

A New Ceramic Assemblage from Caution Bay, South Coast of Mainland PNG: the Linear Shell Edge-Imprinted Tradition from Bogi 1

Bruno David,¹ Ian J. McNiven,¹ Matthew Leavesley,² Bryce Barker,³ Herman Mandui,⁴ Thomas Richards¹ & Robert Skelly¹

ABSTRACT

This paper reports on the ceramics from Squares A and B of Bogi 1, a newly excavated site at Caution Bay, south coast of mainland Papua New Guinea. A dense cultural horizon dated from *c.* 2150 to *c.* 2100 calBP and preceded by earlier cultural deposits contains previously undescribed ceramics of limited decorative variability almost exclusively focused on *Anadara* shell edge impressions below finger-grooved lips, which we term the *Linear Shell Edge-Imprinted Tradition*. Here we present the chrono-stratigraphic evidence for this decorative tradition and how it relates to previously described shell-imprinted ceramics from the broader region.

Keywords: Post-Lapita; Caution Bay; mainland PNG; ceramics; Linear Shell Edge-Imprinted Tradition

INTRODUCTION

The investigation of long-term cultural trends along the south coast of mainland Papua New Guinea (PNG) has long focused on the characteristics of archaeological ceramics (e.g. Allen 1972; Bulmer 1978; Irwin 1985; Swadling 1980; Vanderwal 1973). Yet since the first professional archaeological excavations in the late 1960s, only a single publication systematically reporting on excavated ceramics with chrono-stratigraphic detail has been published (Allen 1972), although unpublished theses have also been produced (see also Frankel and Kewibu 2000; Frankel and Rhoads 1994; Irwin 1985). These writings have been the source of major interpretations focused on: 1) the arrival of colonising ceramicists from the east some 2000 years ago; and 2) an aggregated ceramic sequence now referred to as ‘Early Papuan Pottery’ (EPP) in which ceramic con-

ventions are said to have changed in tandem along the entire south coast of PNG, indicating a ‘connected system [that] appears to have contracted over time, suffering final disruption around 1200 BP’ (Allen *et al.* 2011:69).

The recent discovery and excavation of a number of Lapita sites at Caution Bay, 20 km northwest of Port Moresby between the present-day villages of Boera and Papa, requires a complete rethinking of the region’s cultural history (David *et al.* 2011; McNiven *et al.* 2011). These sites contain not only Lapita assemblages, but also rich ceramic sequences variably covering individual cultural horizons and long cultural sequences. A clear and detailed understanding of ceramics across space and through time is thus crucial for a proper characterisation of the cultural history of the south coast of mainland PNG, and requires an improved ceramic and radiocarbon data set.

Here we thus present a detailed report on the ceramic assemblage from the first two squares (and pit) excavated at Bogi 1 (PNG National Museum and Art Gallery site code ABEN), being the first ceramic sequence from Caution Bay to have been analysed in detail.

The Bogi 1 ceramic evidence is part of a consistent set of excavated ceramic assemblages that sheds considerable doubt over the EPP as a useful marker of a period of social interaction distinct from those that came before and after it along the south coast of PNG. We argue instead that a rethinking of the nature, stylistic and chronological integrity, and timing of the individual ceramic phases purported to occur within the EPP is needed. The sequences from Caution Bay flag a need for such a rethinking, with Lapita-

1 School of Geography and Environmental Science, Monash University, Clayton, Victoria 3800, Australia.

2 Department of Anthropology, University of Papua New Guinea, Post Office Box 320, University Post Office, NCD, Papua New Guinea.

3 School of Humanities and Communication, Faculty of Arts, The University of Southern Queensland, Toowoomba, Queensland 4350, Australia.

4 Prehistory department, PNG National Museum & Art Gallery, Waigani, NCD, Papua New Guinea.

Corresponding author: Bruno.David@monash.edu

Submitted 18.10.11, accepted 2.12.11

into-EPP ceramics having now been found in well-dated contexts near Port Moresby (David *et al.* 2011; McNiven *et al.* 2011).

In addition to the presence of a Lapita horizon dating from *c.* 2900 to *c.* 2500 calBP (Phase 1 of our ceramic sequence; see McNiven *et al.* (2011)), we argue that for Port Moresby at least, and with potential applicability to other parts of the south coast of PNG also, at least four other, chronologically sequential ceramic traditions can be identified (Figure 1):

Phase 2. Post-Lapita Transformative Tradition
(*c.* 2500–2150 calBP)

Decorative conventions on ceramics immediately following the Lapita period went through a process of simplification in design, transforming into recognisably similar but structurally more simple linear, geometric dentate-stamped decorations between *c.* 2500 and *c.* 2150 calBP. The period *c.* 2500–2400 calBP in particular saw a very rapid ‘deterioration’ or break down of the preceding Lapita dentate-stamped decorative system, to the extent that we can

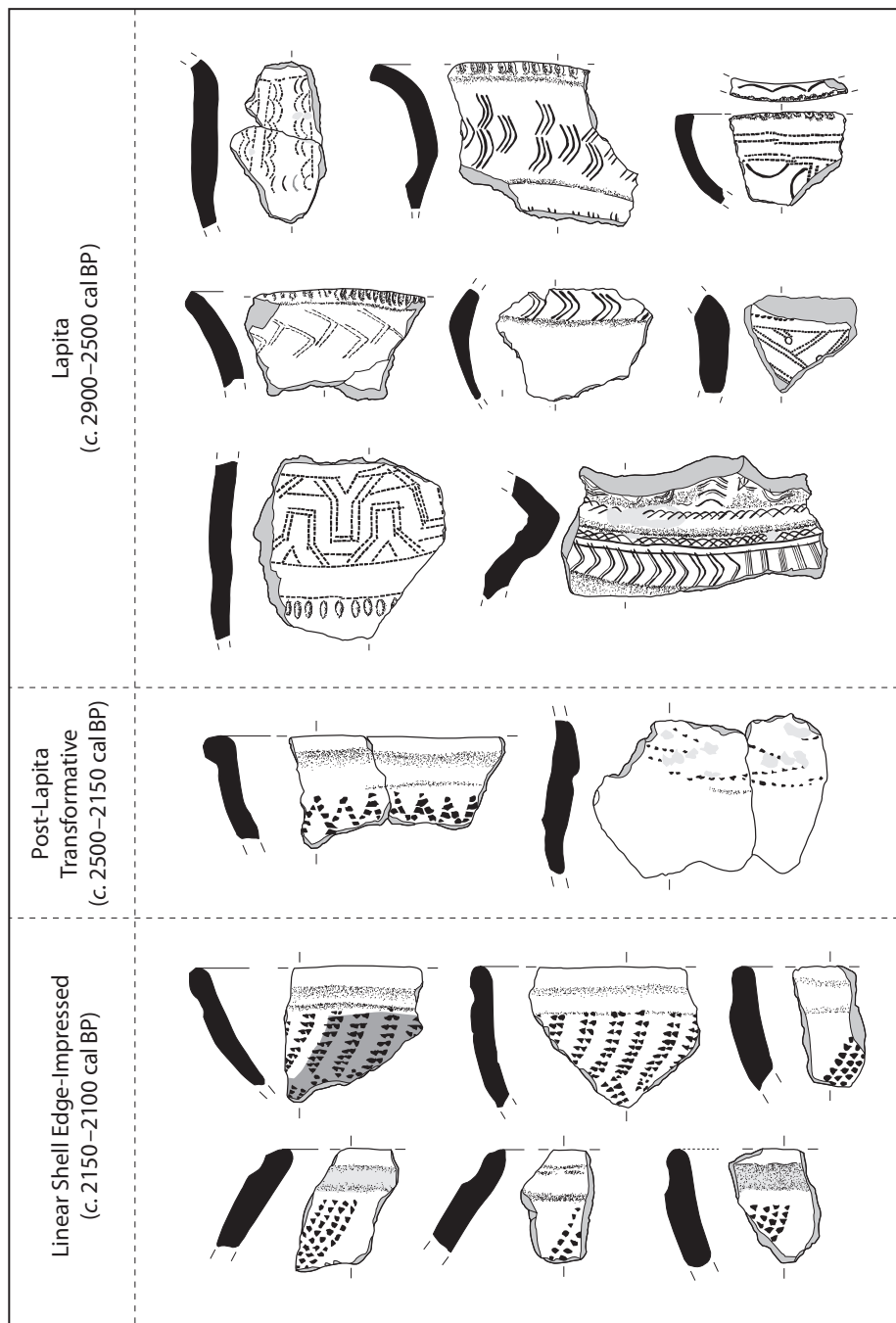


Figure 1. Sherds from pre-2000 calBP ceramic traditions for Caution Bay-Port Moresby: typical decorations.

identify for Caution Bay, within 50 years precision, 2500 calBP as the end of Lapita as defined by its ceramic decorative conventions and vessel shapes (the full evidence for this, based on over 1000 AMS radiocarbon determinations and the excavation of 204 m² from 122 sites, will be the subject of separate monographs).

Phase 3. Linear Shell Edge-Imprinted Tradition
(c. 2150–2100 calBP)

Between c. 2150 and c. 2100 calBP there emerged a highly standardised decorative tradition of shell edge-impressed wares that mimicked the earlier dentate stamping of the *Lapita* and *Post-Lapita Transformative* traditions. We call this the *Linear Shell Edge-Imprinted Tradition* (Phase 3) because the overwhelmingly predominant decoration consists of indentations arranged in structurally simple linear arrangements made by the distal dorsal edges of *Anadara* shell valves (as determined by experimental impressions made from a number of local shell species). Despite a dramatic break down of the Lapita ceramic system c. 2500 calBP, the *Linear Shell Edge-Imprinted Tradition* retained or newly adopted a decorative element reminiscent of Lapita wares: lines of dentate impressions, but now made with sculptured, ribbed shell valves rather than tined tools such as combs. The *Linear Shell Edge-Imprinted Tradition* is chrono-stratigraphically constrained at Caution Bay and has neither been identified as a distinctive decorative phase nor been described before.

Phase 4. Umbo-Bordered Shell Back-Imprinted Tradition
(c. 2100–1650 calBP)

Phase 3 is followed by the *Umbo-Bordered Shell Back-Imprinted Tradition* (Phase 4) already documented from Yule Island (Type A of Zone IIC at Oposisi of Vanderwal (1973)) and Port Moresby (Style H at Nebira 4 of Allen (1972)). In this tradition designs are created by impressing the dorsal surface of shell valves, including lines of umbo impressions that often delimit the margins of geometric designs. Preliminary results indicate that we do not have many sherds from this tradition in the sites we excavated, but the chrono-stratigraphic evidence presented by Vanderwal (1973) and Allen (1972) suggests that this is a distinctive phase (see Discussion below).

