

# *Do Hiccups Echo? Late Holocene Interaction and Ceramic Production in Southern Papua New Guinea*



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## INTRODUCTION

ARCHAEOLOGISTS HAVE BEEN CONDUCTING RESEARCH along the south Papuan coast of New Guinea for over 50 years. Although over the past few years there have been major advances in our understanding of colonization of the Papuan coast, there is still much to be discovered about culture change and interaction in this area. For example, it was long assumed that Lapita did not settle the south coast. However, recent discoveries of Lapita pottery at Caution Bay just west of Port Moresby demonstrate Lapita occupation dating to 2900 years cal B.P. (McNiven et al. 2011). These discoveries demand rethinking and new interpretations of the archaeological record from the south coast region. To that end, we examine the “Ceramic Hiccup,” dated between 1200 and 800 B.P., which marks a break in the understanding of the region’s prehistory.

## THE HICCUP

Following Lapita occupation, there emerged a stratigraphically and decoratively related ceramic tradition known as Early Papuan Pottery (EPP). Dating to between c. 2000 and 1200 B.P., EPP has been found across the south coast of Papua New Guinea and into the southern Massim (Allen 2010; Irwin 1991; Summerhayes and Allen 2007; Yo and Ono 2009) (Fig. 1). Recognizable EPP came to an end c. 1200–800 B.P. The period following EPP has been described as the “pottery transformation” (Bickler 1997), “ceramic seriation break” (Rhoads 1982), or “Ceramic Hiccup” (Allen 2010; Irwin 1991; Summerhayes and Allen 2007). The Ceramic Hiccup represents a general disruption of settlement patterns, socioeconomic systems, and ceramic traditions. Between 1200 and 800 B.P., the recognizable design characteristics of EPP were supplanted by a variety of emergent local styles and, in some areas, an aceramic interlude (Allen 2010; Frankel and Rhoads 1994).

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Fig. 1. Map of Papua New Guinea with location of EPP sites mentioned in the text.

Causative explanations for the Ceramic Hiccup vary, but leading theories point to population movement or environmental change. Bulmer (1971) initially believed the Hiccup to be representative of a population movement from the east, naming the Post-EPP pottery styles observed in the Port Moresby region “Massim” after the Massim archipelago off the eastern tip of Papua in Milne Bay Province. She later retracted this view in favor of a more localized terminology, adopting the moniker “Eriama style,” yet continued to maintain that these were intrusive styles (Bulmer 1978). Swadling (1981; Swadling and Kaiku 1980) noted that styles of pottery excavated from Ava Garau were quite different from other late EPP contexts in the Port Moresby region and argued that this represented an introduction of ideas, and possibly people, from Milne Bay.

Environmental factors may also have influenced ceramic change. El Niño Southern Oscillation (ENSO) variability during the initial colonization phases of EPP as well as during the Ceramic Hiccup could have played a role in disrupting regional interaction systems (Allen 2010; Sutton et al. 2015). The changes to prevalent wind, rain, and ocean current patterns due to ENSO variability can be associated with extreme drought. Such changes have a particularly severe impact on already drought-prone areas such as the Port Moresby region (Bulmer 1979; Oram 1977). Environmental changes within the region could have resulted in shifts in river flow and increased drought, putting strain on agricultural production and limiting access to the resources utilized in ceramic manufacture. Furthermore, migration into the region could have

resulted from environmental pressures elsewhere and might have sparked increased conflict. Any of these factors in isolation or conjunction could lead to disruptions in settlement, exchange networks, and ceramic production. Such interpretations are not necessarily contradictory, and indeed the Ceramic Hiccup might best be explained by a combination of many factors.

The Ceramic Hiccup is perhaps more noticeable farther west, in the Gulf Province. EPP continued in the Gulf of Papua until c. 1200 B.P. at Kulupurari, after which pottery was absent for the next 700 years (Allen 2010:10; Rhoads 1980:138–139). Pottery returned at a number of sites c. 500 B.P. (Frankel and Rhoads 1994). Based on the immediate absence of West Fergusson Island obsidian west of Port Moresby in the early stages of the Ceramic Hiccup, Allen (2010; Allen et al. 2011:75; Summerhayes and Allen 2007) argues that this gap in the ceramic sequence between c. 1200 and 500 B.P. represents trade disruptions. Physico-chemical studies demonstrate that Gulf EPP pottery was not locally produced but originated from Yule Island and the Port Moresby region during the early phases of EPP, and Port Moresby during the later phase (Allen 2010:10; Allen and Rye 1982; Bickler 1997; Rye 1976; Rye and Duerden 1982; Thompson 1982; Worthing 1980).

The Port Moresby region plays a central role in understanding interaction before and during the Ceramic Hiccup. Allen (2010) gives three reasons why this region is important. The first reason is that its pottery styles present some interesting similarities to that of Mailu. Irwin (1985) definitively showed that the occupants of Mailu Island, off the coast of Amazon Bay, dominated regional exchange networks by monopolizing ceramic production, controlling coastal access, and, probably, through warfare. A “vast village complex” observed in the Boera area bears distinctly Post-EPP ceramics of the Massim style (Allen 2010:10; Swadling 1981:245). Boera, located in Caution Bay to the west of Port Moresby, is believed to have been the main population center from c. 1200 through 800 B.P. Afterward, a major population shift is seen into the eastern Bootless Bay area near Port Moresby (Allen 2010; Swadling 1981). This shift in settlement patterns and pottery styles occurred almost contemporaneously with a similar shift in pottery styles at Mailu from Irwin’s (1985) early period (EPP) to the middle (Mayri) and late period (Mailu) (Allen 2010). This population movement corresponds with changes in the use of clay sources in the Port Moresby region across the pottery sequence breaks (Allen 2010:9; Swadling 1980, 1981).

Another reason for Port Moresby’s centrality is the rise of specialization in pottery production in the region. It has been documented that, at the time of European contact, only the Western Motu of the Port Moresby region were producing pottery west of Mailu (Allen 2010:11; Chalmers 1887). The specialized production of pots for exchange allowed the Western Motu to occupy a niche market and gain control over long-distance trade with the Gulf (Allen 2010:11–12). A final reason the Port Moresby region is central to understanding the terminal EPP and Post-EPP ceramic traditions along the south coast stems from the sensitive ecology of the area and the impact this would have had on exchange systems. The Port Moresby region is prone to severe drought and has poor soil for cultivation, which put the Western Motu at risk for environmental disturbances in local subsistence strategies (Allen 1972, 2010:11–12; Bulmer 1978; Oram 1977). Considering the control Western Motu had over exchange into the Gulf, climatic impacts on these local strategies could have led to exponential disruption westward (Allen 2010).

## MODELING SETTLEMENT

In this study of the Ceramic Hiccup, we assess pottery production and consumption at two EPP sites in the Port Moresby region at the turn of the last millennium B.P. to see what they can inform us about settlement patterns. We focus on pottery production at Taurama (site codes AGN and AJA) and Eriama 1 (site code ACV), which were excavated by Sue Bulmer in the 1970s as part of her Ph.D. research. Pottery from these two sites, covering the terminal period of Early Papuan Pottery and continuing chronologically into and through the disruptive sequence known as the Ceramic Hiccup, are here examined and the results presented. In order to understand the interaction and mobility of these settlements before and during the Ceramic Hiccup, a physico-chemical analysis was undertaken on the pottery from both sites. By combining both typological analysis of form and decoration with physico-chemical analysis of the ceramic fabric and non-plastic filler groups, a picture emerges of social processes in the Port Moresby region during this transitional period.

Prior research on EPP has predominantly centered around typological studies as a means for understanding the interaction and mobility of these groups (Allen 1972; Bickler 1997; Bulmer 1978; Irwin 1985, 1991; Rhoads 1980; Swadling 1981; Vanderwal 1973). While these previous ceramic studies revealed a great deal of information regarding EPP settlement strategies as well as ceramic construction and variability, studying surface decoration and vessel form fails to provide a full understanding of interaction and exchange between ceramic producers and consumers. Typological studies must be coupled with physico-chemical analysis of clays and non-plastic mineral inclusions used in ceramic manufacture in order to classify the full variability of an assemblage. By studying the raw materials used to produce pottery, patterns and groupings can be established to examine production, exchange, and interaction. The use of physico-chemical analysis also allows comparison within and between ceramic assemblages across geographical and chronological boundaries. This allows for greater understanding regarding colonization and mobility of settlements, as well as interaction and exchange between communities.

The models to be used in this analysis were developed by Summerhayes (2000a) in his analysis of Lapita pottery. Changes in production strategies over time suggest changes in settlement strategies among the producers. By comparing two sets of production data (i.e., clays and filler), Summerhayes (2000a) correlated changing resource use (i.e., production patterns) with mobility and settlement patterns in Lapita settlements within the Bismarck Archipelago (Summerhayes 2000a, 2000b). Two patterns of production were identified (Figs. 2, 3). The first suggests that production of early Lapita pottery was mostly local. These potters were not technologically conservative: they combined tempers or fillers from different river systems and beaches with different clays to produce identical vessel forms and decorative motifs. A different pattern of production occurred for later Lapita styles. While pottery continued to be locally produced, production became more conservative and standardized with only one temper/filler found with associated clays.

