

Archaeological Studies of the Middle and Late Holocene, Papua New Guinea

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- Preface *Jim Specht*
1–2
- Part I Ceramic sites on the Duke of York Islands
J. Peter White
3–50
- Part II The Boduna Island (FEA) Lapita site
Jim Specht & Glenn Summerhayes
51–103
- Part III The Lagenda Lapita site (FCR/FCS), Talasea area
Jim Specht
105–129
- Part IV Pottery of the Talasea Area, West New Britain Province
Jim Specht & Robin Torrence
131–196
- Part V Pre-Lapita horizons in the Admiralty Islands:
flaked stone technology from GAC and GFJ
Christina Pavlides & Jean Kennedy
197–215
- Part VI Revised dating of Type X pottery, Morobe Province
Ian Lilley & Jim Specht
217–226
- Part VII The evolution of Sio pottery: evidence from three sites in
northeastern Papua New Guinea
Ian Lilley
227–244
- Part VIII A preliminary study into the Lavongai rectilinear earth mounds:
an XRD and phytolith analysis
Matthew G. Leavesley & Ulrike Troitzsch
245–254
- Part IX A stone tablet from Buka Island,
Bougainville Autonomous Region
Barry Craig
255–261

**Archaeological Studies of the Middle and Late Holocene,
Papua New Guinea
Part VII**

**The Evolution of Sio Pottery: Evidence from Three Sites
in Northeastern Papua New Guinea**

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ABSTRACT. This paper describes changes through time in the characteristics of one of the ceramic wares excavated in 1983–84 from the KLJ and KLK sites in the Siassi Islands and the KBQ site at Sio, located in the Vitiaz Strait region in northeastern Papua New Guinea (Lilley, 1986). This region was the scene of one of the anthropologically best-known long-distance maritime trading networks in Melanesia, described in Harding’s (1967) classic ethnography *Voyagers of the Vitiaz Strait*. The pattern of change mirrors that associated with the late prehistoric rise of specialized production for trade described on the Papuan south coast (Allen, 1984; Irwin, 1985). This indicates the operation of similar processes of socioeconomic intensification and concomitant technological evolution across northwestern Melanesia.

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Pottery was probably the most important craft-good traded in the wider Vitiaz Strait area of Morobe Province, Papua New Guinea (Fig. 1), both in terms of quantity and because it could be exchanged for high value as well as low value items, thus facilitating the conversion of one into the other (e.g., taro→pots→pigs; Harding, 1967: 139). Although clays suitable for potting are available in many parts of this wider area, the craft was traditionally practised in only three places: at the western end of the Huon Peninsula in the coastal villages of Sio, nearby Nambariwa and Gitua, some distance east (the three of which made the “Sio” pottery of the

title); on Yabob and Bilibili Islands off Madang in Astrolabe Bay and possibly at Mindiri not far to the east (all usually known as “Madang” pottery); and in five communities on the south coast of the Huon Gulf (Hogbin, 1951: 88–90; May & Tuckson, 1982: 149–151). Sio pottery was the “main stock-in-trade within the Vitiaz Strait”, but Madang pottery attracted better rates of exchange because it was the most “finely made and ... most valuable” in the region (Harding, 1967: 37). Huon Gulf wares seem to have been traded mainly in the Huon Gulf and there is little information on their status as a trade item in the Vitiaz region. Pottery was also made

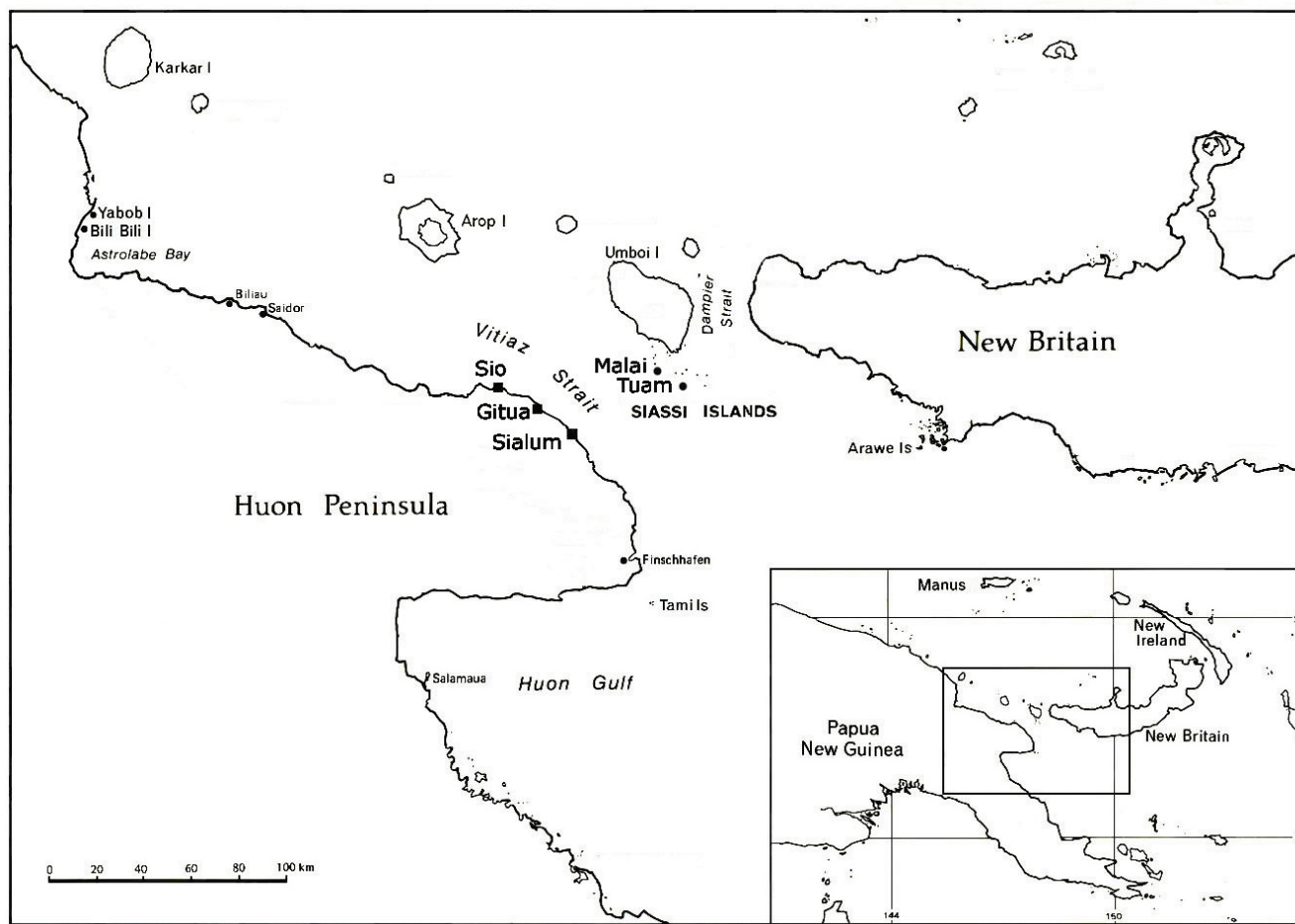


Fig. 1. The study area, showing places mentioned in the text.

inland from Astrolabe Bay and in the Markham Valley inland of the Huon Gulf (May & Tuckson, 1982: 24–25), but none of it was traded in the Vitiaz region at contact.

