STYLE VS. SUBSTANCE:
UNDERSTANDING PREHISTORIC SAMOAN
POTTERY PRODUCTION ON THE ISLAND OF
'UPOLU USING STYLISTIC AND CHEMICAL
TECHNIQUES

BENJAMIN TEELE

A thesis submitted for the degree of Master of Arts
at the University of Otago, Dunedin, New Zealand

December 2011
Abstract:

This study focused on prehistoric pottery production patterns in the Lapita and plainware periods from the islands of ‘Upolu and Manono, Samoa. Incorporating a holistic approach to excavated pottery assemblages, stylistic, temper and clay analysis was undertaken to identify whether initial production technology matched a larger regional signature and to test how production strategies changed through the plainware phase.

Ceramics were sampled from Auckland War Memorial museum collections of five previously excavated sites. This encompassed the only known Lapita site of Mulifanua, as well as a range of temporally and geographically distinct plainware sites located along the north coast of Manono and ‘Upolu. A combination of stylistic and physico-chemical techniques were undertaken to determine the full range of production variation present in Samoan ceramics. Stylistic analysis is a common method on Lapita assemblages, providing insight into distinctive cultural markers and regional cultural suites. This technique is, however, limited on plainware assemblages due to restricted vessel forms and an almost complete absence of decoration. Therefore, chemical analysis was undertaken using an electron microprobe on the temper and clay components of 149 sherds to produce data on production patterns associated with the plainware and Lapita phases.

The results of the stylistic analysis confirm a lack of distinctive features on plainware pottery, and argue against the thin/thick ware division established for pottery assemblages in the archipelago. Two of the plainware sites, Falemoa and Jane’s Camp show strong similarities in forms of decoration to the only known Samoan Lapita site of Mulifanua. A red decorative slip is recorded from these three sites, matching similar descriptions from assemblages on other islands within the archipelago and further afield. The presence of a carinated vessel from Jane’s Camp suggests continuity in vessel forms between Lapita and early plainware sites. Early or transitional plainware sites might therefore be characterised by more diverse vessel forms than is currently established.
The results of the chemical analysis indicate that almost all pottery was produced locally, with the number of resource procurement zones declining over time and a change in production techniques. Initial production utilised a variety of sources, most centred on the coast. Through the plainware period the focus shifts towards inland sources, with pottery produced at the end of the sequence from Saso’a showing a marked change to local trachytic tempers. The homogeneous nature of ‘Upolu makes differentiating clay sources difficult, but they appear to match a pattern of local production.

This research shows how production patterns for initial ‘Upolu settlement were established, including the plainware period, an area currently understudied in Pacific archaeology. Initial colonisation by a Lapita people at Mulifanua was shown to be reflective of a larger regional colonising strategy, utilising the same production technologies and stylistic elements. There appears to be strong continuity in pottery production between the Lapita colonisers and the subsequent plainware settlements. Pottery production is local, with vessels becoming thicker and more heavily tempered over time, suggesting either changes to resource access or the exhaustion of quality clays. Overall production patterns for the two islands match previous work undertaken from other islands in the archipelago. This research provided a key quantifiable dataset and offers the opportunity to further expand prehistoric ceramic studies from Samoa. This thesis has shown continuity in pottery production between Lapita and plainware phases, and suggests the Samoan identity is descendant from the first people to colonise its islands.
ACKNOWLEDGEMENTS:

I would like to first thank my supervisors. Professor Glenn Summerhayes for encouraging me to work on the Samoan material and his positive enthusiasm, even when things looked grim. For looking over drafts and pointing out the problems. Professor Alan Cooper for tolerating simple geological questions and helping me through the intricate art of mineral identification.

Thanks must also go to staff of the archaeology, geology and mathematics & statistics departments at the University of Otago. Phil Latham for putting up with my constant requests and helping me figure out how to get the most out of my pottery in the lab. Brent Pooley, for getting me sorted in the unfamiliar geological laboratories, and trusting that I wouldn't break the valuable equipment. Andreas Auer for training me on the use of the microprobe, helping with technical problems, and not getting frustrated at my constant geological queries. Brian Niven for taking the time to go through statistical techniques and testing innovative applications to archaeological data.

Heartfelt thanks must go to those working at the Auckland War Memorial Museum and the University of Samoa, who lent me access to the assemblages and giving me the space to work.

I received funding from both the University of Otago Department of Anthropology, allowing me to visit the Auckland War Memorial Museum and the University of Otago Postgraduate Award, which led me to achieve this research.

A final thank you must go to my friends and family. To Kirsty Potts, Tristan Wadsworth, Cathleen Hauman and others of PARC, thank you for reading chapters, telling me straight that things needed work, and for putting up with my constant babble about why ceramics are the best. To my family, for their encouragement and interest in my work. And last but not least to Rebecca, whose patience and tolerance in the face of my crazy archaeological problems helped me figure out the solution.
TABLE OF CONTENTS:

ABSTRACT ......................................................................................................................... II
ACKNOWLEDGEMENTS ................................................................................................. IV
LIST OF TABLES ............................................................................................................... IX
LIST OF FIGURES ........................................................................................................... X
LIST OF TERMS .............................................................................................................. XIII

CHAPTER 1: INTRODUCTION .......................................................................................... 1
  1.1 RESEARCH OBJECTIVES.......................................................................................... 2
  1.2 CHRONOLOGY OF WESTERN POLynesia (Tonga and Samoa)................................. 3
  1.3 WHAT IS LAPITA? ..................................................................................................... 4
  1.4 LAPITA IN SAMOA .................................................................................................. 4
  1.5 PLAINWARE SEQUENCE IN SAMOA ...................................................................... 5
  1.6 PRODUCTION STUDIES IN THE PACIFIC ............................................................... 7
  1.7 RESEARCH OUTLINE .............................................................................................. 9
  1.8 THESIS OUTLINE: ................................................................................................. 10

CHAPTER 2: MODELS AND ISSUES IN SAMOAN PREHISTORY ............................... 12
  2.1 INTRODUCTION TO MOBILITY AND CERAMIC STUDIES FOR FIJI/WEST POLynesIA ................................................................. 12
  2.2 CONTEXT OF SAMOAN SETTLEMENT ................................................................ 14
    2.2.1 Lapita colonisation ............................................................................................... 14
    2.2.2 Lapita dispersal into Remote Oceania ................................................................. 15
    2.2.3 Lapita exchange and interaction ......................................................................... 19
    2.2.4 Cultural transition - continuity or discontinuity? ............................................... 21
    2.2.5 Defining an Ancestral Polynesian Society ......................................................... 25
  2.3 SETTLEMENT PATTERNS IN FIJI/WEST POLynesIA ........................................... 29
    2.3.1 Colonisation of Remote Oceania ....................................................................... 29
    2.3.2 The Issue of Subsistence .................................................................................... 30
  2.4 FIJI/WEST POLynesIA POTTERY ......................................................................... 32
    2.4.1 Form and function ............................................................................................. 32
    2.4.2 Production .......................................................................................................... 32
    2.4.3 Disappearance .................................................................................................... 33
    2.4.4 The Problems of Plainware ............................................................................. 35
  2.5 STYLISTIC AND PHYSICO-CHEMICAL ANALYSIS ................................................ 36
    2.5.1 Stylistic Analysis ............................................................................................... 36

V
CHAPTER 3: THE SAMOAN CONTEXT

3.1 INTRODUCTION TO THE GEOLOGY AND ARCHAEOLOGY OF 'Upolu ........................................... 42
3.2 LOCATION OF ARCHIPELAGO................................................................................................. 44
3.3 GEOLOGY OF SAMOA............................................................................................................... 45
  3.3.1 Temper ............................................................................................................................... 47
  3.3.2 Clay................................................................................................................................... 47
3.4 SAMOAN SETTLEMENT PATTERNS ..................................................................................... 49
3.5 MAJOR EXCAVATIONS OF LAPITA AND Plainware SITES IN SAMOA .............................. 54
  3.5.1 Excavations on 'Upolu 1950s............................................................................................ 54
  3.5.2 Excavations on 'Upolu 1960s............................................................................................ 55
  3.5.3 Excavations on 'Upolu 1970s............................................................................................ 56
  3.5.4 Excavations on Ofu in the 1980s....................................................................................... 57
  3.5.5 Excavations on Tutuila 1980s............................................................................................ 58
  3.5.6 Excavations on Tutuila 2000s............................................................................................ 60
  3.5.7 Excavations on Savai'i 2000s............................................................................................. 60
3.6 RADIOCARBON CHRONOLOGIES............................................................................................. 61
3.7 SELECTED LAPITA AND Plainware SITES.............................................................................. 63
  3.7.1 Mulifanua......................................................................................................................... 63
  3.7.2 Falemoa (SM17-2): .......................................................................................................... 65
  3.7.3 Jane's Camp (Faleasi'u)(SUFL-1): .................................................................................. 68
  3.7.4 Vailele (SU-Va-1)(SU-Va-4): .......................................................................................... 70
  3.7.5 Sasoa'a (SU-SA-3): ........................................................................................................ 76
3.8 SUMMARY ............................................................................................................................. 80

CHAPTER 4: METHODOLOGY ........................................................................................................ 81
4.1 METHOD OVERVIEW .............................................................................................................. 81
4.2 SAMPLING STRATEGY ............................................................................................................ 83
4.3 STYLISTIC ANALYSIS ........................................................................................................... 84
4.4 TEMPER ANALYSIS-BINOCULAR DETERMINATIONS .......................................................... 86
  4.4.1 Statistical tests for stylistic analysis .................................................................................. 88
4.5 CHEMICAL ANALYSIS ......................................................................................................... 90
  4.5.1 Multivariate statistical techniques for chemical analysis .................................................. 93
LIST OF TABLES:

Table 4.1: Summary of sherd numbers examined and analysed by site (note * denotes partial access to excavated assemblages) ........................................................................................................... 83

Table 4.2: The division of temper groups with image of clay matrix at 15x magnification and description based on Petchey (1995) and Dickinson (2006) ............................................................................... 87

Table 4.3: Temper groups identified by site using binocular determinations, confirmed with chemical analysis ..................................................................................................................................... 92

Table 5.1: Summary of vessel forms by site ......................................................................................................................... 103

Table 5.2: Early Samoan ceramic vessel forms .................................................................................................................. 103

Table 5.3: Post-Lapita Samoan ceramic vessel forms ....................................................................................................... 104

Table 5.4: Rim profiles from Lapita and plainware assemblages from 'Upolu, Samoa ..................................................... 105

Table 5.5: Presence or absence of decoration in Lapita and plainware assemblages from 'Upolu, Samoa .................................................................................................................................................. 105

Table 5.6: Mineral inclusions present in temper group 1A ................................................................................................. 112

Table 5.7: Mineral inclusions present in temper group 1B ............................................................................................... 113

Table 5.8: Mineral inclusions present in temper group 1C ............................................................................................... 113

Table 5.9: Mineral inclusions present in temper group 3 ............................................................................................... 114

Table 5.10: Mineral inclusions present in temper group 4 ............................................................................................. 115

Table 5.11: Mineral inclusions present in temper group 5 ............................................................................................. 115

Table 5.12: Mineral inclusions present in temper group 6 ............................................................................................. 116

Table 5.13: Composition of CPCRU’s based on temper type and the number of production centres .................................................................................................................................................. 117

Table 5.14: Post Hoc Sheffe Test displaying statistical difference between temper groups based on sherd thickness (bolded values are significantly different) ........................................................................... 118

Table 5.15: Post Hoc Sheffe Test displaying statistical difference between temper groups based on temper density (bolded values are significantly different) ................................................................ 119
LIST OF FIGURES:

FIGURE 1.1: Map showing main islands in Samoan Archipelago ........................................................................ 2
FIGURE 1.2: Cultural chronology for West Polynesia (Tonga and Samoa) ...................................................... 3
FIGURE 2.1: Map showing Lapita geographical divisions of Far Western (Early), Western (Middle), Southern (Middle) and Eastern (Late) Lapita ................................................................................... 15
FIGURE 2.2: Map showing division between Near and Remote Oceania .......................................................... 16
FIGURE 2.3: Map showing suggested zone of delayed Lapita settlement in Northern Tonga and Samoa ................................................................................................................................. 17
FIGURE 2.4: Map showing likely and possible island locations of an Ancestral Polynesian Homeland ................................................................................................................................................ 28
FIGURE 3.1: Map showing main islands in Samoan Archipelago ...................................................................... 44
FIGURE 3.2: Map of ‘Upolū and surrounding offshore islands showing location of volcanic flows (redrawn from Wright, 1963) .................................................................................................. 48
FIGURE 3.3: Map showing general distributions of four main classes of ceramic temper sands (redrawn from Dickinson and Shutler Jr, 1979: 993) ............................................................. 47
FIGURE 3.4: Reconstructed shoreline of ‘Upolū at 2,700 years ago as predicted from marine topography and theories of general subsidence (a) for northwest and central coast, (b) for the embayments of Safata, Falealili, Aleipata and Fagaloa. Locations number 2 to 12 and ? indicate probable or possible Lapita sites. Number 1 is the Mulifanua – Lapita Ferry Berth Site (from Green, 2002) ................................................................................................................................ 49
FIGURE 3.5: Map showing known locations of ceramic finds on ‘Upolū .......................................................... 50
FIGURE 3.6: Map showing known locations of ceramic finds on Savai‘i ......................................................................................................................................................................................... 51
FIGURE 3.7: Map showing known locations of ceramic finds on Tutuila .......................................................... 52
FIGURE 3.8: Map showing known locations of ceramic finds in the Manu‘a Islands of Ofu, Ofosega and T‘au (redrawn from Green, 2002) ....................................................................................... 53
FIGURE 3.9: South face of cutting II, SU-Va-1, Vailie, ‘Upolū, excavated by Golson in 1957 (redrawn from Golson, 1969b) ............................................................................................................ 55
FIGURE 3.10: Map showing location of To’āga excavations at Site AS-13-1 on the island of Ofu (redrawn from Kirch and Hunt, 1993a) ................................................................................................. 57
FIGURE 3.11: Map showing location of ‘Aoa excavations at Site AS-21-5 on the island of Tutuila (redrawn from Clark and Michlonic, 1996) ...................................................................................... 59
FIGURE 3.12: Chart of radiocarbon dates from key ‘Upolū and Manono sites (note * denotes unsecure date as determined by Rieth’s (2007) chronometric hygiene measures, all dates calibrated 2σ) ....................................................................................................................................... 62
FIGURE 3.13: Map showing location of five major Lapita and plainware sites on ‘Upolū and Manono in relation to topography (PIA11966: Independent State of Samoa, Shaded Relief and Colored Height, 2009) ........................................................................................................ 63
Figure 3.14: Map showing general location of the Mulifanua site, which was located underwater during the construction of the ferry berth terminal (redrawn from Green, 2002).............64
Figure 3.15: Map showing location of Falemoa excavations at Site SM17-2 on the island of Manono (redrawn from Lohse, 1980).................................................................66
Figure 3.16: Schematic cross section of strata observed during the Falemoa Excavation. No Scale; degree of seaward slope exaggerated (redrawn from Lohse, 1980).................................67
Figure 3.17: Map showing location of Jane’s Camp excavations at Site SUFL-1 on the island of ‘Upolu (redrawn from Smith, 1976b).................................................................68
Figure 3.18: Cross-section drawings of stratigraphy at Jane’s Camp (redrawn from Smith, 1976b)..........................................................................................................................70
Figure 3.19: Map showing location of Vailele excavations at Site SU-VA-1 on the island of ‘Upolu (redrawn from Green, 1969b).................................................................71
Figure 3.20: Map showing location of Vailele excavations at Site SU-VA-4 on the island of ‘Upolu (redrawn from Terrell, 1969).................................................................71
Figure 3.21: Chart of early radiocarbon dates for Vailele excavations in relation to those from SU-VA-4 (redrawn from Terrell, 1969). .................................................................72
Figure 3.22: Cross-section along south face of bulldozer cutting, SU-VA-1 (redrawn from Green, 1969b).............................................................................................................74
Figure 3.23: Cross-section of east face of bulldozer cut, SU-VA-4 (from Terrell, 1969)........75
Figure 3.24: Site plan of SU-SA-3 showing excavated area (from McKinlay, 1974)..................76
Figure 3.25: Principal cross-sections, SU-SA-3 (from Green, 1974b).....................................79
Figure 5.1: Photographs of sherds showing surface characteristics.......................................107
Figure 5.2: Range of sherd thickness from all five sites. Mean = 8.79 (SD = 2.62), N = 405........108
Figure 5.3: Range of sherd thickness from Saso’a’a. Mean = 8.45 (SD = 2.66), N = 134.............109
Figure 5.4: Range of sherd thickness from Mulifanua. Mean = 8.14 (SD = 2.31), N = 169...........109
Figure 5.5: Range of sherd thickness from Vailele. Mean = 10.66 (SD = 2.25), N = 76................110
Figure 5.6: Average vessel thickness classed by temper group................................................118
Figure 5.7: Average temper density classed by temper group................................................119
Figure 5.8: Results of Chi-Squared Test showing counts and expected counts by temper group for (a) temper size 1, (b) temper size 2, (c) temper size 3 (Wentworth Scale) ..............121
Figure 5.9: Graph of results of Chi-Squared Test showing counts and expected counts of temper group for (a) Layer 5 and (b) Layer 4.................................................................123
Figure 5.10: Graph of results of a Chi-Squared Test showing counts and expected counts of temper groups (a) without decoration and (b) with decoration.......................................125
Figure 5.11: Scatter plot showing PCA components 1 (Z1) and 2 (Z2) for Falemoa, Jane’s Camp, Mulifanua, Saso’a’a and Vailele .................................................................127
Figure 5.12: Scatter plot showing PCA components 1 (Z1) and 3 (Z3) for Falemoa, Jane’s Camp, Mulifanua, Saso’a’a and Vailele .................................................................128
Figure 5.13: Scatter plot showing PCA components 2 (Z2) and 3 (Z3) for Falemoa, Jane’s Camp, Mulifanua, Saso’a’a and Vailele .................................................................129
Figure 5.14: Scatter plot showing PCA components 1 (Z₁) and 2 (Z₂) for Falemoa, Jane’s Camp, Sasoa’a and Vailele ................................................................. 130

Figure 5.15: Scatter plot showing PCA components 1 (Z₁) and 3 (Z₃) for Falemoa, Jane’s Camp, Sasoa’a and Vailele ................................................................. 131

Figure 5.16: Scatter plot showing PCA components 2 (Z₂) and 3 (Z₃) for Falemoa, Jane’s Camp, Sasoa’a and Vailele ................................................................. 132

Figure 5.17: Scatter plot showing PCA components 1 (Z₁) and 2 (Z₂) for Falemoa, Jane’s Camp and Mulifanua ................................................................. 133

Figure 5.18: Scatter plot showing PCA components 1 (Z₁) and 3 (Z₃) for Falemoa, Jane’s Camp and Mulifanua ................................................................. 134

Figure 5.19: Discriminant function analysis of five sites ................................................................. 135

Figure 5.20: Discriminant function analysis of temper groups ................................................................. 136
**LIST OF TERMS:**

Ceramic: a general term for all objects made from a dominantly silicate material which have been transformed in physical state by heat (firing).

Clay (potter's): the basic ingredient in ceramic manufacture composed of plastic particles (clay) and natural non-plastic grains (temper/inclusions). Particles less than 2 µm (micrometres) diameter are considered to be clays.

Temper: Non-plastic inclusions naturally found or added to clay to reduce plasticity

Plainware: Pottery with minimal forms of decoration, considered the key characteristic of the period after Lapita settlement on Samoa and Tonga.

Lapita: A group of people who colonised the islands of the Pacific from Papua New Guinea to Samoa. Characterised by a distinctive dentate-stamping decoration found on their pottery.

Sensitivity (analytical): Primarily refers to the minimal amount of an elemental concentration that can be detected given the experimental conditions. Sensitivity will vary according to technique.

Accuracy (analytical): A statement of how close a measurement of an element is to its actual concentration in a sample.

Precision (analytical): Statement of how well we can repeat the analysis and obtain the same results.
Chapter 1
Introduction

There is a distinct lack of information on the early stages of Samoan prehistory, particularly in the seven hundred year period immediately following initial colonisation by Lapita characterised by simple, plain pottery. This plainware pottery has generally been overlooked in favour of the more distinctive, but spatially and temporally limited, Lapita pottery that signifies the earlier colonisation period of the region. Due to the simplification in the material culture suite following Samoan colonisation, restricting stylistic studies, and the lack of reliable stratigraphic provenance, archaeological analysis on the island of 'Upolu (Figure 1.1) in Samoa has been constrained to a few key studies (Golson, 1969a; Green, 1974a; Jennings, 1976a; Jennings and Holmer, 1980), which have provided only a patchy framework for early Samoan prehistory. This relatively unexplored data set presents unique opportunities to explore themes surrounding the colonisation of the Samoan archipelago, and the subsequent evolution of a Samoan identity. How such an evolution occurred is the subject of
fierce debate, and will only be determined through a multitude of future studies focusing on all facets of early Samoan culture.

1.1 Research Objectives

This thesis will focus on, and develop, one aspect of early Samoan prehistory on ‘Upolu, pottery production, inferred through physico-chemical analysis. Questions on how production changed from the initial colonisation phase through until the cessation of pottery one thousand years later need to be answered. Pottery is one of the dominant elements of early Samoan material culture. Using pottery from existing, stratigraphically reliable excavations, questions are asked on what changes in the patterns of production found in Samoa signify when related to similar processes occurring on nearby island archipelagos, as well as what these changes mean in regards to the emergence of an early Samoan culture.
1.2 Chronology of Western Polynesia (Tonga and Samoa)

Samoa is the eastern-most archipelago settled by Lapita colonisers and considered one of the key launching points for the colonisation of Eastern Polynesia. By acting as a crucial stepping-stone for the migration and movement within the Pacific, understanding Samoa's place in Pacific prehistory is important. But due to a lack of intensive archaeological research (with some exceptions), caused in no small part by the paucity of sites and poor preservation, information on almost three thousand years of Samoan culture remains limited.

The information that has been recovered from Western Polynesia has led to a five-part chronological cultural division (Figure 1.2). The two oldest periods in Western Polynesia are characterised most definably by pottery; at first based on the more complex Lapita style forms and decorations, and then subsequently the simplified undecorated 'plainware' pottery. The following period, so called the 'Dark Ages', lacks the signature pottery of the earlier periods, and the obvious monumental construction of the later. Because of the lack of archaeological material there is very little information about how Samoan and Tongan society developed during this time. The later periods are identified by monument building and historic records, and have had considerable focus from both archaeologists and historians due to ethnographic accounts from European explorers and the large, impressive star mounds associated with the development of West Polynesian cultural hierarchy (e.g. Martinsson-Wallin et al., 2007; Wallin et al., 2007).

<table>
<thead>
<tr>
<th>Period</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lapita Period (Middle to Late Lapita)</td>
<td>ca. 2,850–2500 B.P.</td>
</tr>
<tr>
<td>Plainware Period (Ancestral Polynesian Society?)</td>
<td>ca. 2500–1500 B.P. (Samoa)</td>
</tr>
<tr>
<td></td>
<td>ca. 2500–1500 B.P. (Tonga except Niuatoputapu)</td>
</tr>
<tr>
<td>Aceramic Period ('Dark Ages')</td>
<td>ca. 1500–1000 B.P.</td>
</tr>
<tr>
<td>Monument Building Period</td>
<td>ca. 1000–250 B.P.</td>
</tr>
<tr>
<td>Historic Period</td>
<td>250 B.P.-Present</td>
</tr>
</tbody>
</table>

Figure 1.2: Cultural chronology for West Polynesia (Tonga and Samoa)
Chapter 1: Introduction

1.3 What is Lapita?

Originally defined through dentate-stamped pottery (Clark and Michlovic, 1996: 51), researchers have noted that “the Lapita pottery decoration is in fact heterogeneous or variable in a manner similar to that for other aspects of the Lapita material inventory” (Green, 1979: 39). If we cannot define Lapita based on pottery alone, which also happens to be the most robust and visual marker of their spread, then what exactly do we mean when we use the term Lapita?

The elements that make up Lapita culture now include a variety of material components, settlement patterns, subsistence economies, genetics and language (Kirch, 1996: 60). This has led to a wide range of approaches to define these people or peoples (Ambrose, 1997: 527; Golson, 1971; Green, 1992: 11; Kirch, 1988b: 160; Sheppard, 2009: 1; Terrell, 1989). One of these approaches (Green, 1991: 296) suggests that Lapita’s distribution was widespread and had considerable longevity. There was a strong resistance to cultural replacement, strengthened perhaps through frequent interaction over varying distances. They brought with them a generalised economy, incorporating both maritime and horticultural components, and were thus very effective colonisers of the oceanic world.

1.4 Lapita in Samoa

The first cultural period in Samoa is represented by the colonisation of the Samoan archipelago by Lapita peoples’ around 2,800 B.P. (Petchey, 2001), but known by only one firmly established Lapita site on the island of ‘Upolu. Stylistic analysis has been undertaken on pottery from this Lapita site, which has placed it as contemporaneous or slightly later than other Lapita sites from Tonga and Fiji (Green, 1974c; Jennings, 1974; Petchey, 1995). This suggests that early Samoan colonisers originated from one of these archipelagos (Green, 1981). However, the identification of only one Lapita site has restricted research into how the first colonisers in Samoa adapted Lapita practice and culture, and how long connections were maintained to the other island groups.
Determining the pottery production patterns of these Samoan colonisers allows us to compare their colonising signature to those from Fiji and Tonga. Studies on early Lapita settlements would suggest that Lapita colonisers were highly mobile when settling distant and often remote islands (Summerhayes, 2000a; Summerhayes, 2000b; Summerhayes, 2003). Analysis of the Lapita pottery from Samoa can determine whether this practice was maintained at the furthest eastern edge of expansion by Lapita colonisers. A high mobility in Samoan colonising groups would reflect similar patterns of mobility from those in Tonga and Fiji. Such a practice would have provided a considerable benefit in maintaining a healthy genetic diversity as groups interacted, as well as the potential for improved access to resources. Alternatively, if mobility patterns were not high, this would suggest an alternative colonisation strategy considering new factors not typical of Lapita settlements to the west.

1.5 Plainware sequence in Samoa

It is thought that the physical isolation of Lapita settlements in Samoa from other island groups led to a cultural divergence, indicated by the changes manifested in the material culture in the succeeding plainware period. The pottery within this period is suggested to have undergone a rapid simplification, with only basic vessel forms and minimal decoration remaining (Green, 1974d). Tonga appears to undergo a similar process at a similar time, suggesting that there was some form of cultural exchange occurring within Western Polynesia during this period. Both island groups appear to cease manufacturing pottery around 1,500 B.P. (Green, 1974d), which defines the end of the plainware period and the beginning of the aceramic period.

There are currently two opposing models for the settlement of Samoa during the plainware period of Western Polynesia. The “Cultural Continuity Model”, favoured by authors such as Kirch and Green (2001), rests on a continual occupation of the Samoan archipelago, initiated by Lapita settlement, which transitions into a ‘Polynesian plainware’ sequence. Studies from within Fiji and Tonga (Burley et al., 2001; Clark and Anderson, 2001; Clark and Kennett, 2009; Earle, 1997) suggest a declining level of mobility in these plainware sites,
reflecting a population that is past its colonisation phase and is gradually establishing itself across the landscape, utilising more fixed terrestrial forms of resources. Accordingly, a gradual decline in settlement mobility from Lapita occupation would indicate a population beginning to establish itself throughout Samoa. This assumes that the plainware phase reflects continuity from the original Lapita colonisers of these islands and possibly a transition in the Lapita founding culture into something distinctly Polynesian. Mobility and resource procurement patterns are therefore key in understanding whether such continuity occurred.

A more recent argument, the “Cultural Hiatus Model”, has been put forward advocating that Lapita settlement in Samoa was tenuous and ultimately unsuccessful (Addison and Matisoo-Smith, 2010; Addison and Morrison, In Press; Smith, 2002). The occurrence of plainware is attributed to a subsequent pulse of colonisation several hundred years later, most likely from Tonga. One would expect mobility patterns to have two peaks if this model is correct. The first would be a highly mobile Lapita colonisation that was likely geographically restricted, as occupation in the archipelago was too tenuous. The second mobility peak would be the new arrival of a population several hundred years later, and would either rapidly or gradually decline depending on the size of the colonising populations. These settlers would likely have known about the islands of Samoa, but would have been unfamiliar with its resources. Initially, their mobility would have been high, but would have gradually decreased as these new settlers were more successful than the last and began to establish themselves across the landscape.

Just before the cessation of pottery production, it appears that settlement within Samoa was already well established inland (see Addison et al., 2008a; Davidson, 1974; Eckert and Welch, 2009). The youngest pottery-bearing site from ‘Upolu, Sasoa’a, is located 16 kilometres inland within a large valley system. This would have provided the inhabitants with good access to fertile soils suitable for horticulture, but would have distanced them from marine resources and access to the sea. This is in stark contrast to all earlier Samoan settlements containing pottery, which are located on the coast. Therefore, do pottery production patterns shift to accommodate a change in settlement patterns
inland? Higher degrees of sedentism would suggest changes to resource priorities. More emphasis would be placed on maintaining control of an area, suggesting competition over specific resources.

Around the time pottery ceases to be produced or a little afterward, c. 1,500-1,000 B.P., people appear to have begun a new wave of movement and settlement across the area now defined as East Polynesia (Weisler and Kirch, 1996: 1384). The great distances involved within East Polynesia would suggest that a reasonable level of interaction must have been initially maintained for colonisation to be a success. Based on material interactions, there are questions of whether later plainware sites show changes in levels of settlement mobility or interaction in accordance with a movement of populations and materials to the east. If so, this would suggest, at least within Samoa, that the plainware sequence would have been a component in the colonisation process of East Polynesia. However, if these sites indicate low levels of interaction and mobility, either these changes did not manifest themselves in the settlement patterns of plainware groups, or colonisation movements into East Polynesia were not initiated until after plainware had disappeared from Samoa.

