Schedule for Dr. Glenn Summerhayes during 12/14-23/2007

Host Institute: National Museum of Prehistory

Arriving on 12/14

1. **Colonization along the south coast of Papua for NMP at 14:00-16:00 on 12/15**

Recent research has added considerably to our knowledge of the Austronesian back migration along the South Papuan Coast some 2,000 years ago. Recent analysis if the ceramic assemblages from the south Papuan Coast and the results of recent excavations at the site of Oposisi on Yule Island will be presented. The results will demonstrate an early colonizing community that maintained close ties with other sites as evident by the movement of obsidian and to a lesser extent pottery. 附錄：演講錄影DVD

2. **Archaeological Field Trip on 12/16:** 都蘭、忠勇、長光、高寮及掃叭等五個遺址

3. **Austronesian expansion in southern Japan–the Yaeyama Islands for NMP at 14:00-16:00 on 12/17**

The colonisation of the Yaeyama Islands, southern Japan, allows a closer assessment of the nature and timing of Austronesian movement out of Taiwan. Evidence in the Yaeyama islands suggests that the early occupation characterised by Shimotabaru wares is the signature of Austronesian colonisation from Taiwan, 4000-3800 BP. Yet the Yaeyamas dispersal appears to have been of a different character from that which moved south from Taiwan. This suggests that the nature of Austronesian expansion in general was more complex than is proposed in the prevailing model. The lecture will present the results of recent research into the archaoelogy of the Yaeyama Islands. 附錄：演講錄影DVD

4. **20,000 years of obsidian distribution in the western Pacific at 14:00 on 12/18**
5F, Conference Room, Museum of the Institute of History and Philology, Institute of History and Philology, Academia Sinica

Obsidian from the Melanesian island of New Britain was first extracted and exchanged some 260 kilometres some time prior to 20,000 years ago. By 3000 years ago, this distribution was expanded to 6,000 kilometres, from Borneo in the west, to Fiji in the east. The paper will look at this remarkable distribution of obsidian, its source areas, its exchange patters, and its changing nature over a 20,000 year old period. Summerhayes will also look at the role of obsidian in helping to model the nature of Lapita interaction across the western Pacific.

5. **Lapita in the Bismarck Archipelgo at 14:00 on 12/19**

Room C304, College of Humanities and Social Science, National Tsing Hua University

The Bismarck Archipelago is seen by many as the "Lapita Homeland", where Austronesian influences met with Melanesian cultures and developed into what is known as Lapita culture. This lecture will present the latest updates on Bismarck Archipelago archaeology its chronology, settlement and the nature of these early societies.

6. **Late Austronesian expansions back into Near Oceania – the south Papuan Coast at 12:30 on 12/20**

Room 206, Dept. of Anthropology, National Taiwan University

Recent research has added considerably to our knowledge of the Austronesian back migration along the South Papuan Coast some 2,000 years ago. Recent analysis if the ceramic assemblages from the south Papuan Coast, and the results of recent excavations at the site of Oposisi on Yule Island will be presented. The results will demonstrate an early colonising community that maintained close ties with other sites as evident by the movement of obsidian and to a lesser extent pottery. 附錄：演講錄影DVD

7. **Late Pleistocene occupation of PNG - a View from Kosipe at 14:00 on 12/21**

Room 703, Institute of History and Philology, Academia Sinica

A remote valley in the highlands of Papua New Guinea may hold a key piece in a global jigsaw puzzle that explains how and when ancestors of modern humans left Africa somewhere around 60-70,000 years ago. At the time our modern ancestors arrived in Europe to replace Neanderthals, Homo sapiens had already colonised the land mass known as Sahul (comprising Papua New Guinea and Australia) for many thousands of years. Recent research at Kosipe in the Papua highlands has shown evidence that human occupation was much earlier than the previous estimate of 26,000 years. The Kosipe valley is one of the oldest sites of upland occupation in the world with occupation at 35,000 radiocarbon years.

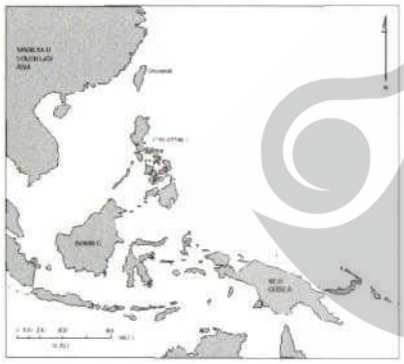
Evidence suggests early colonisers of the Western Pacific not only had the maritime skills to cross oceans, but had the endurance to adapt and survive in a harsh sub-alpine environment 2,000 metres above sea level in an age when the climate was much colder than it is today. The Kosipe valley is important internationally because very little is known about this archaeological period. To date, excavations by Summerhayes and his team have recovered cultural layers dated to over 35,000 years found with pandanus nutshells, stone tools and increased charcoal indicating firing of the landscape. Microscopic analyses of the stone tools have identified starch grains, some of the oldest in this part of the world. Evidence for firing and the presence of massive stone axes indicates clearing activities, perhaps for the management of pandanus growth, suggesting some of the earliest evidence for agroforestry management in the world.

Discussions with Dr. Scarlett Chiu regarding Kamgot (site code ERA) from the early Lapita (3,500 to 3,000-2,900) at Anir Islands at Research Center for Humanities and Social Science of the Academia Sinica

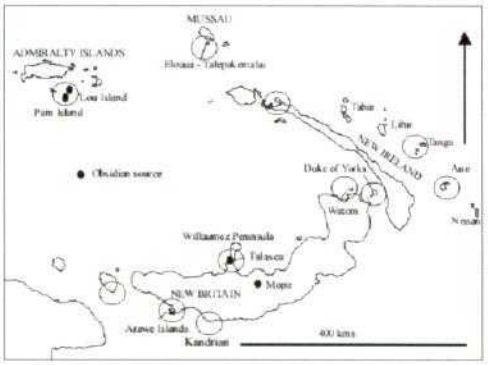
Leaving on 12/23

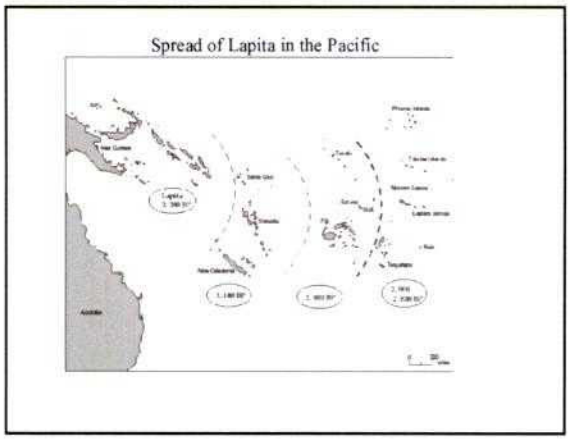
Recent Archaeological Work on the South Papuan Coast: the Archaeology of Colonisation

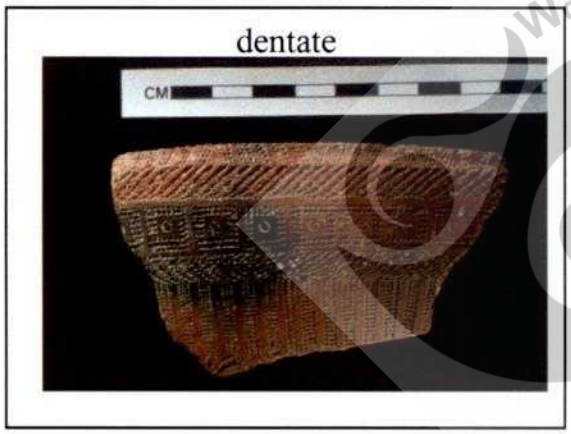
- To understand this colonisation – you have to know about the previous colonisation events in the Pacific - LAPITA