Brief descriptions of the ethnographic Sio industry can be found in Groves (1935: 54–55), Harding (1967: 89–91) and May and Tuckson (1982: 151–155), while Specht recovered pottery like that described ethnographically from test-excavations in the KBP and KBQ sites at Sio in the 1970s. In summary, potting was a female activity, but not all women were potters. At Sio, clay was dug from shallow pits just behind the beach immediately west of Belambu hamlet. At Nambariwa it was obtained from pits adjacent to the Goaling River a short distance upstream from the village. At Gitua the main source was on the north bank of the Sazom River between Gitua and Sialum. The differences between the wares of the three centres were minimal. Clay preparation involved soaking in saltwater, kneading and the removal of large inclusions. No temper was added. The pots were made by paddle-and-anvil and came in small, medium and large sizes. All had spherical bodies, thin walls, restricted necks and thin, everted rims. After forming, the pots were dried then fired once. Decoration was simple (May & Tuckson, 1982: 152) and included “rectilinear geometric arrangements of [incised] straight lines, slash and stab marks, and relief or applied elements used in a repetitive fashion” on the exterior of the upper body and neck and inside and outside the rim. Most rims also had notched lips. Some Nambariwa and Gitua pots also had applied nubbins on the

rim (personal observation). At least some of the decorative motifs were owned by individual women or families and were inherited.

The excavated pottery

Details of the 1983–1984 excavations at three sites in the Siassi Islands and at Sio village are provided elsewhere (Lilley, 1986, 1986–87). Five pottery style groups (Lapita, Type X, Type Y, Sio and Madang) are recognized at these sites, but only the Sio group is discussed here (Table 1). The KLK site on Tuam Island in Siassi yielded 33 Sio rim and decorated body sherds weighing 252 g. They account for 1% by number and weight of all the Sio pottery excavated from the three sites in question. A total of 1,705 rim and decorated body sherds weighing 7.8 kg was excavated from the KLJ site on Siassi’s Malai Island. These quantities amount to 42% by number and 37% by weight of all Sio pottery recovered from the three sites. The excavations in the KBQ site at Sio itself on the New Guinea mainland yielded 2,357 Sio rim and decorated sherds weighing 13 kg. These quantities comprise 58% by number and 62% by weight of all Sio rims and decorated pottery in the sample.

Rim forms. Some 787 Sio rims were recovered from the three sites in 1983–1984. They were split into two classes (Figs 2–5). About 73% fell into Class 1, which comprises thin, vertical to everted rims with flat and abruptly-thickened

Table 1. Distribution of pottery Style groups at the KLK, KLJ and KBQ sites.

pottery style	Tuam KLK	Malai KLJ	Sio KBQ	totals
Lapita rim	17	0	0	26
Lapita dec. body	24	0	0	44
Lapita total	70	0	0	70
Type Y rim	9	0	0	9
Type Y dec. body	20	0	0	20
Type Y total	29	0	0	29
Type X rim	10	48	17	75
Type X dec. body	256	709	237	1,202
Type X total	266	757	254	1,277
Sio rim	14	298	475	787
Sio dec. body	19	1,407	1,882	3,308
Sio total	33	1,705	2,357	4,095
Madang rim	0	103	49	152
Madang dec. body	0	3,527	829	4,356
Madang total	0	3,630	878	4,508
unassigned	2	0	0	0
plain	768	5515	4,633	10,918
totals	1139	11,607	8,122	20,868

lips. Most (73%) have a maximum lip width of 3–6 mm, with a mode of 4–5 mm. Class 2 rims are more variable. They are vertical to everted and gradually thicken towards a flat lip. There is substantial but continuous variation in the width of lips on these rims. This is important, because owing to the comminution of the material, lip width is the only consistently measurable attribute of the excavated assemblages that reflects change in vessel standardization. At one end of the range of variation are a few rims which have lip widths similar to those of Class 1 rims. At the other extreme there are a few sherds with lips almost 20 mm wide. The modal lip-width for Class 2 rims is 8–9 mm. Ethnographic vessels and Specht's (1972) archaeological Sio pottery exhibit only Class 1 rims. The range of mean lip widths derived from three measurements on each of 39 modern Sio and Gitua pots held by the Australian Museum is very similar to the distribution of lip width values exhibited by my sample of archaeological Class 1 rims. The spread of values is almost identical; the majority (69%) of values fall between 3–6 mm and the modal value is 4–5 mm.

Decoration. The decorative techniques considered below are defined as follows.

Slip is a clay coating on the surface of a pot, applied as a solution.

Incision is freehand decoration cut into the unfired surface of the pot (Shepard, 1957: 195). Two forms are present in the sample:

- 1 single-tool incision (STI), where fine decoration is rendered with a single-pointed tool, and
- 2 double-tool incision (DTI), where a double-pointed tool is used. DTI produces sets of two fine parallel lines on the surface of the sherd.

Gashing is similar to STI, but the marks cut into the surface are relatively broad and/or deep.

Gash-Punctuation (G-P) includes both punctuation and decoration which falls between punctuation and gashing. Punctuation is a form of impression which involves displacing clay from the surface of the pot with a rounded tool held approximately at 90° to the surface. The rare examples of fingertip impression in the assemblage are also included in this category.

Appliqué is “shaped pieces of clay ... bonded to the surface [of the pot] by pressure” (Rye, 1981: 93). Two main forms of appliqué are represented:

- 1 narrow, rounded, low-relief ribbons and/or lines of closely-spaced, low-relief spots, a variant of which is provided by appliqué ribbons with closely-spaced oblique incisions, and
- 2 a rarer form consisting of conical nubbins, which, although often aligned, are well separated and of relatively high relief. Ribbon appliqué of variable but usually low relief and with an inverted “V” cross-section is occasionally associated with the nubbins.

The characteristics of the groups defined by combinations of the attributes listed above were compared with those of pottery from the Vitiaz region described in ethnographic and archaeological reports and of modern and prehistoric pottery from the area held by the Australian Museum in Sydney and the Papua New Guinea National Museum and Art Gallery in Port Moresby. This procedure indicated that all but two sherds could be sorted into four highly distinctive groups, which will be described below as Style Groups (cf. Specht, 1969: 66). The two sherds which could not be assigned to a Style Group are both from Tuam (Fig. 6). One is the only shell impressed sherd in the collection and the other is an unusual fingernail impressed sherd. Neither is considered further here.

Sio pottery is unslipped. In descending order of overall proportion by number and weight, the 3,308 body sherds in the sample from the three sites exhibit single- and double-tool incision in approximately equal proportions, gashing, gash-punctuation, again in similar proportions which are about half those of both STI and DTI and finally, conical nubbins and occasional low-relief ribbon appliqué (cf. Specht 1973: 11). I call this last “Sio appliqué”. Examples of body sherds exhibiting the different decorative techniques are illustrated in Figures 7 and 8.

