Neolithic foundations in the Karama valley, West Sulawesi, Indonesia

Anggraeni,[1] Truman Simanjuntak,[2] Peter Bellwood[3] & Philip Piper[3]

Excavations at three open-air sites in the Karama valley of West Sulawesi have revealed similar suites of ceramics and overlapping chronologies. The pottery from the basal layers at Minanga Sipakko and Kamassi resembles that of the Philippines and Taiwan, and suggests the settlement of migrants from those areas, consistent with the theory of Austronesian expansion. The absence of the flaked lithic technology typical of earlier Sulawesi populations indicates that these two sites do not represent the indigenous adoption of Neolithic features. The Karama valley evidence underlines the importance, in the quest for the earliest farmers, of research at open-air sites close to agriculturally suitable land, while indigenous populations may have continued for some time to occupy remote caves and rockshelters.

Keywords: Island Southeast Asia, Sulawesi, Neolithic, pottery, pigs, rice, obsidian, Austronesian linguistic prehistory

Introduction

Recent research undertaken on the island of Sulawesi in Indonesia throws considerable light on a much-debated issue. Was there an initial Neolithic settlement of this island from the north around 3500 years ago, via Taiwan and the Philippines, in accordance with a widely accepted hypothesis for an out-of-Taiwan spread of Austronesian languages and their early speakers (Bellwood 2011)? This paper presents newly analysed evidence from the Karama valley in West Sulawesi (Figure 1), and documents from three sites a sequence of Neolithic archaeology with Taiwanese and Philippine antecedents between *c.* 1500 and 800 BC.

[1] *Department of Archaeology, Faculty of Cultural Sciences, Gadjah Mada University, Jalan Sosio Humaniora 1, Bulaksumur, Yogyakarta 55281, Indonesia (Email: anggra_eni@ugm.ac.id)*
[2] *Center for Prehistoric and Austronesian Studies and National Center for Archaeology, Jalan Raya Condet Pejaten 4, Jakarta 12510, Indonesia (Email: simanjuntaktruman@gmail.com)*
[3] *School of Archaeology and Anthropology, Australian National University, Canberra, ACT 0200, Australia (Email: peter.bellwood@anu.edu.au; philip.piper@anu.edu.au)*

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Figure 1. Location of the Karama valley, West Sulawesi, Indonesia.

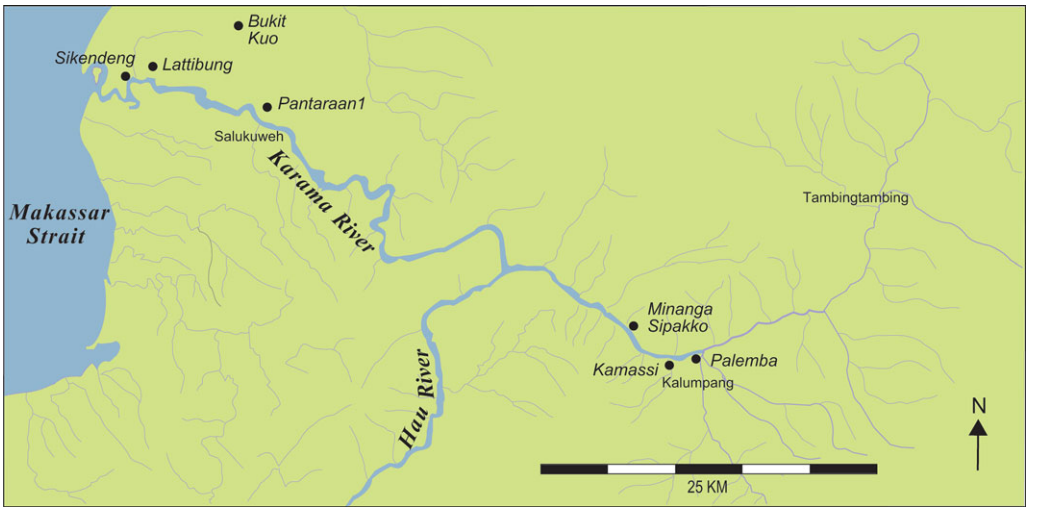


Figure 2. Archaeological sites (in italics) in the Karama valley.

The 150km-long Karama valley has long served as an important arterial route for human interaction between coastal and interior regions of West and Central Sulawesi. River terraces and accessible hilltops supported considerable prehistoric settlement in two separate regions within the valley, the first from the modern coastline upstream to Salukuweh, and the second from Minanga Sipakko upstream through Kalumpang township to Tambingtambing (Figure 2). Modern settlements and agricultural resources still occupy essentially the same locations. The intervening section between Salukuweh and Minanga Sipakko is quite deeply incised in rugged country that is still mainly forested and without road access.

Attention was drawn initially to the Karama valley in 1935, when P.V. van Stein Callenfels (1951) presented his excavation results from the small hill of Kamassi (or Kamansi) in Kalumpang township to the Second Congress of Prehistorians of the Far East in Manila. The most significant findings included sherds of decorated pottery, rectangular cross-sectioned stone adzes, and slate projectile points with apparent Taiwanese Neolithic affinities (Bulbeck & Nasruddin 2002). Research around Kalumpang was continued by H.R. van Heekeren in 1949, who excavated more on the Kamassi hilltop and recovered similar finds from Minanga Sipakko, four kilometres downstream (van Heekeren 1972: pls. 97–102).

After a long period of inactivity, Indonesian archaeologists carried out further excavations at Minanga Sipakko in 1994–1995 and 2004–2007, including a joint season with Australian archaeologists in 2004 (Simanjuntak 1994–1995; Morwood *et al*. 2007; Simanjuntak *et al*. 2007, 2008). Kamassi was re-excavated by Truman Simanjuntak in 2007 and 2008 (Tim Penelitian 2008). More recently, Anggraeni (2012) has excavated the downstream site of Pantaraan 1 and re-examined the excavated assemblages from Minanga Sipakko and Kamassi stored in Jakarta (Anggraeni 2012). Further excavations were also carried out at Kamassi by Balai Arkeologi Makassar in 2011 and 2012 (Hakim & Suryatman 2012). There is not space in this article to discuss details of site layout and stratigraphy, but Figures 3 and 4 will indicate that, in terms of diagnostic ceramic variables, both Minanga Sipakko and Kamassi offer coherent chronological sequences without signs of heavy disturbance or admixture.

