

# Nukuleka as a Founder Colony for West Polynesian Settlement: New Insights from Recent Excavations

David V. Burley,<sup>1</sup> Andrew Barton,<sup>1</sup> William R. Dickinson,<sup>2</sup>  
Sean P. Connaughton<sup>1</sup> & Karine Taché<sup>3</sup>

## ABSTRACT

Previous archaeological studies in the village of Nukuleka, Tongatapu, Kingdom of Tonga proposed it as a founder colony for Polynesia. Additional excavation and survey were undertaken in 2007 to evaluate this status further and to gain new insight into the nature of the occupation and its role in the subsequent peopling of west Polynesia. A review of this project and its findings are presented. Decorated ceramics of western Lapita style, the presence of tan paste ceramics foreign to Tonga, and new radiocarbon dates support Nukuleka as a site of first landfall in the interval 2850 to 2900 cal BP. The ceramic assemblage is distinct from west and central Fiji, and an independent origin for Fijian and Polynesian colonizers is argued. The settlement quickly expanded on the Nukuleka Peninsula to 20 ha or more in size, forming a central place for the eastern Lapita province in Tonga, Samoa and the Lau islands of Fiji. Nukuleka, we believe, provides insight into the cultural if not biological base from which ancestral Polynesian society emerged.

*Keywords:* Lapita, ceramics, tan paste, Nukuleka, Tonga, founder colony

## INTRODUCTION

Nukuleka today is a small fishing village positioned on a peninsula of land at the northeast entrance of Fanga'Uta lagoon on the island of Tongatapu, Kingdom of Tonga (Figure 1). Jens Poulsen (1967, 1987) conducted an archaeological survey here in May 1964 as part of his doctoral research at the Australian National University. Finding several areas with shellfish midden and decorated earthenware ceramics on the surface, he chose to excavate one of these in the southeast corner of the village, a low-lying mound he designated To 2. This work took place on the property of Atungia Moala and the site is referred to alternatively in Oceanic archaeology as Moala's mound. Poulsen's excavations recovered a large assemblage of decorated ceramics that, through method of decoration and artistic motifs, he related to the emerging concept of a Lapita cultural complex. This with other of his Lapita site assemblages has been central to the definition of an eastern Lapita phase and stylistic aspect (Green 1979; Kirch 1997). All but a small sample of Poulsen's To 2 assemblage was destroyed tragically in 2003 when the Australian National University Archaeology Store burnt down during an uncontrollable bushfire.

In 1999, and briefly in 2001 and 2003, Burley and Barton returned to Nukuleka to relocate the 1964 excavation, to carry out further test excavation, and to situate the site within a broader context for the surrounding area (Burley *et al.* 2001). These projects were part of a larger research program focusing upon Lapita settlement and its transformation throughout the Tongan archipelago. Each of the projects gave new insight but they illustrated a complex and confusing archaeological record that, in part, was disturbed frustratingly as part of earthmoving within a contemporary Tongan village. One thing was apparent however. When the site was placed in comparative perspective to all other Lapita sites in Tonga, the data clearly pointed toward Nukuleka as a founder colony (Burley & Dickinson 2001).

Renewed study of the Nukuleka site was undertaken in 2007 to further evaluate its status as a founder settlement and to gain additional insight into the nature of this occupation. A block excavation of 30.5 m<sup>2</sup> in Moala's mound as well as test excavation and survey recovered a large assemblage of materials as well as site context data. In this paper we provide a review of the field programme and its results, plus some interpretation of these data. This enables an examination of the processes of first Lapita settlement in Fiji and west Polynesia and the role of Nukuleka as a central node for expansion on the eastern periphery of the Lapita domain.

<sup>1</sup> Department of Archaeology, Simon Fraser University

<sup>2</sup> Department of Geosciences, University of Arizona

<sup>3</sup> Department of Anthropology, Université de Montréal

Corresponding author: burley@sfu.ca

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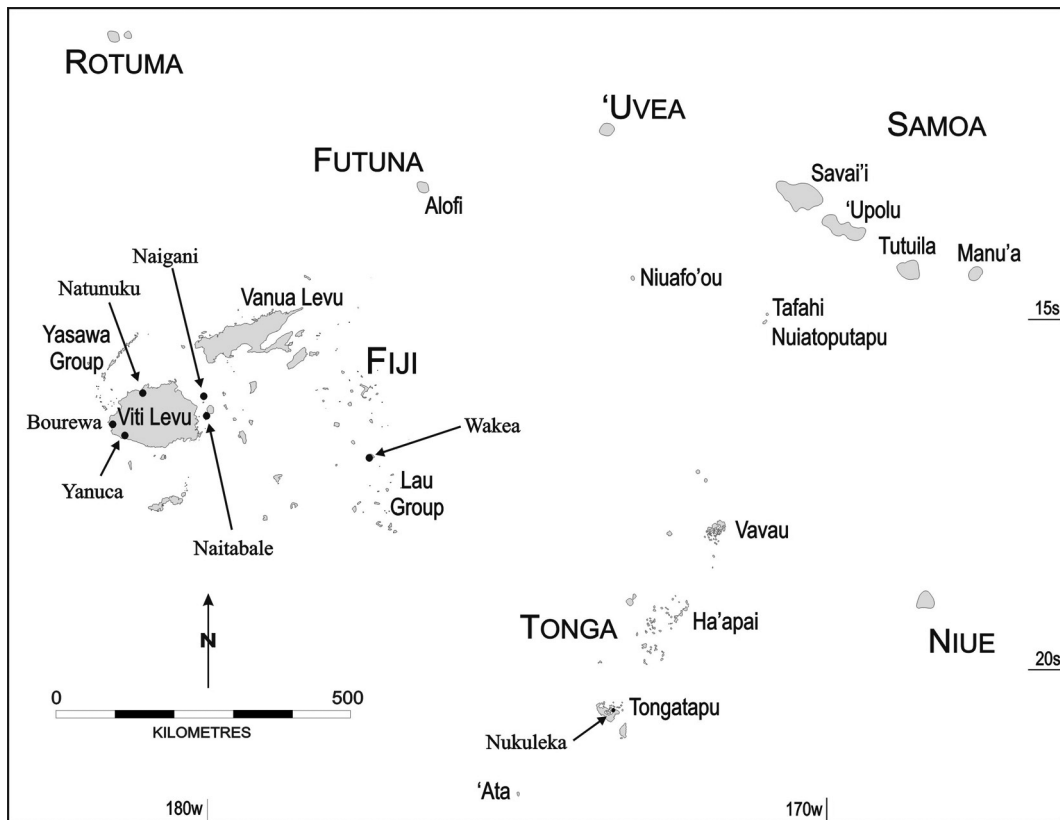


Figure 1. Fiji/West Polynesia illustrating the location of the Nukuleka site in relation to other sites and locations referred to in the text.

#### NUKULEKA 2007 – FRAMING THE FIELD PROGRAMME

Poulsen's 1964 excavation was focused exclusively on Moala's mound, a late prehistoric burial tumulus built atop an earlier Lapita midden. Abundant ceramics were present in secondary mound fills as well as the underlying strata, indicating the mound had been constructed from adjacent site deposits. Poulsen's ceramic assemblage, and others recovered up to 2001, incorporate two elements critical to the identification of Nukuleka as a founding settlement. First there is a small sample of sherds with western Lapita decorative motifs as found in the Reef-Santa Cruz Islands, Vanuatu and west to central Fiji (Burley *et al.* 2001). Second, there is a group of anomalous sherds with white to tan coloured paste, a few including western Lapita designs or complex design elements. Petrographic study of temper sand inclusions in a small number of these identified them as foreign to Tonga (Burley & Dickinson 2001). Both features are suggestive of a colonizing group originating to the west of Tonga. Surveys and test excavations up to 2003 were able to document other places on the Nukuleka Peninsula with Lapita decorated ceramics; those identifying the earliest settlement episode, however, appeared exclusive to Moala's mound. To enhance western Lapita and tan paste sherd sample size as a basis for interpreta-

tion, the 2007 project again focused largely on the mound, problems of secondary context for much of the recovered materials notwithstanding.