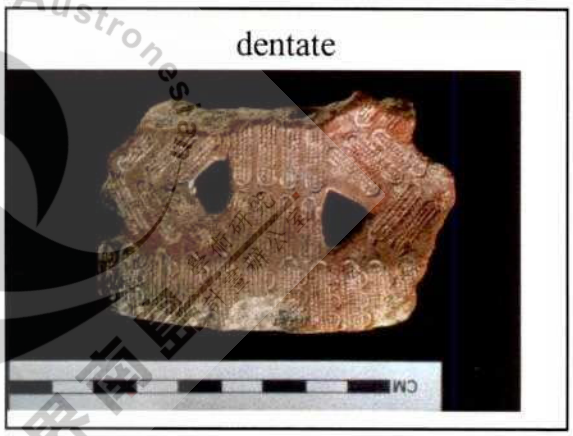


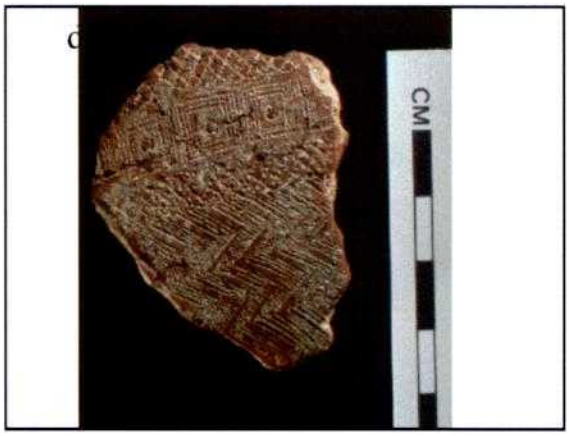
Lapita pottery Arawes

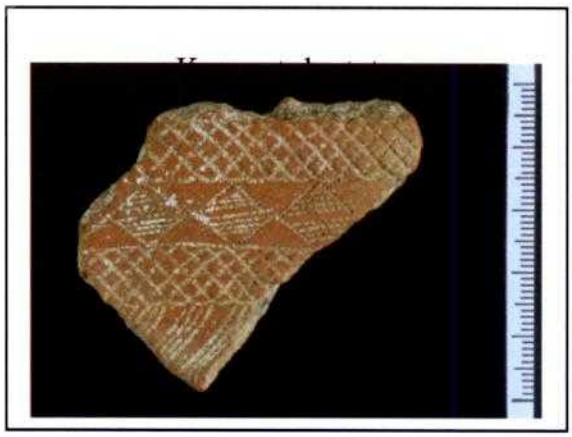


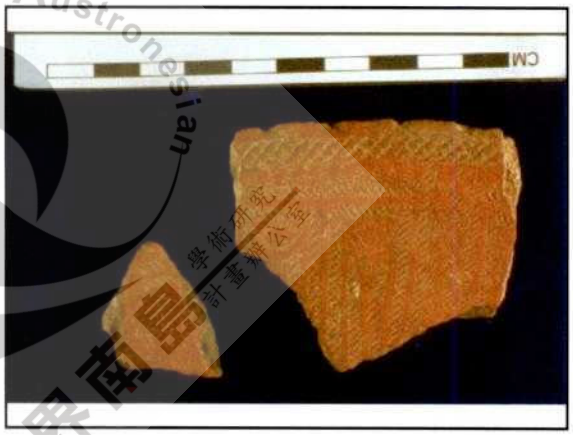


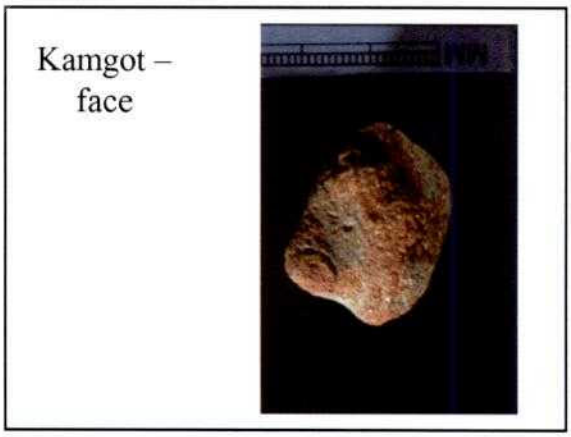




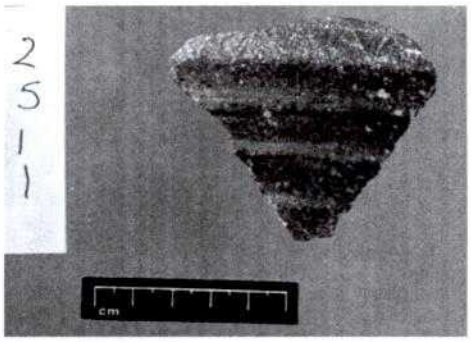




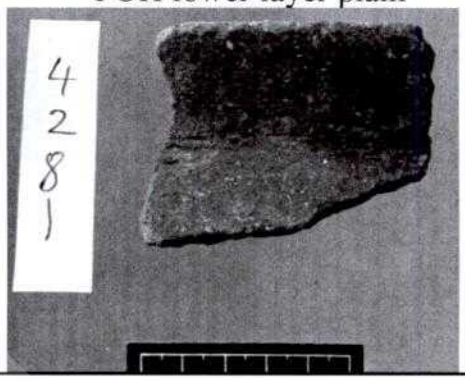




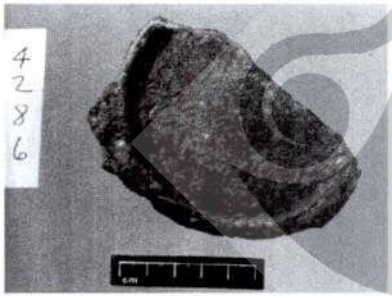
FOH lower layer grooved



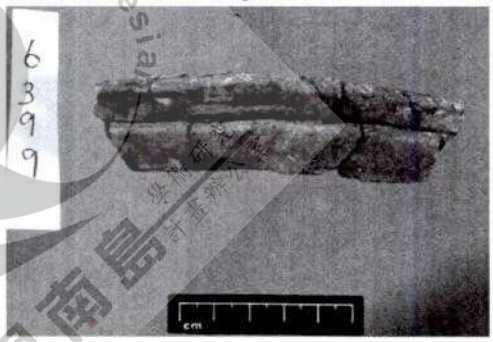
FOH lower layer plain



FOH lower layer base

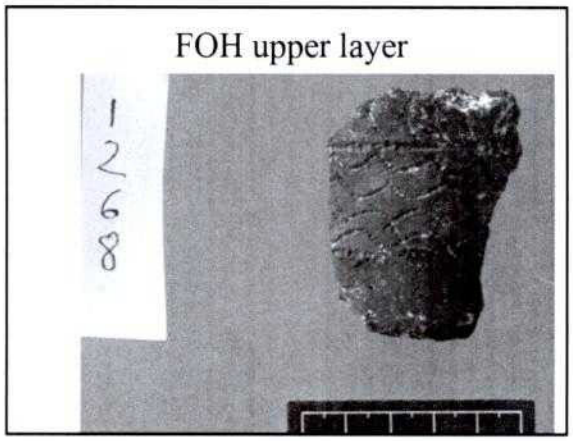


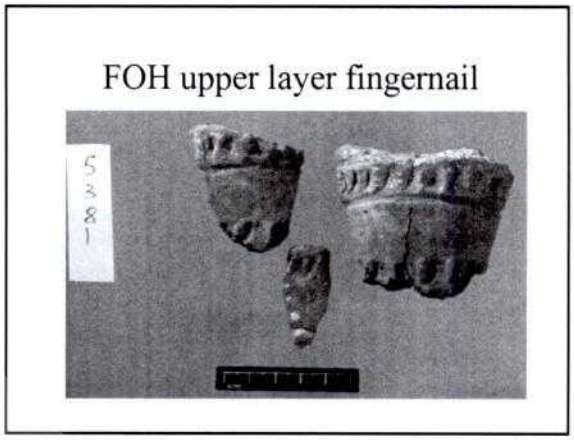
FOH lower layer double rim

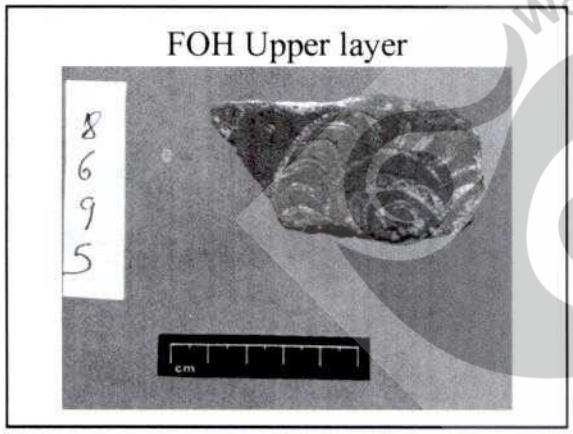


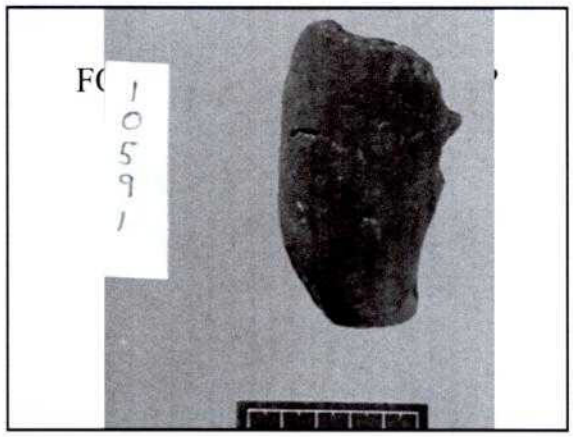
FOH upper layer incised

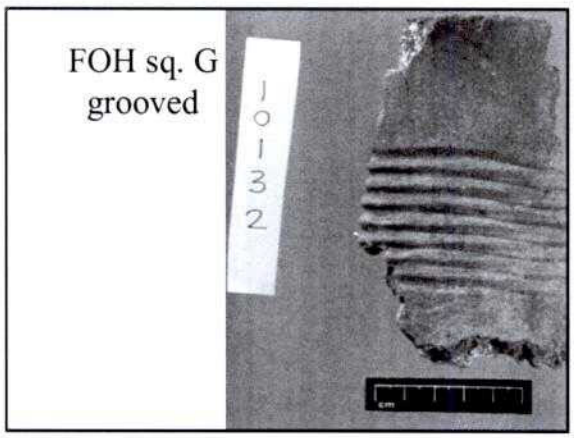
FNZ tp 7 sp 1Linear incised



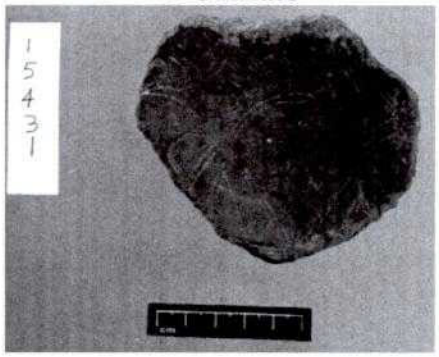








FOH late

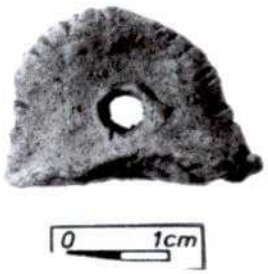


Incised & fingernail FOH tp1 sp 2

FNZ tp 7 sp 1 fingernail

FNY spit 1 crude dentate

FNY Handle

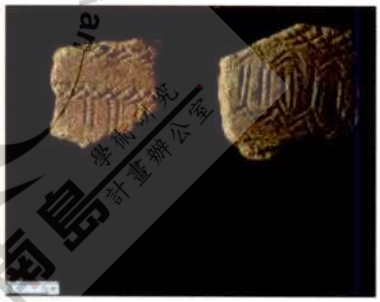


GARUA FSZ
fingernail/impressed

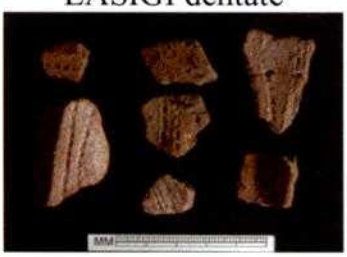
GARUA FSZ applique

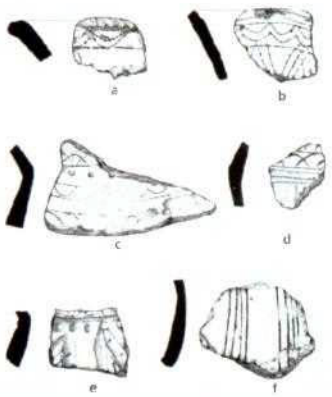
GARUA FSZ dentate

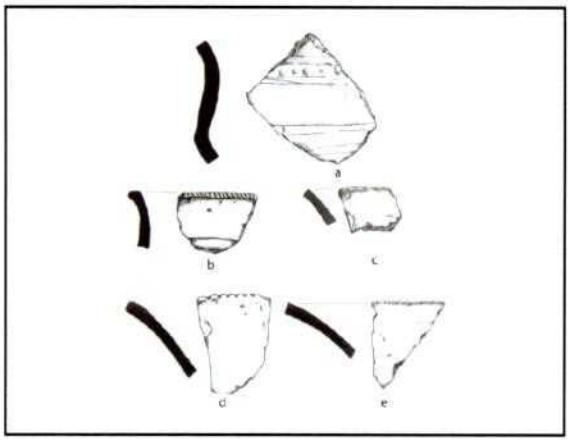
GARUA FSZ dentate

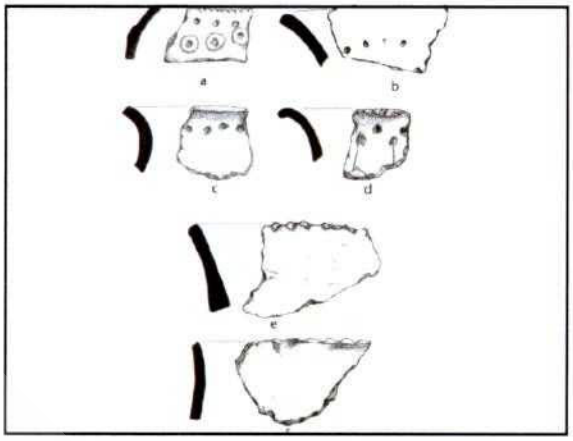


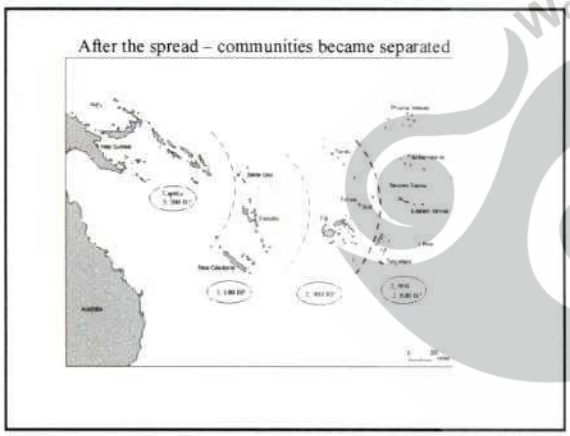
LASIGI dentate

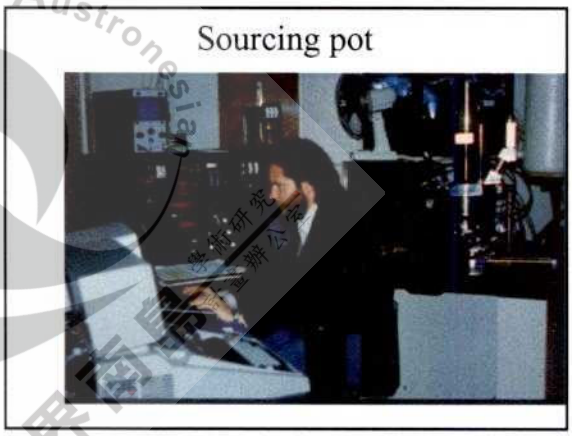


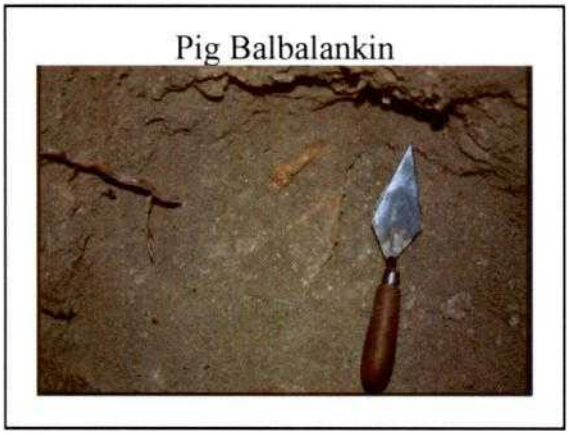


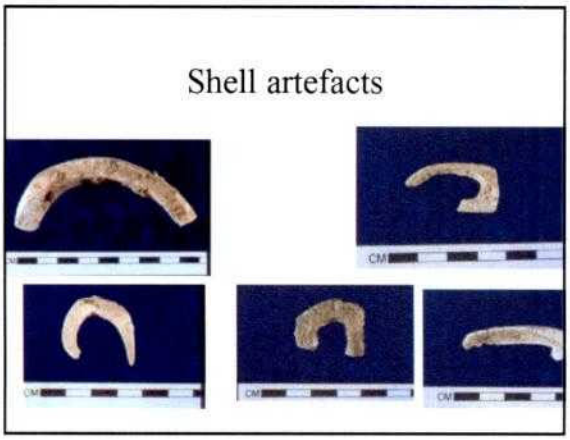


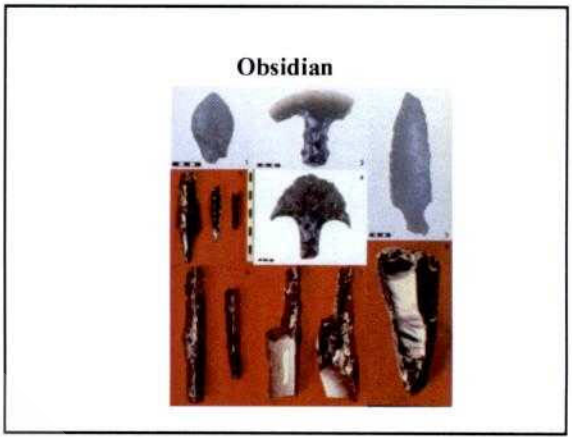


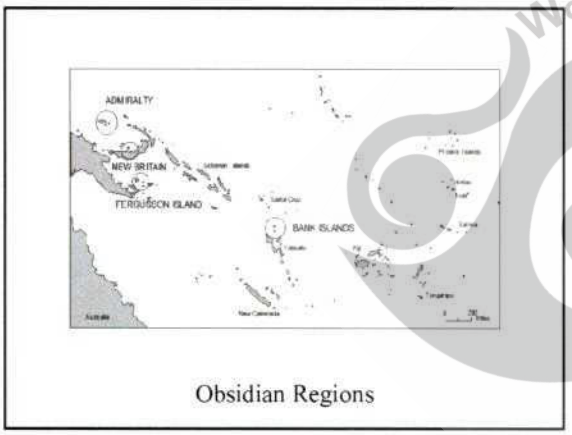


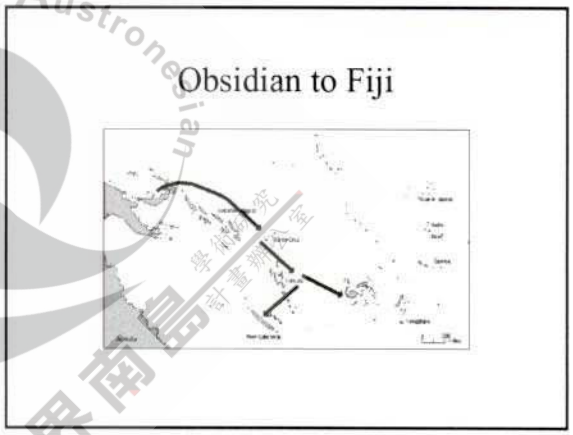


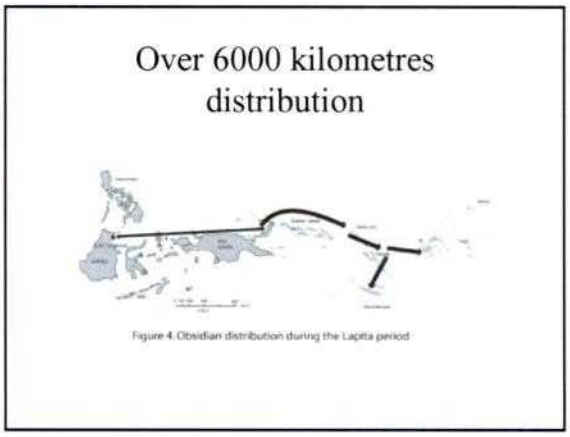


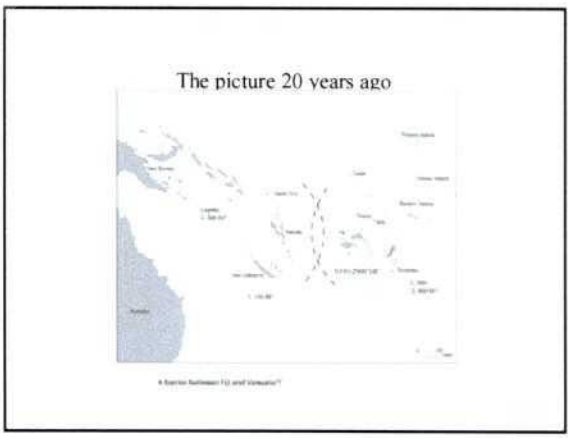


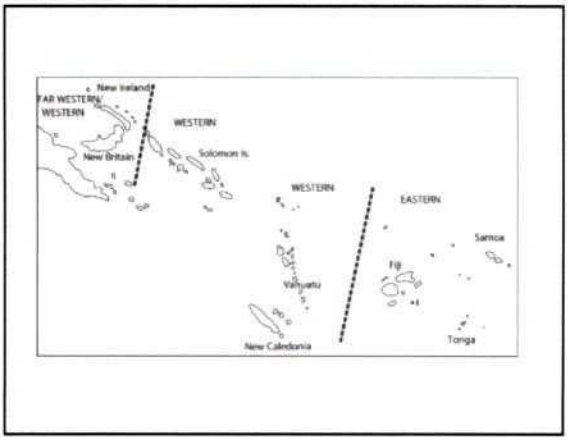








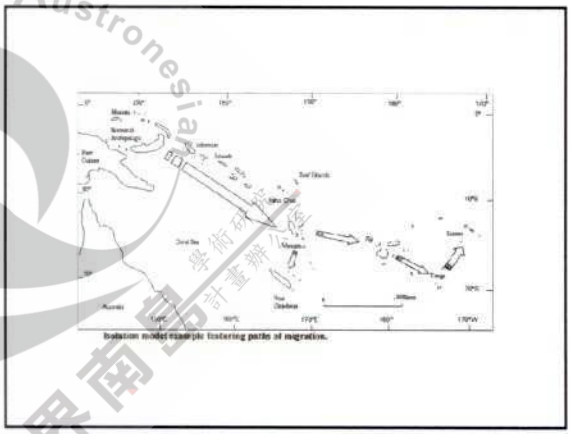


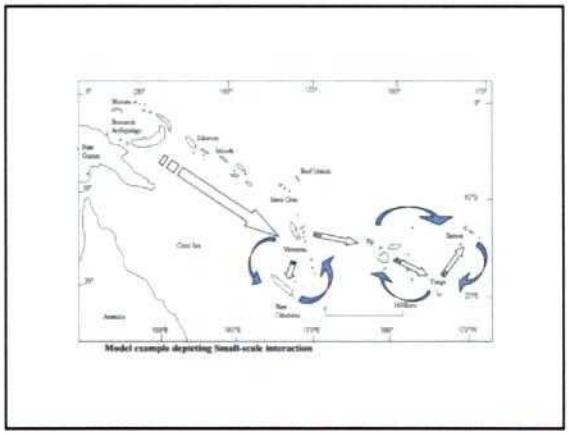


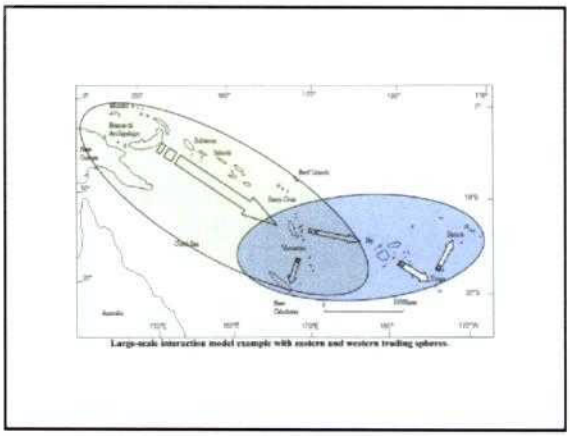
- Over the last 20 years:
- Defined a longer sequence from the Bismarck Archipelago. The unique processes seen to have been undertaken in the East – now seen in the West as well.
- ARE SIMILAR PROCESSES OCCURING IN BOTH AREAS? OR
- Total isolation has not occurred with some form of interaction whatever the nature may be – BIOLOGICAL AND CULTURAL – STILL OCCURING AFTER THE INITIAL COLONISATION OF THESE AREAS?

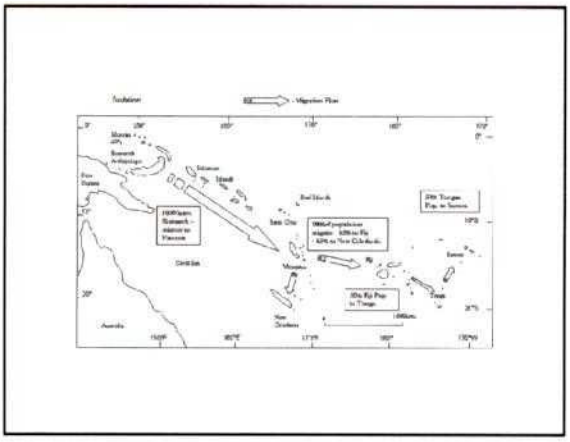
New Terms	Old provinces	Age ranges	Bismarck Archipelago	Reef/Santa Cruz, New Caledonia	Fiji	Rotuma, Fiji, Tonga	Samoa
Late	Eastern	2900BP+	X	X	X	X	
Middle	Western	3100-2900 BP	X	X	X		
Early	Far Western	3300-3100BP	X				

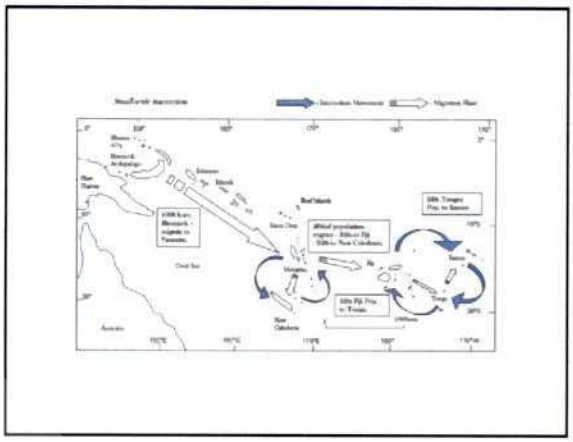
Chronological and spatial spread of Early, Middle and Late Lapita





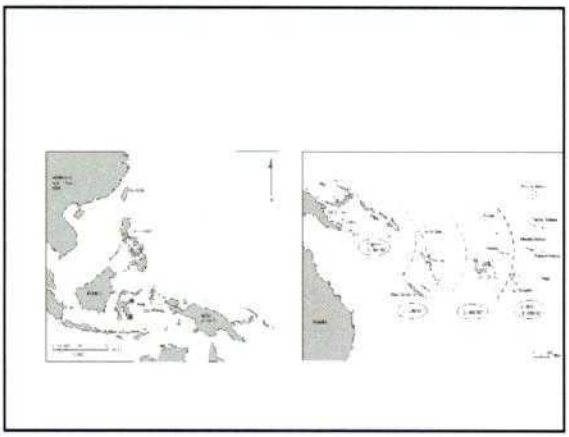






Remember Samoa!

Now back to the south Papuan Coast

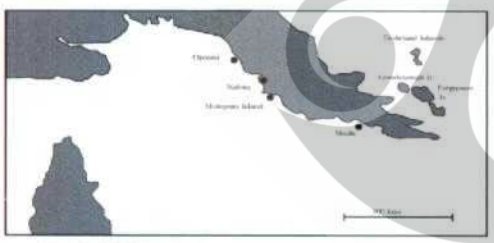


- To understand this colonisation – you have to know about the previous colonisation events in the Pacific - LAPITA

- Vanderwal – was let to Oposisi in search of "Polynesian" adzes?
- Excavated Oposisi as part of his PhD
- He defined a pottery sequence beginning 1800 BP
- A hiccup occurred at between 1200-800 years ago – with changes in the pottery occuring

- Little work in this regions over the last 30 years
- McNiven reckons he has found pottery in the Torres Stratits – 2500 years ago??
- Original Oposisi excavations had their problems – dug in ½" sieves – obsidian falling through?
- Need to have a closer look!!

Map of early sites



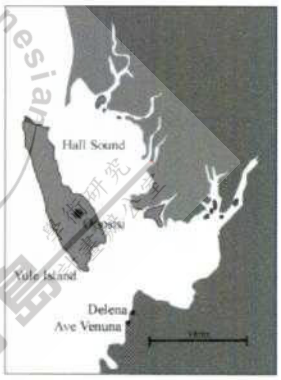
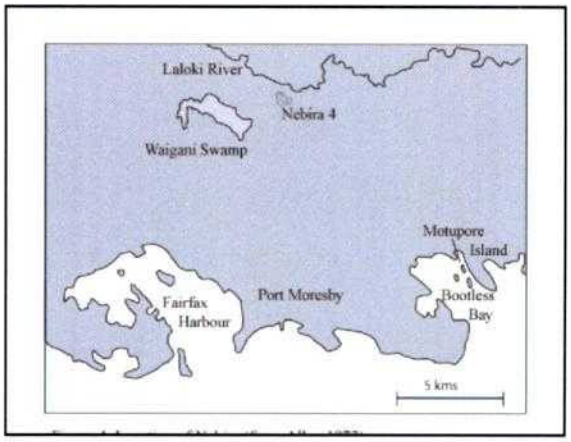


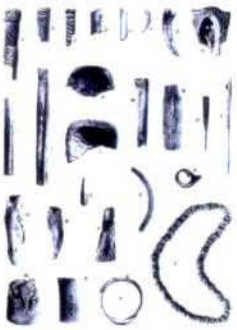
Figure 2. Location of Oposisi and surrounding

Yule Island

Vanderwal at Oposisi



Oposisi bone & shell



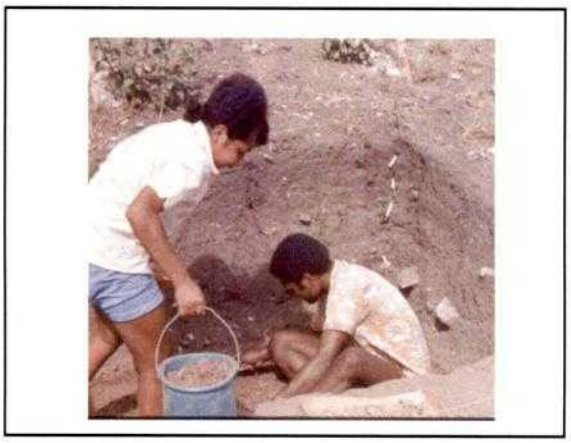
Apere Venuna adzes

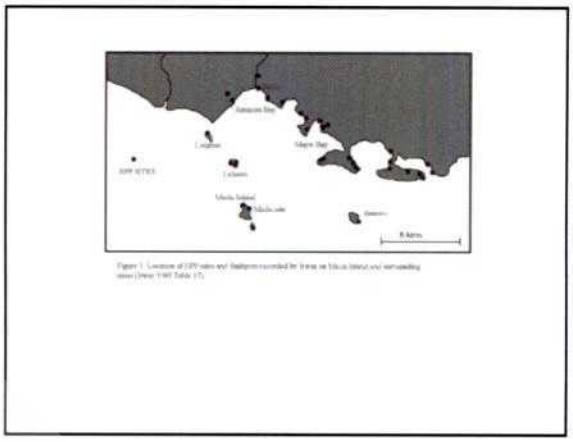
Early Papuan Pottery

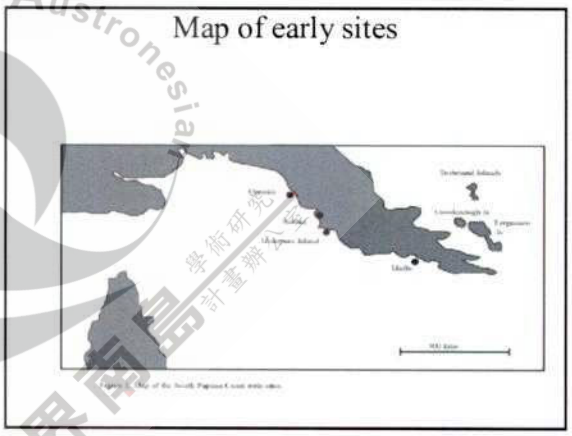
- The south coast of Papua was colonised at 2000 years ago by people bringing with them pots.
- Sites spread from Mailu to the Gulf have identical pots
- Why??????

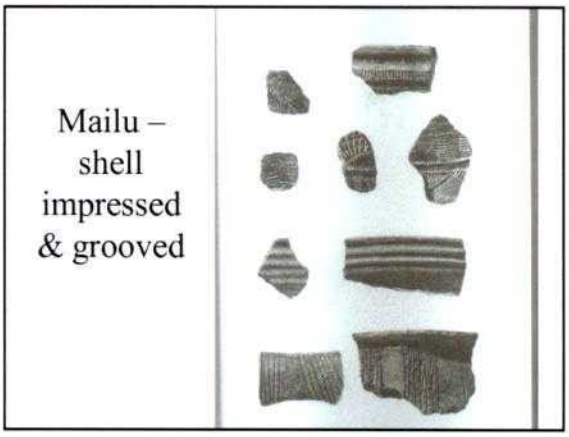
Nebira from Waigani swamp

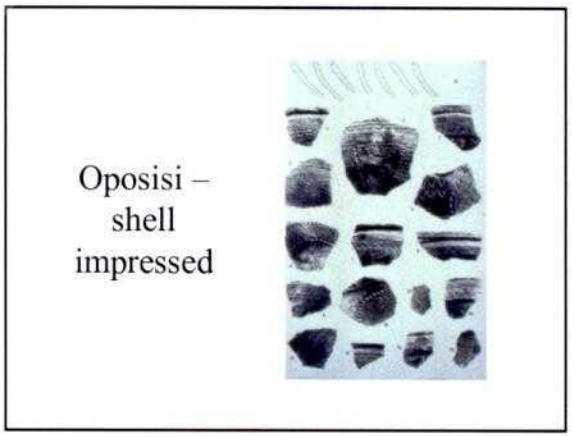
Nebira Hill











Nebira – Incised ware & shell impressed

Nebira – incised

Nebira incised, grooved, shell

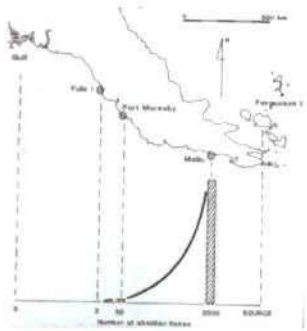
Nebira – etched sherd

Nebira – Late EPP style: etched, multiple incised, painting bottom

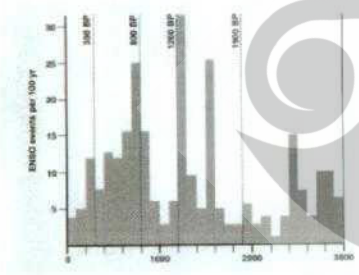
- A similarity between the dynamics of the original Lapita Colonisation and the subsequent colonisation of the South Coast by pottery users reflects the shared processes of colonisation:
  - Speed of colonising push
  - Site locations (larger and smaller offshore islands, beaches, headlands, some inland coastal river valleys)
  - Economy – mixed shell fish/fish/marine mammals plus a horticulturalist ingredient
  - Connectedness

EPP dates

EPP Obsidian



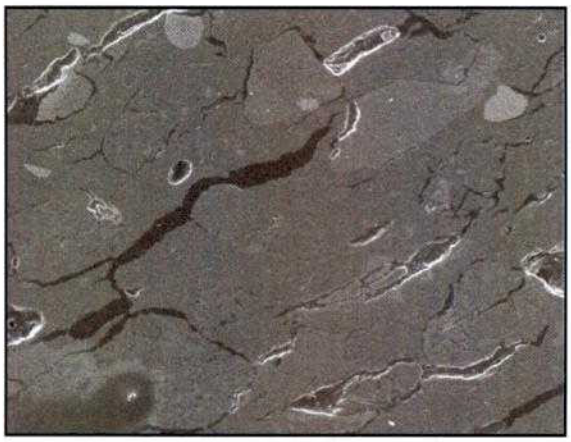
ENSO in Papua



Previous analyses:

- Worthing – thin section analysis
- Irwin – thin section analysis
- Bickler – XRF analysis
- Rye and Allen – thin section, PIXE (later wares)

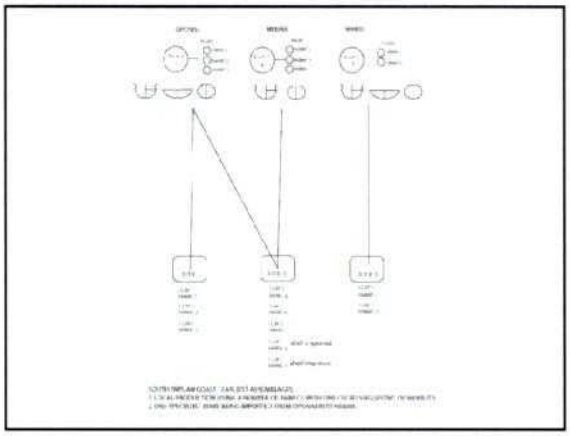
Sourcing pot



PCA of elemental analyses of EPP sherd samples

CPCRU – South Coast

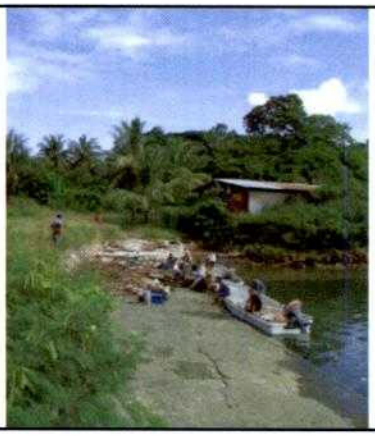
	Site	Site CPCRU
	CPCRU	
I.	OPSISI	NEBIRA SHELL IMPRESSED
II.	NEBIRA	
III.	NEBIRA	
IV.	MAILU	

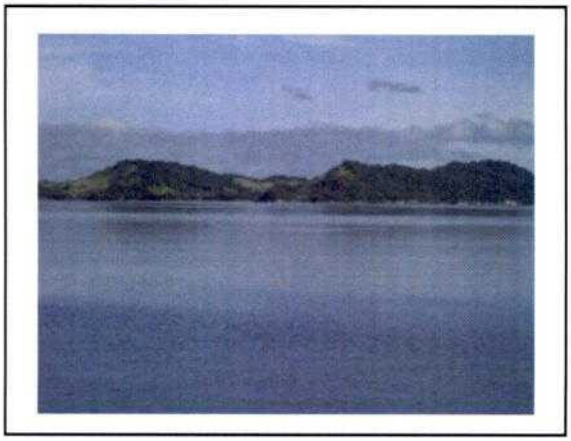


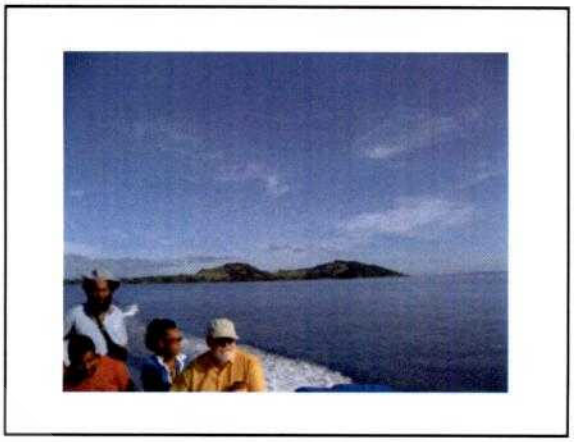
- Little work in this regions over the last 30 years
- McNiven reckons he has found pottery in the Torres Stratits – 2500 years ago??
- Original Oposisi excavations had their problems – dug in ½" sieves – obsidian falling through?
- Need to have a closer look!!