1.6 Production Studies in the Pacific

The study of production and interaction within the Pacific has mainly focused on two aspects of Lapita and post-Lapita material culture: ceramics and obsidian. Authors from various regions have utilised physico-chemical methods to understand the movements of these materials, or the lack thereof. Obsidian can be accurately sourced to its parent material, providing information on how much was being utilised at the site and how far it had travelled. Exchange and production patterns can then be inferred. Chemical and petrographic analysis on clay and mineralogical components within pottery can identify discrete groupings. These groupings allow us to determine the number of clay and mineralogical sources being accessed. If numerous sources were being utilised, then either there was a reasonable degree of mobility or exchange was occurring. Conversely, continual use of one or limited local sources would suggest a degree of sedentism (Summerhayes, 2000a).
Dickinson (2006) has been the most prominent author in petrographic studies within the Pacific, noting whether pottery production was local or exotic. However, limitations to the method mean resource procurement locations can generally only be sourced to islands, or island groups, with the exception of a handful of areas (e.g. New Caledonia, Chiu, 2003). Thus, chemical analysis of the pottery can provide much better resolution, determining the likely number of sources being exploited and their proximity to a site. Traditionally, the predominant focus for chemical studies has been on ceramics that have dentate-stamping, with relatively little attention paid towards plainware ceramics, either from Lapita or post-Lapita sites (Connaughton, 2007: 202-203; Green, 1992: 15).

Within recent years the focus has started to shift, with increased analysis on the numerically dominant plainware pottery, focusing on the settlement strategies of Lapita colonisers and the subsequent phases incorporating plainware pottery (Burley, 1998; Burley, 1999; Burley et al., 2001; Clark and Anderson, 2009; Eckert and Welch, 2009; Galipaud, 2006).

Obsidian studies, while contributing to the larger picture of interaction, have focused more on trade and exchange. This has allowed Lapita interaction spheres to be established across the Western Pacific, most notably in the Bismarck Archipelago (e.g. Specht, 2002; Specht et al., 2009; Summerhayes, 2003; Summerhayes et al., 1998). A small number of studies have analysed the less prominent volcanic glass that is generally found on islands further east in the Pacific in the absence of obsidian. The results from these studies have shown little evidence for the distribution of volcanic glass in the ceramic phases of occupation, with methodological problems in accurate sourcing (e.g. Ward, 1974; Weisler, 1994).

Within the Samoan archipelago, there have been a limited number of physico-chemical studies undertaken on ceramics. The most notable petrographic work has been carried out by Petchey (1995) on the Lapita site of Mulifanua, and by Dickinson (1974, 1976, 1993) across several plainware sites. Their analyses indicated that pottery manufacture was probably local, but due to the homogeneity of mineral sources on the islands, further resolution was difficult with the existing geological data. Chemical analysis has been more limited, with the work done on the To’aga site by Hunt (1993) and on Tutuila by
Chapter 1: Introduction

Eckert (Eckert and James 2011; Eckert and Welch 2009) the notable exceptions. Their data suggests local sources for the clays, indicating local manufacturing practices at the site. Chemical studies on ceramics therefore provide a suitable technique to determine the variation in pottery production and resource selection and can be successfully applied to Lapita and post-Lapita pottery.

1.7 Research Outline

Based on the cultural chronology for Samoan prehistory, this thesis investigates three questions that focus on pottery production within the Lapita and plainware periods:

1/ Does the Lapita settlement of Samoa share similar production patterns to earlier or contemporary Lapita settlements from Fiji and Tonga, indicating uniformity in a larger regional colonisation process?

2/ What do the pottery production patterns from the plainware sites on ‘Upolu indicate for settlement patterns and mobility in the plainware period?

3/ What does the ‘Upolu ceramic production sequence indicate for models of Samoan prehistory?

These questions are addressed through chemical analysis in conjunction with established stylistic and petrographic determinations.
1.8 Thesis Outline:

The following chapter outlines current and past research on the colonisation of Samoa, its subsequent settlement and the physico-chemical methods used in understanding ceramic production. There is a considerable literature on various aspects of Lapita culture, from in-depth site analyses to large regional syntheses. The first part of the chapter details the processes of Lapita colonisation across West Polynesia. This is critical, as such a framework allows for mobility patterns to be compared between different island groups. Less well known is how Lapita culture transitioned from an interconnected regional network into dispersed, and possibly isolated, settlements. When and how this occurred is still locked in contentious debate, and answers will only be forthcoming when the focus is shifted from Lapita to the plainware and aceramic periods. A review of this transition therefore forms the second part of this chapter. The final section reviews existing physico-chemical methodologies, with a focus on understanding the components of Lapita and plainware ceramics.

Focusing on site-specific information, including local geology, location and dating, Chapter 3 provides the context of ‘Upolu pottery assemblages. Regional and site information allows an understanding of the unique factors that would have influenced the colonisation and settlement of Samoa. Because this study is based on material excavated from multiple sites over a 50-year timeframe, the information has been synthesised from a range of sources to allow for a more comprehensive analysis.

Following the regional and local synthesises, Chapter 4 outlines the chosen methodology used in this thesis. While chemical studies are not new in archaeology, there is still a vigorous debate as to how these methods should be applied to ceramic materials. All diagnostic sherds from five sites, covering the entire temporal span of pottery manufacture in Samoa, were examined by hand and under a binocular microscope. A range of information was recorded to allow comparison between various pottery features, and match these with existing analyses from within Samoa, and the larger region. Following this, 149 sherds were sampled using a stratified method to incorporate all five sites, and if appropriate, from multiple layers. These were then analysed using an electron
microprobe. Limitations of the study are addressed in the last section of the chapter.

The statistical and morphological results from the laboratory analysis constitute Chapter 5. This is split into three sections. The first outlines stylistic attributes of Lapita and plainware assemblages on ‘Upolu, Samoa. The second shows the results of chemical analysis on temper components and the subsequent comparisons to other attributes. The final section displays the results of the chemical analysis undertaken on the clay components of the pottery assemblages.

Discussion of the results constitutes Chapter 6. Production patterns of the Lapita colonisers are seen to reflect similar colonising strategies of other Lapita settlements from Tonga and Fiji. A range of resources was accessed and strong similarities in stylistic technique suggest a continued form of regional interaction. An adjustment is needed on the ‘thick’ and ‘thin’ ware classification first outlined by Green (1974b), with more of a focus on pottery fabrics. Pottery production on ‘Upolu suggests strong continuity in techniques from Lapita colonisation. In conjunction with the limited stylistic elements present, this supports the ‘Cultural Continuity Model’, but needs further datasets for confirmation. Production techniques shift in the later phase as populations move inland, and access to resources is restricted.

Concluding remarks are presented in Chapter 7, with a focus on what these results mean for the questions posed above. These are important for current models on the settlement of Samoa, and how these settlement models reflect Samoa’s wider regional position in prehistory.
Chapter 2

Models and Issues in Samoan Prehistory

2.1 Introduction to mobility and ceramic studies for Fiji/West Polynesia

There is a gap in our understanding of how the Samoan archipelago was colonised and how the culture of ancestral Samoan’s gave rise to a Polynesian Society. Therefore archaeologists need to recognize how this early society operated and changed over time. One of the first steps to accomplish this is deciphering production and distribution systems. Recent work (Addison, In Press; Crews, 2008; Eckert, 2006; Eckert and Welch, 2009; Johnson et al., 2007) has begun to target both lithics and ceramics as potential avenues of evidence, but such a concerted approach has not yet been undertaken for the island of ‘Upolu.

This chapter therefore focuses on related aspects of Fiji/West Polynesian migration and settlement. Migration processes and colonisation influences on early Samoan prehistoric settlement are important in understanding settlement patterns on nearby archipelagos, which can serve as a proxy for understanding initial settlement interaction on ‘Upolu, Samoa. Both stylistic and physico-chemical analyses have been used to answer questions on migration and settlement strategies of groups across the Pacific. Therefore, these forms of analyses need to be understood in the context of Pacific pottery assemblages.
This chapter has three sections. The first section (2.2) outlines models for the colonisation and settlement of Fiji/West Polynesia, which are by no means uncontested. Outlining these models is important, as different models of colonisation suggest different outcomes in settlement mobility.

The second section (2.3) looks at settlement patterns in the Fiji/West Polynesia region, measured through the movement and procurement of resources, indicating how early communities colonised and exploited island landscapes. There is considerable variation in the comprehensiveness of these studies within the region, with a notable paucity in Samoa. Much of the evidence suggests that there was a certain amount of material exchange, but what this means for the emergence of a new cultural identity is disputed. Therefore, existing models of interaction need to be tested, and possibly refined, to fit with settlement patterns from the archipelago.

The third section (2.4 and 2.5) focuses on pottery components of Pacific archaeological assemblages and outlines the benefits of taking a physico-chemical approach to understand production systems. Pottery can provide one of the best avenues to understand production and interaction between communities. Studies utilising physico-chemical analyses have provided excellent initial results by understanding the material compositions of its pottery in determining island production systems.
Chapter 2: Models and Issues in Samoan Prehistory

2.2 Context of Samoan settlement

2.2.1 Lapita colonisation

The colonisation of the Fiji/West Polynesia region is characterised by a Middle-to-Late Lapita or Eastern Lapita culture (Summerhayes, 2001a), occurring around 3,000-2,800 B.P. (Figure 2.1)(Burley et al., 2010: 138; Petchey, 2001). The entire colonisation of the western Pacific took only around 300-400 years; a movement of extreme rapidity. This accounts for the strong uniformities in the early material culture and languages of the region. Following settlement by Lapita, relative isolation is thought to have occurred, with new cultural identities emerging in these regions.

Green (1974d; 1979: 34) suggested that Lapita is best described as a cultural complex, as it encompasses both a physical Lapita horizon across the Pacific, and temporal Lapita traditions. Kirch (1987: 163) agreed that Lapita represents a very important horizon, providing the “foundation culture” for the first societies to evolve in Polynesia, Eastern Micronesia and Island Melanesia. Alternatively, Kirch (1997: 18) argued that depending on the point in time and individual archipelago group, the Lapita colonisers and their descendents are likely to have had cultural differences, whether through speech and/or physical changes. This would suggest that each new group of people were slightly different from their predecessors, and thus Lapita are a somewhat diverse group bound by a common horizon. The idea of a Lapita horizon, and thus tradition, is cautioned by Sheppard (2009: 4), for a common connection can only be present if we find contemporaneity or close similarity in processes, such as ceramic simplification, across the Pacific.
2.2.2 Lapita dispersal into Remote Oceania

The rapidity of Lapita expansion into Remote Oceania makes patterns of settlement in the region unclear, and has provoked debate over how successfully this island region was colonised (Figure 2.2). Burley et al. (1999: 66; Burley, 2007) viewed the colonisation of Western Polynesia as a slow progression beginning from southern Tonga through to Samoa, which took place over a minimum of 450 years. A similar conclusion was reached by Best (1984) based on work in Fiji. He suggested that the rate of expansion might have slowed between the islands of Fiji, Tonga and Samoa. In contrast, Anderson and Clark (1999) suggest that there was an expansion in the growth of Lapita settlements in the Western Pacific around 2,900-2,700 Cal. B.P., which was the catalyst for such a rapid eastward expansion (c. 200 years) that the settlement of various islands cannot be separated out from the radiocarbon record. If the colonisation of Remote Oceania were rapid, then this would reinforce a much more punctuated colonisation pattern over one of gradual movement. However, issues with a flattening in the radiocarbon curve make these models difficult to ascertain on radiocarbon analysis alone (Rieth, 2007).
Burley (2007) argued that the fading presence of Lapita in Tonga and Samoa represents the “frontier periphery” of Lapita colonisation, in which these island groups would have had limited settlement at best. Clark and Bedford (2008: 68) support this idea of colonisation exhaustion, arguing that the low density of Lapita sites found throughout Northern Tonga, and their almost complete absence from Samoa, indicate the difficulties associated with colonising an increasingly diverse and isolated environment.

There are problems with this model. Distances between islands in this region were not beyond the capacity of Lapita voyagers, with most island groups being less than 300 km from another point of contact (Davidson, 1978: 384). Another point of contention is likelihood of site preservation, based on the island subsidence occurring in the Samoan archipelago. Such an absence can be explained by taphonomic factors, as opposed to a true settlement barrier (Green, 2002).

The extent of interaction spheres appears to be important in determining settlement strategy in the region. With small populations relying on neighbouring groups for the maintenance of social and economic systems, the need for a strong interaction sphere with surrounding periphery settlements could have discouraged splinter groups settling the more remote islands of the Vava’u group (northern Tonga) and Samoa (Figure 2.3)(Burley and Dickinson,
Chapter 2: Models and Issues in Samoan Prehistory

2001). This appears to be reflected in the discovery of Tongatapu by Lapita peoples and the subsequent high rate of return to the more environmentally familiar islands of Fiji. Therefore, Lapita settlement would have been episodic in this region, with a time gap of 100-200 years before the permanent settlement of Samoa (Clark and Bedford, 2008: 69).

![Figure 2.3: Map showing suggested zone of delayed Lapita settlement in Northern Tonga and Samoa](image)

From Tonga, it is argued that within two generations the Eastern Lapita ceramic series had established itself in Fiji/West Polynesia (Burley et al., 2002). The rapidity of the change to the Eastern Lapita design system is supported by the lack of Western Lapita ceramic motifs from other sites in Tonga and Samoa, and even from the Lau group in Fiji with the exception of Wakea (Burley et al., 2010: 141). Such rapidity in the decline of the Eastern Lapita design system would explain the limited amount of Lapita decoration found on pottery from Samoa. If one accepts that there was a strong physical and/or social barrier in colonising Northern Tonga and Samoa, then such isolation could have provided a strong catalyst for design and vessel form decay.
Further research has confirmed that the ceramic differences between contemporary Lapita sites from Tonga and those from west and central Fiji appear to be caused by spatial, not temporal factors (Burley et al., 2010). This is counter to the ideas of Best (1984; 2002), and suggests that settlement was not incremental in the Fiji/West Polynesia region, but was more episodic. Recent research at the site of Nukuleka (Burley et al., 2010; Burley and Dickinson, 2010) has supported the argument (Summerhayes, 2000a) that Tonga may have been settled directly from central Island Melanesia, rather than from the closer islands of Fiji. This site is argued to be “a staging point for population expansion through Tonga and into Samoa” (Burley and Dickinson, 2010: 1025). These populations, while still shown to be in contact (Best, 1984: 641; Burley et al., 2010: 141), would have had a degree of isolation, and founder effects appear to have occurred rapidly on the Lapita design system (Burley et al., 2010: 141).

Some researchers have extended the argument of island isolation, suggesting that Samoa was beyond sustainable Lapita settlement (Addison and Matisoo-Smith, 2010; Addison and Morrison, In Press). They argue that it was not until c. 2,400 Cal B.P., or 300-400 years after Lapita settlement in Southern Tonga and Fiji, that the islands of Samoa were permanently settled. By accepting that there was a pause in the settlement of islands in the region, this favours the idea that the environment of Samoa was difficult, and settlement would have been tenuous, and ultimately unsuccessful, for the Lapita colonisers (Clark and Bedford, 2008: 69-70).

Clark and Anderson (2009: 407) point out two logical deficiencies to this argument. One is that islands in close proximity to Samoa, such as Niuatoputapu, show clear, continuous, settlement beginning with Lapita colonisation. Kirch’s (1978: 12; 1988a) work on Niuatoputapu, which is in close proximity to both Samoa and the northern islands of Tonga, reveals a close relationship in design motifs and elements to Samoan Lapita pottery, indicating that in the period where Samoa is suggested to have been abandoned (Addison and Matisoo-Smith, 2010; Addison and Morrison, In Press) there appears to have been a certain degree of interisland contact. Burley (2007: 197) argued that Vava’u and islands further to the north, including Samoa, may have been part of a low-density population frontier up until c. 2,250 B.P. This would tie into a settlement strategy
utilising mobile maritime migration (based on sites from Ha'apai), and that inter-island voyaging would have been crucial for settlement survival (Burley et al., 2001: 102). Early sites from Samoa that would confirm this model are likely to either be underwater or under large amounts of eroded alluvium (Green, 2002).

The second deficiency in the argument is that post-Lapita ceramics on Samoa are not identical to other assemblages found within the region. If Samoa had been occupied 200-400 years after Lapita decoration had died away in the region, one would expect to see strong similarities with either Tonga or Fijian ceramics. Instead, post-Lapita Samoan plainware ceramics suggest a unique divergence from an early Lapita population (Clark and Anderson, 2009: 414-415).

2.2.3 Lapita exchange and interaction

The debate about the successful exploration and settlement by Lapita peoples hinges on the ability to trace their movements. This issue often focuses specifically on the concept of understanding exchange (Earle, 1997; Weisler and Kirch, 1996: 1381). Hunt and Graves (1990: 107) point out that despite being a common source of interest for many archaeologists, there is a lack of explanation for why exchange networks develop, why they persisted or ceased, and how they worked. Earle (1997: 225) notes that the nature of exchange can be chaotic in its patterns, with rapid expansions and collapses. There are questions as to whether exchange provided the impetus for the similarities commonly found throughout those areas colonised by Lapita peoples (Summerhayes, 2000b), and whether it can provide the necessary data in understanding how societies developed and transformed (Clark, 2000: 152).

The absence of Lapita pottery as a trade ware (Davidson, 1977: 87; Dickinson et al., 1996: 94-95; Dickinson and Shutler, 2000; Green, 1996) suggests that something other then material exchange must explain Lapita's stylistic similarity. If we accept that isolation is likely to have segregated Lapita communities into several different interaction spheres, we must consider exchange on a regional basis (Kirch, 1988b; Summerhayes, 2000a: 7). While in some areas exchange may have operated a lifeline for colonists exploring an
increasingly distant environment, this idea is not necessarily applicable to the entire western Pacific (Summerhayes, 2000a: 13). We must identify where the pottery was produced and then determine whether this represents the occurrence of an interaction network.

Stylistic motifs have been used to argue for both a single integrated network between Lapita communities, and conversely, strong regionalisation. Green and Kirch (1997: 19-21) suggest that with the low number of recorded items travelling long-distances there was no single integrated network. Because of regionalisation, the processes behind the transfers of material in Near Oceania may be quite different from those in Remote Oceania. The suggestion is to make a distinction in the different forms of exchange: interactions on an intra-community level should be termed internal exchange, while that which involves resource transfer between communities should be called external exchange (Green, 1996).

Summerhayes (2000a) urges caution in ascribing interaction based on stylistic determinations. He argued that iconoclastic studies have shown that the idea that style can be used to determine interaction is false and instead must be proven, rather than assumed. Instead of relying on typologies based on morphology and decoration, Summerhayes (2000a: 30) considered a physico-chemical approach to be more viable, supported by the arguments of Rye and Allen (1980: 305 as cited in Summerhayes, 2000a) who argue that stylistic analysis “cannot provide the basis to support models and reconstructions being offered for the prehistory of the region”.

Evidence for exchange, based on physico-chemical analysis, indicates that pottery does appear to be involved to some degree within an intra-archipelago exchange network. Chemical and petrographic studies have shown that subsequent pottery production in late Lapita sites began to favour local materials (Chiu, 2003: 161, 176). Garling (2007: 26) argued that these results reinforce a pattern of local networks, and a lack of inter-archipelago interaction in both Lapita and post-Lapita pottery. Burley and Clark (2003) indicate that sourcing work on pottery materials has disproved the notion that ceramics had any involvement in long-distance exchange networks (Dickinson et al., 1996).
Summerhayes (2000a) has argued against a dramatic decline in exchange following the initial colonisation event, and while the frequency of interaction cannot be determined by the current data, communication continued throughout the Lapita period. It is theorised that while most of the goods themselves may not have been exchanged between islands, the ideas or people behind them were. While the evidence for wide-scale interaction from central Melanesia to Samoa seems slim, the notable motifs of Lapita pottery across the region change in a consistent manner. Lapita communities would have had sufficient navigation skills to maintain links, if a little fragile, between communities, from West Polynesia all the way through to the Bismarck Archipelago for around 1,000 years. Perhaps this was done through a mode such as spouse exchange, something that would have been vital to maintain strong viable communities that were reasonably isolated from one another. There would then exist a limited number of exotic pots in any excavated Lapita site, perhaps accompanying the new individuals into the community (see Burley et al., 2010; Summerhayes, 2001b: 62). Clark and Bedford (2008) suggested that colonisation could only have been successful for Lapita, based on Moore’s (2001) ideas of colonisation, if there was a continued exchange of non-related marriage partners. The existence of long-distance exchange networks is also supported by research from different sites, suggesting that they were reasonably common in the early phase of Lapita expansion, if not later (Clark and Kennett, 2009: 341; Earle, 1997; Irwin, 1992; Weisler and Kirch, 1996).

2.2.4 Cultural transition - continuity or discontinuity?

Debate currently revolves around whether there is cultural continuity between Lapita settlers and those in the plainware period. The argument in Samoa has been based on the simplification of pottery assemblages in decoration and form, mirrored from other sites in the region. This is associated with material culture suites from Lapita sites simplifying over time (Summerhayes and Allen, 2007: 116). Vessels are restricted to open bowls and decoration becomes confined to incision on rims. Those who favour cultural discontinuity argue that this represents some sort of cultural shift, possibly providing the
foundations for an Ancestral Polynesian Society. In so doing we should label plainware pottery as Polynesian Plainware. Counter to this are those who suggest that the loss of these features, while characteristic of a Lapita assemblage, is not significant enough to indicate a complete paradigm shift into something inherently Polynesian.

The traditional “Cultural Continuity Model” argues for a continuous settlement of the archipelago from the first Lapita colonisers (Green, 1981; Green, 2002; Kirch and Hunt, 1993c). In the ceramic sequence, Green (1974b; 1974d; 2003; Green and Kirch, 1997) modelled that continuity was descendant from a small part of the initial Lapita ceramic assemblage. Through the plainware sequence there was an internal stylistic development from a thin, fine ware with minimal decoration, through to a thick, coarse ware with almost no decoration. Green also noted a decline in vessel quality, with an increased use of coarser temper. However, he argued that current archaeological evidence was not sufficient enough to determine whether plainware ceramics were abandoned uniformly over several centuries, or whether cessation was more fragmented over time and space. Clark (1996) has suggested that the continuation of pottery production was patchy, with some areas retaining its use until much more recently. Green (1974d, 1982, 1991) argued that the loss of pottery does not signal changes to social arrangements or patterns of settlement organisation and that Samoa always retained a strong degree of cultural continuity.

Continuity in Samoan prehistory has been recently challenged on the basis of chronology and geography. Authors such as Addison and Morrison (In Press) favour another approach, the “Cultural Hiatus Model”. This model argues that Samoa was beyond the sustainable settlement of Lapita populations, and hence led to a demographic exhaustion. Addison and Morrison (In Press) suggest that Samoa may have been abandoned before any changes to style and vessel forms could take place. Settlement of the archipelago was therefore not successful until a second wave of migrants colonised the islands several hundred years later. If this were the case one would expect mobility patterns to have two peaks, one for the initial Lapita arrival, the second as the new colonising group several hundred years later rediscovers the archipelago.
This model appears to be supported by an approximately 200 to 500 year gap in the radiocarbon record between Mulifanua and the earliest plainware site of To'aga (Rieth et al., 2008). If the chronology is revised for two supposed contemporary Lapita sites of 'Aoa and To'aga, a possible hiatus of several hundred years (Rieth et al., 2008: 215) is suggested to have occurred between Lapita settlement and a subsequent re-colonisation by groups utilising fully plainware pottery (Addison and Matisoo-Smith, 2010; Addison and Morrison, In Press). However, the current precision of radiocarbon dating is insufficient to provide any definitive answers to whether such a break occurred (Rieth et al., 2008: 216, 226).

Some argue that it is possible to show a ‘transitional pulse’ between Lapita and post-Lapita societies around 2,350-1,900 Cal. B.P. (Garling, 2007). While different island groups had variable cultural outcomes as a result of this pulse, in many instances a change in ceramics appears to have coincided with a change in other forms of material culture and subsistence economy. It appears that there was a degree of synchronisation in the timing of this ceramic change, with a lag of a few centuries occurring in Fiji and West Polynesia compared to sites in the west (Bellwood, 1979). Doherty (2009: 207) agreed that while there is a change to some components and variable longevity to others, overall the rate or scale of change is not dissimilar in the wider regional context. However, it is noted that there is a lack of available data to indicate whether any change in the sequence is a result of substantial outside influence.

Bedford and Clark (Bedford, 2006; Bedford and Clark, 2001; 2008; Bedford et al., 2006; Clark, 1999) counter ideas of cultural continuity in this pulse, suggesting that from around 2,700 years ago there is a clear divergence in the regional archaeological record, which indicates contraction or specialisation in exchange, more local adaption, socio-political transformations and possibly even secondary migrations (Spriggs, 1997). Bedford's (2006) work in Vanuatu suggests that after the demise of dentate stamping, differing cultural trajectories occurred, most notably on the islands of Erate and Erromango. The most obvious change amongst non-ceramic artefacts in this region appears to be a restriction in the variety and quantity, something also acknowledged by Sand (2000) in the case of New Caledonia.
Radiocarbon dating is a crucial aspect in almost all the arguments both for and against cultural continuity. The current debate centres on the initial dates for the earliest plainware sites. Circa 2,500 B.P. is currently suggested to be the defining start point of the plainware period. Dates from pottery-bearing sites on 'Upolu and Tutuila suggest that by c. 2300 B.P. plainware occupations were common across the archipelago. Recent excavations from an inland site at Vainu’u on Tutuila have placed the earliest occupation layer at 2,700-2,300 B.P. (Eckert and Welch, 2009). The chronometric hygiene application by Rieth (2007) to older excavated sites, while needed, has produced an ambiguity to the early settlement sequence following Lapita colonisation. Based on material culture aspects, Falemoa and Jane’s Camp on the northwest coast of ‘Upolu, and To’aga on Ofu appear to be early plainware sites dating to around c. 2,500 B.P. Therefore, the 300 year gap between these sites and the earlier Mulifanua date of 2,850 B.P. is argued by those in favour of the ‘cultural hiatus’ model to indicate a lack of settlement in the Samoan archipelago.

However, one needs to be careful that the premise is not an absence of evidence is evidence of absence. Based on the active geological nature of the archipelago early sites are possibly buried under a significant amount of deposited sediment or are flooded by sea-level rise/land subsidence (Green, 2002). As noted by previous authors (Green, 1974d; Martinsson-Wallin, 2007), site surveys on ‘Upolu and Savai’i have routinely failed to produce results, and it is only in subsurface excavation, or in the case of Mulifanua, by dredging operations, that sites have been found. From Tonga, plainware sites show strong continuity following Lapita occupation and throughout the plainware period (Burley, 1994). I would argue that until the re-dating of sites with discarded dates are undertaken, arguing a settlement model based on a radiocarbon chronology at a point in time where accuracy is difficult is likely to produce impotent results. Systematic archaeological surveys of possible subsurface sites along the northern coast of ‘Upolu, and coastal parts of Savai’i and Apolima, all that have a near proximity to the only known Lapita site, should also be undertaken.
2.2.5 Defining an Ancestral Polynesian Society

Before archaeologists can progress in understanding how Polynesian society emerged following colonisation the role of pottery must be considered. Pottery, while a visible and somewhat common marker in archaeological sites, is only a component of material cultural suites. Based on Kirch and Green (2001), only 18 percent of material used in a traditional Polynesian culture would survive in an archaeological site. Therefore, pottery's role must be considered before any judgements can be made on its reflection of a cultural identity. As Kirch and Hunt note, it is crucial to understand the origins of ancestral Polynesian culture, as doing this will “provide a secure baseline for studying the subsequent development and diversification of later Polynesian groups throughout the vast Polynesian triangle” (Kirch and Hunt, 1993b: 2).

It was argued that the original purpose of Lapita dentate decoration represented a form of structured communication network for the purposes of successfully colonising new islands (Burley et al., 1999; Chiu, 2003, 2005; Clark and Murray, 2006; Summerhayes, 2000a). This would have been expressed through interaction utilising ceremony, feasting and partner exchange to prevent damaging founder effects on somewhat isolated populations (Kirch and Green, 2001: 77; Summerhayes, 2000a). Summerhayes (2007: 116) suggests that the elaborate decoration of ceramics is part of Lapita settlement indicating the strength and fitness of the group, and through exchange would have provided a level of prestige or utilitarian values from the pottery. High social values would have been created through the labour intensive pottery, evident in the ornate curvilinear and rectilinear design patterns (Green, 1979: 42; Summerhayes, 2000a: 32). The associations of decorated ware with Lapita skeletons from the Teouma site in Vanuatu indicate that it had a significant ritualistic role and reinforces the idea of ceremonial use (Bedford et al., 2009: 222-225). In contrast, plainware vessels from the site are found in the midden dumps (Bedford et al., 2006: 824).

The demise of dentate decoration could therefore reflect a decrease in population mobility and increase in settlement density, with a lesser need for large-scale interaction networks as populations began to establish themselves
across their own archipelagos. The speed of the demise of dentate stamping appears to have been rapid (c. 200 years), with early plainware sites showing limited decoration in the form of incision and no evidence of any other decorative elements (Bedford and Sand, 2007; Burley, 2007; Burley et al., 2001; Clark, 1996; Green, 2002: 136; Hunt and Erkelens, 1993).

The site of Mulifanua on 'Upolu is typical of Lapita colonisation. Motifs identified on the pottery by Petchey (1995) share notable similarities to designs found on middle Lapita sites from Tonga, such as those from Niuatoputapu (Kirch, 1988a). These are simplified in comparison to early Lapita motifs found to the west, but still undoubtedly Lapita designs. Such simplification is likely the result of relative isolation in conjunction with founder effects, seen from the Tongan site of Nukuleka (Burley and Dickinson, 2010). Vessel forms also share strong design elements to sites from Fiji and Tonga, most notably the collared rims and carinated vessels, which appear to be an early component in Lapita vessels in the region (Kirch, 1988a: 167).