Dickinson (2007) identified and mapped the Fanga 'Uta Lagoon Lapita-age shoreline as part of the 1999 project. The relative positions of Lapita sites around the lagoon and other paleoshoreline indicators identify a sea level 1.2–1.4 m higher than present at c. 2900 cal BP. The paleogeography of Fanga 'Uta Lagoon was substantially different (Figure 2), with two large open bays, sandy beaches and, based on archaeological recoveries, extremely rich shellfish beds of *Anadara* and *Gafrarium* species (Spennemann 1987; Burley *et al.* 2001). A series of offshore islands fronted the bays and provided additional locales on which to settle. A 1.2–1.4 m higher sea level at Nukuleka raises questions as to the type of landscape present on the Nukuleka peninsula when it was first encountered. Many of the documented areas with Lapita ceramics, including the sub-mound midden, occur at elevations potentially within the Lapita era tidal range, and certainly within limits of tidal wash from seasonal storms (Dickinson 2007). This was observed in 2001 and 2003 when decorated Lapita wares were excavated from what otherwise appeared to be storm beach rubble. A second focus for fieldwork in 2007, then, was to gather data through survey and limited test excavations on the extent, nature and transformation

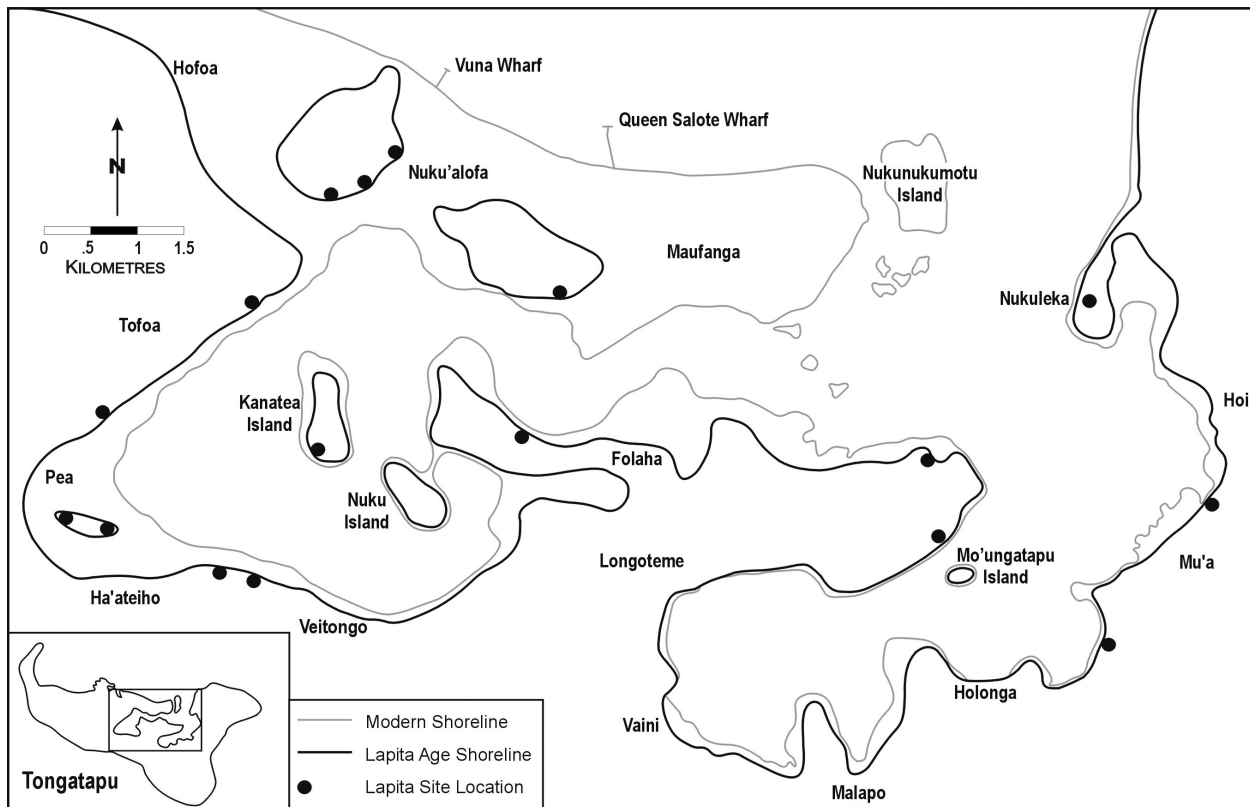


Figure 2. Lapita age shoreline of Fanga 'Uta Lagoon relative to the modern shoreline. Nukuleka and other Lapita sites are plotted with black dots.

of the settlement landscape. A brief follow-up project was conducted in 2010 to re-examine questions of landscape, settlement expansion and sea level.

#### EXCAVATIONS AT MOALA'S MOUND

Moala's mound, as mapped in 2007, is approximately 30 m in diameter with an elevation 1.3 m above the lowest point on its periphery (Figure 3). The maximum height of the mound over the surface upon which it is built, however, is 70 to 75 cm. This indicates there had been an existing elevated rise prior to mound construction. Poulsen's excavation included a 1 × 15 m trench excavated from a central position on the mound top to the northern mound periphery. Some burials interred in coral sand near the mound centre were removed and interred elsewhere by people from the village. The stratigraphy of the trench clearly distinguished a relatively homogeneous 'midden horizon' with an overlying 'mound horizon', the latter incorporating several strata and features. Despite the mound fill's secondary context, Poulsen (1987: 25) was able to cross fit ceramic pieces from one horizon to the other and found no detectable differences in his analysis of the pottery assemblages.

A 5 × 6 m block area was excavated in 2007 on the mound's southeastern quarter (Figure 3). A large fragment of a ceramic jar with western Lapita design was recovered

from a test unit here in 1999 (Burley *et al.* 2001: 97). Trowel excavation was undertaken simultaneously across the area in 1 × 1 m provenience units. The 1999 test, as well as Poulsen's trench, illustrated the secondary nature of the mound deposits and a general absence of stratigraphy in the sub-mound midden. As a consequence, an initial spit of 25 cm followed by 10 cm arbitrary spits were employed for vertical provenience control of ceramics and other materials. Removed matrices, including the uppermost spit, were sieved through 6.4 mm mesh with 3.2 mm mesh applied to control samples. A small northern extension to the block excavation was added later to expose a partial late prehistoric burial, the only human remains encountered during the project. Two 1 × 1 m tests employing similar methods were excavated to the northeast of the mound, and a 2 × 2 m excavation unit was positioned 35 m to the northwest (Figure 3). In the latter case, mechanical trenching for the village waterline had intersected concentrated Lapita ceramics and shell midden in this locale.

Stratigraphy within the mound excavation, save for its western side, is complex, confused by mound construction processes and further disturbed by later features (Figures 4 and 5). The original Lapita midden beneath the mound was deposited on a sand and coral gravel surface that rises slightly in elevation to the west. The midden, a black loam with high organic content, shell and abundant ceramics, seems homogeneous and without discernable strata. The

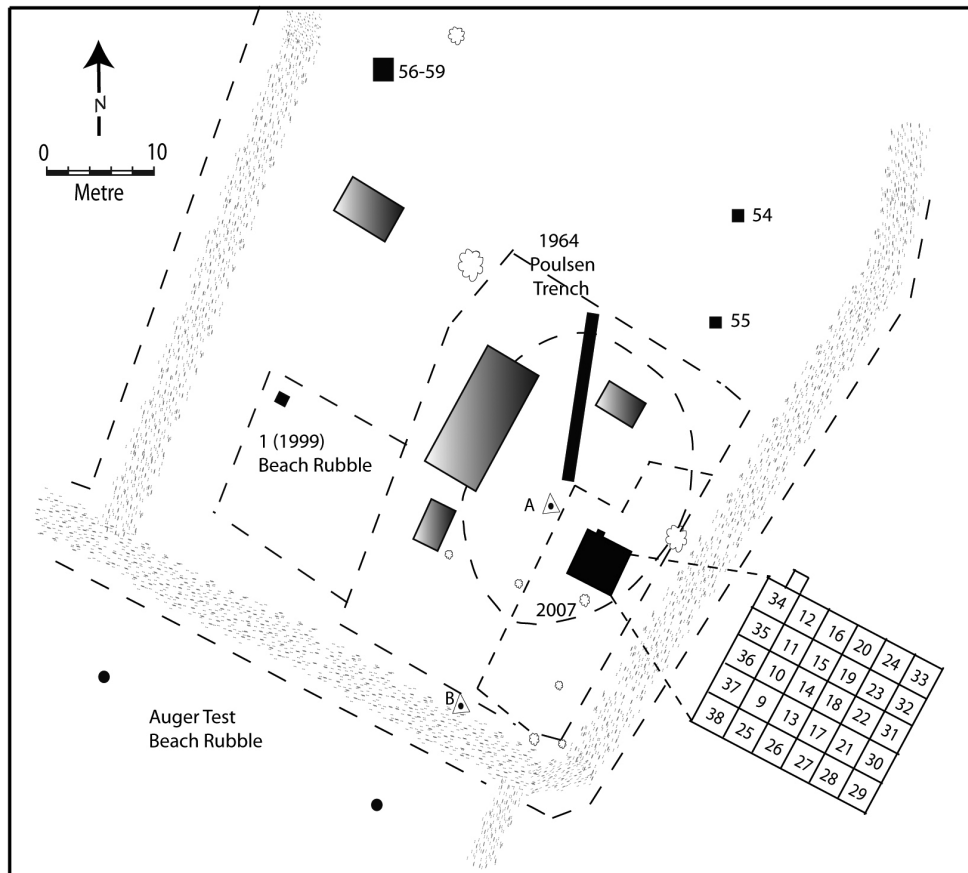


Figure 3. Moala's Mound (Units 9–38) and other 2007 excavations (Units 54–59). Shaded rectangles are structures. Excavated areas are darkened. Poulsen excavated the north/south 15 m long trench in 1964. Dotted lines are fences, except for circled area which is the mound edge. Textured area is road grade. Point A near the mound centre is 1.3 m elevation above point B.

contact between midden and the underlying sand flat is abrupt. The burial mound overlying the midden and the presence of coral sand within the grave pit identified by Poulsen are late prehistoric features dating, speculatively, between 500 and 300 BP. Construction fill for the mound was excavated first from the eastern side of the 2007 block excavation and thrown inward toward the mound centre. In places this cut into the underlying sand removing the midden entirely and redepositing it with intermixed sand lenses to the west. Additional fill from even further to the east was deposited on the previously excavated periphery, possibly to extend mound size after the original core was complete. Because of the destructive nature of mound fill excavations on the periphery, the *in situ* midden to mound horizon separation reported by Poulsen was recognized only in the western third of the excavation block with any confidence (Figures 4 and 5). The vast majority of the 5 × 6 m excavation, as a result, occurs in secondary deposits of mound fill.

