs 2001; Wadell 1932). The degree of Wadell roundness (R_w) is expressed in figure 3.3 where r is the radius of curvature of individual corners, R is the radius of maximum inscribed circle, and N is the number of corners present.

Wadell roundness was originally developed for use in sedimentology (Wadell 1932). This method was first considered for pottery analyses by J. Allen in an attempt to quantify the effect of abrasion due to fluvial transport on Roman pottery (Allen 1989). In archaeological contexts where sheetwash or stream activity may have an effect on the morphology and placement of ceramic artifacts, Allen (1989:143) used this technique address the question: To what degree did the transport processes, through breakage,

abrasion, and size-shape-density sorting, alter the artifact assemblage as initially deposited in the archaeological sediment? The current study asks a similar question to address the degree to which the archaeological assemblages at 'Aoa Locality 2 and Vainu'u have been restructured through natural geomorphic processes.

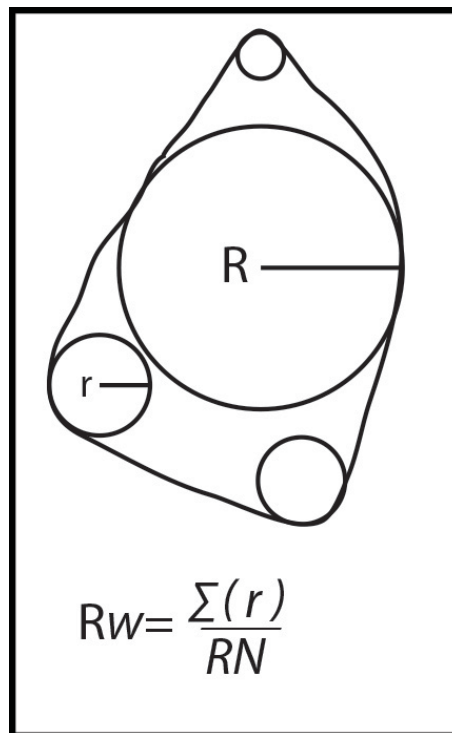


Figure 3.3: Diagram illustrating the method for assessing Wadell roundness.

Rim sherds from both sites were excluded as outlined by Allen (1989) as the inherent angularity in rim edges preclude accurate measures of roundness. Measures of sherd roundness were collected with a 7x Peak Telecentric Loupe (No.1999) to obtain

measurements for individual corners and inscribed circle radii. A telecentric loupe offers the ability to measure the necessary attributes of a three dimensional object without error caused by parallax. This instrument is equivalent in principle to profile projectors used by Allen (1989). The 26mm metric radius scale reticle enabled the collection of radii measurements to within 0.25mm. Data were collected for each primary corner and the mean radius was then divided by the diameter of the maximum inscribed circle for each sherd. This technique enables a direct and precise measure of specimen roundness, which may then be compared to others within an assemblage or compared to other sites with disparate depositional environments to study the effect of post depositional mechanical weathering.

As a vessel breaks, sherds do not form a normal distribution of roundness from very angular to well rounded, but rather they all break into relatively angular portions (O'Brien 1990). To accommodate this dynamic, an independent samples Kruskal-Wallis test was applied to measure significant patterning between the two assemblages at the .05 significance level. This nonparametric technique is appropriate as the test does not assume a uniform distribution of sherd roundness. Individual measurements were binned into corresponding Power's verbal class categories (Powers 1953:118) of very angular through well rounded to assess correlation between size class and roundness class. Roundness measures remained as a string of variables when testing for significant differences in roundness between sites. All statistical analyses were completed with SPSS version 20 for PC.

All vessel body sherds recovered during the 2009 'Aoa excavation were analyzed for Wadell measures of roundness (N=90). For a comparative assemblage, body sherds (N= 32) recovered from an intact cooking feature (*umu*, Feature 4) at the highland site of Vainu'u (Eckert and Welch 2013) were also analyzed for roundness values. This cooking feature was chosen as a control assemblage due to the fact that three radiocarbon dates from charcoal collected within the feature cluster very well ca. 2300 B.P. (Eckert and Welch 2013) and show that this feature and pottery sherds are in direct association and have witnessed minimal post depositional movement. Additionally, the placement of the site upon the large flat summit of Faleselau ridge and the presence of ash-fall overburden suggest that this site is a good candidate as a control assemblage of minimal downslope transport or significant spatial reorganization.

Rounded sherd morphologies indicate abrasion caused by grain to grain contact, often caused by traction transport in running water (Beck et al. 2002; O'Brien 1990; Skibo 1987; Skibo and Shiffer 1987). The work by Skibo and Shiffer (1987) illustrates that, like clastic particles, sherd size decreases and roundness increases as alluvial abrasion continues. In response to this fact, an assemblage that exhibits a high proportion of small, well rounded sherds should not be considered to rest in primary context (Skibo and Shiffer 1987; Allen 1989; Skibo 1987; Shackley 1974).

Significant differences in sherd roundness indices between sites provides an understanding of the degree to which sherds at each site have been transported by running water. A Spearman test for correlation between sherd size and Wadell class interval is used to illustrate the relationship between sherd size and shape. A negative

correlation between sherd size and Wadell class interval shows whether or not the smallest sherds are also the roundest in an assemblage. Sites that have not been affected by running water will have small pottery fragments due to thermal spalling, salt erosion or trampling, yet these sherds will remain predominantly angular. Locations that have been affected by alluvial transport should exhibit high measures of roundness in the smaller size classes that are most easily entrained (Rick 1976).

Four charcoal samples recovered during systematic excavation of Unit B2 in 2009 were sent to Beta Analytic for radiocarbon dating (Table 3.1). All charcoal specimens were collected in situ and placed in foil containers with the appropriate provenience information. Radiocarbon results were calibrated for calendar age with OxCal v4.1.7; interface build: 69 (Bronk Ramsey 2009a, 2009b; atmospheric data from Reimer et. al 2009). Any inverted patterning in radiocarbon age by depth offers additional information as to the degree of post depositional disturbance. Following the chronometric hygiene protocol outlined for the Samoan Islands by Reith and Hunt (2008), if radiocarbon dates are stratigraphically inverted and fail to overlap in age at two standard deviations then the results cannot offer a secure age estimate of “associated” artifacts. An inescapable fact exists that geomorphic change affects the original structure of deposits and morphology of discarded items at archaeological sites (Rick 1976; Shiffer 1987). In interpreting the chronology of craft production at such sites, we must consider the possibility that signals of remarkable behavioral outliers may be the result of remarkable site disturbance.

3.3 RESULTS

The aim of this study is to assess the potential that prehistoric residents at 'Aoa chose to perpetuate the cultural tradition of pottery production for an additional millennia while other communities converged towards an identifiable Polynesian cultural signature (; Clark and Michlovic 1996; Davidson 2012; Kirch 1984: 48-51; Kirch and Green 2001; Smith 2002). If correct, this characteristic would imply a cultural continuity derived from initial Lapita colonists and would support the general consensus that Lapita colonists gradually transformed into the Polynesian chiefdom witnessed at European contact. The cultural and genetic link between Lapita voyagers and Monument Building period Samoans has recently been challenged by researchers who fail to see significant evidence of a gradual cultural transformation expressed in the stratigraphic record of archaeological sites (Addison and Matisoo-Smith 2010; Smith 2002; Welch 2013). An assessment of sherd transport and provenience of radiocarbon dates is provided to furnish an understanding as to whether or not the relationship between pottery fragments and datable charcoal at 'Aoa accurately represents the behaviors that once took place at this key site.

3.3.1 Evidence of Landscape Change

Upward-fining sequences expressed within the soil profile of Unit A1 illustrate a landscape affected by running water such that alternating coarse-grained and fine-

grained sediment packages, indicative of sorting by running water, overlie eroded organic-rich paleosols (Goldberg and Macphail 2006; Pearl 2006) (Figure 3.4). The coarse, grain-supported sediment packages likely formed as running water differentially sorted sediment grains during alluvial erosional events (Goldberg and Macphail 2006). Wavy contacts between coarse-grained gravelly layers and fine-grained relic A horizons serve as evidence of alternating high energy erosional events separated by periods of relative landscape stability. Upon renewed landscape stability fine-grained clastic sediments accumulated and weathered in place to form organic-rich surface layers. Renewed periods of intense rain coupled with deforestation were likely responsible for sheetwash erosional events that removed the upper layers of each successive A horizon (Cerdan et al. 2010:172; Clark and Michlovic 1996:155-156; van Hoof and Jungerius 1984:136). Differential velocities of flowing water selectively transported cultural artifacts, moving items of material culture downhill towards the toeslope environment of Locality 2 where the radiocarbon samples and artifacts under discussion have been recovered.

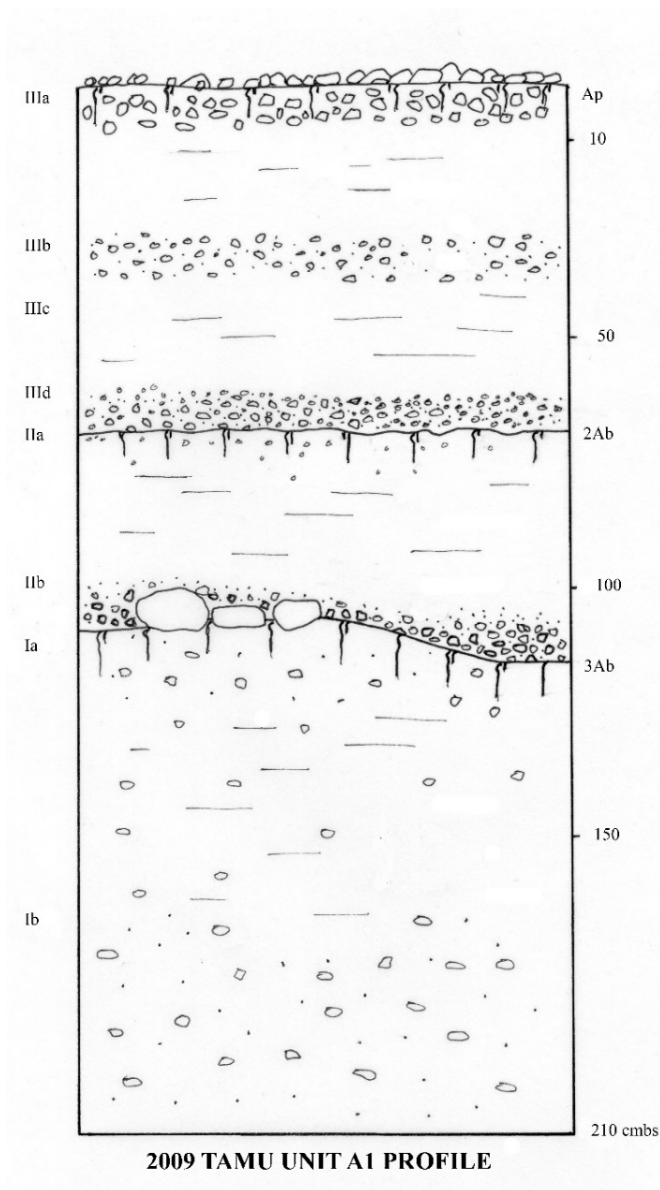


Figure 3.4: Profile of 'Aoa Unit A1 illustrating alluvial gravel deposits. Gravel layers (IIb, IIId, IIIb) are located above eroded A horizons (Ia, IIa).

3.3.2 Radiocarbon Dates

Table 3.1: Radiocarbon dates from 2009 excavations at 'Aoa Locality 2 Unit B2.

Site	Lab No.	Provenience	Sample Material	$^{13}\text{C}/^{12}\text{C}$ Ratio	^{14}C age	Cal. B.P. (1 σ)	Cal. B.P. (2 σ)
'Aoa	Beta-282173	Unit B2, Strat IIIb, Lvl 4, 40 cmbs. Modern debris	Charcoal	-26.4	910 ± 40	908-844 (39.4%) 832-784 (28.8%)	919-740 (95.4%)
'Aoa	Beta-299690	Unit B2, Strat Ia, Lvl 11, 102 cmbs	Charcoal	-25.6	1380 ± 30	1314 -1281 (68.2%)	1344 -1269 (95.4%)
'Aoa	Beta-299691	Unit B2, Strat Ia, Lvl 12, 110 cmbs	Charcoal	-27.0	1470 ± 30	1383-1327 (68.2%)	1405-1305 (95.4%)
'Aoa	Beta-282176	Unit B2, Strat Ib, Lvl 13, 130 cmbs. Crotovina	Charcoal	-25.0	360 ± 40	486-428 (36.1%) 376-322 (32.1%)	500-315 (95.4%)

Table 3.2: Radiocarbon dates provided by Clark and Michlovic (1996).

Sample no.	Unit	Layer	Depth cm	Context	14C years	13C correction	Calibrated age B.P. (2 σ)
48910	SB	II	-	-	540 \pm 70	510 \pm 70	653-746
48047	SB	V	140-156	-	430 \pm 80	400 \pm 80	553-299
28210	4	II	113-123	Fea. 1	330 \pm 40	-	492-293
28211	4	V	150-169	-	350 \pm 50	-	507-293
28212	4	V	160-165	Fea. 9	170 \pm 40	-	293-0
48048	5	V	84-94	-	520 \pm 60	470 \pm 60	643-476
48049	7	VII	170	-	2950 \pm 140	2890 \pm 140	3455-2759
48911	8	VII	128-148	-	2450 \pm 110	2460 \pm 110	2764-2195

The vertical progression of radiocarbon ages from Unit B2 (Figure 3.5; Table 3.1) illustrates that movement of charcoal has occurred between stratigraphic layers and represents local and non-local mixing of two or more discrete occupations (Brantingham et al. 2007:526; Clark and Michlovic 1996). Radiocarbon dates recovered within layers V through II (Table 3.2) by Clark and colleagues (Clark and Michlovic 1996:163) indicate a date of ca. 550-300 cal yr B.P. for the upper-most component. The date of 919-740 cal yr B.P. (Beta-282173, 2 σ) recovered during the 2009 excavations (Figure 3.5; Table 3.1) therefore appears to be out of place as it is likely too old for its stratigraphic location.

Also within the 2009 Unit B2, a radiocarbon date of 500-315 cal yr B.P. (Beta 282176, 2σ) lies below two dates of considerably older age (Beta 229690, Beta 229691) and also points toward stratigraphic mixing of charcoal within the profile. These data correspond well with previous observations (Clark and Michlovic 1996:162) that admixture and intrusion of charcoal materials has taken place within the buried soils at Locality 2.

The inverted radiocarbon dates in Unit B2 fail to overlap at two standard deviations and therefore cannot supply a confident understanding for the timing of craft production under the chronometric hygiene parameter D, as outlined by Reith and Hunt (2008). In following the chronometric hygiene protocol, stratigraphically inverted radiocarbon ages that do not overlap at the two-sigma confidence level indicate secondary context and should not be used to represent the age of targeted archaeological events. Evidence of artifact transport by sheetwash events at this site may help to explain the mixed nature of radiocarbon dates and the inversion of obsidian rim hydration measures by depth within unit XU-7 (Clark and Michlovic 1996:162; Clark et al. 1997:903).

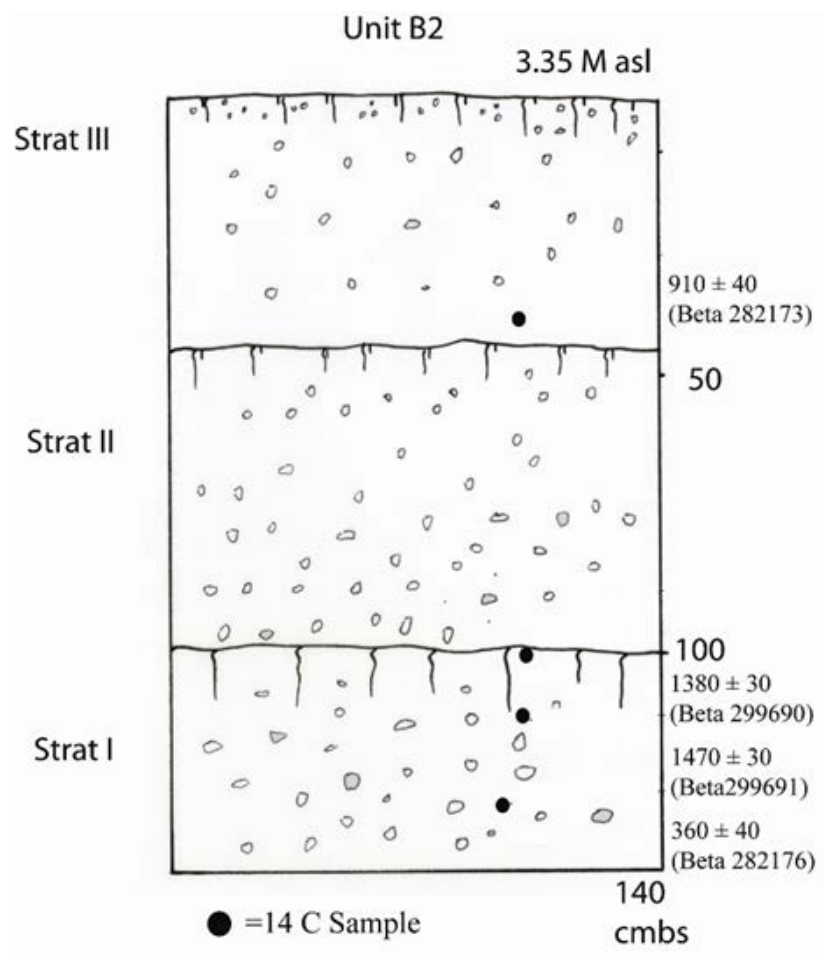


Figure 3.5: Stratigraphic profile of 'Aoa Unit B2 illustrating inverted radiocarbon dates.

3.3.3 Inter-Site Assessment of Wadell Roundness

The results of the independent-samples Kruskal-Wallace Test shows a significant difference between the measures of roundness at 'Aoa Locality 2 and Vainu'u ($H=42.808$, 1 d.f., $P=.000$). As a result, the null hypothesis that the distributions of Wadell roundness measures are similar across the two sites must be rejected.