Subsequently, after the arrival of Lapita settlers, there is a decline in the amount and elaboration of ceramic decoration. Kirch (2000: 222) and Galipaud (2006: 233) argue that the simplification and reduction in decorated pottery may suggest a change in social function in which pottery was no longer a prestige good, and instead became strictly utilitarian. In Tonga and Samoa there is a rapid decline in the Lapita design system, which Clark and Murray (2006: 108) suggest may have been compensated for by local innovations. It is important to note that plainware pottery is never a minor component of Lapita assemblages, and becomes fully dominant in most areas after the demise of Lapita motifs (Spriggs, 1984: 213; Summerhayes, 2000a: 232). The limited decoration that is present in plainware assemblages is usually confined to incising or notching of rims or the application of a red slip (Smith, 2002: 26).

Although plainware pottery suggests a lack of trade, the increasing sedentism of plainware settlements does not necessarily denote a collapse of regional networks. Low population sizes and densities coupled with high mobility usually results in stylistic distributions remaining spatially and temporally homogeneous (Yellen and Harpending 1972 as cited in Hantman and Plog, 1982). The similarities in material culture from Niuatoputapu (Kirch,
1988a), ‘Uvea (Kirch, 1976), as well as the rest of Tonga (Burley et al., 2010; Burley et al., 2002; Burley, 1999), would suggest some form of cultural communication was occurring. The divergent stylistic trajectories of Samoan and Tongan plainware would suggest a limited cultural exchange between the two. Continuity in linguistic data also suggests that there was continued contact in the Polynesian region during the plainware phase (Green, 1981: 146). It seems unlikely that the regional exchange that appears to have occurred in the Lapita phase simply dissipated in the plainware phase. While the ritualistic markers found in the pottery decoration disappeared, these early communities would still have maintained a seafaring method of transport. Niuatoputapu is equidistant between the island of ‘Upolu and the northern chain of Tonga. It seems unlikely that this distance prevented any form of contact. Cultural exchange, if not material exchange, is likely to have continued for some time.

Green and Kirch (Green, 1992; Kirch, 1978) have pointed out that non-pottery items have had almost no attention, with little value placed on their importance in association with plainware pottery, and the analyses that have been undertaken lacks in sophistication. This situation has barely improved. It is the minor variations in material culture that Kirch (1988a) believes are important in identifying processes of cultural differentiation. Other aspects of Samoan material culture, such as adzes, also appear to conform to a general regional pattern (Green, 1969a; Kirch and Hunt, 1993a).

Ancestral Polynesian Society was characterised by Green (1981) as having had a reasonable level of inter-archipelago contact, encompassing the islands of Tonga, Samoa and probably Futuna, Uvea and Fiji (Figure 2.4). This is mirrored in the distribution of post-Lapita plainware. Kirch and Green (2001) are firm supporters of seeing plainware as a definitive cultural boundary, beginning around 2,500-2,200 B.P., which is evident through the regions distinctive material culture. They (Green and Kirch, 1997: 20; Kirch and Green, 2001) stress that the homogeneous nature of Lapita colonisation throughout the region, through a shared cultural and linguistic base, as well as genetics, constituted the ‘foundation population’ for the subsequent rise of an Ancestral Polynesian Society within Western Polynesia.
Within Tonga, it is argued that the transition from Lapita to post-Lapita is both stratigraphically and compositionally distinct. The abandonment of dentate stamping seems to have taken place over two hundred years throughout the archipelago, suggesting a reasonably rapid rate of decline (Burley, 1999; Burley et al., 2001: 101-102; Davidson, 1979). Hunt (1988) suggested that over time connections were lost, and people began to have a more inward-looking focus. Connaughton (2007: 199, 203) argued that plainware assemblages reflect internal social and economic change, indicating the transition into an Ancestral Polynesian Society isolated from outside ideas, and as a result, a much stronger shared identity.

The issue of an absolutely chronology is noted for the time sequence in the region. Due to the flattening of the radiocarbon curve at the time of Lapita and post-Lapita settlement, c. 2,500-1,500 B.P., the level of resolution able to be achieved around this transition period is poor, and unlikely to provide answers as to the speed of this change (Clark, 2000; Smith, 2002: 46). This is highly problematic with any studies that incorporate interpretations of plainware as a Polynesian trait.
Chapter 2: Models and Issues in Samoan Prehistory

2.3 Settlement patterns in Fiji/West Polynesia

2.3.1 Colonisation of Remote Oceania

While still subject to debate, studies on settlement patterns within Fiji/West Polynesia are providing a better understanding of how colonisation and subsequent settlement occurred. A recently updated model (Kennett et al., 2006) based on a summary of current archaeological data, favours a four-stage development in settlement of island archipelagos. Following the colonisation of these islands there was:

1. A pause in further migrations to the east.
2. This initially resulted in increased numbers of coastal settlements, both near existing established settlements and on uninhabited islands.
3. This led to a decrease in settlement mobility (Clark, 1999).
4. A subsequent expansion occurred into the island interiors of larger islands as populations grew (Clark, 1999; Hunt, 1987; Sand, 1996). Population pressure intensified agricultural output, inferred from evidence of inland expansion and development of terracing and irrigation systems on the islands (Kennett et al., 2006: 284).

The first Lapita settlers into the region may have been relatively homogeneous in their language and social customs as the result of interaction in a frontier environment, whereas post-Lapita settlements would have seen new cultural pathways develop. Clark and Anderson (2009: 428-429) argue that post-Lapita settlers would have had to develop new settlement strategies as population densities increased, including adaptations to new social aspects such as land ownership and access. This could have led to conflict or competition over certain resources. Within Fiji this is most visible in the changes to ceramics, but they note other less obvious developments, such as inter-group competition, settlement of island interiors and other vacant areas, with subsequent subsistence adaptations and economic specialisations occurring as a result.

A current model argues that as Lapita pottery production ceased, settlements become more sedentary and food production intensified in archipelagos such as Fiji, Tonga and Samoa (Bellwood, 1979; Clark, 1999; Sand, 1996). While this model fits archaeological evidence from Fiji and Tonga (Burley,
Chapter 2: Models and Issues in Samoan Prehistory

2007: 194), a lack of archaeological analysis currently prevents the model from being applied with certainty to settlement pattern studies in the Samoan archipelago. Recent dating of sites from American Samoa, such as at Vaipito and in the Pava’ia’l-Faleniu area would suggest that there were certain pressures around c. 2,000 B.P. to inhabit non-optimal areas of the archipelago (Addison and Asaua, 2006: 102). Further analysis from other Samoan sites on other islands is needed to assess whether this pattern is consistent.

2.3.2 The Issue of Subsistence

Subsistence studies in the Pacific have long been polarised, notably after the publication of an article by Groube (1971) in which he suggested that Lapita colonisers in Fiji/West Polynesia were strandloopers, primarily focusing on skimming off marine resources, and did not utilise terrestrial foods initially. Colonisation could therefore be effectively continual, and would be influenced by island size and the availability of suitable reefs.

In contrast, arguments made by archaeologists such as Kirch (1987, 1997; 2001), suggest that Lapita colonisers brought with them a transported landscape of crops and animals, utilising both terrestrial foods and marine resources. A low mobility signature from Lapita settlements would suggest that resource exploitation focused on locally available food sources, and in the somewhat depauperate islands of the Pacific, would favour the utilisation of imported terrestrial resources. This would lead theoretically to a more episodic form of colonisation, as groups would have to establish themselves before being able to move on (Kennett et al., 2006: 11). However, if early settlers established a form of horticultural nursery, then they could have easily expanded their terrestrial base while still utilising a degree of settlement mobility.

Current models of Pacific colonisation within Near Oceania place Lapita sites along the coast, near lagoons or accessible reef systems. Similar patterns of settlement are found in Remote Oceania; however, sites there are generally smaller (Kennett et al., 2006). Anderson (2003: 78-81) views population dispersal into the Pacific based on a foraging economy, characteristic of an episodic, quasi-cyclic pattern of expansion. Kennett (2006), in contrast, sees an
early Lapita economy combining select domesticates (chicken and possibly taro), exploitation of shellfish and fish, and easily obtained terrestrial foods (canarium nuts, large birds, eggs etc.).

Recent studies focusing on Lapita period sites have begun to reveal a growing amount of evidence for early horticultural distribution into the Pacific (Crowther, 2009; Horrocks and Bedford, 2005; Horrocks et al., 2009; Horrocks et al., 2008; Horrocks and Nunn, 2007). Residue analysis on Lapita and post-Lapita pottery has shown possible evidence of the early use of taro (*Colocasia esculenta*) from the Mulifanua site. The residues found on two pottery sherds were from depositional sediment, which might represent taro waste discarded into a possible Lapita midden (Crowther, 2009). However, as Morrison and Addison (2008: 32) point out, subsistence patterns are still poorly understood in Samoa. Even so, evidence of subsistence suggests that marine resources were vitally important to early settlement, and would have influenced cultural diversification, competition, cooperation and spatial organisation in these island groups.
Chapter 2: Models and Issues in Samoan Prehistory

2.4 Fiji/West Polynesia Pottery

2.4.1 Form and function

There are a wide range of vessel shapes within Fiji/West Polynesia Lapita pottery assemblages, which include bowls, flat dishes and jars. These middle-to-late period regional Lapita ceramics often have very distinctive forms, such as cylinder stands, collared and everted rims (Birks, 1973). These become rare or absent in post-Lapita plainware sequences (Smith, 1976a). Vessel forms found in post-Lapita plainware sites are much simpler, focusing on large storage jars and a small range of bowls and cups (Burley et al., 2001).

Plain pottery appears to have been most often used for utilitarian purposes such as cooking, but also possibly for food storage and food preparation (Kirch, 1997: 122). Dentate-decorated pottery is suggested to have a more ritualistic use (Kirch, 1997: 172; Sand et al., 1998: 40; Summerhayes, 2001b).

2.4.2 Production

Lapita pottery from Fiji/West Polynesia was usually produced from locally available materials with little importation of either raw goods or finished pottery. Nearby beach or river sand was commonly used as temper (Burley and Dickinson, 2010; Clark and Kennett, 2009: 331; Dickinson, 1974, 1993; Dickinson et al., 1996). Lapita pottery is considered earthenware, as it was open fired under temperatures that rarely exceeded 900 degrees Celsius (Clough, 1992). Construction was usually by slab building or coiling, and was then shaped through a paddle-and-anvil technique (Golson, 1971; Kirch, 1978: 8; Kirch, 1988a: 155; Kirch, 2000: 101-102; Poulsen, 1987: 136).

Summerhayes and Allen (2007) acknowledge that while there has been considerable attention paid to Lapita pottery, little of this work has focused on the production and distribution patterns associated with it. Studies that have
focused on this issue using physical/chemical analysis usually attempt to discern whether the pottery has been imported or produced locally.

Summerhayes (2000a; 2000b; 2003) has instead looked at the issue of mobility and relating it to production patterns of Lapita ceramics within the Bismarck Archipelago. He argues there is a change over time from a mobile society into one that is more sedentary. However, this does not see long-distance interaction come to halt, even after the recognisably Lapita pottery disappears. Instead, early Lapita pottery was predominantly locally produced, with the potters being liberal in their combinations of tempers and clays, but producing identical varieties of vessel forms and decorations. Later Lapita ceramics continue local production, but utilise only one form of temper with associated clays. This is interpreted as indicating a change in Lapita settlement patterns. Early Lapita settlers would have been highly mobile, with liberal production values, while later conservative production reflected more sedentary living.

2.4.3 Disappearance

The disappearance of pottery in West Polynesia is “one of the so-called enigmas of the Pacific” (Best, 2002: 51) and debate surrounds its importance. While there is some argument over the exact period of pottery cessation, the generally accepted date is around 1700-1500 B.P. (Addison and Asaua, 2006: 104; see Addison et al., 2008a: 109-110; Green, 1974d). Several different causes, including functional, societal and changes in inherent value, have been suggested to explain why pottery production ceased and are outlined below.

Marshall’s (1985) study on gender roles in pottery manufacture has produced the contentious idea that Lapita pottery was produced by women and was used in the maritime trade and communications networks that were operated by men. As potteries became smaller and more isolated through population divergence and sedentism, it is argued that the pottery produced was of poorer quality and used only as utilitarian ware. Without the impetus of pottery as a trade ware, its importance and method of use changed (Marshall, 1985: 223-224). Pots would have decreased in demand as they held less value, and could be replaced by other materials (Best, 2002: 52).
Best (2002) notes, in contrast to Marshall, that trade and exchange do not appear to have been factors related to the early production of pottery (see Summerhayes, 2000a), and so value would have to have been focused within the community. Others have noted that while the decorated component of Lapita ceramics appear to have some social importance, they were not produced in areas of specialisation, instead being village-based industries (Dickinson et al., 1996; Green and Anson, 2000; Summerhayes, 2001b; Thomson and White, 2000).

An alternative argument to ceramic disappearance is based on the functionality of pottery. As Lapita and post-Lapita settlers began using the umu method of cooking (Leach, 2007: 53), and had abundant supplies of coconut shells and wood for food preparation (Green, 1974d), which are argued to be more durable and can be used to boil liquids, then pottery in its utilitarian fashion was no longer required (Davidson, 1979: 91; Leach, 1982). Because the subsistence base incorporated root crops, as opposed to cereals, cooking methods, such as the umu, were more practical. Leach (1982) sees this as the preferred method of cooking based on the discontinued use of globular vessels, which have been interpreted as cooking pots. Earth oven cooking did not require labour intensive pottery, allowed meat as well as plants to be cooked in bulk, and was effective at cooking items completely, rather than the uneven results achieved using pottery cooking vessels over open fires. The abandonment of pottery in certain areas may have been reinforced by the preferable choice of wood for creating vessels for mixing, storage and serving vessels over pottery utilising unfamiliar clays (Leach, 1982: 154-155). The regional disappearance in the use of pottery is suggested to have occurred because the interaction between communities led to the transmission of new ideas about food preparation and cooking (Irwin, 1981: 488-489). The counter to this is that this convergence on functional forms may have been coincidental, and not suggestive of population interaction (Cochrane, 2004: 81-82).

An alternative theory has stressed environmental pressures for the disappearance of pottery in Polynesia, arguing that the clay and tempers available were of insufficient quality to produce functional pottery (Claridge, 1984). Both Claridge (1984) and Spennemann (1989) argue that volcanic sand
temper is necessary to create pottery that is hard and non-porous. Those pots with calcareous tempers could not have been used over an open fire, and therefore, the disappearance of pottery was based on the lack of a functional use. However, Best (1984: 351; 2002: 52) has noted that Claridge did not consider the preparation methods of prehistoric pottery, in which pots often have a number of temper types, including calcareous tempers, and clays could be used when blended with substances such as mangrove mud.

2.4.4 The Problems of Plainware

There has been a notable absence in the existing literature of research on plainware, which comprises both Lapita and post-Lapita assemblages. Bedford and Spriggs (2008: 97) point out that “despite the period after Lapita through to the present represents 90 percent of the human history of western Remote Oceania, this time span remains with a handful of exceptions, poorly defined and under-researched archaeologically”. Not only does plainware form a major component of any Lapita pottery assemblage excavated (Summerhayes, 2000a), it is also the only form of pottery that survives in many of the island groups, most notably in Tonga and Samoa, after the demise of dentate-stamping. This period is defined as a post-Lapita culture in most cases, as archaeologists see the absence of dentate-stamping shows the loss of what is most definably Lapita (Garling, 2007: 1). Green (1992: 15) suggested that within ceramic studies, perhaps because of the ease in recognition, dentate-stamped pottery has received an “undue significance and weighting”, while other components, notably plainware, have been “assigned little or no significance”. Thus, our lack of focus on post-Lapita plainware has provided archaeologists with an inability to explain the significance of a transition from a decorated ware to a plainware (Connaughton, 2007: 202-203).

Whilst stylistic analysis is a well-used method for indicating the presence of exchange, at least in ideas if not materials, plainware offers little such benefit. Instead, this lack of such a prominent diagnostic feature has led to questions over the level of interaction amongst plainware communities, with important implications for the formation of societies post-Lapita.
2.5 Stylistic and Physico-chemical Analysis

Ceramics form the major component of material culture studies for Lapita and, where they continue to exist, post-Lapita sites. Stylistic variation can provide clues on temporal and spatial patterns. Physico-chemical analysis of the pottery can tell us about ceramic technology, function and the raw materials used (Ambrose, 1993: 209; Hunt and Erkelens, 1993; Tite, 2008: 216). Both sets of analyses can then be used in conjunction to establish mobility and exchange patterns, as well as understand resource use and provide social reconstructions (Garling, 2007: 107).

2.5.1 Stylistic Analysis

Stylistic analysis can provide evidence for social constructs and movement. Pottery decoration can convey information about group or individual identities. While this allows archaeologists to infer social interaction based on similarities in design, it is more problematic to understand how these ideas were being transferred (Garling, 2007: 111). Most research that incorporate stylistic analysis assume that changes in design occur rapidly, and are followed by long periods of stability (Plog, 1980). However, studies have shown that in some cases change is constant, rather then episodic (Dethlefsen and Deetz, 1966). Therefore, causes of stylistic change, such as subsistence-settlement systems, vessel shapes, ceramic exchange and temporal changes in design need to be understood in order to determine rates of change (Plog, 1980).

2.5.2 Benefits of physico-chemical analysis

Archaeological evidence does not support models of interaction being determined by stylistic similarities. Instead, chemical and petrographic analyses provide independent confirmation (Kingery, 1981: 462-463). This form of approach allows the archaeologist to understand the deposition of artefacts, and possibly determine factors in stylistic change (Plog, 1980). There is opportunity for considerably more diversity in pottery technology when selecting temper
groups than when selecting appropriate clays (Garling, 2007: 105). Clays, having a higher relative value than tempers, would have had a greater expenditure of effort, either through procurement, negotiation or trade with other groups (Ambrose, 1992, 1993). This would have encouraged the continued use of suitable clay sources (Ambrose, 1992: 170). Clay analysis is therefore more likely to determine cultural continuity or discontinuity than temper. Changes to these clay resources, assuming the source was not exhausted, reflect population movement or a change in social parameters (Garling, 2007: 106). However, differences may be representative of technical rather then cultural change (Arnold, 1988).

Compositional analysis of ceramic components can be done in two ways. Directly, where probable relationships are established to geographically localised raw materials (Bishop et al., 1982). This is often the case with petrographic analysis. The other method is indirect, where differences in ceramic pastes are interpreted as representing the existence of geographically isolatable resources (Bishop et al., 1982). Both techniques complement each other, but often only one is utilised due to time and cost constraints. A study that utilises both can provide better results than one alone (Stark et al., 2000: 323). Chemical studies that do not utilise petrographic data are less likely to provide recognisable information about variation introduced through mineralogy (Bishop et al., 1982: 288). Middle-range theory is required to connect ceramic compositional profiles with cultural conventions governing resource selection and paste preparation (Arnold et al., 1991: 87).

### 2.5.3 Petrographic analysis

Petrographic analysis of the temper component in pottery allows archaeologists to determine the processing of raw materials, construction techniques employed, firing methods and what inclusions were added to the clay base (Eckert, 2006: 67). Sampling usually consists of up to 12 sherds from each compositional mineralogical group, as this is deemed sufficient to incorporate the compositional spectrum of any inclusion that might be present (Dickinson, 2006: 5). However, petrographic analysis requires considerable experience to be
highly accurate, and as such, can be defined as much of an art as a science (Bishop et al., 1982: 281; Rice, 1996: 167). Thin-sectioning can suffer from a lack of analytical accuracy and precision (Weisler, 1993: 69). Point-count analysis allows accurate quantification, and there have been attempts to utilise computer software to supersede technical expertise (Livingood and Cordell, 2009). However, such an approach is in its infancy, and petrographic training is still the most efficient method.

In the Pacific, Petrographic analysis has primarily focused on determining pottery provenance. Tempers can usually be identified as exotic or indigenous to an island, archipelago or tectonic province due to the variable geology of the Pacific and the lack of oceanic or continental river systems that can mix sand from multiple source provenances (Dickinson, 2006: 3). This allows pottery movement between islands to be traced in broad arcs, but further resolution, such as an attempt to understand social interaction based on temper composition, is usually impossible due to the limitations of petrographic analysis (Dickinson, 2002: 169; Dickinson and Shutler Jr, 1971: 192; Dickinson and Shutler, 2000).

There are several limitations in this form of analysis, namely: sample preparation is labour intensive; geological similarities can make sourcing inclusions difficult or impossible (Dickinson, 2002); calcareous and grog in high quantities can obscure counts of identifiable terrigenous grains (Cochrane and Neff, 2006: 378). Inclusions in the Pacific can be grouped as terrigenous, calcareous or a mixture of the two. Only terrigenous sands can provide unambiguous evidence in sourcing raw material (Dickinson, 2006: 3).

2.5.4 Chemical analysis

Chemical analysis allows the determination of major, minor and trace elements from a sample, giving a compositional ‘fingerprint’. Major elements give a general idea about type of mineral components in the material. Minor elements indicate the variations between one source material and another. Trace element analysis is much more variable, and can be more difficult to interpret (Velde and Druc, 1999). Looking at major and minor elements is usually more
beneficial than using trace elements (Summerhayes, 2008: 531-533). Even in regions considered relatively geologically homogeneous, clay deposits still contain variability in mineralogy and chemical composition (Bishop et al., 1982). Heterogeneous temper significantly attenuates the separation between clay source-related compositional groups than does a homogeneous temper with similar elemental concentrations (Neff et al., 1988: 170; Rice, 1996: 170). The use of Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS) has been shown to be effective at distinguishing clay compositional groups from the geologically simple Yasawa Islands in Fiji (Cochrane and Neff, 2006) and more recently, on Samoan ceramics from Tutuila (Eckert and James, 2011).

While chemical analysis can allow a much more comprehensive study on archaeological ceramics, there are some inherent problems involved in any chemical technique. Understanding the geological complexity of an island or a region is crucial. Social organisation within a site must also be considered, as pottery use may be internally differentiated. Production techniques and any influences this might have on pottery chemistry need to be understood, so as to reveal any potential contamination or alteration factors. Elemental concentrations in pottery can be affected by how the clay was treated before firing as well as post-depositional processes. In preparing the clay, potters are known to remove large inclusions (levigation), add further non-plastic inclusions, and mix together more then one clay source (Tite, 2008: 225). However, while these factors can affect the composition of the paste, it is not to a degree that prevents the determination of sufficient provenance information (Arnold, 2000: 339). In regards to the methodology itself, both sampling bias and analytical error are elements which can be eliminated or reduced, but must be accounted for if considered an issue.

Contamination may occur to several elements depending on depositional factors. Sodium (Na), potassium (K), magnesium (Mg) and calcium (Ca) can leach from ceramics in a range of environmental conditions (Freeth, 1967). Rare earth metals may also show some alteration during burial (Schwedt et al., 2004). Zinc (Zn) and Copper (Cu) can be affected at high firing temperatures over 850 degrees Centigrade. However, Dickinson (2006: 4) notes that the firing temperatures achieved by Pacific potters would have been insufficient to alter
the mineralogy of terrigenous inclusions in any way. Depending on the application of fresh or saltwater to clays before firing, sulphur (S), Manganese (Mn), Chlorine (Cl), Bromine (Br) and possibly Iron (Fe) concentrations can be altered (Allen and Rye, 1982: 111).

Depending on the chemical technique, samples are analysed in different ways. Several, notably Neutron Activation Analysis (NAA), have the sample crushed into one homogenous mixture, preventing independent analysis of the inclusion and clay components. Ambrose (1992) points out that for Pacific samples this has generally produced poorer results compared to petrography analysis. Successful clay determinations need to separate out inclusions so as not to affect the sherds chemistry (Dickinson, 2006: 5). Techniques, such as the electron microprobe, can target specific areas of the sherd, allowing archaeologists to distinguish between inclusions and clay components. The limitations to such a technique is that only a very small fraction of the sherd is analysed (Ambrose, 1992: 170). Thus, in order to achieve sufficient data for statistical analysis incorporating both the inclusion and clay component present in pottery, this technique needs to be used in conjunction with petrography (Dickinson, 2006: 4).

Based on the chemical data, each sample can be grouped into chemical paste compositional reference units (CPCRU). CPCRU’s are based on similarities in the chemical data, and also reflect accurately archaeological data (Summerhayes, 1987: 163-164). These groups then provide the foundation for determining the variety of sources utilised in pottery manufacture. CPCRU’s work on the premise that discrete groupings or clusters can be defined based on elementary similarity of pastes. These groupings can then be compared against known cultural information to check whether they are valid. Mineralogical studies are required to provide information on the nature of geological variation. In Samoa, information on pottery mineralogy is provided by both Dickinson (2006) and Petchey (1995), and in conjunction with chemical data, provide the necessary information to produce CPCRU’s.
2.6 Summary

Samoa was on the extreme frontier of Lapita colonisation and the last major outpost to be settled around 2,850 B.P. (Petchey, 2001). It is therefore likely that the colonising processes involved in occupying the western Pacific had begun to change. Colonisation was probably complex, subject to environmental pressures and cultural constraints. Lapita settlements in Fiji/West Polynesia were most likely in continued contact, at least initially, forming the basis of an early regional signature for what was to become a Polynesian society. On current evidence, it seems unlikely that there were two distinct migrations to Samoa. Continuity in the material culture suite argues for a cultural emergence from the initial Lapita settlers. Subsequent migrations might have occurred, but there is currently no material evidence of this. Further work will help refine the initial origins of the Samoan population.

While Samoan prehistory can be characterised in broad strokes, little detail is yet known about how early Samoan society emerged. It appears that both marine and terrestrial resources were being exploited early on, but to what extent remains unclear. What little is known about Samoan settlement patterns seems to suggest a similar process of colonisation, if a little delayed, to that of Tonga and Fiji. However, the lack of attention paid to post-Lapita sites have resulted in an absence of information for Samoan settlement patterns, which invariably leads to arguments based on evidence of absence. This needs to be remedied.

Production studies are still limited in the Pacific, and are virtually unknown from Samoa (see Eckert and Welch, 2009; Kirch and Hunt, 1993c for exceptions). A great deal of work has been carried out on determining the stylistic and morphological details of both Lapita and post-Lapita Samoan ceramics. The focus now needs to turn to understanding what the changes and similarities in production techniques mean for early Samoan prehistory. The following chapter summarises the major archaeological work undertaken so far on Samoa and provides information on sites from which the pottery was selected.
Chapter 3
The Samoan Context

3.1 Introduction to the geology and archaeology of ‘Upolu.

This chapter focuses on the geological and archaeological context of early settlement on ‘Upolu. This is useful for an analysis that relies on assemblages collected from several periodic excavations across temporally and geographically different sites.

The first section (3.2, 3.3) deals with the context of the archipelago, including the geological history of its islands, with a specific focus on the raw material constituents for pottery manufacture. Work undertaken by Petchey (1995) and Dickinson (1969, 1974, 1976, 1993; 2006; Dickinson and Green, 1998; Dickinson and Shutler Jr, 1971; Dickinson and Shutler Jr, 1979; 1996) has provided a good foundation for temper and clay analysis of pottery from different Samoan assemblages.

The second section (3.4) undertakes a brief examination of settlement pattern studies on the island of ‘Upolu so as to ascertain what previous studies have understood about early Samoan settlement. These studies have been limited in comparison to other island groups, but still provide a good initial starting point for settlement analysis. This is followed by an outline of all major
archaeological excavations undertaken in the archipelago (3.5), whose contextual understanding is crucial to the subsequent analysis. There is also a brief summary (3.6) on issues with existing radiocarbon applications and chronologies for the archipelago, reflecting the findings from Rieth's (2007) work.

The third and final section (3.7) outlines site details, including: location, age, material culture and site function, for each assemblage sampled. Such details are intrinsically vital when comparing several sites and their associated production systems
3.2 Location of Archipelago

The Samoan archipelago lies in the centre of the Pacific Ocean, forming part of an area now known as Western Polynesia. The Samoan islands are currently divided into two different political entities (Figure 3.1). The Independent State of Samoa (previously known as Western Samoa) includes the larger islands of ‘Upolu and Savai’i, as well as eight small islets, most notably Manono Island and Apolima Island, which bridge the gap between Savai’i and ‘Upolu. American Samoa is an unincorporated territory of the United States and includes the Manu’a Islands (Ofu, Olosega, Ta’u), Tutuila Island, Swains Island and Rose Atoll. These divisions are based on contemporary political factors; in prehistory the whole archipelago is considered inclusive of Samoan culture and settlement.

Figure 3.1: Map showing main islands in Samoan Archipelago
3.3 Geology of Samoa

Samoa is situated within the main oceanic basin, where the island types are restricted to those formed from basaltic shield volcanoes and low lying atolls (Dickinson et al., 1996: 84). 'Upolu and Savai'i are the oldest islands in the archipelago, with islands to the east having emerged later. The island of Ta’u dates to just 100,000 B.P. On 'Upolu, the Fagaloa volcanics may date to the Pliocene (5.3-1.8 million years ago) (Figure 3.2). On Savai'i, the Salani flow is younger, dating to the late Pleistocene (1.8 million-10,000 B.P.). Several other flows on 'Upolu (Mulifanua: 10,000-40,000 B.P.; Lefaga: <10,000 B.P.; Puapua: c. 5,000 B.P.; Apo: historic period) are much more recent (Figure 3.2). Several volcanoes are still active, with recent (1905-1911 A.D.) eruptions covering part of the north coast of Savai'i, and possibly burying archaeological sites (Martinsson-Wallin, 2007). Current calculations of island subsidence on 'Upolu are 1.4 mm per year, which would place any early sites located on the north coast under several metres of water (Dickinson and Green, 1998). Early inland sites may also have been buried under considerable colluvial/alluvial deposits (Clark and Michlovic, 1996). Alluvial deposits are rare on 'Upolu except around Apia and the Falefa district (Jennings, 1976a: 5).
Figure 3.2: Map of Upolu and surrounding offshore islands showing location of volcanic flows (redrawn from Wright, 1963)
3.3.1 Temper

Oceanic basalts characterise the temper of Samoan pottery (Figure 3.3). This temper resembles andesitic arc tempers found in other islands groups to the west with a relatively simple mineralogy, but has different proportions of grain types, often with large amounts of olivine. Calcareous tempers were also used, whose provenance cannot be ascertained based on the nature of the material (Dickinson and Shutler Jr, 1971; Dickinson and Shutler Jr, 1979).