This change in production was interpreted as reflecting a change in settlement patterns, with the early production pattern resulting from higher mobility associated with the initial colonization period and the later pattern reflecting more sedentary communities with less access to diverse raw materials (Summerhayes 2000a). Highly mobile settlements may not be the only explanation for the early production pattern,

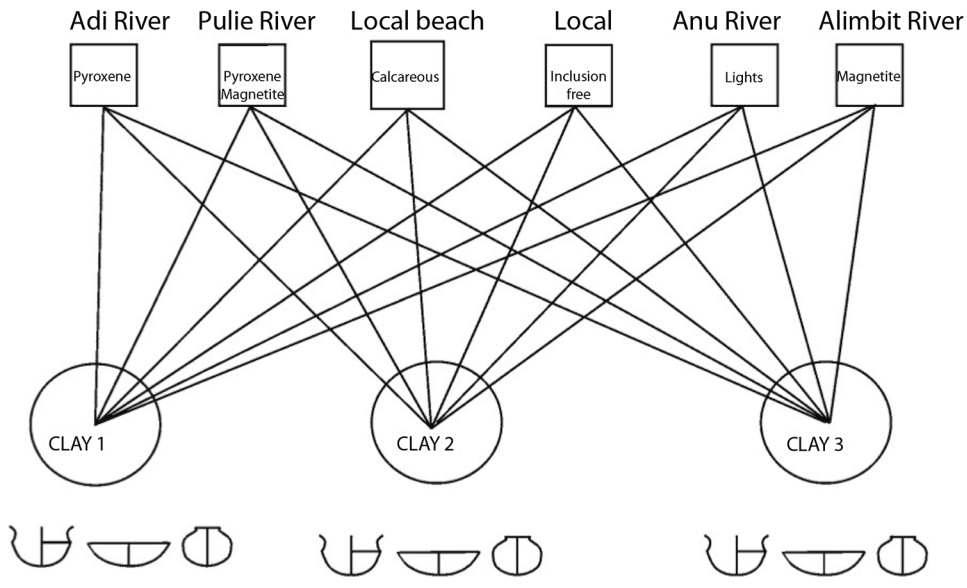


Fig. 2. Mobile pottery production (from Summerhayes 2000a).

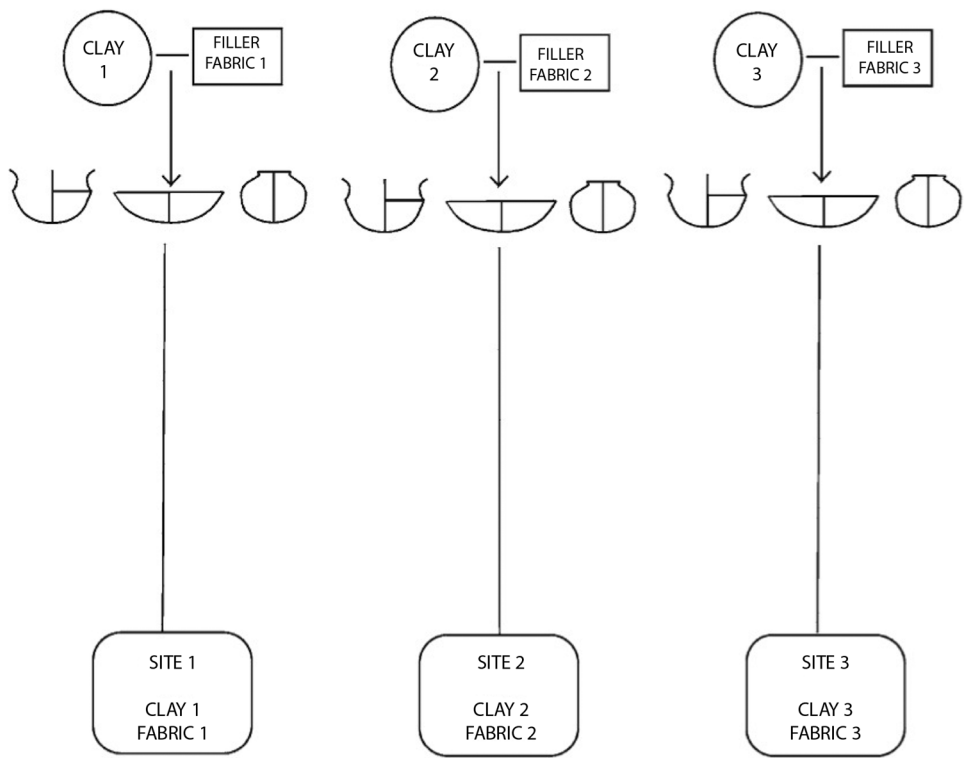


Fig. 3. Sedentary pottery production (from Summerhayes 2000a).

however. Although neither pattern resembles the specialist pottery production for exchange seen in the ethnographic past from a number of areas in Papua New Guinea, the settlements along the south coast may have interacted with one another through exchange, suggesting mobile ceramics as opposed to communities.

#### ARCHAEOLOGICAL CONTEXT

The Port Moresby region is located on the central south coast of Papua New Guinea, spanning ~700 km of drought-prone, low coastal plains, sprawling against the foothills of the Owen Stanley Ranges (Allen 1972; Bulmer 1979). Figure 4 locates the two sites examined in this study: Taurama (AGN and AJA), a beach c. 21 km to the south-east of Port Moresby, and Eriama 1 (ACV), a rock shelter c. 20 km to the northeast. Bulmer (1978) carried out excavations in this region between 1968 and 1972 as part of her doctoral research into the prehistory of southern Papua. She identified six distinct styles of ceramic construction and design from four major site locations (i.e., Taurama, Eriama, Nebira, and Boera). Bulmer breaks five of these ceramic styles into temporal categories that were used in this study to understand the nature of settlement during the Ceramic Hiccup (Table 1).<sup>1</sup>

Style I, the Red Slip Tradition, is the dominant style of EPP ceramics, while Styles II and III, known as Eriama style, represent an abrupt stylistic change in ceramic manufacture following the end of EPP (Allen 2010; Bulmer 1978, 1999; Swadling 1981). Style IV (Taurama style), characterized by shell and/or comb impressions, overlaps or follows chronologically from Styles II and III (Allen 2010). Only sherds from Styles I–IV were examined in the present study as these most closely fit within the temporal confines of terminal EPP, the Ceramic Hiccup, and Post-EPP.

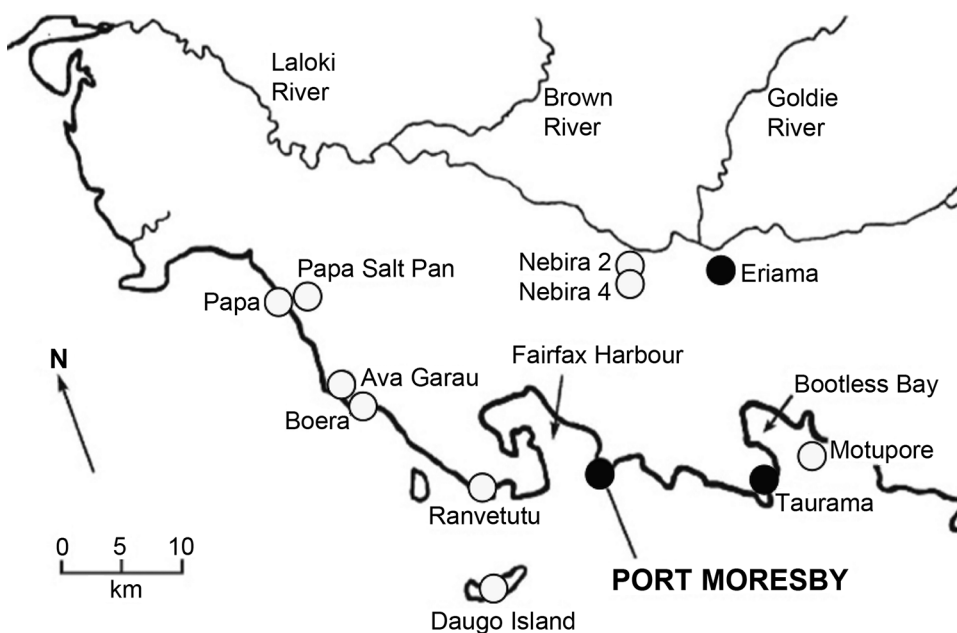


Fig. 4. Port Moresby region (adapted from Allen 2010).

TABLE I. DECORATIVE STYLE BY CHRONOLOGY (ADAPTED FROM BULMER 1982)

STYLE	DECORATION	DATE RANGE
I	Red Slip Tradition	2000–1200 B.P.
II and III	Eriama Style	1200–800 B.P.
IV	Taurama shell and comb incised	800–300 B.P.
V	Taurama incised—punctate	300–80 B.P.

*Taurama (Site Codes AGN and AJA)*

Taurama site codes AGN and AJA refer to two locations on Taurama (a.k.a. Kirra) Beach, about 21 km southeast of the center of the present city of Port Moresby (Bulmer 1978:258). Bulmer's main excavation from June through August 1972 was at site code AJA, an occupation deposit at the western end of the beach at the base of Taurama Hill (Fig. 5). Two lines of 1.8 m squares without baulks were laid out at right angles to each other. Squares 7X and 2X were separate from the main excavation, as Bulmer aimed to investigate an apparent midden on the western side. Excavation of Square 2X was discontinued and Square 7X reduced to 0.9 m when the landowners began to establish a garden on the site (Bulmer 1978:266).

Deposits in the main excavations (including Squares 7X and 2X, which were stratigraphically related) consisted of two soil horizons. The lower horizon was a brown sandy soil, while the upper horizon was a gray-brown soil. These horizons were subdivided further into two sub-horizons (a and b), which were differentiated by the incorporation of a noticeably higher amount of natural stone material in sub-horizon a. In all squares except 7X, the deposits lay on top of a natural layer of yellow beach sand, indicating that the beach was considerably farther inland at the time the site was first occupied. The substratum below Square 7X consisted of weathered stone rubble (Bulmer 1978:268–269).

AGN was about 140 m to the north of the main excavation area, so it was given a separate site code from AJA (Allen 2010:8). The separation of these sites is supported by stratigraphy, which reveals AGN (Square 101/A) to be stratigraphically unrelated to the other squares. AGN has two cultural layers, including a gray sandy soil on top of yellow-brown sand. The natural substratum was light yellow sand.