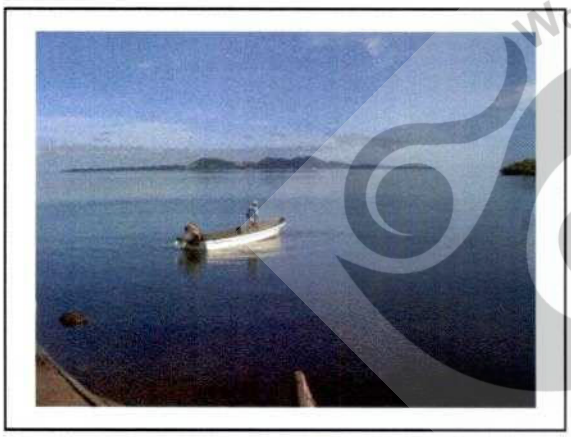
OPOSISI

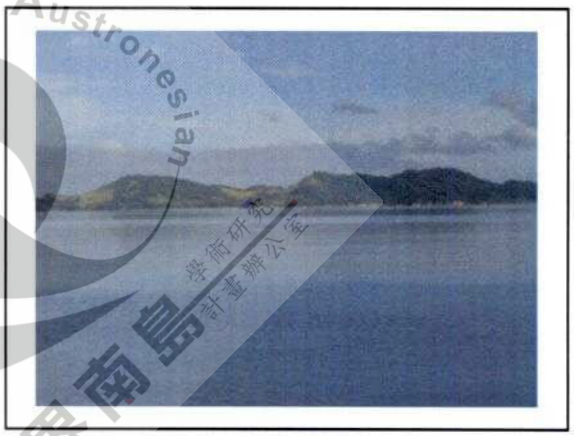
- 2007 FIELD SEASON

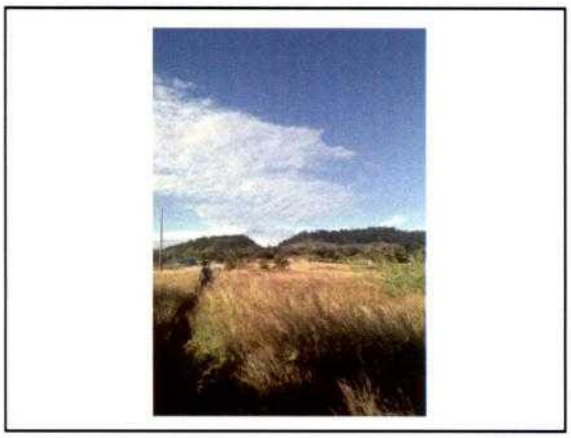


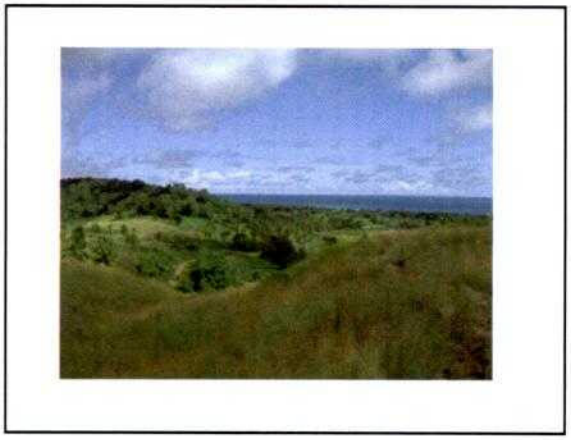


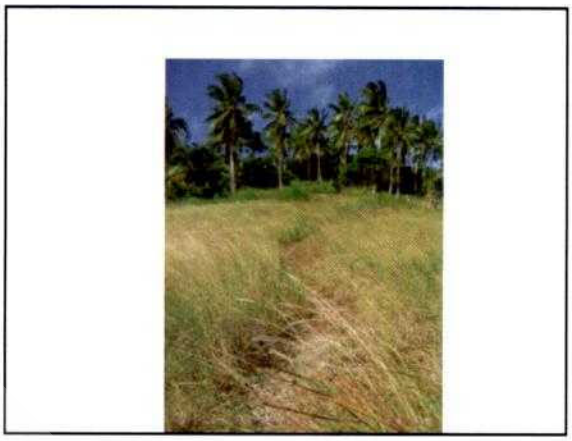


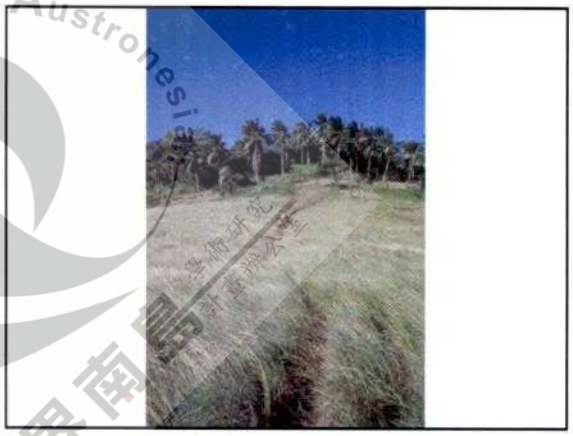


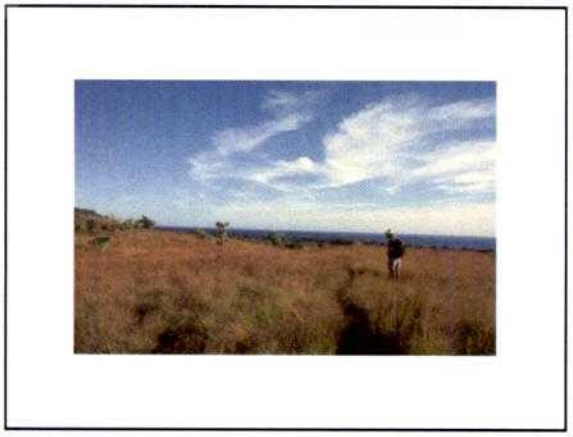


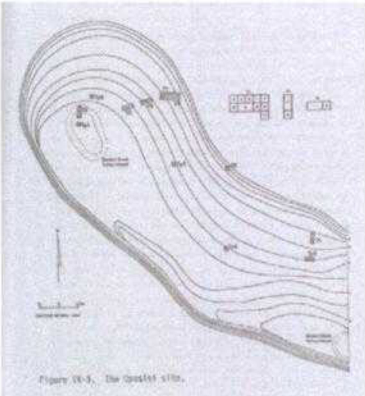


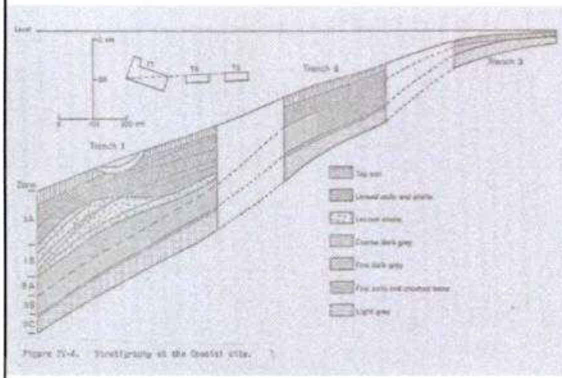


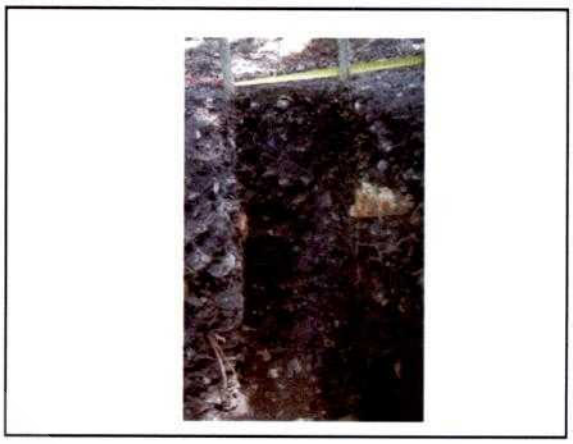


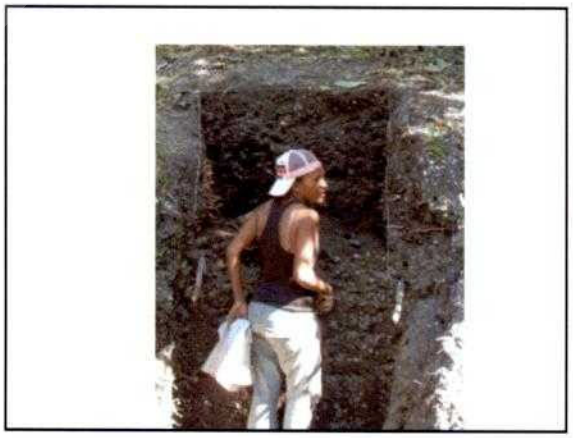


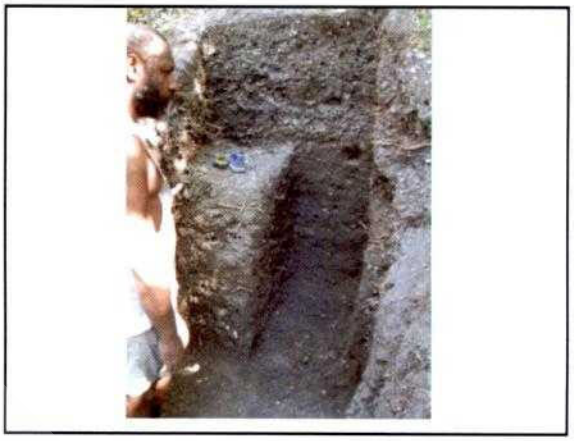


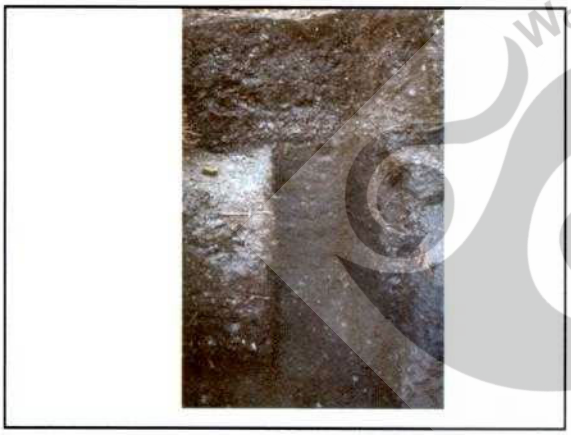


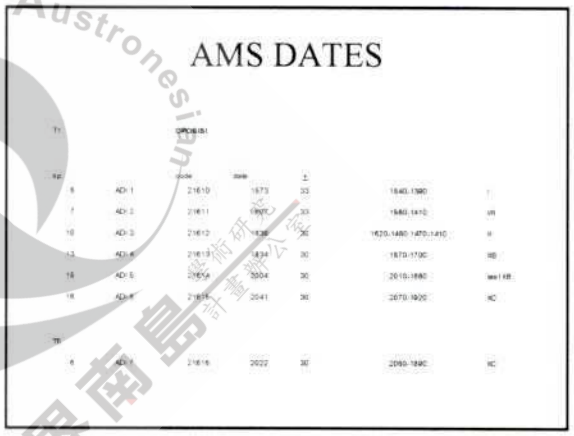


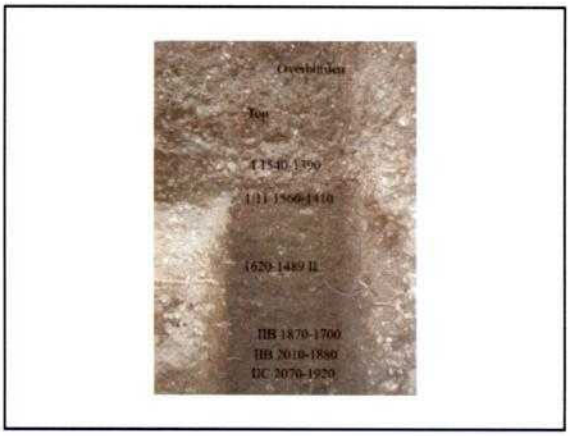




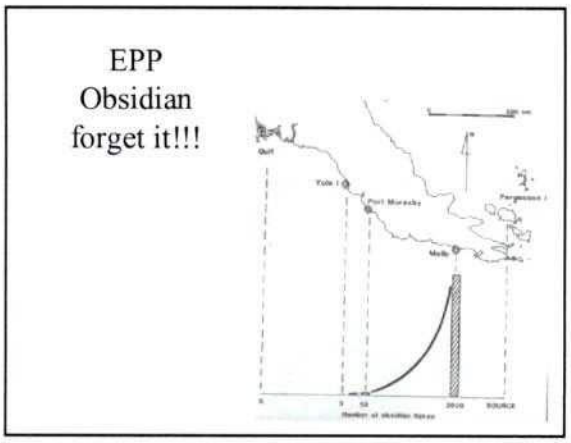


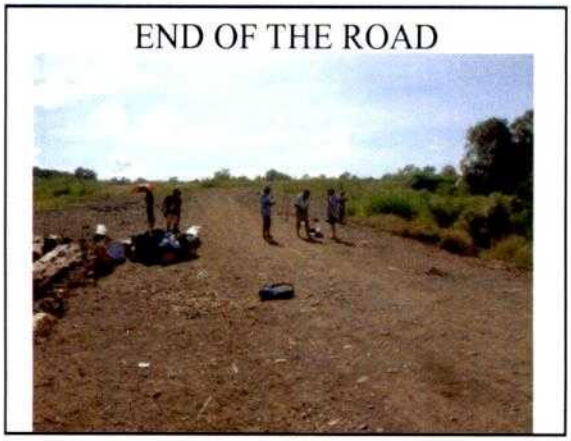






- Obsidian – over 20 pieces found – extrapolate this out = thousands
- Black/red chert found – 100's
- This is a midden site – tonnes of shell.
- Plenty of bone – wallaby, pig, and fish
- Bone carvings, stone adzes, shell beads, armbands
- Ring base – spit 11.





5

Lapita Writ Small? Revisiting the Austronesian Colonisation of the Papuan South Coast

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There may be something to be gained by comparing different episodes of colonisation with one another to see what they have in common as processes (Irwin 1991:506).

Introduction

By the late 1970s the prehistoric sequence of the Papuan coast was perhaps the best known in Melanesia. This was a product of the establishment in 1969 of archaeology at the University of Papua New Guinea and a succession of doctoral theses from the Australian National University (ANU). By this time data informing this sequence were known from excavations right along the south Papuan coast and Massim area (see Figure 1 and Table 1).

A subsequent shift of interest at the ANU to island Melanesia and the parallel growth of Lapita studies has seen the archaeology of mainland Papua languish, with only a couple of research investigations resulting in one major published study (Frankel and Rhoads 1994) and associated articles on Papuan Gulf research (Frankel and Vanderwal 1982a, 1982b, 1985; Rhoads 1982; Rhoads and MacKenzie 1991) together with some lesser enquiries around Port Moresby (Bickler 1997, 1999a). However, in the Massim more recent research by Irwin (1983, 1991), Bickler (1999b, 2006; Bickler *et al.* 1997), Burenhult (2002) and Kewibu (pers comm.) has extended what might loosely be called the South Papuan Province into these islands.

Much of the significance of these early pieces of research is now diminished because they were written, if not in ignorance of Lapita, certainly in the absence of our vastly improved knowledge of Lapita and

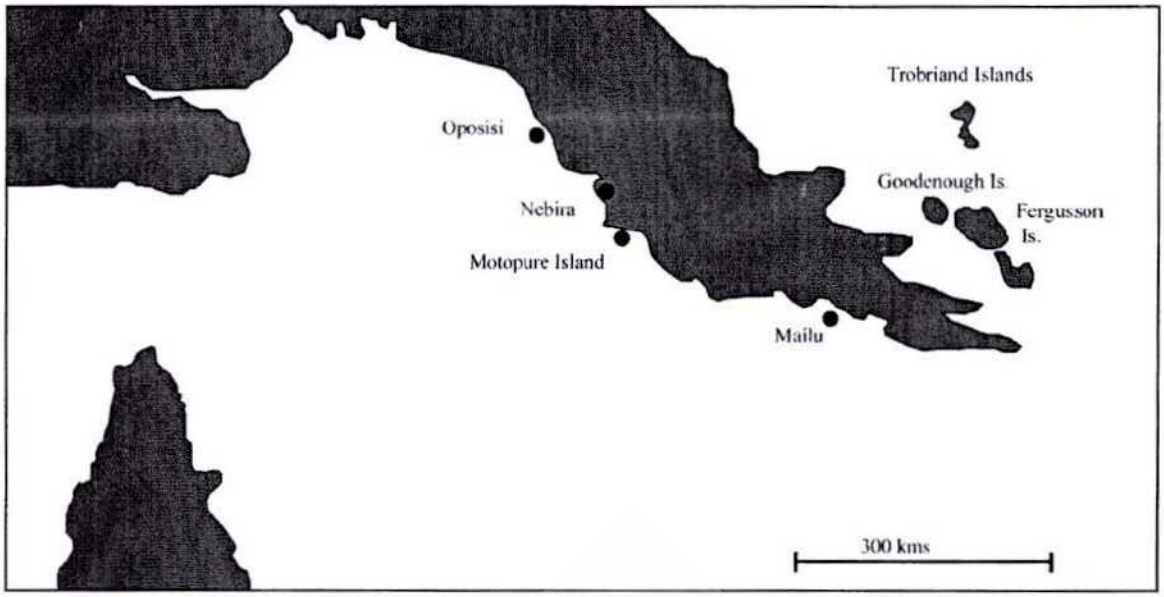

Figure 1. Map of the South Papuan Coast with sites.

post-Lapita archaeology in the Bismarcks and nearer Melanesian islands, and the specific research questions that now occupy researchers in those areas (for an update see Summerhayes in press a). Research into the Lapita assemblages from the Bismarck Archipelago has had a fundamental impact on the way the region's past is now modelled.

For example, early research into Lapita sites suggested that similarities in pottery were due to trade or exchange from a single or small number of production centres. Yet, research using chemical and petrographic techniques has now shown that pottery was mostly made locally. At the same time, we now recognise temporal changes to the production techniques for this pottery. Production during the Early Lapita period used many combinations clays and types of filler, while later Lapita assemblages indicated local production using only one clay associated with one filler in any particular area. Summerhayes (2000a, 2000b, 2003) used this analysis of pot production to argue for a change from a mobile society to a more sedentary one, with the long distance exchange of pottery in the Bismarck Archipelago occurring after Lapita pottery had disappeared. Models of this sophistication were not available to inform early syntheses of south coast Papuan prehistory, although Irwin's (1977) doctorate on the emergence of Mailu as a specialised pottery manufacturing village was seminal in offering moves away from earlier culture history approaches.

We consider it worthwhile to revisit the south coast data for two reasons. The first is to examine the degree to which the colonisation of the Papuan coast is similar to or different from the Lapita colonisation, despite differences of scale. Although the Papuan diaspora involved pot-making Austronesian speakers, themselves ultimately Lapita descendants, an important difference between the two colonisations is that in Papua, people colonised a continental size landmass, something that Lapita itself seems not to have achieved, whether or not it was attempted. The only suggestions of Lapita-like connections with mainland Papua New Guinea are based on tenuous links. There is a Lapita sherd reputedly collected by Leask from the Aitape area of the New Guinea north coast, that has yet to be chemically provenanced; a weathered sherd from Ali Island thought to be dentate stamped (Terrell and Welsch 1997); and from the Wanigela area of Collingwood Bay, cut-out pedestaled bowls reported by Egloff (1971a, 1979) in undated situations are seen by Kirch (2000:122) to possess a "striking Lapita affinity". These finds, together with the single piece of Fergusson Island obsidian recovered from a Lapita site in the Solomons' Reef-Santa Cruz Islands (Green and Bird 1989), does not rule out the future discovery of

Lapita on the Papuan mainland and in the Massim. On the other hand, given the now extensive work in the Massim, it seems improbable that Lapita sites have been missed, given their high visibility elsewhere.

The second reason is that in many Pacific areas it is difficult to choose between two models of post-Lapita change, one being localisation and adaptation and the other being cultural replacement. The occupation of the south coast by pottery users is considered by all researchers there to represent cultural replacement. Thus the question emerges, can the Papuan example inform post-Lapita studies elsewhere in Melanesia?

Following Irwin's directive, this paper draws attention to the similarities between the Lapita colonisation and the colonisation of the Papuan coast by pottery-using communities. Irwin (1991) himself pointed to this comparison without emphasising it and also listed most of the colonising characteristics we also discuss here. This paper is designed to continue that dialogue.

Table 1. Excavations along the south Papuan Coast and Massim Area prior to the 1980s.

Site	Reference
Gulf	
Rupo	Rhoads 1980
Kulupuari	Rhoads 1980
Samoa	Bowdler's work not published
Samoa	Rhoads 1980
Kairuku Region	
Kukubu Cave	White, J.P. 1965
Kukubu Cave	Vanderwal 1973
Oposisi	Vanderwal 1973
Ape Venuna	Vanderwal 1973
Urourina	Vanderwal 1973
Port Moresby	
Nebira 2	Bulmer 1971, 1978, 1979
Taurama	Bulmer 1971, 1978, 1979
Eriama	Bulmer 1971, 1978, 1979
Motupore	
Nebira 4	Allen 1972
Ava Garau (near Boera)	Swadling 1980, 1981
Papa Salt Pan	Swadling and Kaiku 1980
Amazon Bay	
Mailu Is. 01 and 03	Irwin 1974, 1977, 1978a and b
Selai	
Collingwood Bay	
Wanigela Area	Egloff 1971a and b, 1978, 1979
Goodenough Island	
Nuamata	Egloff 1978
Surface Goodenough, Amphletts	Lauer 1970, 1971, 1974
Trobriands	
Kiriwina, Kaileuna, Kitava, Vakuta - surface collections	Egloff 1978, 1979

The South Coast sequence

Sites older than 2,000 years are few along the south Papuan and Papuan Gulf coasts. Two examples from the Gulf are Ouloubomoto and Rupo from the Kikori region (Rhoads 1980). To the east of these it is remarkable that only a single pre-ceramic site has so far been recognised, at Kukuba Cave (ADL) near Yule Island, where a flaked stone assemblage yielded a mid-Holocene date (Vanderwal 1973:44-47, 51). This dearth of evidence is less likely to reflect a landscape empty of humans and more the difficulties of finding these earlier sites. But for the moment we have no idea

Table 2. The South Coast Sequence.

1.	Pre-ceramic ? -2,000 BP
2.	Colonisation 2,000 - 1,600 BP
3.	Regional Isolation 1,600 - 1,000 BP
4.	Pottery Transformation 1200 - 800 BP
5.	Interaction, Specialisation and Exchange 800 - 200 BP

what sort of cultural landscape the earliest pottery-bearing colonists encountered. The remainder of the regional sequence (Table 2) presented above was proposed by Irwin in 1991 and is used here to overcome the earlier confusion of local geographical and decorative style names given by various researchers to their own sites and regions.

Before reviewing Irwin's regional sequence we note that almost universally, early researchers divided the ceramic sequences into a more recent phase, where pots although prehistoric, have generic associations with local ethnographic wares, and an earlier phase where different generic relationships were observed archaeologically between regions. As a radiocarbon chronology was developed, local sequence disruptions were recognised at various sites along the coast somewhere between 800 and 1200 years ago that separated these earlier and later phases. This general disruption, dubbed the "ceramic hiccup" by Irwin (1991), appears to have carried beyond ceramic style changes, invoking socio-economic system changes along the entire coast.

Within this gross Early/Late dichotomy, pottery associated with the earlier phase has been given many labels. At first widely known as Red Slip pottery, this term was rejected because much of the pottery in this tradition is not slipped (Allen 1972). It has also been called the Laloki style (Bulmer 1999), the Initial Ceramic Phase (Vanderwal 1973:232, 1978:426), Early Period (Allen 1977a and b; Bickler 1997), Early Papuan Ware (Irwin 1991:503), and, jokingly, SPECHT ware (South Papuan Early Ceramic Horizon or Tradition). We now prefer and use the term Early Papuan pottery (EPP). While early researchers analysed pot shapes and rim forms of EPP and found changes through time (Allen 1972), decorative techniques and motif analyses have been most informative and these are what we concentrate on here.

Irwin's Regional Sequence (Irwin 1991)

Period 1 represents the sketchy pre-ceramic occupation down to c.2000 BP. Around this time or a little later, a number of sites, spread over 500 km of the south Papuan coast, were occupied for the first time by people using an identical style of pottery (Bulmer 1999:543). Period 2, representing this colonisation phase, is primarily defined from three major locations: Mailu Island's O1 and O3, and the site of Selai (Layer D) on the opposing mainland (Irwin 1977, 1985), Nebira 4 (Horizon III) near Port Moresby (Allen 1972), and Oposisi on Yule Island (Vandewal 1973, 1978) (see Figure 1). Early pottery was also found at Taurama (AJA) (Bulmer 1978), but the site may be disturbed (White with O'Connell 1982:201-2).

At all locations where the stratigraphy is intact, the earliest decorative form is elaborate shell impression (see Allen 1972: Fig. 7; Vanderwal 1978:420), lime infilled, mostly on bowls and found in all zones of the exterior surface. This is consistent from the Massim to the Gulf of Papua. The bowls without shell impression are either plain or have a single groove round the outside of the rim. Other vessel forms include small orifice vessels which Vanderwal (1978:418) called water jars, some with red paint, and the cooking pot which is larger with a wide flat rim. These forms are also found at Nebira 4 (Allen 1972), Taurama (Bulmer 1999) and Mailu (Irwin 1977) at least for cooking pots. As this implies there was some variation, such as the lack of rim grooving at Nebira that was dominant at Oposisi, and the absence of globular water pots at Mailu (see Bulmer 1999 for a review of the pottery). Multiple body grooving below the rim was also found on shell impressed bowls at Nebira 4 and in the Mailu assemblages. (Such grooving is also found in the Lapita assemblages of the Arawes (Summerhayes 2000a)). As discussed below this period was also associated with a wide range of non-ceramic material culture, particularly at Oposisi.

Periods 2 and 3 are separated by Irwin to accommodate a division between a period of initial colonisation where the same ceramics are found from the Massim to the Gulf and the first indication of regional variation in pottery styles. Examples of the latter are seen at Mailu where some local motifs develop and other

more widely distributed motifs like multiple grooving and painting continue, and at Port Moresby and Yule Island, where a similar series of parallel styles continue in both places down to about 1200 BP.

Contact between Mailu and localities further west is difficult to judge because Irwin did not report in detail any temporal sequencing of styles within the EPP tradition at Mailu, however this parallel sequence of styles at Nebira 4 in Port Moresby and Oposisi on Yule Island was quickly recognised. Shell impression in both regions in turn gave way to finely incised wares, again frequently lime-infilled (see Allen 1972: Figure 7 nos. 1-17), then multiple grooving (Allen 1972: Figure 6 nos. 9, 12) and finally etched decoration (Allen 1972: Figure 6 nos. 1-7) where the slip is scraped off prior to firing. Painted wares, present in the Port Moresby and Mailu sites and occurring throughout the Nebira 4 sequence, are absent in the Yule Island area. Conversely, etching, the most recent EPP style in the Port Moresby and Yule Island sites does not occur at Mailu. For a full description of the decoration see the original reports (Allen 1972; Irwin 1977, 1985; Vanderwal 1973, 1978).

Period 4 occupies the period between 1200 BP and 800 BP in which socio-economic systems and accompanying ceramic styles "transformed" in Irwin's terms from the earlier period to the later period as described above. Whereas the sudden appearance of pottery making communities a thousand years earlier is seen universally as a migration/colonisation, this transformation, initially argued by some to represent another migration event, is now seen to be a set of separate local reorganisations that were different from each other but likely to be causally related because of their contemporaneity. We return to this point in the discussion. In each region the record differs; in Mailu Irwin noted continuity in settlement patterns and other non-ceramic data; in Port Moresby Bulmer (1971) thought new pottery styles indicated external introductions from the Massim, a view she later retracted (Bulmer 1978). In the Port Moresby and Yule Island regions settlement patterns changed. At the peripheries changes occurred that were different again. In the Gulf pottery sites disappeared for a time, while in the Louisiade Archipelago "antique" EPP continued to be made for several more centuries (Irwin 1991:507-508).

As stated, all researchers accept that EPP, whatever the local sub-style forms, was abruptly replaced between 1200 BP and 800 BP. Taking a line through several western Port Moresby sites dug by Pam Swadling and colleagues (1977, n.d.; Swadling and Kaiku 1980) we now put the start of this disruption very close to 1200 BP, at least for the Port Moresby area. Elsewhere the dating is less precise and the sequences at the major sites now warrant re-dating. Change and reorganisation over the next 400 years led to the subsequent emergence of the immediate antecedent systems of specialised exchange seen in the ethnographically described Kula, Mailu and the Port Moresby Hiri systems. These occupy Period 5 in the Irwin scheme.

The rest of this paper concentrates on the Period 2 phase of colonisation and structural similarities with the Lapita colonisation of the Bismarck Archipelago and the Western Pacific.

Period 2 Phase – Colonisation of the south coast – the Argument

Any similarity between the dynamics of the original Lapita colonisation and the subsequent colonisation of the south Papuan coast by pottery-users could reflect some of the shared processes of colonisation that Irwin urges us to seek. Here we look at six of these: speed of colonisation, site location, economy, obsidian, other material culture, and pottery, with the latter two being indicators of connectedness. The first five will be looked at briefly, the last in more detail.

Speed of colonisation

No one working in the region doubts that the appearance of pottery-users along the south coast reflects a sea-borne migration of deliberate colonists, which is also the dominant model for Lapita. While some researchers (Kirch 2000) have argued for a west-to-east temporal cline in Lapita colonisation of the Bismarck Archipelago the distinctions may reflect the vagaries of radiometric dating as much as reality. Summerhayes has recently argued that the Lapita colonisation of the Bismarck Archipelago was instantaneous, with differences in dating due to the different calculation of oceanic reservoir effects used on shell samples (Summerhayes in press a). Available dates in Papua (Table 3) show this event also to be archaeologically instantaneous, likely occurring somewhere short of 2,000 years ago. Allen's (1972:109) Horizon III at Nebira correlates with Vanderwal's (1973) Style IIb and IIc, and Irwin's Early Papuan ware (Irwin 1977). Re-dating all these sites using more modern techniques might pinpoint the colonising period more accurately, especially given the presence of "red slip" pottery in Torres Strait argued to be 2,500 years old (McNiven *et al.* 2006). However, despite earlier opinions such as Pawley (1969:3), who suggested on linguistic grounds that Austronesians might have been present on this coast 3,000 years ago, the existing radiocarbon ages are sufficiently similar to put the age of the pottery in Torres Strait in doubt if it reached Torres Strait via Papua, rather than from somewhere to the west.

Table 3. Radiocarbon dates from earliest pottery occupation levels of the south Papuan Coast.

Site	Radiocarbon date	Reference
Mailu Area		
Mailu 01	1900±70 BP (ANU-1229)	Irwin 1988:66
Selai	1790±70 BP (ANU-1316)	Irwin 1977:82
Port Moresby Area		
Nebira 4	1760±90 BP (I-5796)	Allen 1972:99
Eriama	1930±230 (GaK-2670)	Bulmer 1978:213
Yule Island		
Oposisi	1890±305 BP (ANU-425)	Vanderwal 1973:48
	1530±160 BP (ANU-729)	
	1600±210 BP (ANU-728)	
Gulf		
Samoa	1850±95 BP (I-6153)	Rhoads 1980:250
	2430±370 BP (ANU-2061A)	

The ease with which both the Lapita and the Papuan colonisations were achieved has tended to render prior occupants archaeologically invisible. In the case of Lapita in the Bismarcks, sheer persistence by a few workers has forced some recognition of this problem (Specht 2005; Torrence *et al.* 2004). Equally, on the south coast it would be foolish to believe these colonists encountered empty landscapes. Within the Bismarck Archipelago, Summerhayes (in press a) has argued that the population levels for the existing mobile hunting and gathering communities was low and the absence of evidence for earlier hunters on the Papuan coast suggests that the same is true there. In neither case has much attention been paid to the probable interactions between incumbents and new arrivals in these situations (e.g. Kirch 2000:93).