![Map showing general distributions of four main classes of ceramic temper sands](redrawn from Dickinson and Shutler Jr, 1979: 993)

3.3.2 Clay

Due to its location in the tropics, high rainfall and reasonable range in altitude, Samoa has considerable variability in the quality of clay. Clays from the larger islands of Savai’i and ʻUpolu are formed in two different zones. On the coast, where conditions are warm and wet, soils are rapidly weathered from olivine basalts (Claridge, 1984: 42). Clays are generally non-sticky and non-plastic, consisting of gibbsite and iron oxides. Claridge (1984: 42) suggested that these soils are not very good for pottery manufacture, as they fire poorly and are
Chapter 3: The Samoan Context

hard to shape. At the higher altitudes of each island, the soil forms from basaltic ash and has high quantities of allophane and iron oxide, with allophane rapidly transforming into gibbsite. Kaolin, a much more suitable clay for pottery manufacture, increases in quantity at altitude due to the less intense weathering and cooler temperatures. Suitable areas of clay for pottery manufacture on ‘Upolu are found at the western end and in isolated outcrops, with the principle base rock being andesitic basalt derived from part of the Fagaloa volcanics. These soils have a higher plasticity, contain quantities of kaolin, are relatively deep (0.5-1 metre) and have high clay content (Claridge, 1984: 42-43).
3.4 Samoan settlement patterns

Within Samoa, settlement patterns are found to be roughly similar to contemporary sites from Tonga. Most Lapita sites in the West Polynesia region were located on the coast and were generally associated with protected embayments (Green, 2002: 134). The Lapita site of Mulifanua on ‘Upolu follows this pattern, as do early post-Lapita Samoan sites, such as ‘Aoa on Tutuila (Clark and Michlovic, 1996). Lapita settlement in Samoa is reflective of similar patterns from Fiji and Tonga, and therefore expectations are of internally differentiated activity areas (Green and Pawley, 1999; Sheppard and Green, 1991).

One particular issue with understanding early Samoan settlement patterns is determining the extent of Lapita occupation. However, the geomorphological processes occurring on Samoa, including: point loading, hydroisostatic decline in relative sea level, changes in biogenic sediment budget and increases in terrigenous sedimentation, may have either destroyed or covered many of these sites. Green (2002: 137) suspects many Samoan Lapita and early plainware sites will now be offshore and underwater (Figure 3.4).

Figure 3.4: Reconstructed shoreline of ‘Upolu at 2,700 years ago as predicted from marine topography and theories of general subsidence (a) for northwest and central coast, (b) for the embayments of Safata, Falealili, Aleipata and Fagaloa. Locations number 2 to 12 and ? indicate probable or possible Lapita sites. Number 1 is the Mulifanua – Lapita Ferry Berth Site (from Green, 2002)
Settlement in the early plainware period appears to have been almost continuous along the north coast of ‘Upolu (Figure 3.5). Casual use of the interior is suggested by the presence of pottery sherds at sites from Mt ‘Olo and Moamoa (Green, 2002: 134-137). Clark (1996: 453) sees the early permanent inland settlement at Falefa Valley as a unique occurrence under optimum conditions, and is not characteristic of Samoan plainware period settlement patterns. Davidson (1974: 161) strongly disagrees, arguing that the Falefa Valley settlement was not unique. This is supported by Green (2002: 137-138) suggesting that inland settlement was already established in the first centuries A.D., both on raised terrace flats, such as at Vailele, and within the inland valleys, such as at Sasoa’a, with most of the coast of ‘Upolu already occupied. Recent research suggests the pattern of settlement seen at European contact of broad and dense occupation along the central and northwest coast of ‘Upolu originated from settlement patterns established in the plainware period (Green, 2002: 139).

Within the settlements, it is argued that social organisation was based on house societies, which was typified by the ‘aiga social unit and reflected in the archaeological record by an emphasis on the household.

Figure 3.5: Map showing known locations of ceramic finds on ‘Upolu.
While the island of 'Upolu has had some focus on revealing early settlement patterns, other islands in the Samoan group have not had such investigation. On the island of Savai’i, only excavations at the inland Pulemelei mound (Martinsson-Wallin, 2007; Martinsson-Wallin et al., 2007; Wallin et al., 2007) have produced plainware pottery with secure dates. No secure coastal sites have yet been found on the island, either from lack of sites, geomorphological processes or have simply not yet been discovered (Figure 3.6).

Figure 3.6: Map showing known locations of ceramic finds on Savai’i.
Coastal settlement on Tutuila has been recorded at several sites (Addison et al., 2008a), with the site at ‘Aoa purported to be contemporary with the Lapita site of Mulifanua on the island of ‘Upolu (Clark and Herdrich, 1993; Clark and Michlovic, 1996). Inland settlement of Tutuila, around c. 2000 B.P., is suggested by the sites of Vaipito and Pava’ia’i, but this is not yet certain (Figure 3.7)(Rieth and Hunt, 2008: 4). It is argued that the first settlers arriving on Tutuila did not find a very hospitable environment, and these conditions may have lasted for 1,000-1,500 years (Addison et al., 2006: 14). According to Clark and Herdrich (1993: 171-173) this may have been due to the lack of gently sloping tablelands, and limited occupation at higher altitudes.

Figure 3.7: Map showing known locations of ceramic finds on Tutuila.
Excavations from the Manu’a Islands have revealed coastal settlement at the site of To’aga on the island of Ofu (Hunt and Erkelens, 1993; Kirch, 1993; Kirch and Hunt, 1993c; Kirch et al., 1990), which is also suggested to be contemporaneous with Mulifanua but lacks the characteristic Lapita signifier of dentate-stamping. Plainware pottery has also been found from surface finds near the coast on the islands of Ta’u and Olosega (Figure 3.8).

Figure 3.8: Map showing known locations of ceramic finds in the Manu’a Islands of Ofu, Olosega and Ta’u.
3.5 Major excavations of Lapita and Plainware sites in Samoa

Martinsson-Wallin’s (2007: 11) recent summary of Samoan prehistory shows that so far archaeological investigations have been rather limited. Archaeologists have focused on certain periods on certain islands, with some islands remaining relatively untouched. Large amounts of work have recently been undertaken in American Samoa through cultural resource management. However, the earlier research-driven surveys and excavations from the 1950s to the 1980s remain central to current cultural reconstructions of early Samoan prehistory.

3.5.1 Excavations on ‘Upolu 1950s

Excavation by Golson in 1957, on the northern coast of ‘Upolu at the site of Vailele (SUVa-1), revealed ceramics formed a distinctive part of early Samoan culture (Golson, 1969a). The earliest occupation layers contained pottery, which was reaffirmed by subsequent excavations (Green, 1969b) (Figure 3.9). This established the early ceramic component of Samoan material culture, and was the catalyst for subsequent large-scale research projects.
3.5.2 Excavations on ‘Upolu 1960s

The first sizeable archaeological research program targeting both site survey and excavation was led by Green and Davidson in the 1960s. Numerous prehistoric sites were located, but only a handful provided reliable stratigraphic provenance for ceramic deposits, namely the previously excavated site of Vailele, as well as the new site of Saso’a’a (Green, 1969b, 1974b). The results of this work established a descriptive base for the material culture sequence of early Samoan occupation (Martinsson-Wallin, 2007: 21).

The earliest and only as yet known Lapita site in Samoa, first identified by Hansen, who formed part of Green and Davidson’s team, was located at the Mulifanua ferry berth (Green, 1974c). Following this discovery, Jennings and his team further investigated the area, reaffirming the Lapita nature of the site and early Lapita settlement patterns (Jennings, 1974). The ceramics from Mulifanua are considered an Eastern Lapita style, similar to ceramics found at the Fijian site of Sigatoka (Petchey, 1995: 149, 157). Contact between Samoa and Fiji is indicated by the presence of one exotic sherd from the site (Petchey, 1995: 89).
3.5.3 Excavations on ‘Upolu 1970s

Exploration of early Samoan sites was continued by two more projects in the 1970s (Jennings, 1976a; Jennings and Holmer, 1980). Both focused on the north coast of ‘Upolu, locating several more sites containing early plainware pottery. Ceramics from the site at Jane’s Camp provided a comparative study against previously excavated plainware ceramics from Sasoa’a and Vailele. The island of Manono, off the west coast of ‘Upolu, was also explored in more depth, with two ceramic bearing sites uncovered. One site, Falemoa, provided reasonably secure stratigraphy for early ceramic bearing deposits. Jennings (1976a) agreed with Green’s assessment of an internal plainware division, thin fine ware of a reasonable quality, with the poor quality thick ware representing the last stage of pottery production in Samoa.

From this excavated pottery, Smith (1976a) undertook principal component analysis (PCA) on a number of sherd variables, including colour and thickness. This approach was favoured because Smith believed that Green had not considered enough variables to accurately characterise the transition from Lapita into plainware. Smith (1976a: 86) noted that the difference between thick ware and thin ware had no objective measurement, and chose an arbitrary thickness of 10 mm or more to define thick ware. He also added another category “orange ware” to designate any pottery that had an orange wash. He concluded that instead of distinctive periods of Samoan pottery, Green’s divisions were merely arbitrary points on a continuum of ceramic demise in quality and decoration (Smith, 1976a: 94-95).

Further ceramic analysis was undertaken by Holmer in order to determine whether Smith’s PCA results could be duplicated (Holmer, 1980b: 104-105). He agreed with Smith’s ceramic distributions, noting that the division of attributes into groups had been entirely subjective, done in a traditional typological manner. A new sequence for Samoan ceramics was outlined, beginning with ‘Lapita Brown Ware’, which later developed into ‘Samoan Brown Ware’ with two different series, one based on pottery from the island of Manono and the other from pottery on ‘Upolu. It was noted that while both series showed
similar trends, differences were thought to reflect regional variation. Based on this classification, it was thought that the sites of Jane’s Camp and Paradise on the island of ‘Upolu, and the sites of Potusa and Falemoa on the island of Manono were all roughly contemporary with one another (Figure 3.12)(Holmer, 1980b: 115).

3.5.4 Excavations on Ofu in the 1980s

Following the work of Jennings, Kirch and Hunt led a team in the excavation at the site of To’aga, located on the island of Ofu (Figure 3.10)(Kirch and Hunt, 1993b; Kirch et al., 1990). Their major research concern focused on reconstructing Ancestral Polynesian Culture through understanding a variety of aspects of the site, including technology, economy, settlement patterns and socio-political organisation (Kirch and Hunt, 1993b).

Figure 3.10: Map showing location of To’aga excavations at Site AS-13-1 on the island of Ofu (redrawn from Kirch and Hunt, 1993a)
Chapter 3: The Samoan Context

Excavation uncovered plainware pottery, which bore strong similarities to plainware found in previous excavations from ‘Upolu. Once again it was argued that the pottery showed a gradual shift in plainware from thin to thick ware, suggesting this trend occurred across the Samoan archipelago (Kirch and Hunt, 1993a). What was unusual about this research was the argument for contemporaneity with the Mulifanua Lapita site from ‘Upolu, even though no dentate-stamped pottery was found. It was argued that the thin fine ware from the site was similar to plainware components from Mulifanua. Based on radiocarbon dating, the early occupation at To’aga was thought to span from 2,800 to 2,400 Cal years B.P., a late Lapita time frame (Figure 3.12)(Kirch, 1993: 91). Kirch and Hunt (1993c) noted that the lack of dentate-stamped pottery may have been caused by one of three things: that the islands of Manu’a were isolated from the larger islands to the west, insufficient sample size, or that dentate pottery is still covered by a layer of talus further inland. Based on the idea that the To’aga site represents Lapita colonisation on the island, Kirch and Hunt (1993c) found it difficult to understand why Lapita peoples did not continue their exploration into central Polynesia.

Both petrographic and chemical analysis was used to study ceramics from the site. Most of the sherds appeared to be made from local materials, with the exception of the early red slipped ware. There was no compositional difference between the thin and thick ware categories. Over time there appears to be a decline in the number of clay groups, reflecting a homogenisation and simplification in the ceramic assemblage. It was suggested that thick ware should be considered as a stylistic trait rather than a functional one, as styles may vary independently of functional ones (Hunt and Erkelens, 1993).

3.5.5 Excavations on Tutuila 1980s

In the late 1980s excavations were undertaken at the site of ‘Aoa on the northern coast of Tutuila (Figure 3.11)(Clark and Herdrich, 1993; Clark and Michlovic, 1996). Pottery from the site showed no evidence of dentate-stamping, but was divided by the authors into thin and thick ware vessels. Initial occupation of the site was thought to be around c. 3,000 B.P., which placed it
within a similar occupation time frame of the Lapita site of Mulifanua (2,970-2,640 Cal B.P.) (Petchey, 2001) and the then recently excavated site of To’aga (2,800-2,400 Cal B.P.) (Kirch, 1993: 91). Rieth’s (2007: 18-19, 135) application of chronometric hygiene rejected dates corresponding to the period of colonisation at ‘Aoa due to large standard deviations and materials that had combined isotopic fractionation. ‘Aoa has also been affected by geomorphological and sea level changes (Clark and Michlovic, 1996: 152) and thus, the chronology of the site is disputed on these grounds. Excavations suggested that there was no obvious development from thin ware to thick ware over time (Clark and Michlovic, 1996). Plainware was found in the lowest layers of occupation, and in the upper layers as well. Clark has controversially argued that this represents the continuation of plainware from early settlement until around 1650 A.D., which is 1,000 years after pottery had disappeared from other areas of Samoa and Tonga (Clark and Michlovic, 1996: 163; Clark et al., 1997).

Figure 3.11: Map showing location of ‘Aoa excavations at Site AS-21-5 on the island of Tutuila (redrawn from Clark and Michlovic, 1996)
Chapter 3: The Samoan Context

3.5.6 Excavations on Tutuila 2000s

Recent excavations have found plainware pottery from the Aganoa site and the Vainu’u site on Tutuila (Eckert, 2006; Eckert and Welch, 2009). Analysis of the pottery has shown that both grog and basalt temper were regularly used. Based on this evidence, it is argued that there were two contemporary production groups within the Samoan archipelago. These two pottery styles are the result of different decisions made by different potters, but using the same basic method. It has not yet been determined whether the pottery was produced locally or imported (Eckert, 2006).

3.5.7 Excavations on Savai’i 2000s

Plainware was discovered at the base of the Pulemelei mound in 2002-2004, which is located within the Letolo plantation on Savai’i. While the primary focus of the Pulemelei excavations was to determine what the mound had been constructed for, the discovery of pottery indicated early settlement of the island, and once again showed strong stylistic similarities to previously excavated pottery from both ‘Upolu and further afield in American Samoa (Martinsson-Wallin, 2007; Martinsson-Wallin et al., 2007; Wallin et al., 2007).

Dates for the ceramic occupation layer of the Pulemelei site have been placed as early as 2,130-1,920 Cal B.P. (Rieth, 2007: 25). The occupation layer on the south side of the Pulemelei mound contained pottery, earth ovens and stone tools. This layer is thought to represent a dispersed settlement pattern with scattered dwellings (Martinsson-Wallin et al., 2007: 54-57). Based on petrographic analysis, tempers were added deliberately by the potters and predominantly derived from stream sands. They are distinct from tempers found on other Samoan islands, and have been interpreted as indigenous to the island of Savai’i. It is suspected that temper would have been collected from channels or banks in one of the nearby stream courses.
3.6 Radiocarbon chronologies

The collection of radiocarbon dates in Samoa has been ongoing since the 1960s, and as a result has seen vast changes to the methodologies applied in obtaining these dates. The accumulated dates were synthesised recently by Rieth (2007) to provide a more accurate chronology for the Samoan archipelago. Rieth (2007: 1) argued that a “well-defined chronology provides the temporal support for addressing broader research questions regarding resource exploitation, agricultural expansion and intensification, competition and interaction, and social complexity”. Through chronometric hygiene Rieth excluded a large number of dates based on varying criteria.

One notable issue that has subsequently arisen is a gap of several centuries between the Mulifanua Lapita site and the earliest plainware deposits (Figure 3.12). The large probability distributions of radiocarbon dates from ‘Aoa and To’aga, both theoretically contemporaneous with Mulifanua, do not allow sufficient precision to determine the initial colonisation timeframe. In conjunction with the lack of dentate-stamping from the ceramic assemblages, the occupation of To’aga is suggested to have been around c. 2,500-2,400 Cal B.P. This would indicate a time lag of approximately 500-200 Cal years from Lapita settlement at Mulifanua, classifying the site based on chronology as fully plainware without elements of Lapita colonisation. Countering the idea of ceramic production lasting beyond 1700-1500 B.P. in some areas of Samoa (Clark and Michlovic, 1996), the revision of these dates would suggest that pottery had ceased to be produced throughout the archipelago by 1,500 Cal B.P.. From c. 1,500-1,000 Cal B.P. pottery is considered to be absent from all known cultural deposits. This would bring the cessation of pottery back into the time frame of 1,500 B.P., originally proposed by Green and Davidson (1974a), as well as aligning Samoa’s chronology more closely to that of the Tongan ceramic sequence (Rieth, 2007: 83-87).
Chapter 3: The Samoan Context

Figure 3.12: Chart of radiocarbon dates from key 'Upolu and Manono sites (note * denotes unsecure date as determined by Rieth's (2007) chronometric hygiene measures, all dates calibrated 2σ).
3.7 Selected Lapita and Plainware Sites

3.7.1 Mulifanua:

3.7.1.1 Site location

Mulifanua is located on the northwest coast of ‘Upolu, with the site currently under approximately 2.2 metres of water, 114.3 metres offshore (Figure 3.13). A geological reconstruction of the area in which the Mulifanua site is located suggests that the original environment was one of a sandy beach adjacent to the shore on an arm of a sheltered lagoon, opposite a possible pass in the reef (Figure 3.14)(Leach and Green, 1989: 326).
3.7.1.2 Age

Based on turtle bone collagen from dredging spoils the accepted date for the site is 2,970-2,640 Cal B.P. (Petchey, 2001).

3.7.1.3 Material culture

Collected from dredging spoils associated with a ferry landing, pottery, lithic material, coral and bone have been found. Pottery from the site, while lacking any stratigraphic provenance, has both decorated Lapita ware and plainware. Seven basic forms were determined by Petchey (1995: Table 3.8), including: shallow bowls with rounded and flat bases; deep rounded bowls; deep square bowls; deep globular pots with collar rims; shouldered bowls with round and flat bottoms; constricted neck vessels. The plainware pottery appears to be very similar to the thin fine ware found from Sasoa’a (see section 3.7.5), with the exception of an added jar form to the uniform bowl shapes.
Chapter 3: The Samoan Context

Around five to eight percent of the sherds have been classed as decorated (Green, 1974c: 171-173; Jennings, 1974: 176), with dentate-stamping, incision and/or appliqué present. Red slip is present, but, due to the depositional nature of the pottery, it is difficult to identify (Petchey, 1995: 59). Minor decoration elements include circular impressions and nubbins, with gouging on two sherds (Petchey, 1995: 60, Figure 3.7a). Petchey (1995: 60, Table 3.5) identified eight design elements and fourteen motifs, which share close affinities in design to Tongan and early Fijian Lapita sites.

Leach and Green (1989) also recorded two adzes from the site. One consisting of coarse-grained, grey basaltic andesite, was hammer-dressed and is curvilinear in cross-section. Based on morphology and geology, a Tongan source is likely (Poulsen, 1987: 2). The second adze is probably Samoan in origin, consisting of olivine basalt and has a plano-convex profile (Leach and Green, 1989).

3.7.1.4 Site function

The site is estimated to cover an area greater than 3,000 m². Cultural material is located along a narrow band that runs parallel to the beach, with scattered sherds closer to shore (Petchey, 1995: 49). Recreating how the site was utilised is close to impossible due to its location under water. Jennings (1974: 177-178) believed that the black soil found in association with the pottery is indicative of the same dark organic stain found in sites that have substantial or intensive periods of occupation. However, Green (1995 as cited in Petchey, 1995) noted this may just be simply a zone of tidal muck.

3.7.2 Falemoa (SM17-2):

3.7.2.1 Site location

The Falemoa site was found on Manono’s northwest coast and sits over a basalt hillock around 10 metres inland from the present day beach (Figure 3.13,
Figure 3.15. Stratigraphically the site is complex, with stratum II containing the earliest artefacts from the site and having a heavy organic stain. The provenance information for the artefacts was considered to be reliable, unlike the disturbed nature of the Potusa site to the south (Lohse, 1980). A wide reef, part of a larger reef network to the west, surrounds the island. The island has similar exposed lava flows, stony ground and shallow soils to those of western 'Upolu (Jennings and Holmer, 1980: 21). It is likely that Manono was joined to 'Upolu at the time of Lapita settlement (Green, 2002).

![Figure 3.15: Map showing location of Falemoa excavations at Site SM17-2 on the island of Manono (redrawn from Lohse, 1980)](image)

3.7.2.2 Age

Radiocarbon dates obtained from stratum II gave a date of occupation at 2610 ± 50 B.P. for the site. Rieth (2007) has discarded this date because there does not appear to be a cohesive chronology in relation to the stratigraphy. If we accept the calibrated date based on contextual arguments for the site, we would get a date of first occupation of the site at 2,290-2,030 Cal B.P. (Lohse, 1980).
Chapter 3: The Samoan Context

3.7.2.3 Material culture

Along with the pottery, shell beads, shell and bone debris, fishhook fragments, possible shell tools, and adze fragments were collected from strata containing pottery at Falemoa. Potsherds were also found through stratum III, stratum IV, stratum V, stratum VI and stratum VII. It was noted that while strata VI and VII showed signs of disturbance, the layers below this showed no artefact displacement (Figure 3.16).

![Schematic cross section of strata observed during the Falemoa Excavation. No Scale; degree of seaward slope exaggerated (redrawn from Lohse, 1980)](image)

Figure 3.16: Schematic cross section of strata observed during the Falemoa Excavation. No Scale; degree of seaward slope exaggerated (redrawn from Lohse, 1980)

3.7.2.4 Site function

The site has been interpreted as an early living site, with multiple, brief, occupations. Structures were not uncovered in the earlier layers, suggesting temporary campsites. The numbers of occupants appear to have been very low (Lohse, 1980: 23-32). Analysis of the midden indicates that there was a diverse shellfish habitat in close proximity, which seems to have resulted in a favouring
of shellfish over fish. Fish that were caught appear to have been largely reef dwelling. Both fish and shellfish decreased in number over time. Shell scrapers found at the site are interpreted as representing some form of horticultural use (Janetski, 1976b: 117-131).

3.7.3 Jane’s Camp (Faleasi’u)(SUFL-1):

3.7.3.1 Site location

Jane’s camp, also known from the name of the nearby village as Faleasi’u, is located around 16 kilometres west of Apia (Figure 3.13, Figure 3.17). There is an extensive reef around one-to-two kilometres offshore, which currently provides a lagoon environment (Smith, 1976b: 61-65).

Figure 3.17: Map showing location of Jane’s Camp excavations at Site SUFL-1 on the island of ‘Upolu (redrawn from Smith, 1976b)
3.7.3.2 Age

A date of $2,550 \pm 50$ B.P. was taken from a *tridacna maxima* shell from stratum I. Rieth (2007: 29) accepts the dating, giving the earliest date of 2,320-2,080 Cal B.P. for the site.

3.7.3.3 Material culture

Pottery excavated from the site has similar tempers to other Samoan plainware sites. The predominant vessel form appears to be a bowl with an incurved rim, with an absence of surface decoration except for a small amount of incision. Around eight percent of the sherds are coloured with a bright orange wash (Smith, 1976a: 84). A segment of shell ring was found at the site and is usually considered a component of the Lapita cultural assemblage (Green, 1992). Worked shell, including branch coral files, worked bone and conus shell scrapers bear strong similarities to shell artefacts found at contemporary sites from Tonga (Janetski, 1976a: 71-74).

3.7.3.4 Site function

Jennings (1976b: 27) demonstrated that the site was utilised for several hundred years in a discontinuous fashion and has clearly stratified layers (Figure 3.18). There appears to be a shift within the site from one of reef exploitation to one of horticulture and domesticated animals over time (Janetski, 1976b: 75-82). Bird bones, difficult to identify, were found in limited numbers. Fish does not appear to have been a major component of the diet, but shellfish was acquired from the lagoon environment. Some shellfish species such as *Trochus*, decreased over time, and were replaced by bivalves. Two scrapers are suggested to represent tools for preparing of vegetable foods. The lack of pig bone is thought to be associated with the early nature of the site. While they are found in abundance at other younger sites, such as Lotofaga, pigs may not have been present in Samoa early on.
Chapter 3: The Samoan Context

3.7.4 Vailele (SU-Va-1)(SU-Va-4):

3.7.4.1 Site location

Vailele village is located east of Apia on the north coast of 'Upolu (Figure 3.13). Several different mounds underwent excavations, with the sites of SU-Va-1 (Figure 3.19) and SU-Va-4 (Figure 3.20) producing the most pottery. The area in which the sites are located sits on top of the Salani Volcanics, representing the older soils of the drier areas in 'Upolu with low to moderate fertility.
Chapter 3: The Samoan Context

Figure 3.19: Map showing location of Vailele excavations at Site SU-Va-1 on the island of 'Upolu (redrawn from Green, 1969b)

Figure 3.20: Map showing location of Vailele excavations at Site SU-Va-4 on the island of 'Upolu (redrawn from Terrell, 1969)
3.7.4.2 Age

Occupation of SU-Va-1 is placed at 1,950-1,690 Cal B.P. (Rieth, 2007: 29). Rieth (2007: 117-118) has rejected all radiocarbon dates from SU-Va-4. However, Terrell (1969: 166), based on the stratigraphy of the site, believes that occupation was likely between 2,000-1,500 B.P., with radiocarbon dates favouring settlement towards the earlier date. The pottery found from the SU-Va-1 site appears to be very similar in style, suggesting that layer F-1 from SU-Va-4 is either contemporary or antecedent to the ceramic horizon of layer 5 from SU-Va-1, with Terrell favouring the latter (Figure 3.21)(Terrell, 1969).

Figure 3.21: Chart of early radiocarbon dates for Vailele excavations in relation to those from SU-Va-4 (redrawn from Terrell, 1969).
3.7.4.3 Material culture

A range of material culture has been excavated from sites in the area. Pottery, adzes, volcanic glass described as obsidian, basalt flakes, cores, pebble chopping tools, hammer and anvil stones, net sinkers, octopus lures, anchors, stone files and grindstones have been recovered (Green, 1969b: 127-137; Terrell, 1969: 166-175).

The majority of the pottery discovered from SU-Va-1 was located within layers 5 and 6 and associated with adzes and fire-cracked rock (Figure 3.22). The pottery was described as coarse, thick and of local manufacture with a high proportion of basaltic grit. Golson noted that the vessel styles were extremely restrained, mainly in the form of simple bowls (Golson, 1969b). Excavations by Green and Davidson (1969b: 112) found that the pottery within layer 5 appears to be very similar, if not identical, to that found by Golson. One exception to this appears to be the identification of several thin walled vessels, well finished and with fine temper. This was suggested to be an earlier form of pottery, and is found in layer 5 either by its continued production or by chance. Rims with parallel sides seem to be in equal proportion to those with expanded sides, with a similar division between straight and incurved rims. Vessel reconstruction from the site indicates two different kinds of low open shallow bowls of a fair size, which seem to be similar to the kava bowls found in Fiji at this time (Green, 1969b: 116-130).
Most of the sherds recovered at SU-Va-4 were from the lower part of the F-1 layer (Figure 3.23). These sherds were classified as a thin plainware with fine temper, and were geologically different from the thicker coarse tempered pottery. A basic similarity between thin and thick ware was seen in the rim forms and vessel shapes, which is supported by some thick-walled body sherds that have a fine temper (Dickinson, 1969: 271). There appear to be more rim forms of the thin fine ware, with the additional vessel shape of an open mouthed jar. Based on rim and vessel form, as well as manufacturing techniques, continuity in the ceramic tradition has been argued by Terrell (1969). It is suggested that the pottery forms from both sites indicate a separate ceramic tradition from the contemporary ceramics of Tonga. This would reinforce the idea that if the Fijian, Tongan and Samoan pottery horizons were related in the early 1st-2nd century A.D., then this was through a common ancestral tradition, not one derived from direct interaction (Terrell, 1969: 158-175).
3.7.4.4 Site function

Function of the site during the early layers at SU-Va-1 is not known, but layer 5 has been interpreted as an occupation horizon (Figure 3.23). Green and Davidson (1969b) expanded on the importance of layer 6, arguing that it was associated with the occupation and features of layer 5. Layer 6 appears to be the earliest occupation of the site, with a limited occurrence and unknown period of occupation. Layer 5, however, was more productive, with shallow pits appearing earlier than large deep post-holes. They suggest that the pits may have had a variety of functions, but a possible one is as a store for fermented breadfruit. Overall, the stratigraphic sequence is seen to be one of considerable duration, with only one major interruption over 2,000 years. The early use of VA-Su-4 is also somewhat of a mystery, with the function of several pit features at the base of F-1b unknown (Terrell, 1969: 175).
3.7.5 Sasoa’a (SU-SA-3):

3.7.5.1 Site location

Saso’a is notable for its inland location within the Falefa Valley (Figure 3.13, Figure 3.). Soils within the inner part of the valley are alluvial, with generally moderate to low fertility levels, with the exception of Sauniatu sandy clays, which have a high natural fertility. Suitable soils for agriculture are restricted, as a large amount of the valley is occupied by swamp. Access to the valley is easiest from the northern coastline. Sasoa’a was located on flat swampy land, close to the Falefa River and near very fertile soils. The excavators of the site suggested that the suitability of the soils for agriculture quickly drew early Samoan inhabitants to the area (Green, 1974b). On summarising the habitation of the upper Falefa valley, Davidson (1974: 155-162) noted that Sasoa’a was definitively settled by 1,800 years ago, but at that time the valley would have already been extensively occupied.