Phase 5. Varied Incised Tradition
(c. 1650–1000 calBP)

Our *Varied Incised Tradition* (Phase 5), forms the bulk of Bulmer's (1969, 1978) 'Red Slip' style, Allen's (1972) Styles F and G, and Vanderwal's (1973) Types E-W, but is here disaggregated from those previously-defined ceramic styles or types because, in some cases at least, they also incorporated sherds from some of the earlier archaeological traditions identified in this paper. We have found rich archaeological assemblages of such ceramics in well-dated archaeological contexts (unpublished) in our own excavations in the Gulf Province to the west.

We refer to the above decorative phases as archaeological 'traditions' rather than 'styles', 'horizons', and the like for the following reasons:

1. We identify an archaeological tradition as a consistent set of design conventions that repeatedly occur together within an archaeological assemblage relating to a particular temporal phase, and that is distinctive from earlier and later traditions. In our terminology, each tradition may contain a number of decorative conventions, i.e. a range of decorative styles. We have named most traditions descriptively by the predominant decorative conventions that identify them.
2. A 'style' refers not to a temporally-constrained unit of analysis, but to a way of doing things. For example, two sets of artefacts belonging to two very different periods of time may be of a single style (for whatever historical and cultural reasons).
3. We reserve the use of 'horizon' for an archaeologically discrete stratigraphic level forming the subject of discussion on a given topic. By differentiating between a 'tradition' and 'horizon', we can then systematically discuss the exact chrono-stratigraphic distribution of particular design conventions, and traditions, in a given site (i.e. assess the degree of fit between ceramic designs and a site's chrono-stratigraphy).

The degree to which each of these traditions, and their progression from one to the next, is found in different parts of the south coast remains to be systematically investigated at individual locations. We also argue that there is a need for revision of the age and sequencing of south coast ceramics generally, because in recent times sight of the individual traditions and their interfaces has largely been lost as increasing, and virtually exclusive, emphasis has been placed on an artificially constructed 'EPP' that aggregates everything that happened before 1200 BP into a single generic cultural phase.

Understanding the first two millennia of ceramics along the south coast requires understanding what is going on through time at individual locations, itself necessitating a disaggregation of the EPP package. Irwin's (1985:3) view of the mid-1980s, that 'there is now a clear need to attempt to integrate the various data sets from the Papuan coast and islands and to explain, in particular, the occurrence of certain generally comparable developments evident in their cultural sequences' may be warranted, but the task of first obtaining detailed and well-dated evidence for each region is by no means complete or secure. Indeed, not only are key parts of regional sequences missing from the existing evidence, but those parts that are to hand require critical reworking.

BOGI 1

Bogi 1 is situated 45 m inland of Caution Bay (Figures 2 and 3). It occurs 4 m above the high tide mark, midway along a 2 km-long linear aeolian sand dune fronting the

coast. The shoreline side of the site is thickly vegetated with shrubs and emergent trees and slopes steeply down to shallow intertidal flats. The inland side of the site is grassland and very gently slopes up towards the east.

It is only below the surface that the site's cultural richness becomes apparent. Two juxtaposed excavation squares (Squares A and B), each 1 × 1 m in size, were initially excavated, neither of which reached the deepest cultural levels. Square B was positioned against the south wall of Square A, to make a continuous 2 m × 1 m trench. Square A progressed to 47 cm below ground surface, Square

B to 131 cm below ground surface. Further squares were subsequently excavated to the base of cultural deposits in an adjacent pit (McNiven *et al.* 2011: figure 2); these will be reported at a later date. This paper reports on the ceramics from Squares A and B, and in doing so identifies a rich archaeological horizon with a well-defined ceramic tradition which we here term the *Linear Shell Edge-Imprinted Tradition*.

Five Stratigraphic Units (SUs) were identified from Squares A and B (Figure 4); these are continuous across the two excavation squares. From the top of the excavation

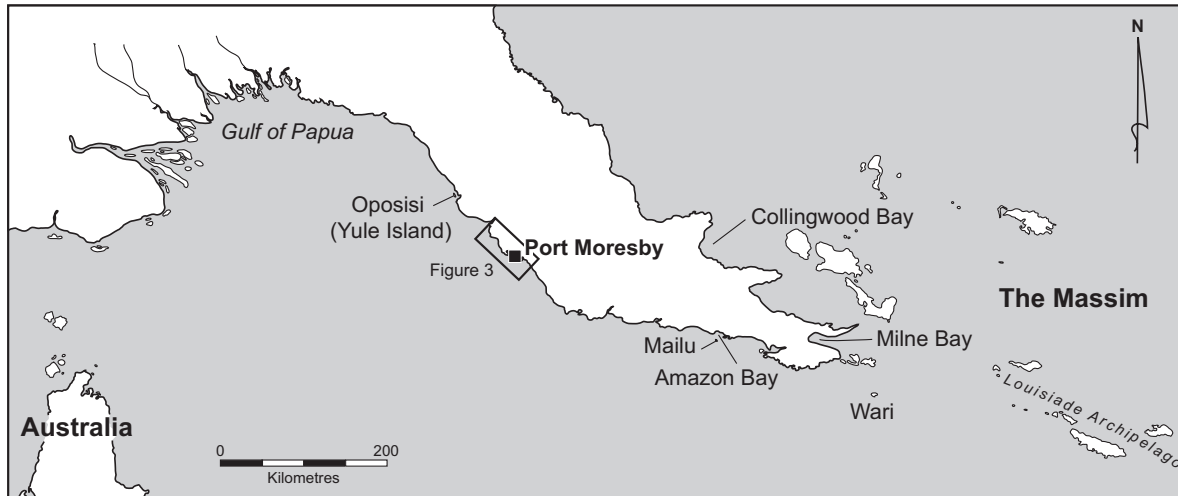


Figure 2. South coast of PNG, showing location of key sites mentioned in text.

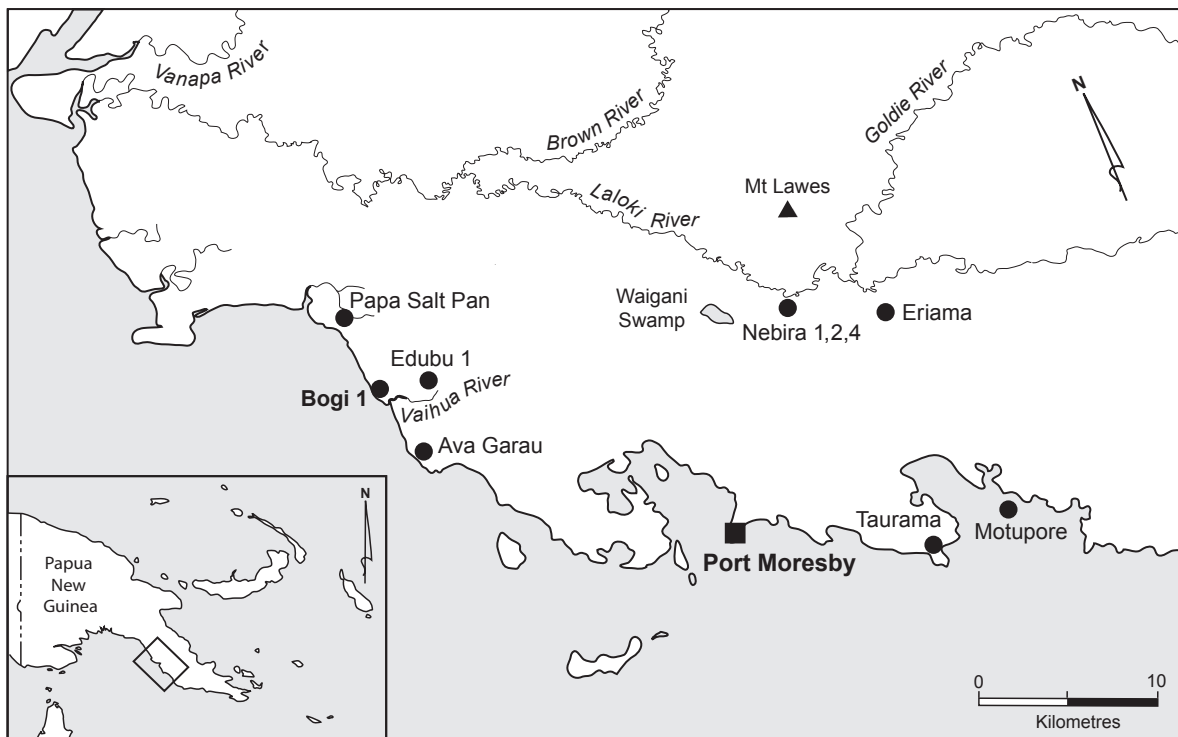


Figure 3. Port Moresby region, showing location of sites mentioned in text.

downwards, sediments consist of a thin layer of unconsolidated silty sand on the surface (SU1); followed by four layers of silty sand becoming progressively lighter and sandier with depth (SU2-SU5). SU3 and SU4 (consisting of XU3 to XU12 in Square A, and XU3–XU15 in Square B) together represent the main cultural level, consisting of an horizon of dense shell, animal bone, stone artefacts and ceramics. This horizon is found from 3 cm to 36 cm below ground. Below this, cultural materials continue to the base of the excavation in both squares (i.e. to at least 131 cm below ground), but in relatively low numbers within the compact and moderately consolidated dune sands.

Excavation was undertaken in arbitrary XUs following the stratigraphy as apparent at the time of excavation. A total of 19 XUs were excavated in Square A, and 50 in Square B (many of which were sub-divided into sub-XUs). XUs average 2.5 cm thickness in Square A, and 2.6 cm in Square B. Selected cultural materials were plotted in three dimensions and individually bagged during excavation, as were charcoal samples for radiocarbon dating. All sediments were dry-sieved and then wet-sieved in 2.1 mm mesh, air dried and bagged unsorted for prompt (air) shipment to Monash University in Australia, where they were

sorted under controlled conditions in the archaeology laboratories. We note that use of 2.1 mm mesh sieves, and the systematic sorting of all cultural items ≥ 2.1 mm long, means that the excavated ceramic assemblage will contain large numbers of very small sherds. The small mean size of the ceramic assemblage presented below is largely due to this fine-sampling protocol.