Site Locations

Lapita site locations are predominantly coastal, with most being beach locations (Anderson *et al.* 2001). The EPP sites are also mostly coastal. Oposisi is located on Yule Island on the highest part of the island at 125 metres a.s.l. (Vanderwal 1973, 1978:417) (Figure 2). Mailu is a small island, while Selai is a beach location (Figure 3; Irwin 1977). In the Port Moresby region EPP sites occur on beaches and headlands such as Taurama beach and headland and on islands, such as Daugo Island. Nebira on the other hand is 15 kilometres inland

from the present coast. Nebira 4 is located at the northern base of Nebira Hill, a twin peaked hill rising c. 180 m from the flat Waigani plain (Figure 4). Nebira 2, excavated by Bulmer (1978), was located in the saddle of the two hills. Allen (1972) pointed out that although the areas is now savannah woodland, it need not have been in the past, since the sea may have been much closer than it is today. The higher sea stand of 1.5 metres at 3300 BP would have covered nearby low lying areas, likely locating Nebira Hill much closer to the sea than it is now. The subsequent infilling of this area is also to be expected, given that Swadling *et al.* (1976:56) point out that the Papuan Coast has prograded with the Angabanga plains being produced by Holocene age alluvial and littoral deposits. Roro traditions note that the Hall Sound area once had islands and Redscar Head, which is today joined to the mainland by a mangrove swamp, was recorded by the Spaniard Don Diego de Prado in 1606 as being an island (Swadling *et al.* 1976:56). More detailed geomorphological work in the region is needed.

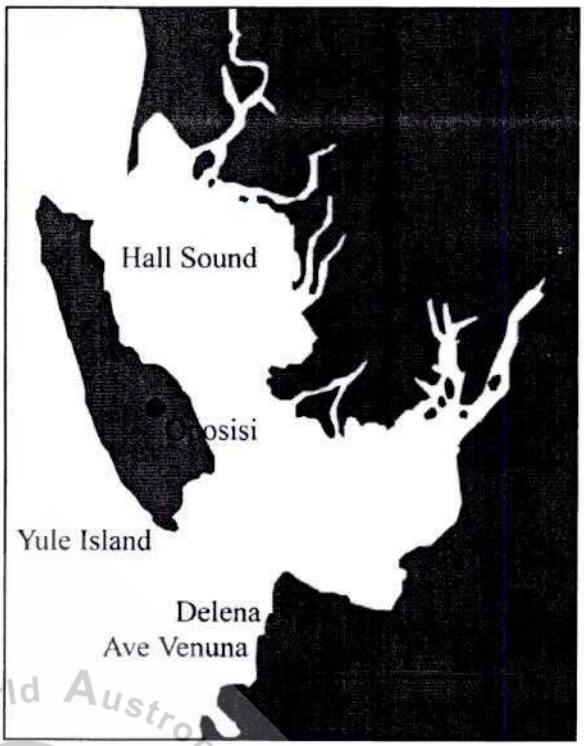

Figure 2. Location of Oposisi and surrounding sites (from Vanderwal 1978).

In summary, site locations reflect the sea-borne nature of the Papuan colonisation, with village sites occurring on larger and smaller offshore islands, beaches and headlands, but with inroads into coastal hills and river valleys occurring quickly. While these last locations probably reflect the utilisation of better gardening land, pottery is also found in caves and rockshelters (e.g. Eriama, Kukubu Cave). Is this reflecting

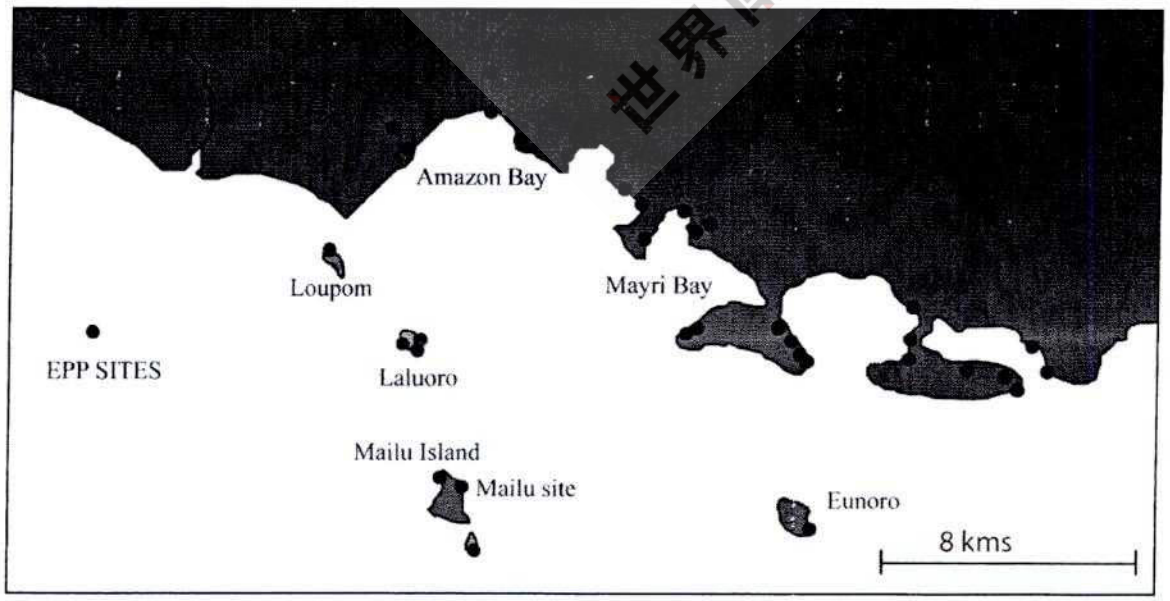

Figure 3. Location of EPP sites and findspots recorded by Irwin on Mailu Island and surrounding areas (Irwin 1985 Table 17).

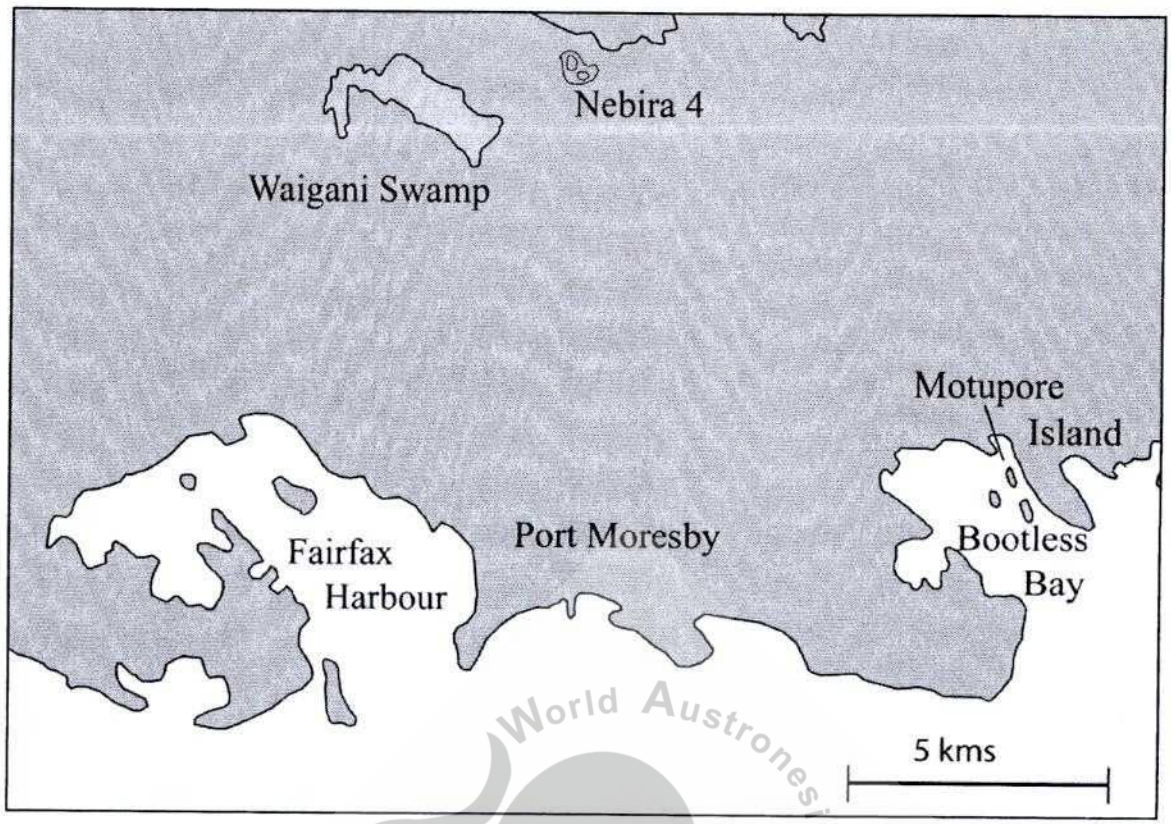

Figure 4. Location of Nebira (from Allen 1972).

the broad spectrum subsistence activities of the colonists or the transfer of pottery to prior occupants through exchange? Certainly in some Lapita situations where there are no prior occupants, it represents the former. On the Papuan coast we simply need more data to investigate this question.

Economy

The economies of both Lapita and Papuan sites appear to be mixed, with strong emphasis on marine resources (fishing and collecting) supplemented by hunted and gathered land resources and with the continuing inference of horticulture. Nebira's inland location is of interest in this respect since the faunal material from the early phase at Nebira 4 reflects a strong marine imput that diminished over time (Allen 1972:116). Apart from catfish (*Tachysuridae*), the rest of the fish found at Nebira 4 were coastal reef dwellers (*Aluteridae* or *Balistidae, Scaridae* and *Labridae*). Turtle and dugong were also found in the earliest levels, as were thirty-six species of marine molluscs. Less than 1 % of molluscs were fresh water species (*Melania* sp and *Velesuni* sp). The most common marine shell species among the 36 species identified were *Chama* sp., and various strombus species (*S. labiatus, S. luhuanus, S. gibberulus gibbosus* and *S. canarium*). Of importance is the presence of *Chama* sp. At Nebira Allen mused over its presence, as the shell has a high shell/meat ratio (Allen 1972:119). Why carry it so far inland? The answer may well lay in the geomorphological changes that have occurred over the last 2,000 years, and may provide support for Nebira being closer to the sea at its initial occupation. Evidence for local hunting was seen in the presence of wallaby (*M. agilis*) and horticulture in the presence of pig.

The economy of the earliest layers at Oposisi was similar, providing evidence that both land and sea were exploited for subsistence. Shellfish remains were found in large quantities, along with wallaby, fish, turtle, dugong, crocodile, cassowary and pig (Vanderwal 1973:178, Table VII-23)

The economy of Mailu in the early pottery period was coastal (see Irwin 1985: Chapter X). Midden material was mostly shell fish, with species of shell reflecting the ecological differences between Mailu and mainland sites. Turtle, dugong, fish, crabs and sea urchins are also found. Shellfish, however, was found in great volume. Vertebrate remains were in Irwin's terms meagre (1985:241). Pig and dog were found, along with two types of wallaby (*M. agilis, Dorcopsis* sp.) which must have derived from the mainland (Irwin 1985:237).

Like the Papuan assemblages, the coastal location of Lapita settlement was reflected in the economy. From the Early Lapita site of Kamgot (on Anir) for instance, fish bone dominates the faunal assemblage. The most popular fish were inshore varieties such as *Scaridae* and *Diontidae*. Most of the fishing was inshore or from the reef, although shark, tuna, dolphin, turtle and barracuda were also present. As expected with some of these species a number of fishhooks were recovered from Anir (Szabo and Summerhayes 2002). A similar exploitation of fish occurs at another Early Lapita site, Mussau, as well as the later Lapita site of Watom (Butler 1988; Green and Anson 2000:52; Kirch *et al.* 1991). Fishhooks are also found at these sites. From Kamgot, the midden remains also have a high land mammal content, including phalanger, *Thylogale browni*, pig, chicken, dog, and *Rattus exulans*. Found in association with house structures, pig, chicken and dog are domesticated, and as such, are also good indicators of horticulture. There is also evidence for arboriculture from the Early Lapita assemblages at Mussau and the Arawe Islands (Kirch 1989; Matthews and Gosden 1997).

From later Lapita assemblages the diet was mostly terrestrial. At Watom for instance it was argued on the basis of stable isotope analysis on human bone that 64 % of the diet was land based, the rest made up of shellfish (8.7 %), coral reef fish (9 %) and non-reef fish (21.3 %) (Green and Anson 2000:51). Plant foods made up most of the food energy (Leach *et al.* 2000:158). Large numbers of pig bones were also found at Watom enabling a detailed study on age distribution that suggests animal husbandry (Smith 2000:145). Green and Anson argue that this is indirect evidence for agriculture necessitating "domesticated plant foods in sufficient abundance to feed both pigs and people" (Green and Anson 2000:50).

Independent evidence for Lapita agriculture using either starch residue analysis on pottery and/or phytolith analysis on sediments is now provided from the following Lapita sites: Kamgot (Crowther 2005); Uripiv Island, Vanuatu (Horrocks and Bedford 2005) and Bourewa, Fiji (Horrocks and Nunn 2007) where *Colocasia esculenta* has been identified. Palms and banana (Eumusa) have also been identified from Watom (Lentfer and Green 2004). Unfortunately, these newer scientific techniques have not yet been applied to the pottery and deposits from the south coast.

It is hardly legitimate to list a mixed economy of fishing, collecting, horticulture and hunting as a distinctive marker, since these may well have occurred before the colonisations and certainly after. But for the first time in both the Bismarcks and the Papuan coast an increased intensity of subsistence acquisition in the archaeological record is sufficient to equate it with the first appearance of open village sites (although these may have already been present in the Bismarcks (Allen 2000:156-163)). While it is acknowledged that the high visibility of sherds in tropical landscapes might explain an increase in recognised sites, it is not sufficient to explain this sudden increased visibility. Sites are occupied by more people for longer periods.

Obsidian

All or most models of Lapita emphasise connections between sites and sometimes back to homeland regions. These linkages continue through time but are most visible and elaborate in the early phases of the colonising

process (Kirch 1988; Summerhayes 2000a). Archaeologically this connectedness is marked by similar pottery styles and the distribution of obsidian and these are clearly parallelled in the Papuan case.

Obsidian, all sourced from Kukuia and Fagalulu, west Fergusson Island, has been reported from a number of EPP sites as far west as Yule Island but not in the Gulf (Ambrose 1976; Bird *et al.* 1981; Green and Bird 1989; Irwin 1991:Fig. 3). The amount of Fergusson obsidian reaching these sites reflects the distance from the source (Irwin 1991: Fig. 3; White *et al.* 2006). In the Oposisi assemblage, two Kukuia flakes were found, more than 650 km from the source area (Vanderwal 1973:214). Two others came from nearby Apere Venuua (Vanderwal 1973:214). From Nebira, which is 550 km from the source, small quantities of flakes were found from the earliest levels to the most recent. From Mailu, which is 350 kilometres from the source, obsidian was found in larger quantities (146 for the early period), however, this decreases over time to only a handful after 1600 BP, with numbers rising again in the second millennium AD (Irwin and Holdaway 1996). However while obsidian again reaches Mailu in significant numbers at the beginning of the post-EPP phase, it does not get as far west as Port Moresby. Obsidian was still traded to Mailu up to the beginning of the twentieth century (Green and Bird 1989).

As modelled by Irwin (1991), the distribution of obsidian is what might be expected by down-the-line exchange, with much more appearing in Mailu sites, nearer to the source. While we believe the two pieces of obsidian reported at Oposisi are an underestimate resulting from the sieve mesh sizes used there (1/2 inch or 1/4 inch used variably in the excavation (Vanderwal 1973:29), these general distinctions of volume between regions remain accurate. Sue Bulmer interpreted the small number of pieces in the Port Moresby sites as reflecting the unimportance of the trade in obsidian to Port Moresby (Bulmer 1979:23). Certainly the ready local availability of good quality chert reduced any utilitarian need for obsidian, and thus we see its small but continuing presence there as an important indicator of the maintenance of eastward linkages throughout the EPP phase, and not merely a reflection of the initial pulse of first colonisation. Yet, was the distribution of obsidian "down the line exchange"?

Changes in the nature of obsidian reaching Mailu inform us about the nature of interaction among these communities. The obsidian found in these early sites is technologically different from later assemblages suggesting different distribution processes. Technological studies on the obsidian assemblages from the Mailu region showed that the earlier "colonising phase" in Mailu had heavier obsidian than later periods, which is "incidental to the high frequency of communication among related communities undergoing a phase of expansion" (Irwin and Holdaway 1996:228). This is different to obsidian reaching Mailu during later periods in what Irwin called a later "trader mode" (Irwin 1991:506).

Similar processes are seen in the distribution of obsidian in the early Lapita assemblages. Earlier Lapita assemblages show an expedient technology not seen in the earlier pre-Lapita or later assemblages away from the source regions (Summerhayes 2004, in press b). Hanslip (2001:196) for instance argues that the earliest assemblages from the Reef Islands and Santa Cruz, RF-2 and SZ-8, which are also part of the colonising phase, not only had the largest pieces of obsidian and lacked bipolar flaking, but also showed no signs of on-site production. That is, the material was imported as is, not as blocks. Such an expedient technology is not expected from a down the line exchange network. Specht (2002:42) also shows that the earlier Lapita assemblages had heavier pieces of obsidian (mean weights) and from the one site where data is available (Adwe) there is a decline in this mean weight over time in the Middle Lapita period. Taken together the reduction in the size and weight of obsidian indicates an "economising" behaviour associated with later down the line exchange.

Yet, like the assemblages from Moresby, obsidian continues to be distributed after the initial colonisation pulse is over. Obsidian continues to be imported into Lapita assemblages in the Reef Islands and Santa Cruz well after it was initially colonised (Green 1987). East of the southeast Solomons obsidian is rare (although see Galipaud and Swete Kelly this volume) although still found in post colonisation contexts, such as in Naigini, Fiji (Best 1987), and Tikopia where it was found in Middle to Late Lapita contexts (Kirch and Yen 1982). Communication between these far-flung communities still existed after the colonisation phase in western Melanesia was over.

Non-ceramic material culture of the EPP phase

The EPP phase contained a suite of artefacts beyond obsidian and pottery that is more reminiscent of the insular Pacific and Lapita sites than the post-EPP phase that eventually replaced it along the Papuan south coast. The best examples come from the Yule Island sites. Oposisi in particular produced an elaborate range of bone and shell artefacts, among them awls, scrapers and gouges, spatulas with handles, tubular bone beads, including some from human bone, human cranial tablets, pierced animal teeth and pendants, shell beads and conus and trochus bracelets. Vanderwal (1973:129-32) also described 26 adzes of which 16 were trapezoidal in form, different from the more common lenticular Papuan forms. These trapezoidal forms occurred mainly in the earliest stratigraphic unit of Oposisi (IIC) and at the nearby site of Apere Venuna, which Vanderwal equated with Oposisi IIC on ceramic grounds (Vanderwal 1973:131). Two similar adzes occurred in the surface collections from Nebira, but no other parallels are known within the EPP phase or subsequent to it along the Papuan coast. There are, however, 127 similar adzes in the Australian Museum in Sydney collected in 1934 by R. V. Oldham, and catalogued as coming from Delena, an existing town adjacent to Apere Venuna. This collection is thus considered to be a part of the Apere Venuna assemblage described by Vanderwal.

Most (but not all) of these artefact types occur only in the early part of the Oposisi sequence and are not seen in this abundance at other EPP sites, although aspects of this assemblage do occur at these other sites. Alone among Papuan researchers, Vanderwal considered that the more elaborately decorated shell impressed pottery and the associated rich bone and shell assemblages of the initial colonisers, when compared to the simpler material culture of later inhabitants at Oposisi, were sufficiently different to argue cultural replacement of the former by the latter. Today this view no longer holds, but the simplification of material culture that accompanied settling into the landscape raises other issues that we will return to in the conclusion.

Pottery

We have already touched upon connectedness reflected in similar sequencing of decoration styles between regions. Here we identify and compare pottery production patterns and changes over time between the south coast and Lapita assemblages in order to identify a pot production signature for colonising societies. This will be done by first outlining Lapita pottery production and its change over time; secondly by reviewing past attempts at identifying pottery production on the south coast using physical/chemical analyses; thirdly, presenting the results of our pottery production analyses using the electron microprobe; and lastly by comparing and contrasting the results of our analysis with Lapita pottery production patterns.

Lapita Pottery Production

Despite the amount of attention that has been given to Lapita pottery, relatively little has been done on identifying production and distribution patterns. With rare exceptions, most of the physical/chemical analyses of pottery have been limited to assessing whether pots have been locally made or imported. However, a study by one of us (GS) has attempted to tie production patterns to mobility/settlement models in Lapita settlements within the Bismarck Archipelago (Summerhayes 2000a, 2000b, 2003). Two patterns of production were identified.

The first suggests that production of Early Lapita pottery was mostly local. Technologically these potters were not conservative, using a number of combinations of tempers/fillers from different river systems and beaches and different clays to produce an identical variety of vessel forms and decorations (Figure 5).

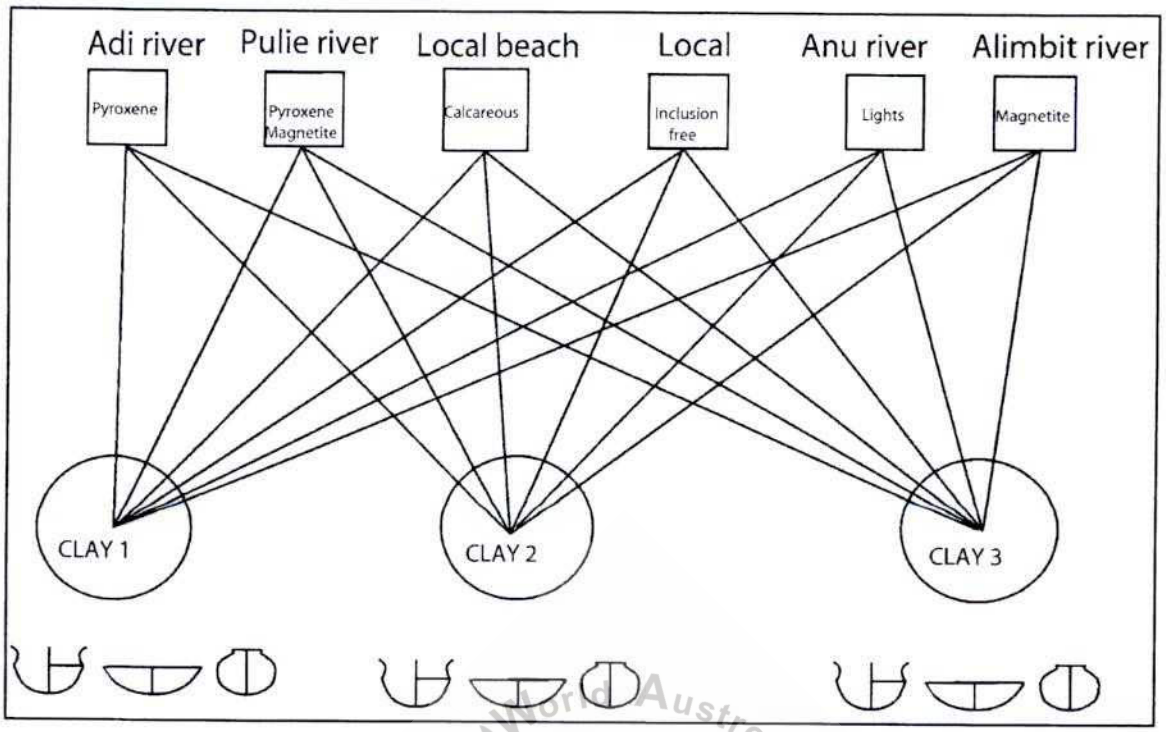

Figure 5. Early Lapita Production Pattern.

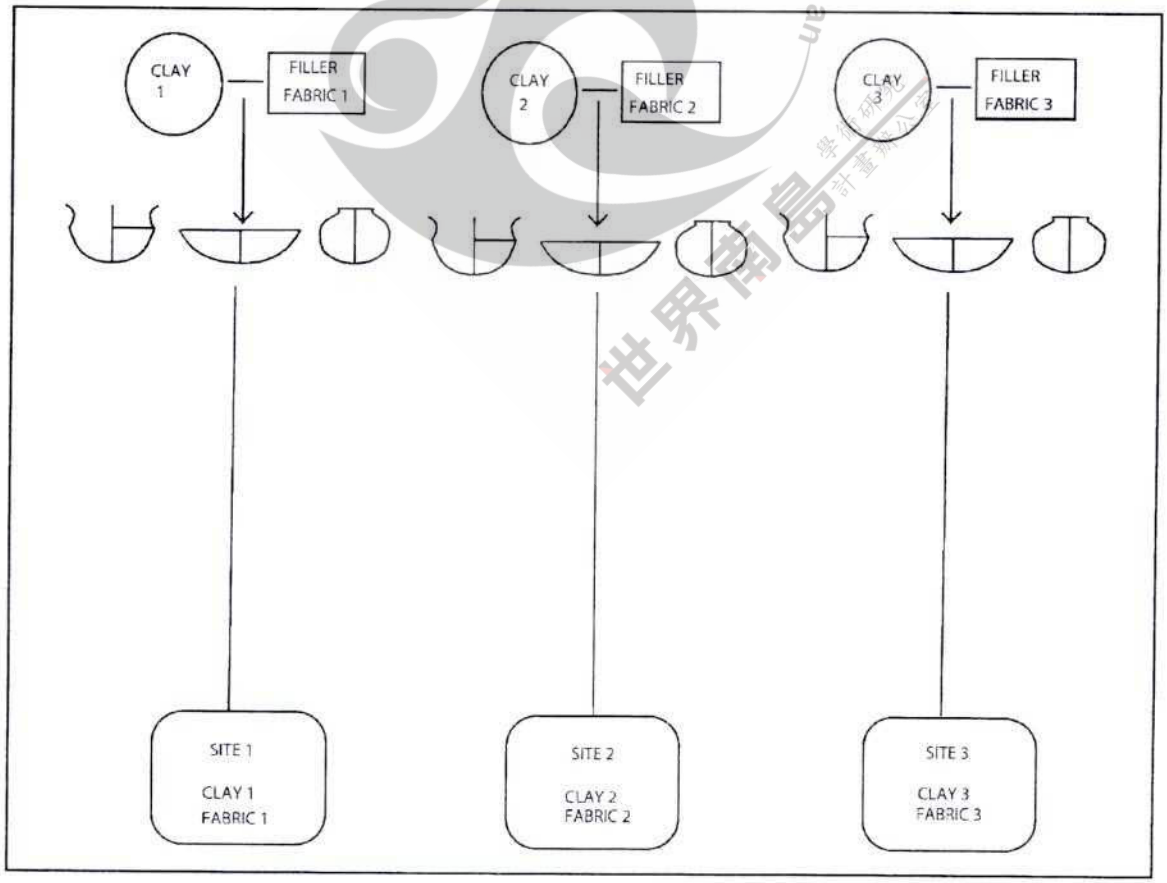

Figure 6. Late Lapita Production Pattern.