Figure 3.24: Site plan of SU-Sa-3 showing excavated area (from McKinlay, 1974)
3.7.5.2 Age

Rieth (2007: 115-116) has discounted radiocarbon dates from the site because they were analysed prior to the 4,500 series by the Gakushuin Laboratory. These dates, when compared to other laboratories, have been shown to be possibly anomalous, and therefore, any of these dates are excluded unless supported by additional dating. The original dates from Green and Davidson’s excavation date the site to 1,900-1,530 Cal B.P., which would place it temporally near the end of the ceramic sequence (Green, 1974b: 113-115). Based on stylistic analysis of the pottery and the site’s location, it is likely that occupation at Saso’a would have been around the first to third centuries A.D.

3.7.5.3 Material culture

The material artefacts from the site were considered the best yet found in Samoa to document the end of the Samoan plainware sequence. Pottery, adzes, flakes, cores, volcanic glass described as obsidian, grindstones, hammer stones, a chopping tool, and notably a red colouring agent were all found at the site. Pottery was ascribed to two classes, coarse-tempered thick ware and fine-tempered thin ware. Vessel reconstruction of both thin and thick wares shows that thin ware has more vessel shape variation, as well as substantially higher rates of breakage. Similar ratios of rims were present from pottery at Saso’a to those found from Vailele. It is stressed that the thick ware from the site is virtually identical to the thick ware found from layer 5 at Vailele (SU-Va-1). The material culture similarities between the sites is argued to be a good case for continuity between the early and later Samoan phases, and as a result there is no basis for arguing a presence of an unrelated cultural complex preceding the aceramic phase (Green, 1974b: 109-153).

3.7.5.4 Site function

A relatively large population appears to have already been established in Samoa by 1800 B.P., with pottery found in the two earliest layers of the Saso’a
site (Figure 3.25). Pottery found at three plainware sites in the Falefa valley (Saso'a’a, Leuluasi, Puna) indicates that inland settlement was already extensive. Pottery was found across a considerable area, but appears to have been limited to the fertile soils found in the bottom of the valley. The lack of pottery misfires, waste products or tools of manufacture have been seen to indicate that while pottery was used at the site, it was not necessarily made there. As the vessel shapes appear to be mainly open bowls, this seems to reflect the functional role of the pottery within a domestic Samoan context. While some bowls show evidence of cooking or heating of food, it is not universal, suggesting other, additional uses. Adzes from the site support a domestic use, being of a size and shape that would have suited fairly precise work. A small proportion of the adzes are heavier and more simplistic, suggesting use in shaping and dressing wooden household artefacts. The domestic context in conjunction with structural data is considered extremely useful in understanding the cultural complex of Samoa at this time. While the valley was occupied, it was by no means the most attractive location, and its settlement indicates that the population on the island had already built up to a point where desirable inland locations were now being settled after coastal locations had been occupied (Davidson, 1974; Green, 1974b).
Chapter 3: The Samoan Context

Figure 3.25: Principal cross-sections, SU Sa 3 (from Green, 1974b)
3.8 Summary

More than fifty years of archaeology in Samoa has led to Lapita and plainware cultural divisions for Samoan prehistory. Extensive survey and excavations have revealed Lapita settlers undertook initial colonisation of the archipelago, probably from Fiji or Tonga. From Lapita settlement, there was a shift in the material culture, with the loss of the distinctive dentate-stamped pottery that characterises Lapita society. Settlement appears to have spread out across the islands, with recorded plainware sites on every major island. It appears that early settlers favoured good access to marine environments, utilising a tool kit inherited from Lapita ancestors. Once optimal coastal areas had been occupied, settlement moved inland, evident from several sites discovered in the Falefa Valley on ‘Upolu and from the Pulemelei mound in Savai’i. Excavations from American Samoa have contested whether dentate-stamped pottery survived for any period of time at all, with the possibility that this Lapita decorative element died out very quickly in Samoa. A synthesis of radiocarbon dates (Rieth, 2007) has shown a gap of around 300 years between the only known Lapita site at Mulifanua and the earliest sites with plainware deposits. Whether this is the result of population absence or lack of site discovery has yet to be established. After using pottery for over a thousand years, production finally ceased, mirroring changes in the Tongan archipelago, and ending the plainware period.

Summaries for the single Lapita site of Mulifanua and the four main plainware sites of Falemoa, Jane’s Camp, Vailele and Saso’a’a have provided a context to archaeology on ‘Upolu. Utilising the known geology of the islands, as well as information gathered from these sites, the following chapter outlines the selection process of pottery assemblages from these sites and the stylistic and chemical analysis undertaken. This methodology was employed to ascertain production patterns and community mobility of early prehistoric Samoan settlement on ‘Upolu.
Chapter 4
Methodology

4.1 Method overview

Archaeology in Samoa, as outlined in the previous chapter, has shown that while we understand the basic tenants of settlement location and occupation, we still know little about how these settlements operated and interacted. Questions have arisen on how Samoan pottery production was organised on the island of 'Upolu, and how this relates in the larger Fiji/West Polynesia settlement sphere. Chapter 2 showed that production and mobility systems are coming under increasing focus by archaeologists on other island groups, but are still a notable paucity in Samoa, especially on 'Upolu. By understanding Samoan pottery production we can begin to make inferences on settlement behaviour, and fill a gap in the region. Previous petrographic work (Dickinson, 2006; Petchey, 1995) has revealed that pottery was almost exclusively produced in the Samoan archipelago, but these studies lack the fine-grained specificity and intra-site comparisons needed to understand how these production systems worked on an island level. By using physico-chemical analysis to target both inclusions and the clay matrix of different pots from geographically and temporally distinct sites on 'Upolu, we can begin to answer
questions on pottery production systems, and subsequently reveal patterns of settlement mobility and structure in the initial settlement phases of Samoan occupation.

This chapter has five sections outlining the methodology employed in this study. The first (4.2) explains how sherds were sampled from collections in the Auckland War Memorial Museum. The second (4.3) outlines the stylistic analysis undertaken on the sampled assemblages. The third (4.4) details how temper groups for each assemblage were grouped and the analysis that was undertaken. The fourth section (4.5) explains the chemical analysis of both the inclusions and clay matrix, including the multivariate statistics employed and justification of their use. The final section (4.6) details the limitations of this study and how these could be avoided or improved upon in any future research.
4.2 Sampling strategy

The pottery analysed in this study was selected from collections housed in the Auckland War Memorial Museum. Each of these collections was selected to provide a good representation of the extended chronology and variations present in the Lapita and plainware periods in Samoa. A sample of sherds from each collection was used for chemical analysis. In order to provide strong provenance information, collections were selected based on two major criteria. The collection had to have been archaeologically excavated and have good stratigraphic provenance for pottery collected. The exception to this was pottery from Mulifanua, as this has been assigned to the Lapita period, thus alleviating to some extent issues of provenance.

Every sherd available from the collection for each site was examined for diagnostic elements (Table 4.1). Diagnostic elements were classified as: rim, base, carination, shoulder or decorated component. Every diagnostic sherd was sampled for further analysis. Full access to sherds from Mulifanua, Jane’s Camp and Sasoa’a was not obtained and therefore only partial analysis was undertaken on these assemblages. Analysis of subsets of the Mulifanua assemblage by other groups and the nature of the site means sherds from the site are only partially representative of the number of sherds recovered. Full access to the complete Jane’s Camp and Sasoa’a assemblages was not possible. The 55 sherds from Jane’s Camp in the current museum collection represent a very small subset of the original 1,642 excavated.

<table>
<thead>
<tr>
<th>Site</th>
<th>No. of Sherds Excavated</th>
<th>No. of Sherds Analysed</th>
<th>No. of diagnostic sherds</th>
<th>No. Sampled for microprobe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mulifanua</td>
<td>5,500+</td>
<td>4671*</td>
<td>169*</td>
<td>50</td>
</tr>
<tr>
<td>Falemoa</td>
<td>754</td>
<td>693</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>Jane’s Camp</td>
<td>1,642</td>
<td>55*</td>
<td>9*</td>
<td>8</td>
</tr>
<tr>
<td>Vailele</td>
<td>986</td>
<td>798</td>
<td>78</td>
<td>37</td>
</tr>
<tr>
<td>Sasoa’a</td>
<td>5,925</td>
<td>&lt;5,925*</td>
<td>135*</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 4.1: Summary of sherd numbers examined and analysed by site (note * denotes partial access to excavated assemblages)
4.3 Stylistic Analysis

All diagnostic sherds were subsequently analysed in the laboratory for additional information (Appendix A). Each sherd had a unique identification number assigned, as well as the allocated museum identification number. If possible, provenance information of square, level, and layer were recorded. If previous classifications existed for sherds from the site these were identified accordingly. These included: thin or thickware division, restricted or unrestricted vessel type, vessel form based on Green’s (1974b) classification or other related classificatory schemes for Lapita pottery from Mulifanua.

All measurements were taken in millimetres using digital callipers. Length was measured for each sherd along the rim. Six measurements were taken to ascertain sherd thickness, three measurements were taken from the rim if possible, and three were taken along the body of the sherd opposite the rim edge. This allowed for a more accurate measurement of vessel body thickness than if the measurements were confined solely to the rim. This is similar to the methodology for sherds found at the To’aga site (Hunt and Erkelens, 1993: 128). All sherds were weighed in grams.

Presence or absence of decoration was noted for each sherd. If decoration was present its location and technique of application was noted. Several decorated sherds from Mulifanua were assigned a motif classification based on Petchey’s (1995) analysis. As rim sherds and their orientation are the most useful in determining vessel forms, rim direction, rim profile and lip profile were recorded for each sherd based on Summerhayes’s (2000a: 35) classificatory system. There were, however, difficulties involved in lip profiles of sherds from Mulifanua due to the post-depositional sub-marine processes and so these profiles are likely to be misrepresentative. Cross-sections for each rim, shoulder and base profile were drawn (Appendix B). Orifice diameter was measured when the pottery had a rim length exceeding 50 mm, as anything shorter was deemed insufficient to provide an accurate determination.

Vessel forms were determined by rim and shoulder profiles, and summarised by site as common (n>3), present (n=1-3) or absent (n=0). Each sherd was assigned a form based on Green’s (1974d: Fig 90) original
classification, and subsequent reprisal by Petchey (1995: Table 3.8). If vessel form could not be identified it was classed as Not Applicable (NA). These vessel forms were then modelled using the 3D modelling software “Blender” to provide a three-dimensional model. Rim direction was also summarised by site to determine the number of restricted and unrestricted forms.

Decoration was recorded by site as present or absent based on the inherent difficulties in quantifying sherds from Mulifanua. Possible decoration was: incision, dentate stamping, finger impression or appliqué. Slip was grouped separately as present or absent as it could be found in conjunction with other forms of decoration.

The robustness of a classificatory scheme based on sherd thickness was undertaken using a Dip Test to determine whether bimodality was present (i.e. thick or thin groups)(Hartigan and Hartigan, 1985). Sherd thicknesses were tested from all five sites, and then individually restricted by site to Sasoa’a, Vailele and Mulifanua. This was undertaken using the statistical program “R”.
4.4 Temper Analysis-binocular determinations

Temper groups were established for all diagnostic sherds using a low powered binocular microscope at 15x magnification. Sherds were grouped by the nature of their temper composition (Table 4.2). The minerals present for each temper group (or subgroup in the case of temper group 1) were then summarised by site (Appendix C). Photographs taken at 15x magnification were provided for each sherd (Appendix D). Inclusion density was recorded using a percentage density chart. Inclusion size was measured on the Wentworth scale using a grain size template viewed under 15x magnification. These were confirmed by existing petrographic work undertaken by Green (1974d), Dickinson (2006) and Petchey (1995). This provided an accurate coverage of all the potential mineral groupings from the assemblage (Summerhayes, 2000a; Tite, 2008). Five major temper groups were defined in this study, with a sixth identified by Petchey (1995) that was not found in these samples. The first temper group was split into three subgroups based on the crystal to lithic ratio. Sherds were classified based on Petchey (1995) and Dickinson’s (2006) original groupings.
Table 4.2: The division of temper groups with image of clay matrix at 15x magnification and description based on Petchey (1995) and Dickinson (2006)

<table>
<thead>
<tr>
<th>Temper Group</th>
<th>Matrix at 15x</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td></td>
<td>Ferromagnesian Basaltic Temper: (a) Crystal/Lithic (55-65% ferromagnesian silicate mineral grains, 35-45% basaltic fragments)</td>
</tr>
<tr>
<td>1b</td>
<td></td>
<td>Ferromagnesian Basaltic Temper: (b) Lithic/Crystal (55-65% basaltic fragments, 35-45% ferromagnesian silicate mineral grains)</td>
</tr>
<tr>
<td>1c</td>
<td></td>
<td>Ferromagnesian Basaltic Temper: (c) Lithic (70-98% basaltic fragments, 2-30% ferromagnesian silicate mineral grains)</td>
</tr>
<tr>
<td>2</td>
<td>Not identified in sample</td>
<td>Basaltic Temper (&gt;95% Basalt) (not identified in sample)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Feldspatic Trachytic Temper (65-85% trachyte fragments, 10-20% feldspar grains)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Feldspatic Basaltic Temper (40-50% plagioclase, 50-60% basaltic fragments)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Glass with the addition of small amounts of pyroxene</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Shell with a ferromagnesian silicate mineral base</td>
</tr>
</tbody>
</table>
4.4.1 Statistical tests for stylistic analysis

4.4.1.1 Chi-Squared test:

A Chi-Squared analysis was performed to determine whether there was any correlation between temper size and temper type. Temper size based on the Wentworth scale was recorded for each temper group. The site at Sasoa’a had two layers (4 and 5) that contained pottery. A Chi-Squared test was undertaken to determine if temper groups became more or less common over time when grouped by layer. As decoration was present on a minority of ‘Upolu pottery, a Chi-Squared test was used to determine its presence or absence based on temper types. All data were tested for suitability using Monte Carlo (Gilks et al., 1996).

The most useful inferential statistic for the analysis of nominal data is the chi-squared statistic ($\chi^2$). This test allows the archaeologist to determine whether there are any statistically significant relationships between two sample means from independent samples (Sinopoli, 1991). If the observed frequencies ($O$) are very different from the frequencies we would expect if no relation existed between the two variables, then we can reject the null hypothesis that suggests a natural distribution. Chi-squared does not tell us about the strength of a relationship; it simply tells us about the probability of whether or not a relationship exists, by measuring the departures of expected from observed values (Sinopoli, 1991). To measure the strength of the association between two variables Cramer’s V coefficient (V) was used. The larger the value between 0 and 1 the stronger the association, with 0.1 the minimum threshold needed to infer a substantial relationship (Chen and Popovich, 2002: 79).

Assumptions that must be met are: that the samples are random from populations, that they are approximately normally distributed and that they have equal variances. All data met test requirements. When the sample sizes are very small the chi-squared statistic is not a reliable measure of the relationship between two variables. As a general rule, with more than one degree of freedom, 80 percent of the cells should contain five or more members (Sinopoli, 1991).
4.4.1.2 Analysis of Variation test (ANOVA):

Sherds were divided into temper groups, and then had their thickness measurements averaged. ANOVA was performed to determine if there was any difference in thickness between groups. Density measurements for each temper group were averaged. ANOVA was then used to determine whether there was any significant difference in temper density between temper groups.

ANOVA is used when dealing with two or more samples. ANOVA involves the estimation of two independent measures of variance; one based on the variability between the groups and the other based on the variability within groups. The $F$-ratio provides a measure for assessing the differences between the two variances. If the between-group variance is large relative to the within-group variance, the $F$-ratio will be large. A large $F$-ratio implies that differences between the groups are greater than differences within any group, and therefore, the differences between groups may be statistically significant (Sinopoli, 1991).

All data were tested for normality with the Kolmogorov-Smirnov test. This tests whether a set of observations are from a normal population when the mean and variance are not specified but must be estimated from the sample (Lilliefors, 1967). Equal variance was tested using the Levene statistic (Levene, 1960; Morton and Forsythe, 1974) and all data met test requirements. The above ANOVAs were then run to determine if there was any statistical difference. Post-hoc tests, in this case the Scheffe test, are run when there is a significant difference between groups to ascertain those that are strongly dissimilar to each other (Sinopoli, 1991). If any statistical differences were indicated, the Scheffe method was run as a post hoc test to determine which groups were statistically different (Scheffe, 1953). The mean values and standard deviation were graphed for each variable, separated by temper type.
4.5 Chemical analysis

Following this initial investigation, pottery was further sampled for electron microprobe analysis. Systematic targeted sampling selected 149 sherds from all five sites. 15 sherds were sampled from Falemoa, eight from Jane’s Camp, 51 from Mulifanua, 39 from Sasoa’a, 36 from Vailele. All sherds were sampled primarily using temper groups; secondary considerations were the presence of decoration and provenance information based on layer. Temper groups were sampled evenly across a site unless they were underrepresented, in which case all sherds of the temper group were selected. Each sherd was examined under a binocular microscope and by hand to ascertain that no two sherds came from the same vessel.

Each of the sherds selected in the sample were washed and then left to dry over several weeks in a drying room. Because these sherds were from a museum collection they had previously been cleaned. Each sherd then had a five millimetre slice cut through from the edge furthest from the rim using a 14 inch diamond edge saw. These slices were then placed cut-side down in groups of one to three into a brass ring set to the same size as the sample holder for the electron microprobe. The brass rings were placed on glass slides coated in candle wax and the inside coated with petroleum jelly to act as a lubricant. Each ring was then impregnated with low viscosity epoxy resin (araldite and a thickener at a ratio of 5:1), with the wax layer preventing the epoxy binding to the glass slide. Identification for each sherd was written on the glass slide. After the epoxy was allowed to set for 24 hours, the glass slides were placed on a hot plate until the wax melted and the brass ring could be removed. The briquettes were then removed from the rings using a press with the appropriate sized punch.

The side of the briquette containing the cut sherd surface was ground down using 400 grit sandpaper on a rotating grinding wheel until the surface of the epoxy was level with the cut face. Each briquette was ground with 600, 1200 and 2000 grit sandpaper by hand to achieve a smooth surface. A thin layer of epoxy was then applied to the surface of each sherd and then wiped off. This allowed any small holes in the sherd to be completely filled, and the briquette
was then ground down again with 1200 grit sandpaper. Each briquette was further polished using two rotating laps, one with a 3-micron diamond silicon paper, the other with a 1 micron paper, to achieve a high level of polish. Every briquette was then examined under a microscope to establish a sufficient level of polish. If the level of polish was insufficient it was run through the rotating laps again until the polish was satisfactory.

The briquettes were then washed in an ultrasonic cleaner with distilled water and allowed to dry. On the reverse side of the briquette from the exposed sherd surfaces the identification numbers for each sherd were cut into the epoxy. Each briquette was then thoroughly cleaned with ethanol before being carbon-coated. The carbon-coat allowed a conductive path for the microprobe current without absorbing too much of the electron current. These briquettes were then placed into the specimen holder specific for the electron microprobe and had carbon paint applied to ensure conductivity between the briquette and the holder.

The electron microprobe used was a JEOL Superprobe JXA-8600 housed in the University of Otago Geology Department. A trained technician undertakes calibration for the machine weekly. Each sherd was photographed at 40x magnification using the SemAfore software (Appendix D). Chemical analysis of the pottery was undertaken using the Energy Dispersive Spectrometer (EDS) attachment. The Moran Scientific MLA software program was used to identify the elemental wavelengths for both mineral inclusions and the clay matrix of each sherd. The results produced relative levels of oxides for each of the following elements: Na, Al, Si, Mg, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe and Ni. Each time the specimen holder was loaded the results were standardised based on a geological silicon standard appropriate for material likely to have derived from an igneous rock base. This allowed the appropriate atomic number (Z), absorption (A) and fluorescence (F) corrections.

Following standardisation, each sherd was analysed seven times. All analyses were conducted at a negative potential of 15 kiloelectronvolts accelerating voltage until 100 counts were reached with a probe diameter of 20 micrometres (µm). The clay matrix was analysed five times, four from near the edges as well as one in the centre of the sherd. Two randomly sampled inclusions
were identified visually under the attached optical microscope and analysed per sherd. Mineral identification is acknowledged to be difficult using a binocular microscope (Velde and Druc, 1999: 267). Therefore, the electron microprobe was used to confirm the binocular temper determinations (Table 4.3)(Appendix C). Inclusions analysed using the microprobe were identified as minerals based on their chemical composition using Deer et al. (1992) as a reference guide. Pyroxenes were classified using the nomenclature established by Morimoto (1988). Mineral inclusions and clays were identified and placed into separate Microsoft Excel spreadsheets. All mineral inclusions were labelled accordingly unless elemental concentrations were too low to allow accurate identification.

Table 4.3: Temper groups identified by site using binocular determinations, confirmed with chemical analysis

<table>
<thead>
<tr>
<th></th>
<th>Temper Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1a</td>
</tr>
<tr>
<td>Mulifanua</td>
<td>X</td>
</tr>
<tr>
<td>Falemoa</td>
<td>X</td>
</tr>
<tr>
<td>Jane’s Camp</td>
<td>X</td>
</tr>
<tr>
<td>Vailele</td>
<td>X</td>
</tr>
</tbody>
</table>

Based on the inclusions identified under the binocular microscope and the electron microprobe, Chemical Paste Compositional Reference Units (CPCRU) were used to group together both the inclusions and the clay matrix into meaningful groupings (see below for multivariate statistics).

All clay matrix totals were normalised by proportionally elevating each element selected. Each elemental concentration was divided by the total count and then multiplied by a hundred (e.g. a SiO₂ reading of 55.45 out of 85.67 becomes 55.45/85.67*100 = 64.73 weight %). The sum totals of all elements selected therefore equated to 100, rather than a lower total such as 85.67, which is common and accepted when analysing a clay matrix, but not acceptable when analysing an anhydrous mineral inclusion.

Before any statistical analysis was undertaken, each of the five chemical clay analyses for every sherd was plotted on a line graph. This provided a good indication of how close the five chemical profiles matched each other across the
surface of the sherd. Any strong variation to the average plotting of a single chemical analysis was likely to have been contaminated from inclusions that were present and thus discarded. The remaining profiles for each sherd were then averaged to provide a singular chemical profile per sherd.

Because of the variable nature of clays it is best to use as many oxides as possible to determine possible variation. However, functional and post-depositional processes can affect certain elemental and hence oxide concentrations. Phosphorus (P) levels have been noted to increase significantly in pottery through absorption from surrounding soils in certain depositional environments (Freestone et al., 1985). Pottery subjected to long periods in salt water, as is the case with all the pottery from Mulifanua, has been noted to significantly increase in Magnesium (Mg) levels, as well as Sodium (Na) and Chloride (Cl) (Freeth, 1967). Due to these potential contaminations, these four oxide percentages were excluded from any statistical analysis.

4.5.1 Multivariate statistical techniques for chemical analysis

The application of chemical characterisation to archaeological materials is a method employed worldwide by archaeologists. As chemical analysis produces a large number of variables to examine to determine groupings, multivariate statistical techniques are needed to reduce the number of variables and produce meaningful clusters. There are three favoured techniques: Cluster Analysis, principal component analysis (PCA) and Discriminant Function Analysis. Each technique has strengths and weaknesses as outlined below, and their application in an archaeological context is strongly determined by the suitability of the data. Due to the unique nature of archaeological material, raw data usually has a non-normal distribution (Baxter, 1994). As multivariate techniques often require a normally distributed sample as a condition of the statistical test, all analyses used a logarithm base 10-transformed data (using $x + 1$ to accommodate zero values) producing a normal distribution. This counteracted any skewness present in the data, which is caused by higher concentration of certain elements compared to rare elements found at concentrations of parts per million.
Chapter 4: Methodology

4.5.1.1 Principal Component Analysis (PCA):

Elemental oxides obtained from the clay matrix using the electron microprobe were run in a PCA to determine whether there were any significant groupings between sites based on clay composition. A second PCA was run, with data from Mulifanua excluded, to determine whether there were any significant groupings between the four plainware sites. Due to their geographical proximity, a third PCA was run testing clay data from Falemoa, Jane’s Camp and Mulifanua to see whether there was any geological overlap.

PCA can be used to obtain a two-dimensional picture that allows any groups differentiated by their chemical composition to be examined (Baxter, 1994). It does this by reducing the total variables to a much smaller number that still reflects reasonably accurately the major patterns in the original dataset (Drennan, 2009). PCA has been shown to be effective at differentiating between pastes, clay and tempers in this regard (Sterba et al., 2009). One of the strengths of PCA is that it provides a very good visual display of potential chemical groupings. However, as a technique used to initially determine these clusters, it has been criticised. One criticism stems from PCA’s tendency to blur distinctions between clusters. The second issue is that it displays the group results in two dimensions, and often in the case of chemical characterisation a large number of dimensions are required to determine group differences (Baxter, 1994). Plotting regression scores of several different components allows the comparison of more than two dimensions.

A good general summary of the applicability of the data set for factor analysis is the Measure of Sampling Adequacy (MSA). If MSA is too low, then factor analysis should not be performed on the data.

All data was tested for suitability with Kaiser-Meyer-Olkin’s (KMO) measure of sampling adequacy and Bartlett’s test of sphericity. If a KMO value of ≥0.5 was not achieved any elemental oxides with a communality extraction value of ≥0.9 were removed. Components with initial Eigen values >1 were selected for interpretation (Baxter, 1994). Regression scores for these values were graphed using biplots.
Cluster Analysis was undertaken to test potential groupings in the chemical compositions of pottery from all five sites. However, because of the reasons outline below and the suitability of the data, it was deemed ineffective at providing any meaningful clusters from this data set, and thus not presented in this thesis. It is possible that analysis that incorporated a larger number of elemental oxides may be more suited to Cluster Analysis.

Cluster Analysis is perhaps the most common form of multivariate technique used in assessing chemical composition groups. However, there is some scepticism amongst both statisticians and archaeologists of the value of Cluster Analysis in archaeological contexts. One particular issue is that there is no generally applicable solution available to determine the appropriate number of clusters. Instead, the archaeologist needs to rely on more subjective criteria based on their expertise in the subject area (Baxter, 1994). Using Average Linkage and Ward’s method allows clusters to be formed based on similarities between groups rather then between pairs of individuals, and as such, provides better clustering results for chemical composition studies.

There are several issues with the use of Cluster Analysis on material from an archaeological context. In many archaeological applications, hierarchical agglomeration is a common method of clustering. However, the nature of archaeological contexts, as opposed to other scientific disciplines, suggests that there is no reason to assume a hierarchy should exist in the data. Another issue in studies that focus on chemical characterisation is that problems can occur with the analysis if elements are highly correlated with each other, a common occurrence in chemical studies. If this is the case, clusters will be non-spherical, and the use of Euclidean distance as a measure of similarity and Ward’s method as a clustering technique is potentially incorrect (Baxter, 1994).
4.5.1.3 Discriminant Function Analysis:

Discriminant Function Analysis was used to test the likelihood of whether each site had a unique clay source. The grouping variable was by site with the elemental oxides from the electron microprobe analysis selected as independents. This analysis used a Linear Discriminant model where 79.1% of the original grouped cases were classed correctly and 70.3% of the cross-validated grouped cases were classed correctly. The first two Discriminant Factors, which explained 92% of the variance, were selected for interpretation. Discriminant factor scores for these values were graphed using biplots.

A second Discriminant Function Analysis was performed to identify whether clay groups could be determined by temper type. Seven temper groups were established (Table 4.2) and used as the grouping variable while elemental oxides constituted the independents. This analysis used a stepwise Discriminant model where 63.5% of the original grouped cases were classed correctly and 62.8% of the cross-validated grouped cases were classed correctly. The two Discriminant Factors, which explained 100% of the variance, were selected for interpretation. Discriminant Factor scores for these values were graphed using biplots.

Discriminant Function Analysis was undertaken to test the validity of clusters identified using PCA. Discriminant Analysis assumes that a set of objects belongs to one of two or more groups. It is used when the number of groups is known, and therefore provides the distinguishing variable(s) between the groups, as well as assigning objects to existing groups on the basis of their characteristics. In the context of archaeological sourcing, this technique can identify important discriminating elements, and can be used to identify unprovenanced sherds to an appropriate group, something that has further potential in identifying pottery from surface collections (Baxter, 1994).

Discriminant Function is used principally by archaeologists to validate clusters determined from tests such as PCA or Cluster Analysis. It should, however, be used with extreme caution. Due to the inherent nature of the test, it is likely to produce “too optimistic a portrayal of cluster separation and therefore may mislead in the genuineness of clusters” (Baxter, 1994: 165).
Chapter 4: Methodology

Certain assumptions should also be met, as linear Discriminant Analysis can perform badly with very different covariances in the data, notably so when groups are similar to each other. Hence, equal covariance should be checked to make sure it meets this assumption. Cross-validation of the data provides another means to check the reliability of the groupings. When it comes to the inspection of relative probabilities of group membership, Pollard (1986) suggests that values in excess of .95 are desirable. Anything less than this suggests that the strength of the grouping may be weak or misleading. Instead of validating clusters with Discriminant Analysis, it is more likely to be accurate and useful to the archaeologist when negative results are obtained (Baxter, 1994).

All Chi-Squared, ANOVA’s, PCA, Cluster Analyses and Discriminant Function Analyses were produced using “Statistical Package for the Social Sciences (SPSS), version 19".
Chapter 4: Methodology

4.6 Limitations

There were some limitations involved in this study:

1. The first is the reliance on radiocarbon dating that was conducted before more rigorous controls were in place. Rieth (2007) undertook chronometric hygiene on the suite of available radiocarbon dates obtained from Samoan sites. Based on his selection criteria many sites have no reliable dates. Due to this, several lines of evidence need to be considered when addressing temporal issues. Some sites retain reliable dates, others have several layers of occupation containing pottery, allowing change over time to be established within a site. Dates for Lapita presence on Samoa have been conducted recently and are considered reliable (see Petchey, 2001). Stylistic factors, while limited, can establish a broad date for site occupation. More recent radiocarbon dating from American Samoa, as well as Tonga and Fiji, provide a good framework in which to establish those Samoan sites that lack reliable dating (see Rieth, 2007). However, new analyses of secure samples from these sites would provide a more secure temporal context.