Six radiocarbon determinations have been obtained from Squares A and B, one on *Anadara granosa* shell from the near-surface (XU2), the other five from in situ charcoal samples (Table 1). Each charcoal date is from an individual fragment of charcoal. The results show good chrono-stratigraphic integrity, with cultural deposits in XU45 near the base of the excavations dating to sometime between 2153 and 2276 calBP at the highest 95% probability range. It is important to note that five more XUs were excavated below this date, and cultural materials continued below the lowermost excavated XU. The median calibrated ages of all radiocarbon determinations above this date are each in the range 2100–2250 calBP (rounded to closest 50 years), indicating that occupation in these levels (and the ground surface) dates to this period of time. Subsequent excavations at this site have revealed ages of 2900 calBP

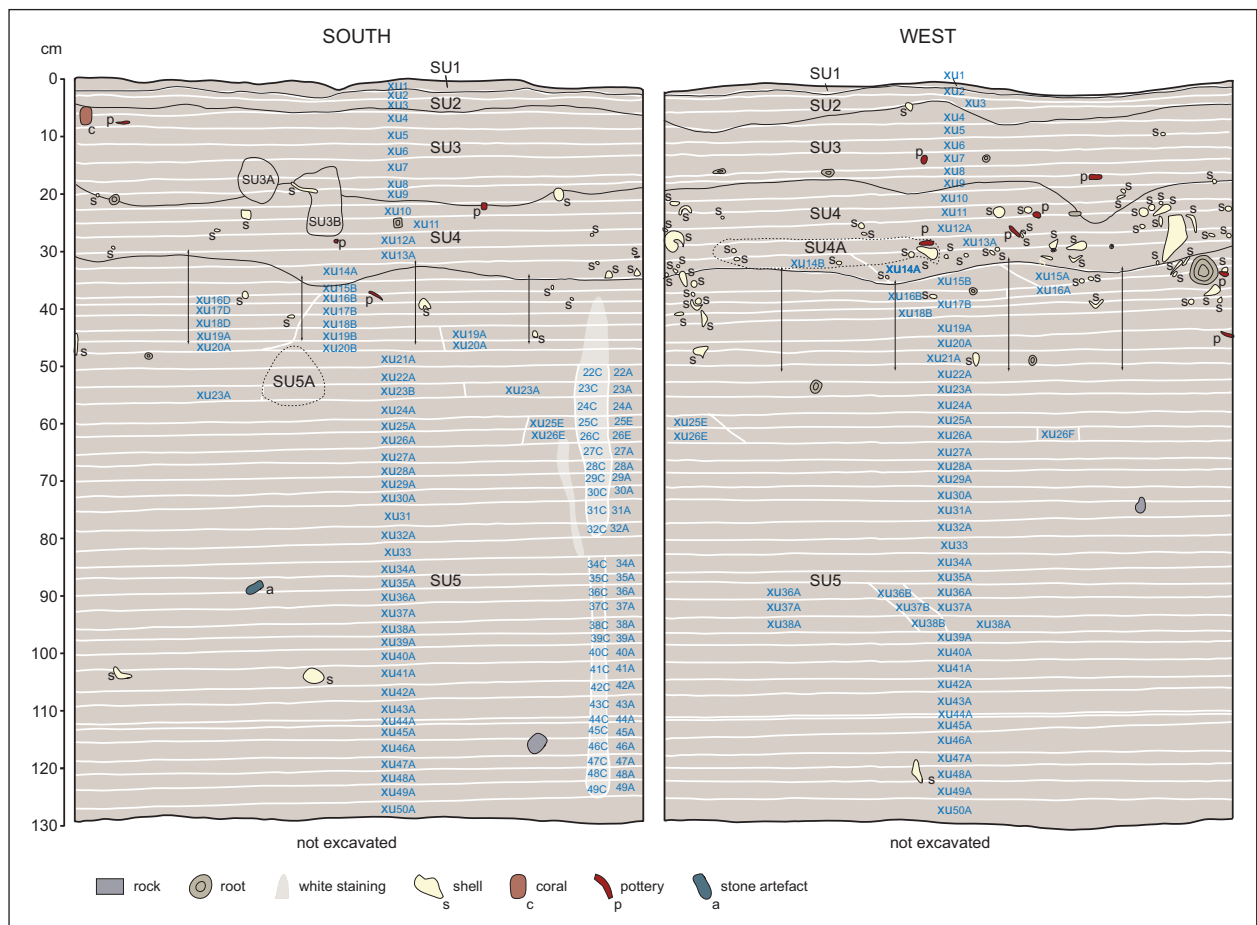


Figure 4. Bogi 1 Square B south and west sections, showing backplotted XUs.

Table 1. Radiocarbon determinations, Bogi 1, Squares A and B. All ^{14}C ages are AMS. Calibrations undertaken using Calib 6.0 (charcoal calibrations: INTCAL09 curve selection; shell calibrations: MARINE09 curve selection, $\delta R = -68 \pm 13$ [Petchey *et al.* in preparation]).

Sq.	XU	Depth (cm)	Wk-Lab. Code	Material Dated	$\delta^{13}\text{C}$ ‰	% Modern	^{14}C Age (yrs BP)	CalBP (68% prob.)	CalBP (95% prob.)	Median CalBP (estimated to closest 50 yrs)
B	2	1.0–2.6	28414	<i>Anadara granosa</i> shell	-3.0 ± 0.2	74.3 ± 0.2	2384 ± 30	2037–2145 (1.000)	1984–2220 (0.992) 2225–2235 (0.008)	2100
A	12	31.3	27154	charcoal	-24.0 ± 0.2	75.9 ± 0.1	2215 ± 30	2157–2210 (0.501) 2221–2265 (0.389) 2297–2309 (0.110)	2151–2326 (1.000)	2250
B	17b	41.0	25748	charcoal	-24.0 ± 0.2	76.7 ± 0.2	2134 ± 30	2059–2152 (1.000)	2003–2158 (0.850) 2173–2176 (0.003) 2250–2299 (0.148)	2100
B	25a	61.6	25749	charcoal	-26.2 ± 0.2	76.6 ± 0.1	2140 ± 30	2062–2087 (0.218) 2101–2154 (0.619) 2272–2293 (0.163)	2004–2027 (0.038) 2036–2161 (0.738) 2168–2178 (0.015) 2243–2302 (0.208)	2150
B	37a	92.0–95.1	25750	charcoal	-24.7 ± 0.2	76.7 ± 0.1	2130 ± 30	2056–2151 (1.000)	2001–2158 (0.890) 2259–2298 (0.110)	2100
B	39	100.0	25751	charcoal	-24.8 ± 0.2	76.2 ± 0.2	2180 ± 30	2141–2180 (0.333) 2239–2303 (0.667)	2116–2314 (1.000)	2250
B	45a	117.0	25752	charcoal	measured but value not available	75.8 ± 0.1	2229 ± 30	2159–2171 (0.100) 2177–2247 (0.703) 2300–2321 (0.198)	2153–2276 (0.761) 2290–2335 (0.239)	2250

associated with Lapita occupation in deeper levels; these are not the subject of the present paper (see David *et al.* 2011; McNiven *et al.* 2011).

We note that we have obtained a further 154 AMS radiocarbon determinations on individual pieces of charcoal or shell from nearby excavated squares forming a much larger adjacent pit at Bogi 1 (McNiven *et al.* 2011). These results show that the chrono-stratigraphy of Squares A and B is continuous with, and consistent with, other parts of Bogi 1 (as indeed it is with other nearby sites also). These results also show clear evidence of progressive age increases with depth from the horizon containing the Linear Shell Edge-Imprinted ceramics to the underlying Lapita horizon. We note that there is no ethnographic evidence for gardening activity in the vicinity of the dune at Bogi 1, and the archaeological excavations indicate limited mix-

ing of deposits (the layering of sediments show relatively constrained interfaces, and the sequence of radiocarbon dates suggests limited stratigraphic mixing of deposits). The radiocarbon, stratigraphic, taphonomic and cultural evidence for the Bogi 1 excavations will be presented in due course in a separate monograph.

SQUARE A CERAMICS

Figure 5 shows the terms used in this paper for vessel parts. On a general note in respect to dentate-stamping, we differentiate ‘dentate’ (tooth-like decoration) from the tool used, rather than assume an automatic corollary of dentate impressions from tined tools. We thus distinguish ‘comb dentate-stamped’ from ‘shell dentate-stamped’ when tooth-like impressions are evident on a sherd. Reducing

dentate stamping exclusively to combs when describing dentate impressions privileges the tools (which are not directly evident) ahead of the impressions themselves (which are evident). Our approach prioritises the nature of the decoration (e.g. dentate impressions) and qualifies their production with a prefixing (deduced) tool (e.g. comb, or shell valve).

A total of 4533 pottery sherds weighing 2830.0 g were excavated from Square A (Table 2). These consist of all the sherds recovered in situ plus those obtained from the $\geq 2.1\text{mm}$ sieve fraction. Only 103 (2.3%) of these are $\geq 3.0\text{cm}$

in maximum length. The average weight of all sherds is 0.62g, and the average by XU is 0.70 ± 0.33 g.

Of the sherds ≥ 3.0 cm long, five are red-slipped or red painted, and 14 are rims. We note from the outset that all sherds with red pigment in Squares A and B are either distinctively slipped, or it is uncertain whether they are slipped or painted (this ambiguity being due to the very small size of such sherds). Only six sherds are large enough to confidently identify aspects of pot shape. Of these, all are from everted vessels. One (XU4 sherd #1) is from a slightly everted plainware vessel with an orienta-

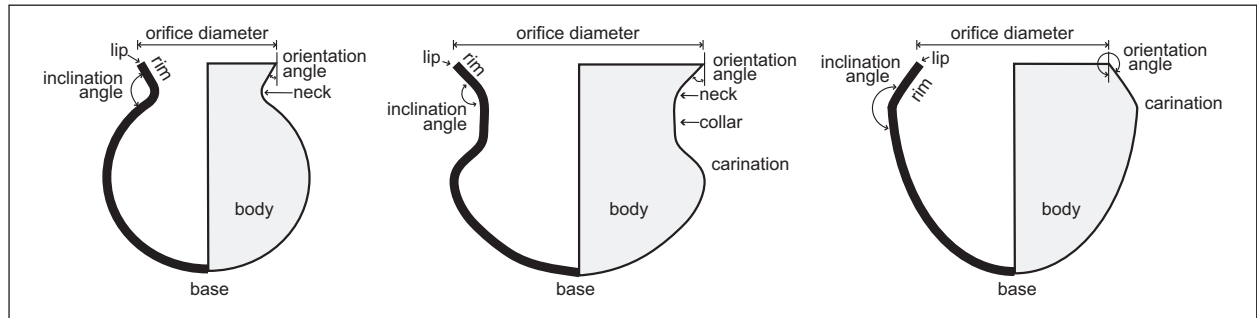


Figure 5. Description of terms used for vessel parts and key variables recorded on pottery sherds ≥ 3.0 cm long. *Left*: indirect everted (with neck) vessel (globular). *Centre*: collared, indirect everted vessel (carinated). *Right*: indirect inverted vessel (carinated)

Table 2. Summary data on pottery sherds by XU, Bogi 1 Square A. *Apart for a single sherd collected in situ, the bag of XU13 sherds had been misplaced at time of analysis for this paper, and are therefore not included here.