No definite examples of EPP were found in the stratigraphically separate site of AGN, although there is a suggestion of EPP in eroded slipped and burnished body sherds (Bulmer 1978:307). Ceramics recovered from AGN are almost exclusively Style IV, representing Post-EPP occupation (Bulmer 1978:307). Conversely, EPP is found in all layers of the main excavation at AJA. EPP is the exclusive style of pottery found in Standard Layer IIb and nearly so in Standard Layer IIa (Bulmer 1978:308). The presence of Style I (EPP) tapers off stratigraphically toward the surface, diminishing in occurrence between Standard Layers Ib and Ia. Bulmer proposed that the presence of Style I sherds in Standard Layer Ia was indicative of the redistribution of sherds from Standard Layer Ib through the process of garden digging. We suggest that Layer Ib is associated with the habitation of Style I pottery (EPP) users.

When this pattern is compared to the exclusive presence of Style IV (Post-EPP) pottery in AGN, a pattern emerges suggesting original occupation of the main site (AJA) by EPP users and a potential secondary occupation of AGN by a later group.

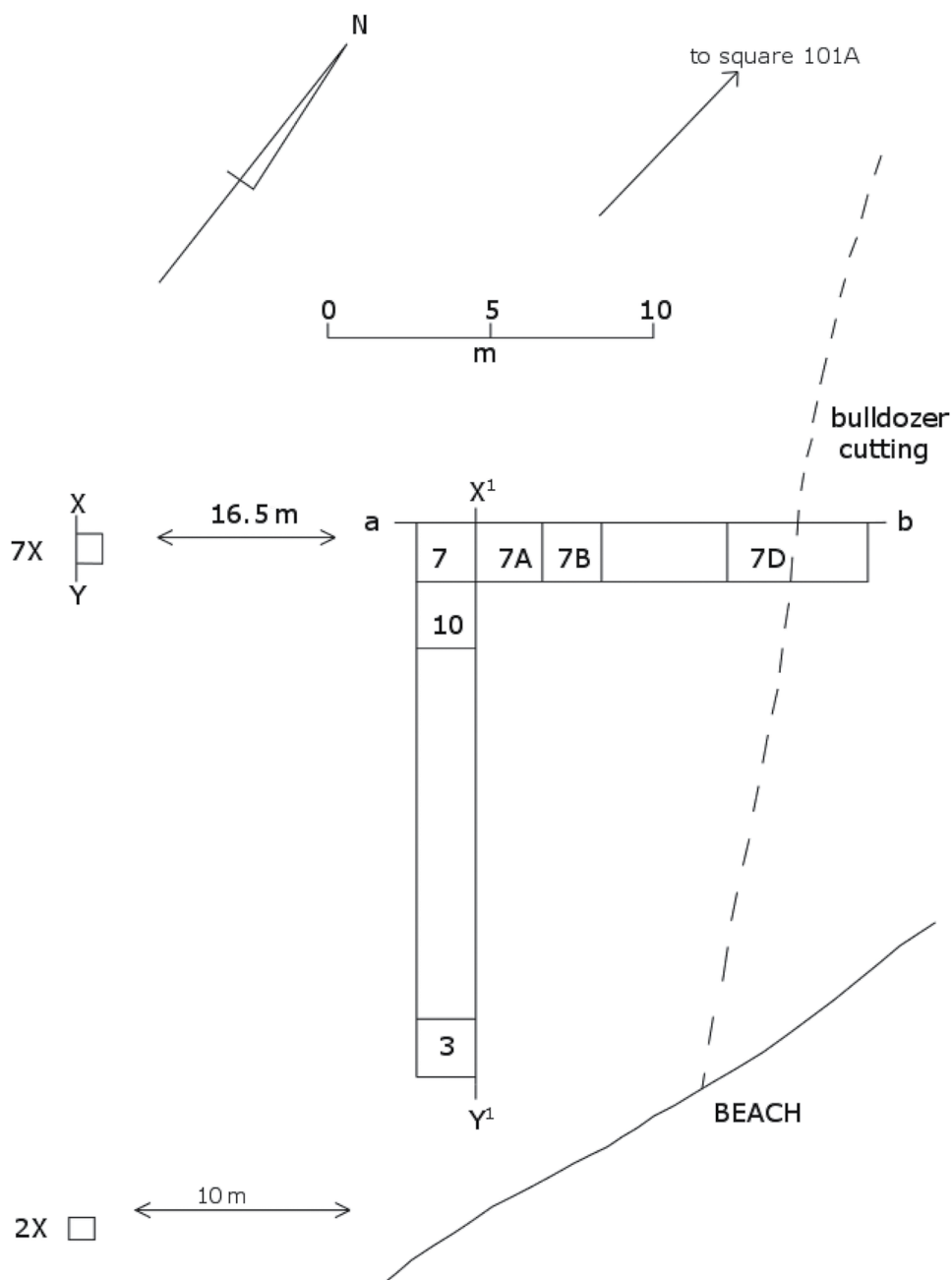


Fig. 5. Plan map of Taurama (AGN and AJA) excavation (adapted from Bulmer 1978).

The chronology of Taurama can then be argued to extend back to around 2000 B.P., but due to separate stratigraphy and lack of any ceramic continuity at AGN, it is not suggested here that AJA and AGN are indicative of continuous habitation. Another piece of evidence that supports a break in occupation is the lack of obsidian in the



cultural deposits of AGN and its presence in all squares of the main occupation site AJA (Bulmer 1978:300). As already noted, the flow of West Fergusson Island obsidian ceases in association with the Ceramic Hiccup and the associated end of EPP (Allen et al. 2011:79). Fourteen of the seventeen recovered obsidian flakes come from contexts below Standard Layer Ia of AJA; the three outliers are explained as a result of the aforementioned garden digging (Bulmer 1978:300).

Three radiocarbon dates are associated with the Taurama excavations (Bulmer 1978:274). Two of these dates come from the stratigraphically separate AGN (Square 101A), and the third from the main excavation (AJA) in Square 3. The two dates are from AGN: I-6862 from charcoal in Layer 9, show a range of 681–464 cal B.P., and I-6887B in Layer 6 providing a date range of 910–630 cal B.P. (Bulmer 1978:275). Both dates are reported at two standard deviations. These overlapping dates could be due to their provenience from scattered charcoal rather than specific living floors and potential secondary redistribution of deposits.

Charcoal from the main excavation provides a date range of 1059–622 cal B.P. (I-6863) (Bulmer 1978:275). This date was gathered from what Bulmer (1978:276) describes as an in situ, wave-washed fireplace in Layers 14 and 15 of Square 3. Both Bulmer (1978:276) and Allen (2010) find this date rather dubious due to its depth and association with recognizable Style I EPP sherds. Square 3 was noted as heavily disturbed by crab activity (Bulmer 1978:276), yet this was the only example of early horizon charcoal, and so was submitted for dating despite the acknowledged risk (Bulmer 1978:276). The dubiousness of dates associated with AJA is mitigated by the presence of recognizable pottery sherds from both EPP and Post-EPP in the same layer as redeposited charcoal.

#### *Eriama 1 (Site Code ACV)*

Eriama Ridge is a line of prominent hills roughly 5 km southeast of Nebira. Eriama 1 (site code ACV) is a north-facing rock shelter at the base of Eriama Ridge. ACV was excavated from May through September 1969; near total excavation was carried out due to concerns over site fossicking (Bulmer 1978:206). The total area sheltered was 13.3 m<sup>2</sup> and a grid of 0.9 m<sup>2</sup> without baulks was laid out (Fig. 6). Alternate squares were removed leaving cross sections of the stratigraphy; they were duly recorded before the remaining squares were excavated (Bulmer 1978:206). Deposits were sieved using 3/16-inch sieves, after all possible cultural material had been excavated during troweling (Bulmer 1978:207). ACV contained the burials of perhaps 48 to 50 individuals (Bulmer 1978:202).

Radiocarbon dating on charcoal and bone for Eriama 1 ACV suggests intermittent use over roughly 2000 years (Bulmer 1978:12). The earliest date of 2400–1334 cal B.P. (GaK-2670) is from a stratigraphically independent crevice in the rear of the shelter in the southwestern corner behind a large boulder. Bulmer (1978:212) noted a crack between the “main boulder and another small boulder” that divided the crevice from Square 6B and permitted an amount of material to spill from the crevice into Square 6B, but not vice versa. While Allen (2010) notes there are no sherds in direct association with this early date, two body sherds were recovered from the layer above. Bulmer (1978:212) argued that this early date is evidence of occupation by users of EPP. Bulmer (1978:223) acknowledged that much of the site had been heavily disturbed, as evidenced by intensely disarticulated burials.