Excavations to the northwest and north illustrate an original foreshore or beach with accretionary ridge and trough-like topography having variable elevations. Cultural deposits extend throughout the area, including

decorated Lapita ceramics in each of the units. The 2 × 2 m excavation was positioned on a natural rise with cultural material and midden extending to a depth of 1.2 m. Post and pit features intruding from upper levels heavily disturb most of this unit but three cultural strata can be defined. These include aceramic (Strata I), Polynesian Plainware (Strata II) and Lapita, (Strata III) phases of occupation. The 1 × 1 m test units north of the mound alternatively were located on low (Unit 54) and high (Unit 55) elevations. Respectively, these incorporated 80 cm and 40 cm thick strata of midden-like loam, similar in many respects to that beneath the mound. Ceramic and midden content were substantially reduced suggesting this area is on the margins of the principal Lapita occupation zone.

#### EXCAVATED ASSEMBLAGE AND ITS INTEGRITY

The excavated assemblage from Nukuleka is abundant including 47,527 ceramic sherds, 699 non-ceramic artifacts as well as fauna (Tables 1 & 2). The 4,376 decorated sherds are identified individually by the presence of dentate stamping, incised lines, shell edge impressions, shoulder or rim notching, appliqué modeling or other decorative

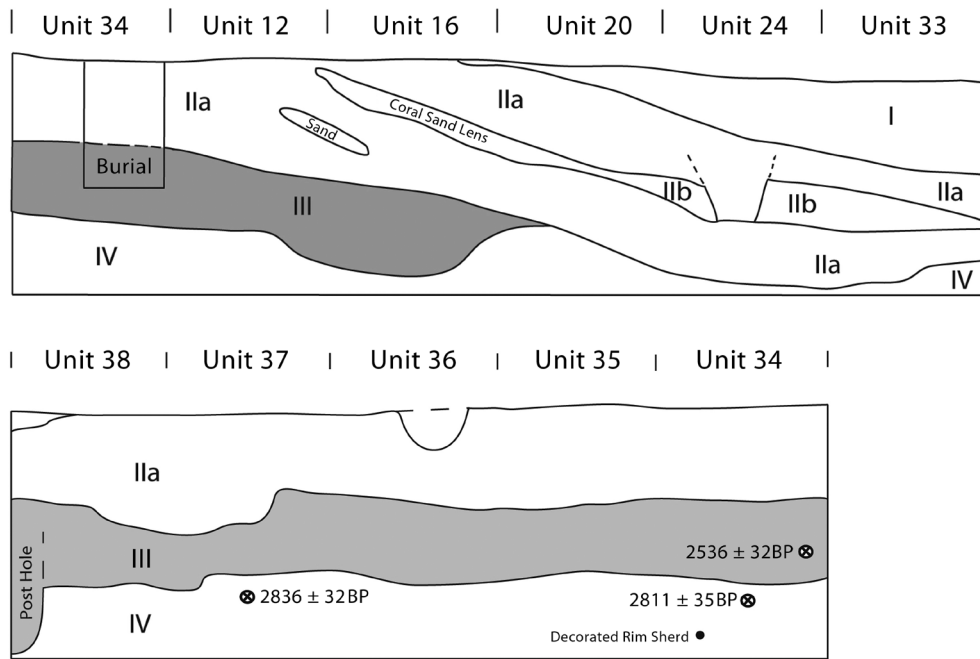


Figure 4. Stratigraphic profiles Moala’s Mound 2007. Upper profile is north face of excavation, lower profile is west face. Radiocarbon dates plotted on west face profile were taken from profile. Stratum I – post mound fill, dark brown sandy loam only; Stratum IIa – secondary burial mound fill, mixed loam, midden and coral sand with lensing throughout, abundant cultural materials; Stratum IIb – secondary burial mound fill similar to IIa but with greater concentration of shell, abundant cultural materials; Stratum III (shaded) – *in situ* midden of black loam with high organic content and shell, abundant cultural materials; Stratum IV – sub-midden coral sand with occasional ceramic sherds mixed in. Stratum III to IV stratigraphic break is abrupt (see Figure 5).

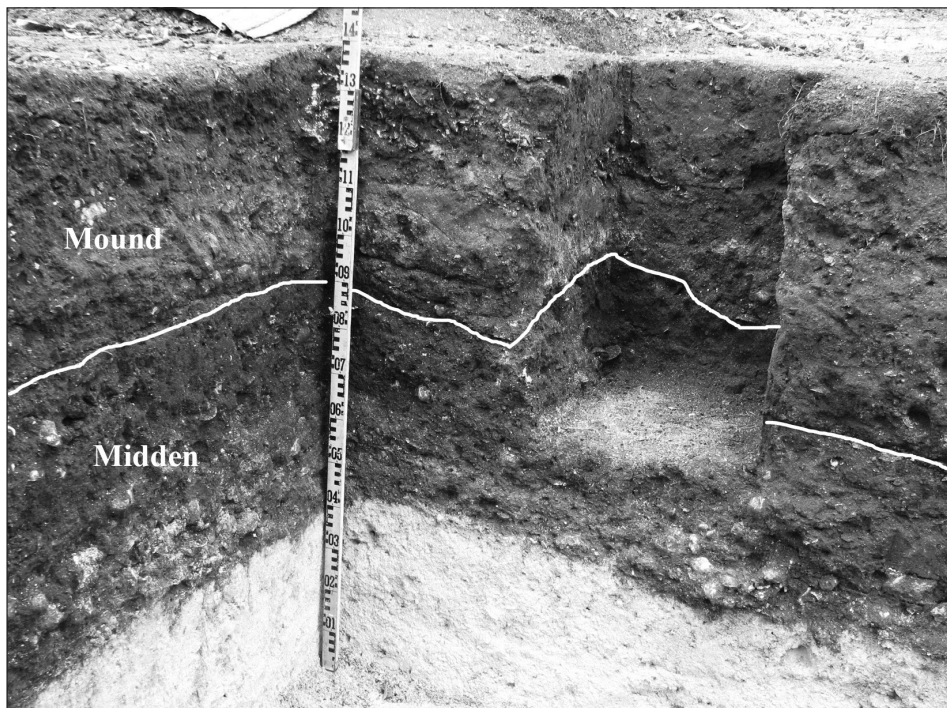


Figure 5. Northwest corner of Moala’s Mound excavation illustrating the stratigraphic break between mound and midden horizons as well as the abrupt nature of the midden to submidden contact. The column to the right was excavated to remove a partial late prehistoric burial. See Figure 4 for location.

Table 1. Ceramic class sherd counts, 2007 Nukuleka Project.

Ceramic Type	Moala's Mound	Units 54–55	Units 56–59	Total
Decorated Rim	491	6	97	594
Decorated Other	3,379	56	347	3,782
Plain Rim	1,234	19	326	1,579
Plain Neck/Shoulder	1,594	21	261	1,876
Plain Body	32,819	782	6,095	39,696
<b>Total</b>	<b>39,517</b>	<b>884</b>	<b>7,126</b>	<b>47,527</b>

Table 2. Nonceramic artifacts from the 2007 Nukuleka Project. Shell bead blank or bracelet/ring blanks are cut and, or, ground *Conus* or *Strombus* tops presumed to be preforms. Miscellaneous shell includes all specimens with surface polish or other alterations that could not be placed within other categories. Only a single non-ceramic artefact was recovered from Units 54 and 55, it being a piece of ground pumice.

	Mound	Units 54–59	Total
<b>Shell Valuables</b>			
Bracelet	92	20	112
Ring	2		2
Bead	9	3	12
Plaque	3	1	4
Long Unit	1	1	2
Bead Blank	52	3	55
Bracelet/Ring Blank	55	42	97
<b>Other Shell Artifacts</b>			
Adze/chisel	6	3	9
Bivalve scraper	73	5	78
<i>Anadara</i> Net Weight	97	14	111
Octopus Lure Cap	15	9	24
Miscellaneous Shell	44	8	52
<b>Lithic Specimens</b>			
Adze/fragment	6	3	9
Cobble/pebble tool	6	2	8
Core/flake	35		35
Abrader	3	5	8
Pumice Stone	10	4	14
Ground/polished	5		5
<b>Other Materials</b>			
Bone needle	1		1
Ground Urchin Spine	1		1
Coral file/abrader	50	10	60
<b>Total</b>	<b>566</b>	<b>133</b>	<b>699</b>

attributes that distinctively mark Lapita wares. Of these, almost 34% have either fully defined (n=183) or partially defined (n=1287) Lapita decorative motifs with potential for comparative classification. Also important is the fact that 10.9% of the total sherd assemblage from the Moala

mound excavation is decorated, a percentage inflated to 28.5% if only rim sherds are compared. Although Poulsen does not provide undecorated body sherd counts from his excavations, 31.6% of his rim sherds are decorated, a number highly comparable to the 2007 assemblage. Several individuals have correlated percentage of decoration with absolute age and Lapita stylistic aspect. In western Lapita sites in central island Melanesia, between 20% and 50% of Lapita sherds are decorated (Sand 2001:72); at Natunuku and Naigani in Fiji, two other sites with western style Lapita sherds, Best (2002:83–84) calculates the decorated assemblages to be 33.08% and 33.5% respectively. Eastern Lapita sites in Tonga other than Nukuleka typically have between 4% and 7% decorated sherds within Lapita levels.