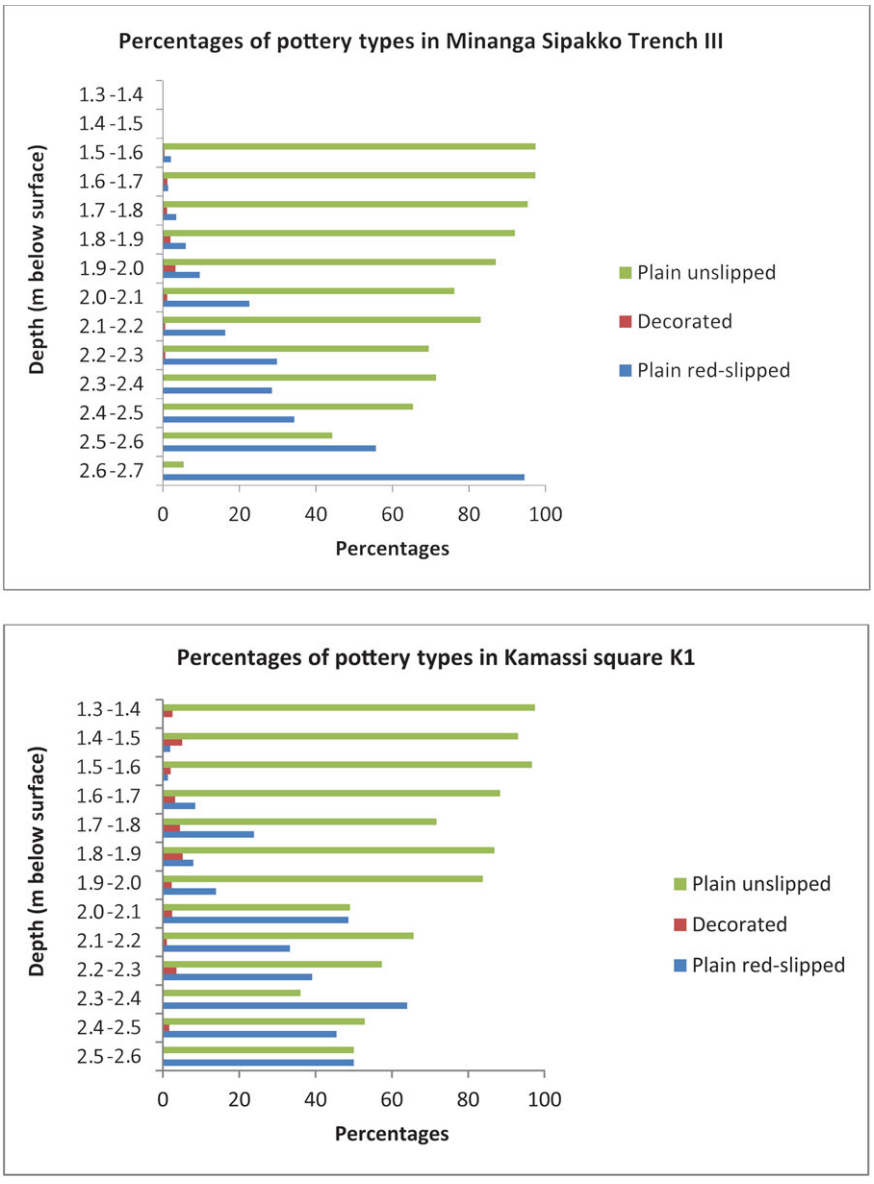
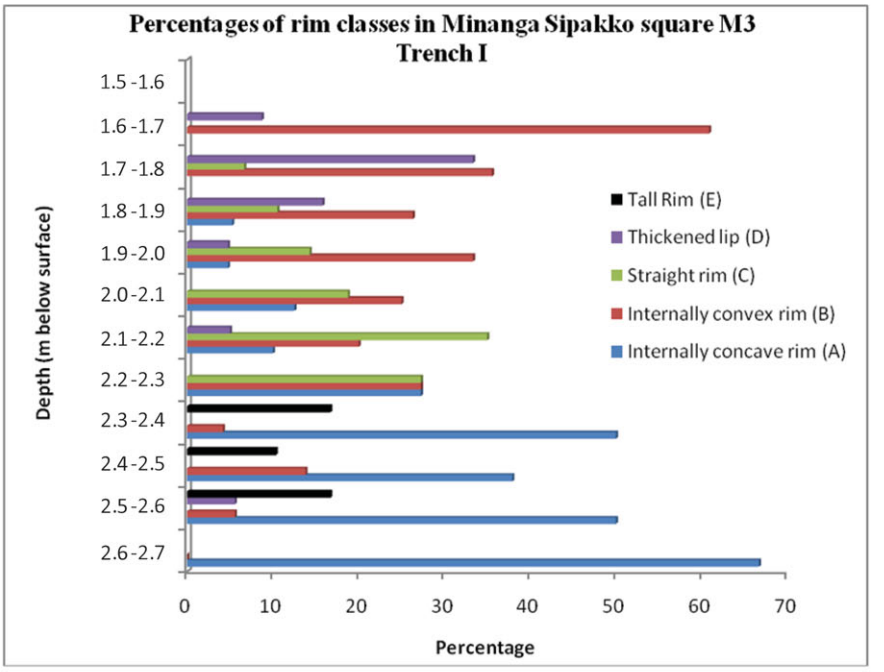


Figure 3. Percentages of pottery types by 100mm spit through the cultural deposits in Minanga Sipakko Trench III (top), and Kamassi square K1 (bottom) (after Anggraeni 2012).