XU	Total sherds		Incised body sherds		Sherds with finger groove below the lip		Red-slipped/painted sherds		Anadara shell edge-impressed sherds		Rim sherds ≥ 3 cm length		Sherds ≥ 3 cm length		≥ 3 cm sherds with dimple marks in internal surface	
	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g
1	15	6.95														
2	92	28.43					1	1.0								
3	437	252.18			3	4.8	7	6.0	10	22.7			10	52.9		
4	325	113.09					7	4.6	2	2.4	1	7.4	1	7.4		
5	695	397.62	1	4.7	4	7.2	10	4.5	18	54.1	1	4.7	16	116.0	1	3.7
6	207	165.01			1	3.1	9	10.9	4	8.5	1	3.1	4	23.7		
7	331	303.26	1	0.5	5	20.1	7	7.2	10	32.8	2	16.2	16	114.1		
8	473	273.98			1	2.9	7	12.5	11	21.5	1	5.6	12	78.8	1	5.6
9	752	384.39	1	1.2	1	4.1	20	9.2	22	21.0	2	9.2	16	102.7	1	15.6
10	405	274.92			2	10.6	21	32.2	18	32.5	2	10.6	10	58.0	1	16.5
11	438	271.78			2	5.4	13	13.4	13	20.6	1	6.9	5	22.4	1	2.8
12	216	202.88			1	2.2	4	5.4	9	18.1			6	33.1	1	8.6
13	1*	42.51*					1	42.5			1	42.5	1	42.5		
14	23	32.39					4	11.2	2	2.6	1	8.8	2	13.0		
15	27	15.69					3	2.5	1	0.9						
16	11	8.72											1	2.5		
17	20	9.84					1	0.2	1	2.6						
18	13	20.04							1	0.7	1	6.5	2	9.5		
19	52	26.31					2	1.3	3	9.4			1	6.6		
Total	4533	2829.99	3	6.4	20	60.4	117	164.6	125	250.4	14	121.5	103	683.2	6	52.8

tion angle of 10° and an orifice diameter of 24 cm. Sherd #15 from XU7 is a slightly everted rim sherd with a finger groove below the lip and *Anadara* shell impressions below the groove; it also has an orientation angle of 10° and orifice diameter of 24 cm, which together with the sherd's curvature indicates that it comes from a bowl. Sherd #10 from XU10 has an orientation angle of 20° and an indeterminate orifice diameter; it has a finger groove below the lip, is decorated with *Anadara* shell impressions on its external surface, and red-slipped on its internal surface. A third probable bowl with a finger groove below the lip and *Anadara* shell impressions is represented by sherd #16 from XU7, which has an orientation angle of 45° and an uncertain orifice diameter (for a description of terms used for vessel parts, see Figure 5).

The two indirect (with neck) everted sherds large enough to measure orientation angles and orifice diameters are from XU8 (sherd #4), which has an orientation angle of 45° and an orifice diameter of 18 cm; and a large, everted indirect rim sherd with an orientation angle of 55° , inclination angle of 100° and an orifice diameter of 20 cm. Neither of these sherds has any decoration. No sherd with a finger groove below the lip has a neck; they do not appear, therefore, to be associated with indirect everted pots, but rather with slightly everted (direct) bowls.

Six sherds possess dimple marks on their internal surfaces, indicating the use of paddle and anvil during manufacture.

A further 112 sherds, each < 3.0 cm long, are red-slipped or red painted; no paint shapes have been identified. This means that a total of 117 sherds, or 2.6% of the total assemblage, are red-slipped or red painted.

Of all the sherds with body decorations (additional to red slipping or red paint), 125 are *Anadara* shell edge-impressed (e.g. Figures 6i–k). These shell impressions are of a narrow range of designs, and consist of rows, columns and/or angled lines of impressions. These decorated sherds, when large enough to tell, typically commence with one or two parallel rows of small *Anadara* shell indentations immediately below a single groove below the lip (from hereon 'finger groove below the lip', probably finger-impressed given its width, depth and shape), with columns, sets of columns or single or sets of diagonal lines of similar small shell indentations aligned downwards from the lower row. On two sherds (XU12 sherd #6; XU14 < 3 cm-long sherd #2), rows of V-shaped sets of small *Anadara* shell indentations are present, and on another sherd (XU3 sherd #10) two such rows of V-shapes are separated by a double horizontal line of indentations; these V-shaped designs are reminiscent of earlier ceramics dating to the immediate post-Lapita period shortly after 2500 calBP evident at other sites nearby, such as Edubu 1 (McNiven *et al.* in press), and thus evidence continuing ceramic transformations from Lapita to post-Lapita to the Linear Shell Edge-Imprinted Tradition. Amongst *Anadara* shell impressions in general, where sherds are large enough to include the lower sec-

tions of vessels, it is clear that the decoration ceases prior to reaching the vessel base (e.g. Figure 6j), although decoration in at least a few cases covers much of the uppermost two-thirds of vessels. There is no indication on any sherd that such decoration continues to the base itself. *Anadara* shell-indentated sherds are present in all XUs containing more than 100 sherds, and most XUs that contain fewer. The implication is that the entire Bogi 1 Square A assemblage dates to the period when such ceramics were made, with the possible exception of the two uppermost XUs.

There are only three other sherds with body decoration in the entire Square A assemblage. These are each incised, and include a single slightly curved thin and shallow incision generally parallel to the lip on a small rim sherd from XU5; a small sherd with a single thin and shallow parallel horizontal incisions on a small sherd from XU9. The ragged edges of these thin incised grooves indicate that they were all added during manufacture after the clay had dried.

Sixteen rim sherds contain the characteristic finger groove below the lip. A further four body sherds retain part of the snapped finger groove below the lip. This groove occurs 6.43 ± 1.78 mm below the top of the lip (range: 4.35–9.79 mm) and is 8.01 ± 2.62 mm wide (range: 6.00–14.63 mm). These sherds with the characteristic finger groove below the lip come from most XUs between XU3 to XU12 – therefore, they are all stratigraphically associated with the densest *Anadara* shell-impressed pottery level. Ten of these sherds with finger grooves below the lip themselves contain *Anadara* shell impressions below the groove (from XU6–XU12); one of these (from XU10) is both red-slipped or red painted and *Anadara* shell-impressed; and 10 are plain sherds (from XU3–XU11). Four (20.0%) of these sherds with the finger groove below the lip are broken along the middle of the groove where they are thinnest (i.e. along their weakest point). This stratigraphic distribution indicates that in Square A the finger groove below the lip has a similar antiquity to *Anadara* shell impressions.

Only 14 sherds ≥ 3.0 cm long have the lip present (thereby constituting 'rim sherds'); a further 37 rim sherds are present among the < 3.0 cm long sherds. Therefore, only 51 (1.1%) of all sherds are rims. Only one rim sherd has lip decoration: XU9 < 3 cm-long sherd #19 has a row of very small, narrow vertical indentations along the inner edge of the lip.

Square B ceramics

A total of 13,240 pottery sherds weighing 4539.8 g were excavated from Square B (Table 3). These consist of all the sherds recovered in situ plus those obtained from the ≥ 2.1 mm sieve fraction. Only 188 (1.4%) of these are ≥ 3.0 cm in maximum length. The average weight of all sherds is 0.34 g, and the average by XU is 0.59 ± 0.54 g.