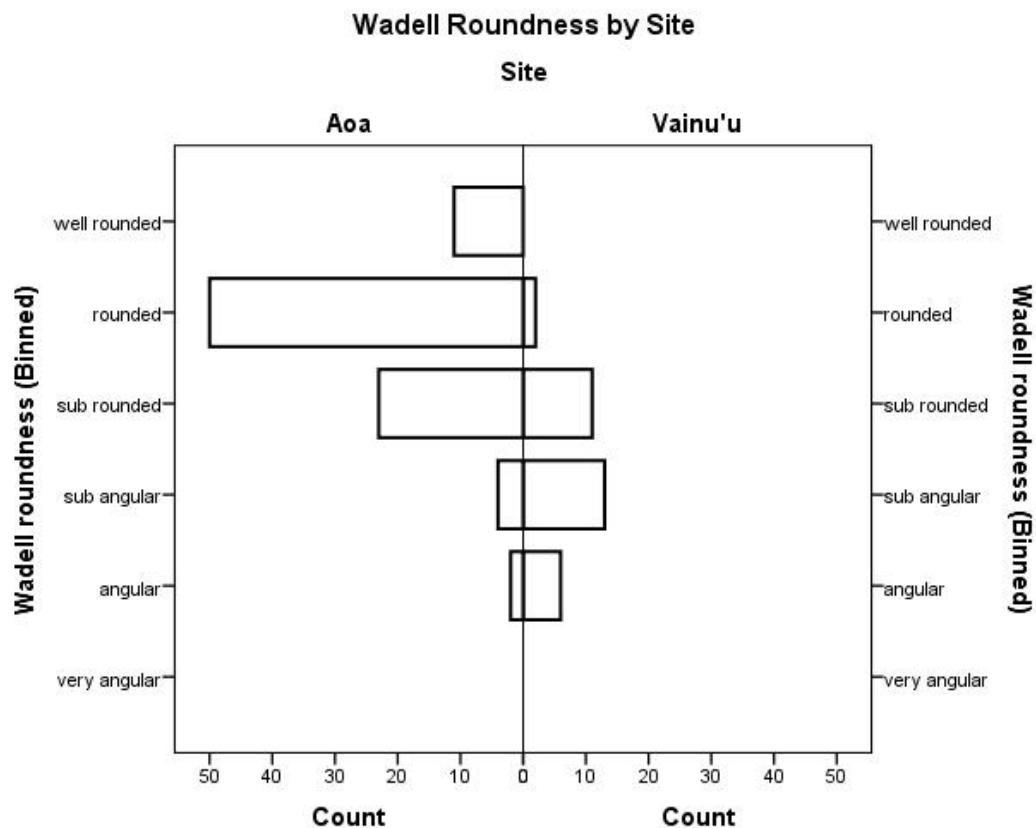


Figure 3.6: Split histogram illustrating a significant difference in sherd weathering.

A split histogram (Figure 3.6) illustrates the frequency distribution of sherd roundness measures between the control assemblage within the cooking feature at Vainu'u and the excavated assemblage at 'Aoa Locality 2. The majority of sherds from Locality 2 fall within the rounded class interval (55.5%) while the assemblage from Feature 4 at Vainu'u includes only two specimens of this class interval (6.25%).

Table 3.3 illustrates the relationship between roundness intervals expressed between the control assemblage from the earth oven at Vainu'u and the excavated assemblage from the 2009 field season at 'Aoa. The data show that Feature 4 at Vainu'u exhibits primarily subangular sherds (40.62%) while the majority of pottery sherds from 'Aoa fall into the rounded class interval (55.5%).

Table 3.3: Waddell roundness measures by site. Note the difference between sites within the rounded class interval.

Site	Waddell Roundness Interval					Total
	Angular	Sub angular	Sub rounded	Rounded	Well Rounded	
'Aoa	2	4	23	50	11	90
Vainu'u	6	13	11	2	0	32
Total	8	17	34	52	11	122

In assessing the relationship between sherd size and sherd roundness at 'Aoa, a Spearman's rho test indicates a significant negative correlation between the two variables ($r_s = -.291$, $P = .003$) such that the smallest artifacts are also the roundest artifacts. This dynamic fits well with formal sherd abrasion studies by Skibo and Shiffer (1987) and suggests that the majority of sherds at Locality 2 have become smaller and rounder through the physical weathering processes associated with alluvial sediment transport.

3.4 DISCUSSION

Archaeological work at Locality 2 appeared to show that an isolated coastal community perpetuated links to initial colonizers through pottery production and volcanic glass use well into an otherwise aceramic Monument Building period on Tutuila Island. This detail would have several important impacts to our understanding of cultural change in Samoa. Of primary importance, evidence for continuity in cultural practices of pottery making peoples into the Monument Building Period would support arguments for gradual cultural transformation and a lack of significant cultural intrusion or replacement on Tutuila at least (Addison and Matisoo-Smith 2010; Davidson 2012; Kirch and Green 2001; Smith 2002). The continued transmission of cultural knowledge about pottery production and the use of volcanic glass at 'Aoa until ca. 400 B.P. might also serve in support of a connection to an Ancestral Polynesian Society on Tutuila Island (Kirch and Green 2001; cf. Smith 2002).

The shape of sherds from at 'Aoa Locality 2 show significant morphological differences when compared to the sherd assemblage recovered from an intact activity surface at Vainu'u in the western highlands. Specifically, the specimens recovered from 'Aoa Locality 2 are well rounded while those from Vainu'u are predominantly sub angular. Physical weathering due to the expansion of precipitated minerals was cited as the cause of roundness for the sherds at 'Aoa in initial studies (Clark and Michlovic 1996). Soft, red-colored inclusions, likely goethite ($\text{FeO}(\text{OH})$), was interpreted to be the cause of the overall poor condition of the excavated pottery. Spalling due to mineral

expansion is evident in a small number of sherds from 'Aoa and indeed shows that this form of weathering occurred to a small degree.

The process of cracking and spalling due to increased internal pressure by mineral accumulation should leave spalled sherds with irregular edges and acute corners (O'Brien 1985, 1990:394; Boggs 2001). If *in situ* deterioration (Skibo and Schiffer 1987:83) by precipitated goethite was the sole weathering factor at work, which could support the hypothesis for a late chronology deposit in primary context, then the assemblage should show a dominant pattern of angular spalling due to mineral accumulation and subflorescence (O'Brien 1990). The morphology of pottery sherds at the 'Aoa suggest the opposite, that multiple processes have been at work over time and that a majority of the items have become rounded through erosion and transport by flowing water. A significant correlation exists between sherd size and sherd roundness within the assemblage excavated from Locality 2. In this case, roundness increases as size decreases. As illustrated by previous sherd abrasion studies (Skibo and Shiffer 1987; Beck et al. 2002) abrasion by sediment grains and tumbling during sheetwash events likely created the rounded morphology expressed within sherds at 'Aoa Locality 2.

Geoarchaeological evidence from 'Aoa indicates that the volume and intensity of sediment transport rose drastically after ca 500 B.P. (Clark and Michlovic 1996:156). The increase in sediment erosion and redeposition of cultural materials is the likely result of increased land clearing for horticulture, unusually high precipitation and faunalturbation (Clark and Michlovic 1996; Goldberg and Macphail 2006). As a result

of stratigraphic repositioning, the existence of pottery in the upper strata should not be interpreted as a signal of pottery production until ca. 400 B.P. Rather, the scattered placement of radiocarbon dates and rounded sherds throughout the stratigraphic profile suggests long-term alluvial movement of pottery along with gravels and cobbles as deforestation for horticulture led to increased overland sheetwash.

Archaeological interpretations regarding the chronology of pottery production at this site then faces the challenges created by secondary deposition where inverted radiocarbon dates near tumbled pottery fragments cannot furnish an accurate chronology for pottery manufacture. As many of the spatial relationships between Monument Building Period radiocarbon dates and pottery sherds at 'Aoa have been redeposited by running water, confident conclusions cannot be drawn regarding the chronology of craft production at this site.

3.5 CONCLUSION

To understand the potential effects of post depositional mixing at 'Aoa, this study compared sherds from Locality 2 to an intact and well dated Ceramic Period cooking feature from the highland site of Vainu'u (Eckert and Welch 2013). 'Aoa was specifically chosen to test for site disturbance because radiocarbon dates recovered near ceramic sherds from this site suggest prehistoric residents maintained the cultural identity of earlier pottery producers for a thousand years longer than other occupants of Tutuila Island. The rounded nature of the sherds from 'Aoa suggests that the assemblage

has seen significant post-depositional transport as the result of gravity and water driven processes. The inverted vertical progression of radiocarbon dates provides additional support of a restructured deposit at Locality 2.

Geoarchaeological evidence from Locality 2 suggests that archaeological remains including ceramic sherds and volcanic glass nodules have been eroded from an upslope deposit and were secondarily deposited alongside the remains of a much later activity surface where they no longer shared a primary spatial relationship. While the study of a Monument Building Period community of pottery makers who also maintained ancestral traditions of volcanic glass use at 'Aoa was the original impetus for this test, an assessment of artifact context at the site indicates that 'Aoa Locality 2 cannot be used to discuss a maintained Ceramic Period identity through late-chronology pottery production. With this understanding, reliable evidence suggests that pottery production and volcanic glass use were practices held by populations ca. 2700-1500 B.P., prior to the Samoan Dark Age, ca. 1500-1000 B.P., and was not an aspect of cultural identity for those living in the islands during the Monument Building Period ca. 1000-250 B.P. (Smith 2002). Future research focused on reasons why ceramic bearing sites do not exist after ca. 1500 B.P. will supply much needed information for recent reassessments of Lapita-only models for Polynesian cultural transformation and models of migration, interaction, integration or cultural replacement (Addison and Matisoo-Smith 2010, Addison and Morrison 2010; Davidson 2012; Irwin 1992; Kirch and Green 2001; Smith 2002; Welch 2013).

4. THE CESSATION OF SAMOAN OBSIDIAN DISTRIBUTION*

This paper examines the stratigraphic record of volcanic glass artifacts from multi-component archaeological deposits to refine the chronology of volcanic glass distribution patterns in the Samoan Archipelago. The chronology of volcanic glass use at three multi-component sites from American Samoa is provided to extend our understanding of the prehistoric use of this raw material resource. The findings of this study suggest that volcanic glass artifacts follow a similar pattern of decline to that of pottery in the Samoan Archipelago, such that by ca. 1,500 B.P. both pottery production and interisland distribution of volcanic glass had ceased. The chronology of late Holocene volcanism in the Samoan Islands is then examined as it may relate to the timing of pottery decline and the discontinuity of interisland volcanic glass distribution. The implications for a discontinuous record of volcanic glass procurement are discussed as it applies to traditional models for cultural transformation via an Ancestral Polynesian Society.

4.1 INTRODUCTION

This paper uses volcanic glass artifacts to challenge the current consensus model of Samoan cultural development and to propose an alternative model. To support a model of discontinuous occupation I examine the stratigraphic record of volcanic glass

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artifacts from multi-component deposits to refine the chronology of volcanic glass distribution patterns in the Samoan Archipelago. Recent works in the Samoan Archipelago (Addison and Matisoo-Smith 2010; Addison and Morrison 2010; Davidson 2012; Reith and Hunt 2008; Smith 2002) have prompted a need to reassess the material record of settlement and social change in Western Polynesia. Ceramic materials have traditionally been studied to identify sociocultural change in Samoa, specifically the shift from Late Eastern Lapita traditions to a fully plainware Ancestral Polynesian Society ca. 2500 B.P. (Green 2002; Kirch and Green 2001; Smith 2002).

The strangest characteristic of the Samoan ceramic record is that pottery production ceases altogether around 1,500-1,700 years ago. Those that study Samoan prehistory have generally viewed this dropout with intrigue but have been unable to produce a satisfactory explanation for why pottery traditions would vanish (Green 1987; Kirch 2000; Leach 1982; Le Moine 1987; Marshall 1985; Smith 2002). Research on this topic has operated under an assumption that the Samoan Islands remained continually inhabited with social relationships becoming hierarchical towards a complex chiefdom while traditions of pottery production faded and were lost (Burley 1994, 1999; Kirch et al. 1990). The concept that a founding group of Lapita colonizers transformed into the Samoans witnessed at European contact has been a model used as fact, unencumbered by details or data to the contrary (Smith 2002:8).

Archaeological evidence of ceramic traditions in the Samoan archipelago disappears just prior to the Samoan "Dark Ages" ca. 1500 B.P.. The Dark Ages constitute a period of reduced archaeological visibility, yet also a period of proposed

population expansion and cultural transformation (Addison and Matisoo-Smith 2010; Green 2002; Green and Davidson 1974a; Kirch and Hunt 1993; Reith and Hunt 2008; Smith 2002). Pottery is only one component of a much larger Late Eastern Lapita toolkit comprised of obsidian, chert and basalt flakes, basalt and shell adzes, shell ornaments, fishhooks, food processing tools and rich faunal assemblages (Clark and Wright 1996; Crews 2008; Eckert 2011; Eckert and Pearl 2008; Eckert and Welch 2013; Green and Davidson 1974a; Kirch 1997; Kirch and Green 2001; Kirch and Hunt 1993; Smith 2002). This paper illustrates that pottery is not the only item of material culture that fails to continue throughout the archaeological record, and in so, cannot provide all of the evidence surrounding questions of shifting cultural traditions. By critically assessing the unusual dynamic of technological discontinuity within a larger material assemblage we may gain additional perspectives regarding the changing social landscape that created the Samoan Dark Age.

Volcanic glass artifacts appear to be associated with ceramic deposits more often than not. This study seeks to clarify whether or not prehistoric communities (Figure 4.1) used volcanic glass after pottery production had ceased. A synchronic discontinuity in pottery production and the distribution of volcanic glass may suggest a larger scale change in subsistence patterns and the ways in which social relationships were maintained (Kononenko et al. 2010:26). In this paper I use the archaeological record of volcanic glass artifacts to test a model of discontinuity and change in the material record of the Samoan Islands (Table 4.1). I will refer to this model for the chronology of prehistoric occupation in the Samoan Islands as the Cultural Hiatus Model (CHM).

From an assessment of current data, I suggest that significant change is observable and is representative of two occupation periods separated by a cultural hiatus beginning ca. 1500 B.P.

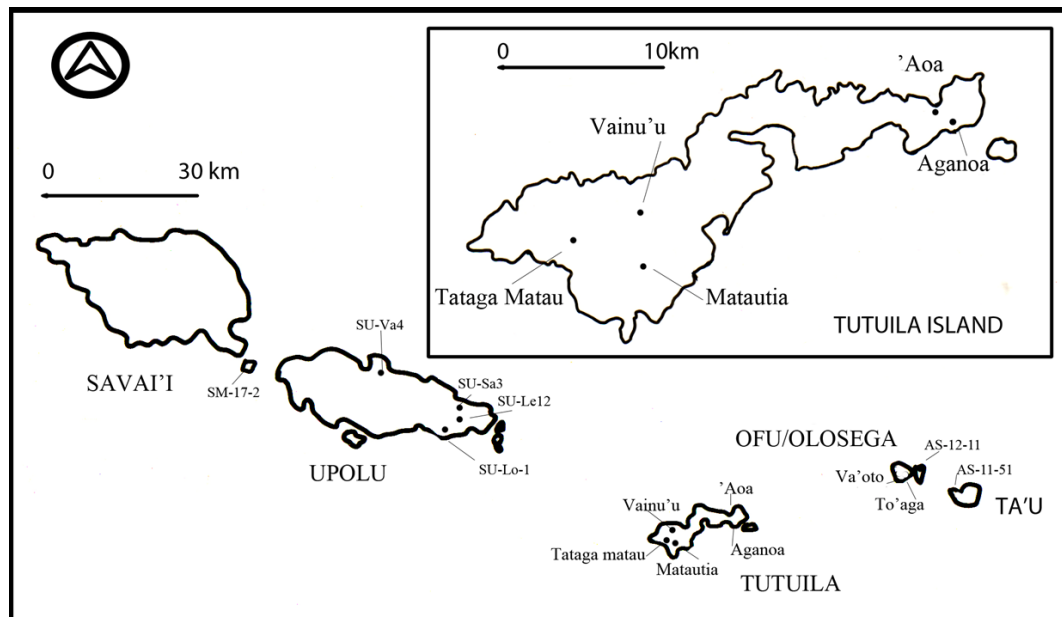


Figure 4.1: Map of the Samoan Islands with sites discussed in text.

Table 4.1: List of flake counts and references for Samoan volcanic glass assemblages.

Island	Site	Total	Cores	Flakes	Raw nodules	Reference	Criteria
Upolu	Su-Va-4	74	23	50	1	Terrell 1969:168	A
Upolu	SU-Le-12	5	1	4	0	Davidson and Fagan 1974:89	n.d.
Upolu	SU-Sa-3	25	6	16	0	Green 1974:146	A,F
Upolu	SU-Lo-1	1	1	0	0	Davidson 1969:250	n.d
Upolu	SU-Sa-1	1	1	0	0	Green and Davidson 1974:33	F
Ta'u	AS-11-51	1	0	1	0	Hunt and Kirch 1987:36	n.d
Ofu	AS-12-11	37	0	37	0	Moore and Kennedy 1996: Appendix A1	n.d
Ofu	To'aga		Numerous unspecified			Kirch and Hunt 1993	good
Ofu	Va'oto	31	2	20	9	Best 1992:28; Clark n.d.	n.d
Tutuila	Tataga Matau	1	0	0	0	Best et. al 1989	F
Tutuila	'Aoa	276	98	178	0	Clark and Wright 1995; Clark and Michlovic 1996	F
Tutuila	Aganoa	65	11	47	7	Welch 2008	good
Tutuila	Vainu'u	24	2	22	0	Eckert and Welch 2007	good

4.2 MODELING PREHISTORIC CULTURAL CHANGE IN THE SAMOAN ISLANDS

The current consensus describes the rise of an Ancestral Polynesian Society ca. 2500 cal B.P. (see discussion in Addison and Matisoo-Smith 2010; Kirch and Green 2001; Smith 2002) while a modified version promotes ideas of multiple integrated populations post ca. 1500 B.P. (Addison and Matisoo-Smith 2010; Addison and Morrison 2010; Smith 2002). These frameworks share commonality in that they both assume continuous occupation within the Samoan Islands. Arguments for Lapita-Only

models include ideas of rapid movement by Lapita peoples across Polynesia as an "Express Train" (Diamond 1988) or alternatively, a "Slow Boat" movement of Lapita populations with embedded time for interaction, integration and innovation towards a recognizable Polynesian conclusion (Green 1991, 2000; Oppenheimer and Richards 2001). The recent admixture hypothesis (Addison and Matisoo-Smith 2010) suggests integration with a population from Micronesia ca. 1500 B.P.. Recently Addison and Morrison (2010) have questioned models of continuous occupation across Samoa which necessitates further research as to what patterns of change in distribution networks and craft production confidently signal population decline.