Minanga Sipakko

Remains of this open settlement, located 95km upriver from the modern coastline, occur sealed within a flat river terrace on the northern bank of the Karama River. They exist as a 1.3m-thick undisturbed cultural layer capped by 1.4m of archaeologically sterile alluvium. Plain red-slipped, incised/stamped and plain unslipped sherds have distinctive distributions within this cultural layer, which was recorded by 100mm spits in several trenches. These



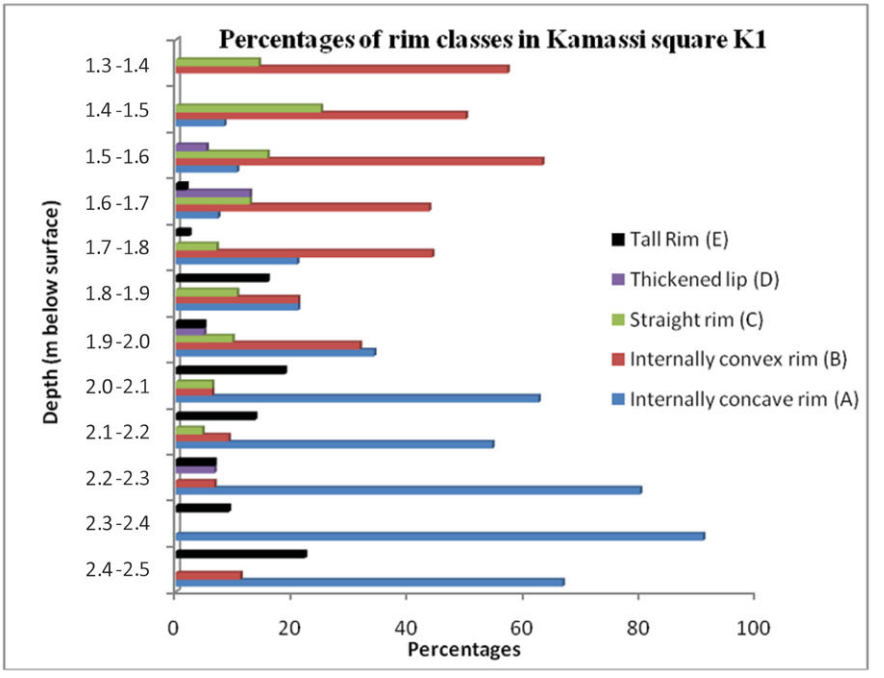


Figure 4. Rim class percentages by 100mm spit in Minanga Sipakko Square M3 Trench I (top), and Kamassi square K1 (bottom) (after Anggraeni 2012).

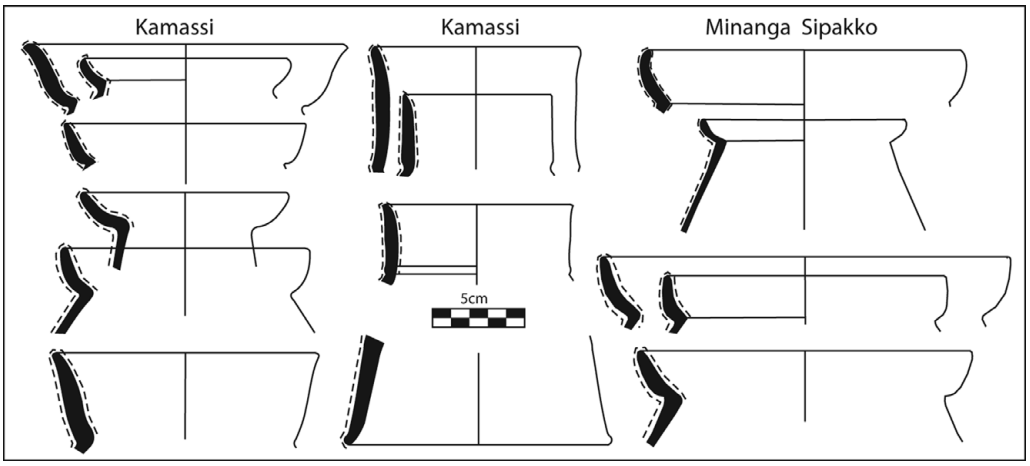


Figure 5. Karama valley early phase rims. Left and middle columns: Kamassi square K1, 2.3–2.5m spits. Right: Minanga Sipakko square M3, 2.4–2.5m spit. Dotted lines indicate red slip.

distributions can be seen clearly in Figure 3, in which the changing proportions of pottery through the Minanga Sipakko cultural layer are compared side-by-side with the similar changes to be discussed below from Kamassi. Plain red-slipped sherds dominate at the base, but then give way gradually to unslipped sherds in the higher spits. Decorated sherds, mostly incised and/or stamped (paddle-impression is absent), occur in small numbers in the middle of the sequence. Figure 4 shows the succession of rim forms on restricted vessels from Minanga Sipakko Trench I, again compared with Kamassi (actual rims are illustrated in Figures 5 & 6), with internally concave and tall rims dominant at the base, giving way to convex and straight rims above.

Small chips and flakes of obsidian, similar in size to those from Bukit Tengkorak in Sabah (Bellwood 1989; Chia 2003), occurred in the middle of the occupation layer in all excavated trenches at Minanga Sipakko, but not at the base of the sequence. Some pieces from Minanga Sipakko and Kamassi have been analysed by Reepmeyer *et al.* (2011), but the chemical signatures do not correlate with any known obsidian source. It is geologically possible that obsidian occurs in several locations in Sulawesi; for instance, it is found in the environs of Lake Tondano in Minahasa, although the Karama specimens do not come from there. Flakes of schist and slate were common, probably as waste from stone adze use and maintenance. Other lithic items included grindstones, hammerstones, stone bracelet and ring fragments, and oblate stone beads (Simanjuntak *et al.* 2004).

The date of Minanga Sipakko is established by a series of five Waikato AMS dates shown in Table 1; all are from well-defined contexts and have small standard deviations. These five dates indicate that the extreme outer limits for occupation of the site would be 3840–2874 cal BP (*c.* 1900–900 BC), but the inversions in this list give cause for caution. In particular, Wk-14651 is from a fairly high level and its relative antiquity suggests that it might be on old wood. If this date is withheld, a date range from *c.* 1600 to 900 cal BC for Minanga Sipakko would be indicated.