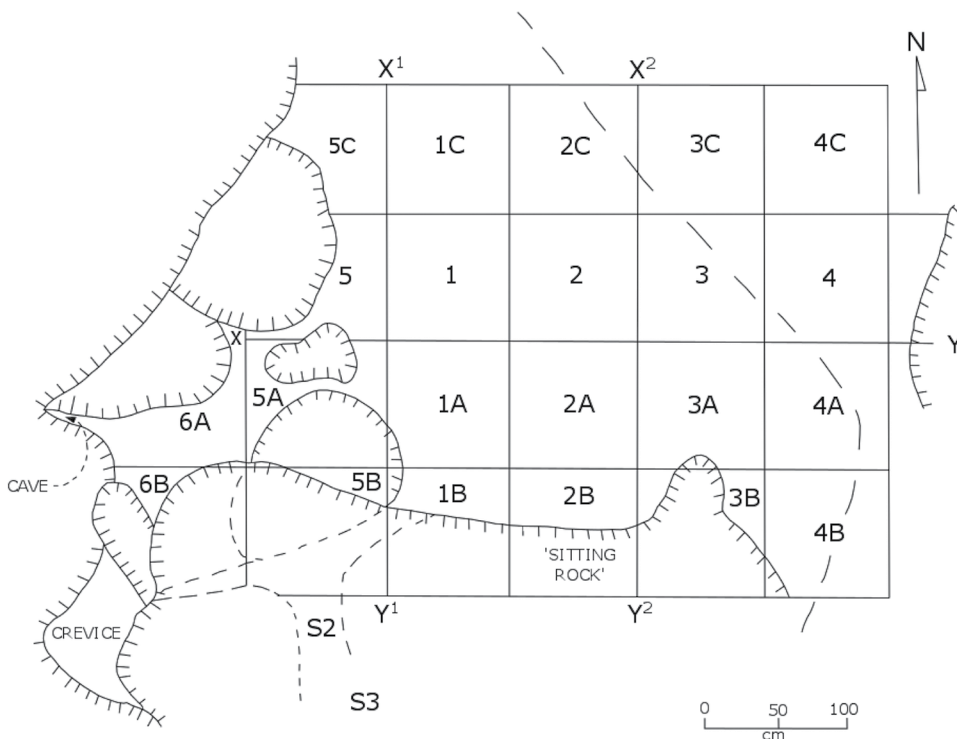


Fig. 6. Plan map of Eriama 1 (ACV) excavation (adapted from Bulmer 1978).

Two radiocarbon dates are associated with the burials, with results of 568–256 cal B.P. (GaK-2668) and 442–339 cal B.P. (GaK-2671), taken from charcoal within Layer B and a pit burial dug into Layer B, respectively (Bulmer 1978:213). These dates are stratigraphically consistent with one another. An additional date of 785–319 cal B.P. (GaK-3334) was obtained from a scattering of charcoal in Layer F in Square 4. Since this is not an in situ fireplace, the result is dubious. Bulmer acknowledged this and suggested it may not be a “true date” for Layer F due to its insecure provenience. Instead she suggested it related to a “middle phase of occupation” of the site due to distinctly Style I (EPP) sherds being found in layers above and below (Bulmer 1978:212–214). This “middle phase” would relate to the late stages of EPP.

It should be noted here that dates provided by Gakushuin for Bulmer’s study are already considered dubious because the laboratory produced unusually early dates during the late 1970s (Spriggs 1989, 1990). We acknowledge this issue with dates from this laboratory, but stress the fact that these dates are the only ones obtained for this site. As such, they must be taken into consideration, especially when paired with relevant ceramics from the period under investigation.

#### SAMPLING METHODS AND MATERIALS

A sample of 39 sherds was selected for analysis from the two Port Moresby sites: 25 from Taurama (AGN and AJA) and 14 from Eriama 1 (ACV) (Table 2). All were se-

TABLE 2. CHRONOLOGICAL DISTRIBUTION OF SHERDS

SITE	EPP	CERAMIC HICCUP	POST-EPP
Eriama 1	6	2	6
Taurama	7	9	9
Total	13	11	15

lected from squares devoid of disturbance and all were from terminal EPP through Post-EPP contexts. Seven sherds from Taurama (AJA) are distinctly EPP, nine are from the Ceramic Hiccup period, and another nine from definite Post-EPP contexts. Six of the sherds from Eriama 1 (ACV) were from EPP contexts, two from the Ceramic Hiccup, and six from Post-EPP contexts.

By focusing on the transition from EPP to Post-EPP, a sampling strategy was necessary to identify sherds for chemical analysis, as it was not feasible to analyze every sherd. The sampling strategy was grounded in “stratified random sampling” (Peregrine 2001:39). Incorporated in the sampling strategy were sherds previously recorded by Bulmer (1978) as belonging to her various styles. Sampling included unique sherds that were relevant to exploring the full range of vessel types and decorative styles. A crucial aspect of the sampling strategy was identifying variation in vessel decorative style groups while maintaining lack of bias and avoiding misconstruing temporally relevant data. Sampling was aimed at styles of decoration and vessel type; identification was based on a selection of rim sherds from relevant layers. Rims are the most important identifying feature of vessel type (Poulsen 1987:870). In order to ensure that rims came from separate vessels, rim observations (rim direction, rim profile, lip profile, orifice diameter) were supplemented with stylistic identification and corroborated with stratigraphic evidence. Rims were targeted from layers that were temporally related to EPP, the Ceramic Hiccup, and Post-EPP phases.

Selected sherds were reanalyzed and samples of Styles II and III from Taurama (AGN and AJA) were included in this study. The fact that sherds representing Styles II and III are present at Taurama contradicts Bulmer’s documentation for her thesis and published statements (Bulmer 1978, 1982:123).

#### SCANNING ELECTRON MICROSCOPY (SEM)

Electron microscopy was used to examine both the non-plastic mineral inclusions and the ceramic matrices to gather raw elemental data for the categorization of clay groups. This study was conducted using the Zeiss Field Emission Gun Scanning Electron Microscope (FEGSEM). The FEGSEM was chosen for this study due to its precision and ability to provide separate chemical analysis of mineral inclusions and the ceramic matrix, something lacking in other techniques such as Neutron Activation Analysis (NAA), X-Ray Fluorescence (XRF), and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS), which use crushed samples or wider area analysis (Summerhayes 1997, 2000*a*; Summerhayes and Allen 2007).

The FEGSEM located in the Otago Centre for Electron Microscopy (OCM) uses an XMax20 silicon drift Energy Dispersive X-ray (EDX) detector for data acquisition. The data was analyzed using AZTEC acquisition and processing software from

Oxford Instruments. The FEGSEM operates by scanning the sample surface line by line with a well-focused electron beam (0.4–0.5  $\mu\text{m}$ ) with an energy range between 0.2 and 40 keV (Froh 2004:159). Using SEM to study ceramics is based on the assumption that X-rays emitted from atoms have characteristic wavelengths and energies (Froh 2004; Summerhayes and Allen 2007). The FEGSEM uses a beam of targeted electrons to knock free those electrons of the inner shell of the atom, allowing them to be supplanted by electrons from a higher shell (Froh 2004:160). The transfer of these electrons from a higher shell to one of the inner shells presents a photoemission of energy, generating a characteristic X-ray as well as a bremsstrahlung X-ray (Froh 2004:160). The characteristic X-ray allows for the identification of elements present in the target surface, while the bremsstrahlung X-ray is “mainly obnoxious,” creating a background of X-rays that reduce sensitivity of detection of the characteristic X-ray (Froh 2004:160). The bremsstrahlung background can be subtracted automatically from the X-ray spectra by computational data processing, but it does slightly impair the detection limit of minor elements (Froh 2004:162). As the beam penetrates the surface of the sample the same energy processes that produce characteristic X-rays and bremsstrahlung also produce secondary and backscattered electrons (Froh 2004:160). Secondary electrons are low-energy electrons with energies below 50eV. Backscattered electrons are those with energy levels between 50eV and the initial emission, as indeed many of these electrons are from the primary electron beam. Both of these emerging electron classes can be used in the production of images (Froh 2004:160). These images, called micrographs, have minute resolution down to about one nanometer and allow for the precise targeting of non-plastic mineral inclusions and clay matrices.

Samples were made into briquettes that were polished to one micron and carbon coated. Examinations at 160x magnification identified the chemical nature of the non-plastic tempers present in each sample using point and ID settings with a count time of 30 to 60 seconds. This was compounded with an analysis of the clay matrices at 1500x magnification to provide an origin for CPCRUs (Chemical Paste Compositional Reference Units, discussed below). Elemental data was provided in the form of percent oxides, then normalized for clay matrices and non-normalized for mineral inclusions. The elements measured for the clay matrix analysis were Mg, Al, Si, P, K, Ca, Ti, and Fe. The non-plastic minerals were identified by comparing chemical data to standard geological reference tables and models (Deer et al. 1998). The ceramic matrix was analyzed using statistical analysis to identify CPCRUs.

#### IDENTIFYING POTTERY COMPOSITIONAL GROUPS

This research is organized around use of the Chemical Paste Compositional Reference Unit (CPCRUs), a crucial tool for interpreting the mobility of ceramics and people (Bishop et al. 1982; Summerhayes 2000a:38–41). A CPCRUs is a group of sherds sharing similar chemical data for clay sources. The similarities and differences between CPCRUs relate to ceramic origins and can be analyzed for patterns associated with exchange and interaction. The CPCRUs is a meaningful tool for organizing a chemical dataset, since the number of CPCRUs present in an assemblage is directly associated with the mobility of ceramic manufacturers (Hogg 2007:18; Summerhayes 2000a). Summerhayes (2000a), Hogg (2007), and Findlater and colleagues (2009) have shown that the CPCRUs is effective for studying the mobility of communities.

Due to the complexity of the chemical data generated using the FEGSEM, statistical analysis was used to form CPCRU groups based on chemical similarity. The method chosen for examining these groupings was Principal Component Analysis (PCA), a multivariate technique that groups samples through chemical similarity. PCA is based on an orthogonal transformation of original variables into a new set of uncorrelated variables or principal components (Sharma 1996:58). The first component is intended to account for the greatest variation in the dataset, the second component for the second highest variation, and so on, proceeding in descending order. In utilizing PCA, the number of attributes is reduced to a few dimensions (Summerhayes 2000a:39). This importantly allows data to be plotted in multiple dimensions, whereby resultant clusters can be identified visually. Previous ceramic chemical studies have used PCA in preference to other multivariate techniques (Clark et al. 1992:259; Elam et al. 1992; Findlater et al. 2009; Fish et al. 1992:239; Glascock 1992; Hogg 2007; Summerhayes 1997, 2000a). In this study, PCA data were standardized using MV-ARCH, which provides for log-contrast PCA using a centered log-ratio covariance matrix (Wright 1991). Results of PCA analysis were then visually identified.