A different pattern of production occurred for later Lapita styles. While production continued to be locally based, production became more conservative and standardised with only one temper/filler found with associated clays (Figure 6).

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 colonisation period and the later pattern reflecting more sedentary communities.

Neither pattern is like specialist pottery production for exchange seen in the ethnographic past from a number of areas in Papua New Guinea. These differences are represented graphically by comparing Figures 5 and 6 with the representation of specialist production in Figures 7 and 8.

Previous attempts at identifying pot production along the south coast

This characterisation of Lapita ceramic production allows comparison with south coast EPP production for the first time, but several previous attempts to characterise this latter set are instructive and are briefly reviewed here.

Previous attempts have mainly used physical characterisation analyses. Bill Dickinson, for example, undertook thin section petrographic analysis on selected pot sherds from Nebira 4 sent by Allen (1972:121).

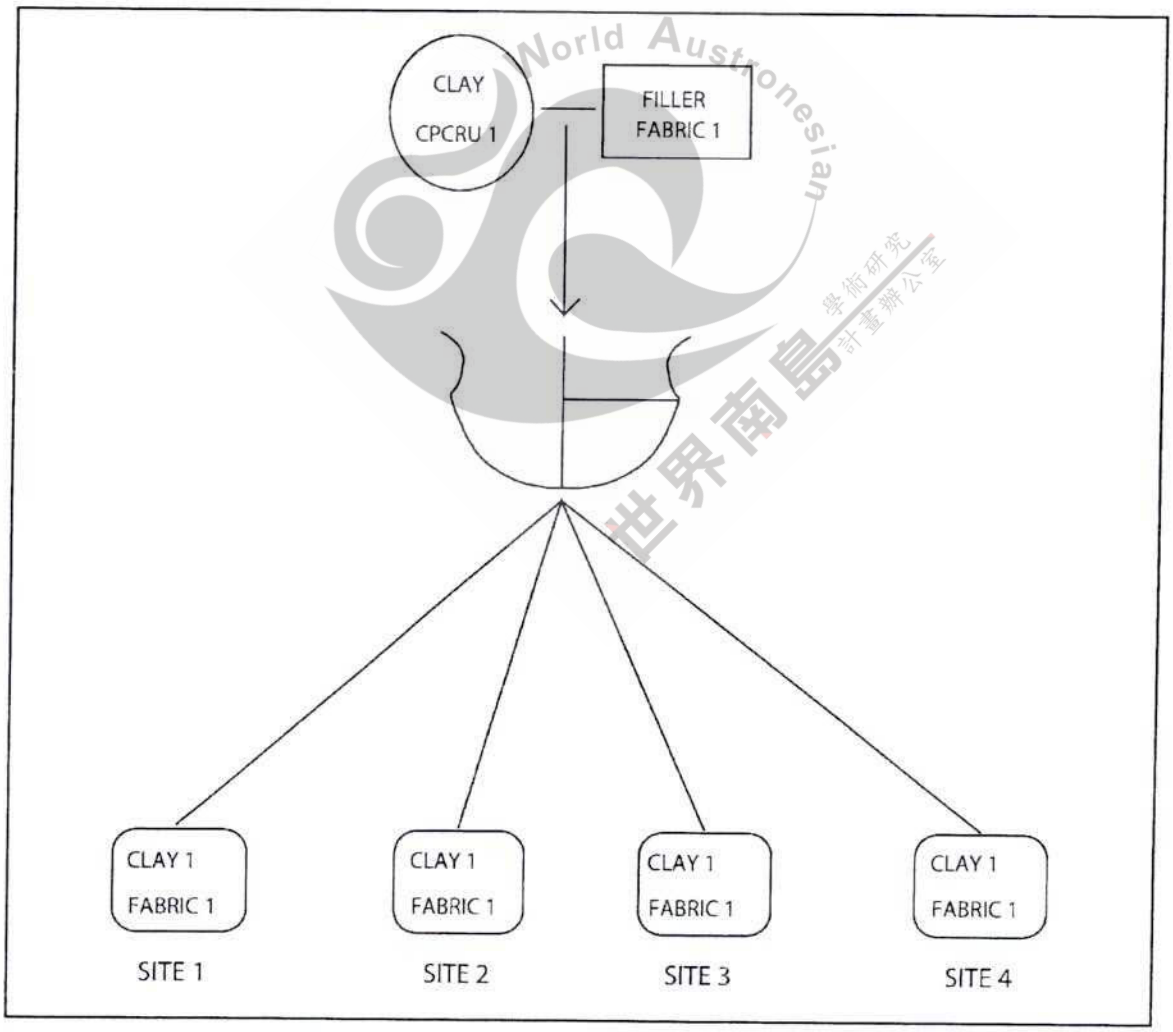

Figure 7. Selection of fabrics from later specialist production, e.g. Motu.

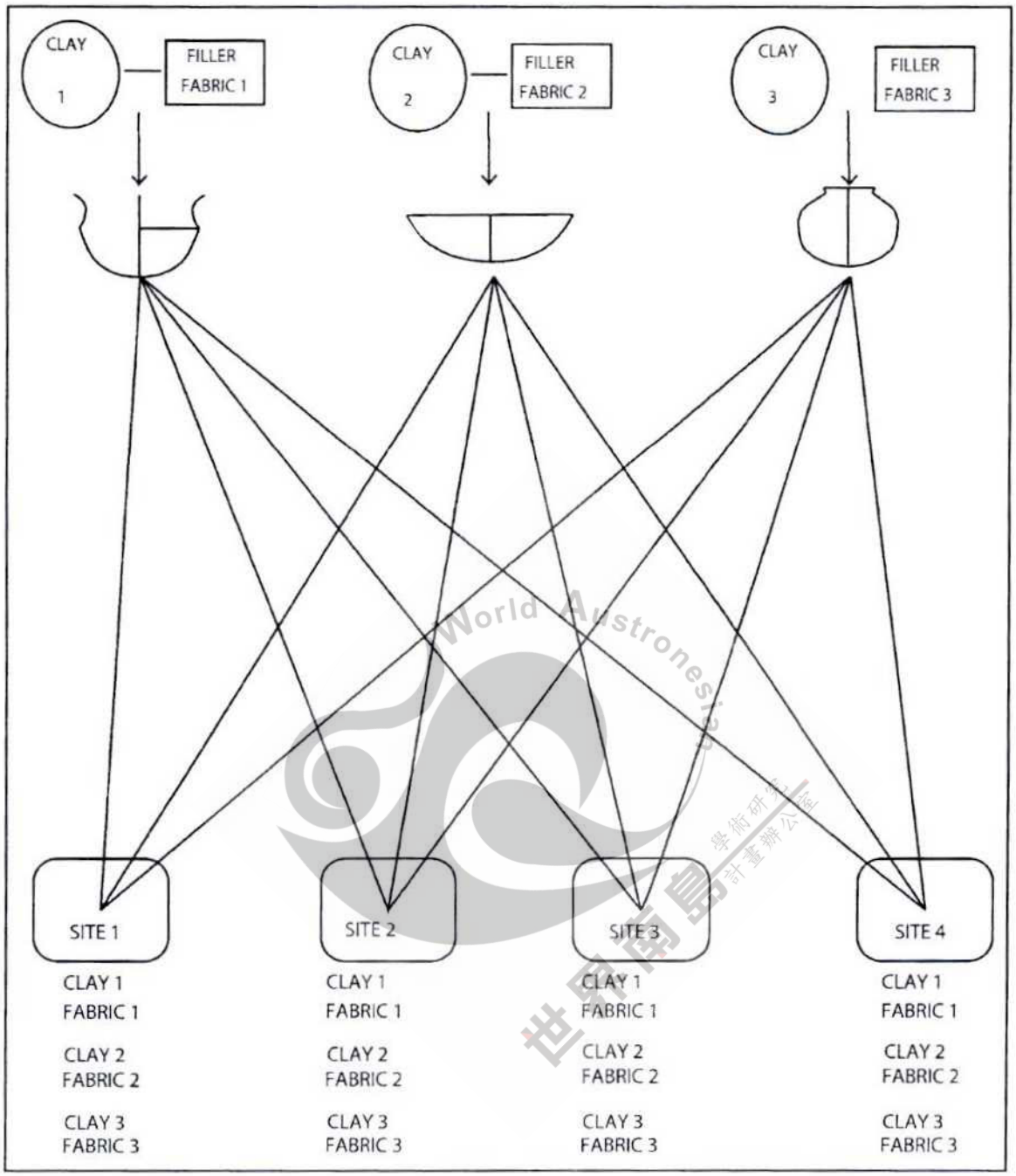

Figure 8. Selection of fabrics expected from a number of operating specialist production centres.

His results led Allen to argue that identically decorated pottery from Oposisi and Nebira 4 was in each case locally made, rather than made in one area and traded out. Allen also noted the presence of misfired pot sherds at both sites, suggesting local production. Allen noting that both sites, although 120 km apart, shared a similar sequence and must have maintained good communication for over 1,000 years: "cultural contact between sites must have been very close" (Allen 1972:121).

Geoff Irwin, as part of his doctoral research into Mailu, argued that there was more than one pot manufacturing area during the early period. He based this on the petrographic analysis of 25 samples, and XRF analysis of 139 samples.

Mike Worthing (1980), a geologist at UPNG, attempted to identify production sites by comparing sands collected from selected beaches from the south coast (Boera, Bootless Bay, Moresby Harbour, Papa, Lealea) to sands in pot sherds from Motupore using petrographic analysis. On the basis of Worthing's work, Swadling (1980) argued that very few late EPP pots from Moresby came from the Kairuku area. Swadling, based on Worthing's identification of quartz with mica from his beach sands, also argued that late EPP in the Gulf came from Lealea-Boki area.

Unfortunately Worthing's analysis is limited since, as Bickler (1997) points out, there is little chronological control on the samples such that we cannot determine which samples are early or late. Further, mica and quartz are common to many beaches along the south Papuan Coast and need not be a marker for the Lealea-Boki area alone.

Jim Rhoads as part of his doctoral research had the geologist D. MacKenzie undertake petrographic analysis on EPP potsherds from Kulupuari in the Papuan Gulf. MacKenzie claimed to have sourced the clays (or minerals in them) used to make the pottery to the coastal plain around the Angabunga and Lakekamu rivers, Hall Sound and Motu Motu respectively (Rhoads and Mackenzie 1991:41).

The most recent attempt was by Simon Bickler, then an MA student at the University of Auckland. Pottery from the National Museum and Art Gallery of Papua New Guinea, Port Moresby, was analysed using both petrographic techniques (69 samples) and XRF (128 samples) from 42 EPP sites. Again, Bickler argued that production was mostly local, but with Yule Island area pottery moving to the Gulf during the EPP, and subsequently with Port Moresby pottery taking over at c.1200 BP. The implication here is that Moresby EPP was made locally and not exported.

Other attempts at pottery analysis from the south coast include Thompson (1980), Allen and Rye (1982), Allen and Duerden (1982), Rye (1976,1981), Rye and Allen (1976, 1980), and Rye and Duerden (1982) using different techniques. However these studies were on post-EPP wares and are passed over here.

There are problems with these attempts at identifying production. XRF is not appropriate for analysing coarse pottery, since the technique requires the sample being crushed into a powder. Thus the chemical analysis is a fingerprint of *both* the ceramic matrix and the inclusions within the fabric. Attempts to characterise production localities is made difficult because of the mineral noise. Thus groupings of production areas based on the chemistry of this analysis may indicate both the variability of the mineral inclusions and combinations of minerals with clays (see Summerhayes 1997 for further explanation). It follows that any comparisons with Lapita pottery production and distribution patterns determined by these studies would be based on faulty data. To redress this problem, we decided to re-analyse new EPP samples.

Detecting production patterns of EPP using the electron microscope

We employed electron microscopy to provide characterisation data allowing the modelling of production patterns. For this study a sample of 40 sherds were provided by the National Museum and Art Gallery of Papua New Guinea, Port Moresby, from the EPP assemblages of Oposisi, Nebira and Mailu, and analysed using electron microscopy. The electron microscope provides separate chemical analyses of the clay matrix and minerals, rather than the blend of both which most other techniques provide. The reason for this is that the samples are not crushed and a smoothly prepared sample can be moved under the electron beam for spot analysis. The chemical results allow the characterisation of production by grouping sherds on the basis of their chemical similarity into groups called "Chemical Paste Compositional Reference Units" (CPCRU) – see Summerhayes (2000a:Chapter 4) for a detailed description. The samples for chemical analysis consisted of early and later styles of EPP from Oposisi (15 samples), Nebira 4 (15 samples) and Mailu (10 samples).

Every sherd from the earliest levels of each site was examined using a low powered (x15) microscope, and a relative sample was selected to cover all fabrics and major styles. The fabrics were described using the macro-categories: ferro/magnesium (hornblende, pyroxene), lights (either quartz, feldspars or glass), or shell (calcareous). The selection of samples was not exhaustive, yet was adequate to cover the basic questions of production. Of this sample, two sherds from a late EPP Oposisi level (sample A5 and A6) were included to compare with the earlier EPP material. Table 4 presents a description of the sample, decoration, CPCRU, and fabric from each site.

Pottery was analysed using a scanning electron microscope (JEOL JSM-6700F) with an EDS (Energy Dispersive Spectrometer) attachment. Machine conditions used a negative potential of 15 KeV accelerating voltage. Analyses were undertaken at x20,000 while photos were taken at x100. Sherd samples were impregnated in epoxy resin pellets. Preparation of sample pellets is identical to those outlined in Summerhayes (2000a), with the exception that slides were not made. Elements analysed were Na, Mg, Al, Si, K, Ca, Ti, Mn and Fe. Multivariate statistics (Principal Components Analysis and Correspondence Analysis) were used to identify clusters in the chemical analysis and define CPCRUs. A primary aim in the quantitative elemental characterisation of pottery was to define groupings. The groupings were expected to not only make chemical sense, but also archaeological sense.

Table 4. List of samples for chemical analysis with CPCRU's

Sample No.	Notes on decoration	CPCRU	Fabric
OPOSISI			
A1	shell impressed	I	Light
A2	incised	I	Light
A3	shell impressed	I	Light
A4	shell impressed	I	Light
A5	incised	I	Shell
A6	incised? (thru red slip)	I	Light
A7	plain rim	I	Fe/mg
A8	cut dec lip, incision inside	I	Shell
A9	incised? (thru red slip)	I	Light
A10	plain rim	I	Light
A11	plain rim	I	Fe/mg
A12	plain rim, incised inside?	I	Fe/mg
A13	None	I	Light
A14	grooved & incised	I	Light
A15	incised lines	I	Light
MAILU			
M1	shell impressed, notched lip	IV	Fe/mg
M2	shell impressed?/incised	IV	Fe/mg
M3	incised	IV	Fe/mg
M4	impressed?	IV	Fe/mg
M5	impressed?	IV	Shell
M6	incised	IV	Shell
M7	plain rim	IV	Fe/mg
M8	plain	IV	Fe/mg
M9	plain	IV	Fe/mg
M10	?notched	IV	Fe/mg
NEBIRA 4			
N1	linear incised	III	Fe/mg
N2	linear incised	I	Fe/mg
N3	plain rim	III	Light
N4	plain rim	III	Light
N5	plain rim	II	Light
N6	incised rim - grooved lip	I	Light
N7	rim	II	Light
N8	rim	III	Light
N9	rim	I	Light
N10	incised lines rim	III	Fe/mg
N11	shell impressed	I	Fe/mg
N12	incised?	II	Shell
N13	incised and grooved	I	Fe/mg
N14	shell impressed	I	Shell
N15	shell impressed	I	Light

The macroscopic fabric analysis showed that both Nebira and Oposisi had three fabric groups (Fe/Mg, shell and lights), while Mailu only had two (Fe/Mg and shell). The chemical analysis on all samples produced four CPCRUs. One consists of all the Mailu samples (CPCRU I). Two CPCRUs comprise only Nebira 4 samples (CPCRU II and III) but these do not contain all the samples from Nebira 4. The last consists of all Oposisi samples and seven Nebira 4 samples, including all the shell impressed samples and the two grooved lip samples from

there (see Table 5 and Figure 9). As previously discussed these sherds comprise the earliest styles at Nebira 4 (Allen 1972:102-8).

In short, most pottery was locally produced at each site, with the important exception of seven samples from Nebira which reflect a similar production to Oposisi and for which the most parsimonious explanation is that the raw materials or much more likely the finished pots came from the Oposisi area. Figure 10 represents the use of fabric (defined macroscopically) with the CPCRUs (defined chemically).

Table 5. CPCRU's of the South Coast pottery assemblages.

	Site CPCRU	Site CPCRU
I.	OPSISI	NEBIRA SHELL IMPRESSED
II.	NEBIRA	
III.	NEBIRA	
IV.	MAILU	

Results of this analysis compared with Lapita patterns

The results from this limited analysis clearly suggests that pottery production is local during the early part of the EPP and at the same time a number of fabrics are being manufactured with different local clay sources. As with early Lapita, potters are not "conservative" in that they produced similar vessels using different clays and fabrics. Yet, unlike Lapita, there is an indication that some of the earliest EPP wares

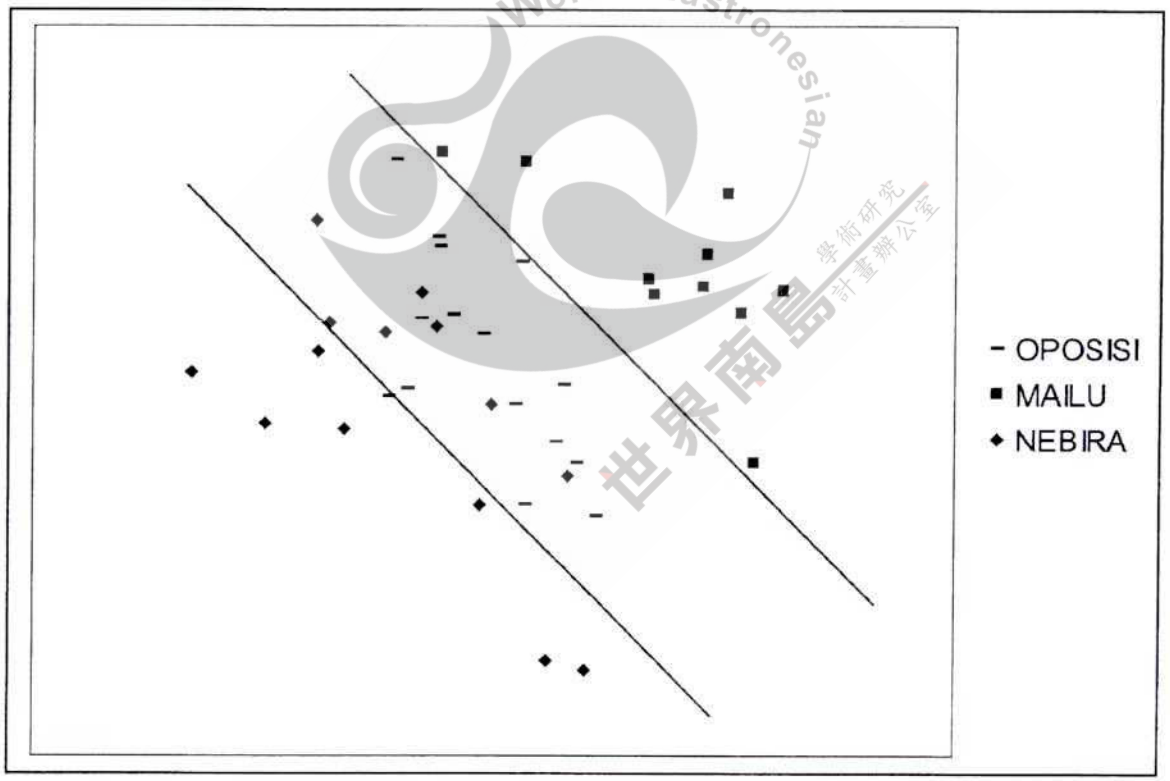

Figure 9. PCA of the pottery analysis.

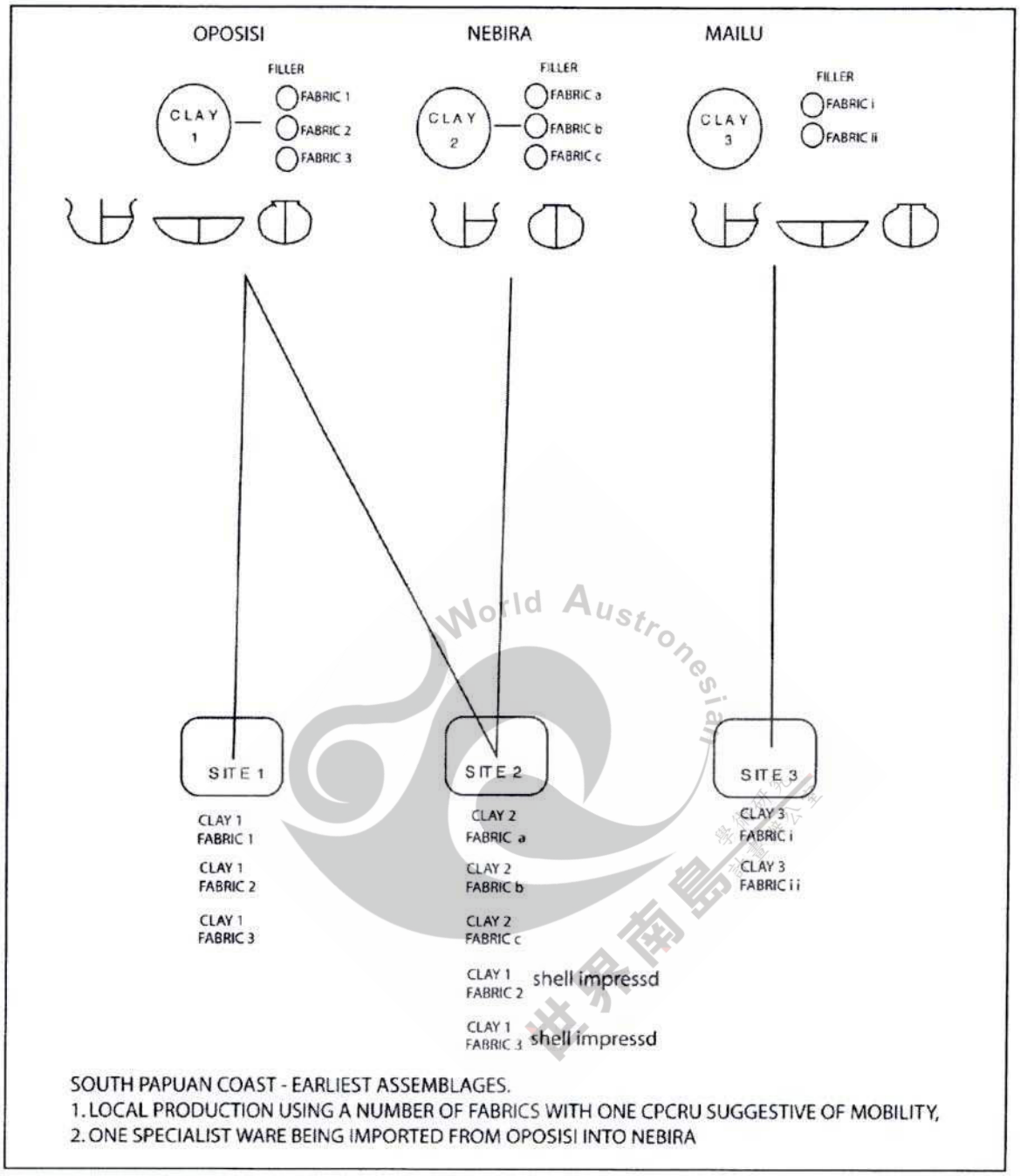

Figure 10. South Coast Pottery Production Pattern.

from Nebira 4 were made in the Oposisi area and taken to Nebira 4. We address this matter further in the discussion.

We would expect this production pattern to change over time as communities become more sedentary. While continuing close connections between EPP groups have been argued on the basis of continuing similarities in general material culture and especially in ceramic forms and decoration, we would still predict that the production patterns of pottery changed, evolving towards the conservative and simple patterns exemplified

in later Lapita pottery. This is an eminently testable hypothesis that we hope to approach with further analysis of later EPP styles and post-EPP wares from these same areas.

The final point to make is that while these similarities in production between EPP and Lapita are evident in the data, both these signatures remain fundamentally different to the pottery production systems witnessed in Papua New Guinea by Europeans in the nineteenth and early twentieth centuries (Figures 7 and 8).

Discussion

Comparing the EPP and Lapita colonisations

It might be legitimately argued that the general similarities between EEP and Lapita in respect of site locations, economies, movements of obsidian, associated non-ceramic materials, and the elaboration of pottery decoration styles, put forward here as similarities in the two colonisations, could equally reflect anticipated similarities between marine communities anywhere in Near Oceania practising a mixed hunter/collector, fishing and horticultural economy. Our argument is rather to suggest that two different rapid colonisations, separated in time and space, both occupying new large territories, did not differ in these general characteristics. These provide the background for more specific characterisations that do relate more directly to the similarities of these colonisations.

Pottery production systems and their implications

Our data show that the pottery production systems associated with these colonisations were not conservative and probably differed from pottery production systems in the homelands of the colonising groups. They reveal local experimentation using different combinations of clays and fillers to make culturally similar pots, in terms of forms and decoration styles, across wide distances. In the case of later Lapita ceramics we know that production techniques simplified towards a single clay and single filler in any local area, and although we are yet to demonstrate it we would hypothesise the same is true for EPP. At the same time these early production techniques in both cases are different from those associated with later specialised trading communities in Melanesia.

As an observation, technological experimentation amongst colonising potting communities is not unexpected to the point of being predictable. However it signals in the archaeological record the expectation that a range of other technologies not preserved in that record, from canoes and fishing technologies to terrestrial subsistence patterns must also have undergone experimentation and adaptation. This in turn focusses on risk and risk minimisation in the colonising process, exemplified in those archaeological indicators that reflect connectedness between colonies and back to putative homelands, such as obsidian and ceramic decorative styles.