The non-ceramic artifact assemblage as given in Table 2 is similar in most respects to the one excavated by Poulsen, albeit somewhat more abundant. Here we note one variation and one qualification for the two most dominant artifact categories, bivalve scrapers and *Anadara* spp. net weights. Bivalve scrapers, predominantly of *Anadara antiquata*, have a segment of their posterior edge prepared by flaking of the ventral margin to create a regularized scraping edge. These previously went unrecognized by Poulsen. Shell net weights, on the other hand, not only were identified in Poulsen's study, but are described by him as 'secure' in their interpretation. Net weights are *Anadara antiquata* valves where the umbo has been intentionally removed for purposes of attachment to the net. Alternatively, and as documented in 2007, the same type of umbo removal results from *taupita*, a Nukuleka village game that, literally, translates as war with shell. That this game may have its origins in the Lapita period of Nukuleka, and that the *Anadara* spp. net weights may not be net weights at all, are issues taken up in detail elsewhere (Connaughton *et al.* 2010). Finally of note, two flakes of volcanic glass were recovered from overlying deposits in Moala's Mound. Clark & Anderson (2009:417, citing pers. comm. by Burley) suggest one of these might be from the Kutau-Bao source of west New Britain. More recent study of the geochemistry of these specimens indicates a Niuaotupapu or Tafahi source in northern Tonga for both (P. Sheppard 2010, pers. comm.).

The greatest impediment to interpretation and comparative analyses of the excavated Nukuleka mound data is the integrity of assemblage context, or lack thereof. Because Poulsen was able to fit together ceramic sherds from mound and midden horizons, he felt comfortable treating the lot as homogeneous and chronologically related. Obviously mound fills are the same midden deposits moved forward, but how temporally extended that might be is a central question. For example, Lapita occupation levels elsewhere in Tonga are overlain typically by Polynesian Plainware phase ceramics extending from 2650 cal BP to as recent as 1600 cal BP (Burley & Connaughton 2007). The mound horizon, therefore, could represent a temporal

span of well over a millennium with fully mixed Lapita and Polynesian Plainware ceramic assemblages. We found little evidence for a Polynesian Plainware phase component in the sub-mound midden during field excavations and assumed it was thin if not absent. To evaluate this observation, the distribution of 1058 decorated sherds was plotted by spit assemblage for the ten 1 × 1 m excavation units on the western side of the excavation block where *in situ* midden occurs beneath the mound, and where the stratigraphic break between mound and midden is documented (Figure 6). This exercise illustrates a highly even

distribution for decorated sherd frequencies across spits in both mound and midden horizons. If a Polynesian Plainware and, or, a ceramic component is present in the upper spits of the midden (Spits 6–7), substantially fewer if any decorated sherds should occur here with none of the decorated pieces being *in situ*. By comparison, in the only unit with stratigraphic integrity in the 2 × 2 m excavation to the north (Unit 56), this type of distribution does occur with aceramic (Spits 1–2) and Polynesian Plainware (Spits 3–7) occupations defined by the limited numbers of decorated ceramic sherds (Figure 7).

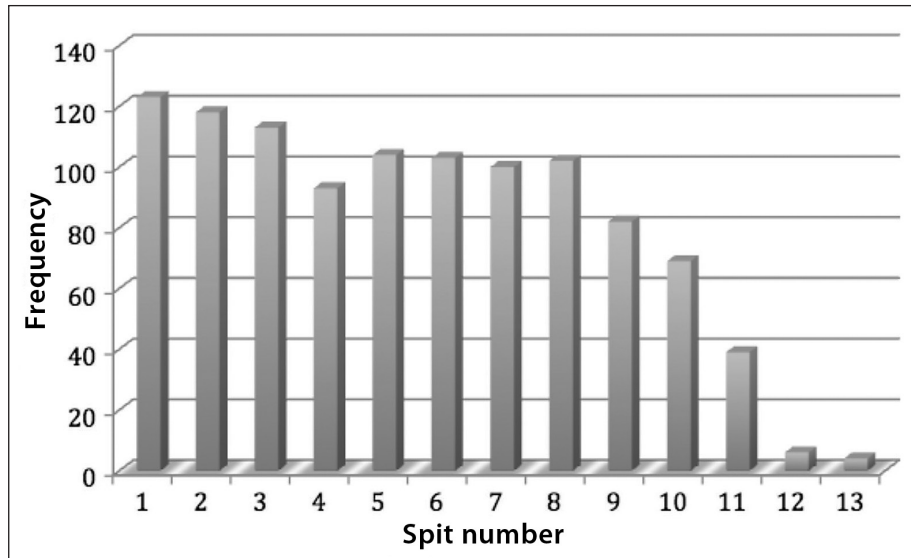


Figure 6. Cumulative distribution of decorated sherds by spit in the ten 1 x 1 m excavation units on the western side of the 2007 excavation block. Sherd frequencies are on the vertical axis. Spits are 10 cm thickness except for spit 1 which is 25 cm. The mound/midden separation is between Spits 5 and 6. The sub-midden (Stratum IV) beach deposit is present in spits 11–13.

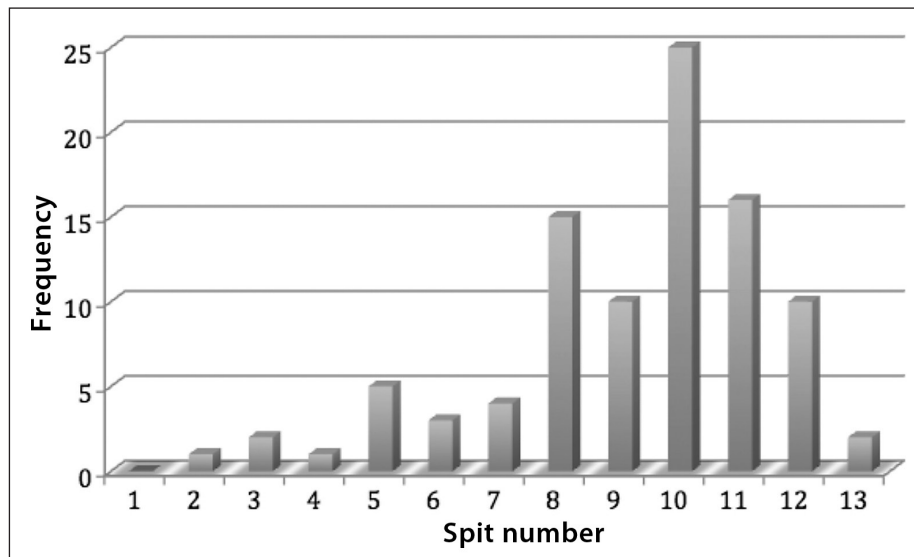


Figure 7. Decorated sherd distribution by spit for Unit 56 to the west of Moala’s Mound. Sherd frequencies are on the vertical axis. Spits are 10 cm thickness except for spit 1 which is 15 cm. Spits 1–2 represent the aceramic period, 3–7 are Polynesian Plainware phase and 8–13 are Lapita. The decorated sherds in spits 2–7 are presumed out of context due to later post hole and pit excavations.

An absence of aceramic and Polynesian Plainware phase components in the sub-mound midden has two important implications relative to assemblage integrity. First, it suggests that the assemblage has a limited chronology and that a general abandonment of the locale must have taken place sometime in the Lapita era. Second, this limited temporal interval allows the mound and midden horizon assemblages, including non-ceramic artifacts, to be employed as a homogeneous unit representative of the Lapita occupation beneath and adjacent to Moala's mound.

#### **TAN PASTE BODY FABRICS AND COMPLEX MOTIFS IN THE NUKULEKA CERAMIC ASSEMBLAGE**

It has been stated previously that two components of the Nukuleka ceramic assemblage identify the site as a founding settlement (Burley & Dickinson 2001, 2010). The first is a small series of sherds with complex decorative motifs or design elements similar to those of western Lapita stylistic aspect. The second is an even smaller group of sherds exhibiting white to tan coloured body paste with temper sand inclusions foreign to Tonga (Burley & Dickinson 2001). The 2007 excavation was in part designed to enhance these assemblages and in this it was successful.

Poulsen (1987: 135) recovered and clearly recognized the aberrant nature of 43 sherds made of 'whitish clay' from his excavations, half of them decorated with 'rare motifs'. He suspected these were 'importations of pottery' but a 1978 petrographic study of sand tempers in four specimens failed to differentiate the group from other Tongan tempers (Dickinson 1987). Excavating a small additional sample of these sherds in 1999, and similarly struck by the tan-coloured body fabric compared to the red to red-brown fabric of all other Tongan ceramics, Burley asked Dickinson to revisit his previous analysis. This re-examination recognized a near absence of orthopyroxene in tan paste sherds in combination with hornblende; the former is ubiquitous and the latter uniformly absent in all other Tongan sherds (Burley & Dickinson 2001). Indeed, the only comparable temper in Dickinson's comparative database of temper types in 2000 was from a single sherd recovered from a site on Nendo in the Santa Cruz Islands of the eastern Solomon Island chain (Dickinson 2006).