2. Due to the time gap between excavation and present analysis there are collection issues. While some sites selected in this study had the full representative number of sherds present as when they were excavated, two had notable exceptions. The Lapita sample from Mulifanua, due to its uniqueness in Samoa and unusual location, has been split into at least three different groups over the past 50 years. However, there are still a reasonable number (n=>4,500) held at the Auckland War Memorial Museum. Because of the underwater nature of the deposit excavation seems unlikely, but more systematic sampling from any new dredging deposits would improve the number and representation of diagnostic potsherds present. Pottery from the second site, Jane’s Camp, is poorly represented in this study, and locating the original collection would provide a much better analysis for the site. Further improvements would
be to sample sherds from more sites, both on ‘Upolu and from other islands, notably Savai’i due to its proximity.

3. Provenance information, while critical in any archaeological research, is currently difficult to access or missing from multiple sites. Accessing old field-notes from a range of excavations is reliant on these records surviving and being accessible. Provenance is unable to be obtained for pottery from Mulifanua, and excavation records for both Jane’s Camp and Falemoa could not be located. This severely restricts any form of intra-site analysis, and limits the strength of any conclusions based on this data.

The following chapter presents the results of the stylistic and chemical analysis using the methodology outlined above.
Chapter 5

Results

5.1 Introduction

The combination of stylistic and physico-chemical methods outlined in the previous chapter allows the archaeologist to understand pottery production in a holistic fashion, providing evidence from a range of sources. This chapter presents the results of these techniques in three sections.

The first section (5.2) outlines the stylistic results obtained from assemblages covering the range of pottery production on ‘Upolu, Samoa. This is divided into the major components of analysis: vessel forms of Lapita and post-Lapita assemblages, rim profiles, presence of decoration technique, and sherd thickness.

The second section (5.3) focuses on the results of the mineral inclusion analysis of the pottery from all five assemblages. The first part of this section covers the minerals present in each temper group. Temper groups were established based on Green’s (1974d), Dickinson’s (1969, 1974, 1976) and Petchey’s (1995) existing classification system. The second part outlines the results of testing temper groups against components of sherd thickness, temper
size, temper density, forms of pottery decoration and prevalence of temper groups over time at Sasoa’a.

The third and final section (5.4) outlines the results of the chemical analysis undertaken using the methodology detailed in the previous chapter. This section focuses on two statistical approaches to clay composition. The first part outlines the groups established using Principal Component Analysis. This involved three tests: the first tested clay groups from all five sites, the second tested only the plainware sites, and the third tested pottery from Mulifanua, Falemoa and Jane’s Camp. The second part presents two Discriminant Function Analyses; the first focusing on the accuracy of using clay composition to predict site provenance, the second using clay composition to predict temper group.
Chapter 5: Results

5:2 Stylistic Analysis

The results of the stylistic analysis are presented in three sections and conform to previous analyses of Samoan ceramics with a few notable exceptions. Because of the stylistic simplicity of Samoan plainware pottery, almost completely lacking in decoration and with few vessel forms, stylistic analysis has been restricted in scope. The initial section presents a summary of vessel forms found across both the Lapita site and the later plainware sites. The next section summarises the decoration found on sherds from the assemblages. The final section outlines results undertaken to ascertain whether the stylistic classification of thick ware and thin ware pottery provides a valid approach.

5.2.1 Lapita Vessel Forms

Ceramics used to determine Lapita vessel forms in Samoa have been restricted to finds from Mulifanua. Forms can only be satisfactorily labelled as common, present or absent (Table 5.1) because of sampling difficulties. Forms 1 and 2, described as bowls, are common at Mulifanua. Form 3, present at Mulifanua, is similar to the previous forms in that it is considered a bowl, is more difficult to identify, as the distinguishing characteristic is a square rather than a crescent cross-section. Form 4, described as a deep globular pot, is more easily diagnosed as it has a characteristic collar rim, and is common among sherds from Mulifanua. Form 5, present at Mulifanua, has a high carinated shoulder, and is difficult to determine unless both the rim and carination are present. Form 6, common at Mulifanua, shares a carination with form 5, but it has a considerably lower shoulder. This form has either a flat or rounded base and is described as a bowl. Form 7, present at Mulifanua, was not included by Green (1974d: Fig. 90) in his original classification as no diagnostic sherd for this form had been found. It was Petchey (1995: Table 3.8) who determined that this form was present at Mulifanua based on the discovery of a handle. This form is common from sites such as Sigatoka in Fiji, and its presence can be expected. In addition to these forms already established and confirmed in this analysis, part of a stand was discovered in the assemblage (Appendix A).
Chapter 5: Results

Table 5.1: Summary of vessel forms by site

<table>
<thead>
<tr>
<th>Form</th>
<th>Mulifanua</th>
<th>Falemoa</th>
<th>Jane’s Camp</th>
<th>Vailele</th>
<th>Sasoa’a</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common</td>
<td>Common</td>
<td>Common</td>
<td>Common</td>
<td>Common</td>
</tr>
<tr>
<td>2</td>
<td>Common</td>
<td>Common</td>
<td>Common</td>
<td>Common</td>
<td>Common</td>
</tr>
<tr>
<td>3</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>4</td>
<td>Common</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>5</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>6</td>
<td>Common</td>
<td>Absent</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>7</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
</tbody>
</table>

Table 5.2: Early Samoan ceramic vessel forms

<table>
<thead>
<tr>
<th>Form 1a</th>
<th>Form 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcurving, direct rims, flat base</td>
<td>Deep globular pots with collar rims</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Form 1b</th>
<th>Form 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incurving, direct rims, round base</td>
<td>Shouldered bowl, Straight or inverted rims</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Form 1c</th>
<th>Form 6a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small coconut shaped cup</td>
<td>Shouldered bowl, Round base</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Form 2</th>
<th>Form 6b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep round bowls, In-curving, direct rims</td>
<td>Shouldered bowl, Flat base</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Form 3</th>
<th>Form 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep square bowls, Straight, direct rims</td>
<td>Jar with handle, Constricted neck.</td>
</tr>
</tbody>
</table>
5.2.2 Post-Lapita vessel forms

Vessel forms manufactured subsequent to Lapita occupation became more restricted, with open bowls almost completely dominating plainware assemblages (compare Table 5.2 and Table 5.3). Green (1974b) has a more extensive classification of plainware vessels. These can principally be classified as belonging to form 1b, 1c or 2. One exception to this is a carinated vessel from Jane’s Camp with a flat base (Form 6a; Table 5.1), which was classified as a shouldered vessel by Smith (1976a: 94). While this carinated form is common from the Lapita assemblage at Mulifanua, as well as from Lapita assemblages from Tonga and Fiji, it is not found in any other assemblage in Samoa classified as a “plainware” assemblage.

Table 5.3: Post-Lapita Samoan ceramic vessel forms

<table>
<thead>
<tr>
<th>Form</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1b</td>
<td>Incurving, direct rims, round base</td>
</tr>
<tr>
<td>1c</td>
<td>Small coconut shaped cup</td>
</tr>
<tr>
<td>2</td>
<td>Deep round bowls. In-curving, direct rims</td>
</tr>
</tbody>
</table>

5.2.3 Rim Profiles

There is a range of rim profiles from across the five sites (Table 5.4)(Appendix B). Direct rims are found at all five sites. From Mulifanua there is a mixture of outcurving, direct and inverted rims, with only two everted rims and one incurring rim. Only at Saso’a’a, Mulifanua and Falemoa were incurring rims recorded. Jane’s Camp produced one carinated vessel with an inverted rim.
Chapter 5: Results

Table 5.4: Rim profiles from Lapita and plainware assemblages from 'Upolu, Samoa

<table>
<thead>
<tr>
<th>Rim Direction</th>
<th>Mulifanua</th>
<th>Falemoa</th>
<th>Jane’s Camp</th>
<th>Vailele</th>
<th>Sasoa’a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everted</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Outcurving</td>
<td>22</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Direct</td>
<td>28</td>
<td>10</td>
<td>3</td>
<td>35</td>
<td>87</td>
</tr>
<tr>
<td>Incurving</td>
<td>1</td>
<td>1</td>
<td>Present</td>
<td>Present</td>
<td>5</td>
</tr>
<tr>
<td>Inverted</td>
<td>17</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

5.2.4 Decoration

Sherds that have decoration constitute a minority of the Samoan pottery assemblages (Appendix A). Decoration of Samoan Lapita pottery includes dentate stamped, incision, appliqué, finger impression and a distinctive red/orange slip (Table 5.5) (see Petchey, 1995: 60-63 for an analysis of motifs present). The presence of different decorative techniques is most common from Mulifanua. A red slip is a form of decoration found on sherds from Mulifanua, Falemoa and Jane's Camp. Based on how pottery from Mulifanua was collected makes it difficult to ascribe a percentage of decorated to undecorated ware as is done at other Lapita sites from Tonga and Fiji.

Table 5.5: Presence or absence of decoration in Lapita and plainware assemblages from 'Upolu, Samoa

<table>
<thead>
<tr>
<th>Decoration</th>
<th>Mulifanua</th>
<th>Falemoa</th>
<th>Jane’s Camp</th>
<th>Vailele</th>
<th>Sasoa’a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incision</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Dentate Stamping</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Finger Impression</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Appliqué</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Slip</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
</tr>
</tbody>
</table>

Following the cessation of dentate stamping on Samoan pottery, considered as a key identifier of Lapita culture, pottery is for the most part undecorated, but decoration still occurs at three of the sites. A minor amount of incision and finger impression occurs on some rims throughout the plainware
period (Table 5.5)(Appendix A). Pottery decoration (excluding slip) is completely absent from Vailele, Jane's Camp and Falemoa on sherds analysed in this study. Incision and finger impression was only found on sherds from Sasoa’a. Pottery that bears incision from the site is restricted to the rim of the vessel, unlike at Mulifanua, where it is also found on the outer body (Appendix D). In addition to decorative elements, a minor component of the pottery sample from Mulifanua shows a blue calcification on the surface (Figure 5.1)(Appendix A). This is due to the depositional nature of the assemblage and not the result of any decorative technique.
Chapter 5: Results

Figure 5.1: Photographs of sherds showing surface characteristics
5.2.5 Thinware and thickware

Because of the lack of decoration and restriction in vessel forms, the dominant classification in stylistic analysis for post-Lapita plainware pottery has been on a thin ware/thick ware division. As Figure 5.2 shows, there is a range in sherd thickness from all five sites, from 3.68 to 18.35 cm. The current thin/thickware division has been proposed at 7.5 cm (Hunt and Erkelens, 1993: 147). If we look at sherd thickness from Sasoa’a (Figure 5.3), the type-site for this stylistic division, there is a potential dip around 7.5 cm. A dip test indicates a bimodal distribution, with a significance of p=0.02. However, dip tests run on ceramics from Mulifanua (Figure 5.4) and Vailele (Figure 5.5) indicate a lack of bimodal distribution.

![Histogram of sherd thickness](image)

*Figure 5.2: Range of sherd thickness from all five sites. Mean = 8.79 (SD = 2.62), N = 405*
Chapter 5: Results

Figure 5.3: Range of sherd thickness from Sasoa’a. Mean = 8.45 (SD = 2.66), N = 134

Figure 5.4: Range of sherd thickness from Mulifanua. Mean = 8.14 (SD = 2.31), N = 169
Figure 5.5: Range of sherd thickness from Vailele. Mean = 10.66 (SD = 2.25), N = 76
5.3 Temper Analysis

The mineral components of pottery from all five assemblages were analysed under the electron microprobe (Appendix C). The results were matched to the temper groups established in Chapter 4 (see section 4.4 for sampling strategy and temper group composition). Following these groupings, results are displayed of the testing between temper groups and a number of different components, including: sherd thickness, temper density, temper size, between layers at Sasoa'a, and the presence or absence of decoration.

5.3.1 Temper Groupings

5.3.1.1 Temper group 1a: Ferromagnesian Basalt (Crystal/Lithic)

Temper group 1a is considered a ferromagnesian basaltic temper, with a predominance of ferromagnesian silicate mineral grains, and a minority of basaltic fragments (Table 5.6). Plagioclase feldspars are found in similar forms, andesine and labradorite. Pyroxenes are common, being diopsidic augite. Spinels have been identified in this group suggesting a mafic basaltic source. Olivine is a common inclusion and some ilmenite was found to be present from Sasoa’a (Appendix C). This temper group has been identified at four different sites and has broadly similar mineralogical compositions.
5.3.1.2 Temper group 1b: Ferromagnesian Basalt (Lithic/Crystal)

Temper group 1b shows a similar composition to group 1a, however, this group has a higher percentage of basaltic fragments (compare Table 5.6 and Table 5.7). Group 1b is the most common temper subgroup from Mulifanua (Appendix A), with a wide range of minerals and also the only temper found at all five sites. Three forms of feldspars are present, with andesine being identified from Mulifanua, Vailele and Falemoa. Pyroxenes are again common in this temper group, found in the form of diopsidic augites. Spinels are also somewhat common in a range of forms, suggesting a mafic base. Olivine is very common, and some inclusions show iddingsite as an alteration product. Ilmenite was identified from Mulifanua, and one grain of quartz from Sasoa’a is reflective of the rarity of this mineral on ‘Upolu (Appendix C). One notable difference between sites is the presence of orthoclase from Sasoa’a, and its absence from other sites (Table 5.7).
Chapter 5: Results

Table 5.7: Mineral inclusions present in temper group 1b

<table>
<thead>
<tr>
<th>Site</th>
<th>Plagioclase Feldspars</th>
<th>Andesine</th>
<th>Labradorite</th>
<th>Pyroxenes</th>
<th>Diopside</th>
<th>Spinel</th>
<th>TiO₂-spinel</th>
<th>Uvospinel</th>
<th>Chromo-spinel</th>
<th>Other</th>
<th>Olivine</th>
<th>Olivine to iddingsite</th>
<th>Ilmenite</th>
<th>Quartz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mulifanua</td>
<td>X X</td>
<td></td>
<td></td>
<td>X X</td>
<td>X X</td>
<td>X X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Falemoa</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jane’s Camp</td>
<td>X X X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vailele</td>
<td>X X X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sasoa’a</td>
<td>X</td>
<td></td>
<td></td>
<td>X X X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3.1.3 Temper group 1c: Ferromagnesian Basaltic (Lithic)

Temper group 1c was only identified from Mulifanua, and as such has the most restricted number of samples from temper group 1 (Table 5.8). This subgroup shares similar compositions to temper group 1a and 1b, but has a higher percentage of lithic fragments, with minor amounts of ferromagnesian silicate grains. Andesine and labradorite are again the dominant feldspars, as is the pyroxene diopside. Olivine is common, as is ilmenite, which in some cases shows alteration to hematite (Appendix C).

Table 5.8: Mineral inclusions present in temper group 1c

<table>
<thead>
<tr>
<th>Site</th>
<th>Plagioclase Feldspars</th>
<th>Andesine</th>
<th>Labradorite</th>
<th>Pyroxenes</th>
<th>Diopside</th>
<th>Other</th>
<th>Olivine</th>
<th>Ilmenite to hematite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mulifanua</td>
<td>X X</td>
<td></td>
<td></td>
<td>X</td>
<td>X X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3.1.5 Temper group 3: Feldspathic trachyte

Pottery containing temper group 3 is found at two of the five sites: Vailele and Sasoa’a (Table 5.9). This temper is characterised strongly by its source,
which is anorthoclase trachyte. Alkali feldspars are common; both orthoclase and anorthoclase were identified. Plagioclase feldspars were more frequent from Vailele then they were from Sasoa’a. The presence of spinels from Vailele pottery would suggest more mixing in the temper sources than was occurring from sources used at Sasoa’a. Olivine and ilmenite are present in pottery from Vailele, as is the alteration of olivine to iddingsite (Appendix C).

Table 5.9: Mineral inclusions present in temper group 3

<table>
<thead>
<tr>
<th>Site</th>
<th>Plagioclase Feldspars</th>
<th>Andesine</th>
<th>Labradorite</th>
<th>Orthoclase</th>
<th>Anorthoclase</th>
<th>Pyroxenes</th>
<th>Spinel</th>
<th>Titanio-Spinel</th>
<th>Other</th>
<th>Olivine</th>
<th>Olivine to iddingsite</th>
<th>Ilmenite</th>
<th>Quartz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vailele</td>
<td>X X X</td>
<td>X X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X X X X X X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sasoa’a</td>
<td>X</td>
<td>X X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X X X X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3.1.6 Temper group 4: Feldspathic Basalt

Temper group 4 was identified as three sites, Jane’s Camp, Vailele and Sasoa’a, all of which are situated on different volcanic basement (Figure 3.2). This temper group is characterised as a feldspathic basaltic temper, with around even amounts of plagioclase and basaltic fragments (Table 5.10). As would be expected in a feldspathic temper, andesine and labradorite are common, and oligoclase was found at Jane’s Camp. Pyroxenes are dominantly as diopsidic augite, and spinels do occur at Vailele and Sasoa’a. As basaltic fragments consist of roughly half the sherds inclusions, olivine is common, with ilmenite and quartz also identified from Sasoa’a. One grain of apatite was found in a sherd from Sasoa’a, which would match the olivine basaltic flows on the Fagaloa volcanics. A mineral grain of anorthoclase from Sasoa’a for this temper group would suggest some mixing of the source, most likely in a catchment below a trachyte flow (Appendix C).
Chapter 5: Results

Table 5.10: Mineral inclusions present in temper group 4

<table>
<thead>
<tr>
<th>Site</th>
<th>Plagioclase Feldspars</th>
<th>Anorthoclase</th>
<th>Pyroxenes</th>
<th>Augite</th>
<th>Diopside</th>
<th>Spinel</th>
<th>Trans-Spinel</th>
<th>Other</th>
<th>Olivine</th>
<th>Olivine to iddingsite</th>
<th>Ilmenite</th>
<th>Lime</th>
<th>Quartz</th>
<th>Apate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jane’s Camp</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vailele</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sasoa’a</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3.1.7 Temper group 5: Glass

Temper group 5 was identified in only two sherds and from Mulifanua. This temper has the most restricted number of inclusions (Table 5.11 compared to Tables 7-11). It is characterised by a very high percentage of glass which has been identified in thin section (Petchey, 1995: 80) as anhydrous sideromelane and hydrous palagonite, and whose likely source is from a Vini basaltic tuff, such as the Tufa 'Upolu cinder cone which is less than 16 km from Mulifanua (Petchey, 1995: 83). It also contained a small amount of augite (Appendix C).

Table 5.11: Mineral inclusions present in temper group 5

<table>
<thead>
<tr>
<th>Site</th>
<th>Pyroxenes</th>
<th>Augite</th>
<th>Other</th>
<th>Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mulifanua</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

5.3.1.8 Temper group 6: Shell detritus

Temper group 6 has only been identified from Mulifanua and Falemoa. This temper is characterised by the presence of calcium carbonate (shell detritus) along with other mineral inclusions (Table 5.12). These inclusions are
similar in nature to temper group 1 (Table 5.6, Table 5.7, Table 5.8), with oligoclase, diopsidic augite and spinels all present. Olivine is also common (Appendix C). These inclusions are differentiated from temper group 1 only by the presence of calcium carbonate. On this premise, it is highly probable that the source was local, and likely reflects site locations near or on the beach.

Table 5.12: Mineral inclusions present in temper group 6

<table>
<thead>
<tr>
<th>Site</th>
<th>Plagioclase</th>
<th>Feldspars</th>
<th>Oligoclase</th>
<th>Pyroxenes</th>
<th>Augite</th>
<th>Diopside</th>
<th>Spinel</th>
<th>Ulvospinel</th>
<th>Other</th>
<th>Olivine</th>
<th>Calcium carbonate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mulifanua</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Falemoa</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

5.3.1.9 Temper group summary - CPCRU’s

The synthesis of these temper groups suggests there are three separate CPCRU’s present from the five different sites (Table 5.13). Mulifanua characterises the CPCRU 1, encompassing a diverse range of temper groups. Based on the number of different sources accessed, it is suggested that at least four different zones of raw material procurement could have been accessed through the occupation of the site. The presence of sub-grouping of ferromagnesian basalt temper group 1 could reflect an even greater number of production centres. Following the initial occupation at Mulifanua, CPCRU 2 encompasses the early sites of Falemoa and Jane’s Camp. Temper groups from these sites reflect very different technologies in use, and suggest a minimum of at least three production centres operating in the early plainware period on the north-west coast of ‘Upolu. The later plainware period is represented by CPCRU 3, and includes the sites of Vailele and Sasoa’a. There is a shift towards production centres utilising feldspathic trachytic and basaltic tempers, but still retaining the use of ferromagnesian basaltic tempers. This indicates at least three distinct production centres functioning through central ‘Upolu during the
Chapter 5: Results

later plainware period, two of which use sources not utilised by Lapita settlers at Mulifanua.

Table 5.13: Composition of CPCRU’s based on temper type and the number of production centres

<table>
<thead>
<tr>
<th></th>
<th>Tempers Used</th>
<th>Production Centres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1a</td>
<td>1b</td>
</tr>
<tr>
<td>CPCRU 1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>CPCRU 2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>CPCRU 3</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

5.3.2 Temper group and sherd thickness

As shown in Figure 5.6, sherds made from temper group 1 were considerably thinner then those made from temper group 3 or 4 (Appendix A). An ANOVA test revealed highly significant statistical difference in mean sherd size between temper groups ($F_6 = 14.794$, $p = <0.001$; Figure 5.6). Temper group 1a was highly significantly different to temper groups 3 and 4 (Post hoc Scheffe Test, $p = <0.001$, Table 5.14). Also, temper group 1b was highly significantly different to temper group 3 (Post hoc Scheffe Test, $p = <0.001$, Table 5.14). Sherds made from either temper group 5 or 6 were found to be similar in size compared to those made from temper group 1 (Figure 5.6), but the lack of a sufficient sample size resulted in a large standard error and therefore, this group had no statistical difference to temper group 3 ($p = .248$) and 4 ($p = .372$). This would suggest that the selection of temper had some influence on the resultant thickness of the pot.
Chapter 5: Results

Figure 5.6: Average vessel thickness classed by temper group.

Table 5.14: Post Hoc Sheffe Test displaying statistical difference between temper groups based on sherd thickness (bolded values are significantly different)

<table>
<thead>
<tr>
<th>(I) Temper Grouping</th>
<th>(J) Temper Grouping</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1b</td>
<td>0.055</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>1b</td>
<td>1a</td>
<td>0.055</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.051</td>
</tr>
<tr>
<td>3</td>
<td>1a</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>1b</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1.000</td>
</tr>
<tr>
<td>4</td>
<td>1a</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>1b</td>
<td>0.051</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.000</td>
</tr>
</tbody>
</table>

5.3.3 Temper group and temper density

 Certain tempers reflected a lower temper density in clays used to manufacture pots (Figure 5.7)(Appendix A). An ANOVA test revealed highly significant statistical difference in temper density between temper group 1 and temper groups 3 and 4 ($F_4 = 10.205$, $p = <0.001$, Figure 5.7). Sherds made using temper group 1a were highly significantly different to temper groups 3 and 4
Chapter 5: Results

(Post hoc Scheffe Test, $p = <0.001$, Table 5.15). Also, temper group 1b was highly significantly different to temper group 3 and 4 (Post hoc Scheffe Test, $p = <0.001$, $p = 0.002$ respectively, Table 5.15). Temper densities in temper group 1a and 1b was on average below 30%, whereas those made with temper group 3 or 4 were around 35% (Figure 5.7).

![Figure 5.7: Average temper density classed by temper group.](image)

Table 5.15: Post Hoc Sheffe Test displaying statistical difference between temper groups based on temper density (bolded values are significantly different)

<table>
<thead>
<tr>
<th>(I) Temper Grouping</th>
<th>(J) Temper Grouping</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1b</td>
<td>.681</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>1b</td>
<td>1a</td>
<td>.681</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>$0.002$</td>
</tr>
<tr>
<td>3</td>
<td>1a</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td></td>
<td>1b</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>.956</td>
</tr>
<tr>
<td>4</td>
<td>1a</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td></td>
<td>1b</td>
<td>$0.002$</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>.956</td>
</tr>
</tbody>
</table>
5.3.4 Tempered group and temper size

Temper group is highly significantly correlated to temper size ($\chi^2 = 138.3$, df=12, $p < 0.001$). All subgroups of the ferromagnesian basaltic temper (group 1) had significantly smaller temper sizes than those for either temper group 3 or 4 (Figure 5.8). More than half (52%) of pottery made with temper group 4 had the largest temper size observed (Size 1). The percentage was slightly lower for pottery made with temper group 3 (32.4%) but still significantly higher than temper group 1a (3.7%) or temper group 1b (4.9%). It appears that both temper group 5 and 6 have a smaller temper size, but an inadequate sample size (n=5, Appendix A) does not allow confirmation. Temper groups therefore have a moderate association ($V=0.411$) with temper size.
Figure 5.8: Results of Chi-Squared Test showing counts and expected counts by temper group for (a) temper size 1, (b) temper size 2, (c) temper size 3 (Wentworth Scale).
Chapter 5: Results

5.3.5 Temper group and layer (Saso’a)

The selection of certain types of temper changed over time at Saso’a ($\chi^2=30.2, \text{df}=6, p<0.001$)(Appendix A). Pottery from the early layer (5) at the site was predominantly made with temper group 1a (47.3%) and 1b (24.7%)(Figure 5.9). In the early layer, temper group 3 was found in limited quantities (22.6%), whereas pottery made from temper group 4 was rare (5.4%)(Figure 5.9). Subsequently, pottery from layer 4 shows a rise in predominance of pottery made from temper group 3 (62.5%), with a sharp decline in the use of temper group 1 (18.7%). Pottery made with temper group 4 becomes slightly more common later in the site (18.8%)(Figure 5.9). Temper groups therefore have a moderate association ($V=0.492$) with layers from Saso’a.
Chapter 5: Results

Figure 5.9: Graph of results of Chi-Squared Test showing counts and expected counts of temper group for (a) Layer 5 and (b) Layer 4
5.3.6 Temper group and decoration

Decoration on pottery was highly correlated to temper type ($\chi^2=43.4$, df = 6, $p < 0.001$). While decoration was absent on most of the pottery (n=322) (Figure 5.10), there was still a significant amount present (n=86), but it was restricted entirely to pottery made from temper groups 1 and 5 (Figure 5.10). No decoration was recorded for pottery that utilised temper groups 3 or 4. Temper groups 5 and 6 are too restricted in number to make any firm judgement on the presence of decoration, but both sherds made from temper group 5 contain some form of decoration (Appendix A). Temper groups therefore have a moderate association ($V=0.326$) with the presence of decoration.
Figure 5.10: Graph of results of a Chi-Squared Test showing counts and expected counts of temper groups (a) without decoration and (b) with decoration
Chapter 5: Results

5.4 Chemical Analysis

The results of the chemical analysis of the clay matrix by the electron microprobe (see Appendix C) are summarised below. These are displayed using biplots showing the results of: the principle component analysis of all five sites, the PCA results of the four plainware sites, the PCA results of Falemoa, Mulifanua, and Jane’s Camp. The greatest variability in chemical composition between clays is shown by components 1 ($Z_1$) and 2 ($Z_2$). Comparing further components, such as 1 ($Z_1$) and 3 ($Z_3$) can indicate more subtle differences in clay compositions. The results of two Discriminant Function Analysis follow, one testing the grouping of clay groups by site, the second testing the grouping of clay groups and temper composition.
5.4.1 Principal Component Analysis:

5.4.1.1 PCA all sites: Components 1 ($Z_1$) and 2 ($Z_2$)

There is a strong separation between pottery from Mulifanua and the other four sites based on clay composition (Appendix C). In Figure 5.11, clays from Mulifanua load heavily on $Z_2$, and to a reasonable extent on $Z_1$. This indicates pottery from Mulifanua is separated from Jane’s Camp along $Z_1$ based on high titanium and iron content and correspondingly low Si content. A similar contrast is achieved along $Z_2$ with pottery from Mulifanua having a higher concentration of potassium, vanadium and sulphur, producing a distinct separation from the plainware sites. The other four sites show lesser amounts of potassium, vanadium and sulphur, indicated by light loading along $Z_2$ axis. Sasoa’a, Falemoa and Vailele have pottery with slightly higher concentrations along $Z_2$ than pottery from Jane’s Camp.

*Figure 5.11: Scatter plot showing PCA components 1 ($Z_1$) and 2 ($Z_2$) for Falemoa, Jane’s Camp, Mulifanua, Sasoa’a and Vailele*
Chapter 5: Results

5.4.1.2 PCA all sites: Components 1 ($Z_1$) and 3 ($Z_3$)

The separation of Mulifanua pottery is less distinct using concentrations of manganese, but pottery from Jane’s Camp and Falemoa shows some separation (Appendix C). In Figure 5.12 we see that most pottery from all sites loads reasonably evenly across $Z_1$. $Z_3$ indicates a stronger difference between Falemoa and Jane’s Camp, and the other three sites. Manganese loads heavily along the $Z_3$ axis, indicating that pottery from Jane’s Camp and Falemoa has higher concentrations than pottery from other sites.

Figure 5.12: Scatter plot showing PCA components 1 ($Z_1$) and 3 ($Z_3$) for Falemoa, Jane’s Camp, Mulifanua, Sasoa’a and Vailele
5.4.1.3 PCA all sites: Components 2 ($Z_2$) and 3 ($Z_3$)

Figure 5.13 once again shows a separation of pottery from Falemoa and the other four sites (Appendix C). Pottery from Sasoa’a displays a stronger divergence from Vailele, with a smaller amount of potassium, vanadium and manganese. Vailele overlaps to some extent with Mulifanua and Sasoa’a, but Mulifanua loads more heavily along $Z_2$, reflecting higher concentrations of calcium and iron. Jane’s Camp pottery is more evenly distributed along $Z_3$, with variation along $Z_2$, showing a fluctuation in concentrations of manganese, but constant concentrations of potassium and vanadium.