Table 2 shows cross-tabulation of rim class and surface decorative technique. Approximately 31% of Class 1 rims exhibit no decoration on their external or internal surfaces. Of those Class 1 rims which are decorated, all but nine (2%) are decorated only on the exterior surface. The remaining nine are decorated internally and externally. Because these sherds constitute such a minor proportion of Sio Class 1 rims, the presence of internal surface decoration is ignored as being typologically insignificant and only the external decoration is considered in further discussion. On this basis, 44% of all Sio rims (or 64% of decorated Class 1 rims) exhibit double-tool incision, 22% (32% of decorated) feature single-tool incision, and 3% (4% of decorated) exhibit other techniques

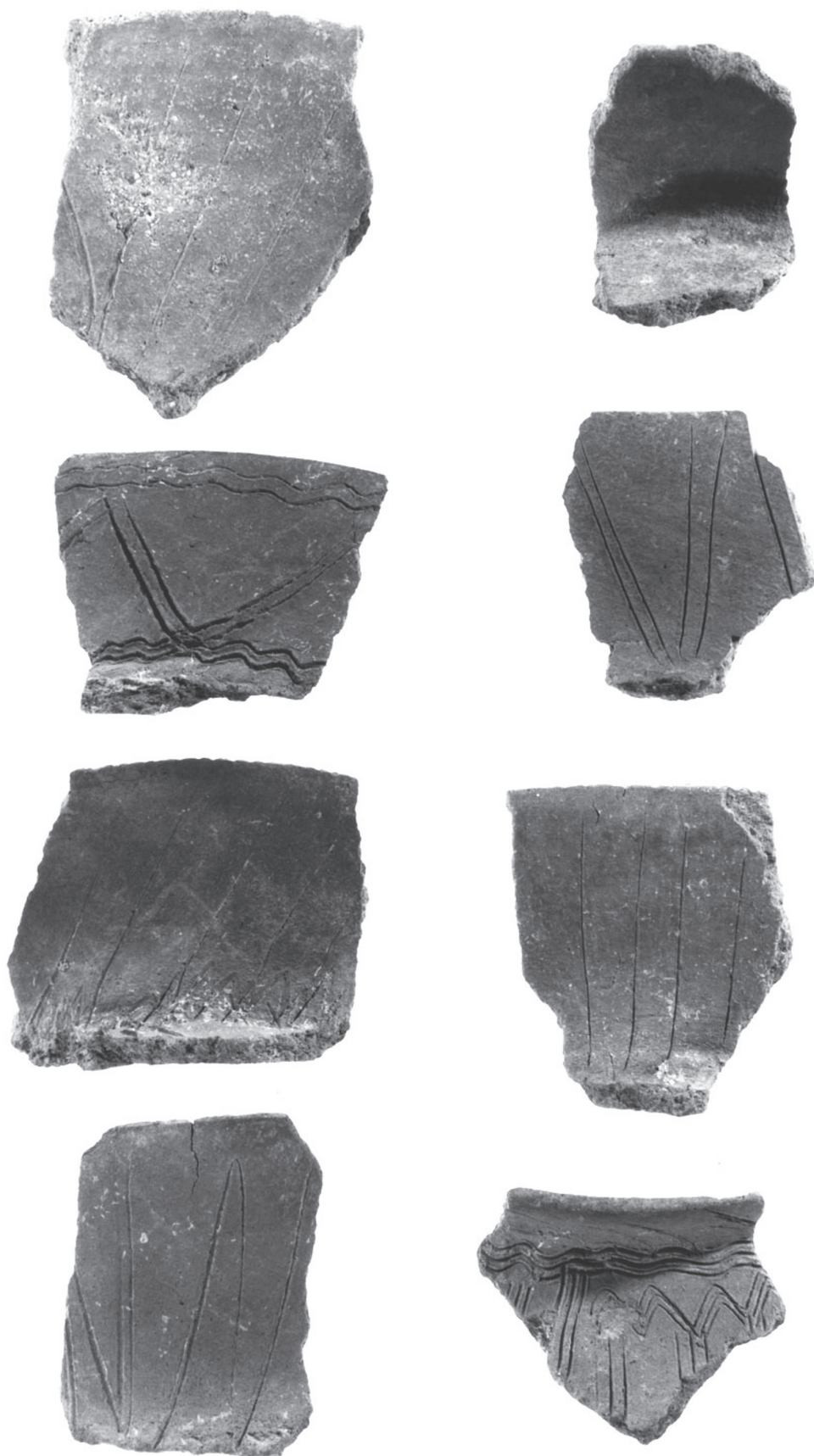


Fig. 2. Sio Style Group, Class 1 rims.

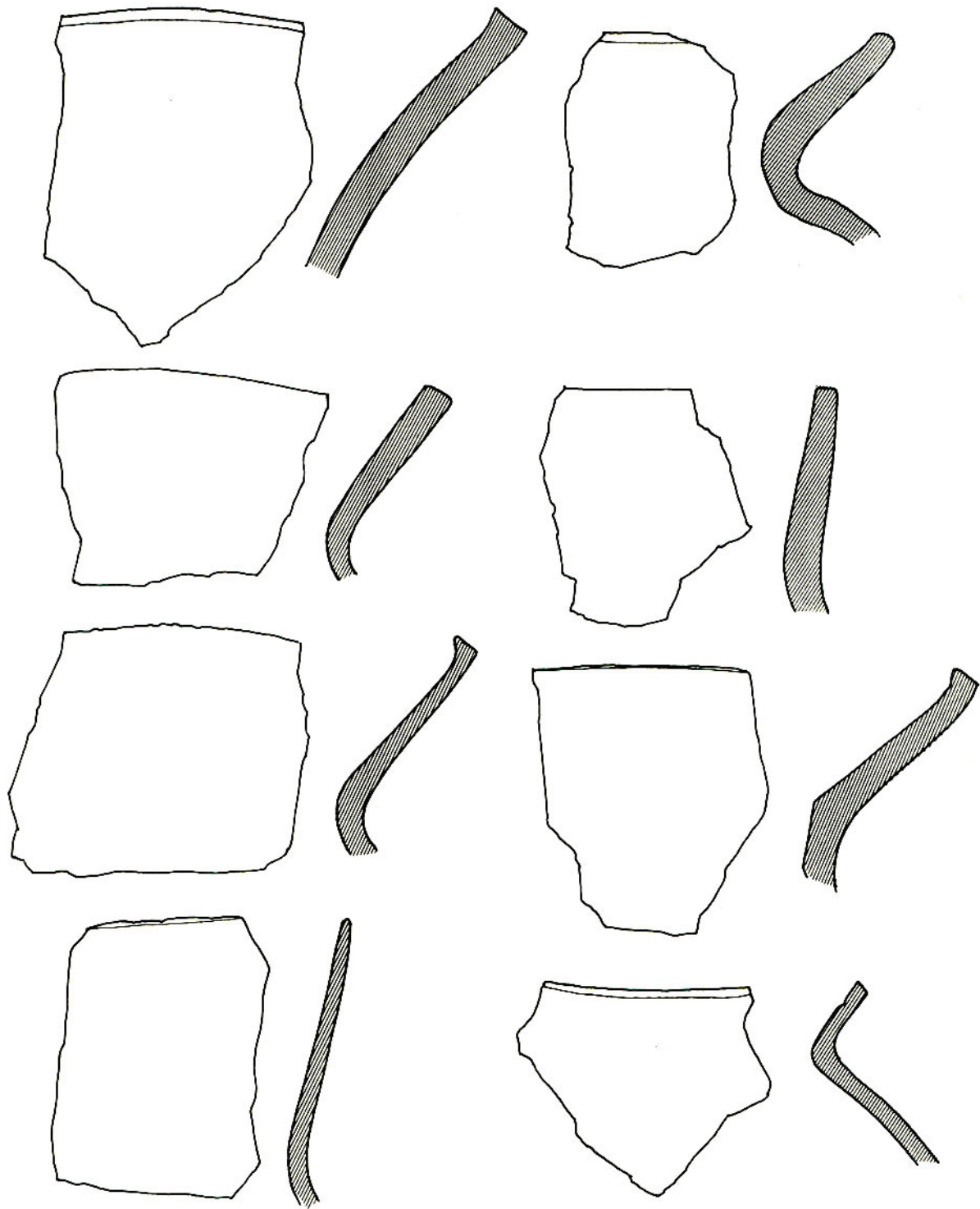


Fig. 3. Sio Style Group, Class 1 rim profiles.

including gashing, gash-punctation and appliqué. In further discussion of Sio rims these last techniques are lumped as “other decoration” (OD) or “other decorative techniques”.