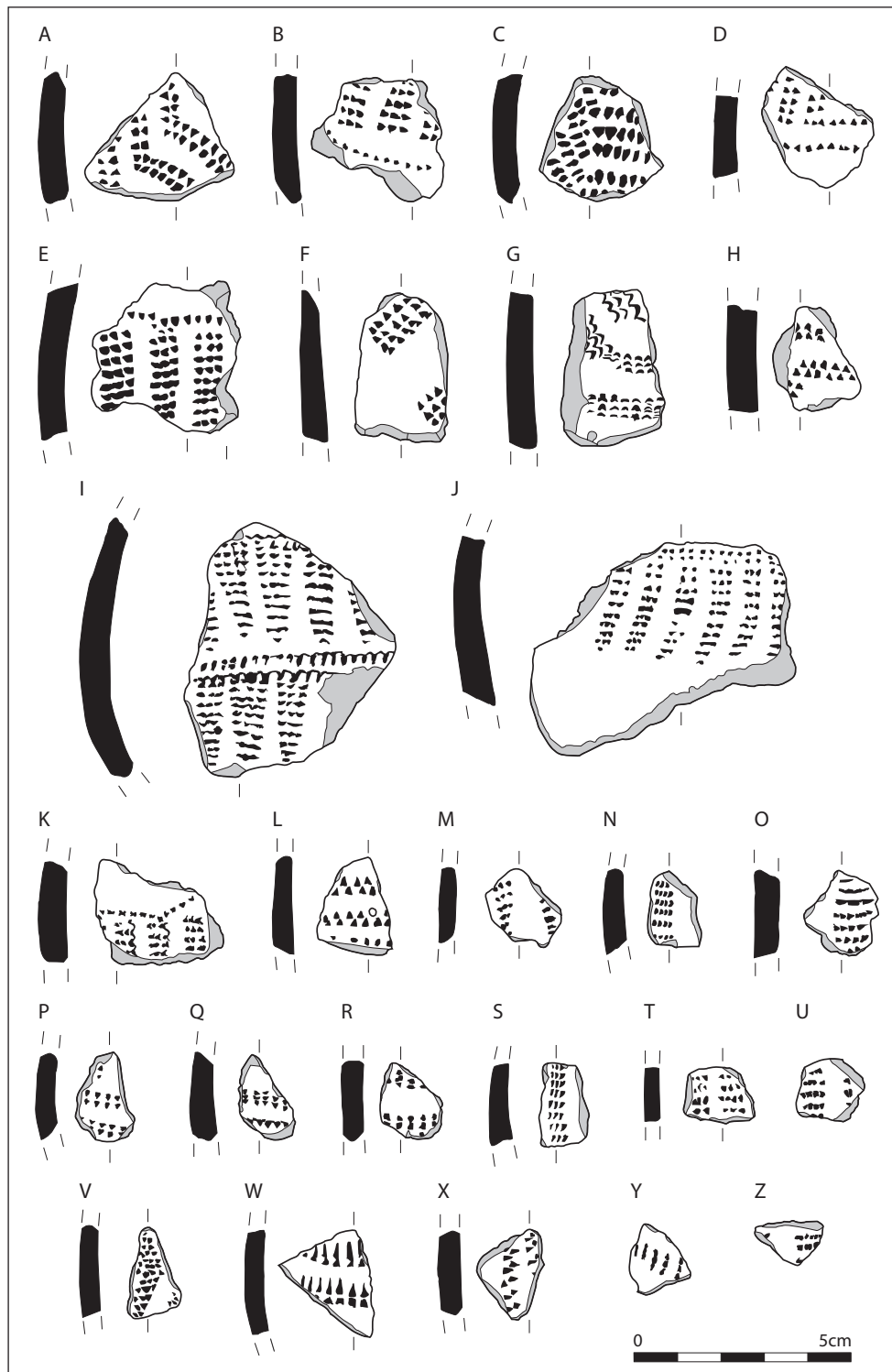


Figure 6: *Anadara* shell edge-impressed body sherds from Bogi 1 Squares A and B. A: Square B XU26a sherd #3; B: Square B XU10 sherd #8; C: Square B XU11 <3 cm sherd #11; D: Square B XU9 <3 cm sherd #13; E: Square B XU16b sherd #5; F: Square B XU14b sherd #16; G: Square B XU11 sherd #9; H: Square B XU9 <3 cm sherd #12; I: Square A XU3 sherd #10; J: Square A XU5 #16; K: Square A XU8 sherd #12; L: Square B XU10 <3 cm sherd #13; M: Square B XU16b <3 cm sherd #12; N: Square B XU28a <3 cm sherd #4; O: Square B XU8 <3 cm sherd #19; P: Square B XU19b <3 cm sherd #1; Q: Square B XU6 <3 cm sherd #6; R: Square B XU8 <3 cm sherd #18; S: Square B XU28a <3 cm sherd #2; T: Square B XU6 <3 cm sherd #5; U: Square B XU8 <3 cm sherd #16; V: Square B XU17b <3cm sherd #4; W: Square B XU10 <3 cm sherd #16; X: Square B XU28a <3 cm sherd #3; Y: Square B XU10 <3 cm sherd #18; Z: Square B XU8 <3 cm sherd #15.

Table 3. Summary data on pottery sherds by XU, Bogi 1 Square B.

XU	Total sherds		Incised and/or 'stick'-impressed body sherds		Indeterminate comb- or shell-impressed (dentate-stamped) sherds		Sherds with finger groove below the lip		Red-slipped/painted sherds		Anadara shell edge-impressed sherds		Rim sherds ≥ 3 cm length		Sherds ≥ 3 cm length		≥ 3 cm sherds with dimple marks in internal surface	
	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g
1	40	12.4							1	0.5					1	5.2		
2	102	15.6							1	1.3	1	1.3	1	1.0				
3	261	88.2			1	1.5			1	0.3	4	2.6			4	14.9		
4	581	108.3							7	10.8	3	1.7	1	1.3	1	6.6		
5	442	153.9							9	8.1	5	3.0	1	1.3	3	22.4		
6	1063	194.0					1	4.3	3	2.9	12	16.5	1	16.9	6	37.0		
7	1395	237.0			1	4.4			10	12.1	3	2.2	4	20.4	7	33.6	2	10.3
8	791	201.6					1	5.4	3	3.1	15	17.9	5	16.7	5	34.2	1	6.9
9	1440	396.3			1	5.2	1	14.2	10	23.6	8	20.8	5	35.5	15	89.7	1	5.9
10	822	300.0					2	14.5	9	14.9	12	30.0	8	38.3	10	59.1		
11	850	238.2					4	7.5	6	15.2	6	19.7	5	9.6	9	37.1		
12	891	428.8					1	3.5	4	9.8	11	14.1	8	34.6	15	85.8	1	6.0
13	645	284.4					4	5.0	6	23.1	6	10.4	10	23.2	14	69.8		
14	521	316.5					4	26.6	7	9.1	14	43.6	13	64.2	23	147.2	2	16.7
15	290	201.6					2	6.2	13	25.3	12	21.6	5	19.9	10	58.9		
16	237	101.4							14	28.7	7	21.1	3	11.7	7	44.6		
17	375	138.4			1	5.0	1	5.9	6	6.4	5	10.0	3	16.3	8	51.6		
18	189	74.4							5	13.7	2	5.6	4	10.7	3	15.8		
19	289	110.6							5	15.3	5	8.6	2	9.0	4	25.9	1	4.4
20	200	83.1					2	9.7	6	2.9	2	9.7	4	19.6	8	34.0		
21	137	90.2							9	7.9			1	28.4	3	39.2		
22	254	55.9							4	6.1	1	1.6			4	15.5	1	2.5
23	104	88.7					1	1.5	5	8.8	2	1.9	3	12.1	6	30.0		
24	207	55.6							1	0.6	3	12.6	1	2.5	2	16.1		
25	51	67.0							3	4.3	2	7.0	2	10.0	4	25.7		
26	105	52.6					1	8.9	1	7.1	3	16.0	1	8.9	3	21.5		
27	80	20.4					1	2.5	1	2.5			1	2.5				
28	60	21.2							1	0.6	3	3.8						
29	53	31.3							4	2.2	2	1.7			3	13.5		
30	44	26.8							2	1.1					1	3.0		
31	29	7.2													1	2.3		
32	22	7.9							1	1.2			1	4.1				
33	17	8.2									1	0.8						
34	28	3.4	2	14.8														
35	31	15.9																
36	41	34.7											1	14.9	1	14.9		
37	38	23.9							1	0.3					2	11.8	1	9.2
38	60	18.6																
39	26	13.3													1	3.7		
40	36	19.1													1	3.0		
41	16	8.8											1	2.0				
42	26	18.3													1	4.0		
43	34	10.5																
44	19	24.4											1	18.0	1	18.0		
45	72	14.4																
46	30	16.3																
47	28	18.2																
48	44	16.0											2	3.0				
49	48	10.9																
50	74	40.6													1	1.8		
Total	13,240	4539.8	2	14.8	4	16.1	26	115.7	159	269.8	150	305.8	98	456.6	188	1097.4	10	61.9

Of the sherds ≥ 3.0 cm long, 18 are red-slipped or red painted, and 45 are rims. Only 28 are large enough to confidently identify aspects of vessel shape. Of these, four sherds are from inverted and 23 are from everted vessels (the orientation angle of one sherd is uncertain). The four inverted sherds come from a slightly carinated bowl with indeterminate comb- or shell-impressed dentate stamped designs below the rim in XU7 (Figure 7b); an undecorated (plainware) rounded bowl from XU20a; and two other slightly inverted to vertical vessels from XU8 (Figure 8k) and XU9 (Figure 8f) that are too small to determine shapes, but for which orifice diameters are 18 cm and 20 cm respectively; these sherds therefore likely come from bowls (both are *Anadara* shell-impressed, with the XU9 sherd also having its internal surface red-slipped). Each of the four inverted sherds has an orientation angle between 340° and 355° . Three of these inverted sherds possess the characteristic finger groove below the lip; the fourth is the indeterminate comb- or shell-impressed sherd with the shallow concave rim reminiscent of a finger groove below the lip (Figure 7b).

The everted sherds consist of a wide range of rim orientation angles spanning 15° – 90° , where 0° refers to a vertical rim and 90° to a horizontal rim parallel to the ground. The more open everted vessels (those with orientation angles between 60° and 90°) include an indirect (i.e. with neck) pot with an orifice diameter of 40 cm from XU9; three sherds from XU12a, two of which are from indirect (with neck) pots, the other being from an indeterminate vessel shape with an orifice diameter of 52 cm; one sherd from an indeterminate vessel shape with an orifice diameter of 42 cm from XU14b; and two sherds from indeterminate vessel shapes, one with a small orifice diameter of 18cm, from XU15b. None of these are decorated, and none possesses the finger groove below the lip. With the exception of the XU15b sherds, the measurable sherds indicate that these are all from large vessels with orifice diameters between 40 cm and 52 cm. Of the remaining everted sherds (that is, those with more closed orientation angles between 0° and 55°), none are indirect (with neck) sherds,

although it is stressed that most sherds are too small to determine vessel form conclusively. Of these remaining everted sherds, two are from *Anadara* shell-impressed bowls each with a finger groove below the lip; one has an orifice diameter of 18 cm from XU10 (Figure 6e) and the other 34 cm from XU14b (Figure 8n). The other 10 everted sherds are from vessels of indeterminate shape with orifice diameters of 9 cm, 21 cm, 22 cm, 27 cm, 28 cm, 30 cm, 35 cm, 40 cm, 42 cm and 42 cm. There is here a wide range of vessel sizes from a small number of sherds, indicating a non-standardisation of ceramic production. None of these latter 10 sherds are decorated except for two sherds that are red-slipped (from XU10 and XU16c), and none has the finger groove below the lip. These sherds come from XU6 to XU44a.

Ten sherds possess dimple marks on their internal surfaces, indicating the use of paddle and anvil during manufacture.

A further 141 sherds, each < 3.0 cm long, are red-slipped or red painted (all probably representing red slipping, with no clear-cut incidence of painting having been identified). This means that a total of 159 sherds, or 1.2% of the total assemblage, are red-slipped or red painted.

Of all the sherds with body decoration (other than red slipping or red paint), 150 are *Anadara* shell edge-impressed (e.g. Figures 6 and 8). These shell impressions are of a similar narrow range of designs as in Square A. There is no indication that such decoration continues to the base itself, but a few sherds show that the decoration stops prior to reaching the base. It is shortly below the widest point of the vessel that linear shell edge-impressions suddenly change direction, meeting another set of similar decorations at close to right or slightly greater angle (Figure 8f is a good example). Such decorations commence in XU33 and continue in most XUs to XU2.

In addition to the shell-impressed sherds, four other sherds have dentate stamping made from indeterminate comb or shell impressions: XU3 < 3 cm long sherd #2 (a body sherd with two rows above a set of parallel angled lines of dentate impressions); XU7 sherd #7 (a rim sherd:

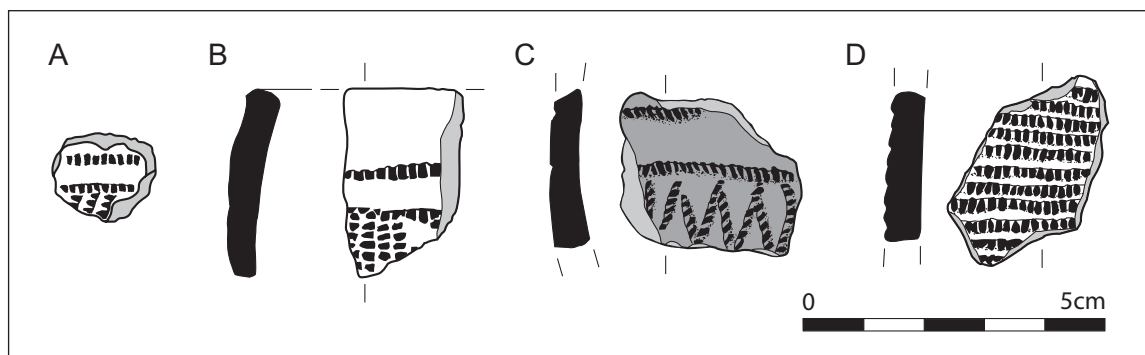


Figure 7: Indeterminate comb- or shell-impressed (dentate) sherds from Bogi 1 Square B. A: XU3 < 3 cm sherd #2; B: XU7 #7; C: XU9 #13; D: XU17b #6.