As ceramic traditions appear to have ceased across Western Polynesia at some point around 1,700-1,500 B.P. (Green and Davidson 1974a; Kirch and Green 2001; Reith and Hunt 2008; Smith 2002) researchers of Polynesian prehistory identify two major behavioral periods: Ceramic Period and Aceramic Period. These two components are further subdivided into phases that follow inferred changes in behavioral traits. A brief description of the traditional chronology of cultural and material change in the Samoan Islands (Table 4.2) is provided below.

Table 4.2: Consensus for transformation in the Samoan Islands

Cultural Period	Age Range B.P.	Associated Material Culture
Early Eastern Lapita	Ca. 3100-2700	Decorated vessels in small frequency, plainware, volcanic glass, plano convex adzes, shell goods
Late Eastern Lapita	Ca. 2700-2300	Reduced decoration in ceramic vessels, diminished range in vessel form, volcanic glass, plano-convex adzes
Plainware Period	Ca. 2300-1700	Plainware dominates, simple decoration on rims present in rare cases, volcanic glass, plano-convex adze forms present
Aceramic Period (Dark Ages)	Ca. 1700-1000	Absence of pottery, volcanic glass unknown, small-scale shell middens, ephemeral small-scale tool production
Monument Building Period	Ca. 1000-250	Absence of pottery, absence of volcanic glass, advent of triangular adze forms. End of plano-convex forms. Rise of large-scale stone architecture. Increased basalt tool distribution
Historic Period	Ca. 250-present	Complex chiefdom

4.2.1 The Current Consensus

The Early Eastern Lapita Period, ca. 3100-2700 B.P., represents the earliest settlement of West Polynesia and is identified archaeologically by the presence of dentate-stamped pottery, shell tools, flaked obsidian and plano-convex adze forms. Established radiocarbon evidence from Mulifanua on Upolu Island indicates that initial colonization took place approximately 2800 years ago (Jennings 1974; Jennings and Holmer 1980; Petchey 2001) and marks the earliest reliable radiocarbon dates encountered in the Samoan Archipelago.

The Late Eastern Lapita Period, ca. 2700-2300 B.P. is recognized as a cultural continuation derived from the Early Eastern Lapita tradition and is chiefly characterized by the absence of dentate-stamped vessels and an overall simplification of decorative motifs and vessel form. When considering the chronology of these sites, data suggest that the original division of ceramic traditions onto Early Eastern Lapita and Late Eastern Lapita is appropriate for the Samoan Islands in spite of the fact that this chronology encounters difficulty elsewhere in Western Polynesia (Burley et al. 1999; Kirch 1988).

During the Plainware Period, ca. 2300-1500 B.P., volcanic glass was still used as a lithic material alongside high quality basalt. Triangular adze forms were not yet present and plano-convex adze morphologies had not yet disappeared from use (Best et al. 1989; Green and Davidson 1974a; Smith 2002). Traditional models maintain that this period is significant because it is from this tradition that ensuing Polynesian cultures

arose to later colonize the untouched islands of the Eastern Pacific Ocean (Kirch and Green 2001). At this time, as the consensus model suggests, the Lapitoid/Melanesian traditions begin a transformation towards an early proto-Polynesian behavioral motif.

The period of time between the cessation of pottery traditions and the rise of the complex chiefdom level society evident at European contact is often referred to as the Samoan "Dark Age", ca. 1500 - 1000 B.P (Poulsen 1976; Spennemann 1986). The exact timing for the end of the Plain Ware Period remains unclear. Most researchers agree on a date between 1,700-1,500 years ago, while Clark and colleagues have argued for a later date, ca. 400 B.P. (Clark and Michlovic 1996). During this period of time, between 1500 and 1000 B.P., traditional models suggest increased political complexity accompanied an expanding residential base. An unfortunate fact for traditional models is that archaeological evidence of increased population or large-scale residential sites is notoriously illusive during this period of time (Davidson 1979:94-95; Green 2002:140). The lack of archaeological visibility has traditionally been seen as a result of the termination of ceramics, a characteristic that would make finding sites of this age difficult (Poulsen 1976; Spennemann 1986).

The majority of known prehistoric sites in Samoa date to the Monument Building Period, ca. 1000-250 B.P. This period was one of frequent warfare between villages, districts, islands and archipelagos. Archaeological signals of increased lithic production and internal and external warfare come in the form of defensible highland villages, fortifications, trenches and large basalt adze quarries (Best et. al 1989; Clark 1989; Clark and Herdrich 1988). By this point in time plano-convex adzes are no longer present in

well-preserved archaeological contexts, nor are volcanic glass flakes. The advent of this aceramic, monumental architecture tradition also ushers the introduction of triangular adze forms (types VI and VII), which are absent during all phases of the Ceramic Period (Green and Davidson 1974; Smith 2002).

4.2.2 A Revision to the Current Consensus

Addison and Matisoo-Smith (2010) recently proposed that a revised version of Green's Triple-I model for Lapita Origins (Green 1991) might help to explain the archaeological record of the Samoan Islands. Proponents of this framework suggest that initial occupants to the Samoan Islands were affiliated with the Lapita culture complex and remained there relatively unchanged in terms of social organization and material culture until ca. 1500 B.P.. Those living in the Samoan Islands would have shared common concepts of craft production, social organization and subsistence strategies with other Late Eastern Lapita populations. Inhabitants in Samoa ca. 2700-1500 B.P. would have been genetically and phenotypically similar to other Lapita voyagers in Remote Oceania, appearing much like present populations in Vanuatu, New Caledonia and Fiji (Addison and Matisoo-Smith 2010). They had mtDNA lineages affiliated with haplogroups P, Q, M and perhaps B4 with Y chromosomes of the C2, K-M9*, M1* and O3* types (Addison and Matisoo-Smith 2010:7-8).

The model suggests that dispersed pottery-producing communities were present across the landscape beginning ca. 2800 B.P. and remained for a little over one thousand

years. Around 1500 cal B.P., archaeological evidence, as argued, indicates the admixture of a new population with typically Asian-derived physical characteristics. At this point the introduction of Asian-derived mtDNA lineages occurred and brought the current Polynesian motif and Y chromosome of the O3-M324 lineage. The newly arrived population was also responsible for the introduction of commensal animals and plants that do not appear prior to 1500 cal B.P. (Addison and Matisoo-Smith 2010; Smith 2002). Ultimately this interpretation suggests an early Polynesian population formed shortly after 1500 B.P. as the result of intrusion, integration and innovation via interaction with populations originating from Micronesia.

This revised approach does not place the same level of importance on linguistic evidence as Kirch's original model of Polynesian origins, but rather employs archaeological and biological evidence to explain the patterns of prehistoric population change. This model suggests that population admixture occurred roughly at the beginning of the Samoan Dark Ages ca. 1500 B.P., yet does not account for the lack of archaeological visibility during this period. An alternative model that accounts for the gap in archaeological visibility is offered by the Cultural Hiatus Model.

4.2.3 A Challenge to the Consensus: The Cultural Hiatus Model

Lapita-only models operate on an understanding that population demographics did not waiver significantly over the course of the 400-500 year long Samoan Dark age. A constant, ever-growing population allowed for increased social hierarchy and the

eventual rise of the Samoan complex chiefdom structure (Kirch and Green 2001). An increase in political hierarchy and community division, along with increased trade and competition for prestige and resources should leave an indelible mark on the archaeological landscape. After forty years of research we have been unable to identify the archaeological signals of political expansion during this modeled timeframe, yet the argument for the rise of Samoan chiefdoms via a transformed Lapita population continues. This hole in our understanding is largely due to a paucity of archaeological deposits from which to recover information. This detail, in its own sense, may offer important chronological implications as to the arrival of a markedly Polynesian cultural signature in the Samoan Archipelago. The revised version of Green's intrusion, integration and innovation model for Lapita Origins (Green 2000), tailored for Polynesian cultural transformation by Addison and Matisoo-Smith (2010), offers valuable thoughts for future research in population replacement, yet it also maintains a framework of relatively constant habitation and does not explain the how, the impetus for evidence of large scale demographic change after a period of minimal archaeological impact.

The proposed hiatus model does not assume consistent occupation of the Samoan Islands and takes direction from discontinuous relationships apparent in the stratigraphic record of occupation as certain artifact classes appear to vanish and never return after the Samoan Dark Age (Table 4.3). The ability to infer the actual cause of a decline in volcanic glass use and discard is reliant on cross checking other subsistence practices such as patterns of pottery production to differentiate between a technological shift and a

population downturn. By studying the chronology of the relationships between these artifact classes we may investigate the archaeological record for evidence of population decline or technological replacement.

Table 4.3: Key material differences as forwarded in the Cultural Hiatus Model.

Cultural period	Age range B.P.	Key Archaeological observations
Early Eastern Lapita	Ca. 3100-2700	Mobile marine explorers- Volcanic glass/pottery/ plano-convex adzes,
Late Eastern Lapita	Ca. 2700-1500	Increased settlement, Volcanic glass/pottery/plano-convex adzes
Cultural Hiatus	Ca. 1500-1250	Volcanism- failure of regional volcanic glass distribution and pottery production, archaeological signals of reduced population density
Polynesian Period	Ca. 1250-250	Appearance of triangular adzes, no pottery, new genetics, new animals and plants. Complex chiefdom distribution system
Historic Period	Ca. 250-present	European contact

To be fair, a decline or loss of an artifact class may not necessarily reflect population decline. Perhaps basalt flakes replaced the functional role of volcanic glass and created a pattern of decline in the material record independent of population shifts. If basalt flakes replaced obsidian due to cost-benefit based decisions, one might assume that this shift would not affect the frequency or mode of production in unrelated subsistence items. From this, if obsidian declines and pottery traditions remain constant

then we may infer that the cessation of the tool stone was the result of technologically-based decisions on behalf of the individual and is not a reflection of population decline (Ricklis and Cox 1993). On the other hand, if a non-locally procured item for use in domestic activity falls from the record in concert with other subsistence items, pottery or adze types for example, then we may begin to think about decreased inter-island movement and demographic decline. If patterns of decline in multiple areas occur coevally across the archipelago then the possibility of a large-scale demographic downturn may be a sensible explanation for evidence of decreased inter-island voyaging and reduced domestic waste.

Here I focus on modeling five different factors of technological organization that may affect the volume of volcanic glass deposition within the stratigraphic record of the Samoan Islands. First, if population remains constant and the role of volcanic glass does not change, then volcanic glass tools should maintain a stable rate of procurement, use and discard. Second, if population rises and the function of volcanic glass remains constant then there will be an associated increase in the volume of use and discard. Third, if at some point volcanic glass becomes incorporated within a larger suite of tasks then there will be a corresponding increase in the frequency of materials consumed and discarded. Next, if volcanic glass no longer plays a role in subsistence, or is replaced by another material within a stable population then there will be a decline in the frequency of use and volume of discard with other subsistence items remaining constant. Finally, if tool function stays constant and population density decreases then there will be an

attached decline in the volume of other subsistence based items with an embedded decrease in raw material procurement, use and discard.

If there is a synchronic decrease in evidence of subsistence activity at the island or archipelago level we may infer a population decline at each respective level of organization. Further, if mutually exclusive forms of material culture exist between occupation events we may begin to entertain the concepts of a cultural hiatus with population replacement. A truncated record of island occupation necessarily challenges the consensus viewpoint of a transformation toward an aceramic complex chiefdom via an ancestral pottery producing population. A hiatus with cultural replacement would then call into question the hypothesis of Samoa as the birthplace of Polynesia and Lapita colonists as ancestral to Samoans. The classic term "paucity" as related to the lack of archaeological visibility during the Samoan Dark Ages may indeed then be the result of the disappearance of pottery and volcanic glass artifacts and plano-convex adzes and the people that had created them for over a thousand years. The chronology of change in volcanic glass procurement and use through the Samoan Dark Age is evaluated to determine evidence of population decline and cultural replacement.

4.3 STRATIGRAPHIC RELATIONSHIPS AND CHRONOLOGY OF USE

Volcanic glass as an item of material culture lends itself well to questions of prehistoric technology and distribution patterns as widespread movement and use of the material has created archaeologically stratified deposits across the Samoan landscape.

Spatial and temporal variability in these assemblages inform lithic reduction techniques and use at the site level and distribution networks between communities on a regional level. In the case of volcanic glass in ceramic-period Samoa, current information indicates that inhabitants did not acquire obsidian through exchange partners in Tonga (Burley et. al 2011). Technological adaptations to the small volcanic glass nodules procured from the Samoan Island of Tutuila may have provided a dependable resource such that inter-archipelago exchange was not necessary (Clark and Wright 1995).

4.3.1 Previous Studies of Volcanic Glass Use in Oceania

As this study relies heavily on archaeological information supplied by Samoan obsidian assemblages, a discussion of obsidian, or volcanic glass as it is termed in Samoa, is especially warranted. The study of stone tool procurement, production, morphology, and trade is a valuable tool for illuminating adaptation, evolution and interaction within prehistoric Oceanic societies (Burley et al. 2011; Torrence 2011). Attribute analyses address the intricacies of stone-tool production strategies and serve to show change in social stratification within Pacific communities over time (Best et al. 1988; Clark and Wright 2005; Kononenko 2010; Torrence 2011). This method of study in turn sheds light on the record of human thought, interaction and adaptations to environmental changes throughout prehistory. Due to the fact that many igneous materials exhibit unique elemental compositions, geochemical characterization offers a distinct advantage to the researcher interested in raw material procurement and

distribution (Burley et al. 2011). The characterization of these unique elemental signatures gives archaeologists the opportunity to track procurement and trade of stone artifacts across time and space. Through the combination of archaeological geochemistry and attribute analysis, one may track procurement and exchange systems across vast distances and also illuminate environmental adaptations, population movement and cultural evolution over time.

While multiple studies of technology, procurement and geochemical characterization of obsidian exists for much of Melanesian Near Oceania and Western Remote Oceania (Ambrose et al. 1981; Smith 2002; Torrence 2011; Ward and Ambrose 1977; Wiesler and Clague 1998), only a handful of studies have focused on Samoa (Clark and Michlovic 1995; Clark and Wright 1995; Eckert and Welch 2013; Sheppard et al. 1989; Ward 1974; Welch 2008).

The use and exchange of volcanic glass is documented for the Reef/Santa Cruz islands (Green 1987; Green and Bird 1989), Fiji (Best 1984, 1987), Pitcairn and Henderson Islands (Weisler 1997) and for portions of Samoa (Clark and Michlovic 1996; Clark and Wright 1995; Green and Davidson 1974; Kennedy and Moore 1999; Sheppard 1989; Ward 1974). The overarching term volcanic glass, as opposed to obsidian, is used in reference to the glassy volcanic material present on many of the Pacific Islands due to the fact that regional geochemistry is variable, with some islands producing high-silica obsidian, while others exhibit less-siliceous basaltic glass.

The raw material package size of volcanic glass and obsidian is generally larger on the islands north of Vanuatu, collectively referred to as islands of Near Oceania

(Kirch 2000; Torrence and Boyd 1997; Torrence and Summerhayes 1997). High quality sources existed south of the Manus in the Lau, Pam Lin, Pam Mandian in the Admiralty Islands (Clark and Wright 1995). Additionally, raw materials existed on the north coast of New Britain in the Willaumez Peninsula-Cape Hoskins region near Talasea (Clark and Wright 1995: 239; Kirch 2000). Raw materials are present on the Banks Island of Vanuatu, namely the islands of Gaua and Vanua (Ambrose et al. 1981; Smith et al. 1977).

The Tongan Islands held knappable materials on the island of Tafahi (Rogers 1974); however, artifacts or workshops associated with this location have not been reported (Clark and Wright 1995). Volcanic glass tools also have been recovered in large amounts from Niuatoputapu, boasting a total of 11, 475 pieces from 10 sites (Clark and Wright 1995; Kirch 1988b:213). However, volcanic glass use in Tonga was not widespread. With the exception of Tafahi, which is reported to have some amount useable raw materials, and Niuatoputapu, which has an abundance of artifacts, the Tongan islands are relatively barren of flaked volcanic glass.

Geochemical sourcing of the Niuatoputapu artifacts and Tafahi glass by Ward (1974) and Smith, Ward and Ambrose (1977:196) indicate that the most likely source for the artifacts on Niuatoputapu are indeed from Tafahi. Later, Kirch (1988b:215) discovered an “outcropping of volcanic glass” on a central ridge on Niuatoputapu that in his view “may well fall within the elemental ranges already determined”. As a result of multiple sources and limited testing, the full potential for volcanic glass sources on Niuatoputapu remains unknown.

Ward (1974) conducted a geochemical analysis of volcanic glass artifacts from the Western Samoan Island of 'Upolu. He concluded that the materials were definitely not from the Tongan island of Tafahi; however, the actual source of the materials could not be determined. Roger Green (in Terrell 1969:169) mentions the presence of un-worked nodules that exist in alluvial deposits of Falefa Valley on 'Upolu, Western Samoa. This potential source remains untested and the validity of a volcanic glass resource in Falefa Valley is yet to be demonstrated.

Volcanic glass artifacts are reported from twelve sites throughout Samoa included in works such as Green and Davidson (1969, 1974), the To 'aga site on Ofu (Kirch and Hunt 1993) as well as multiple sites on Tutuila Island such as 'Aoa (Clark and Wright 1995; Clark and Michlovic 1996) and Aganoa (Kennedy and Moore 1991; Crews 2008) and the recently excavated highland ceramic-period site of Vainu'u (Eckert and Welch 2013, 2009; Hawkins 2008; Welch 2007).

Volcanic glass in Samoa is found predominantly, if not exclusively, in association with ceramic bearing sites and follows a similar chronology of decline in use (Green and Davidson 1969, 1974; Kirch 1993). On Tutuila, volcanic glass materials are rarely absent in assemblages ranging from Lapita contact ca. 2,700 B.P. to approximately 1,500 B.P..