In round figures, 34% of Class 2 rims feature no surface decoration. The surface decoration on the remainder occurs only on the outside of the sherds. The proportions of different surface decorative techniques exhibited by Class 2 rims are more even than is the case with Class 1 rims. Approximately 27% (41% of decorated Class 2 rims) exhibit single-tool incision, 23% (35% of decorated) feature

double-tool incision, and 16% (24% of decorated) exhibit other decorative techniques.

There is a very weak but statistically highly significant association between the two variables. Class 1 rims exhibit STI, DTI or no decoration about as often as statistically expected, but are unlikely to feature other decorative techniques. Class 2 rims exhibit STI and no decoration as often as expected, but feature DTI much less frequently than expected and other decorative techniques much more frequently than anticipated. In short, in addition to their



Fig. 4. Sio Style Group, Class 2 rims.

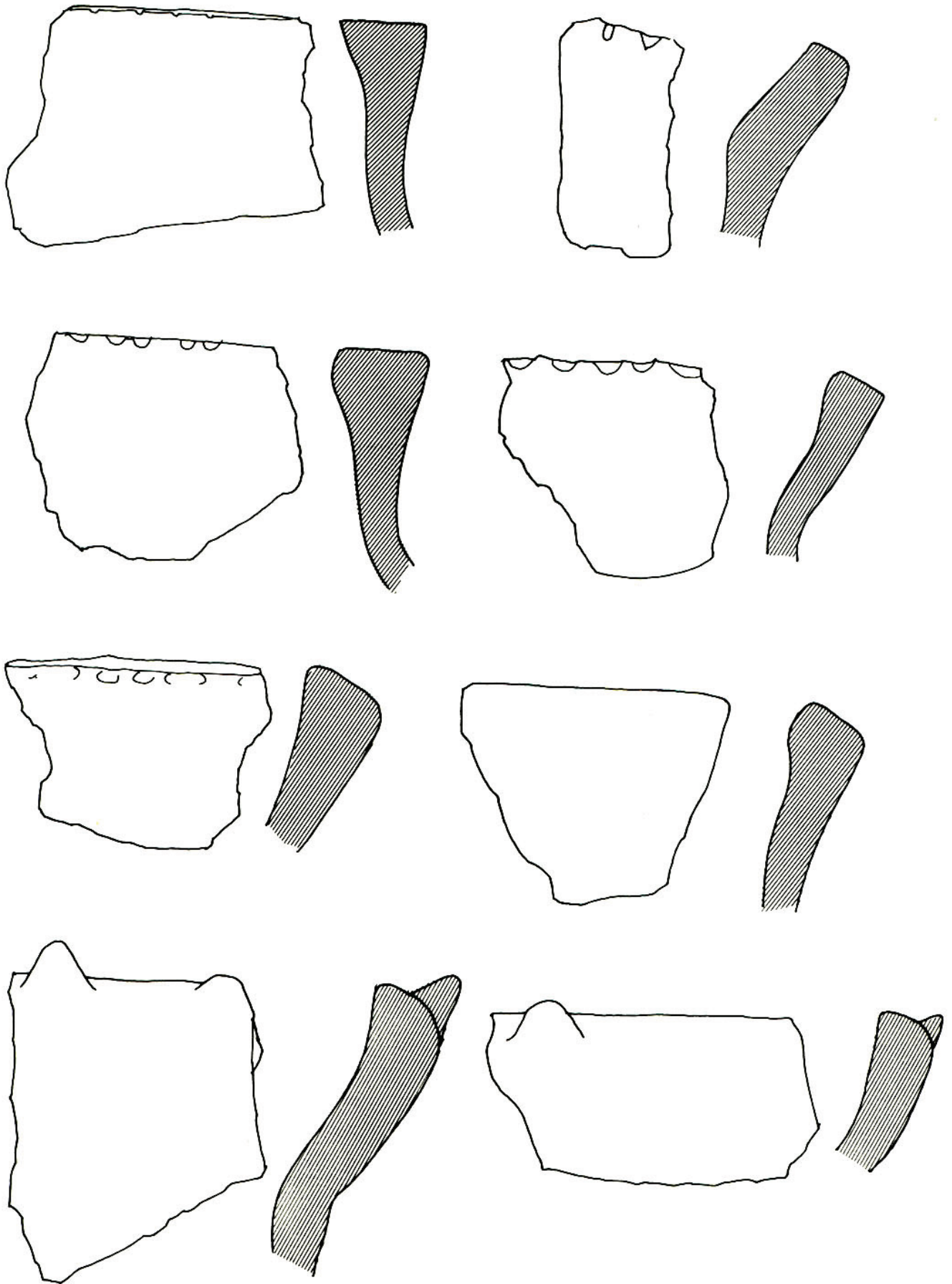


Fig. 5. Sio Style Group, Class 2 rim profiles.



Fig. 6. The two sherds from KLK not assigned to a Style Group (upper shell-impressed, lower fingernail-impressed).

distinct morphologies, there is a noticeable difference in the proportions of different decorative techniques exhibited by Class 1 and Class 2 rims.

Table 2. Crosstab and Tau-b: Sio rim class and surface decoration at sites KLK, KLJ and KBQ.

	STI	DTI	ND	OD	total
Class 1	128	251	180	15	574
Class 2	58	49	73	33	213
total	186	300	253	48	787

$\chi^2_3; 0.05 = 7.8147; \chi^2 = 61.7266; \text{Tau-b} = 0.08; \text{null hypothesis} = \text{no association: rejected} < 0.001.$

Table 3 presents a cross-tabulation of rim class, lip notching and surface decoration. Lip notching occurs on 50% of all Class 1 rims and 53% of all Class 2 rims.

The results indicate there are very weak but statistically significant correlations among the three variables. In both Class 1 and Class 2 the most outstanding deviations from expected values occur in the unnotched subclasses; notched rims in both Classes exhibit the various decorative techniques about as often as statistically expected. Unnotched Class 1 rims feature DTI far more than anticipated, while unnotched Class 2 rims exhibit DTI less frequently than expected but other decorative techniques occur more often than expected.



Fig. 7. Sio Style Group incised decoration (STI upper three, DTI lower four).

Table 3. Crosstab and Tau-b: Sio rim class, lip notching and surface decoration at sites KLK, KLJ and KBQ.

	STI	DTI	ND	OD	total
Class 1 notched	76	83	119	8	286
Class 1 unnotched	52	168	61	7	288
Class 2 notched	21	36	45	11	113
Class 2 unnotched	37	13	28	22	100
total	186	300	253	48	787

$\chi^2_6: 0.05 = 12.5916; \chi^2 = 145.1584$ Tau-b = 0.1; null hypothesis = no association: rejected <0.001.

Vessel forms. The greater variation in rims notwithstanding, there is no positive evidence that the body shape(s) of prehistoric vessels differ radically from the globular pots produced in ethnographic times. This is difficult to gauge with any degree of certainty, though, owing to the very small size of most of the sherds. Class 1 rims which are large enough to indicate the shape of the upper part of the pots from which they come are indistinguishable from modern wares (Fig. 9), and suggest orifice diameters ranging from 15–20 cm. Diagnostic Class 2 rims suggest the lower vessel form shown in Figure 9, but there are no rims large enough to provide any unambiguous evidence for orifice diameter.