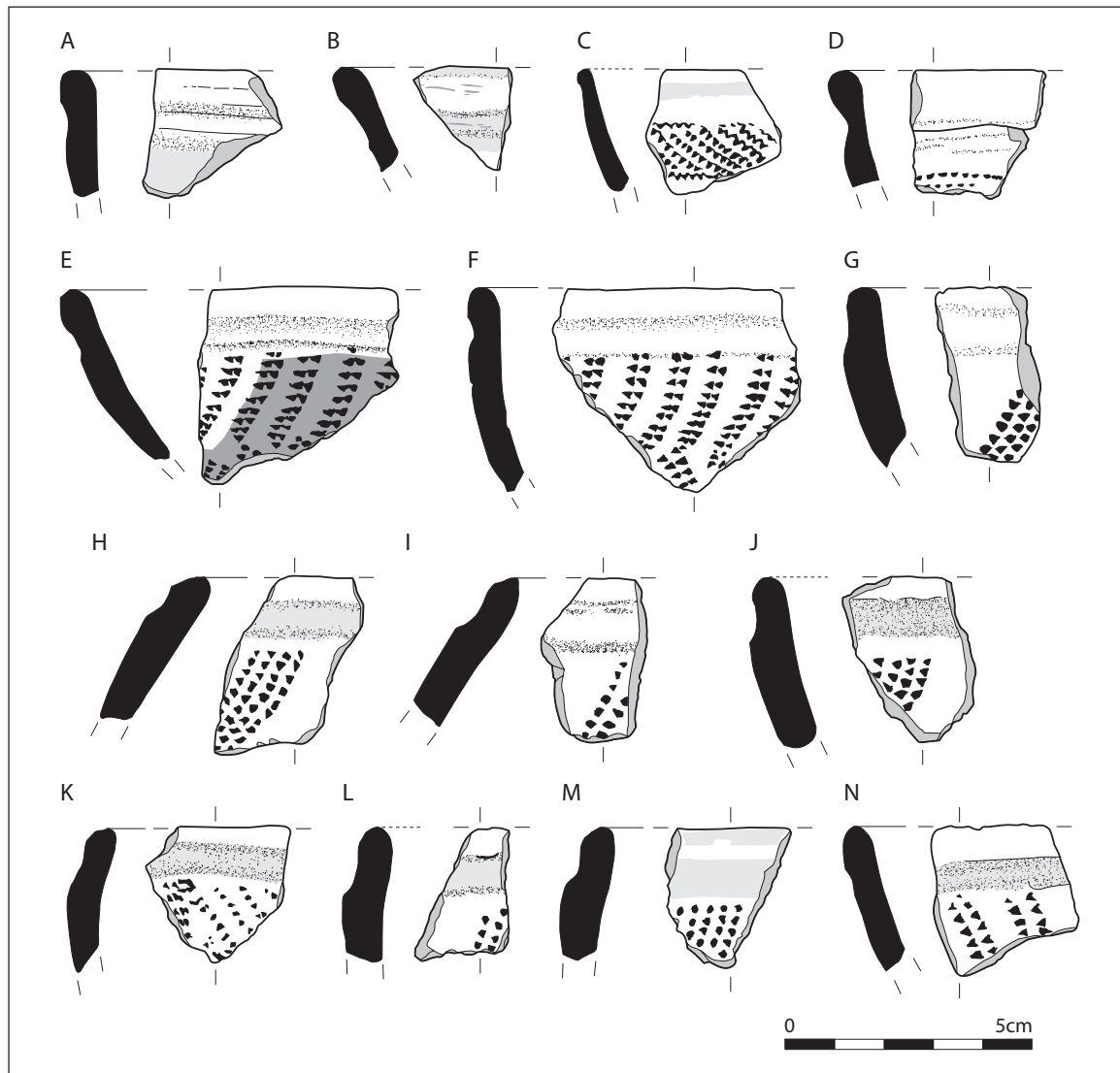


Figure 8: Plain and *Anadara* shell edge-impressed rim sherds with the finger groove below the lip from Bogi 1 Square B. Dashed line = probable but uncertain orientation angle. A: XU14a sherd #4; B: XU13a <3 cm sherd #12; C: XU12a <3 cm sherd #12; D: XU15a <3 cm sherds #11 (top) + #12 (bottom); E: XU10 sherd #7; F: XU9 #15; G: XU14b sherd #19; H: XU26a sherd #2; I: XU17d sherd #2; J: XU14b sherd #18; K: XU8 sherd #5; L: XU20a sherd #8; M: XU20a sherd #7; N: XU14b sherd #17.

2 rows of indeterminate comb or shell impressions immediately below a shallow concave rim that is reminiscent of a finger groove below the lip, with sets of columns of indeterminate comb or shell impressions progressing down from the lower row); XU9 sherd #13 (a body sherd: 2 rows of indeterminate comb or shell impressions with a row of indeterminate comb- or shell-impressed zig-zagging V-shapes immediately below the lower row); and XU17b sherd #6 (body sherd: adjacent rows or columns of indeterminate comb or shell impressions covering the entire sherd) (Figure 7). All of these dentate-stamped sherds except for the one from XU3 are ≥ 3.0 cm long.

There are only two other sherds with body decoration in the entire assemblage. Both are from XU34a, and consist

of 1) a very small sherd with a thin incised line (the sherd is too small to determine the design that this line represents); and 2) a sherd with what appears to be a thickened shoulder, possibly a carinated vessel, with a row of short vertical and broad stick(?) impressions along the shoulder. It is significant that both of these sherds come from below the lowermost level (XU33) containing shell-impressed sherds. The indication is that prior to XU33, and around 2116–2314 calBP (95% probability) as determined by a radiocarbon determination from XU39 in Square B, an earlier ceramic tradition existed at Bogi 1 Square B. Subsequent excavations in Squares C and D have revealed that this is indeed the case, with the discovery of Lapita ceramics in the lowermost ceramic levels (David *et al.* 2011; McNiven

et al. 2011). These will be reported in detail elsewhere, but are mentioned here to show that in Square B the earliest Linear Shell Edge-Imprinted sherds are preceded by something else, and therefore the commencement of the Linear Shell Edge-Imprinted Tradition can be dated.

Twenty-six rim sherds contain the characteristic finger groove below the lip (e.g. Figure 8). This groove occurs 7.2 ± 1.9 mm below the top of the lip (range: 2.6–10.5 mm) and is 7.7 ± 1.5 mm wide (range: 4.5–10.1 mm). They come from XU6 to XU27a – therefore, they are all stratigraphically associated with the *Anadara* shell-impressed pottery level. Eleven of these themselves contain *Anadara* shell impressions below the groove (from XU8–XU23a); five are red-slipped or red painted (from XU9–XU27a); two have the finger groove below the lip lime-infilled (both are from XU20a); and 12 are plain sherds (from XU6–XU15a). Ten (40%) of these sherds with the finger groove below the lip are broken along the middle of the groove where they are thinnest (i.e. along their weakest point). This indicates that, as was also the case in Square A, the finger groove below the lip is contemporaneous with *Anadara* shell impressions.

Only 45 sherds ≥ 3.0 cm have the lip present (thereby constituting ‘rim sherds’); a further 53 rim sherds are present among the < 3.0 cm sherds. Therefore, only 98 (0.7%) of all sherds are rims. In total five rim sherds have lip decorations: XU25a sherd #1 is impressed with an unknown, thin-edged tool (stick?) to create a thin, shallow groove across the lip; XU32a sherd #1 is impressed with an unknown tool (stick?) to create grooves emanating from the outer edge continuing across most of the width of the lip; XU36a sherd #1 is impressed with an unknown, thin-edged tool (stick?) to create a thin, shallow row of slashes along the outer edge of the lip; XU44a sherd #1 is impressed with an unknown tool (stick?) to create grooves emanating from the outer edge continuing across most of the width of the lip; XU48a sherd #1 is impressed with an unknown tool (stick?) to create alternating vertical grooves along the inner and outer edge of the lip. It is significant that these lip-decorated sherds occur almost exclusively in levels below the shell-impressed sherds, signalling a pottery decorative tradition preceding the establishment of the shell-impressed tradition.

The earliest evidence of pottery at Bogi 1 Square B comes from the base of the excavation in XU50a, dated to some time shortly before 2153–2276 calBP (radiocarbon determination from 117cm depth in XU45a, 13.5 cm above the base of XU50a, at highest 95% probability). Excavation Unit 1, the most recent pottery-bearing level in this square, dates to 1984–2220 calBP (as evidenced by a radiocarbon date from 1.0–2.6 cm depth in XU2 immediately below XU1, at highest 95% probability). Peak ceramic vessel use and deposition in Square B took place from XU4 to XU15 (Figure 9), corresponding precisely with SU3 and SU4. Within that level, the highest concentrations of sherds are found in XU6 to XU9, representing the lowermost four XUs (and

lowermost 10.4 cm) of SU3, and thereby indicating that this level represents an old surface upon which peak pottery deposition took place sometime between 1984–2220 calBP (from XU2 above) and 2003–2158 calBP (from XU17b below) (highest 95% probabilities).