The 2007 excavations recovered 87 additional tan paste sherds of which 38 had decorative application. In combination with Poulsen's collection, a minimum of 16 different ceramic vessels is represented based on decorative motif, application of design elements, presence of slips and other features. Portable x-ray fluorescence spectrography of 15 tan paste and 14 red paste Lapita sherds illustrate homogeneous but substantially different geochemical signatures for each of the samples (Burley & Dickinson 2010). Homogeneity and sample distinctiveness are supported by petrographic study of 30 additional sherds by Dickinson. Sherd temper constituents again indicate a

source that is foreign to Tonga and most likely the Fiji and west Polynesian region more broadly. The geological composition of the tan paste tempers suggests a dacitic high island source probably located in the New Hebrides island arc of Vanuatu and the eastern Solomon island outliers or, perhaps, from an area even further to the west (Burley & Dickinson 2010: 1026). The Nendo specimen noted previously continues to be the only recognized sherd with comparable temper, but it too is exotic to the island on which it was found.

The western Lapita stylistic aspect of the Nukuleka ceramic assemblage is present in two ways that are absent elsewhere in Tongan Lapita sites. First, there is a limited representation of motifs typical of Lapita ceramics in eastern to central Melanesia including west to central Fiji, New Caledonia, Vanuatu and the Reef/Santa Cruz islands (Figure 8). Of particular note is one tan paste sherd illustrating a restricted zone marker probably bordering a central frieze with anthropomorphic face motif. Two other sherds including one excavated by Poulsen (1987: Plate 50–1) have partial motifs falling within Chiu's (2007) head-dress category. Also typical of the western Lapita motif suite are dentate stamp labyrinth and incised joined triangle patterns (Sand 2007). Both occur on multiple sherds at Nukuleka with tan paste and red paste vessels represented. The intricacy and complexity with which some motifs and design elements are applied constitutes the second western Lapita-like quality within the assemblage. Among these features are fine pointed and closely spaced dentate stamp application, dentate stamp infilling of triangles, overlapped and curved stamping, multiple and closely spaced parallel stamped zone markers, precise and sharply applied incision, considerable use of impressed hollow tube circle design elements (DE 3 after Mead 1975) and possible roulette use with raised ridge impression (Ambrose 2007). A preliminary categorization of all Nukuleka sherds with full or partial motifs tentatively identifies 204 specimens as falling within a complex category for decorative application, either because of the motif or for the manner in which it has been applied.

To assess the temporal distribution of tan paste and complex decorated sherds as defined, respective sherd assemblages were plotted by spit for the ten 1 × 1 m units where mound and midden horizons could be separated. Only 23 tan paste sherds came from these units, but their distribution is highly informative (Figure 9). All of the sherds save one come from either the mound horizon (n=16) or from the lowest two spits of the excavation (n=6). The lower two spits occur fully within the sub-midden beach matrix for these units, thus associating the tan paste assemblage with the earliest site deposit. The dominance of tan paste sherds in secondary mound deposits may indicate also that greater numbers of these sherds occur to the east where mound fills had been originally acquired. When the 71 specimens categorized as complex are similarly plotted, a different pattern occurs (Figure 10).



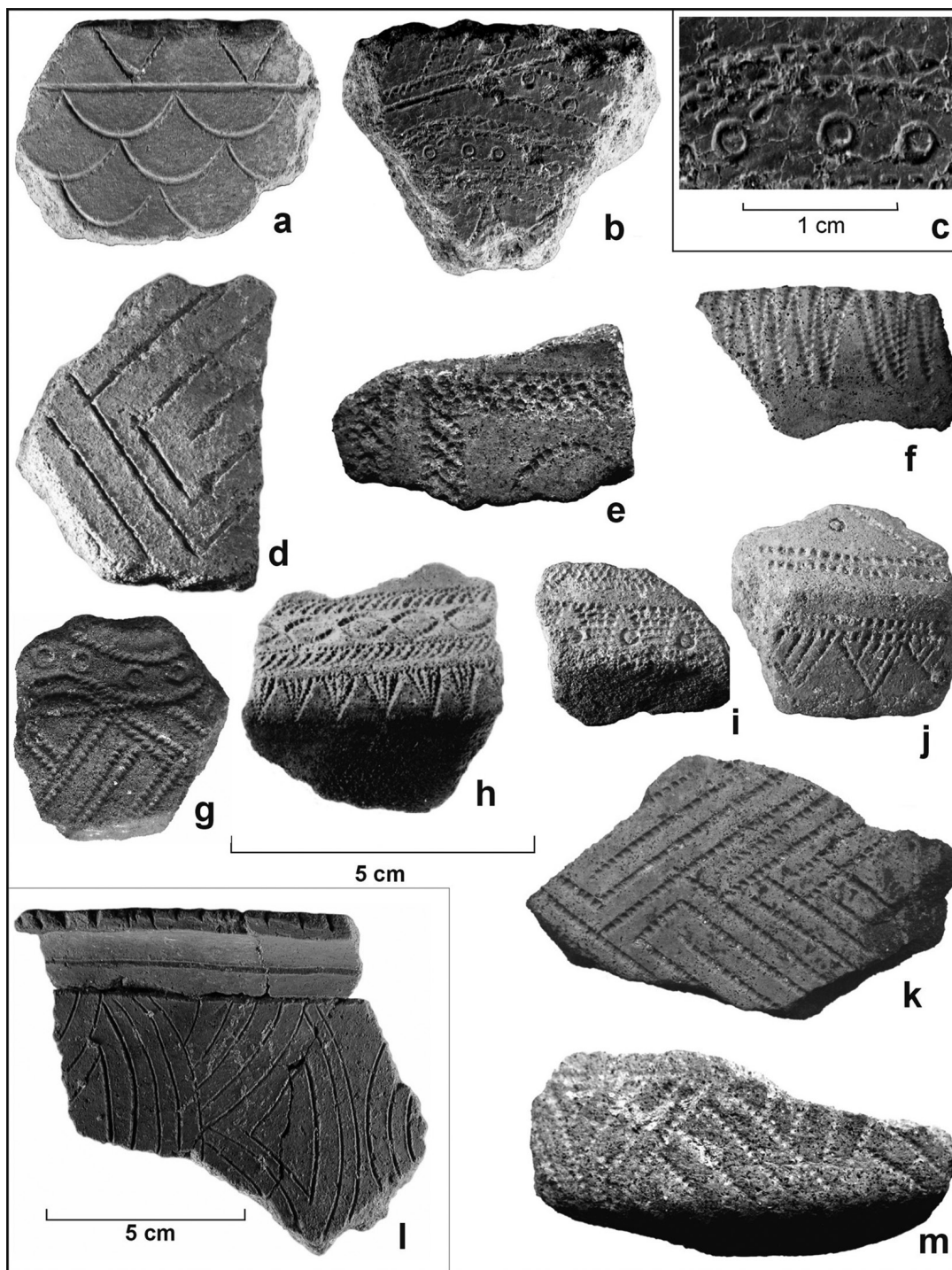


Figure 8. Western Lapita style sherds from Moala's Mound. (a) slipped red paste with fine incision, (b) slipped with dentate and possible roulette decoration probably associated with headdress motif (after Chiu 2007), (c) inset of b with raised rib impression of possible roulette, (d) slipped red paste with incised labyrinth pattern, (e) tan paste sherd with restricted zone marker bordering a possible frieze with eye, zone marker is created by overlapping dentate stamp, (f) tan paste rim sherd with fine dentate stamp, (g) tan paste sherd with restricted labyrinth pattern, fine dentate stamp and use of hollow tube design elements, (h) tan paste sherd with restricted zone marker, fine dentate stamp and infilled triangle, (i) red paste sherd with infilled triangles, fine dentate stamp and hollow tube design elements, (j) red paste sherd with infilled triangles and hollow tube design elements, (k) tan paste sherd with dentate stamp labyrinth pattern, (l) red paste rim and neck sherd with overlapping triangle pattern (Sand 2007) and notched rim, (m) tan paste sherd with dentate stamp infilled triangles and lime infill. Sherd h was excavated by Poulsen (1987) and sherd l was recovered in 1999. The remainder was excavated in 2007.