Petrology. The thin-section petrology of 93 Sio sherds was examined as part of a wider sourcing study also involving Lapita, Type X, Type Y and Madang wares, (Lilley, 1986, 2002; Watchman, 1986). This work was supplemented by emission spectrographic analysis of selected sherds and clay samples by the Australian Mineral Development Laboratories (AMDEL) and X-ray diffraction and petrographic microscopy of some of the clays and potters' mixes previously done by other researchers (M. Tuckson, pers. comm. 1985; cf. May & Tuckson, 1982: 30).

The sample of pottery was obtained by judgement (as opposed to probabilistic) selection of sherds to cover the range of variation through space and with excavated depth that is represented by differences in rim form or sherd decoration. With the exception of the Tuam clays, the sample of clays and potters' mixes is representative of the materials used today by north-coast potting communities east of the Ramu delta. One sample of potters' mix comes from each of Tavultae and Moap, both to the north of Madang and west of Karkar Island, Yabob and Bilibili off Madang and Mindiri between Madang and Sio. Potters' mixes from these areas were analysed in preference to unmodified clay because potters in these localities traditionally tempered their clays. All samples of mixes were provided by Ms Margaret Tuckson. The unmodified clays include two samples from the *lakakulu* source near Belambu hamlet of Sio (used by potters from Sio No.1 hamlet), two samples from the *kukolo* source about 1 km up the Goaling River from Nambariwa (used by Sio No.2 and Nambariwa potters) and one sample each from the *kukumei* source near Gitua and the *nama* source near Sialum. Unmodified clays from these sources were analysed because potters from these centres traditionally did not temper their clays. One of the two samples from both the *lakakulu* and *kukolo* sources as well as the samples from the *kukumei* and *nama* sources were collected by Specht

while the other two samples from Sio and Nambariwa were collected by me. The Tuam clay was included in an attempt to determine whether any of the pottery is made from the clays found on the raised parts of Tuam and Malai Islands. It was not possible to acquire a sample of the Uliawa Island clay used by the potters of the Huon Gulf.

Analytical procedures. Analysis focussed on the non-plastic inclusions in the samples (Watchman, 1986). Although the ultimate aim of the exercise was to match pastes, sources and stylistic groups, no reference was made to style in the analysis: sherds were identified only by site and excavation unit. The first part of the work involved paste characterization. This described the petrology of the sherds and clustered them in like groups without reference to the potters' mixes and clay samples. The second part of the study concerned sourcing. It clustered the potters' mixes and clay samples in like groups and reordered the pottery according to similarities between the sherds and the source material. It should be stressed that owing to constraints on time and money, the analysis was limited to a brief qualitative assessment of petrological characteristics (i.e. exact point counts were not made). Thus while the study was successful in highlighting major trends in the data, it could not be expected to furnish definitive results. For comparative purposes, the Paste Group/Source Group matches for all of the Style Groups that were analyzed are shown in Figure 10.

Paste characterization. Most of the Sio sherds analysed—66, or 71%—were classed in a single group (Paste Group 11) and they constitute 99% of all sherds in that group (Table 4, Fig. 10). Paste Group 11 is a high-pyroxene type with a low to moderate shell component. The remaining 27 (29%) Sio sherds were assigned to seven other Paste Groups, with 12 (45% of the remainder) in Group 2. Paste Group 2 is distinguished by a high shell content, which can be attributed to either a natural shell-grit component in the clay or addition of temper containing shell. This clear-cut pattern is mirrored by the pattern of association between Paste Group and all classes of body-herd decoration except Sio appliqué; the single analyzed sherd in that class falls in Paste Group 9 and is the only sherd in that group. Rims were classed only in Paste Groups 2, 11, 13 and 16, with 73% overall in Group 11. Group 13 contains moderate pyroxene, trace plagioclase, low to moderate volcanic rock fragments, no shell and low amounts of quartz/feldspar. Group 16 is characterized by low to moderate amounts of pyroxene and plagioclase, but relatively high quantities of quartz/feldspar. Referring to Class 1 rims, 25% fall in Group 2, 71% in Group 11 and 4% in Group 16. When Class 1 rims are divided into those with notched lips and those without, there is only a slight difference in the distributions. Approximately 83% of unnotched rims occur in Paste Group 11, while the remainder fall in Group 2, while 63% of unnotched rims fall in Group 11, 31% in Group 2 and 6% in Group 16. With regard to Class 2 rims, 78% fall in Paste Group 11 and 11% in each of Groups 2 and 14. All notched Class 2 rims are Paste Group 11, as are most unnotched Class 2 rims, the remainder of the latter being equally spread between Paste Groups 2 and 13.

Paste Group 11 is clearly the "typical" Sio paste. The Sio sherds with a shelly paste in Group 2 comprise 71% of the non-Lapita component of that Group, the remainder



Fig. 8. Other decorative techniques in the Sio Style Group: gashing (top two), gash-punctuation (middle two) and Sio appliqué (bottom) decoration.

being Madang ware. Those classed as Paste Group 16 make up half of the sherds in that Group. As in Paste Group 2, the remainder of the sherds in Group 16 are Madang pottery. These overlapping distributions are a function of the shell in the paste, not of common sources for stylistically distinctive wares (see below).

Sourcing. About 87% of the Sio material submitted is accounted for by three Source Groups: Source 1 (50%), Source 6 (28%), and Source 5 (c. 9%) (Table 5, Fig.

10). The remaining 12 sherds (13%) are spread through six other Source Groups, about half in Source Groups containing only Sio Style sherds, and all in Paste/Source matches comprising only Sio Style sherds. These facts indicate that all the residual sherds can be classed as petrological variants of Sio Style pottery and that the variability results from the nature of the analysis.

Returning to the three dominant Source Groups, Group 5 is equated with the Nambariwa/Gitua sources and, with a single exception, comprises Sio Style pottery, most of which