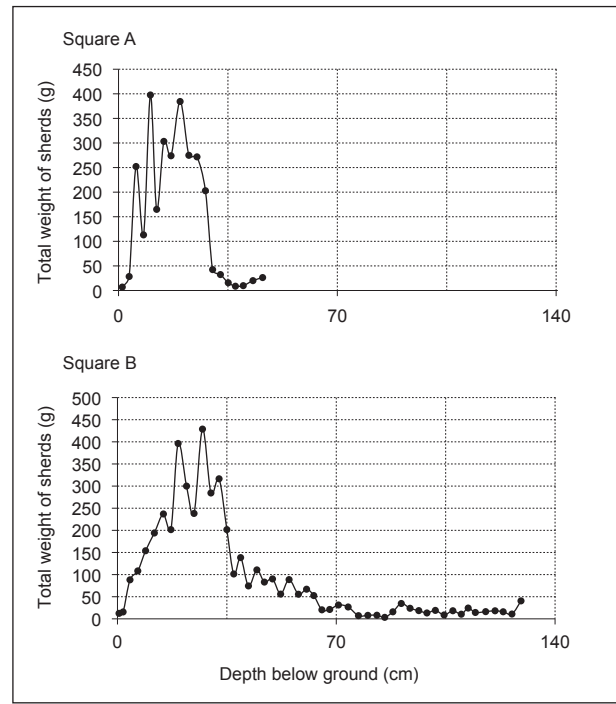


Figure 9. Distribution of pottery sherds by XU, Bogi 1 Squares A and B.

DISCUSSION

Ceramic sherds occur relatively sparsely throughout much of the Squares A and B deposit when contrasted with a very dense midden layer spanning XU3–12 (4–29 cm below ground) in Square A and XU4–15 (5–36 cm) in Square B. We refer to this dense cultural deposit as the Upper Horizon. This Upper Horizon is well demarcated stratigraphically, and indicates a 25 cm to 31 cm-thick cultural unit; 93.3% (by weight) of ceramic sherds from Square A, and 67.4% from Square B come from this Upper Horizon (remembering that excavation of Square B progressed deeper than Square A).

Both the depth of the SU4–SU5 stratigraphic interface, and the incidence of sherds below SU4 relative to those above, indicate some 20 cm of post-depositional downward movement and mixing (from c. 34 to c. 53 cm depth) from an occupied surface at the base of SU4. This is consistent with the evidence from neighbouring excavated squares. The radiocarbon determinations from all the excavated squares indicate rapid deposition of SU3 and SU4 in particular (the culturally dense Upper Horizon sediments), preceded by a period of c. 300 years for the build-up of SU5.

The Bogi 1 Squares A and B ceramics have been presented separately to show that a consistent vertical distribution of Linear Shell Edge-Imprinted ceramics occurs in both squares (we note that the other excavated squares from the adjacent pit at Bogi 1 duplicate the results from Squares A and B, and will be presented in the Bogi 1 monograph). The range of decorative conventions within this tradition is extremely narrow, consisting of straight or slightly curved linear arrangements of small *Anadara* shell edge indentations, with the individual indentations ranging from 0.50 mm to 2.29 mm in width (suggesting that *Anadara* shell valves of all sizes were used). The individual indentations are usually triangular in shape (e.g. Figure 8f), although sometimes they are connected by the curvilinear impression of the shell valve's contours between the individual indentations representing the shell's dorsal ridges (Figure 6g and the centre-rows on Figure 6i), indicating not so much that greater pressure was applied while pressing the shell into the clay, as a change in angle of application. The linear arrangements occur singly, in pairs, or in juxtaposed parallel sets. The decoration is invariably shell edge-impressed: no combinations of shell impressions and other decorative techniques have been encountered (apart from the finger groove below the lip, which always occurs singly, with or without the shell impressions that always occur exclusively below the groove when present). The decoration is so far limited to the following designs on individual sherds (these all relate to straight or slightly curved lines of small indentations, in parallel groups when in sets):

1. Rows, columns or angled lines, singly or in sets, often paired (e.g. Figures 8h, n);
2. One to three rows meeting single, paired or multiple columns or angled lines beneath (e.g. Figure 6e);
3. Angled lines meeting angled lines at an obtuse angle beneath (Figures 5a and 8f);
4. Repeated set(s) of rows, columns or angled lines, sometimes beneath one or two rows (e.g. Figure 6f);
5. One or two rows of down-pointing triangles, sometimes separated by a double row of indentations (Figure 6i);
6. Intersecting/meeting lines.

Putting the data from both squares together, out of a total of 17,787 sherds from this chrono-stratigraphically contiguous shell-impressed horizon (16,850 or 94.7% being less than 3cm long, the vast majority of which are tiny sherds a few millimetres long), 287 sherds (1.6%) contain *Anadara* shell edge-impressions; 48 sherds (most with the lip present, but some missing the lip itself) possess the finger groove below the lip (24 of which also have *Anadara* shell edge-impressions, and 24 of which are undecorated). In addition, there are four indeterminate comb or shell dentate-stamped sherds and two small sherds each with a thin and shallow linear incision within the same level as the shell-impressed sherds; and one sherd with a linear incision and one with a row of short stick(?) impressions

along the carination, found stratigraphically below the shell-impressed and finger groove horizon. Two hundred and fifty-six (1.4%) of the sherds from the *Anadara* shell edge-impressed horizon are red slipped. Below XU33 in Square B *Anadara* shell-impressed sherds are entirely absent, as are sherds with finger grooves below the lip. Although cultural materials are far less dense in those deeper levels, they contain a total of 651 sherds, only one (0.2%) of which is red-slipped and two (0.3%) of which possess other forms of decoration. The evidence from Squares A and B indicates that within the shell-impressed ceramic horizon, one in every 60 sherds possesses *Anadara* shell edge-impressions, one in every 357 sherds possesses a finger groove below the lip, and one in every 60 sherds is red-slipped. This means that in the underlying levels in Square B, statistically we would expect about 10 sherds to have *Anadara* shell impressions, one sherd with a finger groove below the lip, and ten red-slipped sherds if such existed at that time. The complete absence of *Anadara* shell edge-impressed sherds from this lowermost excavated level, coupled with the presence of other kinds of decorated sherds that do not occur further up, is meaningful and indicates a temporal succession in decorative conventions.

While we will address in detail this issue of succession of decorative conventions in later papers when the other Bogi 1 squares and nearby sites are analysed, we establish here that a well-defined cultural horizon at Bogi 1 contains a ceramic decorative tradition of limited design variability almost exclusively focused on *Anadara* shell edge-impressions below finger-grooved lips. It is this tradition, decoratively and chrono-stratigraphically constrained, that we term the Linear Shell Edge-Imprinted Tradition after its overwhelmingly dominant decorative convention. We were tempted to adopt Bulmer's (1999) most recent terminology, the Early Laloki style, but decided against this because even though it is clear that she sees shell-impressed sherds to have developed locally from earlier traditions likely to include Lapita, her Early Laloki style continues to incorporate ceramics from a number of different styles and periods of time, despite her own attempts at disaggregation (constrained by poor chrono-stratigraphic evidence and no data preceding 2000 calBP). Thus, Bulmer (1999:555) notes that:

The Early Laloki pottery from Port Moresby has the following techniques of decoration; slipping, burnishing, incising, shell edge impressing (both straight and curved), impression of the backs of shells, impressing of the end of straight and curved multiple-toothed tools, i.e. 'dentate stamping', end impressing of single- and double-pointed tools, painting, grooving, and lime infilling.

The Linear Shell Edge-Imprinted Tradition, on the other hand, is almost entirely restricted to red slipping, shell edge impressing (both straight and slightly curved),

a single finger groove below the lip and rare lime infilling; there are no unambiguously burnished wares. Furthermore, the shell edge-impressed decorations reported by us in this paper represent a highly homogeneous ceramic convention that is tightly constrained chrono-stratigraphically at Bogi 1, and indeed at other sites in Caution Bay also (the latter to be reported elsewhere). They are not simply the early expression of a discrete style that continues for hundreds of years more, but rather belong to a distinctive and previously undescribed chronological phase in a long ceramic sequence that begins with Lapita and ends with the ethnographic period. For this reason we cannot simply combine the linear shell edge-impressed ceramics reported here within Bulmer's Early Laloki style which contains other forms of decoration belonging to a different period of time.

We stress that the differentiation of chrono-stratigraphically constrained ceramic traditions within individual sites and regions, as we have done here, enables us to critique and disentangle previously proposed, broader concepts such as the Early Laloki style and the EPP. It also enables us and other researchers to systematically investigate connections and discontinuities with earlier and later conventions and traditions.

The two questions we now ask are:

1. How old is the Linear Shell Edge-Imprinted Tradition? and
2. How does it fit with broader stylistic trends previously proposed for Port Moresby and the broader south coast region?

The age of the Linear Shell Edge-Imprinted Tradition

The evidence from Bogi 1, presented in some detail in this paper, strongly indicates that Linear Shell Edge-Imprinted Tradition ceramics date from *c.* 2140 ± 30 BP (charcoal date) to at least 2384 ± 30 BP (shell date). With the lowermost sherds of this tradition coming from XU33 of Square B (down to 84 cm depth), and with radiocarbon determinations of 2134 ± 30 BP from XU17b (41 cm depth) and 2140 ± 30 BP from XU25a (62 cm depth) above, and 2130 ± 30 BP from XU37a (92–95 cm) below, the age of XU33 seems secure. We note that there is no evidence for Linear Shell Edge-Imprinted Tradition ceramics in XU39 of Square B; a radiocarbon determination of 2180 ± 30 BP (= 2116–2314 calBP at highest probability of 2 sigma, or *c.* 2250 cal BP median age) from 100 cm depth in this XU indicates that Linear Shell Edge-Imprinted decoration does not yet occur at this time. However, a slightly out-of-sequence radiocarbon date of 2215 ± 30 BP from XU12 (31 cm) above could suggest a slightly older age than 2150 calBP for its commencement. Nevertheless given the three other, internally consistent radiocarbon determinations, we interpret the XU12 date as possessing an inbuilt old wood factor (see Rowe 2001:144), a potential problem with radiocarbon dating of wood charcoal generally. This, we suggest, is the

most apt interpretation in light of the otherwise consistent depth-age chronology supported also by radiocarbon determinations from Squares C and D at Bogi 1 (see McNiven *et al.* 2011 for details).

With the uppermost Linear Shell Edge-Imprinted sherds at Bogi 1 Squares A and B coming from XU2 (1–3 cm depth) in Square B, their most recent appearance at the site can be said to date to 2384 ± 30 BP (shell date also from XU2, at 1–3 cm depth). As we do not know from Bogi 1 when this tradition ends, as its most recent expression is not superseded by anything else, we cannot say when the tradition itself here ends, beyond determining that it is sometime after the 2384 ± 30 BP shell date (corresponding with a 2100 calBP median age).

This means that the Linear Shell Edge-Imprinted Tradition dates from 2036–2161 calBP (highest 95% probability calibration for the 2140 ± 30 BP charcoal date), or around 2150 calBP, to an indeterminate time after 1984–2220 calBP (highest 95% probability calibration for the 2384 ± 30 BP shell date), or after *c.* 2100 calBP (see Table 1).