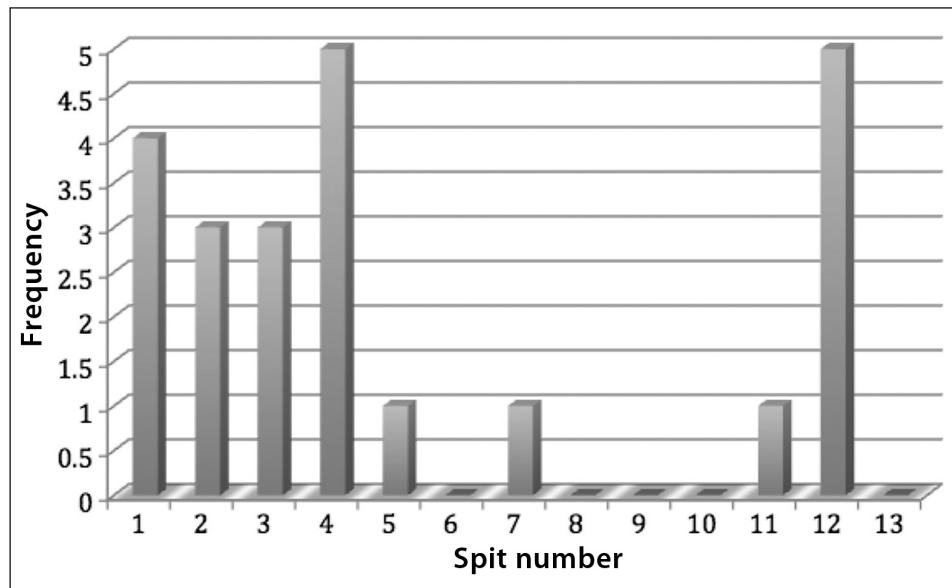


Figure 9. Cumulative distribution of tan paste sherds by spit in the ten 1 x 1 m excavation units on the western side of the 2007 excavation block. Sherd frequencies are on the vertical axis. Spits are 10 cm thickness except for spit 1 which is 25 cm. The mound/midden separation is between Spits 5 and 6. The sub-midden (Stratum IV) beach deposit is present in Spits 11–13.

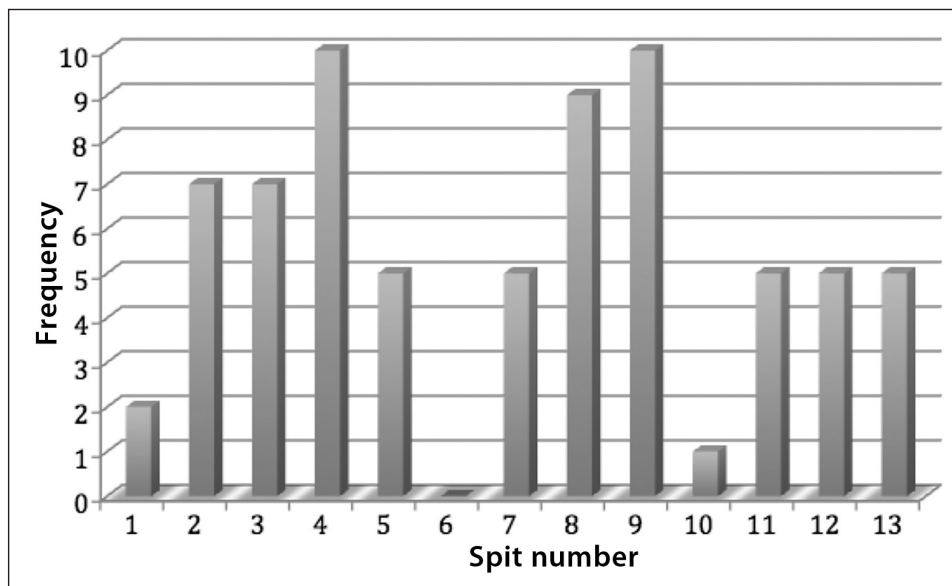


Figure 10. Cumulative distribution of complex decorated sherds by spit in the ten 1 x 1 m excavation units on the western side of the 2007 excavation block. Sherd frequencies are on the vertical axis. Spits are 10 cm thickness except for spit 1 which is 25 cm. The mound/midden separation is between Spits 5 and 6. The sub-midden (Stratum IV) beach deposit is present in spits 11–13.

Rather, and with the exception of the uppermost part of the midden (Spit 6), they are distributed across spits, including the sub-midden beach stratum. It is difficult to infer much from this pattern other than to say complex appearing Lapita wares occur throughout the midden horizon. In this, they are associated with large numbers of open and more simplified decorative motifs of the eastern Lapita style.

#### RADIOCARBON DATING OF THE NUKULEKA MIDDEN

Radiocarbon dating of the Lapita settlement at Nukuleka has been frustrated by a variety of factors, not the least being the heavily disturbed nature of mound deposits from late prehistoric, historic and recent activities. Suitable charcoal samples with clear context and stratigraphic

association are rare. Two radiocarbon dates were reported by Poulsen (1987: 27), one based on charcoal from an earth oven thought to date the upper midden deposit and the other taken from 'six *Anadara* shell net sinkers ... found securely at the very bottom of Zone 1 of the midden deposit'. Only the latter, with an original date of  $3090 \pm 95$  BP, was considered acceptable (Poulsen 1987), (Table 3). Spennemann & Head (1997) have since revised this  $^{14}\text{C}$  age to  $2819 \pm 89$  BP based on a lagoon-specific reservoir correction. A single charcoal-based AMS radiocarbon date of  $2790 \pm 50$  BP was acquired from the sole  $1 \times 1$  m unit excavated near the base of the mound in 1999 (Burley *et al.* 2001). From the 2007 excavations, four charcoal samples were selected for AMS  $^{14}\text{C}$  radiocarbon measurement (Table 3). Samples were selected exclusively from proveniences on the western side of the excavation block where *in situ* midden deposits are secure. Three of these, ranging from  $2832 \pm 32$  BP to  $2696 \pm 32$  BP, come from immediately below the midden in the upper beach/coral gravel substratum (Stratum IV) where tan paste and other complex sherds occur. These dates are taken to represent initial settlement. The fourth sample, dating  $2536 \pm 32$  BP, comes from a mid context in the accumulation of midden deposits. This date, unfortunately, falls on a flattened segment of the radiocarbon calibration curve and the  $2\sigma$  range is abnormally broad.

The radiocarbon record cumulatively, and we would argue securely, indicates initial settlement between 2900 and 2850 cal BP (950–900 BC). This date is approximately 50 years earlier than other settlements around Fanga'Uta lagoon and northward into the Ha'apai and Vava'u island groups (Burley *et al.* 1999; Burley & Connaughton 2007). How long the Nukuleka midden took to accumulate, and an age span for its ceramic assemblage, is less clear. Elsewhere in Tonga, the loss of decorated ceramics and concomitant transition to the Polynesian Plainware phase is c. 2650 cal BP as noted (Burley & Connaughton 2007). Decorated vessels by this time are restricted in number, reduced to highly simplistic motifs and have limited variation in motif application (Best 2002; Connaughton 2006). The

mid-midden radiocarbon date of  $2536 \pm 32$  BP at Moala's Mound incorporates the transition date of 2650 cal BP within its  $2\sigma$  calibrated range. The presence of complex ceramics with eastern Lapita wares in the upper spits of the midden, nevertheless, suggests abandonment somewhat earlier than the terminal date for late eastern Lapita elsewhere in Tonga.

#### THE NUKULEKA SITE LANDSCAPE

Two of the most perplexing matters about first Lapita settlement at Nukuleka are how the landscape on which it occurred should be reconstructed and how expansion of settlement occurred across that landscape during the Lapita period. Poulsen (1987: 23) reported the discovery of 'several midden sites in Nukuleka and quantities of potsherds were collected all over the peninsula and on the sand flats exposed at low tide'. He made no attempt to interpret this broader context or its relationship to the Lapita occupation beneath and adjacent to Moala's mound. Scattered ceramics and midden debris continue to erode or be present in surface exposures in a number of locales in the village, from the Nukuleka beachfront and reef flat to the southwest, from gardens and surface exposures across the southern half of the peninsula, and from active shoreline erosion along the south and southeast coastline facing the lagoon. Based on the distribution of decorated ceramics in these exposures, the site is estimated now to cover an area of 20 ha or more with a continuous lens of midden of variable thickness throughout the southern half of the peninsula (Figure 11). Even in areas on the northern half of the peninsula, patch-like midden deposits with ceramics occur and sherds can be recovered from gardens without much difficulty.

The Nukuleka peninsula was built as a sandy spit part way across the mouth of the easternmost embayment of what is today Fanga 'Uta lagoon (Burley *et al.* 2001; Dickinson 2007). Wind driven long-shore drift of reef-derived calcareous sand and detritus continue to accumulate along the western shore of the peninsula and contribute

Table 3. Radiocarbon dates for Nukuleka. WK 23707–23710 are 2007 excavated samples. ANU 541 is from Poulsen (1987: 26). Spennemann & Head (1997) employ a lagoon-specific reservoir correction to provide a corrected date of  $2819 \pm 89$  BP and the calibration range as listed in the table. CAMS 59624 is published in Burley *et al.* (1999) but is recalibrated here. Calibration for CAMS 59624 and WK 23707–23710 was carried out using the Calib 5.1 radiocarbon calibration program employing the southern hemisphere 2004 calibration curve (McCormac *et al.*, 2002).