Recent testing on Tutuila Island, namely the coastal sites of 'Aoa (Clark and Michlovic 1996; Clark and Wright 1995) and Aganoa (Crews 2008; Kennedy and Moore 1999) show that the presence of volcanic glass on Tutuila is unusually high in relation to the surrounding Samoan islands. Excavations at 'Aoa produced an unprecedented 154

flakes and 98 cores. Twenty-four flakes in the 'Aoa assemblage exhibit evidence of edge damage from use. Clark suggests that the rounded cores encountered at 'Aoa may have served a ceremonial function, or were possibly goods of prestige. This interpretation is based upon the fact that numerous cores from 'Aoa became rounded through multidirectional reduction. Clark sees this not as a utilitarian practice of exhaustive flake removal, but rather the result of preconceived manipulation to create a final rounded form. The quantity of volcanic glass artifacts recovered from 'Aoa exceed that of any other excavation on Tutuila to this date. The unusually large quantity of volcanic glass recovered from 'Aoa may be attributed to the use of 1/8 inch water screening. While 1/8-inch screen is beneficial for the collection of volcanic glass chips, it is not efficient in CRM archaeology, which comprises much of the excavation carried out on Tutuila Island. This raises questions regarding the loss of volcanic glass artifacts from previously excavated sites due to larger screen sizes.

Green (1974a) reports that volcanic glass is most often found in association with ceramic-period assemblages. The result of excavations at the coastal site of Aganoa and Vainu'u serve to strengthen this trend. While the chronology of initial entrance into the Samoan archipelago is under debate, ceramic use throughout Samoa exists upon initial contact, approximately 3,000 B.P. (Clark and Michlovic 1996; Crews 2008; Green 1974b; Kirch 1993). It has been shown that the chronology of the LEL/APS assemblage in Samoa is a major point of contention; however, most archaeological evidence suggests that by AD 300-400 ceramics, and many other portable artifacts cease to exist (Green and Davidson 1974:224).

After the decline of the early period assemblage (ceramics, volcanic glass, certain shell objects, adze type V), archaeological information detailing cultural activity between 1,500 B.P. and 1000 B.P. on Tutuila Island is exceedingly sparse (Dark Ages). Additional archaeological investigations focused on the cultural occurrences within this time gap may serve to illuminate the forces responsible for the decline of the early assemblage.

Testing by Clark (Clark and Michlovic 1996) at 'Aoa on Tutuila Island suggests that ceramic and volcanic glass use, at least in parts of Samoa may have continued for more than a thousand years longer than previously known (400 B.P.). If this is the case, then not only did ceramic use continue, in some cases, much longer than previously demonstrated, but also volcanic glass would have been obtained well into the second millennium.

A closer look at the radiocarbon dates from the upper levels at 'Aoa suggests stratigraphic mixing, evidenced by older dates overlying younger dates (290-0 B.P. of layer V under 653-476 B.P. layer II). The laws of stratigraphic superposition maintain that this sequence cannot occur without truncation and/or mixing. The "old wood effect", relic carbon superimposed upon a younger deposit, could explain a much older date resting within younger deposits; however, the degree of chronostratigraphic mixing in the upper layers at 'Aoa cannot be explained by anything other than secondary deposition. This fact suggests that intensive post-depositional transformations (Schiffer 1987) have played a role in the formation of the upper levels at 'Aoa. If this observation is accurate, then the chronological framework supporting the "late model" of ceramic

use, (Clark and Michlovic 1996; Davidson and Asaua 2006:104) as well as the chronology of associated volcanic glass should be revisited.

The use of volcanic glass appears to have been relatively widespread throughout early sites in Samoa (approximately 2,700 B.P. to 1,700 B.P.) (Clark and Michlovic 1996; Green and Davidson 1969, 1974). Unfortunately, however, geochemical testing of volcanic glass in Samoa to understand procurement and interaction is in its infancy. Clark includes geochemical characterization data regarding volcanic glass in his work on the coastal site of 'Aoa (Clark and Wright 1995), utilizing a scanning electron microscope with an energy-dispersive (EDAX) attachment. Clark and Wright tested a total of 16 samples, 14 from excavations at 'Aoa. Results indicate that the 14 archaeological samples originated from the same source. Clark and Wright found that the two non-archaeological obsidian samples were more siliceous and less aluminous than the archaeological volcanic glass samples.

While the samples exhibited little variation in chemical composition, there are several macroscopic differences. Clark describes three different color types, black, brown and a dull opaque green, along with several cortex textures. Still, while there is macroscopic variation in both color and cortex, tests indicate that there is too little variation to consider multiple sources of origin. Color differentiation in the volcanic glass found on Tutuila is most likely a result of slightly heterogeneous volcanic deposits and is not a reliable indication of discrete procurement locations. As a result, several colors of raw material may be present in a deposit from a single volcanic plug.

Sheppard and colleagues (1989:70-74) tested glassy material from Goat Island, in Pago Pago Harbor, Tutuila Island, to determine a potential source of volcanic glass artifacts recovered from excavations on Upolu, Western Samoa (Green and Davidson 1969, 1974) and Tataga Matau, Tutuila (Best 1988). The result of this study concludes that Goat Island is not the source for the archaeological samples from either island. Later studies of the Goat Island glass (Clark and Wright 1995) illustrate that the material is basaltic glass, which forms at the periphery of basaltic dykes and is by definition much less siliceous than any archaeological specimen from Tutuila.

To this date, no sources have been identified on Tutuila Island that coincide with the geochemistry of artifacts recovered from the island. The geochemistry of the Pago Pago caldera suggests that the volcanic glass formed by the quenching of liquids as magma cooled, and may be present in plugs about the periphery of the modern harbor (Clark and Wright 1995:256). Previous studies suggest that one common characteristic of the volcanic glass found on Tutuila Island is a diminished levels of TiO_2 . This is reportedly due to its removal by early crystallization of Titanian Magnetite (Clark and Wright 1995; Natland 1980). Clark and Wright (1995) suggest that the similarity in Pago volcanic geology and analyzed artifact composition implicates Tutuila Island as the potential source for the volcanic glass utilized throughout prehistory, namely the Matafao and Pioa volcanic plugs. It would seem likely that a readily available source of volcanic glass on Tutuila Island would be prominently represented across the archipelago and consistently exploited throughout prehistory; the opposite is the case, however. (Clark and Wright 1995; Eckert and Welch 2013).

Volcanic glass artifacts in Samoa offer a novel avenue to assess the chronology of raw material procurement and distribution. Unfortunately many volcanic glass artifacts recovered over the last forty years of archaeological investigation in the Samoan Islands were not encountered in securely dated deposits (Table 4.1). As a result, the relationships between radiocarbon dates and target events cannot be confidently established and may not reliably inform diachronic variability in distribution and use (Dye 2000). Volcanic glass artifacts have been encountered within post Ceramic Period deposits across the Samoan Islands; however, examination of artifact provenience shows that post depositional events such as prehistoric mound building, house construction or natural geomorphic processes are often responsible for artifact translocation (Clark 1989; Clark and Herdrich 1988; Clark and Michlovic 1996:155; Green and Davidson 1974:148).

4.4 METHODS

To control for secondary contexts and problems of loose association, archaeological deposits that do not meet the requirements of a chronometric hygiene protocol (Reith and Hunt 2008; Smith 2002) were removed from the study group (Table 4.1). Thus, secure association between radiocarbon events and target archaeological events are confident and offer an accurate portrait of activity, time and place (Dye 2000; Reith and Hunt 2008). In assessing the chronology of archaeological deposits in Samoa, I follow the method outlined by Pearl (2006:338) and emphasize age ranges at one

standard deviation (68% probability) as a move to two standard deviations overstates the probability that the true age lay in the tails of the probability distribution. Calibrated age ranges are assessed at two confidence intervals when measuring evidence of secondary deposition and site disturbance as outlined by Reith and Hunt (2008). Radiocarbon dates were recalibrated using OxCal v4.1.7; interface build: 69 (Bronk Ramsey 2009a, 2009b; atmospheric data from Reimer et al. 2009). For wood charcoal samples I use the Northern Hemisphere calibration curve (IntCal 09) as used for Samoa by Reith and Hunt (2008) and discussed by McCormac and colleagues (2004:1088). Samples from marine shell were calibrated using the marine curve (Marine 09) with a ΔR offset of 57 ± 23 as given by Phelan (1999) and employed by Reith and Hunt (2008). Four sites were selected based upon 1) Multi-component deposits and 2) meeting the chronometric hygiene protocol with volcanic glass artifacts in association with pottery bearing activity surfaces. Special attention is paid to the sequence of deposition as these sites share important stratigraphic, chronological and material relationships (Table 4.4).

Table 4.4: Radiocarbon dates from multi-component sites in the Samoan Islands.

Site	Lab No.	Provenience	Sample material	$^{13}\text{C}/^{12}\text{C}$ ratio	^{14}C age	Cal. B.P. (1 σ)	Cal. B.P. (2 σ)
Aganoa	Beta-228302	Block C, 155 cmbs	Charcoal	-28.1	2540 \pm 40	2743-2698 (28.3%) 2636-2615 (12.9%) 2592-2540 (23.3%) 2526-2516 (3.8%)	2750-2655 (36.8%) 2644-2488 (58.6%)
Aganoa	Beta-218273	Block C, Lvl 12, 136 cmbs	Soot on sherd	-24.9	2530 \pm 40	2738-2697 (22.2%) 2636-2614 (12.2%) 2592-2538 (25.3%) 2528-2506 (8.5%)	2748-2486 (94.8%) 2478-2472 (0.6%)
Aganoa	Beta-228301	Block C, 150 cmbs	Charcoal	-29.5	2500 \pm 40	2716-2680 (13.5%) 2640-2610 (11.4%) 2600-2493 (43.3%)	2740-2455 (92.2%) 2410-2400 (1.0%) 2390-2366 (2.2%)
Aganoa	Beta-231699	Unit 1017/1007 midden, lvl 8, 80 cmbs	Charcoal	-21.7	2410 \pm 40	2648-2645 (.2%) 2486-2352 (67.0%)	2700-2636 (15.7%) 2616-2589 (4.8%) 2542-2345 (74.9%)
Aganoa	Beta-228295	Block L, 160 cmbs	Charcoal	-23.6	2360 \pm 40	2457-2387 (38.0%) 2369-2338 (30.2%)	2680-2640 (5.0%) 2610-2600 (0.8%) 2494-2321 (89.6%)
Aganoa	Beta-228296	Block L, 168 cmbs	Charcoal	-23.9	2320 \pm 40	2360-2308 (62.8%) 2223-2209 (5.4%)	2463-2301 (78.7%) 2244-2178 (15.9%) 2169-2160 (0.8%)
Aganoa	Beta-228298	Block L, 177 cmbs	Charcoal	-23.9	2300 \pm 40	2354-2307 (55.8%) 2227-2207 (12.4%)	2363-2296 (59.4%) 2270-2155 (36.0%)
Aganoa	Beta-	Block L,	Charcoal	-27.2	2290 \pm	2350-2306	2356-2298 (52.5%)

Site	Lab No.	Provenience	Sample material	$^{13}\text{C}/^{12}\text{C}$ ratio	^{14}C age	Cal. B.P. (1σ)	Cal. B.P. (2σ)
	228299	177 cmbs			40	(46.4%) 2232-2206 (16.5%) 2194-2184 (5.3%)	2262-2157 (42.9%)
Aganoa	Beta-228305	Block L, 172 cmbs	Soot on sherd	-26.0	2210 ± 40	2310-2294 (8.7%) 2272-2221 (28.1%) 2210-2154 (31.4%)	2334-2132 (95.4%)
Aganoa	Beta-228297	Block L, 156 cmbs	Charcoal	-24.4	2180 ± 40	2305-2235 (40.1%) 2182-2126 (28.1%)	2328-2103 (92.3%) 2086-2063 (3.1%)
Aganoa	Beta-228306	Block L, 148 cmbs	Charcoal	-24.0	2130 ± 40	2290-2275 (60%) 2153-2042 (62.2%)	2304-2239 16.3%) 2180-1995 (79.1%)
Aganoa	Beta-228303	Block L, 80 cmbs	Charcoal	-24.8	1260 ± 40	1270-1172 (68.2%)	1282-1080 (95.4%)
Aganoa	Beta-231700	Block O, 23 cmbs	Charcoal	-24.6	410 ± 40	513-455 (58.7%) 348-334 (9.5%)	524-426 (72.0%) 392-318 (23.4%)
Aganoa	Beta-231701	Block O, 30 cmbs	Charcoal	-22.6	370 ± 40	498-429 (44.5%) 375-368 (3.7%) 360-328 (20.0%)	504-315 (95.4%)
To'aga	Beta-35604	Unit 23, Layer IIIB, 198 cmbs	Marine shell (<i>Tridacna maxima</i>)	+ 1.7	2770 ± 80	2555-2313 (68.2%)	2348-1947 (95.4%)
To'aga	Beta-25033	Unit 6, Layer IIA-1	Marine shell (<i>Turbo setosus</i>)	+ 2.3	2640 ± 80	2340-2139 (68.2%)	2485-2024 (95.4%)
To'aga	Beta-25034	Unit 6, Layer IIB	Marine shell	+ 2.5	2570 ± 80	2295-2090 (68.2%)	2348-1947 (95.4%)

Site	Lab No.	Provenience	Sample material	¹³ C/ ¹² C ratio	¹⁴ C age	Cal. B.P. (1σ)	Cal. B.P. (2σ)
To'aga	Beta-19742	Unit A, Layer D, Lvl 10	(<i>Turbo setosus</i>) Marine shell	+ 2.9	2350 ± 50	1976-1838 (68.2%)	2060-1762 (95.4%)
To'aga	Beta-35924	Unit 15, Layer II, 60-70 cmbs	(<i>Turbo setosus</i>) Marine shell	+ 2.7	2100 ± 70	1701-1520 (68.2%)	1802-1424 (95.4%)
To'aga	Beta-26463	Unit 3, Layer II, 40-70 cmbs	(<i>Tridacna maxima</i>) Marine shell	+ 2.5	1910 ± 50	1467-1330 (68.2%)	1520-1286 (95.4%)
To'aga	Beta-35600	Unit 17, 53 cmbs	(<i>Turbo setosus</i>) Charcoal	- 26.1	1190 ± 70	1232-1208 (7.0%) 1181-1052 (53.9%) 1030-1006 (7.3%)	1269-968 (95.4%)
To'aga	Beta-26465	Unit 13, Layer III, 35-45 cmbs	Marine shell	+ 2.0	1600 ± 70	1180-1004 (68.2%)	1254-941 (95.4%)
Vainu'u	Beta-240800	Unit C5, Feature 3, Layer III, Lvl 7,	(<i>Turbo setosus</i>) Soot on Sherd	-25.3	2440 ± 40	2682-2640 (15.5%) 2610-2599 (3.9%) 2494-2362 (48.8%)	2702-2634 (21.6%) 2617-2560 (12.1%) 2546-2355 (61.6%)
Vainu'u	Beta-240791	Unit B4, Layer III, Lvl 4	Soot on sherd	-24.9	2440 ± 40	2682-2640 (15.5%) 2610-2599 (3.9%) 2494-2362 (48.8%)	2702-2634 (21.6%) 2617-2560 (12.1%) 2546-2355 (61.6%)
Vainu'u	Beta-240793	Unit C1, Feature 3, Layer III, Lvl 5	Charcoal	-27.9	2330 ± 40	2460-2346 (68.2%)	2692-2637(9.2%) 2613-2596(2.0%) 2499-2335(84.2%)
Vainu'u	Beta-240797	Unit C5, Feature 3, Layer III, Lvl 5	Charcoal	-27.8	2320 ± 40	2459-2385(42.5%) 2375-2342(25.7%)	2684-2638(6.9%) 2612-2598(1.4%) 2495-2330(87.2%)
Vainu'u	Beta-	Unit C2,	Charcoal	-27.5	2300 ±	2452-2444	2664-2644 (1.4%)

Site	Lab No.	Provenience	Sample material	¹³ C/ ¹² C ratio	¹⁴ C age	Cal. B.P. (1σ)	Cal. B.P. (2σ)
	240792	Feature 5, Layer III, Lvl 4			40	(2.7%) 2438-2410 (11.8%) 2400-2389 (4.0%) 2367-2326 (49.6%)	2488-2306 (90.2%) 2233-2204 (3.0%) 2196-2184 (0.9%)
Vainu'u	Beta-240796	Unit C6, Feature 5, Layer III, Lvl 4	Charcoal	-28.3	2270 ± 40	2360-2308 (62.8%) 2223-2209 (5.4%)	2463-2301 (78.7%) 2244-2178 (15.9%) 2169-2160 (0.8%)
Vainu'u	Beta-240799	Unit C5, Feature 3, Layer III, Lvl 6	Charcoal	-27.3	2240 ± 40	2347-2306 (41.0%) 2233-2205 (19.4%) 2196-2184 (7.8%)	2353-2296 (45.8%) 2266-2156 (49.6%)
Vainu'u	Beta-240795	Unit C5, Feature 3, Layer III, Lvl 5	Charcoal	-28.0	2240 ± 40	2350-2306 (46.4%) 2232-2206 (16.5%) 2194-2184 (5.3%)	2356-2298 (52.5%) 2262-2157 (42.9%)
Vainu'u	Beta-228642	Unit 1, Post hole, Layer III, Lvl 4	Charcoal	-29.0	1710 ± 40	1809-1800 (3.0%) 1780-1756 (8.5%) 1740-1687 (30.1%) 1673-1620 (26.5%)	1820-1600 (94.1%) 1582-1572 (1.3%)
Vainu'u	Beta-240798	Unit D2, Feature 6, Layer V, Lvl 5	Charcoal	-25.9	650 ± 40	667-639 (33.9%) 591-563 (34.3%)	676-620 (47.5%) 610-554 (47.9%)
Vainu'u	Beta-228641	Unit 1, Layer V, Lvl 3	Charcoal	-28.6	150 ± 40	301-270 (24.6%) 210-208(1.7%) 187-149 (30.7%) 12 - -2 (11.2%)	421-410 (0.6%) 316-254 (28.9%) 225-136 (46.4%) 115-72 (3.1%) 34 - -4 (16.4%)
Vainu'u	Beta-228640	Unit 1, Layer V,	Charcoal	-28.2	100 ± 40	281-54 (11.6%)	285-166 (46.0%) 155-57 (32.6%)

Table 4.4 Eontinued

Site	Lab No.	Provenience	Sample material	$^{13}\text{C}/^{12}\text{C}$ ratio	^{14}C age	Cal. B.P. (1 σ)	Cal. B.P. (2 σ)
		Lvl 3				224-170 (24.4%) 152-136 (7.0%) 114-105 (3.4%) 100-73 (9.7%) 33-6(12.1%)	44--2 (16.9%)
Matautia	Beta-299692	Unit A1, Lvl 3, 132 cmbs	Charcoal	-25.0	1620 \pm 30	1554-1510 (37.3%) 1464-1418 (30.9%)	1593-1586 (0.9%) 1568-1412 (94.5%)

4.5 RESULTS

4.5.1 To'aga

The To'aga site (AS-13-1) located on the southern shore of Ofu Island offers secure radiocarbon dates for buried activity surfaces that include both volcanic glass and pottery (Figure 4.2). Excavations at this site took place over three field seasons from 1986 to 1987 and were led by Patrick Kirch (Kirch and Hunt 1993). Volcanic glass artifacts in association with acceptable radiocarbon dates come from Unit 23 layer IIIc (Beta-35604, 2555-2313 cal B.P. (1 σ) mean 2447 cal B.P.) and Unit 15 layer II (Beta-35924, 1701-1521 cal B.P. (1 σ) mean 1615 cal B.P.). Four radiocarbon dates from this site fail to meet the chronometric hygiene protocol criteria B (Reith and Hunt 2008:1906). These samples have standard deviations greater than 100 years and are

therefore omitted from this study. Volcanic glass artifacts were encountered within other excavation units; however these are the only specified dated contexts for this material. Radiocarbon dates from this site illustrate a time span from at least ca. 2500 cal B.P. until ca.1500 cal B.P. for volcanic glass procurement. Beta 35924 is of special interest as the date suggests movement of volcanic glass had ceased by the six century A.D.