All sherds were initially analyzed using a low-powered microscope (x18 magnification) in order to identify fabric groups from which samples could be selected. Four major fabric groups were identified: Ferro-Magnesium/Light (PL), Ferro-Magnesium (PM), Light Inclusion (L), and Calcareous (CA) (Table 3, Fig. 7). These fabric groups are identified based on predominant mineral inclusions used in ceramic production. When combined with elemental data generated by the SEM, they provide a basis for characterizing clay groups defined as CPCRU.

The SEM results allow for identification of the minerals within each fabric group. Ferro-Magnesium/Light (PL) is categorized by a roughly even mix of heavy and light mineral inclusions such as pyroxene, ilmenite, plagioclase feldspars, orthoclase feldspars, and quartz. Ferro-Magnesium (PM) is defined by large numbers of heavy, iron-rich minerals such as hematite, magnetite, pyroxene, and ilmenite. Light Inclusion (L) has very little to no heavy, iron-rich minerals present and is dominated by plagioclase feldspars, quartz, and zircon. Calcareous (CA) is defined by the major inclusion of shell and coral fragments mixed with light inclusions and is devoid of pyroxene.

#### TAURAMA (AGN AND AJA) POTSHERD MINERAL INCLUSIONS

Six samples from Taurama (AGN and AJA) belong to the Ferro-Magnesium/Light (PL) fabric group. These samples had characteristic high levels of plagioclase feldspar, orthoclase, pyroxene, and the non-silicate ilmenite. All samples contained amphibole and quartz. Five samples contained zircon. Four samples had tongxinite present; two

TABLE 3. DISTRIBUTION OF FABRIC GROUPS PER SITE

FABRIC GROUP	AGN & AJA	ACV	ALL
Ferro-Magnesium/Light (PL)	6	5	11
Ferro-Magnesium (PM)	3	2	5
Light Inclusion (L)	2	1	3
Calcareous (CA)	14	6	20
Total	25	14	39

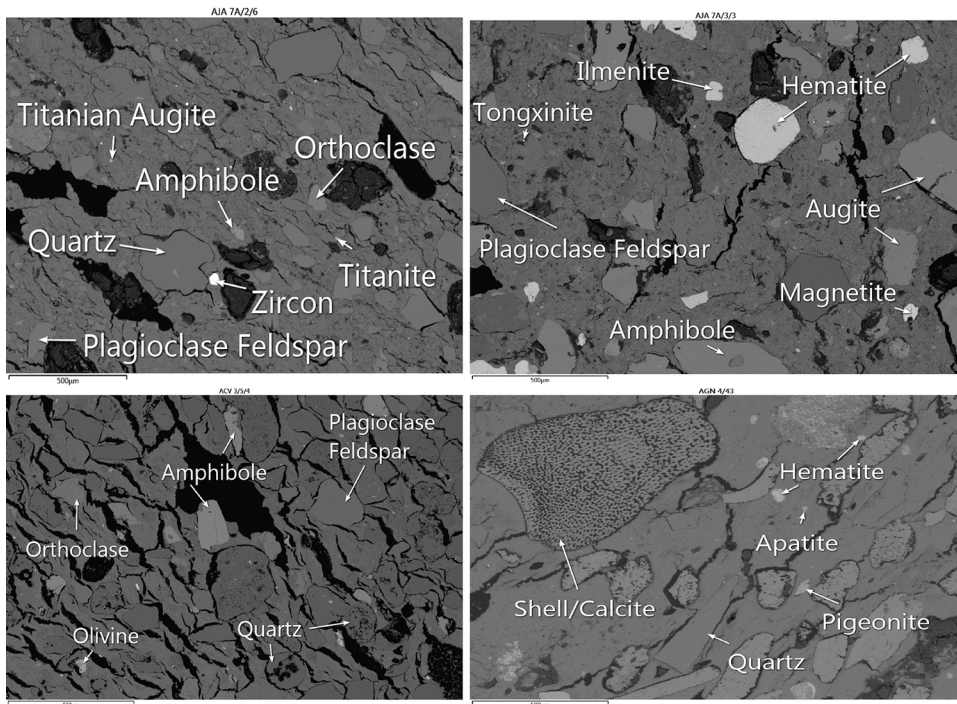


Fig. 7. Micrographs of temper groups at 160x. Top left, Ferro-Magnesium/Light (PL); top right, Ferro-Magnesium (PM); bottom left, Light Inclusion (L); bottom right, Calcareous (CA).

samples displayed the Spinel group minerals magnesiochromite and titanite. Two samples had the phosphate monazite and one sample had baryte present. One sample had the copper-zinc hydrosilicate present.

Three samples distinguished by the presence of high levels of pyroxene and magnetite fell into the Ferro-Magnesium (PM) group. All samples contained high levels of pyroxenes (augite, jadeite), magnetite, hematite, and ilmenite. Two samples contained tongxinite, one of which also displayed baryte and the Spinel group minerals magnesiochromite and titanite. One sample contained zircon.

Only two samples could be classified as belonging to the Light Inclusion (L) group. The minerals prevalent in these samples were quartz, plagioclase feldspar, orthoclase, and amphibole. Both samples had zircon present, one of which also displayed magnesiochromite, epidote, baryte, and tongxinite. One sample included titanite and had small amounts of ilmenite present.

Taurama (AGN and AJA) had fourteen samples in the Calcareous Fabric (CA) group. These samples all contained the characteristic shell and coral fragments, as well as quartz. Eleven of these samples contained amphibole; ten samples contained plagioclase feldspars and ilmenite. Nine samples included examples of rutile. Seven samples displayed the copper-zinc hydrosilicate. Seven samples included tongxinite; some of these overlapped with others displaying copper-zinc hydrosilicate. Six samples included zircon. Six samples had mica present. Five samples contained inclusions of baryte. Five samples had hematite and four samples included the ring-silicate olivine. Three samples contained epidote as well.

## ERIAMIA 1 (ACV) POTSHERD MINERAL INCLUSIONS

Based on predominating mineral inclusions, five of the fourteen samples from ACV were designated as belonging to the Ferro-Magnesium/Light (PL) group. These samples all were dominated by inclusions of plagioclase feldspar, orthoclase (alkali feldspars), quartz, pyroxene (predominantly augite), and the non-silicate oxide ilmenite. Smaller amounts of other minerals were also present in each sample. They include zircon, baryte, apatite, amphibole, tongxinite, magnesiochromite, and copper-zinc hydrosilicates.

Two samples dominated by iron-rich minerals fell into the Ferro-Magnesium (PM) group. This group was distinguished by high amounts of pyroxene, magnetite, hematite, and non-silicate ilmenite. Also included in these two samples were lesser amounts of mineral inclusions of plagioclase, orthoclase, quartz, and amphibole. Both samples had tongxinite present. One sample contained baryte and zircon, the other contained magnesiochromite.

Only one sample from Eriama 1 (ACV) was determined to belong to the Light Inclusion (L) group. This sample was dominated by inclusions of plagioclase feldspars, orthoclase, quartz, and amphibole. Also present in this sample were low amounts of the phosphate apatite and the ring-silicate olivine.

The major fabric group from Eriama 1 (ACV) was assigned to the Calcareous (CA) group, represented by six samples. Prevalent in all of these samples were inclusions of shell, quartz, and plagioclase feldspars. The non-silicate ilmenite was present in all samples, but in very limited amounts. Four samples had amphibole present, three of which also had the phosphate apatite. These three samples also had the mineral rutile present. Zircon was recorded in two samples, as were tongxinite and copper-zinc hydrosilicates. One sample contained a unique instance of beryllium oxide. Another sample had the unique inclusion of celsium (baryte feldspar).

## LITHIC INCLUSIONS

Both sites had samples that displayed varying amounts of lithic inclusions. Many of these lithics were of igneous origin, composed of varying minerals bound together with volcanic glass (Dickinson 2006:26; Hogg 2007:50). Accompanying these were several inclusions of sedimentary and metamorphic rock types. These inclusions made it difficult to gather accurate mineralogical information from the samples. However, the precision of the FEGSEM overcame this issue. Accurate provenience for these rock inclusions has not been undertaken, but it is likely that they are local, possibly from the Port Moresby beds or perhaps the Astrolabe region (Yates and de Ferranti 1967).

## OVERALL TRENDS AND PATTERNS

When viewed over time, there are noticeable shifts in fabric groups selected for ceramic manufacture (Table 4). The data presented above suggest, firstly, continuity between Taurama and Eriama 1 in non-plastic mineral inclusion usage in ceramic production. Calcareous inclusions dominate the collective samples from both sites. Similarly, the second most prevalent temper group, Ferro-Magnesium/Light, is seen across the collective samples in both sites. Samples from both sites include unique minerals such as zircon.

TABLE 4. FABRIC GROUPS BY SITE AND CHRONOLOGY

SITE	FABRIC GROUP	EPP	HICCUP	POST-EPP
Taurama	Ferro-Magnesium/Light (PL)	1	4	1
	Ferro-Magnesium (PM)	3	0	0
	Light Inclusion (L)	0	2	0
	Calcareous (CA)	3	3	8
Eriama	Ferro-Magnesium/Light (PL)	3	2	0
	Ferro-Magnesium (PM)	0	0	2
	Light Inclusion (L)	0	0	1
	Calcareous (CA)	3	0	3
Total		13	11	15

While there is a noticeable similarity across both sites, there are also important differences in non-plastic mineral inclusions between sites. At Eriama 1 (ACV), few (i.e., three) samples display rutile and no samples include mica, two minerals that are prevalent in samples from Taurama (AGN and AJA). Also of note is the presence of baryte in only one sample at Eriama 1 compared to eight samples from Taurama.