Figure 5.13: Scatter plot showing PCA components 2 ($Z_2$) and 3 ($Z_3$) for Falemoa, Jane’s Camp, Mulifanua, Sasoa’a and Vailele
5.4.2.1 PCA for Falemoa, Jane’s Camp, Vailele, and Sasoa’a: Components 1 (Z$_1$) and 2 (Z$_2$)

If we remove Mulifanua from the analysis, there is a strong separation between Jane’s Camp and Falemoa, and Sasoa’a and Vailele (Figure 5.14) (Appendix C). Both Jane’s Camp and Falemoa have oxides that load heavily on Z$_2$, which have moderate concentrations of both calcium and iron, and low concentrations of aluminium and sulphur. Several pottery sherds from Vailele contradict this trend, and load very highly on Z$_2$, more in line with concentrations from Falemoa. Pottery from all four sites is somewhat evenly distributed along Z$_1$, with only pottery from Jane’s Camp having a restricted distribution, indicating lower concentrations of titanium and higher amounts of potassium.

Figure 5.14: Scatter plot showing PCA components 1 (Z$_1$) and 2 (Z$_2$) for Falemoa, Jane’s Camp, Sasoa’a and Vailele
Chapter 5: Results

5.4.2.2 PCA for Falemoa, Jane’s Camp, Vailele, and Sasoa’a: Components 1 ($Z_1$) and 3 ($Z_3$)

Little differentiation, based on these components, can be made between Falemoa, Jane’s Camp, Vailele and Sasoa’a (Figure 5.15)(Appendix C). One exception to this is a slight separation of the pottery from Jane’s Camp. Certain oxides from Jane’s Camp load lightly on $Z_1$, indicating low titanium and higher amounts of potassium. The other sites reflect higher concentrations of titanium and a corresponding lower amount of potassium along $Z_1$, but retain even concentrations along $Z_3$ with the exception of some outliers. This suggests that most of the pottery from these four sites had low levels of chromium and higher levels of vanadium.

Figure 5.15: Scatter plot showing PCA components 1 ($Z_1$) and 3 ($Z_3$) for Falemoa, Jane’s Camp, Sasoa’a and Vailele
5.4.2.3 PCA for Falemoa, Jane’s Camp, Vailele, and Sasoa’a: Components 2 ($Z_2$) and 3 ($Z_3$)

Figure 5.16 shows a similar distribution to Figure 5.15, with a separation of pottery from Sasoa’a and the other sites. Vailele and Falemoa (Appendix C). Sasoa’a, with some outliers, loads lightly in elemental concentrations on $Z_3$ and only moderately on $Z_2$, reflecting higher levels of vanadium, lower levels of chromium, and moderate levels of calcium, sulphur, aluminium and iron. Falemoa in contrast, has much higher concentrations of iron and calcium than Vailele, which load more heavily on $Z_2$. Vailele has somewhat of a cluster around low concentrations of iron and calcium, and higher concentrations of sulphur and aluminium. There is, however, a range of sherds from Vailele spread across the $Z_2$ axis, suggesting these concentrations are not consistent in pottery from the site.

Figure 5.16: Scatter plot showing PCA components 2 ($Z_2$) and 3 ($Z_3$) for Falemoa, Jane’s Camp, Sasoa’a and Vailele
Chapter 5: Results

5.4.3.1 PCA for Falemoa, Mulifanua, and Jane’s Camp: Components 1 ($Z_1$) and 2 ($Z_2$)

If we analysis clay compositions in pottery from Falemoa, Jane’s Camp and Mulifanua we find in Figure 5.17 a distinct difference between Mulifanua and the other two sites, and a more moderate distinction between Falemoa and Jane’s Camp (Appendix C). Mulifanua has a broad distribution across $Z_2$, indicating variable levels of iron. In contrast to the other two sites, certain elements load heavily on $Z_1$, indicating high levels of titanium and vanadium, and a lower amount of calcium. Jane’s Camp and Falemoa have lower levels of titanium and vanadium, but are separated by differences in elemental concentrations along $Z_2$. Iron concentrations from Falemoa load lightly on $Z_2$ reflecting lower levels, and with higher levels of potassium then pottery from Jane’s Camp, this separates the two sites out.

Figure 5.17: Scatter plot showing PCA components 1 ($Z_1$) and 2 ($Z_2$) for Falemoa, Jane’s Camp and Mulifanua
Chapter 5: Results

5.4.3.2 PCA for Falemoa, Mulifanua, and Jane’s Camp: Components 1 ($Z_1$) and 3 ($Z_3$)

We see a very similar distinction between sites as in Figure 5.17, with Mulifanua separate from Jane’s Camp and Falemoa (Figure 5.18) (Appendix C). Mulifanua loads highly on $Z_1$, reflecting increased amounts of titanium and vanadium, and has a wide distribution along $Z_3$, indicating varying levels of manganese and chromium. Jane’s Camp and Falemoa group along $Z_3$, with both sites having similarly low levels of chromium and higher amounts of manganese.

Figure 5.18: Scatter plot showing PCA components 1 ($Z_1$) and 3 ($Z_3$) for Falemoa, Jane’s Camp and Mulifanua
Chapter 5: Results

5.4.2 Discriminant Function Analysis

5.4.2.1 Discriminant Function Analysis for all sites:

Figure 5.19 shows the results of a Discriminant Analysis when groups are predicted based on site provenance. There is a strong grouping of sherds from Mulifanua, distinct from the other four sites. Pottery from Mulifanua loads highly on Z1, indicating an increased concentration of sulphur and a lower concentration of aluminium. The other four sites show an interesting distribution along Z2. Pottery from Falemoa has the lowest loading on Z2, suggesting higher amounts of calcium are present. This is similar to pottery found from Jane’s Camp, which loads only slightly higher on Z2. Vailele has a wider distribution along Z2, overlapping with Jane’s Camp and Sasoa’a on either end. Sasoa’a itself loads highly on Z2, indicating low levels of calcium and moderate concentrations of aluminium (Appendix C).

![Discriminant function analysis of five sites](image-url)
5.4.2.2 Discriminant Function Analysis for all temper groups:

Figure 5.20 shows the results of a Discriminant Analysis when groups are predicted based on temper type. Pottery made with temper of feldspathic basalt, ferromagnesiam basalt and shell strongly cluster together indicating moderate amounts of titanium, iron, and sulphur. Ferromagnesiam basaltic tempers have a wider distribution across both $Z_1$ and $Z_2$, and therefore, are more variable in these concentrations. There appear to be two distinct groups separate from this main cluster. The first group comprises several sherds made with a trachyte temper. This would suggest clays in this group have a higher amount of sulphur, and lower amounts of titanium and iron than found in other temper groups. The second group is two glass-tempered sherds clustered together, independent from any other temper group. This group has higher amounts of titanium and iron than the other temper groups (Appendix C).

*Figure 5.20: Discriminant function analysis of temper groups*
Chapter 5: Results

5.5 Summary:

The combination of stylistic, temper and chemical analysis has produced results reflecting the changes that occurred to Samoan pottery manufacture and production from the initial Lapita ware to the end of the plainware period. Stylistic analysis shows a considerably diverse range of forms in the initial Lapita period of Samoa. Following this period, vessel forms are almost solely restricted to open bowls, which dominate plainware assemblages. Decoration shows a similar trend, with a range of techniques employed by Lapita potters in Samoa. Once again the transition of pottery into plainware assemblages shows only incision and red slip continued as techniques of decoration, with similar red slipping noted from assemblages on other islands. The stylistic classification of thin ware/thick ware is shown to have some validity on the pottery from Sasoa’a, the site from which the original classification was made. But when compared to other plainware sites, and in a holistic approach to plainware from ‘Upolu, there does not appear to be any valid stylistic division.

Temper analysis of the pottery from each of the five sites has confirmed the patterns first put forward by Green (1974b;d) and Dickinson (1969, 1974, 1976), as well as providing more detail on the nature of the inclusions. Conclusions include:

1. Pottery tempered with a ferromagnesian basalt is present at every site, both Lapita and plainware. This reflects a common preference for this form of temper, and is likely to have been acquired from coastal sources.
2. Feldspathic trachyte is found at Vailele, but is much more common from Sasoa’a, a probable reflection of the proximity to the source.
3. Feldspathic basalt is found at every plainware site except Falemoa, and has possibly been sourced from three different groups of volcanic outcrops.
4. Pottery tempered with glass is only found from Mulifanua, and based on previous petrographic work the source is likely to be inland at one of the volcanic cones.
Chapter 5: Results

5. Calcareous temper is found from both Falemoa and Mulifanua, and is suggestive of an early manufacturing technique utilising coastal ingredients.

These temper groupings, when compared against other sherd characteristics, produced a variety of results. There appears to be strong correlations in an increase in sherd thickness, temper density and temper size with the utilisation of feldspatic trachytic (group 3) and feldspatic basaltic (group 4) tempers. The utilisation of certain tempers also appears to change over time from the site of Sasoa’a. Ferromagnesian basalt is a common temper in the early stages of the site, but appears to be replaced by feldspatic trachytic and basaltic tempers in later use. Decoration is also constrained to pottery made from ferromagnesian basaltic and glass tempers, with none yet found on pottery using any other temper groups.

The chemical analysis undertaken on the clay compositions of pottery from Samoa shows a related but distinct chemical composition between Lapita pottery from Mulifanua and pottery from all the plainware sites. Within the plainware assemblages, pottery from Falemoa and Jane’s Camp show strong chemical similarities to each other, with a similar grouping of pottery from Vailele and Sasoa’a. The grouping of pottery from Falemoa and Jane’s Camp appears particularly strong when compared to Mulifanua pottery. These three sites are in close geographical proximity, and while the chemical compositions of the clays are somewhat similar, pottery from Jane’s Camp and Falemoa cluster together and most pottery sherds from Mulifanua are once again compositionally distinct. Discriminant Function Analysis, while not particularly strong in this instance, does show the general trend established by PCA. Sasoa’a and Vailele cluster around one centroid, Jane’s Camp and Falemoa pottery another; Mulifanua pottery has its own cluster. When clay compositions are grouped using temper types, there is little differentiation between groups, with the exception of those manufactured using glass tempers.
Chapter 6
Discussion

6.1 Introduction to ceramic production in Samoan prehistory

This research has focused on producing new data on prehistoric ceramic production from the island of 'Upolu that can be used to update and provide new provisional models for the early settlement phases in Samoa. Samoan archaeology has had a resurging focus from archaeologists recently (Addison and Matisoo-Smith, 2010; Addison and Morrison, In Press; Addison et al., 2008a; Addison et al., 2008b; Eckert, 2006; Eckert and James, 2011; Eckert and Welch, 2009; Rieth et al., 2008; Rieth and Addison, 2008; Rieth and Hunt, 2008), as models of the region are challenged and data are needed for confirmation. Even so, the limitations of these existing data sets, as acknowledged by Green (1986: 51) in the 1980s, have yet to be overcome. Some datasets have been reworked with new methods (e.g. Holmer, 1980b; Smith, 1976a), but provided little additional information (Martinsson-Wallin, 2007). Temporal models using radiocarbon dates cannot achieve the necessary precision due to a flattening of the radiocarbon curve over this time-period, and therefore, cannot be relied on
to establish a sequence of events from Lapita colonisation through the plainware phase.

The first section of this discussion (6.2) outlines the settlement strategy employed by Lapita and plainware groups who occupied the coastal margin, including small offshore islands such as Manono. Because of current issues with the radiocarbon chronology there is some ambiguity between the material cultural suite found at Falemoa and its current chronology. It is possible based on its location, that it was occupied during the Lapita settlement phase, and therefore would support Kirch and Hunt’s (Kirch, 1993; Kirch and Hunt, 1993c) argument that dentate-stamped pottery as a marker for Lapita groups rapidly disappeared in the Samoan archipelago.

The second section (6.3) discusses the importance of decoration and the current issues with the plainware classification scheme of thin/thick ware first outlined by Green (1974d). Stylistic analysis is naturally restricted on Samoan plainware assemblages. The limited decorative elements present suggest some form of connection to a larger regional pattern. The results of pottery divisions based on sherd thickness show a lack of quantifiable justification. Instead, pottery should be classified based on its composition.

The third section (6.4) of this chapter considers the production patterns of Lapita and plainware pottery from 'Upolu. Samoan Lapita pottery production focused on a range of different materials, reflecting similar regional production patterns from Tonga and Fiji. The number of resource procurement zones following Lapita settlement declines, with a subsequent shift to different production technologies. It is likely that the majority of the pottery was produced locally, with only the presence of a few pots exotic to a site. Pottery declines in quality through the plainware period, increasing in temper density and size.
Chapter 6: Discussion

6.2 Lapita and plainware settlement strategy

6.2.1 Initial Lapita settlement

The colonisation of Samoa was undertaken by Lapita peoples who initially maintained a level of high mobility, indicative of Lapita settlement strategies found on the islands of Tonga and Fiji (Best 1984; Burley 2007; Clark and Anderson 2001). While there are limits to any analysis of the Mulifanua site due to taphonomic issues, it is clear that early settlers were highly mobile around the northwest corner of ‘Upolu. Studies on early Lapita settlements would suggest that Lapita colonisers were highly mobile when settling distant and often remote islands (Summerhayes, 2000a; Summerhayes, 2000b; Summerhayes, 2003). The Samoan archipelago has been argued to be on the frontier and at the limits of Lapita colonisation, and it appears in this case a high level of mobility would have allowed access to a diverse range of sources.

The discovery of taro residue on one of the pots from Mulifanua by Crowther (2009) would indicate horticultural activity at some period in the sites history. However, due to the nature of the deposits, it is impossible to tell how long the site was in use, and whether horticulture was an early practice on the island. Shell scrapers from Falemoa, if this was accepted as an early site, provide ambiguous evidence that terrestrial domesticated foods were already established (Lohse, 1980: 29).

As horticulture generally reflects a reasonably sedentary society, there are two possible models for settlement strategy in early Samoan colonisation. One is that the first people living at these early sites were broad-spectrum maritime foragers, favouring more of a weakened ocean strandlooper model that appears to be common amongst early communities on Tonga (Burley 2007, Burley et al. 2010). As settlement progressed and the initial resources were over-exploited, such as the nearby reef system, horticultural practices became common. The second model is that the initial colonisers rapidly established a horticultural base, perhaps utilising a nursery crop approach, resulting in a degree of sedentary settlement. As Bailey and Parkington (1988) point out, there is a continuum between fully sedentary settlement and fully mobile economies.
Chapter 6: Discussion

with seasonal occupations. One issue with the second model is that the range in production materials from the site (Table 5.13) would suggest a considerable degree of movement to obtain these resources, especially in the case of material accessed inland. Another problem lies in the distance between the Samoan archipelago and the nearest Tongan island, Niuatoputapu. It would have taken a reasonable period to establish enough of a horticultural base for the first colonisers to survive, and would have had difficulty relying on any other Lapita communities. It seems more plausible that the first colonisers would have more readily adapted to a new island group by maintaining a degree of mobility for a period of time, with the possibility that a nursery crop was established early, and was subsequently utilised by returning groups.

Such a model bears striking similarities to initial settlements in Tonga and Fiji (Kennett et al., 2006). These settlements were generally close to an extended reef system, and had good access to waterways between islands. Mulifanua would have been ideally situated, allowing a considerable degree of mobility for early settlers, with a proximity to Manono, Apolima and Savai’i, in conjunction with having a protected lagoon for canoes (Green, 2002). The stilt house method of construction would have been well suited in the shallow lagoon, and it appears there would have been good access to fertile soils along the coast. Mulifanua pottery has a wide variety of forms, many of which match closely to contemporary forms from Tongan and Fijian assemblages (Best, 1984; Birks, 1973; Burley et al., 2010; Burley, 2007; Burley and Dickinson, 2010; Clark and Kennett, 2009; Cochrane, 2004). This includes the characteristic carinated vessel with both a flat and round base (Form 6). The indication that pottery materials were being sourced from both the immediate area and further afield (Table 5.13) would reflect an exploration of the surrounding environment for suitable resources. These factors suggest that the method of colonisation on 'Upolu matched closely the colonising strategies found on Tongan and Fijian islands (Best 1984; Burley 2007; Burley et al. 2010; Clark and Anderson 2009; Cochrane 2004). Other Lapita settlements may have been established along the northern coast of 'Upolu, and possibly on the offshore islands of Manono and Apolima, but subsequent subsidence and sediment accumulation may have buried these sites.
6.2.2 Settlement strategy in the plainware period

It is argued that as Lapita communities became established across the Western Pacific, the large regional networks that maintained material and social connections, providing marriage partners and ideas, began to collapse into smaller ones reflective of a growing group of settlements within each archipelago. The mobility associated with Lapita settlements declined, as communities branched out and settled new areas in each archipelago (Clark, 1999, 2000; Clark and Anderson, 2001). From Tonga and Fiji it appears that new settlers initially targeted coastal areas, retaining good access to reef systems and providing safe launching areas for canoes. It is only after a substantial period of time, around 2,500-2,000 cal. B.P., on the islands of Fiji that settlement begins to move in any great numbers inland (Clark and Anderson, 2009: 427). By this stage horticultural practice was long established, allowing communities to survive without traditional marine resources, although trade probably occurred between inland and coastal settlements. Other resources were also exploited during the plainware phase, most notably material suitable for adze manufacture. The Tataga-Matau source on Tutuila, which formed part of an extensive interaction network during the settlement of East Polynesia, began to be utilised in the plainware period (c. 2,200 B.P.), with the material transferred at least as far as 'Upolu (Best et al., 1992; Weisler, 1993).

If populations remained small, as seems likely based on Samoa’s relative isolation, these communities would have to have remained in contact to provide genetic diversity through new marriage partners, otherwise they would have rapidly suffered debilitating founder effects (see Burley and Dickinson, 2010 for founder effects on Tongan design system; Moore, 2001: 397; Weisler and Kirch, 1996). The communities on the north-western coast of 'Upolu were not in isolation. Settlement in the plainware phase on Savai’i is attested from pottery deposits at the early end of occupation at the Pulemelei mound (Martinsson-Wallin et al., 2007) and from the midden site of Si’utu (Ishimura and Inoue, 2006). Plainware deposits have also been found across Tutuila, Ofu, Olosega and
Ta'u (Figure 3.7, Figure 3.8). The initial Lapita population rapidly expanded to settle all the major islands in the Samoan archipelago.

The end of the plainware period shows a marked change in settlement strategy, evidenced from the site of Saso’a, as well as recently discovered sites from Tutuila (Addison et al., 2008a; Eckert and Welch, 2009). Plainware settlers, perhaps focusing on agriculturally rich soils, such as those found around Mulifanua (Jennings, 1974: 177), also occupied inland sites, such as Puna, Leuluasi and Saso’a in the Falefa valley, the terraced flats at Vailele and inland at Mount Olo (Davidson, 1974; Green, 1974b; 2002: 137; Holmer, 1980a; 1980c).

6.2.3 Falemoa as a Lapita site

Pottery production between Mulifanua and Falemoa shows strong similarities, and is possibly indicative that the site is representative of a Lapita period settlement. There are several similarities between the sites of Falemoa and To’aga. Both have good access to a reef system, which would have been harvested for reef fish. Material culture from Falemoa has produced shell beads and tools, as well as fishhook fragments, all from the same pottery-bearing layer (Lohse, 1980). It is also noteworthy that four pieces of obsidian whose source is unknown were collected from the site (Howitt, 1980: 142), but reaffirms the sites early nature. What is different between this site and To’aga is its function, and therefore scale. To’aga appears to have a considerable period and size of occupation, stretching through most of the plainware sequence (Kirch and Hunt, 1993c). Falemoa, in contrast, is argued to be a small temporary living site, with low numbers of occupants and no real structures.

The use of calcareous tempers has been noted to be restricted to Lapita period sites. However, from Samoa there are two sites that contain pottery manufactured using calcareous inclusions intermixed with a ferromagnesian basaltic temper (Table 5.12). The first site, Mulifanua, contained several sherds identified with calcareous temper (Table 4.3)(Petchey, 1995), which is not unusual as this site is classed as a Lapita occupation.

The second site that contained calcareous tempered pottery was at Falemoa (Table 4.3). Because Rieth (2007) disputes the age of the site due to
issues with a cohesive chronology in relation to the stratigraphy, the original calibrated date of 2,290-2,030 Cal B.P. (Lohse, 1980) is not reliable. If we disregard the single radiocarbon date for the site, one could argue based on the material culture and the sites location on a small offshore island (that is likely to have been joined to 'Upolu at the time of colonisation), it would have been a suitable area for Lapita habitation.

The issue of dentate decoration as a Lapita marker and what this absence means for Lapita aged sites found has also been raised at two other sites in the Samoan archipelago, one at 'Aoa and the other at To'aga. Kirch and Hunt (1993c) both argue strongly that To'aga is in fact a Lapita site absent of any distinctive Lapita decoration. However, Rieth (2007: 1) has suggested that it is more probable that occupation occurred around c. 2,500-2,400 Cal B.P., not as early as 2,800-2,400 Cal B.P. (Kirch, 1993). Based on the material culture suite from these excavations, it does appear that the site is more reflective of an early plainware occupation, showing many similar characteristics from sites on 'Upolu, such as a red slip found on pottery from Jane’s Camp.

Pottery from Falemoa is not as numerous as any of the other four sites examined in this research (Table 4.1) and decoration is constrained to rim incision (Lohse, 1980: 29-30). Analysis of the fabrics would suggest that pottery was manufactured locally, sharing strong similarities in clay and fabric to Jane’s Camp (Figure 5.19, Figure 5.11, Table 4.3). The argument that decorated pottery, already in a minority at Lapita sites, had a ritualistic purpose, which would seem unlikely to be required at a temporary camp/fishing site. If we consider all these factors: unreliable radiocarbon date, material culture with strong similarities to Lapita sites, temporary settlement, calcareous temper, local manufacture of pottery, proximity to Lapita site of Mulifanua, geographical proximity to a reef system and the islands of Apolima and Sasoa’a, then there is the possibility that this site was occupied during the Lapita period or immediately afterward.
6.3 Plainware classification

6.3.1 Weakness in stylistic analyses

Due to the inherent cultural markers that pottery can provide, archaeologists in the Pacific trying to identify shifts in cultural paradigms have used it extensively. This has recently been met with some resistance, by authors such as Smith (2002), who argue that stylistic change can be related to any number of factors, not necessarily only cultural ones. The first two periods of Samoan prehistory have been characterised by the stylistic elements of its pottery, but this would have only been a part of the material cultural suite present. But, because pottery survives, it has been seen by most archaeologists as critical to understanding the transition from the Lapita phase into a Polynesian one. Because plainware is characterised by its lack of decoration and complexity, stylistically it cannot be used as a cultural marker. Stylistic analysis requires changes in stylistic markers to be used effectively, and without these one cannot argue with any certainty what a lack of these markers actually means.

If pottery design is not an accurate reflection of cultural groups, then it should not be used as a categorical tool for Samoan prehistory. By grouping sites based on one aspect of one form of a larger material cultural suite we obscure possible similarities and differences. This has manifested itself in the attempts to create stylistic differences amongst plainware assemblages on Samoa (Green, 1974d). Instead, shifts in production strategies are more likely to reflect changes in social strategies of those manufacturing pottery (Summerhayes, 2000a). This is particularly useful in the Samoan context with the restrictions in stylistic analysis.

6.3.2 Plainware Decoration

The absence of decoration on plainware pottery, with the exception of some rim incision and red slip, has long been noted. If one compares pottery with and without decoration (incision) against fabric type (Figure 5.10), it appears that decoration is only found on pottery made with ferromagnesian
basaltic tempers. This is the dominant temper group on pottery from early plainware sites, in which decoration is present in any large numbers on sherds. Red slip is another decorative element found on plainware pottery. As with incision, it appears to be restricted to pots from early ‘Upolu sites of Mulifanua, Falemoa and Jane’s Camp (Table 5.5), as well as early pottery from To’aga on Ofu (Hunt and Erkelens, 1993), and even further away on islands such as Futuna (Kirch, 1976: 43). Based on the dates of these sites, red slip appears to be an early regional characteristic.

If one accepts the current dating of sites on ‘Upolu, it appears that decoration becomes less frequent over time, and completely absent from the final phase of pottery at Sasoa’a (Table 5.5, Appendix A). It also suggests that pottery manufactured from ferromagnesian basalt or in the rare case of a glass temper, was the preferred or only option for potters who added decoration to their pots. While incision is rare on plainware, it is most common on that termed ‘thin ware’ (Green, 1974b). It can be inferred that those sites that contain decorated, incised pottery are earlier then the last phase at Sasoa’a where Green’s ‘coarse ware’ dominates. A similar pattern is suggested to have occurred at To’aga, with coarser tempered pottery becoming dominant over time (Kirch, 1993). This would indicate that whatever motivations were present for decorating pottery on ‘Upolu, it gradually declined, as it ceased to be used before the termination of pottery production altogether. If Lapita decoration represents a form of cultural communication, then the loss of plainware decoration before pottery cessation would suggest that pots in the last phase of manufacture (with simplified vessel forms) were most likely to have had a purely utilitarian function.

The strength of this argument lies on the importance of decoration, something that has had an intense focus from archaeologists studying Lapita assemblages. Dentate-stamped decoration is argued to be a form of cultural identity. While it seems plausible that decoration was a medium for some form of cultural identification, its loss on pottery does not indicate that this association ceased to exist. This communication may have shifted into other mediums, such as tattooing, which would work in a similar fashion to pottery design (Bedford
and Sand, 2007; Kirch, 1997). Thus one cannot be certain that the loss of decoration represents a cultural change.

6.3.3 Plainware vessel form and function

With the exception of the carinated vessel found from Jane’s Camp, post-Lapita pottery across the archipelago is characterised in its entirety by open bowls and a few jars. Analysis of rims from the plainware period indicates that direct rims predominate, and only a minor occurrence of incurving rims are found (Table 5.4). This would suggest that there was a major simplification in the design of ceramic forms in the plainware period. The question is whether this can be considered a cultural shift, and therefore representative of a new cultural identity.

Initial Samoan Lapita vessel forms are strongly characteristic of contemporary Tongan and Fijian vessel assemblages (Birks 1973), reflecting settlement of the archipelago by Lapita migrants (Table 5.2). Following the loss of dentate-stamping, simple bowl forms dominate plainware assemblages (Table 5.3). It is probable that plainware pottery was almost always functional, used as containers for foods and utensils for processing (Crowther, 2009; Leach, 1982).

The orthodox model that pottery vessel forms on ‘Upolu declined in variability over time is confirmed (Table 5.1), but the rapidity is questioned. While bowl forms are overwhelmingly represented in Samoan plainware sites, it is not exclusive. The single example of a carinated vessel with a flat base from Jane’s Camp argues that some vessel variation continued in the early plainware period (Table 5.1). There are two possible hypotheses as to how this occurred. The first is that the carinated vessel is merely a relic of earlier vessel forms and is not representative of other contemporary plainware sites. The second hypothesis is that because of the difficulty in securing accurate dates for Samoan sites excavated before strict radiocarbon standards were employed is that the site is earlier then currently dated, or that the duration of the Lapita/transition-period is longer than is currently established. The earliest plainware sites are poorly represented on ‘Upolu, with Jane’s Camp being the best current example of this type of site.
Chapter 6: Discussion

It seems likely that the second hypothesis is valid, as it seems improbable that a single individualistic vessel form characteristic of a Lapita assemblage survives on its own. If one takes into account the likelihood of early sites to be situated on the coast, and therefore underwater, it seems reasonable that the transition in vessel forms from Lapita into the plainware period was not necessarily an extremely rapid occurrence, but instead can be identified tangibly from sites such as Jane's Camp. In addition, the excavation of any given site based on intensive test squares as opposed to extensive site excavation could add a sampling bias. If one accepts the argument that some vessel forms had a more ritualistic than utilitarian use in Lapita communities, and therefore a different depositional history, then such a theory could be applied to later sites.

Simplification in pottery forms also occur across many cultural assemblages, not merely restricted to Samoa, or even Tonga. The argument that such a loss is reflective of the emergence of a society that is distinctly Polynesian (Green 1981, 1986) is therefore false. It is possible, and probably likely, that there were similar changes occurring in these communities roughly contemporary with each other, but to what outcome has yet to be ascertained. Instead, simplification of vessel form was likely driven by new environmental and social conditions that were similar across these island groups.

Pottery must also be considered by its function. While detailed analysis on the function of pottery, its subsequent loss and what that means for Samoan society is beyond the scope of this research, function is important to consider when undertaking stylistic analysis. The simplification in vessel forms would have restricted possible uses. In the Samoan assemblages the noted darkened or fire-blackened areas would indicate a use for cooking, confirmed from similar indications on pottery from To’aga (Hunt and Erkelens, 1993). The dominant bowl form would have been unsuitable for long-term storage of any kind, and would likely have had a more immediate use. Green (1974b) suggests that while cooking was undertaken using pottery, the bowls had other additional uses. The smallest size bowl would suggest drinking cups or serving fluids, such as for kava, water, or holding dyes. Comparable uses found ethnographically on medium sized wooden bowls are to hold arrowroot paste and dye, to pound cooked breadfruit, or to prepare and even cook various foods in by dropping
heated stones into the bowls. Medium to large bowls may have been used as kava containers. This range in vessel size would have provided a number of different uses likely to be required in a domestic household. The incision found on a limited number of rims could have been indicative of its use as a kava bowl, similar to those found in Fiji (Green, 1974b).