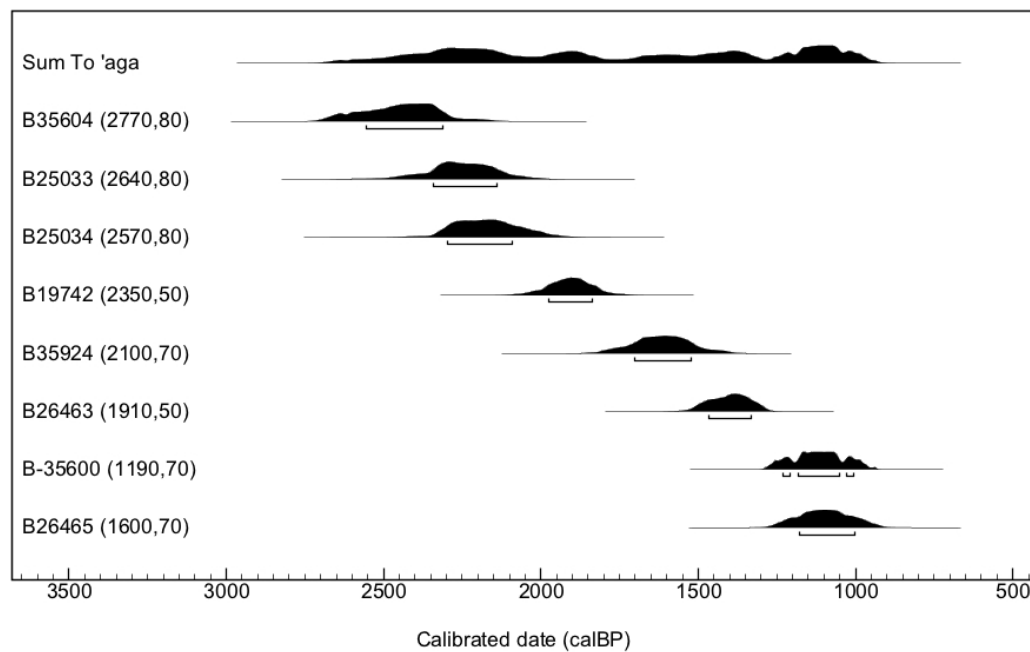


Figure 4.2: Radiocarbon dates from To'aga. These data illustrate the movement of volcanic glass from ca. 2500-1500 cal B.P.. Volcanic glass artifacts are absent after Beta 35924. Atmospheric data from Reimer et al (2009). Marine data from Reimer et al (2009)

One date that falls within the early age range for the Dark Ages (Beta-26463, 1467-1331 cal B.P. 1σ) comes from the bottom of a shell midden and may indicate short-term coastal activity after the cessation of pottery and before renewed occupation ca. 1000 B.P.. Alternatively, the midden may have been created just prior to the end of the pottery period and simply didn't include any ceramic materials within the feature. Two dates from aceramic deposits that, interestingly enough, also lack volcanic glass are younger than 1200 cal B.P. and are attributed to the initial centuries of the Monument Building period (Beta-26465, 1180-1004 cal B.P. 1σ) and Beta-35600 (1232-1208 cal B.P. 1σ (7.0%); 1181-1053 cal B.P. (53.9%); 1030-1006 cal B.P. (7.3%) ; mean 1117 cal B.P.). Sample bias due to collection strategy may be argued to have created the truncated nature of the radiocarbon record. This is unlikely. The stratigraphic profiles of units 15 and 23, among multiple others, exhibit culturally sterile sediments that separate buried paleosols from more recent deposits and further suggest that this site saw decreased cultural activity for perhaps 250 years. The data from the To'aga site illustrate that volcanic glass accompanied ceramic materials from at least 2500 cal B.P. until the end of pottery traditions at the site ca. 1500 cal B.P.. After 1500 cal B.P., signals of occupation are exceedingly sparse until aceramic activity is evident by ca. 1100 cal B.P. (Beta 35600, Beta 26465).

The coastal area of Ofu Island appears to have been used for two main periods of occupation. These periods are separated in the sequence by considerable deposition of natural, culturally sterile sediments. This multi-component sequence likely formed as

human impact declined ca. 1400-1500 B.P., sea levels dropped and shorelines prograded ca. 1300-1200 B.P. (Kirch and Hunt 1993:89; Pearl 2004) prior renewed occupation ca. 1100 B.P.. This site offers valuable chronological information about the regional volcanic glass exchange network and is among the very few deposits that offer terminal ceramic period dates ca. 1500 cal B.P.. The characteristic stratigraphy at To'aga is expressed at other sites throughout the archipelago.

4.5.2 Aganoa

Texas A&M University conducted archaeological excavations at Aganoa located on the southern shore of Tutuila Island in 2006 (Eckert 2006, 2007; Crews 2008; Welch 2008; Eckert et. al 2008; Roberts and Eckert 2008) and produced 14 new dates from well-stratified deposits that meet all chronometric hygiene protocol criteria (Figure 4.3). Excavation recovered 47 volcanic glass flakes, 7 un-worked nodules and 11 flaked cores. The inverted radiocarbon record supplied by Kennedy and Moore corroborate with unpublished dates from the 2006 excavations and indicate that portions of the upper 30-40 centimeters at Aganoa have seen post-depositional disturbance due to horticulture and residential activity during the Monument Building period and into historic times.

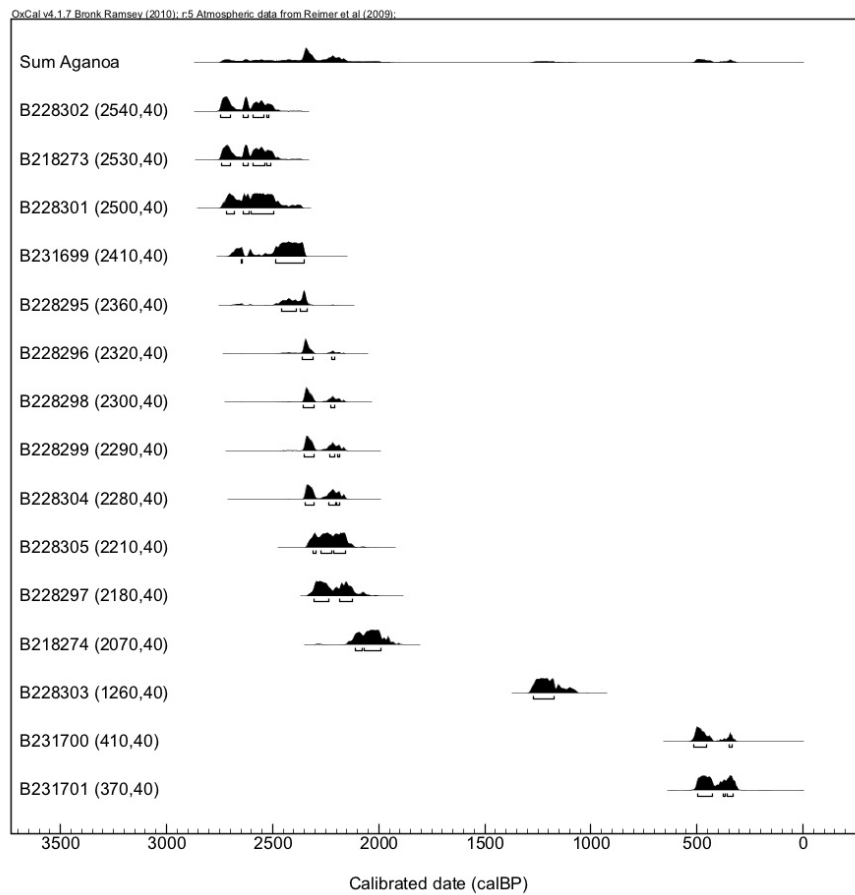


Figure 4.3: Probability distributions of accepted radiocarbon dates from Aganoa. These data illustrate a time gap between ceramic period and aceramic activity ca. 2000-1200 B.P. Volcanic glass is absent after Beta-218274.

Volcanic glass artifacts were recovered in primary contexts during the 2006 field season and show that the material was used from ca. 2600 cal B.P. until at least 1900 cal B.P.. Two main excavation units (Block C and Block L) exemplify the stratigraphic record of pottery production and volcanic glass use at Aganoa. The earliest suite of

dates (Beta 228302, Beta 21873 and Beta 228301) were recovered from Block C, a zone of dark gray ashy soil buried by aeolian sand within a 2x2 meter unit (Figure 4.4). The patchy deposit included faunal remains and plainware sherds alongside volcanic glass and basalt tools. The earliest radiocarbon date from this portion of the site suggests initial occupation took place between ca. 2743-2698 cal B.P. (28.3%) and 2592-2541 cal B.P. (23.3%) (Beta 228302 at 1 σ). A step to two standard deviations supplies an age range of 2751-2655 cal B.P. (36.8%) and 2644-2488 cal B.P. (58.6%). A combined age estimation from this deposit offers a pooled mean conventional age of 2520 \pm 29 and a calibrated mean of 2607 cal B.P. (N=3; df=1; T=0.5 χ^2 (.05) = 3.8) for activity along the western portion of the frontal zone.

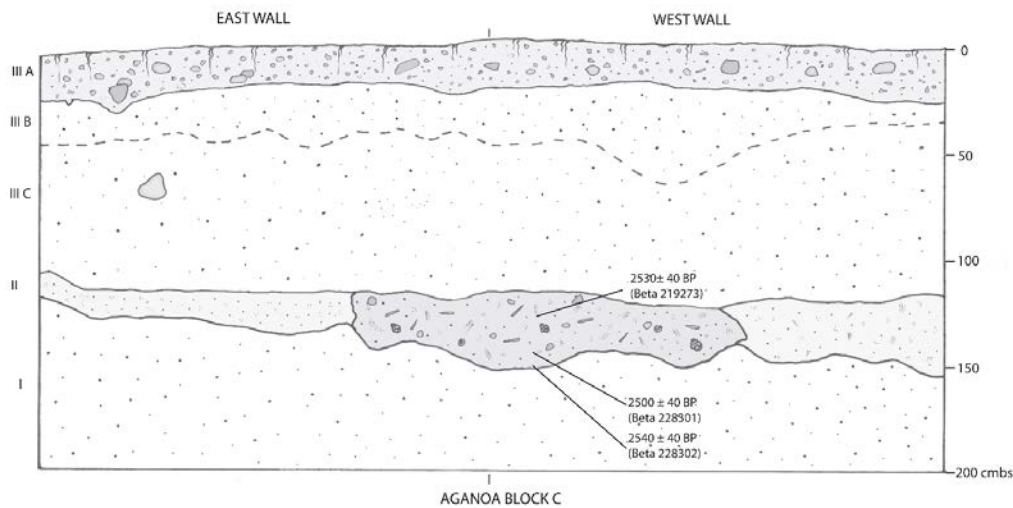


Figure 4.4: Aganoa Block C. Profile shows the relationship of early dates to buried ceramic Period activity surface at 150 cmbs.

A second suite of seven radiocarbon age determinations (Table 4.4) comes from Block L, a 3x3 meter excavation unit (Figure 4.5) located approximately 100 meters to the east of Block C. The buried surface was composed of compact ash and charcoal and was continuous across the 3x3 meter area. The activity area included fire-cracked cooking stones, basalt adzes, volcanic glass flakes and cores, shell beads, fishhook fragments, remains of marine and terrestrial fauna and plainware pottery. The combined mean conventional age is 2274 ± 18 and offers a calibrated age range of 2343-2310 cal B.P. ($N=8$; $T=7.4$; $df=4$ $\chi^2(.05)=9.5$) with a mean calibrated date of 2291 cal B.P.. A date of 1271-1172 cal B.P. 1σ (Beta 228303) comes from charcoal recovered from underneath a basalt boulder and gravel pavement *fale* foundation above the ceramic period deposit of Block L and supplies an age estimate for renewed occupation within the valley. The stratigraphic profile of this unit is similar to that of Block C in that a ceramic period horizon is capped by a thick layer of sterile beach dune sand, both of which rest below a Monument Building period occupation.

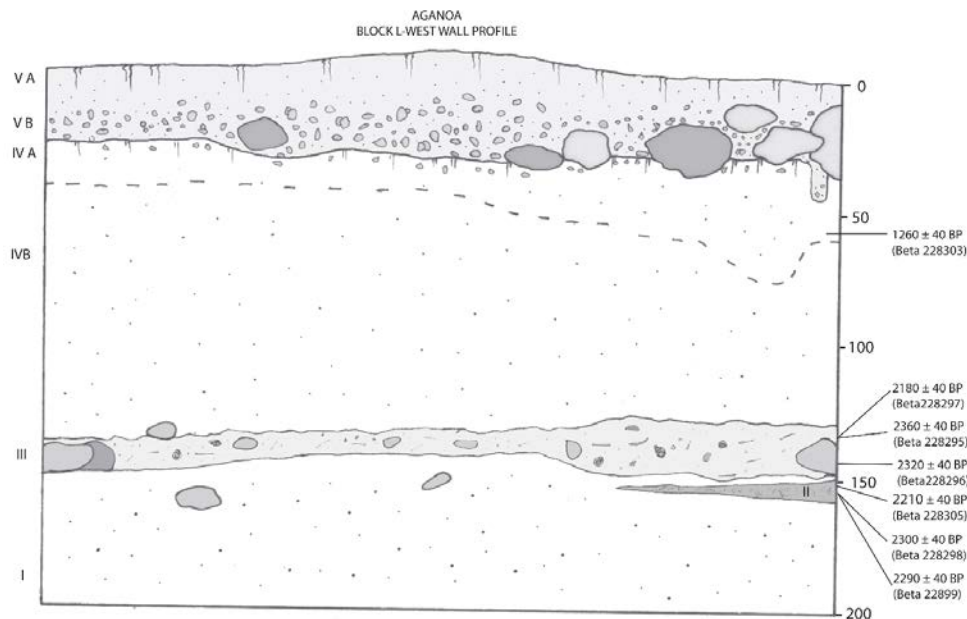


Figure 4.5: Profile of Aganoa Block L. Profile shows presence of Ceramic Period surface with volcanic glass buried by culturally sterile beach sand. A date of ca. 1200 cal B.P. shows renewed aceramic residence.

Results of this study show that the earliest activity at Aganoa took place ca. 2600-2700 cal B.P.. Current evidence from this site suggests somewhat episodic occupation with volcanic glass use until at least ca. 2000 cal B.P.. Renewed activity by a population that did not seek volcanic glass or make pottery took place ca. 1200 cal B.P.. Additional excavation may provide a later suite of dates for ceramic period activity at this location. From this information, Aganoa and To 'aga were contemporaneous settlement areas for coastal populations that engaged in local production of pottery (Eckert 2006, 2007; Roberts and Eckert 2008) and had access to

volcanic glass, either by direct procurement or exchange, from initial occupation until site abandonment (Welch 2008).

4.5.3 Vainu'u

The Vainu'u site (AS-32-16) is located atop the western highlands of Tutuila Island and is the first highland ceramic site to be excavated in the Samoan Archipelago (Eckert and Welch 2009; Eckert and Welch 2013; Welch 2007; Roberts 2007; Eckert and Hawkins 2008). A total of 24 volcanic glass artifacts were recovered from systematic excavations between 2006 and 2007. Along with an artifact assemblage of volcanic glass, pottery, basalt adzes, scrapers and lithic debitage, a total of twelve dates exhibit secure stratigraphic contexts and fulfill the chronometric control protocol criteria previously described (Figure 4.6).

Evidence for the earliest activity at this location comes from a suite of seven radiocarbon dates recovered in situ during excavation of two hot rock ovens (*umu*) buried below a deposit of weathered volcanic ash. Agreement between associated radiocarbon dates illustrate that both features are in primary context with associated pottery and a small amount of volcanic glass. Additional volcanic glass artifacts were recovered several meters away within the same stratigraphic layer (strat III). Feature 3 provided four radiocarbon determinations (Beta-240792, Beta-240793, Beta-240797 and Beta-240800). A combined charcoal date from this feature suggests an age of 2356-2340 cal B.P. at 1σ ($N=3$; $df=2$; $T=3.8$; $\chi^2(.05)=6.0$) with a mean calibrated date of 2357 cal

B.P.. An average age of fuels used in cooking collected from soot residue on the surface of a sherd within Feature 5 (Beta-240800) has a mean calibrated age of 2517 cal B.P. at 1σ . The latest age range intercept for Beta-240800 shows a range of 2494-2362 cal B.P.