Modelling colonisation

In another context one of us (JA) together with Jim O'Connell (University of Utah) is currently modelling the initial colonisation of Australia and New Guinea some 45,000 years ago. In considering continents devoid of previous humans we favour the Ideal Free Distribution (IFD) model developed by Fretwell (1972:83 and ff.). This model suggests that the way individuals occupy new territories is set up via habitat selection. The model suggests that in an empty landscape the "best" habitats, that is, those that optimise evolutionary success, will be occupied first. These "best" habitats we call sweet spots. As well as offering the best avenues to subsistence, sweet spots will have other advantages ranging from good defences against predators (human or non-human), to the availability of required raw materials, to open lines of

communication with other related groups of colonists in order to ensure longer term biological success, a difficult task for small groups of isolated colonists. Sweet spots diminish in suitability as populations within them increase, at which time new sweet spots further afield may be sought or less sweet spots behind the line of colonisation, by-passed in the first onwards movement, may be subsequently occupied. If the colonists are fishing/hunting horticulturalists, a variation on this model might see initial "beach head" colonies expanding locally to occupy other valuable niches.

Although we would not push the case too far we see that Nebira 4, an outlier in a locational sense among EPP sites, might have been particularly dependent on a parent colony in the Oposisi area, thus making sense of the Oposisi fabrics identified in the early EPP wares at Nebira 4.

How this model applies in occupied landscapes (as is the case with EPP and Lapita in Near Oceania), is less certain. While some locations such as small offshore islands may have been little used by non-pottery using hunter-gatherers, other parts of the coastline and inland are assumed to have been occupied before these colonisations, and valuable resources such as New Britain obsidian would likely have been controlled by incumbent groups. The IFD model assumes that new arrivals are free to settle where they want and the model loses coherence when this assumption is not met. A possible archaeological signature reflecting the colonising of occupied lands is discussed in the next section.

The elaboration of material culture by colonising groups

A striking feature of both colonisations is an initial elaborate material culture that becomes less elaborated through time. This decline is particularly rapid in the case of EPP. It has sometimes been argued that the early elaborate material is a reflection of the homeland culture, and at some level it must be – no group can invent a new and elaborate material culture instantaneously and *in vacuo*. But the fact that these 'homeland cultures' remain elusive demonstrates that this explanation is at best only a partial one. In the case of Lapita there has been a long and fruitless search for immediate antecedents for highly elaborate dentate stamped pottery west of the Bismarcks, nor can we point to antecedents of the initial highly decorated shell impressed wares of the EPP beyond the Massim.

The evident conclusion in both instances is that pottery decoration is elaborated internally as part of the colonising process.

In seeking an explanation for this we have been drawn to "costly signalling", a theory of behavioural ecology applied to human and non-human organisms that has developed from Veblen (1994[1899]) and Mauss (1969[1925]) and has had a recent resurgence as an explanatory tool in anthropology (Bliege Bird and Smith 2005 plus comments and references). For present purposes we can define costly signalling as expensive displays designed to show the signaller's worth to observing predators and competitors. In two papers on turtle hunting in Torres Strait, Smith and Bliege Bird (2000) and Smith *et al.* (2003) propose that costly signalling must be observable by others, be beneficial to others, be truthful, must demonstrate some strength or fitness of the signaller and must be costly to the signaller in ways that cannot be directly reciprocated. Thus, altruistic acts, while costly, establish reputation that encourages others to engage in reciprocal altruism.

We see two immediate applications of this theory to the colonisations described here. The elaboration of pottery decoration and the bone and shell components of the earliest phases of both the EPP and Lapita can be seen to have two roles within the framework of costly signalling as just described.

The first is in relationships between colonisers and incumbent groups. Although they may have superior technology it is in the best long term interests of colonists to avoid conflict with incumbent groups when, by the very nature of the colonising act, the newcomers will inevitably compete for land and resources with existing groups. By elaborating their material culture the colonists signal their own strength or fitness and provide objects that by exchange will confer prestige or other more utilitarian values on the recipients. Exchanges of colonisers' artefacts for hunted food and raw materials would facilitate the success of a new

settlement both directly and by promoting peaceful relationships. Alternatively if colonists could access wives from local incumbent groups they could improve their likelihood of biological success and again promote peaceful relationships. As the colonisers became established the levels of costly signalling would become less immediately necessary and would predictably diminish, but should never completely disappear.

The second use of costly signalling should be between different colonising villages to maintain access to resources not available locally and also to marriage partners. If women were potters, well-made, elaborately decorated pots could signal the fitness of marriage partners. This model makes sense of movement of pots (and their contents) between villages that all most likely made pottery. We have already seen in our sourcing results this process on the Papuan coast, in respect of Oposisi area pots appearing in the early levels of Nebira 4, even though pots were also being made at this latter site; for Lapita, Kirch (2000:113) notes that during its earliest phase the Mussau site of Talepakemalai received a significant range of outside materials, including obsidian, basalt and andesite rocks, chert, metavolcanic adzes and pottery, "especially decorated vessels", from at least 12 different localities / clay sources thought to include Manus, New Ireland and New Ireland's offshore islands. While these were likely traded against a range of locally made shell valuables, under the model we would anticipate that decorated pots might also move out of Mussau.

On the central Papuan coast this internal reciprocity continues throughout the EPP phase at least between sites in the Port Moresby and Yule Island areas. Although the most elaborate shell impressed decoration disappears quickly the subsequent EPP bowls in particular are still well-decorated, especially when compared to the most recent millennium. It may be telling that the percentage of decorated bowls at Nebira 4 rarely falls below 50 % until the end of the sequence.

In conclusion this proposal offers an alternative explanation for the initial phase of elaborate dentate stamping in the early period of Lapita (see also Clark this volume). It is an idea that has sprung directly from a comparison of two different but similar colonisations as we have been urged to do by Irwin. Its explanatory power seems difficult but perhaps not impossible to test in the EPP case, but seems to have a straightforward test that might be applied in the case of Lapita, since that colonisation occurred firstly in the previously occupied lands of Near Oceania and very soon after in the unoccupied islands of Remote Oceania. A detailed review of highly decorated wares in the early sites of each main island group on either side of this divide, in terms of their nature, the lengths of time they endured and their frequency within the wider Lapita ceramic repertoire, could illuminate this question. If this model has any usefulness we would predict that the frequency of elaborate decoration would be lower and its loss quicker in Remote Oceania compared with Near Oceania.

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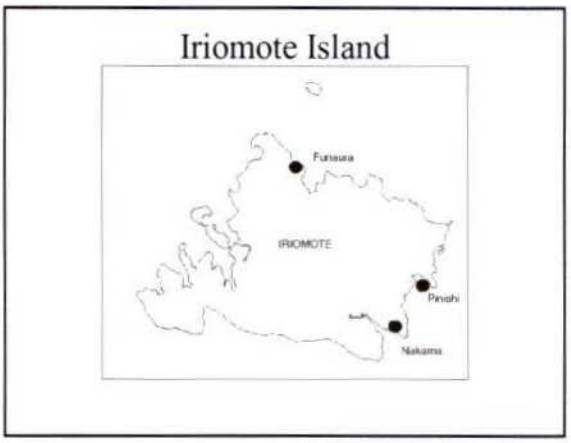
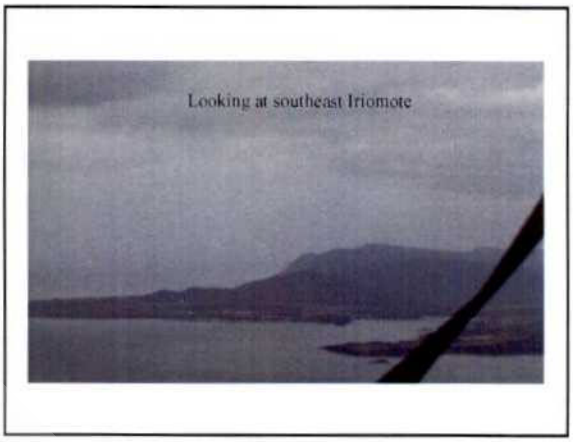
Shimotabaru pottery, the Yaeyama Islands and their relationship to the Austronesian expansions out of Taiwan at 4,000 years ago.

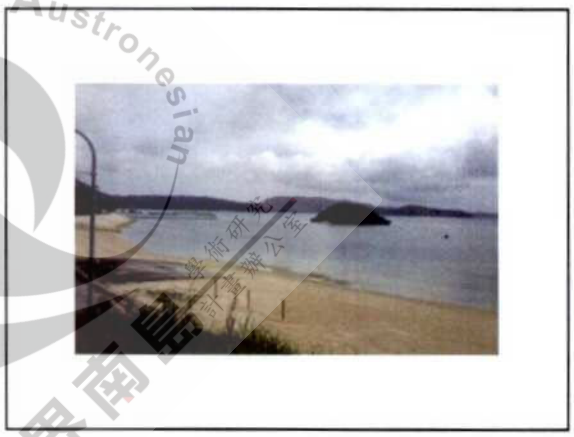
G.R. Summerhayes
A.Anderson
Mr Asato
Mr Shimogi

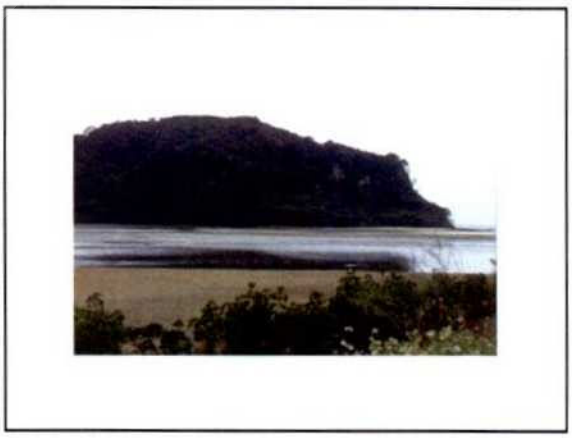
Yaeyama Islands

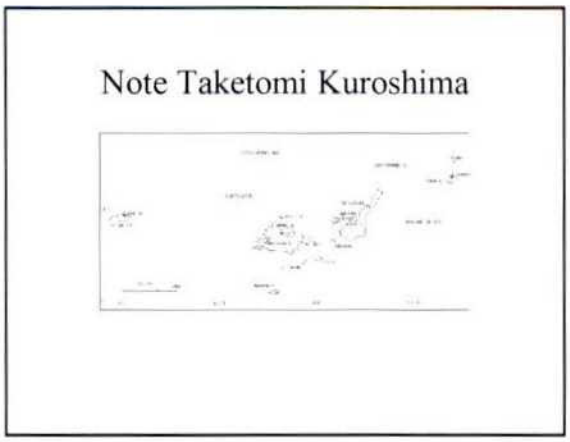
Ishigaki

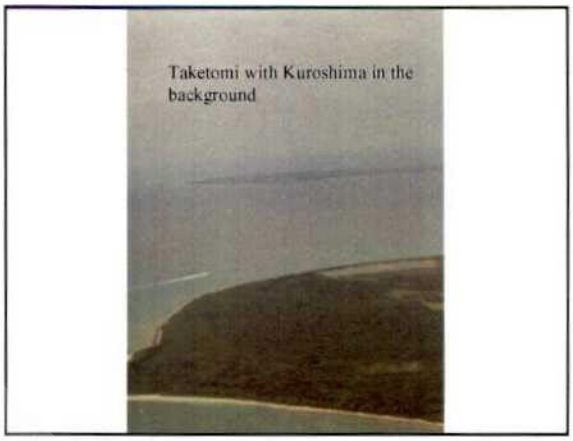


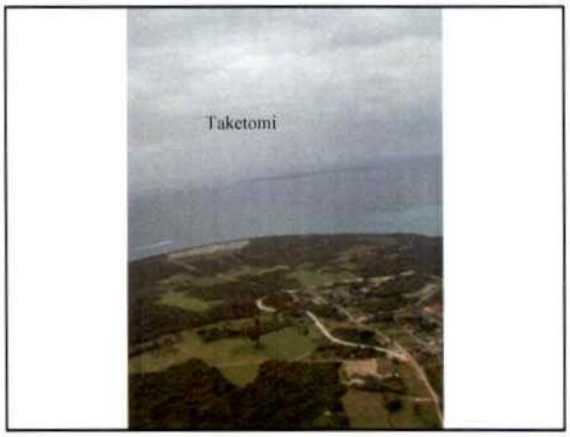




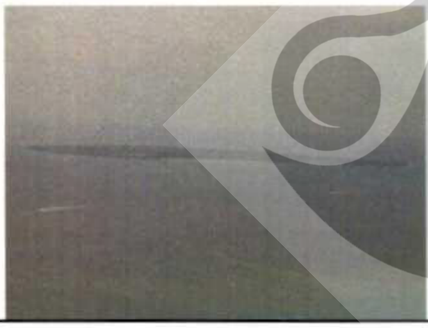








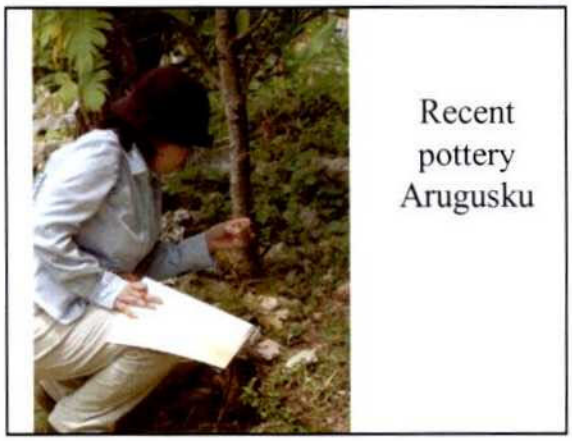
Kuroshima



Kuroshima

Arugusku

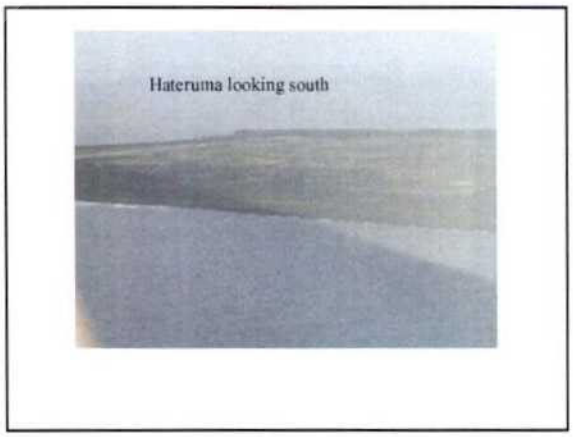
Arugusku



SHIMOTABARU WARE:

- Shimotabaru, Hateruma
- Otabaru, Ishigaki
- Pyutsuta, Ishigaki
- Nakama No. 2 Iriomote
- And 15 others

Chronology



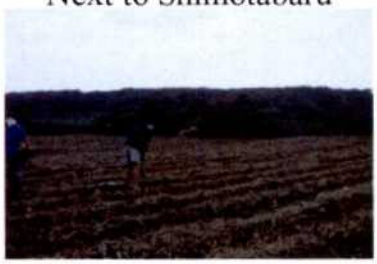
South side of Hateruma

Iriomote in the distance

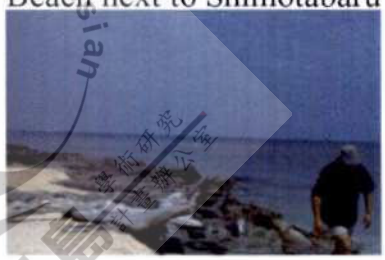
Shimotabaru – looking north

Shimotabaru obelisk

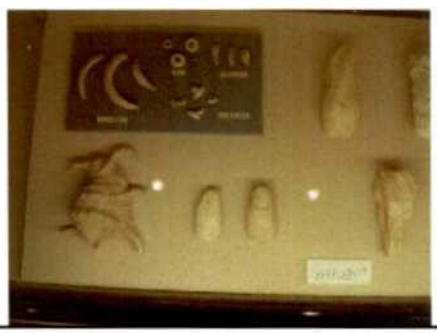
Next to Shimotabaru

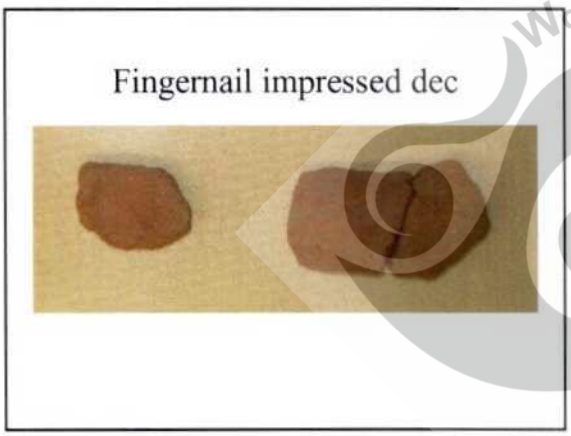


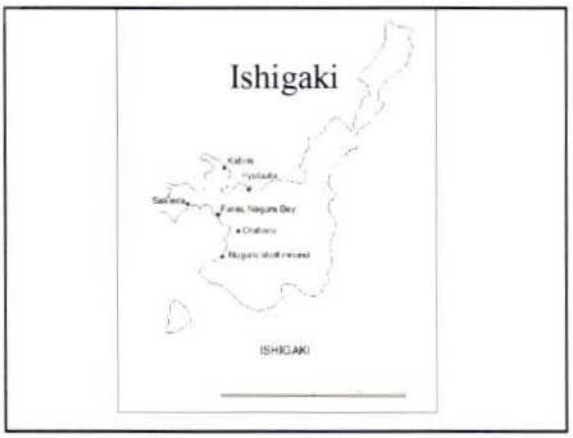
Beach next to Shimotabaru



Shell artefacts, sharks teeth etc.

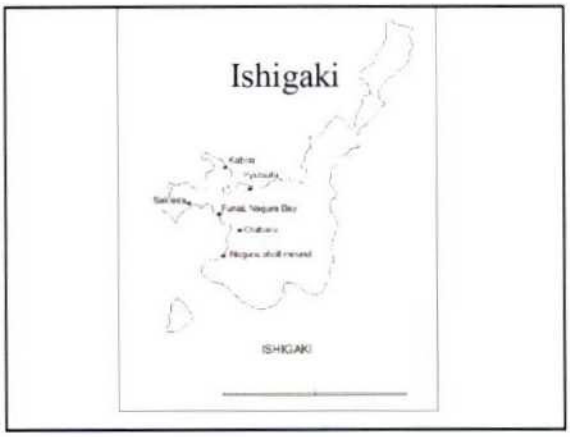


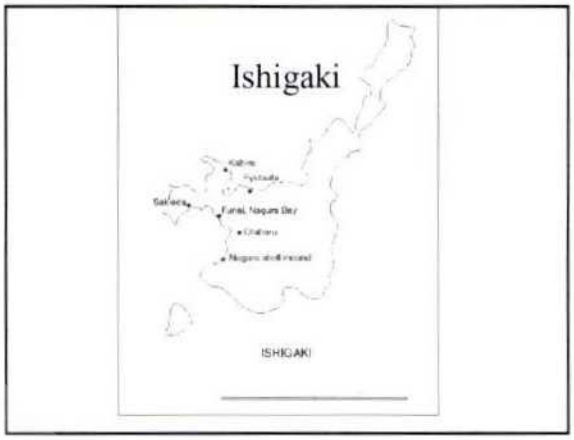


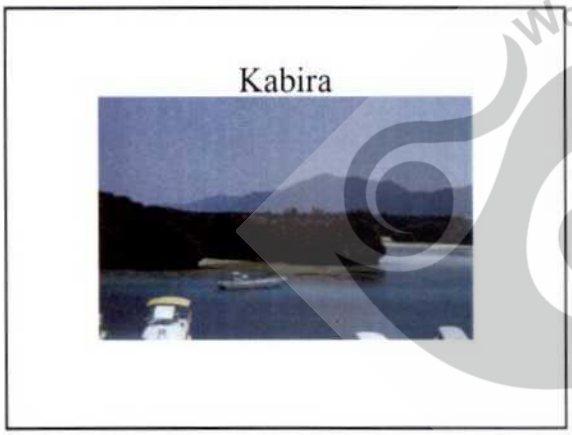


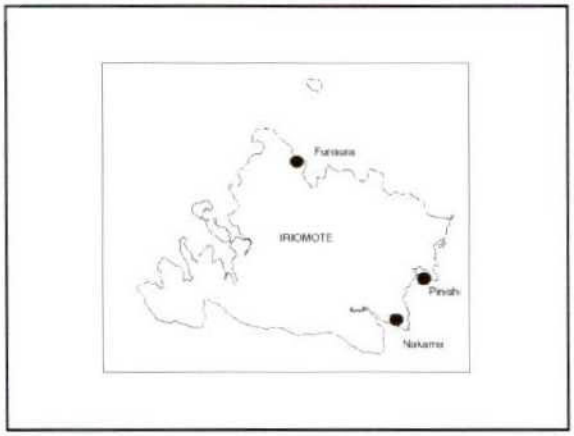
Ishigaki

Otabaru









River next to the site

Nakama No. 2

Looking east from Nakama No.2

Lecture with archaeologists at the Ishigaki Board of Education

Chemical analysis of pottery

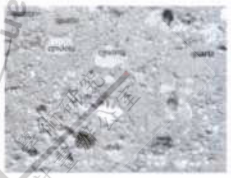
- 1. Fabric analysis using low powered microscope
- Chemical analysis using the Scaning Electron Microscope with EDAX attachment
- Elements analysed: Na, Mg, Al, Si, K, P, Ca, Ti, Mn, Fe

Yaeyama Islands

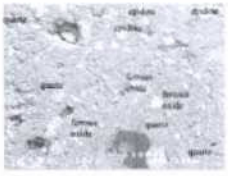
Shimotabaru site

Shimotabaru site

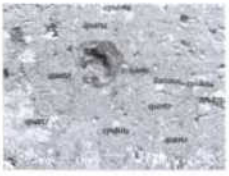
Shimotabaru site



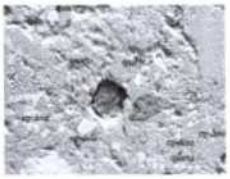
Shimotabaru site



Shimotabaru site



Shimotabaru site



Otabaru

Otabaru

Otabaru

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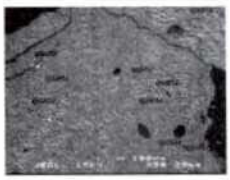
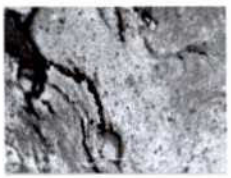
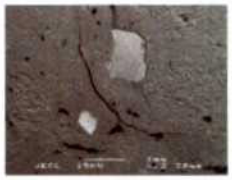


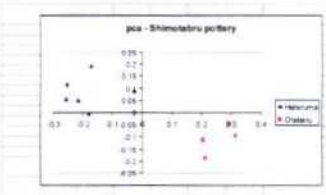
Otabaru



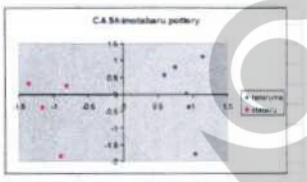
Otabaru

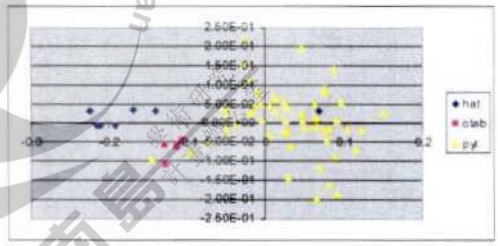


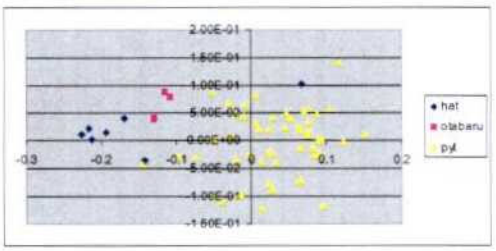
PCA Analysis

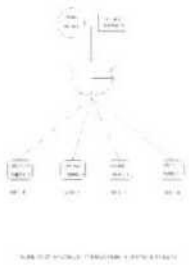


Correspondence Analysis









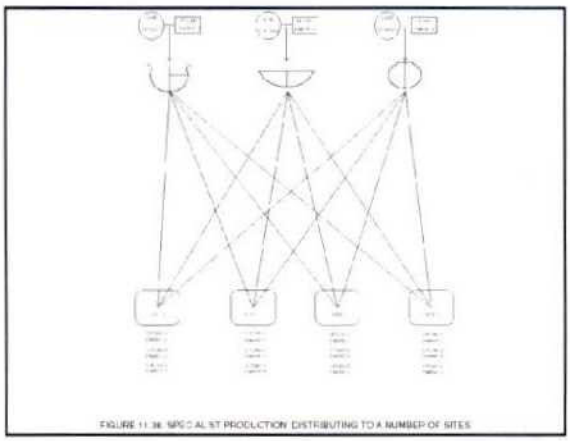
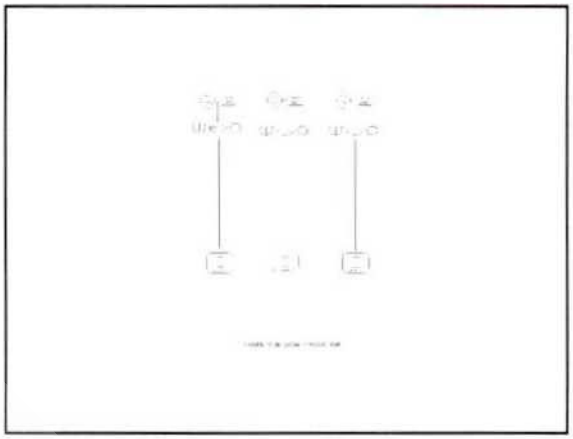


FIGURE 11.36 SPECIALIST PRODUCTION DISTRIBUTING TO A NUMBER OF SITES



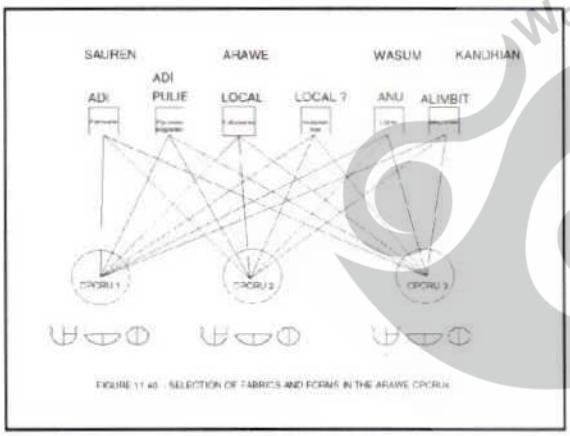
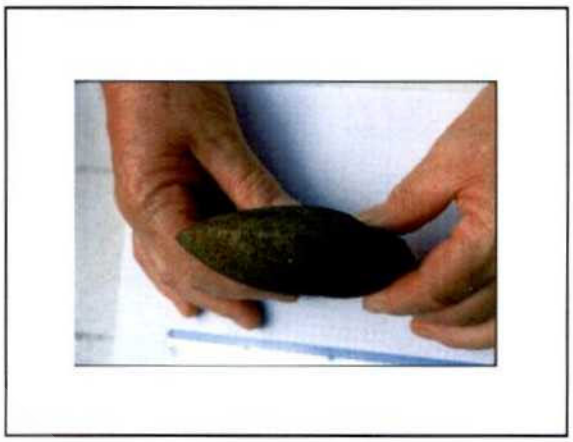


FIGURE 11.40 SELECTION OF FABRICS AND FORMS IN THE ARAWE OPORUS

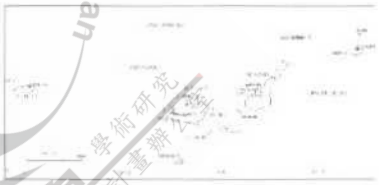
New Dates from Otabaru

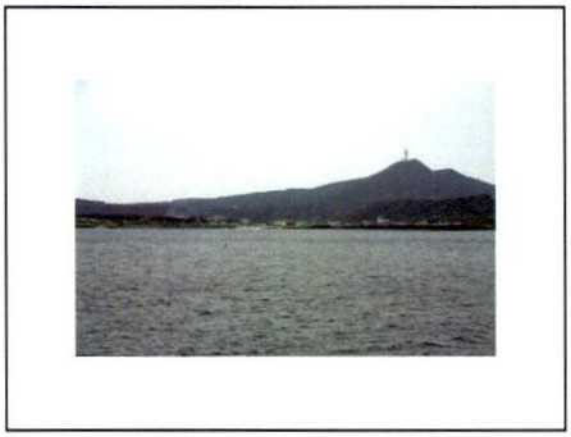
- Wk-15793 3841±35 BP
- 2460 BC (95.4%) 2190 BC
- Seed identified as Mallotus japonicus



East Asia

Yaeyama Islands





An Austronesian presence in southern Japan: early occupation in the Yaeyama Islands.