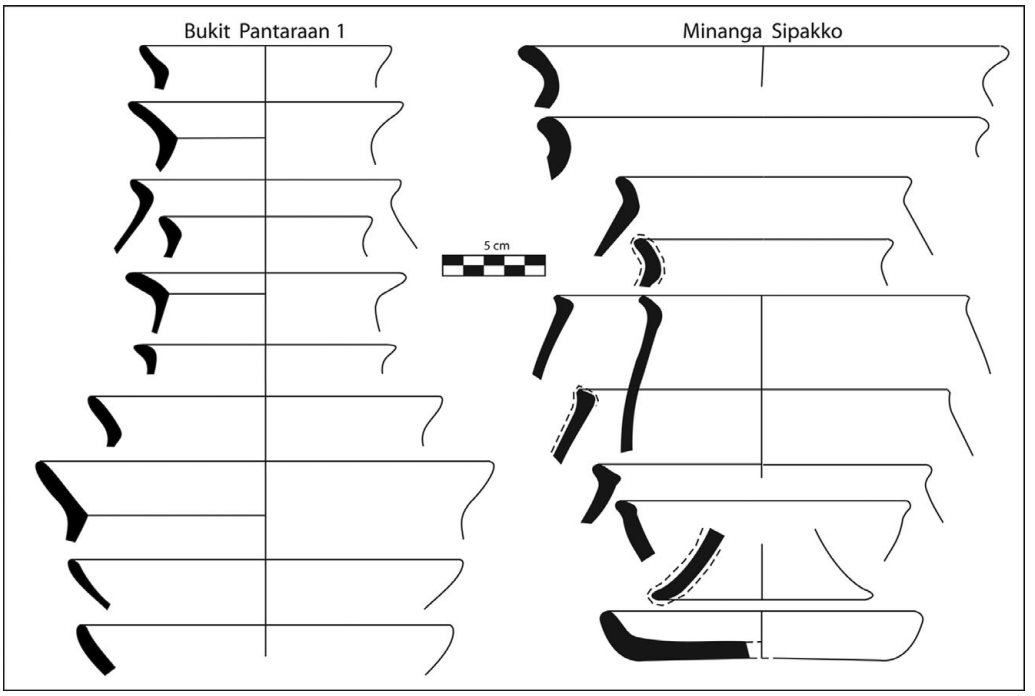


Figure 6. Karama valley late phase rims. Left: Bukit Pantaraan 1; right: Minanga Sipakko Trench I, square M3, spit 16. Dotted lines indicate red slip (Minanga Sipakko only).

Kamassi

By 2008, the original *c*. 0.5m-deep cultural layer on the top of Kamassi hill, excavated by van Stein Callenfels and van Heekeren, had evidently been washed downslope through cultivation and no obvious trace of it survives today. Instead, the 2008 excavation focused on a buried cultural layer about 1.8m thick near the base of the northern side of the hill that appeared to represent *in situ* midden deposition. This was capped and protected from disturbance by 0.8m of culturally sterile colluvium (Tim Penelitian 2008). The pottery trends here are exactly the same as those at Minanga Sipakko, and thus show considerable stratigraphic coherence with no signs of disturbance or secondary deposition.

Kamassi has four relevant ^{14}C dates (Table 1, except ANU-35126), without definite inversions (ANU-36406 is an estuarine shell, so left uncalibrated), suggesting an overall date range between 1550 and the early first millennium BC, very close to the range suggested above for Minanga Sipakko and overlapping with the younger site of Pantaraan 1, a range reinforced by the pottery seriation of all three sites. ANU-35126 is clearly much too young for its context and probably reflects disturbance. Geolabs-411 was a conventional rather than AMS date so its error range is very large. Taken as a group, however, the dates from both Minanga Sipakko and Kamassi indicate that Neolithic settlement was underway in this inland portion of the Karama valley by at least 1500 BC, and perhaps a century earlier.

As at Minanga Sipakko, at Kamassi (Figure 3) plain red-slipped sherds dominate at the bottom and diminish upwards, whereas plain unslipped sherds follow the opposite trend.

Table 1. AMS ^{14}C dates from Minanga Sipakko, Kamassi and Pantaraan 1. Dates calibrated in OxCal v4.2 using IntCal13 curve (Bronk Ramsey 2009; Reimer *et al.* 2013).

Sample code	Dated materials	Test pits/depth (m)	Lab. date BP	Years BC (2σ, 95.4%)
Minanga Sipakko				
Wk-14653	charcoal	M4 (1.9–2.0)	2881±46	1209–929
Wk-14654	charcoal	M4 (2.4–2.5)	2996±41	1391–1091
Wk-14651	charcoal	M3 (1.55–1.7)	3446±51	1889–1634
Wk-14652	charcoal	M3 (2.2–2.4)	3082±50	1451–1212
Wk-17981	charcoal	M1 (1.7–1.8)	3343±46	1742–1512
Kamassi				
ANU-35126	freshwater gastropod *Melanoides* sp.	2.3–2.4	1620±30	(AD) 382–539
ANU-35127	freshwater gastropod *Melanoides* sp.	2.4–2.5	3225±30	1607–1429
ANU-35128	freshwater gastropod *Melanoides* sp.	2.1–2.2	3140±30	1497–1305
ANU-36406	estuarine shell *Geloina* sp.	2.3–2.4	3345±40	(not calibrated)
Geolabs-411	charcoal	K2 (1.6–1.7)	2700±150	1226–416
Pantaraan 1				
ANU-9438	carbonaceous residue on sherd	xVI (1.1–1.2)	2505±25	786–541
ANU-9707	carbonaceous residue on sherd	xVI (1.0–1.1)	2850±50	1194–899

Rim forms also follow exactly the same trends as at Minanga Sipakko, as shown in Figure 4. Figures 5 and 6 illustrate the changes in rim forms through time at both Minanga Sipakko and Kamassi. Figure 5 shows early phase rims at both sites, dominated by the red-slipped internally concave and tall vertical types. Both of these forms disappear in the upper layers, to be gradually replaced by unslipped rims that are usually concave or straight internally, quite short in vertical height and sometimes slightly thickened towards their lips. Some of these later rims are shown in Figure 6, from an upper spit at Minanga Sipakko and from Pantaraan 1 (see below). In practice, the early and late rim forms are easily distinguishable when present in large numbers, although there is no sharp break between the two groups, only a continuous internal evolution.