Lab Number	Material	Date	$\delta 13$	Calibrated $2\sigma$	Stratum
ANU 541	marine shell	$3090 \pm 95$	unknown	2781–3026 BP	III/IV?
WK 23708	wood charcoal	$2836 \pm 32$	–25.9	2781–2963 BP	IV
WK 23710	charred nut	$2811 \pm 35$	–23.5	2769–2947 BP	IV
CAMS 59624	wood charcoal	$2790 \pm 50$	–24.6	2753–2949 BP	III/IV
WK 23707	wood charcoal	$2696 \pm 32$	–24.5	2721–2844 BP	IV
WK 23709	wood charcoal	$2536 \pm 32$	–24.6	2364–2718 BP	III

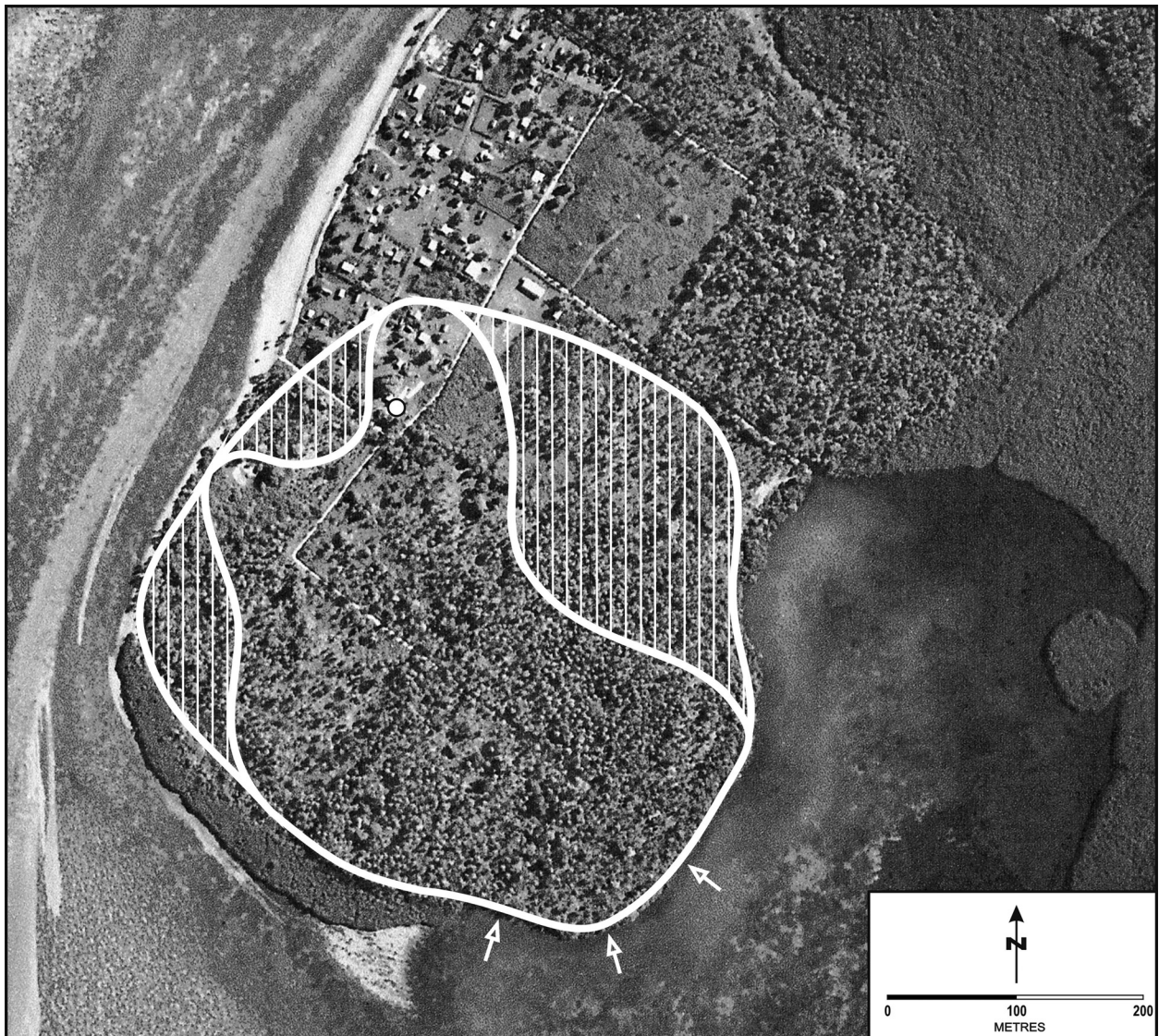


Figure 11. Air photograph of the Nukuleka Peninsula illustrating areal extent of shell midden deposits and decorated Lapita wares. Lined areas incorporate ceramics within mixed -beach deposits including branch and other coral fragments, pumice and sand. The unshaded area within the white perimeter line is the *in situ* site extent with shell midden depth varying between 0.2 and 2.0 m thickness. The circle on the north is Moala's mound excavated in 2007. The arrows on the south and east perimeter identify the area of active erosion with decorated Lapita sherds on the beach.

to the formation of extensive off-shore sand bars that are exposed at low tide to the west and south. Strong currents flow around the peninsula to the south and storm-surge tidal wash has cut a scarp-like eroding face into the coastline for a distance of 300 m or more (Figure 11). Shell midden deposits between 40 and 70 cm thick are exposed continuously here with decorated Lapita sherds and other artifacts now littering the beach. In one area on the south coast, densely compacted shell midden up to 2 m thick is present, with Lapita ceramics in it.

It is difficult to infer what this landscape must have looked like when first encountered by Lapita peoples given the accretionary complexities of development and rede-

velopment over the past 3000 years. In a general sense, there are two basic terrain features, a broad coastal flat to the west and north, and slightly higher topography to the east and south. Moala's mound and other excavations in 2007 occurred on the coastal flat, an area that generally is no more than 1 m above the elevation for modern high tide. Not surprisingly a large part of this flat has mixed deposits, with ceramics and other materials integrated into a matrix of coral sand, branch coral fragments, reef detritus and pumice. This type of beach rubble indicates a storm wash-over beach if not an active intertidal zone in the past. A 1999 test excavation (Unit 1) slightly to the west of the mound and east-west auger tests across the

garden to its south document, in part, the extent of this deposit (Figure 11). However, the midden beneath Moala's mound, within the 2 × 2 m excavation unit, and in other areas of the coastal flat, occurs *in situ* without this type of disturbance. This depositional context implies a variable shore-scape with elevated sandy cays and, or, accretionary long-shore ridges with intervening lows. The beach deposit beneath Moala's mound is notable also for its abrupt contact with the overlying midden, appearing to have been laid down in blanket-like fashion on an open and compact beach surface. In this, it is one of the very few excavated Lapita sites in Tonga without a notable beach to midden turbation zone of dark sand defining the initial settlement episode.

The elevated section of the peninsula is marked by a c. 1.5 m gradual rise in slope 40 to 50 m east of Moala's mound. This is part of a ridge that crests and then slopes slightly downward again to the east. The grade of this terrain rises subtly from north to south with parts of the south coast having an elevation of 2 m or more above modern high tide. Test excavations in 1999 (Units 3–6) on the slope behind Moala's mound (Burley *et al.* 2001: 95), as well as auger tests and subsurface exposures inland from the south coast, illustrate a consistent 20 to 60 cm thick deposit of midden, with variable quantities of shell, formed over a base of yellow coral sand. Thickness of the midden thins on a south to north gradient, merging eventually with the coastal flat and intertidal debris in the northern half of the peninsula (Figure 11).

Lapita-age sea levels on the Fanga 'Uta shoreline are estimated as 1.2–1.4 m higher than today (Dickinson 2007). We take this estimate as a robust figure with little room for further variation because it is based not only on palaeo-shoreline indicators, but also on the shoreline elevations of other Lapita sites around the lagoon. Particularly notable in this respect are three Lapita middens that, formerly, were positioned on the beach of a palaeo-island in the western side of the Fanga 'Uta embayment (Figure 2). These sites today are landlocked within the urban precincts of Nuku'alofa and can be explained only by the presence of higher sea levels which, minimally, were in the range given by Dickinson. The relative elevations of Lapita cultural deposits to contemporary mean sea level at Nukuleka thus seem problematic. Several areas with *in situ* deposits on the coastal flat are within the paleo-intertidal range given estimated higher sea levels, and ceramic sherds without beach degradation erode from back beach deposits of the present shoreline to the immediate southwest of the village. We can explain these contradictions only as a consequence of compactional subsidence on the Nukuleka Peninsula over the past 3000 years. A recent study of sediment compaction relative to palaeoshoreline in estuaries along the east coast of England by Horton & Shennan (2009) suggests an average rate of 0.4 mm per year. If Pacific lagoonal sediments are analogous, and this seems reasonable, that rate predicts a subsidence value of

1.2 m since initial Lapita landfall. This would account for the perceived incongruity at Nukuleka. Within the Pacific specifically, issues of landform compaction are identified similarly for Fiji (Dickinson *et al.* 1998), the Society Islands (Dickinson 2003), and Palau (Dickinson & Athens 2007).

#### NUKULEKA IN THE CONTEXT OF REGIONAL ARCHAEOLOGY FOR FIJI/WEST POLYNESIA

The ceramic data from Nukuleka, radiocarbon dates, and the absence of comparable sites in West Polynesia, identify it as a founding settlement for Polynesia. We have discussed the tan paste sherd assemblage already, and its potential source origins from a dacitic high island of the New Hebrides island arc. If correct, this implies a colonization event from central-island Melanesia, a difficult feat given voyaging distances of between 1750 and 2300 km (Clark & Anderson 2009: 414). The pattern of Lapita dispersal predicts the settlement of Tonga as an outgrowth of incremental Lapita expansion across and from Fiji. Tan paste sherds in this scenario must incorporate an as yet undiscovered Fijian temper type. This is an unlikely circumstance, but one not ruled out categorically (Burley & Dickinson 2001). The question remains of how Nukuleka fits within the overall context of the Lapita settlement of Fiji and the surrounding region.