Of great importance was the presence of mica (biotite) in seven samples from Taurama: one of these samples comes from the Ceramic Hiccup, one from EPP, and five from Post-EPP periods. Mica, in particular biotite, has also been recorded as present and a significant characteristic of ceramics produced at Boera and Lea Lea, near Caution Bay, some 50 km to the west of Taurama beach (Worthing 1980). None of the sherds from Bootless Bay that Worthing (1980) analyzed had any types of mica present, so Worthing suggested that there is no mica in the Bootless Bay area adjacent to Taurama. Since an earlier geological survey of the region demonstrated that mica and other light siliceous minerals are indeed present in Bootless Bay (Yates and de Ferranti 1967), people in the two areas may have chosen different fabrics for pottery manufacture.

Another major finding is the presence of Light Inclusion (L) and a lack of Ferro-Magnesium (PM) during the Ceramic Hiccup, suggesting there were changes in choice of fabrics or access to raw materials.

While source data for tempers utilized in ceramic production in the Port Moresby region is currently limited (Worthing 1980), some suggestions can be made based on the geological nature of the mineral inclusions seen at Taurama. Here the importance of geological origin of tempers becomes apparent. Recording the presence of placer sands is a useful method for studying the tempers utilized at Taurama (AGN and AJA). Placer sands are defined as heavy mineral particles that accumulate along beaches and riverbeds in large quantities (Carling and Breakspear 2006:379). These “heavy minerals” are designated by ferromagnesian silicates (i.e., pyroxenes) and iron oxides (Dickinson 2006:25), both of which have been recorded in the ceramic samples from Taurama. Due to the extensive nature of placer sand deposits, they make a “very dependable and lucrative” temper source (Carling and Breakspear 2006:378; Hogg 2007:75). The presence of these placer sands along with calcareous temper inclusions at Taurama fit the model for local production before and after the Hiccup, as Taurama is a beach settlement with sands high in iron-rich minerals (Yates and de Ferranti 1967).



CHEMICAL PASTE COMPOSITIONAL REFERENCE UNITS (CPCRU) AND  
PRINCIPAL COMPONENTS ANALYSIS (PCA)

Four CPCRU were identified across all sites of AGN, AJA, and ACV. All four were identified at Taurama (AGN and AJA), while only three were present at Eriama 1 (ACV). The plots of PCA of both sites show a clear divide chemically between clay sources and some associated ceramic styles (Fig. 8). At each site, variations are noted in the clay sources and fabric groups that were utilized in ceramic production before, during, and after the Ceramic Hiccup (Figs. 9, 10).

*Taurama (AGN and AJA)*

Of the nineteen samples that were included in CPCRU 1, seven were Style I or from the EPP at Taurama (AGN and AJA). This is of interest when compared with the rest of the results, in particular those sherds of Post-EPP styles. The remaining four samples came from Post-EPP contexts.

Two samples were grouped into CPCRU 2. Both depicted the decorative Style II, which originated in the Ceramic Hiccup.

Seven samples were grouped into CPCRU 3. All seven depict decorative Style III. This is of particular interest as this Style is suggested to be intrusive. The fact that these samples have fully separated out from the rest is supportive of this intrusive movement of ceramics.

As mentioned above, CPCRU 1 reveals something more about ceramic production at Taurama. Grouped with the aforementioned EPP ceramics are four samples from

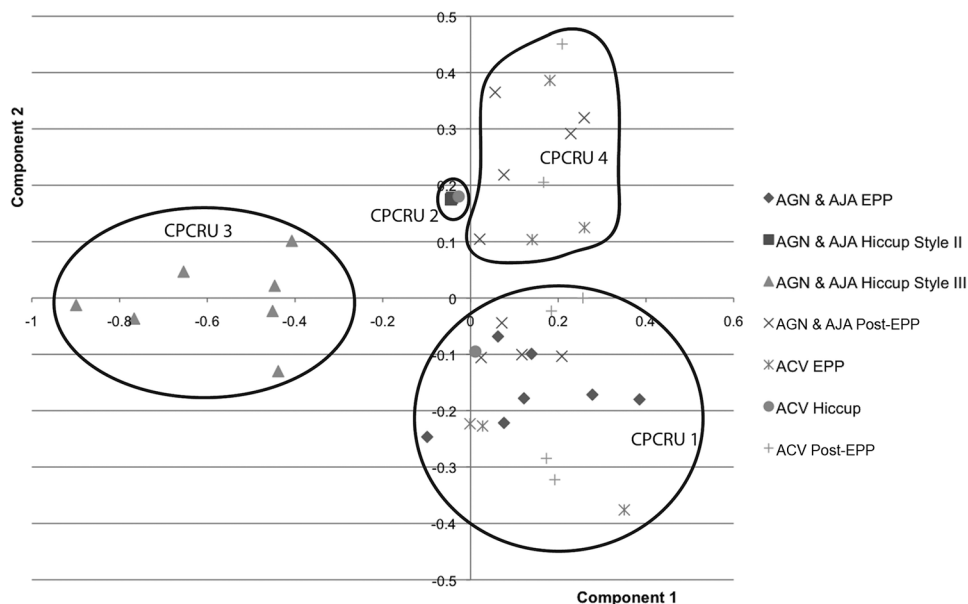


Fig. 8. Principal components 1 and 2 across both sites.

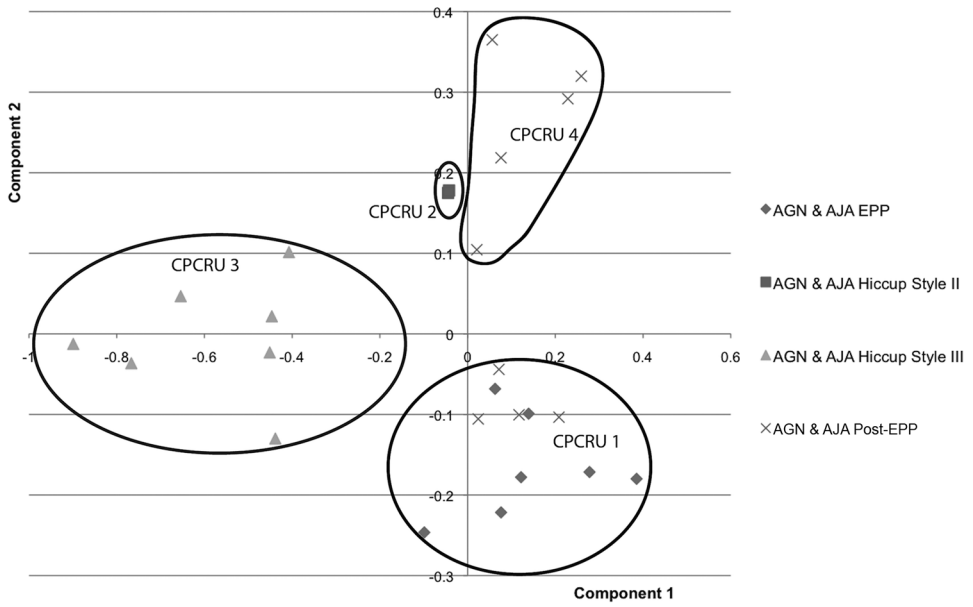


Fig. 9. Principal components 1 and 2 at Taurama (AGN and AJA).

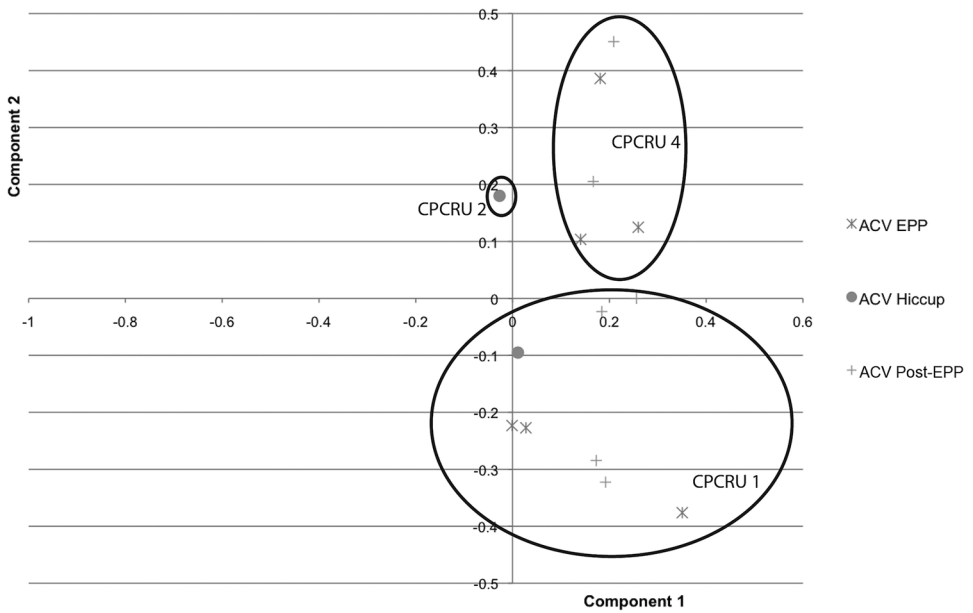


Fig. 10. Principal components 1 and 2 at Eriama 1 (ACV).

Post-EPP contexts. The data suggest a return to local sources following the Hiccup, but the fabric data are required to fully realize this suggestion.

At Taurama, five samples were grouped into CPCRU 4. These samples were all from Post-EPP contexts.

#### *Eriama 1 (ACV)*

Only three CPCRUs were identified at Eriama 1 (ACV). These were the same as those at Taurama, with the noticeable absence of CPCRU 3.

EPP samples were distributed between two CPCRUs: CPCRU 1 and CPCRU 4, both with three samples (Fig. 10). These were the same clay sources as found at Taurama.