The stone artefacts recovered from Kamassi were similar to those from Minanga Sipakko, and again the obsidian was confined, in small quantities, to the middle of the cultural layer, here between 1.2 and 2.1m in depth. This stratigraphic observation was repeated during the 2011–2012 excavations at the site by Balai Arkeologi Makassar (Hakim & Suryatman 2012). Of the 58 mainly slate and schist adzes found during the 2007–2008 excavations at Kamassi, 51 have rectangular cross-sections and only 7 are lenticular. A few, as from the earlier

excavations, are waisted or incipiently shouldered, like those illustrated by van Heekeren (1972: pl. 100). There was also a complete penannular ear ornament of pyrophyllite from a depth of 1.6–1.7m (Figure 7), hence quite late in the site sequence. This might be seen as a possible predecessor for the Iron Age *lingling-o* earrings with circumferential projections, made after about 400 BC of Taiwan nephrite, and traded widely right across the South China Sea through the Philippines, Sarawak, Vietnam, Thailand and possibly Cambodia (Hung *et al.* 2007).

Figure 7. Penannular ear ornament of soft metamorphic pyrophyllite (identified by Yoshiyuki Iizuka, Academia Sinica, Taipei, exact source unknown) from Kamassi Trench K3, 1.6–1.7m spit. 31mm diameter.

As at Minanga Sipakko, so also at Kamassi there was little trace of any flaked lithic industry independent of the manufacture of the polished slate and schist tools. The remarkable industry of agate microblade drills so common in the site of Bukit Tengkorak, across Makassar Strait in Sabah (Bellwood 1989; Chia 2003), was totally absent, suggesting lack of any direct contact, or the absence of such high-quality rocks in the vicinity of the Karama valley.

Pantaraan Site 1

The most important downstream site investigated by Anggraeni in the Karama valley was Pantaraan 1, situated on a small terrace about 20m above the north bank of the river. This site was very rich in surface finds, including stone flakes and cores of silicified stone (possibly redeposited from pre-ceramic contexts, since pre-ceramic flake tools occur in a higher terrace directly above the site), a blade of silicified limestone with silica gloss, stone adzes, bark-cloth beaters, glass beads and bracelets, and iron slag. Two highly weathered decorated sherds from the surface are particularly interesting because of their apparent parallels with dentate-stamped Lapita pottery of the western Pacific (Figure 8). These two sherds shed an air of intriguing mystery over the site, although none similar occur

Figure 8. Highly weathered sherd with incised, dentate-stamped and lime-infilled decoration from the surface of Pantaraan 1. Maximum dimension 40mm.

elsewhere in the Karama valley. Dentate-stamping has occasionally been reported from sites in eastern Kalimantan (Chazine & Ferrié 2008: fig. 6) and northern Luzon (Carson *et al.* 2013: 24), so no exclusive link with Lapita can be claimed.

Two trenches were excavated at Pantaraan 1 in 2008, revealing a well preserved cultural deposit about 0.4m thick, sealed about 0.3m below ground level. The pottery from Pantaraan resembles that from the upper layers in Minanga Sipakko and Kamassi, as can be seen from Figure 6, and is dominated by quite short internally convex or flat rims. The early concave and tall rim forms are absent, and none of the pottery appears to be red-slipped or decorated in any way. The Pantaraan 1 stone adzes and chisels were similar to those from Minanga Sipakko and Kamassi. A number of glass beads and fragments of cupreous metal and iron were found inside or close to the base of a burial jar which had been placed in a hole dug through the cultural layer into the sterile gravel below. This burial clearly occurred quite independently of and later than the deposition of the Neolithic cultural layer. Unfortunately, all human remains appear to have dissolved in the acid soil.

Two AMS ^{14}C dates (Table 1) from samples of carbonaceous residue on sherds from the cultural layer are slightly inverted, perhaps because of disturbance caused by the placing of the burial jar, but otherwise they correspond well and suggest that the site was occupied at some time between 1100 and 500 BC, before the deposition of the metal artefacts in the burial jar. The Pantaraan 1 cultural layer thus overlaps with the later occupations in the two Kalumpang sites and provides additional support for the tail end of the Kalumpang sequence here outlined.

Additional observations on the Neolithic sequence in the Karama valley

Simple flaked lithic industries on cryptocrystalline raw materials, without pottery, were also found in an upper terrace of Bukit Pantaraan (directly above the Neolithic location just discussed), and also in the Neolithic layers themselves at Pantaraan 1, although in this case there is a strong possibility that they eroded from the upper terrace during the Neolithic occupation. They also occur in pre-Neolithic contexts at the sites of Lattibung and Bukit Kuo. Such flaked tools on non-obsidian cryptocrystalline raw materials, as opposed to adze maintenance debitage, are very rare in Minanga Sipakko and Kamassi, and were clearly not part of the main lithic assemblage in either of these sites. None of the three pre-Neolithic assemblages, interestingly, yielded any microliths or backed tools, these being forms so typical of the Toalian cave and open-site assemblages of the south-western peninsula of Sulawesi, around Makassar (Bellwood 2007: 193–96).