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Abstract

The colonisation of the Yaeyama Islands, southern Japan, allows a closer assessment of the nature and timing of Austronesian movement out of Taiwan. Evidence in the Yaeyama islands suggests that the early occupation characterised by Shimotabaru wares is the signature of Austronesian colonisation from Taiwan, 4,000-3,800 BP. Yet the Yaeyamas dispersal appears to have been of a different character from that which moved south from Taiwan. This suggests that the nature of Austronesian expansion in general was more complex than is proposed in the prevailing model.

Introduction

The extensive mid- to late Holocene migrations which took elements of Neolithic culture into island Southeast Asia and across both the Pacific and Indian Oceans are described collectively as "Austronesian" after the language family closely associated with the dispersal (Bellwood 1997, 2007). Austronesian origins have been sought in east Asia, with much attention focussed upon Taiwan. Subsequent expansion is seen as moving through the Batanes Islands southward to the Philippines and Indonesia by 4,000 years ago and then to West Polynesia by 3,000 years ago, to Madagascar about 2000 years ago and across East Polynesia by 800 years ago. The movements in general are seen by Bellwood (2004, 2007) and Diamond and Bellwood (2003) as having been driven by an expanding Neolithic population and economy (Bellwood 2004; 2007). Alternative views propose a more complex set of Southeast Asian origins (Szabo and O'Connor 2004; Anderson 2005) and suggest that maritime technology, possibly in conjunction with change in maritime climates, played more important roles (Anderson 2005, Anderson et al., 2006).

Until now, discussions about the first phase of Austronesian expansion have focussed on archaeological sites lying along the route from Taiwan to the Philippines, notably in the Batanes Islands. Yet, this was not the only possible route of initial dispersal. A group of islands located just east of Taiwan, the Yaeyama Islands (Figure 1), lies in a similarly strategic location . Consideration of early Yaeyamas prehistory can throw some light on

the specificity of Austronesian movement out of Taiwan and upon the nature of the migrations.

The Shimotabaru phase

The Yaeyama Islands are made up of the two larger islands of Ishigaki and Iriomote, and a number of smaller surrounding islands (Taketomi, Kuroshima, Aragusuku, Kohama and Hatoma), and the island of Hateruma 25 kilometres south of Iriomote, and 40 kilometres south west of Ishigaki (see Figure 2).

Although forming the southern most islands of Japan, they are located in a strategic position as part of an interspersed archipelago that linked China with Japan in past trade networks. They are only 250 kilometres east of Taiwan. In between is the island of Yonaguni lying 125 kilometres to the west of Yaeyama. To the north is Miyako Island about 90 kilometres away, and at over 400 kilometres lie the main island of Okinawa. The islands of Yaeyama and Miyako are known collectively as the Sakishima Region, and the closer past relationships with this region to areas further south such as the Philippines, rather than any to the north, has been recognised in the literature (Asato 2001:107)

Despite archaeological attention by Japanese archaeologists during the twentieth century, the Yaeyama island group is still relatively unknown to the archaeological community. There are a number of reasons for this. The first is that archaeological reports from all excavations on Shimotabaru sites have been published in Japanese. Very little has been published in English. A single page summary was published in 1996 (Pearson 2001), and the original description of Shimotabaru in the late 60s (Pearson 1969:85-86), with a two page discussion on chronology in the early 80s (Pearson 1981:141). No detailed archaeological description of these early sites has been published in English. Secondly, Japanese archaeologists focus on the Palaeolithic, Jomon, Yayoi and subsequent periods of mainland archaeology. Jomon pottery is found in the Ryukyu Island chain but it ceases at Okinawa and is not found any further south (see Figure 1). Consequently, the Yaeyamas stand largely outside the general sequence and seldom rate a mention in reviews of Japanese archaeology.

The first archaeological excavation took place at the Kabira shell mound, Ishigaki, over one hundred years ago in 1904 by Dr Torii Ryuzo of Tokyo University. Half a century later in 1954, a site on Hateruma Island called Shimotabaru was excavated by Dr Kaneseki and Dr Kokubu (Kanaseki et al. 1964). This site was re-excavated in 1959 by a team from Waseda University (along with the site of Nakama Shell mound on Iriomote Island)(Nishimura 1960), and in the 1980s a third excavation was undertaken by a team from the Okinawa archaeological survey (Okinawa Prefectural Board 1986). The pottery from this site was a type of crude low fired ware from flat bottomed vessels. It was subsequently found at a number of sites from the Yaeyama Islands and was called Shimotabaru Ware (see below).

Distribution of settlements

Ishigaki

Most Shimotabaru sites from Ishigaki are on small hills or terraces behind the coastline. These sites are found on a red volcanic soil. Their presence behind present day coastal plain on hills was no doubt due to the mid-Holocene marine transgression when the sea level was much higher than at present. Chen and Liu (1996:table 2) estimate a height of 2.4 metres above present levels at 4,500-4800 BP and 2.1 metres from c. 4500-3500 BP (Chen and Liu 1996: Table 2). The present day dunes below the Shimotabaru sites would have been covered by water at 4000 years ago. As noted earlier, Shijun Asato (1990:29) partly characterised this "Early Neolithic" by their settlements locations "on low hills near the coast". Ohama was more specific – the occupation as located on "the diluvial plateaux behind the dunes and alluvial plains" (Ohama 1996).

The site of Otabaru is one of these sites. It is located just over a kilometre inland from the coast on top of a narrow ridge above a river within the Nagura catchment area. Some 4,000 years ago the site would have been on an island within an embayment or extended wetland area. Excavations found pottery and stone tools. Not all sites, however, were found on terraces. Pyutsuta is not exactly found on higher ground. It is located next to a river flowing into the coast, a couple of hundred metres in from the beach, and about 4 metres above sea level. The development of the present beach was later in time. The excavations recovered pottery, stone, a little shell and not much else.

Iriomote

Like sites on Ishigaki, the site of Nakama No.2 is found on a red soil on a low limestone ridge next to a major river. Of note was the surface find of one *Tridacna* adze made from the hinge, but found with Shimotabaru pottery. It is the only shell adze associated with this early period (Asato 1990:31). Shijun Asato argues for strong connections with the Philippines and southern Ryukyus based on shell adzes (Asato 1990:34). Pearson also recognises shared traits such as *Tridacna* shell adzes, or perforated shell pendants, with the Philippines and Micronesia (Pearson 2001:97).

Hateruma

Unlike sites listed above, the Shimotabaru type site on Hateruma is located on an uplifted beach terrace behind the present beach on the northern side of the island. A 30 metre high uplifted limestone ridge located c.200 metres inland protects the site from the southern side. It is at this uplift that a fresh water spring is located. The site is slightly raised above areas to the east and west, and was probably an elevated sand spit or slightly raised spur into the ocean when it was occupied 4,000 years ago and the seas were 2.1 metres higher than today (Chen and Liu 1996).

Surface finds are also known from a dozen other localities from Ishigaki Island. Another site, Toguruhama, has been classified as a Shimotabaru site yet no pottery has been found. The Toguruhama site is located on Yonaguni island situated between the Yaeyama Island and Taiwan (Asato 1990; Asato 1991; Okinawa Prefectural Education Board 1985). Also, it is now accepted that the Nakama No. 2 is a Shimotabaru site.

Post-Shimotabaru site locations

After the short lived Shimotabaru phase, the next occupation is argued to have been some 800 years later (Ohama 1996:27). These sites are aceramic shell mounds located on low lying sand dunes. As noted above, these sand dunes did not exist during the earlier Shimotabaru phase as this area was covered by water. Shell adzes appear during this period and are used from 2500 BP to about 1000 years ago (Asato 1990:29-30). Ohama calls this period the A-ceramic Culture. The hinge working has led some to see a Philippine origin. An increase in burnt pebbles led Shijun Asato to argue that steaming with stones (earth oven) took over as the major cooking method.

Shimotabaru pottery and adzes

The Okinawan archaeologist Shijun Asato (1990) who placed what he called Shimotabaru culture into the earliest phase of occupation in this island group. Asato (1990) characterised this "Early Neolithic" not only on the basis of pottery but also by site occupation, partly polished adzes, and little fauna. Local amateur archaeologist, Eisen Ohama (1996:27), called this pottery the "Red Pottery Culture" and describes it as a red earthen ware with "a bucket shape with a pair of bull horn shaped handles on both side of the bodies as well as bone needles and points" (Ohama 1996). Basically the pottery is crudely constructed, low fired earthen ware. It has a standardised form - a flat base open unrestricted vessel, with direct rims. Some of the vessels are slightly incurving. Lugs/handles, in the form of large applied knobs of clay, are located just below the lip of the vessel. Ohama's description (above) is an apt one.

There is little evidence of decoration on Shimotabaru style pottery. One sherd from the Shimotabaru site has parallel striations (Okinawa Prefectural Board 1986:plate8 #6). From Pyutsuta there is evidence on a handful of sherds of wide incision running from the rim to the base of the vessel wall, while one sherd has two lines of single tool impressions running just below the rim. Half a dozen sherds have evidence of fingernail impressions placed in vertical lines from the rim to the base (Ishigaki City Education Board 1997: Pl. 11-13, 21 and 33).

As noted above adzes are found with Shimotabaru pottery. These stone adzes are semi-polished and chipped with a variety of cross sections, and shapes. All are made from local rocks which occur naturally in Iriomote and Ishigaki. From the early excavations on Hateruma, Pearson (1969) (from Kanaseki et al 1964) noted that the adzes were divided into two on the basis of cross sections: trapezoidal and rough ellipsoidal. It was also noted that just under half the adzes (those with rough ellipsoidal section) had a "rough transverse step on one side", which was noted to at least have been an attempt at "stepped butt" (Pearson 1969:85). However, the excavations from Otabaru (Prefectural Education Board 1980:63-91), Pyutsuta (Ishigaki City Education Board 1997: pl. 34-35) and the later excavations at the Shimotabaru type site (Okinawa Prefectural Education Board 1986:pl. 18-25) have yielded many varieties of chipped and polished adzes, including lenticular, quadrangular/rectangular, and trapezoidal cross sectioned adzes.

Prehistoric economy

According to Shijun Asato (1990:29) based on unpublished reports the Shimotabaru inhabitants subsisted on fish and shells gathered from lagoons. The presence of edge ground adzes and pottery suggests some sort of agricultural base as well. Other forms of material culture included "pendants or weapons made of shark teeth with an opened hole and shells of Chiragra spider conch". Unfortunately due to taphonomic problems, the evidence for diet is limited. The red earth soils which are characteristic of many of these Shimotabaru sites, are volcanic soils with little if any organics survive in these conditions. Otabaru and Pyutsuta have little bone or shell surviving.

However, the Shimotabaru type site on Hateruma has beach midden deposits. Hateruma is a raised limestone island and lacks volcanic deposits. Organics include shell beads, fish bone, some fresh water shellfish from Iriomote, and mangrove species shells. The latter would have been imported as there are no mangroves found on Hateruma. There is also plenty of pig bone in the deposit. There is no chicken. The pig is *Sus leucomystax riukiuanua*, which Colin Groves renames *sus scrofa riukiuanus* (Groves 1981: 35-36). The *leucomystax* is the Japanese wild boar. Whether pig was brought into Yaeyama by people at this date or earlier is unknown as pig bone is supposedly found on Ishigaki, in non-archaeological contexts and dated to 8,500±500 BP, although it was pointed out that "determinations on bone of this type are not always reliable" (Foster 1965: 83; Pearson 1969:82). It can however be reasonable to assume that pig was brought to Hateruma with the makers of Shimotabaru pottery.

Another site, Nakama No. 1, which was excavated in 1959, also yields evidence of a prehistoric economy. Dugong, boar, and turtle bone was found in the early deposit. This along with chipped and polished adzes (polished rectangular in plan, and oval in cross section) said to resemble east Tawain, plus pecked hammer stones which again suggests external links (Pearson 1969:84).

Unfortunately, there has been no study on early agriculture in this island group. To date no environmental work has been undertaken to assess changes in vegetation with the advent of people. No pollen work near archaeological sites, no phytolith analyses. It has been argued that the earliest evidence for rice here is during the Heinan period by AD 200 (Pearson 2001:96). To the north on Okinawa, it was argued that these people lived a hunting and gather existence with a very late introduction of agriculture (and here agriculture equates with rice) during the Gusuku Period at between c.AD1100-1400 (Takamiya 2006:60). Such a scenario for the Yaeyama Islands seems unlikely, as will be argued below.

Chronology of the Shimotabaru phase

Although early radiocarbon dates on Shimotabaru sites suggesting occupation in the early fourth millennium BP were obtained over thirty years ago, they were ignored as pottery was considered to have been a late addition to the archaeological record. The earliest occupation on these islands was thought to have been aceramic with Shimotabaru pottery

appearing in a later phase (Pearson 1969). Pearson's chronology followed the development of a four cultural period chronology by Mr Tawada in 1956, and also by the Waseda University team (Dr Kokubu) in 1959. The latter saw the earliest occupation in the Yaeyamas associated with lithics found at the Nakama No1 site on Iriomote Island. They interpreted pottery in association with lithics found in nearby sites (Nakama No 2) as later in time. We now know that in fact the sequence should be reversed. With added radiocarbon dates available in the late 1960s from Hateruma (Kokubu 1966a and b; 1973; Yamasaki et al 1967), Pearson (et al. 1978:table 1) noted that perhaps the islands were inhabited in the second millennium BC. Yet, at this time there was an absence of excavated Shimotabaru sites on both Ishigaki and Iriomote, and these islands were still considered to have been occupied much later. The only sites available for comparison at this time were from Iriomote: Funaura and Nakama 1 (Pearson et al. 1978:13). Pearson did not consider Nakama 2 to have been early.

Thus up until recently the published (in English) orthodox chronology for this region had the occupation of these islands with a pre-ceramic phase at 2000 B.P. Yet, over the last few years local archaeologists have re-written the cultural sequences with archaeological excavations identifying an early occupation phase with Shimotabaru pottery dating from the early fourth millennium BP. The revised chronology was first published by Takemoto and Asato (1993) and Kin (1994), while Pearson was the first to mention the new chronology in English, albeit briefly, in 1996 (Pearson 2001 – originally published in 1996). This new sequence is based not only on the re-excavations of Hateruma in the mid 80s, but also by excavations at: Pyutsuta on Ishigaki Island excavated in the mid 1990's (Ishigaki City Education Board 1997); Otabaru on Ishigaki Island excavated first in the early 1980s (Ishigaki City Education Board 1982) and subsequently in 2004; and the Soedo site from Tarama Island located between the Yaeyama group and Miyako to the north (35 kilometres from the northern tip of Ishigaki) (Okinawa Tarama Education Board 1996).

In summary, radiocarbon estimates (table 1) show colonisation of these islands by a group or groups of people over a very short period in the early fourth millennium BP. Kin (1994) and Ohama dated this Shimotabaru or Red slipped pottery age to between 4,000 – 3,500 BP. A seed sample collected from the 2003 excavations of Otabaru by the Ishigaki City Board of Education, given to Anderson and Summerhayes for radiocarbon dating, was identified by Dr Andrew Fairbairn (then of the Australian National University) as *Mallotus japonicusa* in the family Euphorbiaceae. According to Fairbairn it is a deciduous shrub/tree common in open woodlands and thickets. The sample was sent to the Waikato Radiocarbon Laboratory for AMS dating. It produced a date of 3841±35 BP (Wk-1579), or 2460 BC (95.4%) 2190 BC.

There is much to tell us about interactions between these islands. Pig, fresh water shell fish/mangrove shell species and stone adzes must have been imported to Hateruma from Iriomote and Ishigaki. Interaction between the islands is also suggested by the

homogeneous nature of the pottery. An examination of the production of pottery can provide us with a handle on the nature of these interactions.

Interaction and Pottery Production

Prior to our study little was known about the production of Shimotabaru pottery. Clays suitable to make pottery were located on Ishigaki. Next to the site of Otabaru were found the Nagura Gravels, a geological formation made up of clays and sands (Foster 1965). Iriomote has little clay, while no clays are found on Hateruma.

A major aim of our research was to undertake a chemical characterisation analysis on the pottery to help determine production patterns of these early colonising populations. We needed to know whether similarities in style of this low fired red pottery was due either:

1. to production in one area and then exchanged out,
2. or was it produced in a number of areas.

This information is important in determining the nature of colonisation and interaction between colonising populations. Studies undertaken by Summerhayes (2000) demonstrated that the production of pottery by colonising populations from the Western Pacific was complex, with stylistically complex identical wares being produced using different technologies and resources from a number of locations. This production pattern was an epiphenomenon of the process of colonisation and the high mobility of these populations. An understanding of the production strategies would thus shed light on the nature of settlement of these early colonisers of Yaeyama.

Detecting production patterns of Shimotabaru pottery

We employed electron microscopy to provide characterisation data allowing the modelling of productions patterns. For this study a sample of 22 sherds were provided from the Shimotabaru assemblages of Hateruma (n=3), Otabaru (n=5) and Pyutsuta (n=14), and analysed using electron microscopy. The Hateruma samples came from excavations undertaken by Shijun Asato of the Okinawa Prefectural Board (1986); Otabaru from excavations in 2003 by Mr Suguru Shimoji (unpublished); and excavations at Pyutsuta in the 1990s by the Mr Suguru Shimoji and Ms Ayano Shimabukuro of the Ishigaki City Board of Education (1996).

The electron microscope provides separate chemical analyses of the clay matrix and minerals, rather than the blend of both which most other techniques provide (see Summerhayes in press). The reason for this is that the samples are not crushed and a smoothly prepared sample can be moved under the electron beam for spot analysis. The chemical results allow the characterisation of production by grouping sherds on the basis of their chemical similarity into groups called "Chemical Paste Compositional Reference Units" (CPCRU) (Bishop, Rands, and Holley 1982; see also Summerhayes 2000: chapter 4 for a detailed description).

Every sherd was examined using a low powered (x15) microscope. Pottery was analysed using a scanning electron microscope (JEOL JSM-6700F) with an EDS (Energy Dispersive Spectrometer) attachment. Machine conditions used a negative potential of 15 KeV accelerating voltage. Analyses were undertaken at X20,000 while photos were taken at x100. Sherd samples were impregnated in epoxy resin pellets. Preparation of sample pellets is identical to those outlined in Summerhayes (2000), with the exception that slides were not made. Elements analysed were Na, Mg, Al, Si, K, Ca, Ti, Mn and Fe. Multivariate statistical analysis was undertaken on the elemental data from the ceramic matrix. Principal Components Analysis was used with the data standardised using log transformations, and the components used for hierarchical clustering analysis to identify clusters in the chemical analysis and define CPCRUs. A primary aim in the quantitative elemental characterisation of pottery was to define groupings. The groupings were expected to make not only make chemical sense, but also archaeological sense.

Results

Ceramic matrix

The chemical analysis of the ceramic matrix demonstrates that the production of Shimotabaru pottery from Pyutsuta, Otabaru and Hateruma were not from the same clay sources. Sherds from these sites have different chemical compositions. Four CPCRUs were formed using Principal Components Analysis (see Figures 3 and 4). The first three are chemically homogenous units, while the fourth is not, being made up of only two samples both dissimilar from the other CPCRUs. They are grouped together for convenience only.

1. Pyutsuta
2. Hateruma
3. Otabaru
4. Two outlier Otabaru samples.

Pyutsuta separates from both Otabaru and Hateruma on the first component where the element Calcium (Ca) loads heavily. Hateruma forms a tight group of three samples, while Otabaru groups into two CPCRUs (n=2; n=3), primarily on the basis of Ca. The Otabaru CPCRU 4 samples have less Ca than the other samples, with on average 0.1%. This is followed by the Pyutsuta samples with on average 0.5 %, while Otabaru CPCRU 3 and Hateruma CPCRU 2 samples have 1.5% and over 2% Ca respectively. This suggests that Pyutsuta (CPCRU 1) and Otabaru (CPCRU 4) with lesser amounts of Ca could well be formed from volcanic clays, while Hateruma (CPCRU 2) and Otabaru (CPCRU 3) developed out of calcareous clays.

Hateruma (CPCRU 2) separates from Otabaru CPCRU 3 primarily on the basis of the element Potassium (K) and Magnesium (Mg), with Hateruma having lesser K, and higher Mg.

Thus we have identical pottery found from a number of sites, each made with different clays. Two sites, Shimotabaru on Hateruma and Pyutsuta on Ishigaki, would have had their pots or clays physically brought in. As noted earlier the island of Hateruma has no clays, and suitable clays are not located near Pyutsuta which is situated on sandy deposits and next to a granite spur protruding perpendicular to the beach (Foster 1965).

Identifying the origin of clays used in pottery manufacture is always difficult to assess. However, the catchment behind Nagura Bay encompassing the site of Otabaru contains a variety of clays which could have provided the variety of CPCRUs seen in this study. For example, non-calcareous clays are found in the Nagura Gravels located in the Nagura catchment. These clays have a yellowish brown colour with reddish streaks (Foster 1965:50). Those CPCRUs with higher concentrations of Ca may have originated from coastal marine terrace deposits. Yet it is also noted that clays described as calcareous are also found near the Nagura catchment (Foster 1965:56). Thus the potters from Otabaru had access to both clays. There was an area on the east coast of Ishigaki (1.5 kilometres north of Miyara) where clay for pottery was dug in recent times, however, it can be discounted for use with the pottery under analysis as it was based on weathered andesite (Foster 1965:107). Minerals associated with andesite have not been found in this pottery (see below).

Inclusions

There are four fabrics identified by the analyses (see Table 2). The first (fabric 1) is made up of alkali feldspars, epidote and quartz. This fabric is identified in in Otabaru's CPCRU 3 (1 sample) and 4 (2 samples). Alkali feldspar is found in one of the Pyutsuta sherds but not with epidote. This sole sherd makes up fabric 2.

The third fabric is similar to fabric 1, except it is lacking alkali feldspar being made up of quartz, epidote and ferrous oxides. This fabric is common to all CPCRUs with five samples identified from Pyutsuta's CPCRU 1, and one sample each from Otabaru's CPCRU 3 and 4. Fabric 3 is the sole fabric identified from Hateruma (CPCRU 2). The last fabric (Fabric 4) is made up of just quartz and ferrous oxides without the epidote, and is identified in the remaining Pyutsuta's samples (n=4).

Of interest is the presence of quartz in all fabrics. Also, the presence of epidote in two of these four fabrics. Epidote is a mineral formed from metamorphosed rocks and is common in the geology of Ishigaki Island. Epidote, plus quartz and some feldspar is associated with greenschist. Pumpellyite glaucaphone is also associated with quartz and ferrous oxides and no epidote. These combinations can account for the four fabrics identified and are all found in the catchment area behind Nagura Bay where Otabaru is located. Other metamorphic rocks with epidote and quartz are located on Ishigaki, yet these can be discounted as they are found in association with mica. Mica is noticeably absent in this pottery. Also noticeably absent are the inclusions from igneous derived deposits such as andesite or rhyolite (pyroxenes or plagioclase of any kind).

Discussion

We can now return to the question posed earlier as to whether similarities in style of the pottery was due to either production in one area and then exchanged out,
or production in a number of areas. The results suggest production in a number of areas. More than one clay source was used with different mineral tempers to produce a stylistically similar ware. This ware or the clay and temper was imported to Hateruma Island and also Pyutsuta. From the distribution of clays and minerals presented above, they could all have come from the Nagura Basin catchment, on the west coast of Ishigaki.

Not much exists to make chemical comparisons with these results. From Taiwan comparable pottery from the sites of Tapenkeng and Fengpitou (see the section below) were analysed by X-ray diffraction analysis (Chang 1969: appendix 1). Such an analysis provides an indication of which minerals were present. The pottery from Fengpitou ranging from the TPK phase, through to the sandy red ware phase, to black ware and later materials all had quartz, feldspar and mica present. Tapenkeng pottery also from the full range of phases found within that site, also contained mainly quartz, with feldspar, and mica. These compositions are unlike those from the Yaeyama assemblages.

A possible connection could be made with a lug sherd sent by Richard Pearson to Bill Dickinson for analysis from Funaura site, Iriomote. This site is located on a ridge 1 kilometre west of the Funaura shell mound, and Pearson suggests that the sherd may be related to the early Shimotabaru ware (Pearson 1981:176). Unfortunately as noted by Pearson, the site was destroyed by agricultural activity and bulldozing. Petrographic analysis has the temper as 90% quartz, with feldspar and quartz (Dickinson 1981:171). An origin with the "erosion of sedimentary strata including sandstone beds" was suggested.

In summary:

1. Shimotabaru pottery was not made from a single specialist production centre and then distributed across the archipelago (see Figure 5).

2. All clays and minerals used in the production of Shimotabaru ware could have all originated from a restricted geographical location near the site of Otabaru.

3. No pots were exchanged between these three sites. Each site used separate clays – i.e. all CPCRUs are site specific.

4. The production distribution suggests

i. the importing of pots or resources into Hateruma from Ishigaki.

ii. The importation of pottery or resources into Pyutsuta from other areas within Ishigaki, probably from the Nagura catchment area.

iii. Local production for Otabaru.

Thus, a colonising group made identical pottery using many resources, and imported some to outer islands, along with adzes (see below) and probably a transported economy as well.