The earliest settlement of Fiji occurs 2950 to 3050 cal BP at Bourewa on the southwest coast of Viti Levu (Nunn 2007). This leaves 100 to 150 years for an infilling of the Fijian landscape and for an incremental settlement expansion eastward into Lau, Tonga and Samoa. The Bourewa decorated ceramic assemblage is large and it has a complex and fully developed western Lapita style as one might expect given the age of the site and its nature as a colonizing outpost facing west (Nunn 2007). Ceramics of Western Lapita aspect are predominant also at four other excavated Lapita sites in west to central Fiji – Natunuku, Yanuca, Naigani and Naitabale (Best 2002; Nunn *et al.* 2007; Clark & Anderson 2009) (Figure 1). These assemblages are somewhat varied in the relative percentage of decorated to undecorated sherds and in their decorated motif suites (Best 2002; Clark & Anderson 2009), but as a group they share the overall western Lapita complexity of vessel decoration and design. The assemblages also appear qualitatively different, with more detailed and complex motifs, and without the abundant assemblage of simplified eastern Lapita motifs in association as occurs at Nukuleka. Excluding Natunuku, a site that is not well dated, Yanuca, Naigani and Naitable are co-incident in age with Nukuleka at 2850–2900 cal BP (Clark & Anderson 2009: 418). The ceramic distinction between Nukuleka and west and central Fijian sites, then, must be *spatial not temporal*. This is an important distinction, since the reverse has been long asserted by Best (1984, 2002), and it is central to an incremental settlement model.

Of Fijian Lapita sites with comparable time depth to Nukuleka, only Wakea on Lakeba island in Lau is similar to Nukuleka in having two sherds of clear western Lapita aspect integrated into an otherwise large component of eastern Lapita ceramics (Best 1984, 2002). The affinity of Wakea and other Lau ceramic assemblages with Tonga and Samoa as opposed to other Fijian Lapita sites is described by Best (1984: 653) as demarcating a 'break to the west' that is 'substantial and real'. The distinct nature of the west and central Fijian Lapita wares, as represented at Naigani, led him (Best 1984: 641) to further remark, perhaps prophetically, that 'a simple settlement model for Fiji may not be tenable, and that multiple settlement for the early period is equally as probable.' To this we can only agree, the logic of an incremental settlement model notwithstanding.

An argument for different settlement events in Tonga and Lau and in west and central Fiji has been proposed and discussed elsewhere (Burley & Dickinson 2001, Burley *et al.* 2002). Necessarily, this rejects an earlier view of the ocean gap between central island Melanesia and Fiji as an isolating barrier crossed but once by a founding Lapita group (Kirch 2000). As an alternative, it proposes return voyaging from Fiji to a homeland source to the west, resulting in the spread of new geographic knowledge as a stimulus for additional emigration events over the next few centuries. The settlement of Tonga with a landfall at Nukuleka represents one of these later voyages, perhaps direct, but possibly with intermittent short-term landfalls across Fiji on its way. The length of time this voyage must have taken was obviously short, defined as it is by the life history of a single set of tan paste pots. The significant distance involved in a central island Melanesian-Tongan voyage is not without consequence. It discourages if not eliminates return voyaging, and this must have led to the relative isolation of a founding colony on an extreme eastern frontier. The presence of imported items from Kadavu, Viti Levu and Vanua Levu in the Lapita assemblages at Lakeba, however, indicates isolation was not total and that some degree of trade or contact may have developed quickly with Lapita groups in Fiji, at least in Lau (Best 1984: 641).

Whatever the origins and circumstances of the colonization at Nukuleka, it represents a founder population for Tonga and, so far at least, forms an initial settlement for Polynesia as a whole. In this it provided a population nucleus for subsequent expansion throughout other islands of the archipelago extending to Samoa in the north. Its radiocarbon record secures this status as does its ceramic assemblage and uniqueness relative to all other sites in west Polynesia. The ceramic assemblage is the potting tradition of a western Lapita homeland where, we suspect, simplification in decorative design already may have been taking place. The founder effect, combined with isolation, amplified Lapita ceramic design change with complete development of an eastern Lapita ceramic series as a result (Burley *et al.* 2002). That this process was fully complete

within as little as two generations is attested to by the absence of any semblance of western Lapita ceramic motifs elsewhere in Tonga, Samoa or Lau, save for Wakea.

Part of the uniqueness of the Nukuleka site is its settlement size over an area of 20 ha or more, and its rapid growth across the southern half of the peninsula. This suggests a principal centre or node for the eastern Lapita area, a region where virtually all other Lapita sites are hamlet-sized in areal extent (Burley 2007). From this settlement, expansion took place rapidly over the next 50 to 100 years, ringing the shoreline of the twin Lapita-age embayments on today's Fanga 'Uta Lagoon. With 16 other Lapita sites now reported there, and the strong probability that others are still to be recorded, Dickinson (2007: 184) suggests it may be 'one of the densest Lapita populations in the ancient Pacific world'. Expansion was not simply around Fanga 'Uta lagoon but occurred as rapidly to the north through the Ha'apai islands to Vava'u, Niuaotuputu and Samoa. The density of sites decreases, however, and what Clark & Bedford (2008) refer to as demographic exhaustion may have taken place. Given the near identical eastern Lapita ceramic style in the Lau islands of Fiji, and an archaeological record that is identical to Tonga for the first millennium of occupation, these islands were undoubtedly tied to this expansion process as well. Geraghty's (1983) inclusion of languages from eastern Vanua Levu, Lau, Tonga and Samoa within proto Tokelau Fijian, a dialect chain distinct from western Fijian languages, understates this relationship in the context of historical linguistics.

## CONCLUSIONS

The presence of a small sample of western Lapita aspect ceramics at Nukuleka has been recognized for a long time as identifying one of the earliest settlements in the Kingdom of Tonga (Poulsen 1987). The exotic nature of temper sands in a collection of associated tan paste sherds was documented also in 1999, and this supported a further argument for Nukuleka as a founder colony for Polynesia (Burley & Dickinson 2001). With no comparable temper identified in Fiji, and with the only comparable temper found in a sherd in the Reef-Santa Cruz islands, the orthodox incremental settlement model for Lapita expansion across the Pacific was questioned (Burley *et al.* 2002). Rather, the possibility was raised that Polynesia had been colonized directly from central island Melanesia. The data were thin and they were derived from a site heavily disturbed by the construction of a late prehistoric burial mound. As most of the Nukuleka archaeological collection had been destroyed in 2003 a project was implemented in 2007 in order to evaluate further the site's status as a founder settlement and to gain insight into the nature of this occupation, the integrity of its archaeological record, and the status of its place in Oceanic prehistory.

The 2007 project involved re-excavation of Moala's mound, the only part of the Nukuleka site where both

western Lapita style and tan paste ceramic sherds have been found. Employing a block excavation, it was possible to document the mound construction process, the *in situ* presence of midden deposits beneath secondary fills, and the relationship of mound to midden horizons as Poulsen has referred to them. Additional test excavations and survey of the Nukuleka Peninsula provided further data essential to site understanding and site context.

Four conclusions can be drawn:

*First*, midden deposits beneath and within Moala's mound incorporate a single Lapita phase component without evidence for later Polynesian Plainware phase materials. Based on radiocarbon dates, we relate the beginning of this settlement securely to between 2850 and 2900 cal BP. It is more difficult to define an end date but we suggest it predates terminal eastern Lapita at 2650 cal BP based on the distribution of ceramics with complex decorative applications in the midden horizon.

*Second*, the founding of Nukuleka is marked by scattered ceramics that occur in the sub-midden beach deposit. This includes a series of vessels with tan paste body fabrics and sand temper inclusions that are exotic to Tonga and probably Fiji. Several of these have western Lapita style decorative motifs that, in some cases, are replicated in vessels made of local clays. Transformation of the decorated assemblage into one with a dominance of simplified eastern Lapita motifs was rapid.

*Third*, Moala's mound and its immediate vicinity continues to be the only locale at Nukuleka where tan paste and western Lapita aspect ceramics occur. It is taken as a point of first landfall from which settlement expansion spread over an area in excess of 20 ha across a coastal flat and elevated terrain on the southern half of the peninsula. This scale indicates a substantial village unlike any other Lapita site in Tonga. We conclude that Nukuleka was a central place in the eastern Lapita region. We also note that Fanga 'Uta Lagoon on Tongatapu, with no less than 16 other Lapita sites reported, had a substantial population size in the initial Lapita phase of colonization. This population nucleus served as a source for expansion northward through Tonga to Samoa. Given the identical nature of eastern Lapita ceramics in Lau, we anticipate that expansion reached there as well.

*Fourth*, the tan paste sherd assemblage suggests central island Melanesia as a point of origin for the Nukuleka colonizers. The site assemblage has no new data with which to identify the source or validate this claim directly. The Nukuleka ceramic assemblage, however, is different from Lapita ceramic assemblages of west to central Fiji of equivalent age. The difference, we conclude, is spatial rather than temporal, a circumstance that is difficult to

reconcile with an incremental settlement model of population expansion across Fiji.

The 2007 project at Nukuleka has clarified at least a few of the issues surrounding this site and its context in Oceanic prehistory. Its ceramic collection now provides the comparative base from which future studies of the emergence, expansion, transformation and demise of the eastern Lapita ceramic series can be undertaken. It, with other site data, ultimately facilitates new insight into the cultural if not biological basis from which ancestral Polynesian society emerged.

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