The Kalumpang inhabitants were certainly involved in hunting and gathering, as can be seen from the Minanga Sipakko and Kamassi faunal remains, which were dominated by pig bones (no animal bones survived the acid soil conditions at Pantaraan 1). The native wild suid *Sus celebensis* is common throughout the archaeological sequences at both sites, and *Babyrousa* sp. is present in small numbers. The introduced domesticated pig, *Sus scrofa*, was initially identified from casts of third molar teeth by Philip Piper, and further study of the actual teeth has now confirmed the presence of introduced pigs in or close to the basal spits at both Kamassi and Minanga Sipakko. Direct evidence of dog was recorded at 1.6m

in Kamassi with indirect evidence of gnawing from at least 2.1m (no native carnivorous bone scavengers exist in Sulawesi). However, the inhabitants of the Kalumpang sites had very few contacts with the coastline, and both marine and freshwater shells were rare. The Karama River itself is very fast flowing, and its unstable boulder bed does not encourage large freshwater shellfish populations. A few bones of freshwater and marine fish, the latter including shark and stingray, occurred in the middle part of the occupation at Minanga Sipakko.

Phytolith analysis by Anggraeni (with advice from Doreen Bowdery) of sediment samples from Kamassi and Minanga Sipakko indicates a dominance of palms, followed by grasses (presumably indicating clearance), shrubs and trees. Phytoliths of bamboo and a small number of *Oryza* sp. (wild or domesticated rice) were identified in well-stratified samples from both sites (Anggraeni *et al*. 2012). These rice phytoliths are of bilobe and fan morphologies (Figure 9) and can be confirmed as Neolithic, rather than disturbed modern, due to the observed absence of any similar phytoliths in the protective colluvium above the Kamassi cultural layer. However, too few specimens were identified to establish whether rice cultivation was actually carried out in the valley. It is possible that a wild rice species is represented, and the situation certainly merits more archaeobotanical attention in the future.

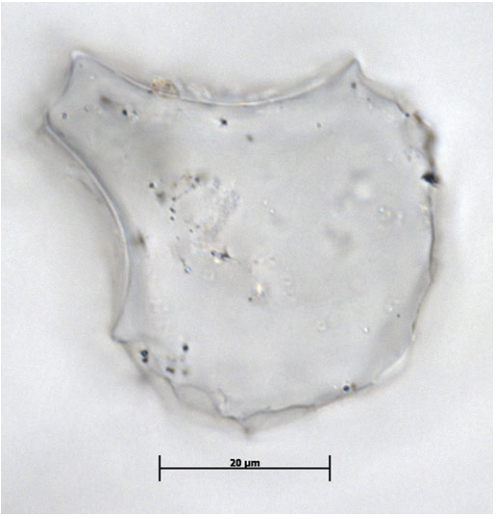


Figure 9. Fan-shaped rice phytolith identified from the cultural layer at Kamassi.

The Karama valley sites in regional perspective

The overall Karama valley ceramic sequence has an early emphasis on tall and/or concave rims and red-slipped plain ware, with a slightly later but always minor peak in the incidence of incised and stamped decoration (not impressed, whether by cord-wrapped or carved paddles), followed by reductions in rim length and the demise of the concave rim form. It is so closely paralleled in contemporary pottery sequences from eastern Taiwan, the Batanes Islands (Figure 10), northern Luzon and eastern Sabah that sheer coincidence is not acceptable as an explanation. All of these regions shared a common ceramic sequence over a period of perhaps 1000 years, from about 1800/1500 to 800 BC. This need not mean that we can pinpoint an origin for the Karama Neolithic to a single location somewhere in the Philippines, but the general direction of movement is very clear. This cultural tradition came neither from the south nor east of Sulawesi, and neither did it emerge in isolation from the Karama valley pre-ceramic. Unfortunately, however, very few adequately studied Neolithic sites are known between the northern Philippines and Sulawesi, and at present we have only a very generalised regional picture.

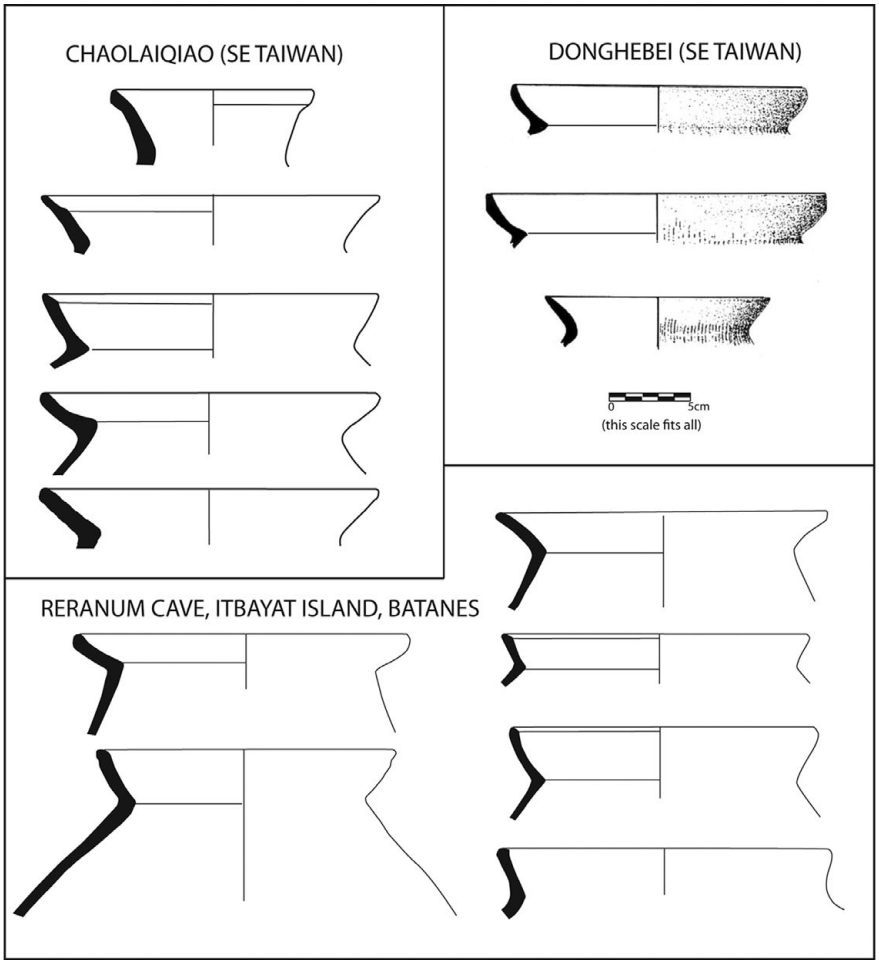


Figure 10. Red-slipped rim sherds from Chaolaiqiao (Hung 2005, 2008), Donghebei (south-eastern Taiwan) and Reranum Cave (Batanes), all dating to c. *2200–1500 BC and all dominated by tall rims that are internally concave or straight (not convex or thickened). Compare with Figure 5 from the Karama valley.*