CPCRU 2 contains one sample from Style II. The other sample from the Hiccup falls into CPCRU 1. The single sample of Style II in CPCRU 2 is from the same clay source as the two samples of Style II from Taurama.

Similar to the data from EPP, the six samples from Post-EPP contexts were grouped into the same two CPCRUs. CPCRU 1 contains four samples of Post-EPP ceramics, and CPCRU 4 has two samples. The importance of these chemical separations within each site and across the temporal divide of the Hiccup will be discussed below.

### CERAMIC FABRICS

The mineralogical results, when compared to the clay chemical data, reveal some consistent fabric groups associated with specific clay sources (Table 5). These various fabrics are chosen by the potter for a multitude of reasons, but broadly they reduce the shrinkage and cracking during the firing process. Similar fabrics and clay sources suggest pots being manufactured in the same area, potentially by the same potter.

#### *Taurama (AGN and AJA)*

CPCRU 1 contains all the samples depicting the EPP-associated Style I, showing a continued clay source used across the Ceramic Hiccup with a variety of fabric groups. The data best fit the model of a highly mobile settlement, and the suggestion is made that ceramic producers during EPP were highly mobile and interactive. Also present

TABLE 5. DISTRIBUTION OF FABRIC GROUP BY CPCRU

FABRIC GROUP	CPCRU AND SITE							
	1		2		3		4	
	AGN & AJA	ACV	AGN & AJA	ACV	AGN & AJA	ACV	AGN & AJA	ACV
Ferro-Magnesium/Light (PL)	1	4	1	1	3		1	
Ferro-Magnesium (PM)	3	2	1					
Light Inclusion (L)		1			1			
Calcareous (CA)	7	1			3		4	5
Total	19		3		7		10	

in CPCRU 1 are four samples from Post-EPP contexts, of which all fall into the Calcareous (CA) fabric group. Within CPCRU 1 there were three fabric groups identified. Calcareous temper inclusions were the most common fabric group, making up nine of the thirteen samples that belong to CPCRU 1. The second largest fabric group was Ferro-Magnesium (PM) with three samples, and one sample from the Ferro-Magnesium/Light (PL) fabric group. This suggests a return to local sources following the intrusive Hiccup. As mentioned above, four of these samples contained the characteristic mineral biotite, known to be present in pots around Boera, Caution Bay (Worthing 1980). One of these samples is from EPP contexts and the other three are from Post-EPP. CPCRU 2 contains the only two examples of Style II from Taurama. The samples showed different fabric groups, with one belonging to Ferro-Magnesium/Light (PL) and one from the Light Inclusion group. Again this fits the model of a mobile society; however, it is important to note that the small sample size potentially limits the strength of this interpretation.

CPCRU 3 is comprised of seven samples depicting Style III decoration. This CPCRU is associated with three separate fabric groups, including three samples from both the Ferro-Magnesium/Light (PL) group and the Calcareous (CA) group. One sample belonged to the Light Inclusion (L) group. Again the model of a highly mobile society presents itself and the data fits neatly into this pattern. One sample from this group contained the important mineral mica (biotite), shown to occur in a separate location (see above). CPCRU 4 has five samples of Post-EPP ceramics. This CPCRU is associated with two fabric groups, albeit limited to one sample of Ferro-Magnesium/Light (PL) and four of Calcareous (CA). All samples of Style IV (Post-EPP) ceramics were of the Calcareous fabric group. The association between a nearly exclusive fabric group (CA) used Post-EPP and CPCRU 1 suggests a return to a local source being utilized for manufacture. These data are seen as representing a shift from the highly interactive and mobile groups during the EPP to a more sedentary and isolated community following the Hiccup.

#### *Eriama 1 (ACV)*

Of the three CPCRUs present at Eriama 1 (ACV), only one CPCRU relates to a unique fabric group (Table 5). There is not as definite a separation along chronological boundaries at Eriama 1 (ACV) as at Taurama. CPCRU 1 contains seven samples of various fabric groups. Four samples are Ferro-Magnesium/Light (PL), two Ferro-Magnesium (PM), one Light Inclusion (L) and one Calcareous (CA). These seven samples come from EPP, Hiccup, and Post-EPP contexts. CPCRU 2 is limited to one sample of Style II, which contains Ferro-Magnesium/Light (PL) fabrics. CPCRU 4 has five samples, which are all Calcareous (CA) but come from both EPP and Post-EPP contexts. The data most accurately fit a model of a highly mobile society before, during, and after the Ceramic Hiccup, correlating with the established interpretations regarding the intermittent use of the Eriama 1 rock shelter by transient groups (Bulmer 1978).

#### DISCUSSION

What can the data presented tell us about ceramic mobility and interaction patterns before, during, and after the Ceramic Hiccup in the Port Moresby region? The two

sites studied here reveal similar CPCRU in association with a variety of tempers used. While this might immediately suggest that both of these sites were frequented by highly mobile ceramic producers, a clearer pattern emerges when the data are examined through a temporal lens at each site.

*Production before the Hiccup*

At Taurama (AGN and AJA), the data suggest a relatively sedentary group during the EPP phase, using a single clay source (CPCRU 1) but with different temper groups (Fig. 11), suggesting possible experimentation in pottery production but with a continued decorative style (Style I). This could also be indicative of different production centers using the same clay deposits. At Eriama 1 (ACV) there were two clay sources used with two fabric groups, which is interpreted as either one group using two different clays or two groups using the site during this period. There are a range of vessel forms and decorative styles (painting, slipping, and Style I) and, when considered with the number of burials and lack of observed living floors, is argued to support the use of this site as a more ritualistic center, as opposed to an actual dwelling, which has been previously suggested by Bulmer (1978).

*Production during the Hiccup*

From Taurama (AGN and AJA), the sherds identified to be from the Ceramic Hiccup, recognizable from their context and decorative style (Styles II and III), come from different clay sources of CPCRU 2 and 3, respectively (Fig. 12). These sources are

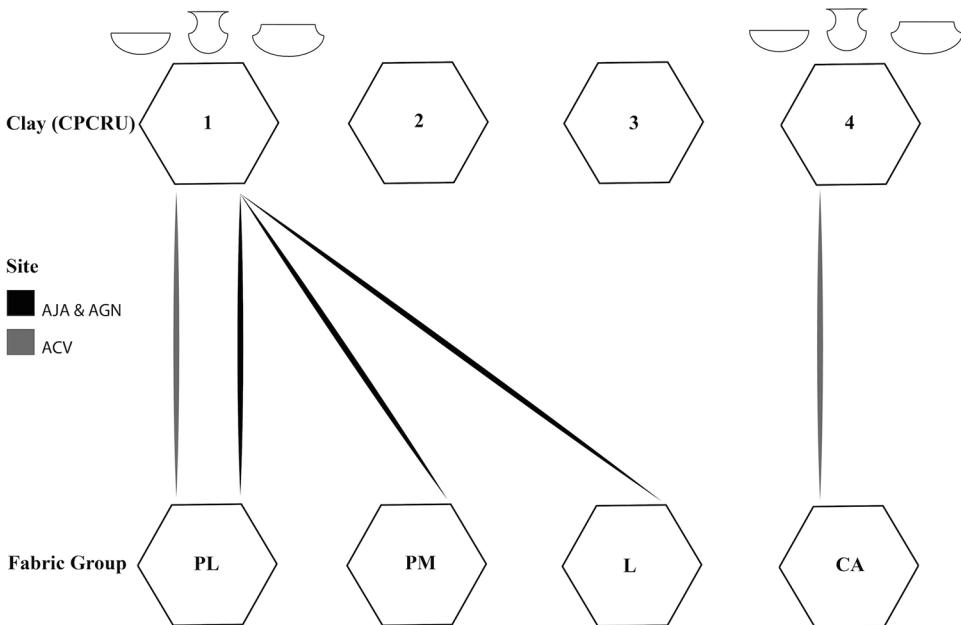


Fig. 11. Production during EPP.

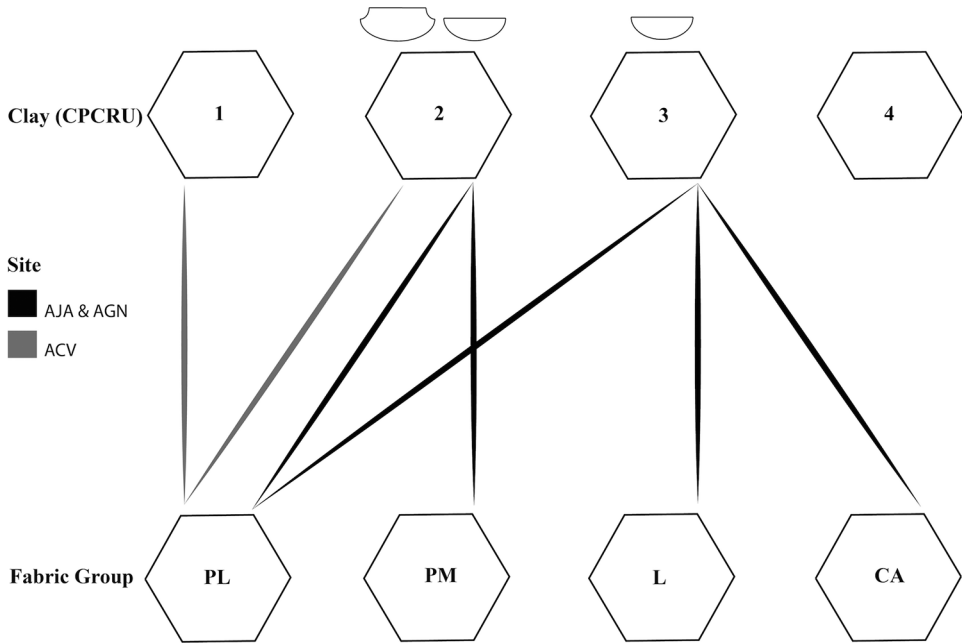


Fig. 12. Production during the Ceramic Hiccup.

separate from each other and those utilized during EPP occupation of the site. The variety in tempers used with these clay groups suggests several possible scenarios. Perhaps there was a more interactive settlement pattern during this phase or even an introduction into the area of a new group of ceramic users. The exclusive association between CPCRU 3, Style III decoration, and a unique vessel form (simple bowl) is argued to be representative of an imported group of ceramics if not a migration of ceramic users. However, this could also represent expansion in local exchange networks. At Eriama 1 (ACV), the same intrusive clay chemical signature presents itself with CPCRU 2, suggesting the same group may have utilized this rock shelter as well. Interestingly, the only example of Style III decoration from this time period is actually produced with the same clay source (CPCRU 1) and the same fabric group (PL) as during EPP.