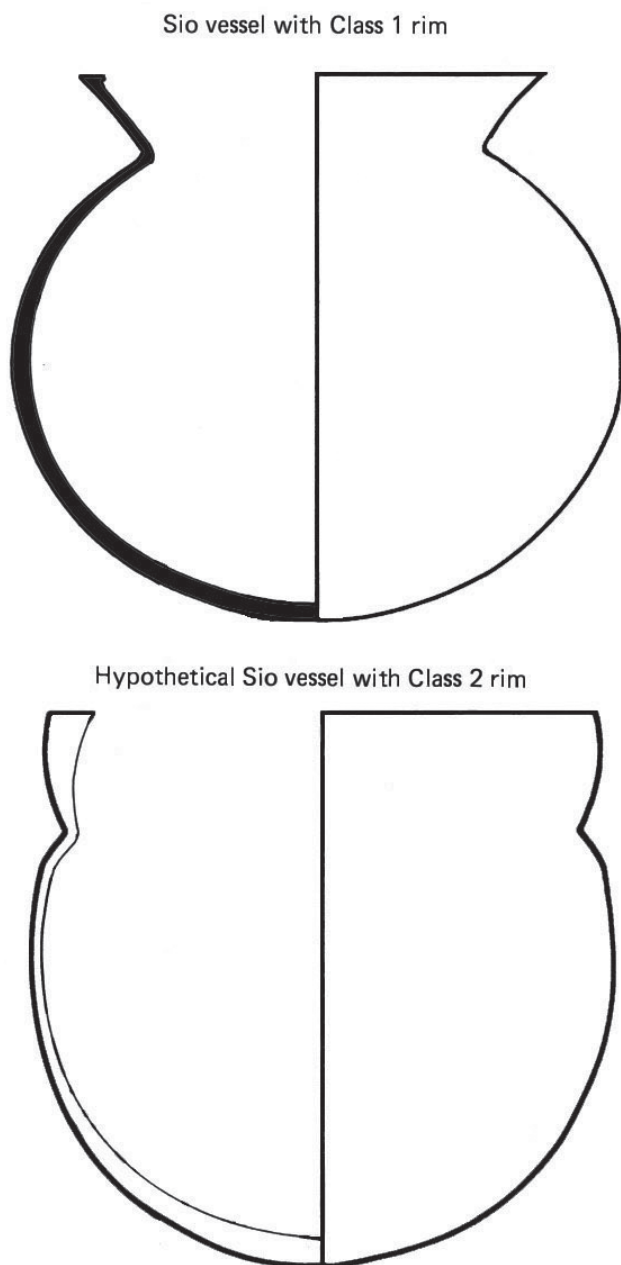


Fig. 9. Sio vessel forms: upper—Class 1 rim form, lower—Class 2 rim form.

also falls in Paste Group 2. This helps resolve the problem of overlap of Sio and Madang pottery in Paste Group 2 raised above: the bulk of Sio Style sherds in that Group is made from clay from a source with a high natural shell-grit component. Source Group 5 is represented in all classes of body sherd decoration except gashing and Sio appliqué. Interestingly, however, no unnotched Class 1 rims and only one Class 2 rim are assigned to this Source Group. This suggests that the communities using the Group 5 sources used neither gashing nor appliqué and produced few if any pots with rims of the sort mentioned above. Source Group 6 is equated with the *lakakulu* source at Sio and, excepting one Type X sherd, is made up of Sio pottery, 85% of which falls in Paste Group 11. Source Group 6 is represented in all classes of body sherd decoration and all classes and subclasses of Sio rim.

Interpretation of Source Group 1 is less straightforward. The analysis indicates that it clusters with Astrolabe region potters' mixes, but (excluding one sherd each of Lapita and Type X) 87% of the sherds in it belong in the Sio Style Group. Moreover, Source Group 1 is represented in all classes of body sherd decoration except appliqué and all classes and subclasses of Sio rim, comprising the greater proportion of items in all instances. The difficulties created by these facts are obvious. It is possible to suggest, however, that the composition of Sio Style sherds in Source Group 1 is more similar to that of those in Source Group 6 than it is to the composition of Madang sherds in Source Group 1 and thus that the Sio sherds in the two Source Groups are likely to derive from the same source, rather than from opposite ends of the Vitiaz Strait.

To begin with, 71% (40) of the 56 Source 1 sherds and 81% (22) of the 27 Source 6 sherds are Sio sherds classed as Paste 11 (Fig. 10). This means that Paste Group 11 includes 85% of the Sio sherds in Source Groups 1 and 6 together. Put the other way around, Source Groups 1 and 6 account for 94% of Sio sherds in Paste Group 11. A likely principal cause of this overlap lies in the relative proportions of pyroxene and plagioclase feldspar, the two dominant mineral constituents of Sio sherds in Paste Group 11/ Source Group 1 matches and Paste Group 11/ Source Group 6 matches. The range of plagioclase values is the same for both lots of sherds, but Source Group 6 sherds are characterized by moderate to high pyroxene values while Source Group 1 sherds typically contain low to moderate amounts of pyroxene. More importantly, there is a 44% overlap in the 10–15% range of the pyroxene values for Source Groups 1 and 6. In the light of the overlap in Paste Group 11, this suggests that the Sio Style Source 1 and Source 6 sherds are made from low to moderate and moderate to high-pyroxene variants respectively of the same basic clay represented by Paste Group 11.

Table 4. Distribution of Paste Groups in Sio Style sherds at sites KLK, KLJ and KBQ.

paste group	all Sio sherds	all Sio rims	Class 1 all	Class 1 notched	Class 1 unnotched	Class 2 all	Class 2 notched	Class 2 unnotched
2	13	22	25	31	17	11	0	17
11	71	73	71	63	83	78	100	67
13	6	3	0	0	0	11	0	17
14	1	0	0	0	0	0	0	0
16	4	3	3	6	0	0	0	0
8,9,10,17	4	0	0	0	0	0	0	0

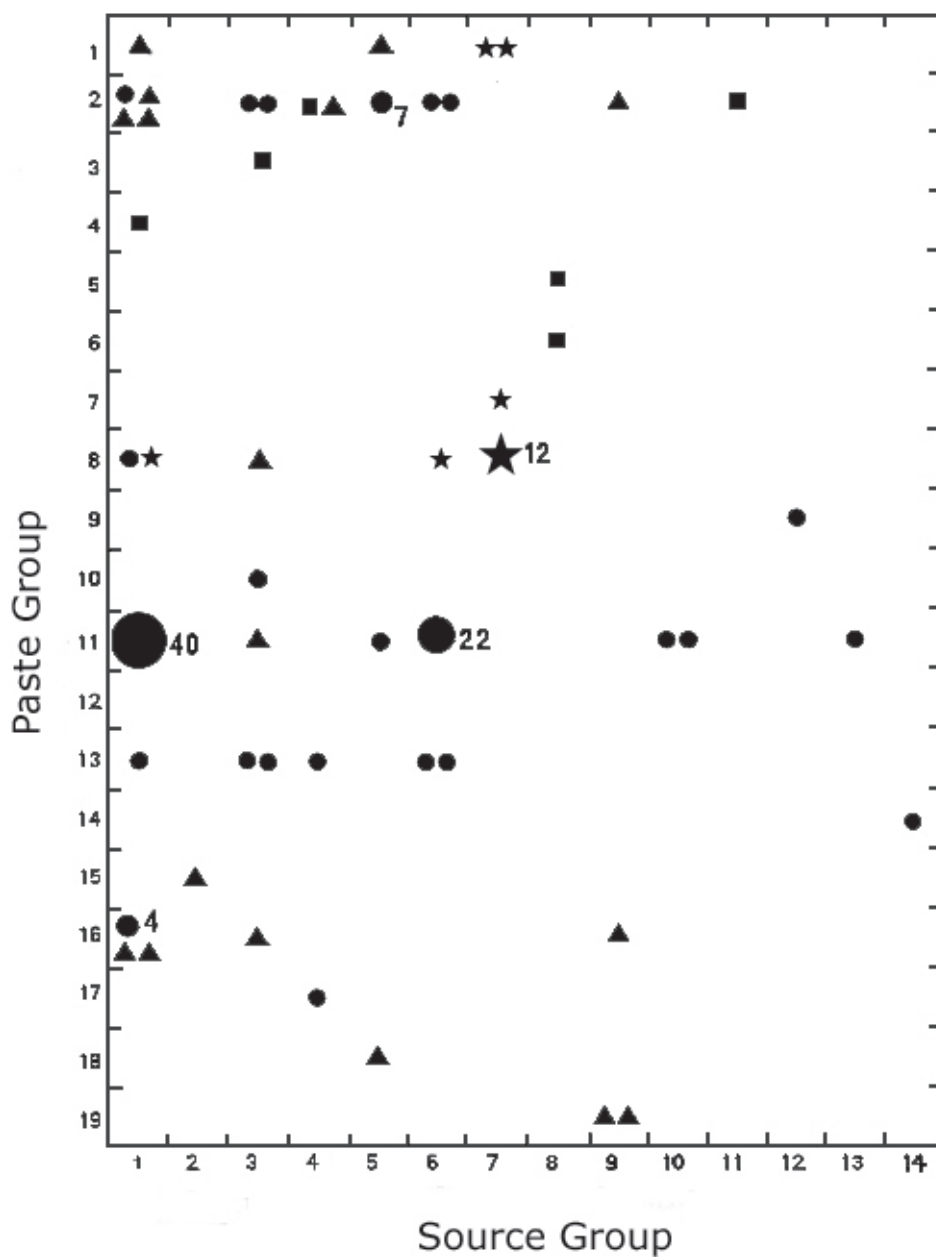


Fig. 10. Frequencies and distributions matches of Paste Groups (vertical axis) and Source Groups (horizontal axis) organized by Style Groups. Style Group symbols: ● = Sio; ▲ = Madang; ■ = Lapita; ★ = Type X. Numbers indicate multiple occurrences.