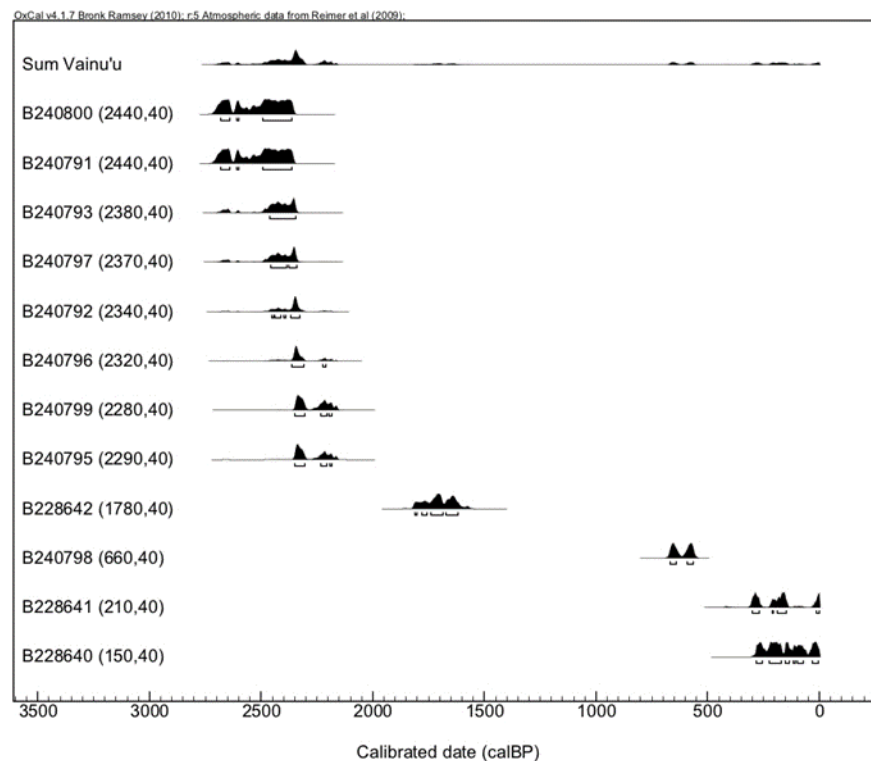


Figure 4.6: Probability distributions of accepted radiocarbon dates from Vainu'u. These data illustrate highland activity ca. 2300 cal B.P. and last use of volcanic glass ca. 1650 cal B.P.. Volcanic glass is absent after Beta-228642.

(48.8%) and overlaps the combined charcoal age at the 2-sigma confidence interval. The soot date appears to predate the charcoal dates from the same feature and suggests the vessel had been heated with older fuels prior to use at Vainu'u Feature 5. Combined

charcoal dates from Feature 4 provide an age range of 2350-2335 cal B.P. and a mean of 2336 cal B.P. at 1σ ($N=3$; $df=2$ $T=0.8$ χ^2 (.05)= 6.0). These two features are chronologically indistinguishable from one another and indicate habitual use of highland resources along with local production of pottery, woodworking and use of volcanic glass ca. 2350 cal B.P. (Eckert and Welch 2009; Eckert and Welch 2013).

One radiocarbon result (Beta-228642) was recovered within a posthole stain underneath the layer of volcanic ash (Layer III/Component I). Due to a reversal in atmospheric carbon during this period the date has multiple intercepts yet provides an estimated age range of 1673-1620 cal B.P. (26.5%) and 1740-1687 cal B.P. (30.1%) at 1σ with a mean age of 1702 cal B.P.. A step to two standard deviations provides a result of 1800-1600 cal B.P. (94.1%). This age determination is coincident with a sharp increase in the presence of basalt debitage and pottery sherds. The date also supplies a *terminus post quem* date for a single flake of volcanic glass found 5cm above the charcoal specimen. Later dates from the same unit come from postholes intrusive into the volcanic soil and fall within the Monument Building and Historic periods. The earliest date from the aceramic component (Beta-240798) comes from a posthole on the periphery of a house platform and indicates an age range of 667-639 cal B.P. (33.9%) and 591-563 cal B.P. (34.3%) at 1σ with a mean of 615 cal B.P.. The earliest signals of site use appear ca. 2350 cal B.P. and extend to ca. 1650 cal B.P.. After this date a volcanic event blanketed the site with approximately 30cm of volcanic ash and welded tuff such that a root-restrictive layer of fused volcanic ejecta seals portions of the

ceramic bearing deposit. By ca 600 B.P. house foundations were present upon the current surface and habitual use of the location continued into historic times.

Summary of Volcanic Glass Chronology

Radiocarbon dates from buried volcanic glass-bearing activity surfaces in the Samoan Islands are compiled to study the chronology of procurement and distribution. A majority of sites where volcanic glass artifacts have been recovered fail to meet chronometric hygiene protocol standards and cannot offer clean data. Radiocarbon determinations from the recently excavated Tutuilan sites of Aganoa and Vainu'u are combined with information from To'aga on Ofu Island. The findings suggest that volcanic glass artifacts were used early in the prehistoric record ca. 2650 cal B.P. and continued to be procured until ca. 1500 cal B.P. (Figure 4.7). Contemporaneous activity was taking place at all three sites by ca. 2350 cal B.P. (Figure 4.8).

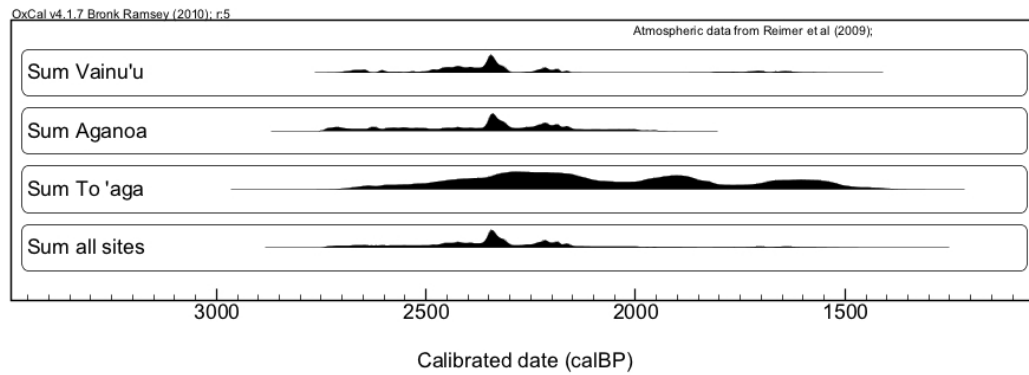


Figure 4.7: Single plot of summed probability distribution. Volcanic glass-bearing deposits indicate a halt in procurement and distribution ca. 1500 cal B.P..

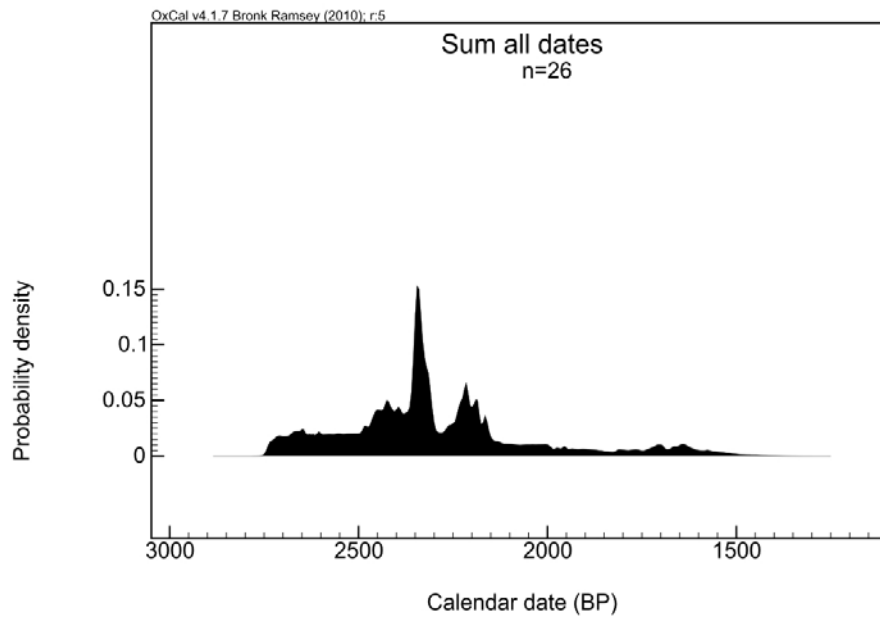


Figure 4.8: Summed probability distributions for volcanic glass use.

One radiocarbon date from a Ceramic Period posthole at Vainu'u indicates that volcanic glass-using activities were not present after ca. 1500 B.P.. Dates from Aganoa

show early use of volcanic glass ca. 2600 cal B.P. until at least 2000 cal B.P.. To 'aga illustrates that volcanic glass moved from Tutuila Island to Ofu Island routinely from ca. 2600 cal B.P. until ca. 1500 cal B.P.. A summed probability distribution shows volcanic glass use from ca. 2750 cal B.P. at the earliest until ca. 1500 cal B.P.. The stratigraphic integrity of charcoal present within the thick colluvial soils at the coastal site of 'Aoa has been assessed to determine the possibility of volcanic glass use post ca. 1500 B.P.. The inverted nature of the radiocarbon record is indicative of significant post depositional restructuring by geomorphic processes and cannot be seen as convincing evidence for volcanic glass use, or pottery production post ca. 1500 B.P..

4.6 EVALUATING THE CURRENT MODEL

In turning to the expectations of the Cultural Hiatus Model, volcanic glass was recovered in association with the archaeological remains of ceramic-rich subsistence-based activity in the form of hot rock ovens at Vainu'u, midden deposits and cooking features at Aganoa and midden deposits at To'aga. Current chronological evidence suggests that the function of this domestic item remained stable through time from initial occupation to site abandonment. As outlined, a sudden disappearance of archaeological sites would point towards a significantly reduced population across the landscape. The discontinuity evident in the artifact record suggests a cessation of inter-island procurement and distribution of volcanic glass alongside a halt in the production of ceramic vessels ca. 1500 B.P.. A new population that did not use volcanic glass or

produce pottery would begin to visit the archipelago in small numbers during what we have termed the Samoan Dark Age and would begin to settle in larger number by ca. 1250 B.P.. Discontinuity in cultural traditions of pottery production and distribution of volcanic glass suggests that different cultural practices were in place on either side of the Samoan Dark Age, ca. 1500-1000 B.P.. What natural and/or social factors might be responsible for prompting an end to ceramic technology and volcanic glass use in conjunction with a five hundred year period of reduced population?

Late Holocene volcanism, attributed to the Puapua volcanics, is well evidenced across the Islands of Upolu and Savai'i (Kear 1959; Kear et al. 1981; Németh and Cronin 2009). Available ^{14}C dates from the Puapua volcanics illustrate extensive and repeated volcanic activity spanning the record of human occupation in the Samoan Islands from initial occupation through to end of the Monument Building Period (Németh and Cronin 2009). The most explosive events are attributed to the early Tafua Savai'i and Tafua Upolu eruptions and those on the offshore islands of Namu'a and Fanuatapu (Németh and Cronin 2009). Less explosive lava flows have also been shown to have destroyed horticultural areas and covered lagoons and reefs throughout the late Holocene as they covered extensive areas of Savai'i and portions of Upolu with thick basaltic lavas (Addison et al. 2006; Eckert and Welch 2013; Kear 1959; Kear et al. 1981; Németh and Cronin 2009:227).

Recent archaeological investigations on Tutuila Island, American Samoa have provided additional evidence of late Holocene destruction of Ceramic Period activity areas across the western portion of the Island ca. 1,500 B.P. (Addison et al. 2006; Eckert

and Welch 2013). Relic volcanic landforms and witness accounts on Upolu and Savai'i attest to volcanic activity of variable intensity throughout the late Holocene, with direct evidence of significant associated ash fall, toxic gas, lava bombs, widespread deforestation, and destruction of marine resources, earthquakes and tsunamis (Anderson 1910; Kear 1959; Kear et. al 1981; Németh and Cronin 2009).

Kear and colleagues have shown Ceramic period dates to exist on the Tafagamanu coastal sands under thick basalt lava flows on Savai'i (Kear 1959; Kear et al. 1981) which occurred as late Holocene volcanism on Savai'i covered half of the island's surface area and left the southern shore blanketed under thick basalt sheets (Kear 1959). These works illustrate that volcanism affected Ceramic Period communities On Upolu where volcanic flows covered ten square miles of the south coast at O le Pupu and filled valleys at Lefaga, Lau'i'i and Soaga. These events appear to have subtracted substantial portions of arable land and destroyed much of the marine foraging resources within lagoon and reef environments and would have forced prehistoric occupants to relocate subsistence practices elsewhere for some period of time (Anderson 1910; Boyd and Parr 2005; Cronin and Neall 2000; Kononenko et al. 2010). At present, further archaeological inquiry is needed to assess the socio-environmental relationship between late Holocene destruction of usable land and Ceramic Period cultural response within the Samoan Islands.

New Data for Old Questions

Our understanding of prehistoric population demographics is primarily informed by chronological variation in the discarded remains of human activity. The long held understanding of cultural transformation in Samoa from an early ceramic making tradition to an aceramic population via an Ancestral Polynesian phase has been maintained due the assumption that there is no definitive archaeological evidence for population discontinuity (Davidson 2012; Kirch and Green 2001; Reith and Hunt 2008). Traditional models explain that initial inhabitants to the Samoan Islands rapidly changed pottery traditions to exclude decoration, stopped making pottery altogether as they became proto-Polynesians, and then moved eastward after achieving the archaeologically definable Polynesian assemblage. Although pottery traditions disappear in the Samoan Islands ca. 1500 B.P., this point has been explained as an in-situ cultural shift, rather than a demographic crash, population replacement or complete cultural hiatus.

Recent geochemical sourcing studies in the Samoan Islands indicate that the production of ceramic vessels appears to be a predominantly local activity (Eckert and James 2011) and were not a primary inter-island exchange good. Volcanic glass, on the other hand, has been shown to originate from a single source and was used at both residential and special activity sites across the archipelago (Clark and Wright 1995; Clark and Michlovic 1996; Eckert and Welch 2013; Sheppard et al. 1989). The widespread distribution and deep chronology of this raw material offers valuable

temporal information towards variation in early intra-archipelago exchange networks. This study suggests that volcanic glass was an item specific to the ceramic period tool kit, and in so, an item of material culture that also disappears alongside pottery. A contemporaneous halt in pottery traditions and volcanic glass distribution suggests that both local production of goods and regional exchange networks failed just prior to the Samoan Dark Age ca. 1500 B.P.. The chronology of volcanic glass recovered from multi-component sites illustrate that archaeological discontinuities are increasingly evident within stratified deposits.

If down-the-line exchange was the mode of material movement, then the exchange network that supplied volcanic glass to To'aga and Vainu'u likely ceased to function ca. 1500 cal B.P.. If individual procurement forays from To'aga to Tutuila Island supplied the material, which due to distance from source is unlikely, then it is during this century that those practices stopped. The synchronic cessation of pottery production and movement of volcanic glass is significant as it implies the stoppage of both local and regional production and interaction ca. 1500 cal B.P.. A halt in domestic production and intra-island exchange on the eve of the Dark Ages are traits that archaeologists should not see from a blossoming Proto-Polynesian chiefdom, but might see as the result of a demographic decline.

Volcanism, Punctuated Occupation and Material Change

Archaeological work throughout Oceania has provided an exceptional image of prehistoric migration patterns, interaction, change in material culture and shifting horticultural practices in response to environmental factors associated with volcanic activity (Boyd et al. 2005; Boyd et al. 1999; Cronin and Neall 2000; Machida et al. 1996; Torrence et al. 2000; Torrence 2002). Of special relevance to this study are the material correlates that represent the relationship between volcanic activity and the choices that populations made regarding migration and reoccupation of volcanically active landscapes. The archaeological record in volcanically active New Britain, Papua New Guinea illustrates cyclical human colonization, abandonment due to eruptions and later resettlement (Kononenko et al. 2010:17). Changes in technological choice and systems of material exchange often occur upon recolonization as new or transformed cultural traditions resettle abandoned areas; for instance, changes in ceramic technology and the disappearance of stemmed obsidian tools on Garua Island, Papua New Guinea (Kononenko et al. 2010:19).

Parr and colleagues (2009) show that prehistoric groups in West New Britain, Papua New Guinea, created increasingly flexible land-use practices in response to frequent landscape disruption due to volcanism. Small-scale volcanic events were likely beneficial for prehistoric inhabitants as the new sediment allows for the formation of rich soils and rapid revitalization of cultigens (Boyd and Parr 2005). In these cases migrations away from active areas were minor and residential areas were quickly

reoccupied. In instances where volcanic activity completely destroyed foliage, eliminated marine foraging areas and buried residential locations (>ca. 1m thick) entire regions were abandoned for several hundred years (Cronin and Neall 2000; Parr et al. 2009). Site abandonment occurred in Samoa as late as 1905 after the Matavanu eruption covered five villages with lava, forcing displaced residential groups to move to other villages (Anderson 1910).

The ability to relocate before, or after cataclysmic events is reliant on external assistance by those occupying unaffected areas (Parr et al. 2009:171). Torrence and colleagues (Kononenko et al. 2010; Torrence 2004; Torrence and Summerhayes 1997) suggest that prehistoric communities maximized social links through the exchange of obsidian, among other items, to secure the ability to relocate in times of environmental instability. In this case, the movement of obsidian between islands may not have been “obsidian-driven” as a purely functional material (Frahm and Feinberg 2013). Rather, volcanic glass may have been part of a phenomenon in which the raw material was imbedded within a larger system of interaction that served to create social connections and maintain relationships with those living in areas to which a group may relocate. As to the role of Lapita obsidian, recent authors suggest that a lack of standardized reduction strategies to maximize the product of small obsidian nodules may indicate that the glassy material was primarily a symbol of connectedness, a social currency, with its functional role secondary to the larger significance of inter-island partnerships (Kononenko et al. 2010; Torrence 2011:34).

Evidence of repeat volcanism throughout the record of human habitation in the Samoan Islands is well represented (Addison et al. 2006; Eckert and Welch 2013; Nemeth and Cronin 2009). What remains unclear, however, is an understanding of the affect that high and low intensity events had on prehistoric migration patterns, subsistence, and systems of production and distribution. Previous work On Upolu and Savai'i show that Lapita communities faced various degrees of environmental destruction between ca. 3,000-1700 B.P. by the Puapua volcanics (Kear 1959; Németh and Cronin 2009). Recent evidence from Tutuila Island, American Samoa show that volcanic eruptions also heavily impacted residential sites across the western half of the island ca. 1500 B.P. (Addison et al. 2006; Eckert and Welch 2013).

Additional archaeological investigation is needed to clarify the relationship between late Holocene volcanism and cultural change in the Samoan Islands. If patterns of migration in response to catastrophic volcanism were similar in Samoa to that of Lapita strategies in other parts of Oceania (Boyd et al. 1999; Boyd and Parr 2005; Cronin and Neall 2000; Machida et al. 1996; Torrence 2002; Torrence et al. 2000) then we might expect to find analogous material evidence of regional abandonment with renewed colonization by a transformed, or perhaps unrelated, society. Could evidence of discontinuity in volcanic glass distribution and decreased residential activity during the Samoan Dark Age reflect a fallow period due volcanism?