Shimotabaru and the regional picture

The dates for colonisation of the Yaeyama Islands at between 4,000-3,800 years ago fits well with new research from Taiwan and islands to the south. The archaeological evidence suggests that these early colonisers probably came from Taiwan. Connections to the Jomon Cultures to the north can be ruled out on a number of reasons.

First, the distance between Yaeyama Islands and Jomon centres to the north were too great for non-agriculturalists to travel. It has been argued that the inhabitants of Okinawa, Jomon, were hunter-gathers.

Secondly, there is evidence of Shimotabaru occupation of Yonaguni (Toguruhama site – a site without the pots) which suggests that this colonisation phase passed through this island.

Thirdly, the Shimotabaru pottery is totally unlike anything seen in the Jomon of Okinawa. It has been suggested that it is similar to plain ware found in archaeological sites on north east Taiwan. The same can be said for the adze forms, some of which are not found north of Okinawa (Kokubu 1963:229-231).

Thus there are strong arguments why this Neolithic phase could not have originated from the Jomon occupations from the northern islands. The closest Jomon was found on Okinawa, some 400 kilometres to the north. Thus links between the Sakishima Islands and islands to the north were thought to non-existent (Ito 2003:63) or very weak.

The Taiwan Connection – pottery (see Figure 6 for sites from Taiwan)

If the Shimotabaru Ware did not originate from the Jomon pottery traditions found to the north, then they were either independently invented or originated from areas to the west – i.e. Taiwan. Yet which assemblages in Taiwan are they related to? An early contender was the TPK cultural complex. TPK was found and named after the site of Tapenkeng (or Dabenkeng) located near Taiwan and dated to between 5500-4500 cal BP (Chang 1969). The pottery from the TPK culture (incised and cord marked) has a wide distribution round coastal areas of Taiwan suggesting to some a "unified cultural milieu and were perhaps immigrants into Taiwan from Fujian or Guangdong" (Bellwood and Hiscock 2005:283-284). K.C. Chang (1995) also argued that similar pottery is found here on mainland China at this time. Evidence for this is also seen in the presence of TPK sites located on the Penghu Archipelago (Tsang 1992). These islands are located 45 kilometres west of Taiwan, and 140 kilometres east of mainland China (Tsang 1992:3). Other characteristics of TPK culture included red paint and red slipped pottery, stone bark cloth beaters, shouldered stone adzes, baked clay spindle whorls, shell bracelets and ear rings,

dog burials, carbonised rice and foxtail millet remains. Most of the TPK sites were found on ridges or hills overlooking the coastal plain, such as Fengpitou (Chang 1969).

It was long thought that the TPK pottery was the immediate precursor of the red slipped pottery traditions that supposedly moved south into the Philippines. That is, people from a later stage of this TPK culture moved into the Philippines. Yet it is obvious that the TPK is too old to be associated with Shimotabaru pottery from Yaeyama, although the latter appeared when the former declined. Furthermore no paddle impressed ware (characteristic of TPK) was found in Shimotabaru deposits. A recent re-assessment of the TPK now views it as too old to be related to the Austronesian movements from Taiwan into northern Philippines (Bellwood and Hiscock 2005:284). Bellwood, for instance, now believe that the earliest pottery from the Batanes and northern Philippines looks most like post-TPK pottery from southern Taiwan, such as the Yuenshan culture of Taipei basin, and Peinan Culture of southeast Taiwan. Both derived out of TPK and have predominant red slipped pottery, and stamped design, without cord marking. Bellwood sees the later as probably the source of movements to the south into the Philippines (Bellwood and Hiscock 2005:284). (See Bellwood and Dizon (2005), and Bellwood et al. (2003) for recent results from the Batanes Islands).

It is also from these sites that Ohama thinks that Shimotabaru pottery originates. Ohama (1996:27; 1999: 52-56) argued over a decade ago that the Red Slipped Culture originated from the following assemblages:
:

a. Post-TPK assemblages at Fengpitou in south-western Taiwan,
b. Yuenshan Culture north coast of Taiwan
c. Peinan culture on East coast of Taiwan.

These sites are mostly post-TPK pottery phases. The dates for Peinan fit well with the earliest dates for red slipped pottery in the northern Philippines at between c.4,000-3500 BP (Hung 2005). Hung also notes similarities between pottery from north Luzon sites of Nagsabaran and Irigayen (excavated by Ogawa) and from Taiwan. For instance:

1. Everted concave rims are shared between these Philippine sites and in eastern fine cord marked pottery sites of Yuchangnan, Fushan, Yanliao, Dakeng and Shanyuan dated to 4000-3500 BP. Also found is polished red slipping.
2. Everted rim with outer thickening of the lip is found at Magapit on Northern Luzon, the Batanes site of Torongan Cave (1600 BC), and several sites (Bushan, Jialulan and Shanyuan) in southeast Taiwan.
3. Bowls on ring foot are found in Northern Luzon with red-slipped pottery at Nagsabaran, Dimolit, Magapit and Irigayan. In Taiwan they are found at Fengpitou, and in the eastern Taiwan sites of Fushan, Zhanchang, and Peinan.
4. Basins are found at Nagsabaran in the Philippines, and at Fengpitou (fine corded pottery), and Qiguan in Taiwan. The surfaces of these vessels have red slip or fine cord marks. (Hung 2005).

Although strengthening links between Taiwan and the northern Philippines, unfortunately none of these vessel forms were found in the Shimotabaru assemblages. Also there is also no cord marked pottery from the Yaeyama assemblages. It should be noted, however, that the absence of cord marking here is not as important as it seems. Hung (2005) makes the important point that fine cord mark sherds only make up 10% or less of the assemblages in the eastern Taiwan sites such as Fushan. This site was dominated by red slipped or plain pottery. Hung also notes that red slipping in Taiwanese assemblages occurs in the late phase of Tapenkeng (Dabenkeng) (TPK) Culture after 4600 BP. It became popular at 4,000 BP (late phase of Middle Neolithic).

There is, however, a resemblance between the Shimotabaru pottery form with the vertical lugs/handles bears with a form that K.C. Chang calls a beaker from Fengpitou's Phase 2. Chang calls this ware the "sandy red pottery" (Chang 1969 plate 57). Chang originally called this phase II of his Lungshanoid Culture and estimated its age to between 1900-1400 BC (Chang 1969:51, 228). Lungshanoid (a term derived from mainland Chinese assemblages) was a phase following the TPK Cord Ware Culture. As noted above, Fengpitou is located in southwest Taiwan and is dated to between 1900-1400 BC (Chang 1969:51, and plate 57). The site is located on a terrace about 700 metres in from the present beach. The terrace is over 39 m above the road below, and Chang notes that this terrace would have had the sea lapping against it during occupation (Chang 1969:19). With the higher sea levels at that time, similar site locations are found in the Yaeyama Islands.

In short, the pottery form from Taiwan that bears similarities with Shimotabaru pottery forms dates to the same time span as the Shimotabaru ware. This is a period of time that witnessed a dramatic increase is archaeological sites in Taiwan. Hung (2005) notes out that in the pre-4500 BP period, only six TPK sites are known, compared to forty three from the period 4500-3500 BP.

The Taiwan Connection – adzes

Similarities in adze forms have also been used to identify connections between the early Shimotabaru colonisers and areas to the west. Firstly, from the earlier excavations at Hateruma adzes with a "rough transverse step on one side" were noted to at least have been an attempt at a "stepped butt" (Pearson 1969:85). Such stepping was thought to be closely associated with types found in Taiwan, southern China and the northern Philippines (Kanaseki et al 1964: 11). Although originally thought to be restricted to the Taipei Basin (Pearson 1969:111) they are now found wider afield, eg. Nanguanli (Nan-kuan-Li), Tainan County (Tsang 2005:69) in TPK contexts. Secondly, Kokubu noted similar links between Yaeyama, Taiwan, Philippines based on the presence of trapezoidal sectioned adzes, what were called by Kokubu (1963:229) "semi-polished, ridged-stone implements". Lastly, Pearson (1969:105, 111) also noted similarities between the slightly polished, ovoid in section basaltic adzes from the T'ai Yuan and Peinan site and those sites from Yaeyamas (Pearson 1969:105).

Any similarity between the adzes from these two areas was not the result of physical exchange. The adzes found in the Yaeyama Shimotabaru assemblages were from a variety of local rocks. From Pyutsuta the adzes were identified by a geologist (Itsuro Oshiro) as from the same gabbro (Ishigaki City Education Board 1997: 85). However, from our observations these adzes were made from metamorphic greenschist. Adzes from Otabaru were not allocated a source rock in the original site report, however, from our own observations and from photographs in Takemoto and Asato (1993: plate 47) the earlier adzes were again made from greenschist. Greenschist adzes were also identified from Nakama No. 2 contexts (pers. observation). Outcrops of greenschist exist on Ishigaki next to the Otabaru site in the Tumuru Geological Formation (Foster 1965), and also on Iriomote. We were shown a beach level outcrop on the eastern coast of Iriomote at Nihara by Mr Takamine, a local resident. Adzes made from this material are magnetite rich with lots of green amphiboles, and few crystals of black magnetite, and garnet is visible (Professor Alan Cooper, Otago University, pers. comm.). Although the latter outcrops would have been covered by water 4,000 years ago, further outcrops are found inland on Iriomote. By its very nature, greenschist is difficult to polish, thus accounting for adzes made from this rock being partially polished.

From Hateruma, a number of metamorphic rock types used in the manufacture of adzes. Most were defined as gabbro, with dolerite (diabase), amphibolite and a single crystalline schist adze also found (Okinawa Prefectural Education Board. 1986: 49-60). All these metamorphic rock types are found on Ishigaki. Also found from Hateruma were a series of round pecked hammer stones made from sandstone, granite, limestone, schist and gabbro. All these stones would have been imported into Hateruma. Granite outcrops are only found on Ishigaki within the Yaeyama group (Foster 1965:13).

We know the ages of these Shimotabaru adzes but what about the Taiwan adzes? Stone adzes first appear in Taiwan during the Dapenkeng (TPK) Culture in association with the first appearance of pottery at 5500 BP (Rolett et al. 2002 – see above). Quadrangular sectioned adzes occur after the TPK at about 4000 BP. The adzes are made from grey slate, green nephrite, andesite and basaltic rocks (Chang 1969). Some of the basaltic adzes found in Taiwan assemblages were quarried from the Qimei Island, in the Penghu Archipelago (Rolett et al. 2002:313). Two sites with adzes from Penghu are Fengpitou, dated to between 4500-3500 BP (Chang 1969), and Nanguanli (Bellwood and Hiscock 2005:284). Stylistically similar adzes to those made in Taiwan are also found on mainland China in 5,000-4,300 year old contexts at the Damaoshan site (Jiao 2007:26), and also in 4000-3500 year old contexts in at the Huangguashan site (Rolett 2002: 315; Tsang 2002:23), both in Fujian Province. The adzes from Damaoshan were not made locally, and could not be allocated to either the Penghu or mainland China sources (Guo et al. 2005). Those from Huangguashan were not quarried from the Penghu Archipelago (Rolett 2007: 58).

Hung (2004) has analysed over 1000 stone adzes from 210 Neolithic sites from Taiwan and the Penghu Archipelago and has identified source rocks for al these adzes (nephrite, andesite, basalt and slate). None are made from the same materials used in the manufacture of the Yaeyama adzes.

In conclusion, similar forms of adzes from the same period are shared between the Shimotabaru and Taiwan assemblages. Yet, there is no evidence of adzes from either location being traded between these two regions.

Nature of Interaction

Whatever the nature of interaction that occurred between Taiwan and Yaeyama, it different nature to that which occurred between Taiwan and the Philippines in a number of respects. First, the majority of vessel forms and decorations shared between Taiwan and the Philippines are absent. Only one vessel form was shared between Taiwan and the Shimotabaru assemblages.

Second, there is no jade (nephrite) in the Shimotabaru deposits. This is important as there is a strong association with movements south into Batanes and the Philippines and the presence of Jade sourced to Taiwan (Iizuka et al. 2005; Iizuka and Hung 2005). Green Jade was common from the middle Neolithic sites of Taiwan and nearby islands of Penghu. The main source is on the east coast of Taiwan. Sites with fine cord mark pottery in eastern Taiwan (Fushan and Beinan) and southern Taiwan produced a large number of jade bracelets. Hung (2005) notes the distribution of nephrite at the northern Luzon sites of Nagsabaran with red slipped pottery, and also Dimolit, Arku (Cagayan Valley) and other sites in Luzon. There is no natural source for jade in northern Luzon. She argues that "ancient Austronesians were very active in trading or exchanging jade from Early Neolithic times through into the Metal Age in the South China Sea region" (Hung 2005). Thus absence of jade in Yaeyama suggests a distribution network of jade which went to the south

Third, spindle whorls that are common in northern Luzon and Taiwanese assemblages are absent in Shimotabaru contexts.

Fourth, rice is absent in Yaeyama. Although the earliest evidence for rice and foxtail millet in Taiwan is from the site of Nanguanli dated to 5310-4870 BP, there is no evidence for rice in the early Shimotabaru deposits. Indeed Takimaya (2006) suggests that agriculture is a late addition to the central Ryukyus, located further north. Pearson suggests that if early populations of Hateruma came from Taiwan, then they would have known cultivation (Pearson 1981: 141), and there are suggestions that historical Yaeyama agriculture was influenced from Taiwan. Yuji Akei (referenced in Pearson 2003:95-96) reports that: Cultivation systems of Iriomote originated from the south; traditional rice from Iriomote, *Oryza sativa javanica*, is different that from Okinawa and could have originated from Taiwan and Large yam grown on Iriomote also comes from Taiwan. The question is when did these introductions first occur? Serious archaeological investigations into recovering palaeobotanical evidence is required.

On the other hand, the presence of Shimotabaru ware and these early colonisers was archaeologically short lived. Perhaps agriculture was not introduced explaining why there was no sustainable occupation on these small islands? The pottery and adzes found seem

to be poor imitations to those found in Taiwan. There are post-Shimotabaru connections to the west and south. Ohama (1996:27) argued that after the disappearance of the Shimotabaru ware there was a break of 800 years followed by an aceramic phase with *Tridacna* shell adzes suggesting ties with the Philippines (rather than communities to the north). The use of the hinge for the *Tridacna* shell adze suggests a connection with the Philippines, but Ohama (1996:27) notes that that we need better sequences from the Philippine to confirm this.

Of interest is the presence of shell adzes found in Urasoko and other sites on Miyako Island (Takayama 2001). Shell adzes are also found round the Toguruhama site on Yonaguni (along with shark teeth with perforated hole, operculum scrapers); Nagura Bay, Sakieda-Akasaki site, Saowaka-nishi shell mound, Fusaki shell mound, Hirakubo, Kandobaru and several other locations on Ishigaki. They are argued not to found in the Shimotabaru period – they are post Shimotabaru. It is to the later period that shell adzes appear (from 2500 to 1000 years ago). BUT one shell adze was found in association with Shimotabaru pottery at Nakama No.2 on Iriomote (Asato 1990:31). It was made from the hinge. In fact most of these shell adzes were made from the hinge, or using the hinge part. Shell adzes are not found to the north in Okinawa nor other northern Ryukyu Islands, nor Japan. They are also not found in contemporary levels in Taiwan. They are found in the Philippines and areas to the south, and also east in Micronesia. Those from the Philippines were made using the hinge part of the *Tridacna*, unlike Micronesia, leading Asato (1990) to argue a case for cultural connections with this area.

Conclusions

The evidence presented suggests that the nature of Austronesian expansion out of Taiwan is complex. Occupation of the Yaeyama Islands some 4,000-3,800 years ago probably originated from Taiwan by Austronesian speaking populations. A similar point has been made by Hudson (2006). Whether these colonisers introduced agriculture is not known, but likely. Future research into palaeobotanical remains will assess the impact of agriculture into this island chain. There is a degree of interaction between islands, with the transfer of pottery, faunal remains and adzes to Hateruma, and probably other islands as well. Evidence for this early occupation of Yaeyama is short lived, with sites disappearing after a few generations.

The pulse of colonisation and settlement by 4,000-3,800 BP in the Yaeyama region reinforces the later post-TPK movement of ideas and peoples from Taiwan to the south and into Philippines. The nature of the movements of people and ideas to the Yaeyama islands, however, was of a different kind to that happening in areas to the south. This late movement of ideas/peoples also has implications for the settlement of areas in the Pacific as well as it shortens the time span for the movement of ideas, peoples and language from Taiwan to New Guinea to only 400-500 years, some 20-24 generations of peoples. The implications for demographic growth and populations movements needs further attention.

This "pulse" of colonisation was unlike others seen in southeast Asia and Near Oceania. Areas to the south of Taiwan down to the end of the Solomon Island chain had a previous

50,000 year old history of human occupation. It is in these already occupied areas that a supposedly "Austronesian" movement propelled by agricultural expansion took place. By the time this expansion reached New Guinea, distinctive pottery called Lapita appears with complex dentate-stamped design characters said to be a social markers or result of "costly signalling" (see Summerhayes and Allen 2007). Such "costly signalling" continues for a further millennium in those areas previously inhabited, such as the Bismarck Archipelago. Yet in previously uninhabited Remote Oceania (New Caledonia, Vanuatu, Fiji) these elaborate complex design characters disappeared, having no need for such "costly signalling". A similar model may be applied in the early Yaeyama assemblages that had mundane, clumsily made pottery with little if any decoration. With few colonists and no prior populations evident on the island group there was not a need to signal or reinforce their own identity through complex decoration.

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Figure Captions

Table Captions

Table 1. Radiocarbon estimates for Shimotabaru phase

	Lab. Reference	Sample	Reference
SHIMOTABARU			
3870+100 yBP	Gak-3766	SHELL	Pearson et al. 1978; Ohama 2000
3290+90 yBP	Gak-3765	SHELL	Pearson et al. 1978; Ohama 2000
3800+130	N-259	*Geloina papua*	Pearson 1981; et al 1978
3740+85 yBP	not given	CHARCOAL	Okinawa Prefectural Board 1986
3660+70 yBP	not given	SHELL	Okinawa Prefectural Board 1986
PYUTSUTA			
4250+50 yBP	Beta-97153	CHARCOAL	Ishigaki Education Board 1997
3870+50 yBP	Beta-97154	CHARCOAL	Ishigaki Education Board 1997
OTABARU			
3970+95 yBP	unknown	*Tridacna*	Okinawa Pref. Ed. Board 1980
3870+65 yBP	unknown	*Tridacna*	Okinawa Pref. Ed. Board 1980
TOGURUHAMA - YONAGUNI ISLAND			
3890+40 yBP	unknown	SHELL	
3770+40 yBP	unknown	SHELL	

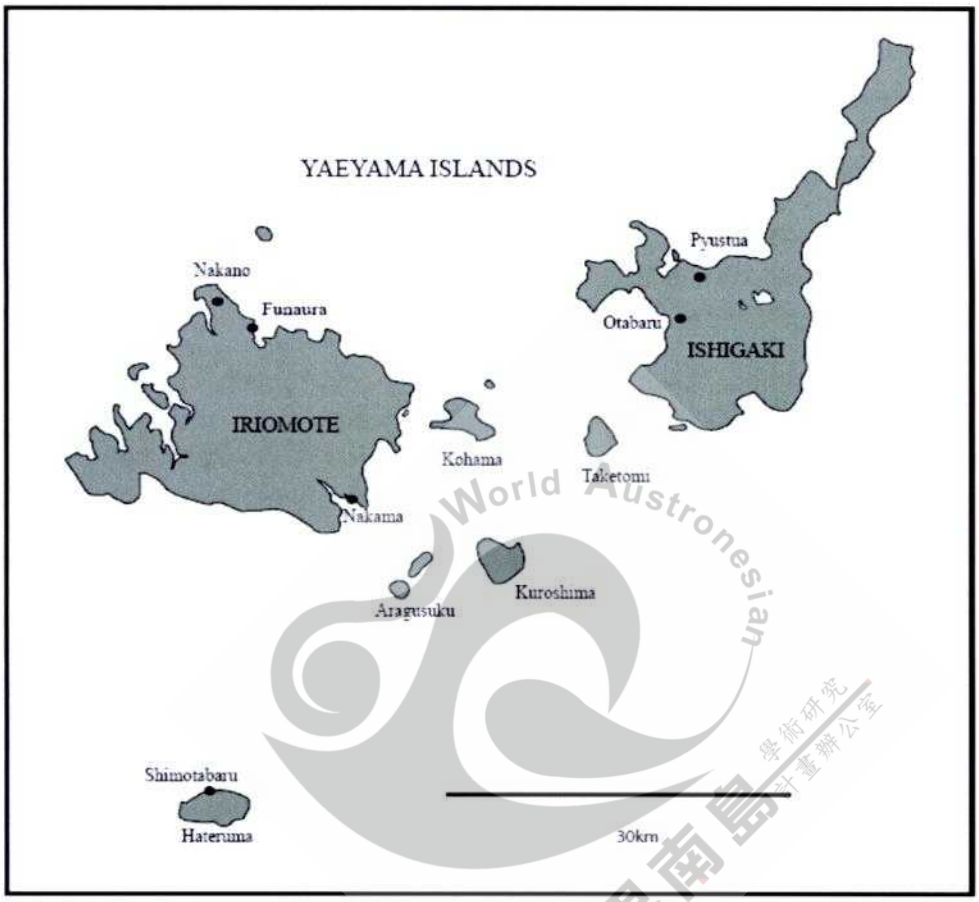
Table 2. Presence of fabrics in CPCRUs

	CPCRU 1 Pyutsuta	CPCRU 2 Hateruma	CPCRU 3 Otabaru	CPCRU 4 Otabaru
Fabric 1	-	-	X	X
Fabric 2	X	-	-	-
Fabric 3	X	X	X	X
Fabric 4	X			

Figure 1.


KOREA
KYUSHU
EAST
CHINA
SEA
Ryukyu Islands
Amami
Jomon Boundary
Okinawa
Miyako
YAEYAMA
TAIWAN
Botel-tobago

Figure 2



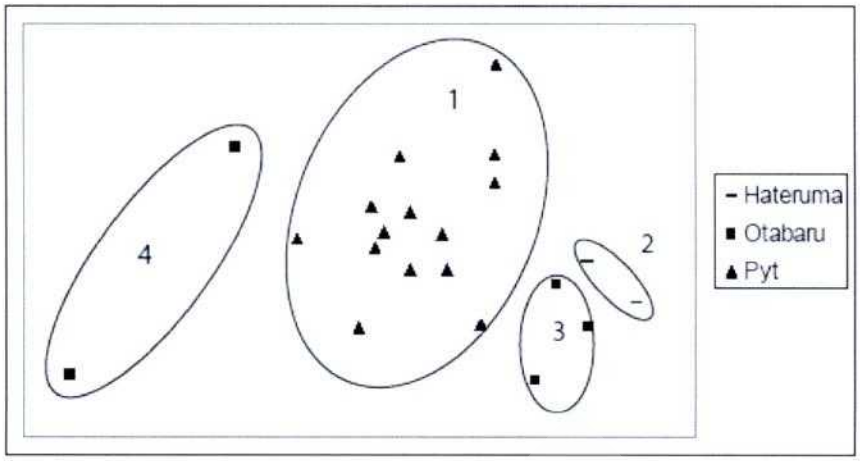


Figure 3

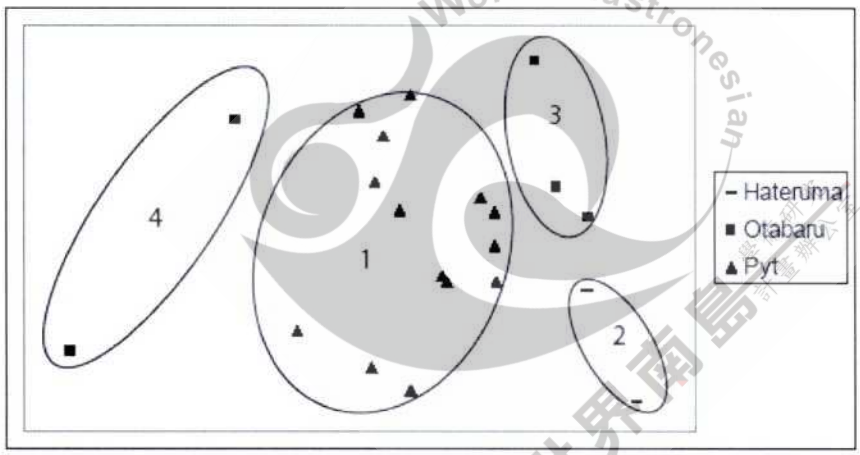


Figure 4

Figure 5

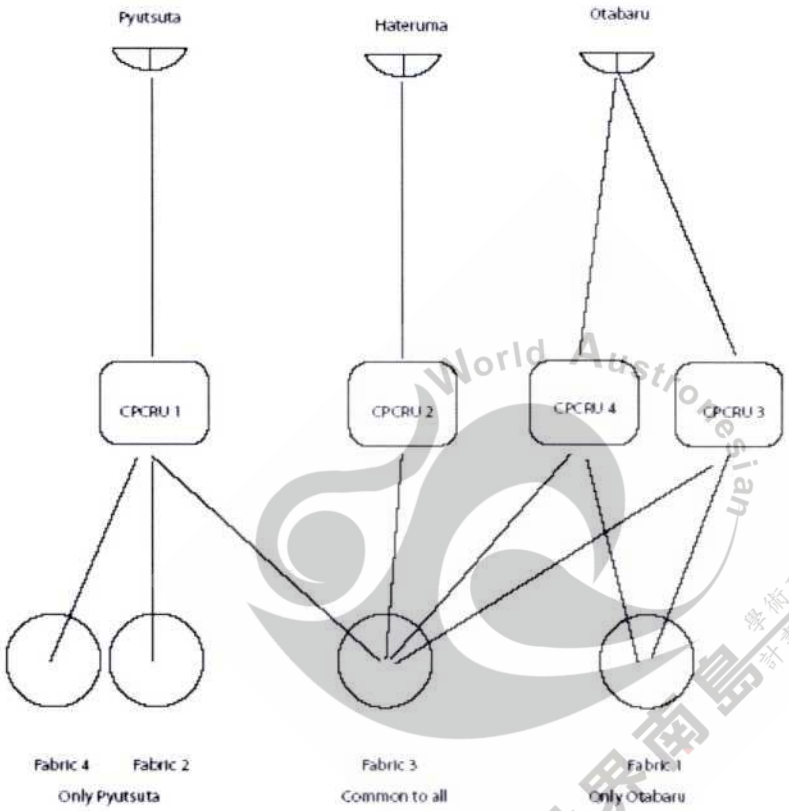

Pyutsuta
Hateruma
Otabaru
CPCRU 1
CPCRU 2
CPCRU 4
CPCRU 3
Fabric 4
Fabric 2
Only Pyutsuta
Fabric 3
Common to all
Fabric 1
Only Otabaru

Figure 6