Table 5. Distribution of Source Groups in Sio Style sherds at sites KLK, KLJ and KBQ.

source group	all Sio sherds	all Sio rims	Class 1 all	Class 1 notched	Class 1 unnotched	Class 2 all	Class 2 notched	Class 2 unnotched
1	50	54	35	50	67	67	100	50
3	5	3	6	4	0	0	0	0
4	2	0	0	0	0	0	0	0
5	9	14	14	25	0	11	0	17
6	28	30	32	31	33	22	0	33
10	2	0	0	0	0	0	0	0
12	1	0	0	0	0	0	0	0
13	1	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0	0

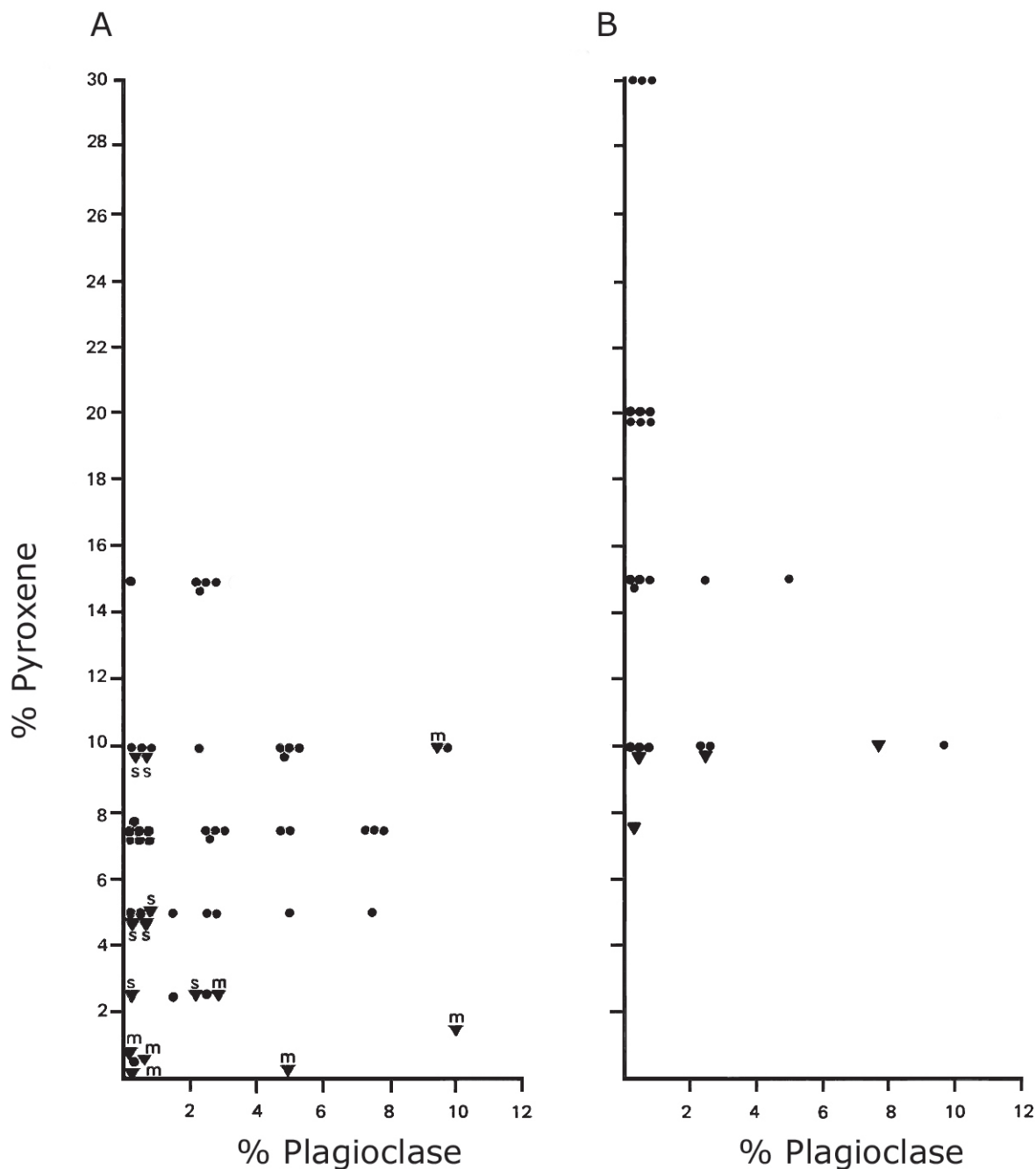


Fig. 11. Percentage frequency distributions of pyroxene and plagioclase of Sio Style group sherds in Paste Group 11. (A) ● = Sio Style Group sherds in Paste Group 11/Source Group 1; ▲ = Paste Group 11 sherds that are assigned to other Source Groups (*s* = Sio, *m* = Madang). (B) ● = Sio Style Group sherds in Paste Group 11/Source Group 6; ▲ = Sio sherds in Paste Group 6 that are assigned to other Source Groups.

In this regard it is instructive to note the results of petrographic analysis by Anderson of the coarse fraction of a sample of *lakakulu* clay “as used by the potter” (per Margaret Tuckson; Lilley, 1986: 532). He found that pyroxene constituted 90% of the sand (2–0.2 mm) component, with “quartz, obsidian, pumice fragments and shell fragments” making up the remaining 10%. Pyroxene comprised 14% of the sample as a whole, a value squarely in the area of overlap between the present Source Groups 1 and 6 (Fig. 11). This finding adds weight to the idea that a pyroxene content of 10–15% can be considered average for *lakakulu* clay but that there is considerable variation about this figure. The

pyroxene and plagioclase values for all other non-Lapita, non-Type X Source 1 and Source 6 sherds strengthen this suggestion. The four extra Source 6 pieces on Figure 11 are Sio Style Group sherds. The 14 additional Source 1 sherds are equally divided between the Sio and Madang Style Groups. All the additional Sio sherds from both Source Groups contain low to moderate amounts of pyroxene, with 45% falling in the area of overlap between Source 1 and 6. This separates them from the Madang pieces, all but one of which fall at the low to very low end of the range of pyroxene values. In other words, all of the additional Sio Style sherds cluster with those Sio pieces, while all but one

of the Madang sherds fall in an almost completely separate cluster. This result buttresses the inferences drawn from the other evidence for an overlap between Paste Group 11/Source Group 1 and Paste Group 11/Source Group 6 sherds. Taken together, the two data sets indicate that while low-resolution sourcing suggests the compositions of Sio Source Group 1 and Madang Source Group 1 sherds are similar to those of Astrolabe region potters' mixes, closer scrutiny of the data suggests that the composition of the Sio Style sherds is more likely to be a low to moderate-pyroxene variant of Source Group 6, the *lakakulu* clay.