We can thus conclude that sometime between approximately 2150 and 2100 calBP, peak rates of pottery deposition took place in Square B. The people who deposited these pottery sherds utilised, and possibly made, sherds impressed with the distal edge of *Anadara* shell valves that included the characteristic finger groove below the lip (the question of where the ceramics were manufactured is the subject of current investigations). A small number of indeterminate comb- or shell-impressed ceramics are also evident during this time. In earlier levels, a different type of pottery occurs at Bogi 1, a style that is only hinted at by a handful of sherds in Square B but which is consistent with numerous Lapita and immediately post-Lapita ceramics subsequently found in neighbouring excavation squares at those equivalent and lower levels (David *et al.* 2011; McNiven *et al.* 2011).

We have now excavated a number of other sites at Caution Bay with excellent representation of the Linear Shell Edge-Imprinted Tradition; analysis, including AMS dating of numerous additional charcoal and shell samples, is in progress and will be reported in due course.

We conclude that the Linear Shell Edge-Imprinted Tradition dates from *c.* 2150 to *c.* 2100 calBP at Bogi 1.

The place of the Linear Shell Edge-Imprinted Tradition in the regional ceramic sequence

As a defined ceramic tradition, the Linear Shell Edge-Imprinted Tradition is older than anything previously documented for the south coast of Papua, with the exception of the recently reported Lapita wares from this same area (David *et al.* 2011; McNiven *et al.* 2011). We note in this context that Negishi and Ono (2009) have reported ceramics dating back to *c.* 2700 calBP from Kasasinabwana Midden on Wari Island in the Massim to the east, with the few sherds from the earliest levels consisting of 'non-

slipped pottery' that is 'basically plain ware with simple decorations except for grooving on the shoulders ... and notched lips' attributed to late Lapita times (Negishi and Ono 2009:34). Although a small 'shell-stamped' sherd is reported from Kasasinabwana, there are no indications from the Negishi and Ono (2009) report that this site contains ceramics of the Linear Shell Edge-Imprinted Tradition. This may indicate either that the period of its production is not represented there, or that this ceramic tradition did not extend that far east, or both. The presence of a radiocarbon determination of 2463 ± 38 BP (Wk-25603) on shell from Layer 4 (95% calibration range = 1994–2262 calBP (Negishi and Ono 2009:30) suggests that ceramics from the same period as the Bogi 1 dense ceramic horizon probably exist at the site, indicating that the Linear Shell Edge-Imprinted Tradition probably did not exist in the Massim given the absence of such ceramics at Kasasinabwana (although accurate local δR values need to be determined for the Kasasinabwana shell radiocarbon dates to ensure contemporaneity of ceramic ages). Only more archaeological research will be able to shed further light on this issue.

Yet it is apparent that rare sherds identical to the ones reported here from Bogi 1 had earlier been reported by Bulmer from surface collections around Port Moresby (some sherds from Style I at site ACI, a.k.a. Nebira 1; see Bulmer 1978:plate 1 top right-hand image; see also Bulmer 1969:figure 4 bottom right-hand image); and by Allen (1972:figure 7 item 18) from Nebira 4 Horizon 3-Style H. These sherds remain undated in the case of Bulmer's Nebira 1, but come from levels pre-dating 1760 ± 90 BP (= 1511–1887 calBP, or around 1700 calBP at highest 95% probability) at Nebira 4. We thus suggest that the Nebira site complex contains cultural levels significantly older than those revealed in the late 1960s–early 1970s by the few radiocarbon dates obtained from Nebira 2 and Nebira 4.

Vanderwal's (1973:figure VI-6) pottery Type A from Oposisi and Irwin's Early Period pottery are to some degree reminiscent of Linear Shell Edge-Imprinted sherds, but the internally consistent decorative conventions of Oposisi Type A and Amazon Bay-Mailu Early Period pottery – consisting of typically umbo-bordered, dorsal shell valve impressions – are different enough to be excluded from the Linear Shell Edge-Imprinted Tradition. We note that Allen (1972:figure 7 bottom three images) reported both of these types of ceramic decoration in an aggregated Horizon 3 / Style H from the deepest cultural levels of Nebira 4. The implication is that these two ceramic styles are near-contemporaneous; we here suggest that our Linear Shell Edge-Imprinted Tradition transformed into a tradition of umbo-bordered, dorsal shell valve impressions such as found in the Oposisi pottery Type A and the similar sherds of Style H at Nebira 4 sometime between 2100 and 2000 calBP. We argue for their sequential development because of their decorative similarities coupled with the consistently older radiocarbon ages from Bogi 1 (dating

the Linear Shell Edge-Imprinted Tradition). The similarity of the Linear Shell Edge-Imprinted sherds from Bogi 1 and decorated ceramics from the earliest phase of Oposisi suggests that the former transformed into the latter sometime between the end of the Bogi 1 sequence and the beginning of the Oposisi sequence. The few sherds of the Linear Shell Edge-Imprinted Tradition from Nebira 1 and Nebira 4 should thus also be disaggregated from their original coarse-grained ceramic styles or horizons, and attributed a style and antiquity of their own: the Linear Shell Edge-Imprinted Tradition. The very few such sherds present in these sites suggest that those sites themselves contain the tail end of this ceramic tradition, slightly preceding the earliest (non-basal) radiocarbon determinations originally obtained by Allen at Nebira 4 and by Vanderwal at Oposisi. This is confirmed for Oposisi by the recent re-excavation and redating of the lowermost cultural deposits of the site to 2041 ± 30 BP (Wk-21615) on charcoal (= 1924–2068 calBP at highest 95% probability calibration, or 2000 calBP median age) (Allen *et al.* 2011:table 3) – a radiocarbon determination perfectly congruent with the results presented here for Bogi 1, and indicating that at Oposisi the tail end of the Linear Shell Edge-Imprinted Tradition may be present in the very deepest levels. We await publication of the ceramics of the newly-excavated cultural sequence from Oposisi, which should shed further light on the terminal age of the Linear Shell Edge-Imprinted Tradition and its subsequent transformations. However, the implication of this redating of the commencement of the cultural sequence at Oposisi, together with a near-contemporaneous terminal age for Bogi 1, is that the Linear Shell Edge-Imprinted Tradition indeed ends around 2100 calBP and quickly transformed into a tradition of umbo-bordered, dorsal shell valve impressions within a few decades of that age.

Acknowledgements

Thanks to Renagi Koiari and Tedi Tolana of Papa, Kevau Fearaka of Boera, and Jeremy Ash and Duncan Wright of Monash University for fieldwork. BD thanks the ARC for Discovery grant and QEII Fellowship DP0877782. Thanks to Toby Wood and Kara Rasmanis for drafting Figures 2–5, and Cathy Carigiet for drawing the ceramics of Figures 1 and 6–8. Thanks to Timothy Thomas, Atholl Anderson and two anonymous referees for useful comments.

References

- Allen, J. 1972. Nebira 4: an early Austronesian site in central Papua. *Archaeology and Physical Anthropology in Oceania* 7: 92–124.
- Allen, J., G. Summerhayes, H. Mandui & M. Leavesley. 2011. New data from Oposisi: Implications for the Early Papuan Pottery phase. *Journal of Pacific Archaeology* 2: 69–81.
- Bulmer, S.E. 1969. Archaeological field survey and excavations in central Papua, 1968. Unpublished manuscript, Department of Anthropology and Sociology, University of Papua New

- Guinea, Port Moresby.
- Bulmer, S.E. 1978. Prehistoric culture change in the Port Moresby region. Unpublished PhD thesis, University of Papua New Guinea, Port Moresby.
- Bulmer, S.E. 1999. Revisiting red slip: the Laloki style pottery of Southern Papua and its possible relationship to Lapita. In J.-C. Galipaud and I. Lilley (eds), *The Western Pacific from 5000 to 2000 BP: Colonisation and Transformations*, pp. 543–77. IRD Editions, Paris.
- David, B., I.J. McNiven, T. Richards, S.P. Connaughton, M. Leavesley, B. Barker & C. Rowe. 2011. Lapita sites in the Central Province of mainland Papua New Guinea. *World Archaeology* 43: 580–597.
- Frankel, D. and V. Kewibu 2000. Early Ceramic Period pottery from Marua (Site ODR), Gulf Province, Papua New Guinea. In A. Anderson & T. Murray (eds), *Australian Archaeologist: Collected Papers in Honour of Jim Allen*, pp. 279–91. Coombs Academic Publishing, The Australian National University, Canberra.
- Frankel, D. & J.W. Rhoads (eds). 1994. *Archaeology of a Coastal Exchange System: Sites and Ceramics of the Papuan Gulf*. Research School of Pacific and Asian Studies, The Australian National University, Canberra.
- Irwin, G. 1985. The Emergence of Mailu. *Terra Australis* 10. Research School of Pacific Studies. The Australian National University, Canberra.
- McNiven, I.J., B. David, T. Richards, K. Aplin, B. Asmussen, J. Mialanes, M. Leavesley, P. Faulkner & S. Ulm. 2011. New direction in human colonisation of the Pacific: Lapita settlement of south coast New Guinea. *Australian Archaeology* 72: 1–6.
- McNiven, I.J., B. David, K. Aplin, J. Mialanes, B. Asmussen, S. Ulm, P. Faulkner, C. Rowe & T. Richards (in press). Terrestrial engagements by terminal Lapita maritime specialists on the southern Papuan coast. In S.G. Haberle and B. David (eds), *Peopled Landscapes: Archaeological and Biogeographic Approaches to Landscapes*. *Terra Australis* 34. ANU E-Press, Canberra.
- Negishi, Y. & R. Ono. 2009. Kasasinabwana shell midden: the prehistoric ceramic sequence of Wari Island in the Massim, eastern Papua New Guinea. *People and Culture in Oceania* 25: 23–52.
- Petchey, F., S. Ulm, B. David, I.J. McNiven, B. Asmussen, H. Tomkins, N. Dolby, K. Aplin, T. Richards, C. Rowe & M. Leavesley (in prep.). High-resolution radiocarbon dating of marine materials in archaeological contexts: Radiocarbon marine reservoir variability between *Anadara granosa*, *Anadara antiquata*, *Strombus luhuanus*, *Gafrarium tumidum* and *Echinoidea* at Caution Bay, southern coastal Papua New Guinea.
- Rowe, M. 2001. Dating by AMS radiocarbon analysis. In D.S. Whitley (ed.), *Handbook of Rock Art Research*, pp. 139–66. AltaMira Press, Walnut Creek.
- Swadling, P. 1980. Decorative features and sources of selected potsherds from archaeological sites in the Gulf and Central Provinces. *Oral History* 8(8): 101–25.
- Vanderwal, R.L. 1973. Prehistoric studies in central coastal Papua. Unpublished PhD thesis, Australian National University, Canberra.