A few additional comments can be made about the decorated, or otherwise distinctive, pottery sherds found at Minanga Sipakko and Kamassi. Some of the newly recovered decorated sherds are almost identical to examples from the earlier Dutch excavations at both sites (van Stein Callenfels 1951: pls. XIV–XIX; van Heekeren 1972: pl. 101). We now have a reasonable chronology for this kind of decorated pottery in the Karama valley, in that most of it probably clusters between 1500/1300 and 1000 BC. Most strikingly, the Kamassi sherd shown on the left in Figure 11 has a specific design, composed of incised and punctate-filled triangles and unfilled lozenges flanked by rows of stamped circles, that is paralleled almost precisely in the two adjacent illustrated sherds of similar date from the site of Magapit in the Cagayan valley, 2300km north of the Karama valley in northern Luzon (Aoyagi *et al*. 1991). Unfortunately, the two highly weathered dentate-stamped surface sherds discussed above from Pantaraan 1 lack stratified provenances or chronology, which makes

Figure 11. Decorated body sherd from Kamassi at left, flanked to right by two rim sherds with very similar incised, punctate-filled and circle-stamped decoration from Magapit, Cagayan valley, northern Luzon. All sherds date to the mid to late second millennium BC. Magapit sherd images courtesy of Kazuhiko Tanaka.

them harder to interpret—their generalised affinities with assemblages in Lapita Melanesia, eastern Kalimantan and northern Luzon are too diffuse to warrant further comment. Both Minanga Sipakko and Kamassi also have 'phallic-shaped' lid knobs and fragments of pottery cooking stoves, both again closely paralleled in contemporary assemblages in the Batanes Islands and Cagayan valley respectively.

In order to put the Karama valley sequence in its proper regional perspective, we need to review briefly the comparative details available from other significant locations (Figure 12). In south-eastern Taiwan, red-slipped plain pottery was dominant by at least 2200 BC in the site of Chaolaiqiao (Hung 2005, 2008), and cord-marking, dominant in earlier Neolithic sites in Taiwan, had virtually disappeared by the time of the Beinan culture, at about 1500 BC. In the Batanes Islands, between Taiwan and Luzon, the oldest pottery is also predominantly red-slipped plain ware, and cord-marking only survived to be represented by a few sherds in the site of Reranum Cave (Bellwood & Dizon 2005, 2008, 2013). The red-slipped plain pottery from both Chaolaiqiao and Reranum is remarkably similar to that from the basal levels in Minanga Sipakko and Kamassi, as can be seen by comparing the tall and often concave red-slipped rims from these two sites shown in Figure 10 with those from the Karama valley shown in Figure 5.

As just discussed in connection with the Kamassi sherd in Figure 11, however, decoration begins to resemble the Karama examples much more closely when one moves from Taiwan and the Batanes Islands into northern Luzon, and especially into the Cagayan valley. The sites of Nagsabaran and Magapit both have many red-slipped internally concave rims (Hung 2005: fig. 4), identical to the early Karama specimens. This region also has a fairly prolific presence of the combination of circle- and punctate-stamped decoration shown in Figure 11 (Hung *et al*. 2011). The Philippine connection in fact extends much further, since this