Cultural Transformation or Cultural Replacement?

The timing of volcanic events and the nature of sediment accumulation at Vainu'u and other multi-component sites on the western half of Tutuila Island may be of critical importance to understanding the circumstances of pottery decline and the end of volcanic glass use in the Samoan Islands. Excavation at Vainu'u (Eckert and Welch 2013), and other sites, (Addison et. al 2006; see below) show that a large portion of Western Tutuila was blanketed by pyroclastic flow and ash fall ca. 1500-1400 cal B.P.. A date of ca. 1650 cal B.P. associated with pottery is capped by ash at Vainu'u. Three terminal Ceramic Period locations within the lower Pava'ia'i valley are capped by welded tuff and date to ca. 1500 cal B.P. (Addison et. al 2006).

Further, a previously unpublished radiocarbon date from the Matautia site located in the upper Pava 'ia'i valley was collected during excavation by the author in 2009 (Table 4.4). This charcoal sample came from systematic excavation below one meter of welded volcanic tuff. The sample was collected in situ from a charcoal feature at the contact of laminated welded tuff and a buried organic-rich A horizon. This buried surface contained burned pottery and stone flakes fused into welded tuff along with a broken type V adze, other basalt tools and remains of marine fauna. Radiocarbon results indicate an age range of 1569-1412 cal B.P. (Beta-299692 at 2σ) with a mean of 1496 cal B.P.. This date coincides with those provided by Addison and colleagues (2006) and provides a substantial case for a large-scale destruction of highland work stations, inland residential sites and near-coast activity areas on Tutuila Island ca. 1500 cal B.P..

Multi-component sites routinely illustrate that pottery and volcanic glass were a common aspect of material culture until ca. 1500. After this point, pottery is no longer evident in stratified contexts and volcanic glass artifacts cease to appear in primary cultural deposits. Concurrent with the widespread and apparently rapid halt in local traditions of pottery production and the closure of intra-archipelago lithic exchange networks is a volcanic event that covers half of Tutuila Island in cinders, lava bombs, rolling clouds of superheated gas and a suspended cloud of slowly falling ash.

Late Holocene volcanism was also active on the islands of Upolu and Savai'i where lava and ejecta from the Puapua volcanic series filled in lagoons, covered reefs, buried coastal sands and flowed through valleys (Kear 1959; Kear et. al 1981). These cataclysmic events no doubt had serious consequences for ensuing attempts at regional interaction, craft production and distribution and subsistence. The destruction of arable land and contamination of lagoon and coastal margin resources due to volcanism in concert with falling sea levels (Kear 1959; Kirch and Hunt 1993; Pearl 2004) may have provided the impetus for the movement of a pottery making people away from the islands that they had inhabited for over one thousand years.

4.7 CONCLUSION

Geoarchaeological evidence from well-stratified sites in Samoa suggests that volcanic glass was in use in domestic activities by a least ca. 2650 cal B.P.. Radiocarbon dates associated with the volcanic glass assemblages indicate that

procurement and distribution ended ca. 1500 cal B.P.. Excavation of multi-component sites that remain in primary contexts illustrate that volcanic glass is an item of material culture specific to Ceramic Period assemblages and that Monument Building period distribution networks, ca. 1200-250 cal B.P., did not include this raw material. The glassy items were an item of importance, a functional element in the unique ceramic period lithic tool kit that may have helped maintain social networks across the entirety of the Samoan Archipelago for over a thousand years. Continued study of these distinctive items of material culture will no doubt offer valuable insight regarding the chronology of island occupation, intricacies of lithic technological organization and an understanding of how Lapita groups maintained intra-archipelago social networks.

The disappearance of a regional volcanic glass distribution network that had been in place for over one thousand years may present valuable insight into social change that took place ca. 1500 cal B.P.. Archaeological evidence for the collapse of inter-island volcanic glass movement and the concurrent cessation of pottery production suggests that the culturally transmitted behavior of pottery production and raw material procurement was absent ca. 1500 cal B.P.. In other words, those who received instruction, likely via vertical transmission, and in turn transmitted those behaviors to others (Henrich 2001; Hosfield 2009) would be absent from the Samoan Islands by ca. 1500 cal B.P..

The disappearance of inter-island volcanic glass distribution networks adds credence to the notion that the pottery making, volcanic glass-using society was greatly diminished or absent after ca. 1500 cal B.P.. If still marginally populated between ca.

500-1200 cal B.P., demographic levels were below the threshold of maintained cultural transmission and regular inter-island voyaging. The near absence of archaeological remains from this period, none of which contain pottery or volcanic glass in primary deposits, suggests that the islands were only used intermittently until renewed large-scale residence by monument-building groups ca. 1000 cal B.P..

Arguments for Lapita ancestry typically view the cessation of pottery traditions as the result of in-situ cultural transformation during the Samoan Dark Ages toward an aceramic, complex-chieftdom level society (Davidson 2012; Kirch and Green 2001). Traditional models suggest that this quiet time in the archaeological record is where Lapita-derived Ancestral Polynesians became fully Polynesian in language and material culture. Geoarchaeological evidence from multi-component sites in Samoa, however, indicates that the four to five hundred years of the Dark Ages are expressed as thick layers of culturally sterile sediment.

When we combine the timing for the cessation of pottery production with new evidence for a concurrent closure of volcanic glass distribution networks and large-scale environmental change, the picture starts to become clearer. This study suggests that local production of goods and long-distance movement of lithic materials ceased at the same time that a volcanic eruption covered half of Tutuila Island. Radiocarbon dates for the timing of this event consistently point toward an eruption date of ca. 1500-1450 cal B.P.. During this time, prior to 1,900 B.P., the cinder cones of Fito and Tafua upolu were active on Upolu Island and erupted with large amounts of ash and tuff (Kear 1959:47; Kear et. al 1981:75). Late Holocene volcanism attributed to the Puapua volcanic series

(Kear 1959) also covered wide barrier reefs, coastal sands and inland valleys on the western islands on Upolu and Savai'i. Late Holocene volcanism affected the entire periphery of Savai'i and left the southern shore completely covered. On Upolu, volcanic flows covered ten square miles of the south coast at O le Pupu and filled valleys at Lefaga, Lau'i'i and Soaga.

For a population largely dependent on lagoon environments and near-shore resources, a shrinking subsistence base across the Samoan Islands may have had a rather unsettling effect. Burial of arable land and destruction of lagoon and reef environments by volcanism may have prompted a "paucity of populations", of which the "paucity of sites" described in the archaeological literature of the Samoan Dark Ages would be a natural result. This work suggests that population movement in response to late Holocene volcanic activity is responsible for the lack of archaeological visibility during the Samoan Dark Ages. The apparently synchronic disappearance of pottery production and volcanic glass distribution, both integral parts of Lapita social traditions, suggests that the populations that practiced these activities no longer acted upon the Samoan landscape after ca. 1500 B.P.. The resilient anticipation for archaeology to reveal the efflorescence of social complexity during the Samoan Dark Age has embedded an illusion of population continuity and Lapita ancestry. While this research offers an alternative explanation for cultural transformation within the Samoan Archipelago, continued archaeological work toward the refinement of admixture or population replacement models for cultural change is necessary as new information arises.

5. SUMMARY AND CONCLUSIONS

5.1 RETURNING TO THE CONCEPT OF MULTIPLE WORKING HYPOTHESES

The consensus model for cultural transformation in the Samoan Islands posits that the initial Late Eastern Lapita colonizing population gradually changed into the Polynesian complex chiefdom encountered at European contact (Kirch and Green 2001). For this dissertation I have observed Geoarchaeological evidence for island occupation and material traits of artifacts created and used through time. Each site used in the study was approached in this regard: with geoarchaeological information and items of material culture examined for evidence of gradual cultural drift or discrete assemblages within punctuated occupation events. Gradual cultural transformation (drift) would be supported by a continuous record of residence with a visible pattern of change in traditional knowledge toward a divergent cultural signature. A cultural hiatus/replacement model would be well supported by sites that exhibit discrete aspects of material culture and social organization separated by a period of demographic decline.

In critically assessing the sites excavated for this research, the geoarchaeological, chronological and material evidence does not appear to support hypothesis B or C, that the sites show general continuity in occupation with gradual change in culturally transmitted knowledge from an ancestral population to a transformed Monument Building period community. One site, 'Aoa, was examined specifically because this location had the best chance of supporting hypothesis number one, primarily because of

a potential for a continued practice of pottery production and obsidian procurement into the Monument Building Period. Maintained traditions of pottery manufacture and obsidian use would help to illustrate some small form of maintained ancestral identity within the Monument Building Period. Ultimately, geoarchaeological evidence of sherd abrasion through water transport and chronometric inversion due to downslope superpositioning preclude this site from offering a firm argument for a late chronology of ancestral traditions. As 'Aoa was the only Samoan site suggested to exhibit the transmission of ancestral techniques into the Monument Building Period (Clark et al. 1997; Clark and Michlovic 1996; Clark and Wright 1995), the chronology for the disappearance of those that made pottery and used obsidian should remain within the generally accepted timeframe of ca. 1,500-1,700 B.P. (Kirch and Green 2001; Reith and Hunt 2008; Smith 2002; Welch 2013).

The multi-component highland site of Vainu'u offers new data from well-preserved Ceramic Period cooking features with associated radiocarbon dates, pottery sherds and obsidian. This site contains undeniable evidence of regional volcanism and abandonment at some point just prior to ca. 1500 B.P.. Not until approximately 650 B.P. do we see archaeological evidence for this area being used again. Upon rejuvenated use of this area, new triangular basalt axes had replaced earlier plano-convex forms, pottery was not a part of the subsistence tool kit and obsidian use was absent. The archaeological remains of later activity at this site lacks any surviving material items to suggest shared identity through cultural transmission with the communities that used the landscape before the volcanic eruption. In the case of Vainu'u, the diachronic change in

traditions of tool manufacture and use supports hypothesis number two, that two separate cultural identities used the landscape before and after large-scale volcanic activity and did not share an ancestor-descendant relationship.

Matautia supplied valuable radiocarbon evidence that adds to our understanding of late Holocene volcanism across the Samoan Islands (Addison et al. 2006; Addison et al. 2008; Eckert and Welch 2013; Welch 2013). Dated charcoal from the contact of welded volcanic tuff and a destroyed living surface points to an eruption date of 1480 cal. B.P. (Section 4). This date is in agreement with radiocarbon evidence collected by Addison to the east of the Tafuna Plain (Addison et al. 2005). Matautia offered pottery and a type V (plano-convex) adze below the ash layer, two forms of material culture that were not made after the 1,500 B.P. volcanic event. Extensive surface survey within the Pava'ia'i valley where Matautia is situated illustrated a lack of pottery within Monument building Period sites and a predominance of triangular adzes, a tool form unseen below the 1500 B.P. volcanic event. Excavation and surface survey within the Pava'ia'i valley then appears to compliment the sequence exhibited at Vainu'u and supports hypothesis number 2 of a cultural hiatus.

The coastal sites of Aganoa and To'aga were extensively dated (Eckert 2007; Kirch and Hunt 1993; Welch 2013;) and offer a significant contribution to the corpus of systematically excavated radiocarbon dates. This study used recalibrated dates for To'aga to assess continued occupation and volcanic glass use across this coastal area. Again, as seen at Vainu'u and Matautia, disparity is exhibited in the morphology of specialized stone tools, obsidian distribution and pottery production at Aganoa and

To'aga (Crews 2008; Kirch and Hunt 1993; Welch 2008, 2013). The chronology of site occupation at Agaona confidently illustrates two separate habitation periods separated by approximately 650 years. While this specific range of reduced population density may not reflect the entirety of Samoa, all sites under study indicate a significant span of site abandonment. Aganoa displays the patterning seen at Vainu'u and Matautia (and that forwarded by Smith 2002) where pottery, plano-convex adzes and obsidian is prolific in the basal component and absent in the later period of residential activity. To'aga also exhibits a gap in residential use synchronic with other sites in this study (see Manuscript 3). These differences in traditional knowledge, separated by a period of site abandonment, adhere most closely to the conditions of hypotheses A and D. These hypotheses are supported by discontinuity in site occupation with discrete forms of tool production, systems of exchange and political stratification separated by demographic decline during the Samoan Dark Age period.

To'aga, on Ofu Island to the East of Tutuila, excavated by Kirch and colleagues in the late 1980's offers a large dataset and again illustrates a halt in obsidian procurement, pottery production and plano-convex adze forms ca 1500 B.P.. The stretch of coastline that comprises the area of usable land on Ofu Island shows that population density was severely reduced until approximately 1000 B.P., again fitting with the chronology of migration and cultural replacement seen at the other locations under study that support punctuated occupation and replacement (hypothesis D). A detailed argument for site chronology and site abandonment is offered in Manuscript 3.

5.2 DESPITE THEIR OWN EARLIER HISTORY OF POTTERY MANUFACTURE

Did Polynesians persistently decline to relearn the art of pottery production, despite their own earlier history of pottery manufacture? Excavations at Vainu'u, To'aga, Matautia and Aganoa illustrate that sweeping technological change took place at onset of the Monument Building Period, ca. 1000 B.P. Archaeological evidence produced in this study indicates that ceramic technology, obsidian use and the production of plano-convex adze forms all disappear at the beginning of the Samoan Dark Ages, ca. 1,500 B.P. Earlier archaeological works suggest that the reduced ability to see evidence of prehistoric activity during the Samoan Dark Age, the centuries between definable cultural periods, was due to the cessation of pottery, making surface sites difficult to locate (Green and Davidson 1969, 1974; Smith 2002). I suggest that sites dating to the Dark Age are not difficult to locate because of a lack of pottery, but because there was a significant demographic decline during the Dark Age (Reith and Hunt 2008). For the Samoan Dark Age, the absence of evidence for significant human occupation may best represent significantly reduced population density. If a population is no longer present of a landscape, then there will not be evidence of pottery manufacture, cooking, obsidian or and stone axe production.

The population that resettled Tutuila show a suite of technological choices divergent from those made by communities prior to the Dark Age. Recently, two authors have suggested a model of population intrusion into the Samoan Islands from northern Oceania ca. 1,200 B.P.. (Addison and Matisoo-Smith 2010). The findings from

archaeological sites in this study compliment recent models of population migration and replacement by illustrating discontinuity in site use and significant disparity in the economies of early and late Samoan Islanders.

In this case, mutually exclusive cultural traditions of subsistence and interaction, seen by the disappearance of pottery, plano-convex adzes and obsidian distribution networks are seen as a signal of demographic decline. Upon renewed Island occupation, basalt tool production increased dramatically (Best et al. 1989.) long-distance basalt tool distribution expanded (Weisler 1997; Best) and monumental architecture began (Best 1992; Clark and Herdrich 1988; Clark 1989; Green and Davidson 1974; Herdrich 1991; Pearl 2004, 2006). Patterns of migration due to environmental catastrophes, particularly volcanism are well evidenced in the lithic record of Papua New Guinea (Parr et al. 2009; Torrence 2011) and in the ceramic assemblages of Fiji (Cronin and Neall 2000). The necessary archaeological signals of volcanism, migration and material change appear to also be present in the Samoan Islands, evidenced in Section 4 of this work.

This dissertation tested the archaeological record of four multi component sites within the Samoan Archipelago to gain an understanding of the degree to which new information meshes with generally accepted models of Polynesian cultural transformation. The radiocarbon evidence for the timeline of pottery production, obsidian use and basalt tool production at these habitation sites appear to illustrate a very different story to that of gradual cultural evolution via an Ancestral Polynesian Society. The presence of what appears to be two discrete colonizing events, ca. 2700 B.P. and ca. 1200 B.P. may break the ancestral connection between Melanesian pottery makers

associated with the Lapita complex and Polynesians present throughout the archipelago today. Anita Smith (2002) first identified the fact that the archaeological record of Polynesia does not support the consensus model for the role of Lapita colonists as Polynesian Ancestors. A loosely modeled hypothesis of cultural replacement for Samoa was recently published by Addison and Matisoo-Smith (2010) yet did not provide new archaeological data. New archaeological data provided in this study fail to provide evidence for persistent population growth and gradual change technological change through experimentation or shifting cultural values (Kirch and Green 2001).

As Janet Davidson (1977) noted, why would such a rich, powerful and complex Lapita colonizing culture choose to “unlearn” a tradition of pottery production that had lasted on Tutuila Island for approximately 1300 years prior? The conclusion given by the research presented here is that residents during the Monument Building Period did not forget anything about pottery production. The population that took hold in the Samoan islands after reoccupation ca. 1200 B.P. did not bring a tradition of ceramic production to the islands.

We are looking at two separate groups, as signified by the presence of multi-component sites across the archipelago that repeatedly fail to exhibit the assemblages needed to form a link between ancestral and descendant communities. On one end we have a culture associated with an initial pottery making group that had ties to Fijian and early Tongan lifeways and on the other we have a population that had no cultural identity instilled within pottery use or volcanic glass procurement. The research presented here is but a start and results in more questions than answers.

5.2.1 Has the Evolutionary Approach Been Applied Correctly?

In discussing the development of stratification in Polynesia, Kirch argues that there was no standard progression but rather that social organization on the various islands is "best seen as a series of sometimes parallel or convergent, sometimes divergent, historical trajectories, all ultimately springing from the common basis of Ancestral Polynesia Culture" (Kirch 2000). In this statement Kirch (2000) is referring to the problem of seeing the rise of complex chiefdoms as the result of a unilinear model of evolution as initially posed by Sahlins (1958) and Goldman (1970). Initial thoughts by Sahlins defined the level of complexity within Polynesian societies as being the product of specific island landscapes. For instance, the smallest-scale societies inhabited the small atolls and sustained minimal populations. The largest and most complex social groups were at the pinnacle of achievement with multiple levels of social stratification as the result of their relationship with a bountiful natural environment. In this model the amount of workable land or available resources created differentiation between those that produced (non-chiefs) and those that distributed (chiefs). More resources equaled more opportunity for social stratification to be exhibited.