6.3.4 Thick/thin ware division for plainware pottery

Green (1974b) divided Samoan plainware pottery into two groups based on vessel thickness. Because his approach did not provide a quantitative measurement by which to determine the division, there have been several subsequent attempts to provide a representative figure. Petchey (1995) in her analysis of ceramics from Mulifanua, came to the conclusion that there was no thin/thickware division from this site. This in itself is not surprising, as the site is distinctly Lapita and while it has a large component of plainware pottery, it is not representative of a post-Lapita plainware site. From Jane’s Camp, Smith (1976a) attempted to test quantitatively whether a thickness division could be discerned. The results suggested that there was a considerable overlap between types based on classifying sherds by thickness, with Smith suggesting that this merely emphasised a continuation in declining quality and elaboration of Samoan ceramics. More recent studies, (e.g. Eckert and Welch, 2009) have continued to classify pottery assemblages based on thickness, with the addition of several other attributes, such as temper size and paste colour. However, these studies continue to fail to provide quantitative values for this form of classification. Exceptions to this were the analyses undertaken on the To’aga ceramics (Hunt and Erkelens, 1993) and from Niuatoputapu (Kirch, 1988a: 152). There is as yet no accepted quantifiable division in sherd thickness in a satisfactory classificatory system.

In an attempt to quantify this categorical division a dip test was run to determine whether there was a bimodal distribution amongst sherd thickness. If two groups could be divided based on thickness alone, then the thickness of every sherd from a site would be expected to show a bimodal distribution. Using sherd measurements from Sasoa’a (Figure 5.3), the site that Green originally
used for his classification, a division can be seen around 7.5 cm. However, this binomial distribution is not represented at Vailele (Figure 5.5) or at Mulifanua (as Petchey 1995 determined)(Figure 5.4) nor is it representative of sherds across a range of plainware sites (Figure 5.2). The possibility exists that there was a stylistic division based on pottery thickness from its manufacture at Sasoa’a, but as an exception within the plainware period. Instead, I would argue that sherd thickness in Lapita and plainware sites is dominantly a continuous variable, not a categorical one, and should not be used in a classificatory scheme.

6.3.5 Reclassification of Samoan plainware pottery

Instead of a new approach, updating Green’s (1974b) original classification scheme is more prudent. In his summary of the plainware sequence, Green classified pottery as either ‘thin fine ware’ or ‘thick coarse ware’. His grouping criteria were based on decoration, vessel form, sherd thickness and fabric. This has produced varied attempts by subsequent archaeologists in Samoa to either assign pottery from their assemblages to one of these groups (e.g. Addison et al., 2006; Eckert and Welch, 2009; Hunt and Erkelens, 1993), attempt to revise the scheme based on a North American tradition producing wares, series and types (e.g. Holmer, 1980b), or discard the system altogether (e.g. Petchey, 1995). The underlying issue that has plagued this scheme has been the lack of quantitative validation. Most groupings have been made based on sherd thickness, which was shown to be a misclassification based on the Sasoa’a collection. As a result, those who have attempted to demarcate groups based on quantitative values from other sites (such as Hunt and Erkelens, 1993; Kirch, 1988a) have struggled to show any sort of differentiation. Others (Holmer, 1980b) have used classificatory schemes based on limited attributes, such as paste colour, and failed to take into account other forms of variables present.

Decoration is uncommon or absent altogether on plainware, and therefore should be limited in its application to a classificatory scheme. Vessel forms, as outlined by Green (1974b), are variants on an open bowl and provide little value in distinguishing different groups. Thickness has been shown to be
reflective of some changes to plainware pottery, but is a by-product of raw material selection, and not a stylistic choice.

Instead, a revised classification scheme focuses primarily on the fabric aspect of plainware pottery. ‘Fine ware’ under Green’s classification is measured by a low temper density (Figure 5.7), small temper size (Figure 5.8), the selection of ferromagnesian basaltic, calcareous and glass tempers and as a result an increase in porosity. This type of ware is most common in the early sequence of Samoan settlement, completely dominant at Mulifanua and Falemoa, with a strong presence at Jane’s Camp. ‘Coarse ware’ under Green’s classification is measured by an increase in temper density (Figure 5.7), an increase in temper size (Figure 5.8), and a shift in production technology to feldspathic varieties of basalt and trachyte tempers on Upolu. This form of production becomes more common as the plainware period progresses, is present at Vailele and becomes dominant at Sasoa’a in the later phase (Figure 5.9). Temper types are based on pottery compositions from Upolu (Table 4.2), but can be substituted with appropriate local tempers using the other components as a guide. This classificatory scheme reflects the shifts in pottery production technology over the plainware period, resulting in poorer quality pottery that ceased to be produced in quantity before the cessation of ceramic production altogether.
6.4 Pottery production on 'Upolu

Production over 1300 years in the Samoan archipelago is likely to have changed as potters reacted to their environments (Eckert and James, 2011: 2157). Evidence of production (polishing stones, waster sherds etc.) has never been found in Samoa. Therefore, production patterns can only be ascertained through indirect evidence, involving inferences about the raw materials used.

6.4.1 Production centres for Lapita settlement

Pottery production from Mulifanua indicates that there was no single source utilised, but instead what appears to have been a multitude of raw resources, most likely from across the northwest coast of 'Upolu as well as inland (Table 5.13). This matches production strategies from other Lapita potters, with no standardisation in the selection of raw materials (Chiu, 2003: 176; Clark, 1999). Tempers at the site are dominantly ferromagnesian basalt (Appendix A), whose source is most likely streambeds and outwashes along the coast (Dickinson, 1974; Petchey, 1995). The ability to distinguish three subgroups of ferromagnesian basaltic temper would suggest these raw inclusions were sourced from a number of different points, possibly from different catchments or streambeds further afield, which display different ratios of basaltic fragments. The initial settlers to the site appear to have sampled a range of materials in order to determine those most suitable for pottery manufacture. Clays from the site also support this argument (Figure 5.19, Figure 5.11) showing a strong dispersal in geological composition, indicating more then one clay group was accessed.

Two other temper types are found in pottery from Mulifanua (Table 4.3). Calcareous temper was utilised, and is considered a signal of Lapita pottery production. While a purely basaltic temper was not found in the current sample, its identification by Petchey (1995) would suggest another source, possibly located inland or on another volcanic flow. A distinctive glass temper was noted for two sherds. Based on previous petrographic analysis (Petchey, 1995) and the
clay composition it appears that the materials for this pottery were sourced inland, possibly near one of the numerous volcanic cones. The very strong distinction in clay composition between these two sherds and every other sherd from the site would indicate a distinct clay deposit (Figure 5.20), possibly aimed at utilising the more suitable kaolinite clay found at higher altitudes. As noted in Petchey's (1995) petrographic work, one sherd that had an unusually high quantity of quartz is unlikely to have been sourced on 'Upolu, and probably originated from Fiji. The presence of this single anomalous sherd indicates almost all pottery from the site was produced locally.

The large number of different tempers used, in combination with the geological diversity of clays from Mulifanua pottery, indicates that four zones of procurement could have been present for the duration of habitation at the site (Table 5.13). It must be cautioned, however, that the lack of reliable stratigraphic control means it is impossible to accurately define the longevity of production. The number of zones does fit with colonising Lapita strategies from other islands in the region. New settlements generally recorded a diverse selection of resources for pottery production (Chiu, 2003: 176; Clark, 1999). Based on the surrounding geology, defined by the Mulifanua Volcanic, the resources for this production could have been acquired from the surrounding area, including the inland cinder cones.

6.4.2 Production centres of plainware sites

Plainware settlements show a shift in the composition of production centres following Lapita habitation. The early plainware sites of Falemoa and Jane’s Camp continue to use certain tempers established during Lapita settlement, but fail to utilise others (Table 4.3). Three production techniques can be defined between the two sites. They share a very similar geological basement to the Mulifanua site, even with Falemoa’s location on Manono. It is likely, based on the similarities in clay compositions between the two sites (Figure 5.11, Figure 5.12, Figure 5.13), that these resources were obtained from geologically similar areas. These are likely to be situated on the Mulifanua volcanic, indicating a local collection source. This is reinforced by the dominant temper, consisting of
ferromagnesian basalt (temper group 1)(Table 4.3) and probably acquired from a nearby beach or river channel. The separation of clays between the two sites (Figure 5.17) does suggest that sources were different or clays were being prepared in different ways. The proposed contemporary nature of the sites (Holmer, 1980b) and the similarities in production techniques (Table 5.13) suggest either some form of continued cultural contact between early plainware communities or a common inheritance from earlier Lapita settlements. Because of the geographical proximity of sites along the northwest coast of ‘Upolu, it is possible that both ideas are correct. This interaction would have been beneficial for group survival in a frontier area with a low population density, as suggested by Burley (2007) to have occurred in the Lapita and early plainware periods for northern Tonga and Samoa.

The later plainware sites of Vailele and Sasoa’a a marked shift in resources compared to earlier plainware sites. Feldspathic trachyte (temper group 3) and feldspathic basalt (temper group 4) become the prominent forms of temper inclusions, with a resulting decline in the dominance of ferromagnesian basalt (temper group 1). This matches the local geological basement that these sites are situated on, with both being in areas of more considerable geological complexity (Figure 3.2). Clay compositions from both sites group together (Figure 5.11, Figure 5.14, Figure 5.19), warranting a combined CPCRU (Table 5.13). A similar relationship can be seen in the temper compositions. While Sasoa’a pottery has a larger component of temper group 3 due to the proximity of nearby trachytic plugs situated on the older Fagaloa volcanics, this group is still present from Vailele (Table 4.3). The use of feldspathic basalt varieties from both Vailele and Sasoa’a suggest that there are similar resources being accessed between these sites, and are most likely centred along the northern coast of ‘Upolu and further inland. The suggestion by Green (1974b) that pottery between the sites is virtually identical could imply that ideas about resource access and production techniques were communicated and inherited between nearby plainware communities. This would explain the strong similarities in both clay and temper compositions in the pottery from these sites.
6.4.3 The issue of pottery as a trade ware

Trade is a key factor in facilitating the movement of people between groups. What is notable about pottery production in the plainware phase is that very few pots appear, based on their geological composition, to have had any significant movement from their place of origin. There are a handful of pots that have been identified by Dickinson (2006: 37, 107) as indicative of pottery movement from east to west on 'Upolu, most likely along the coast. The handful of pots might be suggestive of an exchange of spouses between communities or the movement of a small group. However, the vast majority of pottery cannot be considered an island trade ware. This lack of pottery movement indicates trade, likely to occur when any groups facilitate some form of interaction, was in materials likely to have perished due to an organic nature.

The one possible exception to this lack of trade is the occurrence of a red slipware found at several different plainware sites on both 'Upolu and Ofu (Hunt and Erkelens, 1993; Smith, 1976a: 84). Because of the relative geological homogeneity of the archipelago it is difficult to rule out any pottery exchange completely. However, based on olivine ratios (Dickinson, 2006) it seems unlikely that this form of pottery was used as a trade good.

The decreasing importance of pottery, either functionally, ritualistically, or both, would reduce any role it once had as a form of cultural communication. A possible transfer to some other cultural medium might have occurred to replace the role of decorated pottery from the Lapita period (Marshall, 2008). In the first phase of the plainware period, settlements accommodated a growing population that spread along the coast and to other suitable islands. Therefore, local production would have provided satisfactory pottery needed for basic functional use. From the Teouma site in Vanuatu, pottery production appears to be small, of dispersed scale, and with no evidence of specialisation (Bedford et al., 2009: 230). These patterns of dispersed households appear to be similar to settlement patterns on Savai'i, with pottery from the early settlement phase (150 B.C.-200 A.D.) produced from nearby materials (Martinsson-Wallin et al., 2007).
6.4.4 Change in plainware technology

Analysis of pottery fabrics can provide an additional avenue of understanding in Samoan archaeology that stylistic analysis cannot, especially in the case of plainware pottery. Most of the attention paid to fabric analysis by archaeologists in Samoa has been to ascertain whether ceramics were involved in long distance exchange. Understanding the raw material components of pottery allows the archaeologist to determine technological techniques and constraints imposed by the natural materials found on different island groups, and to deduce how these early potters adapted.

The use of different tempers is argued to reflect a difference in production technology (Arnold, 2000; Summerhayes, 2000a: 32). This is because the mineralogical properties of temper impart physical and performance characteristics of the pottery, and in some instances may be conscious choices in production. Eckert (2006) has argued this based on the assemblage from Aganoa on Tutuila. She suggested that the two different technological styles reflect two different, contemporary production groups on the archipelago. This group forms a network of potters who pass on their experience, creating a tradition in raw material selection using a similar set of tools and techniques. However, due to limited site excavations, intra-site analysis on changes in pottery production can only be obtained from Sasoa’a, a site near the end of the plainware period (Green, 1974b: 117).

Pottery is found in the two earliest layers from Sasoa’a, and can be tentatively broken into two different phases. Due to the chronometric hygiene protocols of Reith (2007) these layers do not have any reliable radiocarbon dates, although it appears they were both occupied within a short time-span of each other (Green, 1974b: 115). The first phase appears to show that the dominant material used to manufacture pottery shares a similar ferromagnesian basaltic composition to pottery manufactured along the coast at other earlier plainware sites (Figure 5.9). Based on the known geology of the Salani Volcanics and the situation of the site, it is possible that the oldest pottery was manufactured nearer the coastline, where a ferromagnesian basaltic temper would likely be found. This is very similar to the production patterns of Jane’s
Camp and Vailele (Table 4.3). Inclusions from this pottery group have small amounts of alkali feldspars (Table 5.7), which would have derived from a trachyte source. As trachyte is restricted to plugs on the Salani volcanics (Dickinson, 2006: 37), it seems likely that the raw material for this group was sourced from a catchment below a trachyte plug. This could be either along a streambed further down the valley, or along the immediate coastline where small amounts of alkali feldspars had intermixed with inclusions classed as ferromagnesian basalt.

Pottery found in the second layer of the site shows a considerable shift in production strategy. Pottery, which was once dominated by materials from the coast, shifts to a predominance of trachyte tempered ware (Figure 5.9), which, based on the geology of the Salani Volcanics (Wright 1963), is likely to have been obtained further inland. There appears to be little intermixing in this group of inclusions from a ferromagnesian basaltic source. Spinels and ilmenite are absent, suggesting a very different composition to the ferromagnesian basaltic tempers found at every other site (Table 5.7). Because of this, it is likely that raw materials for this temper group were acquired from an area very close to the trachyte source. Based on the surrounding geology and known trachyte plugs, these potters are unlikely to have travelled as far as when ferromagnesian basalt tempers were collected.

This shift in production technology could be due to a number of reasons. One is that either the quality of the original deposits either declined to a point where they were unsatisfactory, or was exhausted altogether. The presence of around 20% of pottery in the younger layer being made with a ferromagnesian basaltic temper would suggest this did not occur (Appendix A). Another possible factor might have been a restriction to the source. If optimal coastal settlements have been taken, resulting in a push of settlement inland, then cultural boundaries may have arisen that prevented further access to coastal resources. However, the presence of two other temper groups (Table 4.3) indicates that more than one source is being accessed. A ferromagnesian basaltic source might have been located along one of the streambeds within the valley, and the presence of alkali feldspars (Table 5.7) strongly indicates that the source was restricted to the Falefa Valley or along the outwash plain.
Chapter 6: Discussion

Whether the shift was caused by cultural and/or natural factors, it does appear that it manifested itself as a considerable change in production technology at the site. Pottery manufactured from the later materials is not as thin (Figure 5.6), requires greater amounts of temper (Figure 5.7), has a lower porosity (Intoh, 1989: 143) and has almost no forms of decoration (Table 5.5). If one assumes this was not an aesthetic choice, then such a change reflects a shift in the technology. Because pottery from the site is still being sourced from several different areas (Table 5.13), it appears that there was no single resource considered to provide better quality clay. By adding larger, and more numerous pieces of temper to these clays, it would indicate that the quality of pottery manufacture is declining in the site or there is a strong functional shift in production.

Settlement at Sasoa’a appears to have initially retained a reasonable level of coastal access, which declined over time. By the end of the plainware period, pottery from the site is being manufactured predominantly from raw materials sourced inland, which marks a major shift in collection strategies seen from any other plainware site analysed in this study. This shift, which appears to produce poorer quality pottery, would indicate that either available sources have been overexploited or that there is a cultural restriction to better sources. From later plainware sites on Tutuila (Addison et al., 2008a), after optimal coastal areas had been settled, less desirable areas of the island began to be settled, most likely due to growing population pressure. It seems plausible that such factors could have occurred on ‘Upolu, with the later phase at Sasoa’a a reflection on inland settlement, which in the case of pottery resulted in a shift in technology to accommodate lesser quality material.

6.4.5 Decline in pottery quality

Over time the increase in temper size and quantity in plainware ceramics would suggest that Samoan potters were actively changing their production technology. Because decoration declines and vessel forms simplify it seems unlikely this was an aesthetic choice. Ambrose (1992) noted that Lapita potters often preferred a smooth, workable surface to apply a variety of decoration, and
Chapter 6: Discussion

it would appear that the finer ferromagnesian basaltic temper would be more suited to this task. It also seems unlikely that there was a restriction in raw material access, as this temper appears to have been common along either streambeds or along the coast, and is present at all five sites in varying quantities (Table 4.3). If the reason for this shift in pottery technology cannot be attributed solely to either aesthetic design or restriction in access, then a more plausible reason might be the decline in the quality of clay.

Potters, to improve the workability of clay and prevent shrinking and cracking of the pot when fired, use additions of temper (Claridge 1984). Based on the current dates of colonisation by Lapita peoples and the cessation of pottery across the archipelago around 1,300 years later, pottery would have been manufactured on 'Upolu for a considerable period of time. One initial suggestion for the absence of pottery from Samoa was based on the idea that clay quality was insufficient or non-existent to manufacture pottery (Buck, 1938). While this was disproved based on pottery found from sites across the archipelago, it does offer the possibility that good quality clay sources were depleted or exhausted after a considerable period (Nicklin, 1979).

While at the higher elevations of 'Upolu some kaolinite quality clays can be produced due to less intense weathering, it appears that clays around the coast are more restricted and usually have a smectite base, a poorer material for pottery production (Claridge, 1984: 42). The initial production of pottery on the island would have sampled a variety of clays and quickly determined those most suited to pottery manufacture. If over time the quality of available clays decreased, either through use or restriction by neighbouring groups, then the production of suitable pottery for a variety of uses could have been more difficult. One feasible way to improve the usefulness of poor pottery clays is to add more temper (Claridge, 1984), and we see this in pottery manufactured from the later plainware sites of Vailele and Sasoa’a (Figure 5.7). Dickinson (2006) has suggested that the feldspathic basaltic temper found at Jane’s Camp, Vailele and Sasoa’a may have in some cases been actively ground up from basaltic outcrops. The selective targeting of making a suitable temper would suggest a certain technological pressure to optimise poor quality clays. As a result of using these forms of temper, pottery thickness also increases (Figure 5.6). Claridge (1984:
44) suggested that over time the considerable levels of skill required to produce a functional pot could have been lost, as it would have been uneconomic to produce sub-standard materials requiring a considerable amount of effort.

The indication that these pots were used for cooking (Green, 1974b; Hunt and Erkelens, 1993) would require that structural and thermal stability would have been necessary. By the time pottery manufacture is being undertaken near the site of Sasoa’a, there are still a number of temper groups being accessed (Table 5.13). One would expect that over time, the number of temper sources would decrease as people became more familiar with local resources, and selected the ones most appropriate for pottery manufacture. This is evidenced from the site of To’aga on Ofu (Hunt and Erkelens, 1993), where the number of pottery sources appears to decline. If clay sources declined in quality over 1,000 years to a point where they were no longer functionally useful for pottery, then the cessation of pottery would occur at a roughly similar time. Based on the geology of the islands within the Samoan archipelago, as well as the islands of Tonga, a similar pattern could apply Once pottery manufacture ceased on these islands, even contact with other groups still utilising pottery, such as Fiji, would fail to restart the industry because of poor clays and the replacement by other materials, such as wood. The restriction to simple bowl forms in the plainware period would indicate that wooden vessels became perfectly sufficient functional replacements.
6.5 Summary

Based on pottery production from Samoa, a pattern of initial high mobility declines over time on the islands of Manono and ‘Upolu. The Lapita settlement at Mulifanua was well situated on the northwest coast of ‘Upolu. It was probably part of a larger regional colonising sphere that contracted in the plainware phase. The earliest plainware sites with good stratigraphic provenance from the island show that these sites continue to be located along the northern coast, retaining easy access to good marine resources. Falemoa, if not occupied in the Lapita period, is roughly contemporaneous with the early plainware settlement at Jane’s Camp (Holmer, 1980b). Both sites show the utilisation of local resources. Vailele, further east of Jane’s Camp, was probably occupied several generations later (Smith, 1976b), and appears to reflect the trend that coastal sites were the favoured settlement strategy in the early plainware period. Settlement at Sasoa’a is characteristic of the later plainware period, showing a marked shift towards inland habitation, but strong similarities in pottery production to plainware sites along the coast to the west. Local production of pottery on ‘Upolu matches similar patterns from across the archipelago from sites such as Vainu’u on Tutuila (Eckert and Welch, 2009) and at To’aga on Ofu (Hunt and Erkelens, 1993: 142), as well as further afield from nearby Niuatoputapu (Kirch, 1988a). Due to their geographical proximity and the similarities in production materials and techniques, it would seem plausible that these plainware communities could have been in contact with one another. The presence of a carinated vessel from Jane’s Camp offers the possibility that a transition site between Lapita and plainware settlements would produce a signature of declining diversity in vessel forms and decoration techniques. If these sites exist they are potentially located underwater offshore or on the smaller islands of Manono and Apolima. Further research is required to understand this transitionary phase better.
Chapter 7

Concluding Remarks

Ceramic production, as inferred from physico-chemical analysis, is a growing discipline in the Pacific. However, such studies are still in their infancy, most notably in Samoa (see Eckert and James, 2011; Eckert and Welch, 2009; Hunt and Erkelens, 1993). Previous archaeological work on the island of 'Upolu has focused predominantly on establishing a cultural sequence for the ceramic period of Samoan settlement. This dataset has been expanded by studies from Tutuila (Addison and Asaua, 2006; Addison et al., 2008a; Eckert and James, 2011; Eckert and Pearl, 2006; Eckert and Welch, 2009) and the Manu'a Islands (Kirch and Hunt, 1993b), as well as further work in the region (e.g. Burley et al., 2010; Burley et al., 2002). However, production systems, a basic component of ceramic analysis and reflective of larger social conditions, have been restricted primarily to inferring whether pottery was used in long-distance trade (e.g. Dickinson, 1969, 1974). In combination with disjointed analysis across several decades, this has led to paucity in our understanding of how these initial systems worked.

Three questions were therefore posed at the beginning of this thesis (section 1.8). The first asked whether Lapita settlements on Samoa share similar
production patterns to earlier or contemporary Lapita settlements from Fiji and Tonga. If this was the case then arguments could be made for uniformity in the larger regional colonising process.

The results of this study have shown that the only known site showing a strictly Lapita material cultural suite is that of Mulifanua. Pottery production from the site shows strong similarities to other sites from Tonga and Fiji. This combination of stylistic and technological homogeneity between archipelagos would strongly suggest that there was a larger regional colonising strategy incorporating certain cultural markers of a Lapita people. This is reflected in the acquirement of a range of sources utilising a similar technology. Pottery was manufactured using a variety of different tempers and clays, similar to procurement strategies from other archipelagos, including the use of calcareous inclusions, something that appears to be a distinctly early signature of Lapita colonisers. These first settlers appear to have maintained a mode of communication through their dentate motifs, as well as maintaining specific vessel forms, such as collared rims, which show strong stylistic similarities to assemblages from Fiji and Tonga. These connections would have improved the success of any colonising attempt, providing economic and social benefits, and therefore minimising any founder effects.

In addition to the known Lapita site of Mulifanua, sites of Falemoa from Manono Island and Jane’s Camp from ‘Upolu, as well as the site of To’aga on Ofu (Hunt and Erkelens, 1993), show similar production techniques, indicating that either these sites can be classified as Lapita sites lacking the distinctive dentate-stamped pottery, or there was a strong cultural continuity between Lapita colonisers and subsequent plainware settlements. Further radiocarbon dating is important is ascertaining the exact place these sites occupy in the settlement chronology of the archipelago, and may suggest that in similar fashion to settlements from Tonga, certain Lapita identifiers rapidly underwent modification and adaption in this eastern-most colonised island group.

Further adaptations to early Samoan pottery production are manifested in the limitation of decoration techniques on pottery from these early plainware sites, becoming almost completely absent with the exception of rim incision and a red slip. Both these elements appear to be an early characteristic of
Fiji/Western Polynesian pottery. Red slip has been identified from a range of sites within Samoa as well as from islands further afield. Its presence on early plainware pottery strengthens the argument that regional interaction continued to occur after the settlement of the Samoan archipelago.

The second question that was asked at the start of this research was what do the pottery production patterns from plainware sites on 'Upolu indicate for the development of settlement patterns and mobility following Lapita colonisation. The results indicate strong continuities in pottery production between the Lapita and early plainware phases on 'Upolu. This, however, begins to change later in the plainware sequence, both from coastal and inland settlements. As inland areas become established across the archipelago, the access to different raw materials for pottery production shifts. Pottery manufactured from the early plainware sites of Falemoa and Jane's Camp is dominated by a ferromagnesian basaltic temper, producing higher quality pottery that requires less tempering material. This temper was most likely sourced from nearby river channels or beaches, and suggests a strong coastal signature in early pottery production. The later sites of Vailele and Sasoa’a show a gradual shift to feldspathic varieties of trachyte and basalt, which result in coarser pottery, with larger, denser temper inclusions. These forms of temper reflect a more localised source, probably inland. However, inland sources are not exclusive. From both Vailele, situated near the coast, and from Sasoa’a, found in the upper Falefa valley, production continues to utilise ferromagnesian basaltic tempers, whose provenance is most likely coastal. The use of this form of temper lessens near the end of the plainware period, and may reflect restrictions to the source from either cultural or natural factors. What is notable about the change in production technology through the plainware period is that the resulting pottery declines in quality, with a parallel loss of decoration. It is possible that a combination of access to poor quality clays and loss of pottery production techniques led to the cessation of pottery manufacture altogether. Because of the purely utilitarian role of the vessels at the end of the plainware period, wooden bowls would have provided an easy functional substitution to pottery vessels.

The third and final question looked at how important understanding pottery production on 'Upolu is for larger models of Samoan prehistory.
Archaeologists have long considered questions of how an Ancestral Polynesian Society was established across the region. Pottery, as the dominant marker in Pacific archaeological sites, has been labelled as the answer to determining the cultural history of early Polynesia. However, as has been repeatedly expressed by authors such as Green and Kirch (1997), pottery forms a minority of any Pacific assemblage, and needs to be considered as an aspect of a larger cultural suite. Before we can ascertain with any confidence that plainware pottery sequences represent the emergence of an ancestral Polynesian culture, we must first consider the range of other material components and how they represent the early cultural history of Polynesia. Therefore, pottery and understanding its production should still remain a component of these studies, but placed in an appropriate context.

In trying to establish the origins of a Polynesian society, a contentious issue has arisen as to whether settlement on Samoa has been continuous from initial colonisation, or whether the island proved to be too isolated and environmentally challenging for continued settlement until repopulation several hundred years later. Production techniques show continuity between Lapita and plainware groups. This suggests that whatever factors are important in defining the rise of a Samoan society can be initially derived from the first Lapita colonisers. Based on these continuities in technology and technique, as well as the rapidity of settlement across the archipelago, it seems unlikely that the Lapita settlement was ultimately unsuccessful. Stylistic analysis is limited on plainware assemblages, but decorative elements, such as red slips, and vessel forms reflect similar, but divergent styles to Tongan plainware reinforcing a pattern of continued settlement. In each case there are debates about the radiocarbon chronologies for the archipelago (see Rieth, 2007). However, the early nature of the material from Falemoa, as well as from To'aga (Hunt and Erkelens 1993), suggests that while these sites lacked the dentate signifier of Lapita ware, they represent an early settlement strategy, possibly favouring small islands. Further additions of linguistic data support the ‘Cultural Continuity’ model, which would have seen a growth in settlement throughout Samoa, including the habitation of inland sites in the plainware period. There appears to be continued cultural contact of some form to Tonga, resulting in
shared cultural similarities, possibly the precursor to an Ancestral Polynesian Society.

Questions on the speed and success of Lapita and plainware settlement on ‘Upolu can only be answered by providing further datasets on new and old assemblages. Green (1974b) used thickness, in combination with decoration, form and fabric of the pottery, in a classificatory scheme of ‘thin fine ware’ and ‘thick coarse ware’. However, this research shows that thickness is not a suitable measure of stylistic variation, as it is a continuous and not categorical unit of measure on Samoan pottery. The thick/thin ware classificatory scheme has been revised, eliminating sherd thickness as an appropriate variable. Pottery should instead be classified based on composition, with elements of decoration and form noted. By removing a misleading element from Samoan pottery classification, new avenues of pottery technology and subsequent adaptations can be explored, providing more valuable datasets to the archaeologist.

Quantifiable data has been lacking in these analyses due to the initial attempts of pioneering archaeologists such as Golson, Green, Davidson and Jennings to encompass a cultural history for an entire archipelago. These models, first outlined more then fifty years ago, need to be strengthened or challenged based on robust, testable datasets encompassing all components of Samoan material culture and settlement strategy. This study has therefore focused on a holistic approach, analysing a combination of stylistic attributes and fabric components of temper and clay, providing an initial model of pottery production for the north coast of ‘Upolu. These results match previous studies from Tutuila and Ofu, and have begun to build a framework of initial Samoan settlement through to the end of the plainware phase. By providing a new set of information on pottery production from the synthesis of existing archaeological assemblages it helps in developing our knowledge of Samoan prehistory. Further answers on Samoan prehistory will only be forthcoming when archaeologists strengthen current data sets and provide new avenues of research. Until then, archaeology on Samoan prehistory will remain restricted and undervalued.
REFERENCES:


References:


References:


References:


References:


References:


References:


References:


References:

Archaeology in Western Samoa. Auckland, The Auckland Institute and Museum.


References:


References:


References:

*Islands, American Samoa.* Berkeley, Archaeological Research Facility University of California.


References:


References:


References:


References:


185
References:


References:


Appendices:

APPENDIX A-D

See attached DVD for all appendices information:

- Appendix A – Sherd Variables
- Appendix B – Rim Forms
- Appendix C – Chemical Data
- Appendix D – Photographs