#### *Production after the Hiccup*

At Taurama (AGN and AJA) the data collected from after the Ceramic Hiccup relate to two clay sources (CPCRU 1 and 4), with Calcareous tempers being exclusively connected with the Style IV sherds analyzed (Fig. 13). The re-use of CPCRU 1 is argued to be indicative of a return to the local source used during EPP, suggesting an increasing isolation or a sedentary group at the site, while the use of CPCRU 4 could suggest some experimentation or response to sources becoming inaccessible. The intrusive clay sources (CPCRU 2 and 3) disappear from the record as well.

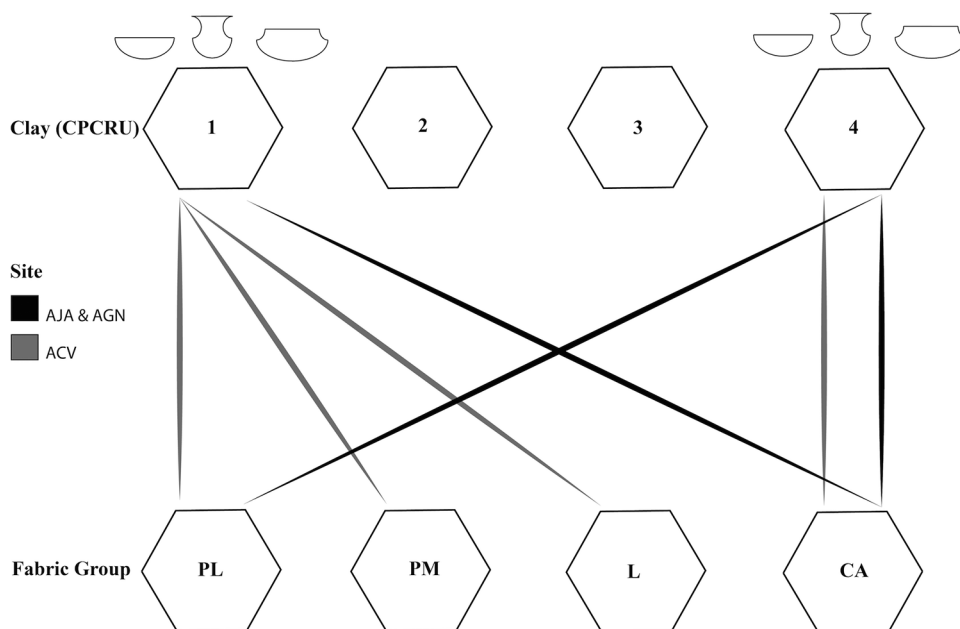


Fig. 13. Production Post-EPP.

At Eriama 1 (ACV), the clay sources revert back to those originally used during EPP (CPCRUs 1 and 4), but the number of fabric groups increases from two to all four. This is possibly indicative of a return to the site by its original users, or perhaps the intrusive group(s) from the Hiccup utilized the local clay sources again. It may be representative of a break in local production during the Ceramic Hiccup, where site occupants imported ceramics from a separate production center. The great reduction in use of the rock shelter, with abandonment shortly after the Ceramic Hiccup, may indicate the increasing isolation of ceramic users in the region.

#### *Production in the Region through Time*

The general trend at both study areas in the Port Moresby region is one of interruption. During the EPP, settlements utilized local resources in the form of clay sources and manually added tempers, with these two areas (Eriama 1 and Taurama) even sharing the same clay source (CPCRUs 1). The same decorative style (Style I) is used for the duration of this period and disappears with the emergence of Styles II and III.

During the Ceramic Hiccup, there was a noticeable shift in clays and tempers used in production. The presence of new clay sources (CPCRUs 2 and 3) and associated decorative styles (Styles II and III) is perhaps more noticeable at Taurama. This is argued to be indicative of a migration of ceramic users, especially when combined with the aforementioned trade disruptions and overall change in settlement patterns. The presence of these unique styles and clay sources diminishes over time toward the end of the Hiccup.

Following from this tumultuous period is a return to using the same clay sources that were exploited during the EPP. Of note here is the inclusion of CPCRU 4 at Taurama, which suggests new knowledge of another accessible clay source. Style IV ceramics at Taurama were produced using the original local clay sources (CPCRU 1 and 4) and are exclusively associated with the Calcareous temper group, suggesting increased standardization and increased sedentism. The same is seen at Eriama 1 (ACV) in terms of a return to the original, local sources.

Overall it is suggested here that the Ceramic Hiccup represents an introduction of ceramics, if not ceramic users, from a different region. It manifests itself in a general disruption of EPP production and settlement, but it does not seem to have an echo in terms of continued clay sources and styles used.

#### CONCLUSIONS

The data as presented here allow for six provisional conclusions:

1. The evidence from Taurama, when examined across the Ceramic Hiccup, suggests a transition from a sedentary, isolated community in late EPP to one that is highly mobile and interactive during the Ceramic Hiccup, before reverting back to one of a more sedentary nature. Local production of ceramics occurred before and after the Ceramic Hiccup.
2. The presence of Style II and Style III ceramics at both Eriama 1 and Taurama is significant. Style II has its own chemical signature, the origin of which can only be speculated at this point. The unique chemical signature of Style III ceramics present at Taurama coupled with the significant presence of Light (L) and lack of Ferro-Magnesium (PM) fabrics is suggested to represent an introduction of material from the area around Boera, Caution Bay.
3. The presence of mica (biotite) in samples from EPP, the Hiccup, and Post-EPP contexts at Taurama is suggestive of a movement of ceramics if not people from the Boera/Lea Lea area in Caution Bay into the Port Moresby region.
4. Due to the isolated nature of settlement at Taurama during the EPP phase, and the resultant increase in mobility during the Ceramic Hiccup, Bulmer's (1978) hypothesis suggesting continued occupation from 2000 through 300 B.P. is cast into doubt, due to the presence of intrusive styles (II and III) of separate chemical origin, especially when compounded with comparative stratigraphic evidence presented by Allen (2010:9).
5. The site of Eriama 1 has all of the attributes that define a highly mobile and transient settlement. The data suggests occupation by mobile groups in at least three phases, early occupation during EPP, and then a spotty, more intermittent occupation as EPP ends, and subsequent abandonment.
6. The ceramics at these two sites during EPP help to display the attributes of mobile, highly interactive groups. This interaction declines over time with late EPP settlements transitioning into a more sedentary and isolated pattern. The presence of Style III sherds is argued to be indicative of an intrusive movement from elsewhere in the region during the Ceramic Hiccup, with a return to localized production following afterward.

As mentioned above, the explanations for the Ceramic Hiccup vary, from a migration to the west from the Massim island group (Bulmer 1971; Swadling 1980), to environ-



mental change (Allen 2010; Sutton et al. 2015), to possible defensive intensification and increased isolation (Allen 2010). These explanations may not be singular causes, but mere facets of a more complex system of culture change. The centrality of Port Moresby and its influence during this tumultuous period is crucial to understanding the nature and impact of the Ceramic Hiccup. The current study suggests that a population migration may have caused the Ceramic Hiccup, probably stemming from the west (Boera, Lea Lea) as opposed to the originally proposed east (Massim). Further archaeological investigation in the region will be required to refine chronologies and settle debates about questionable radiocarbon dates. An increase in physico-chemical studies of ceramics from this region and further afield will allow for a better understanding of interaction during this period and possibly shed light on the true nature of the Ceramic Hiccup.

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#### NOTE

1. The sixth style comes from a range of biomes, according to Bulmer (1982). It was left out of our study because it is not close chronologically to the period under investigation.

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## ABSTRACT

The last five decades of research into Papua New Guinean archaeology have revealed a variety of rapid late Holocene cultural changes. The Ceramic Hiccup (c. 1200–800 years B.P.) is a little understood period of change along the south Papuan coast. It presents itself at the terminus of the Early Papuan Pottery (EPP) tradition as a rapid change in ceramic styles, lithic exchange, and settlement patterns. Previous interpretations have invoked causal factors such as migration, environment, and conflict. This article investigates this period of change by examining exchange and mobility patterns during EPP, through the Ceramic Hiccup, and into the ensuing traditions. Physico-chemical analysis (scanning electron microscopy, SEM) of 39 potsherds was conducted to understand changes in ceramic production during this period at two key sites, Taurama (AGN and AJA) and Eriama 1 (ACV), in the Port Moresby region of the south coast of Papua New Guinea. Although our interpretations are provisional due to a small sample size, it is argued here that, following the highly interactive period of EPP, a migration of ceramic manufacturing groups from the west supplants the local tradition (EPP) during the Ceramic Hiccup. There is a decline in interaction between ceramic communities toward the latter stages of EPP, with increased isolation and standardization of ceramics. This decline of interaction in the region is associated with a decline in chemical variability in ceramic components. The Ceramic Hiccup is representative of introduced ceramics, increased interaction and mobility. KEYWORDS: Papua New Guinea, Port Moresby, Early Papuan Pottery, EPP, pottery, culture change, SEM, Taurama, Eriama.