Goldman, on the other hand, stressed that social differentiation within Polynesian communities was the result of status rivalry. From this perspective he formed three distinct types of political structures. In "Traditional" societies seniority was central and senior descendants established rank through control of mana, or spiritual power (Goldman 1970). In "Open" systems, seniority was modified to allow military or

political contingents to govern decision-making. In societies such as this social differentiation is less graded and sharper distinctions rest between ranked individuals. The last system is defined as “Stratified” and is defined by clear-cut and socially maintained distinctions on social class. These social distinctions are both political and economic, such that differential access to resources creates disparate suites of material goods that flow through each successive social rank. Still, each of these systems had their own noted environments across Polynesia, and both authors were in agreement that no form of island society could cross the threshold of “primitive society itself” (Sahlins 1972:148).

In his discussion of the rise of sociopolitical structures and social differentiation Kirch (2000) chooses to dismiss the unilinear and ecological models of cultural evolution and views the variability inherent within Polynesian political organization systems as the result of convergent, divergent and parallel historical trajectories. This understanding frees anthropological thought from concepts of strict environmental determinism and allows for the cultural part of human behavior (i.e. interaction, seclusion) to guide cultural variation within and between Polynesian archipelagos. For example, similarities in linguistic patterns between Monument Building period Samoa and Tonga likely took form through similar ancestry (likely post ca. 1500 B.P.) with some level of regional isolation or cultural identity promoting differentiation in vocabulary and material morphology.

On the notion that innovation and affinity between and within Polynesian societies is guided by assorted degrees of isolation and interaction, I agree with Kirch.

Diverse histories of technological and sociopolitical choices will uniquely shape those things learned, shared and made ... what we have come to define as culture. Of course a discrete suite of behavioral traits becomes wonderfully blurred within a few generations of outside interaction. Lest we forget that culture is a dynamic entity created by those who operate within the bounds of a shared knowledge base and is composed of harder and softer components, all of which are apt to change at different rates through time or necessity.

To document the "historical trajectory" for the development of stratification in Samoa would fill a multi-volume dissertation. That being said, I will discuss the matter in the following section. The Samoa at European contact operated under a complex chiefdom level society (Kirch 2000; Kirch and Green 2001; Pearl 2004). Multiple tiers of social rank in which individuals interact vertically and laterally through economic and communal relationships signify this form of governance. This form of social and political structure redistributes the products of inter-island exchange alongside goods produced by craft specialists and non-elite labor within separate, sometimes overlapping, levels of exchange (Kahn et al. 2013). The benefit of this system is that material goods are supplied to those that require them through the direction of chiefs who orchestrate the division of labor and distribution of wealth.

5.2.2 Multiple Historical Trajectories of Samoan Islanders?

In considering the historical trajectory of the Samoan Islands we run into the problem of what appears to be a discontinuous record of occupation with divergent forms of sociopolitical organization and associated material goods separated by a period of minimal residential activity. Specifically, the early component (ca. 2800-1500 B.P.) includes pottery, volcanic glass, one piece fish hooks and plano-convex adze forms while a later component (ca. 1200 B.P.) includes no pottery, no volcanic glass, a wide range of two piece fish hooks and triangular adze forms to the exclusion of earlier plano-convex types (Smith 2002). A hiatus in occupation is exhibited at Vainu'u and Matautia, and in both cases this break is expressed by thick layers of volcanic sediment. At Aganoa and To'aga, thick windblown sand dune deposits separate chronologically discrete occupation events. The suite of new dates provided in this study illustrate a period of reduced landscape use ca. 1500-1,250 B.P. (see Section 4) and support the findings of Reith and Hunt (2008), who argue archaeologists have put an unfounded level of social importance on the Samoan Dark Ages as a formative period.

As illustrated in this work, the stratified occupation components of Late Eastern Lapita age and Monument Building deposits cannot not be linked together as ancestor and descendant communities as there are no signals of cultural activity or significant cultural material links between the deposits to suggest a continuous record of landscape use. Rather, archaeological sites that contain the remains of ceramic period and Monument Building Period occupation are generally separated in time by a century at

least and exhibit significant differences in raw material procurement strategies and subsistence practices.

The full significance of this pattern is currently under further investigation. However, at first blush the archaeological record of the Samoan Islands suggests that a socio-political composition unlike that of the previous two thousand years of occupation appears ca. 1000 B.P. The presence of large monumental architecture about the landscape suggests coordinated labor under the guidance of regional leaders (Herdrich 1991; Pearl 2004, 2006). Large lines of boulders that run from the coast the mountain crest suggest the division of political boundaries and terraced villages with specialized architecture at the topmost levels suggests the observance of social rank within habitation sites. These are attributes unmarked in currently known deposits dating prior to ca. 1000 B.P.. (Clark 1989; Clark and Herdrich 1988; Pearl 2004, 2006; Welch 2009).

There is a sparse distribution of archaeological evidence of “aceramic” activity during the Dark Ages ca. 1500-1200 B.P., yet there is scant notice of the kinds of coordinated effort or shared intentionality that is so prevalent for over one thousand years prior. Archaeological deposits during the Dark Age period are typically shell middens and small flake scatters, the type of behavior associated with mobile marine foraging and exploration by small groups (Kirch and Hunt 1993). By ca. 700 B.P. evidence of warfare with neighboring Tonga is exhibited in oral traditions and correlates well with radiocarbon evidence and the construction of highland defensive structures such as trenches, walls, pits and observation platforms (Clark 1989; Herdrich 1991; Pearl 2004, 2006; Welch 2009). The archipelago-wide pattern of interconnected

mountaintop villages and defensive architecture at this time suggests a higher level of regional alliance within the Samoan islands, perhaps prompted by the Tongan invasion starting ca. 700 B.P.. Ethnographic evidence suggests that chiefly sport was taking place within late prehistory and into historic times in the form of pigeon snaring. Specialized sport in this case further illustrates class differentiation and the use of public displays to symbolize social order. Archaeological evidence for the timing of pigeon snaring platforms suggests initial mounds were built ca. 500 B.P.. Limited archaeological evidence suggests relative stability in terms of social organization until the next period of convergence that occurred at the onset of European contact in the 18th century.

Little information is known regarding the historical trajectory of the earliest component in the Samoan Islands. Ceramic production technology is similar in ways to that of Tonga suggesting a common ancestry prior to the discovery of Samoa. From there the two traditions diverge somewhat in terms of pottery morphology, design elements and lithic technology. Evidence provided through geochemical analysis of volcanic glass artifacts suggests mutually exclusive distribution spheres within Tonga and Samoa (Burley et al. 2011; Clark and Wright 1995; Eckert and Welch 2013; Sheppard et al. 1989; Welch 2008). Presently, more information from primary excavations is needed to assess the degree of isolation between archipelagos ca. 2800-1500 B.P..

Post ca. 1200 B.P., we can distil the material evidence so as to observe a short list of hard evidence for interaction and convergence to some degree (Davidson 2012; Weisler 1997). Geochemical studies have shown that stone adzes were dispersed from

sources in Samoa throughout the far reaches of Polynesia to the archipelagos of the Marquesas, Cook Islands, Fiji, the Tuamotu Islands and Tonga during the Monument Building period, with minimal long-distance distribution during the ceramic Period (Best et al. 1989). Exchange relationships between prehistoric residents within the Samoan complex chiefdom ca. 1000-250 B.P. would have handled items native to Samoa while being exposed, in various degrees of intensity, to the behaviors and material goods local to the Cook Islands, the Marquesas, the Tongan Empire, Fiji, and the Tuamotus. All of these social relations likely formed the Samoa encountered by Europeans at contact.

As archaeological evidence presented in this study suggests a chronological, political and economic disconnect between ceramic making populations and aceramic inhabitants, it is difficult to draw a line between two entities with a single historical trajectory. As earlier populations are potentially unrelated to later social groups in the Samoan Islands, connecting the two forms of social organization into a pattern of an egalitarianism or big-man society shifting towards marked social stratification ca. 1000 B.P. would be in error. New evidence from future investigations that are specifically tailored to address this issue will offer valuable information as to the possibility that the distinct forms of social organization within the Samoan Islands represents two separate ways of living on the same set of islands by two distinct cultural groups before and after population replacement.

5.2.3 What Items of Material Culture Bridge the Ceramic/Aceramic Gap?

Anita Smith (2002) notes that there is a flaw in using pottery to infer the rise of an ancestral population, as the technology does not exist at all during the later Monument Building Period and therefore cannot operate as a suitable marker of cultural transmission into the MB.P. via APS. The research presented in Section 4 shows that obsidian procurement also halts at the end of the Ceramic Period, so that fact precludes us from using that raw material to infer population continuity or similarities in cultural identity. Basalt, however, was used during both the ceramic and aceramic periods for stone adzes, scrapers and expedient flake tools. Perhaps there are similarities or differences that can help to clarify the problem of cultural transformation or cultural hiatus in Samoa. The following section will summarize the findings from formal tool analyses within the multi-component sites under study in this dissertation. Formal tools offer a relevant avenue to examine potential change in traditional approaches to tool manufacture as significantly more time was put into shaping formal tools as opposed to expedient flake tools.

The study of prehistoric lithic technology has the potential to provide both useful and problematic data. As in any field of research, problems accompany success as hypotheses are created, tested, weighed and retested in an endeavor to achieve a clearer understanding of past human behavior. No, there is not a 1:1 ratio between the shape of a stone tool and social identity or temporal range. While at times the morphology of a tool or set of tools may help as a guideline as to time period of affinity, the ever-present

phenomenon of multiple stable equilibria serves to remind us that prehistoric social identity or group affiliation cannot be surmised by stone tools alone. This being said, patterning in the morphology of tool types between temporal units often gives us a clue as to different traditions of shaping stone to overcome environmental challenges or display social identity. Discrete tool morphologies between occupation periods in a given setting may be a signal of divergent ways of teaching and learning...the foundation of what perpetuates a cultural identity. Manuscript 3 discusses how new cultural identities are visible in Papua New Guinea and Fiji as the result of migration and replacement in response to volcanic activity. I suggest that a population replacement model is also valid in the Samoan Islands and is apparent in the archaeological record of multi-component sites.

5.2.4 Why Variability in Tool Form?

A brief review of how and why tool types change is necessary here as variability in tool form such as the shift from plano-convex stone adzes to triangular forms (Manuscript 1), the cessation of pottery (Manuscript 2) and raw material procurement changes (Manuscript 3) is the basis of measuring cultural affinity between Lapita colonizers and later Polynesian communities in this dissertation. Shiffer and Skibo (1997) suggest that formal variability is caused by artisans (individuals) as they execute different sequences of material procurement and manufacture. This encompasses concepts of adaptations to small material package size, mobility strategies, material

distribution spheres and culturally learned modes of tool production. Individual approaches to the manufacture, maintenance and discard of stone tools are all technological choices and follow a line of succession from raw material choice, tool production strategies, tool maintenance styles and patterns of tool discard. The available approaches to shaping stone for use as a tool are the result of learned behavior from parents and other teachers (vertical and horizontal transmission) or by learning on one's own (environmental learning). The term "choice" is used here to denote the fact that during each activity (or suite of activities) there are multiple potential options available as alternatives. The resulting archaeological artifact or suite of similarly formed artifacts within an assemblage is the result of a set of choices or activities made by individuals, often as the product of learned behaviors. Activities are defined as patterned interactions between elements (elements being people, artifacts, animals, cultigens, etc.).

Formal variability, as forwarded by Shiffer and Skibo (1997) is the result of differential technological choices. These technological choices may be affected by a number of variables, cultural or environmental. A feedback loop exists in the procurement, production and use chain of events that affects how items look and how they are used. For instance, a technical choice may affect the performance of a tool and offers feedback to the individual regarding the viability of that approach on that raw material. Artifact design (i.e. a suite of technological choices) is based on trade-offs or compromises in artifact performance, targeted use and material availability.

These collective understandings of how and when to implement specific technological choices are, to me, what encompasses a cultural approach to stone tool

production, a stone tool tradition in other words. Perhaps “lithic technological tradition” is an acceptable term for a recognizable suite of technological strategies used in a discrete region during a specific time, what others may define as lithic “cultures”.

Confusion may exist as to the nature of tool traditions and “culture” to those that wish to implement a study of stone tool within their own research. A stone tool assemblage recovered from a discrete activity surface represents the suite of technological choices used to perform specific tasks at hand by those using the space. Stone tool assemblages are not cultures in and of themselves, but are rather one element of a larger behavioral motif that is the combined result of all information learned from previous generations within and between interacting individuals and social groups.

If certain traditions are archaeologically recognizable and fulfill the definition of *an element* of culture (a suite of behavioral traits passed down through successive generations), what might happen over time, seasonally for instance to the distribution of specific tool forms? Culture is of course not a static object, but rather a constantly changing and adaptive social structure. Lithic analyses offer archaeological insight into prehistoric culture, yes, but each excavated deposit is only the discarded remnants of a suite of remembered behaviors, any of which have the potential to be employed at any time.

What might a cultural hiatus look like in the archaeological record of stone tool use on Tutuila Island? Multiple possibilities exist. For instance we could model that initial culture A has an assemblage of tools that is completely different from replacement population B. More likely, perhaps there are only subtle differences that are focused

around a core suite of relatively similar tool forms between two Oceanic colonizing communities. On the opposite end of the spectrum we could model that all tools are the same between initial population A and replacement population B because both have parallel trajectories of experimentation and technological adaptation.

Large-scale alteration in the archaeological record of tool manufacture, such as sudden disappearances of distinctive local tool shapes and the substitution of previously unseen tool forms have been successfully shown to signal the advent of new cultural traditions (Parr et al. 2009; Torrence 2011). If, after a period of reduced population density in a region, a substitution of distinctive localized tool forms and distribution networks takes place, then a cultural hiatus model might be a strong framework to move forward with. This line of reasoning is similar in logic to successful works with obsidian implements by Torrence and colleagues in Papua New Guinea (Parr et al. 2009; Torrence 2011). A lack of significant change within Samoan basalt adzes during the ceramic period is illustrated by Smith (2002) where she questions the evidence for the rise of a definable Ancestral Polynesian culture in the Samoan Islands, ca. 2400 B.P.. Here I have moved forward in time by approximately one thousand years and have asked the same question of the sites described in this study: is there evidence during the Samoan Dark Ages, and after 1500 B.P., during the Monument Building Period to suggest a cultural connection to initial Lapita colonists?

The artifact record at Aganoa, Vainu'u, Matautia and To'aga indicate that residents during the Monument Building Period did not see pottery as important enough to pursue the technology, although pottery manufacture was prevalent in Fiji to the

northwest. Nor did this aceramic community distribute obsidian, a hallmark practice of those living on the same islands prior to 1500 B.P.. An examination of the formal basalt tools from Vainu'u, Aganoa, To'aga and the Pava'ia'i show discontinuity in type V adzes and replacement by triangular types IV and IIV between the Ceramic period (ca. 2,700-1500 B.P.) and Monument Building Period components (ca. 1,200-250 B.P.).

5.3 CULTURAL TRANSFORMATION OR CULTURAL HIATUS?

The hypothesis of gradual cultural transformation built on the Phylogenetic linguistic framework is not supported by the archaeological evidence exhibited at the sites under study in this dissertation. The fact that four multi-component sites do not fit the consensus model for cultural transformation in the Samoan Islands forces us to reconsider the ancestor-descendant relationship of the Lapita-only model. Evidence of late Holocene volcanism between two occupation periods with different material culture and sociopolitical organization seems to point more toward an abandonment/replacement scenario rather than continuous residence and gradual change. This research compliments that of Anita Smith (2002) where she identified the problematic nature of observing material evidence for the rise of an Ancestral Polynesian Society ca. 2400 B.P. The findings of this test agree with Smith (2002) and strengthen the argument that we cannot identify archaeological patterning in those items that survive within archaeological contexts to confidently assert that a transformed Lapita community

remained within the islands with a population density high enough to effect the technological choices of the later aceramic complex chiefdom society.

The work described in this study within the Pava'i'ai valley at Matautia and Vainu'u offers strong evidence for regional abandonment due to intense volcanic activity at the same time that pottery production and obsidian use halts across Tutuila Island. Unique basalt tool types, specifically plano-convex adze types also disappear and are replaced by a new triangular group of tools. Recent findings from Matautia confirm the evidence from Vainu'u and suggest that a major eruption covered western Tutuila ca. 1500 cal. B.P. Below the thickly bedded ash there exist pottery, plano-convex stone adzes and obsidian, and above the ash a completely new way of tailoring raw materials to suit the natural and socially constructed environment.

My study has shown that 'Aoa, the one site that hinted at a cultural link has been reorganized through natural processes and has gained a false appearance of late pottery production and volcanic glass use. Currently there is not a single site within the archipelago that offers securely stratified archaeological evidence of transmitted cultural knowledge about pottery production, obsidian procurement or distinctive basalt tool types between the two behavioral periods.

The findings from Aganoa, Vainu'u and To'aga offer important details regarding the chronology of obsidian use. Obsidian in the Oceanic world, as in other places, held special significance to pottery producing communities (Clark and Michlovic 1996; Kirch and Green 2001; Torrence 2011; Welch 2013). The act of travel and gifting perpetuated social ties to distant places and maintained connections that allowed places to stay,

people to form families with and alliances during strife (Torrence 2011). The radiocarbon evidence associated with obsidian at Vainu'u, Aganoa and To'aga indicates that the practice of obsidian procurement and distribution stopped concurrently with the 1500 B.P. volcanic events. Pottery production, food preparation, residential structures...all things that suggest habitation also disappear. On any other island, as illustrated by research in Fiji and Papua New Guinea (Kononenko et al. 2010; Parr et al. 2009; Torrence 2011), the obvious and correct conclusion would be abandonment or large-scale exodus with renewed occupation by a new or transformed colonizing population. Yet, because the phylogenetic model labels Samoa as the birthplace of Polynesian cultural traditions, the accepted culture history maintains that people must not have left, but rather forgot everything about who they once were and stayed on an island demolished by natural disaster without leaving a significant archaeological footprint for three hundred years, then decided it was time to start building monuments.

When the archaeological record is used, first, as prompted by Anita Smith (2002) to better understand prehistoric behavior on Tutuila Island, rather than lexico reconstruction, the sites considered in this study fail to compliment the Phylogenetic model. The findings contained within this work suggest that Samoan sites oppose the role of an Ancestral Polynesian society and cannot support the consensus of constant occupation and gradual cultural evolution within a single colonizing population. Material change, late Holocene volcanism and centuries-long gaps in residential activity best represent a scenario of population replacement between the Ceramic period and the Monument Building. The fact that multiple sites do not agree with the dominant

viewpoint for Lapita ancestry in Polynesia forces us to reconsider the modeled culture history. Further work considering the extent of volcanic disturbances and the chronology of material change will no doubt continue to offer valuable information to the study of prehistoric Samoa.

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