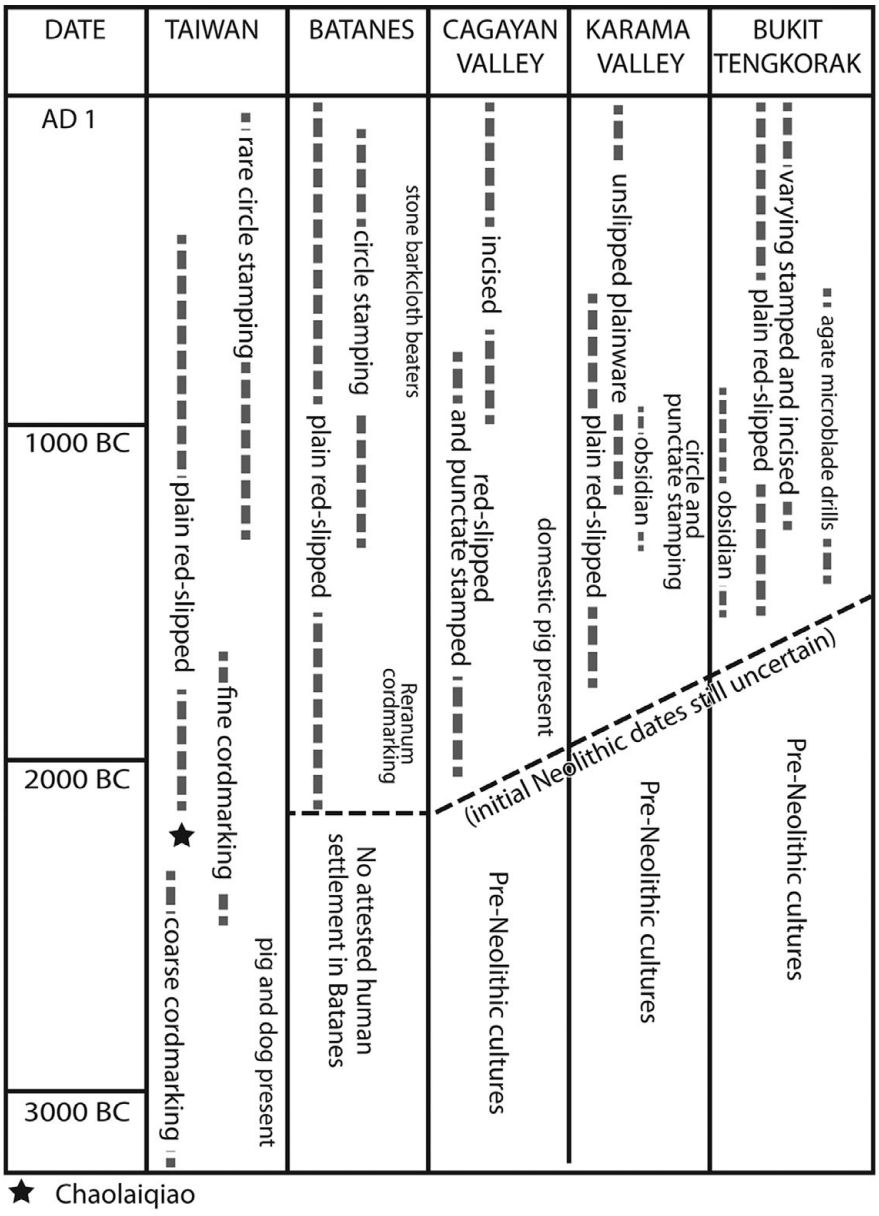


Figure 12. Regional ceramic and other artefact sequences between 3000 BC and AD 1, from southern Taiwan, Batanes Islands, Cagayan valley, Karama valley and Bukit Tengkorak.

specific kind of circle- and punctate-stamped decoration is also typical of the oldest pottery assemblages from the Mariana Islands and Island Melanesia/western Polynesia (Lapita), as discussed by Carson *et al.* (2013).

Across the Strait of Makassar, in eastern Borneo, a number of assemblages reveal generic similarities with those in the Karama valley, as noted above in connection with Pantaraan 1. Here, however, the similarities are not as specific as in the Taiwan-Luzon region and seem

instead to record shared origins followed by subsequent differentiation, rather than direct migratory contact. The main site here is Bukit Tengkorak in Sabah, 800km north of the Karama valley, with a Neolithic sequence that starts with plain red-slipped pottery and little other decoration (Bellwood 1989). Concave and tall rims are not particularly evident in Bukit Tengkorak (Bellwood 1989: fig. 6), but the general trend through time is much the same as in the Karama valley, and most decorated pottery here probably post-dates 1000 BC. Bukit Tengkorak has no definite examples of the combined punctate- and circle-stamped decoration noted in the Karama and Cagayan sites, and also differs from the Karama sites in having a remarkable and unique agate microblade drill industry. Furthermore, the obsidian at Bukit Tengkorak came mainly from the Talasea sources in New Britain, and not from the unknown but probably Sulawesi source represented at Minanga Sipakko and Kamassi. It is also present from the base of the Bukit Tengkorak sequence, rather than mid-sequence as in the Karama valley. This implies that the Karama sites and Bukit Tengkorak perhaps had common connections going back into earlier times in the Philippines, but were never in direct and contemporary sea-borne contact. Each followed their own slightly different cultural trajectory.

The dates for Neolithic assemblages with red-slipped plain ware, circle- and/or punctate-/dentate-stamped pottery, polished stone tools, bark-cloth beaters, domesticated rice and domesticated *Sus scrofa* pigs definitely become older as one moves northwards from Sulawesi through Luzon towards Taiwan (Bellwood 2007, 2011; Bellwood *et al*. 2011). We can therefore infer a southward movement of early Neolithic populations and their cultural assemblages from the general vicinity of the Philippines into the Karama valley. Contemporary populations perhaps travelled separately further west to reach northern Borneo and Bukit Tengkorak. It might alternatively be proposed that these cultural characteristics were all adopted by *in situ* pre-ceramic populations with only a flaked lithic technology, such as that represented at Lattibung, Bukit Kuo and Pantaraan, and of course in many pre-ceramic cave assemblages in Borneo and South Sulawesi. That is negated by the simple fact that such industries never really continued into the Neolithic in most excavated *open* settlement sites in the western, northern and central islands of Southeast Asia. Such flaked lithic industries often continued into the Neolithic in caves and rockshelters, especially in Luzon, South Sulawesi, and many regions of Borneo and eastern Indonesia, but these naturally protected sites may have continued to be used by indigenous hunter-gatherers long after the regional appearance of Neolithic technologies (see Mijares 2006 for this suggestion for the Cagayan valley). When unground core and flake tools are found in open-site Neolithic contexts, one must also be sure they are not present due to stratigraphic admixture, as possibly at Pantaraan 1.

In conclusion, the Karama valley Neolithic sites reveal a cultural and possibly also a population source that lay to the north of Sulawesi, most probably in an immediate sense in the Philippines. Unfortunately, there are no human bones apart from a few teeth from the Karama sites, so the biological anthropology of these populations cannot be discussed. Neither is there a detailed archaeobotanical record, which leaves unanswered many questions concerning the nature of the Karama Neolithic economy. It is not the purpose of this paper to debate linguistic or genetic issues connected with Austronesian origins in Taiwan, or elsewhere, but the Karama valley archaeological materials that have been presented here

render a Taiwan/Philippine origin for the cultural traditions that they represent far more likely than an origin in other regions such as Borneo, Vietnam or eastern Indonesia, and certainly more likely than a totally isolated and indigenous origin amongst the pre-ceramic hunter-gatherers of West Sulawesi.

The Karama sites, in fact, give us an unparalleled picture of Neolithic life *c*. 1500 BC along the Equator in central Indonesia, one that we could not hope to reveal from the many remote and sometimes very small caves and rockshelters that have provided the bulk of the eastern Indonesian Neolithic record so far. Neolithic archaeology in Island Southeast Asia must advance by the excavation of many more large open settlement sites in alluvial settings, most no doubt buried under many metres of late Holocene alluvium, as in Luzon (Bellwood *et al*. 2008). This will require not only time and money, but also increased attention to the activities of developers within and beneath the modern cities and towns of the region. Surely, it is a good bet that people in 1500 BC, especially those with traditions of food production, lived close to the same fertile and accessible agricultural locations as do most modern populations. We need to focus less on remote caves and much more on those locations.

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