Sourcing discussion. If the arguments concerning Source Group 1 are accepted, the foregoing demonstrates that the Sio Style Group can be equated with a distinctive low-diversity range of petrological characteristics and that the greater proportion of pottery in the Group derives from a single source. The Style Group is typified by Paste Group 11, which corresponds to high- and moderate-pyroxene variants of Sio clay from the *lakakulu* source. While the correspondence of style, paste and source is by no means perfect and is clearly in need of more detailed investigation, it is sufficiently close to indicate that the "Sio pottery" initially recognized on stylistic grounds constitutes a valid working taxon. The next section of the paper considers spatial and temporal patterns in the distribution of this material.

Change through time

KLK Tuam. Only a very small sample of Sio pottery was recovered from the KLK site on Tuam in Siassi, where the relevant levels date from 1700 to 300–350 cal. BP (for all dates and their calibrations in this and the following sections, see Lilley, 2002: table 1). The limited numbers of diagnostic sherds preclude any comments regarding stylistic change through time. It can be noted though that the Sio sample includes both classes of Sio rim with the majority of both forms exhibiting either STI or no decoration as well as body sherds exhibiting all Sio decorative techniques with DTI the most common overall.

KLJ Malai. Two pits were excavated about 80 m apart at the KLJ site on Malai. KLJ is a mound over 3 m high and about 400 m long that runs parallel to the beach and is immediately inland of the present village. It comprises multiple layers of dense *Strombus* shell midden inter-fingered with coarse sands to about 1.5 m depth, underlain by increasingly coarse sands. Excavation ceased about 3 m below surface, some 50 cm into very coarse clean beach sand. Sio rims and/or decorated body sherds occur in all layers in both pits, but by far the greatest densities by number and weight occur in the midden layers. Fifteen dates were obtained from the site. They indicate that the bulk of the mound built up within the last 200 years, with the lowermost levels dating to no more than about 500–600 cal. BP.

Rim forms. Pit I yielded 243 Sio rims, all but five (2%) of which are Class 1 forms. All of the Class 2 sherds are from the upper midden layers. All 55 Sio rims from Pit II are Class 1 forms.

Decoration. Pit I yielded 1,063 decorated Sio body sherds totalling 5.1 kg. All Sio techniques of decoration are represented in all levels except the first level below the

Strombus shell midden, where there are no gash-punctate or applied sherds. STI and DTI dominate overall and the proportion of DTI increases with depth, largely at the expense of STI. The extent of this shift could be exaggerated by sampling error, as there are comparatively few decorated body sherds below the midden layers. None of the five Class 2 rims from Pit I exhibits surface decoration. The two in the upper part of the midden include one with a notched lip and one with nubbins on the lip, while two of the three in the lower part of the midden exhibit lip notching. Techniques other than STI, DTI and no decoration are represented at negligible levels on Class 1 rims from Pit I. It is also clear there is a marked difference between the midden levels on the one hand and the lower sands on the other. All decorated Class 1 rims in the lower sands exhibit DTI, while in the midden a slight majority of sherds is undecorated and STI and DTI are represented in approximately equal proportions.

Referring to lip decoration on the Class 1 rims, notched variants dominate in the midden, while unnotched pieces comprise the majority in the lower sands. The most notable difference between the two rim variants in all layers is that most notched rims are otherwise undecorated, while most unnotched forms exhibit DTI. This contrast is most marked in the lower sands. While the pattern is discernible in the midden, all surface-decorative techniques are represented in those layers by both notched and unnotched rim variants and the proportions of the dominant techniques are reduced. As is the case with decorated body sherds, the differences between the upper and lower levels described for surface decoration on both notched and unnotched Class 1 rims could be the product of sampling error caused by the low numbers of both variants in the lower sands.

Pit II yielded 344 decorated Sio body sherds totalling 1.5 kg. The major difference in the distribution of decorative techniques is between the midden on the one hand and the lower sands on the other. STI dominates in the former, while in the latter DTI replaces STI as the most common technique. As regards surface decoration on Pit II Class 1 rims, DTI or no decoration account for virtually the entire sample, occurring in approximately equal proportions in all levels except at the very top and bottom. In the uppermost level undecorated rims are almost completely dominant and in the basal layer only DTI is represented (by a single rim). For lip decoration, there is a change in the relative proportions of notched and unnotched rims, with notched rims dominant in the midden and unnotched rims dominant in the lower sands.

Petrology. Samples of Sio pottery from both the midden and the lower sands in Malai Pit I were submitted for petrological analysis. Both the Paste Group and Source Group data imply there are changes with depth in the paste composition of the Sio pottery in the Malai mound. In view of the limited number of sherds analysed it would be unwise to attach too much weight to the patterns unveiled, but it is possible to draw two tentative inferences from the data. The first is that Paste Group 11 pottery becomes petrologically less uniform from the bottom to the top of the site. In the lower sands it is virtually all the high-pyroxene Source Group 6 variant, in the lower midden both the high and low-pyroxene Source Groups 6 and 1 variants occur, and in the upper part of the midden the high-pyroxene variant occurs with minor

fractions of the low-pyroxene and other variants. The second implication is that as Paste Group 11 material becomes more heterogeneous, there are changes in the source(s) of non-Paste Group 11 pottery. In the lower sands there is a mixed and proportionally significant group which probably represents unidentified Huon Peninsula sources. The single sherd in the lower part of the midden is probably made from a variant Sio paste but cannot be matched with a known source. In the upper midden a homogeneous Paste Group 2/Source Group 5 cluster almost certainly represents pottery from one or more known Huon Peninsula sources other than Sio. In short, in the lower sands Paste Group 11 material is least diverse and other pottery is most diverse, while the reverse is true of the upper midden. The petrological change between the lower sands and the bottom part of the midden may be related to the shift in predominance from unnotched rims and DTI to notched rims and STI. The petrological differences between the lower and upper midden do not correspond with any dramatic stylistic change. I will return to the correlation of petrographic and stylistic change at the end of this section and again towards the end of the paper.

KLJ discussion. The Sio material from KLJ accounts for approximately 40% of all excavated Sio Style pottery. In overall terms the sample is characterized by a near-total dominance of Class 1 rims exhibiting standardized lip widths and either DTI or no decoration and by decorated body sherds exhibiting either STI or DTI. The principal distinction in both pits is between the midden and the lower sands. Most rims in the Pit I midden are notched Class 1 forms with no surface decoration and most decorated body sherds exhibit STI. Most rims in the lower sands are unnotched Class 1 forms which exhibit DTI. Most decorated body sherds in the lower sands also have DTI. The most common rims in the Pit II midden are notched Class 1 forms with either DTI or no decoration, and most decorated body sherds exhibit STI. Most rims in the lower sands are unnotched Class 1 forms which exhibit either DTI or no decoration and most decorated body sherds exhibit DTI. Almost 60% of the Sio pottery in the lower sands is made on high-pyroxene Sio clay and the remainder on a variety of shelly Huon Peninsula pastes which have not been precisely sourced. There is a shift in paste composition between the lower levels and the midden. High pyroxene Sio clays dominate in the lower levels, but in the midden there are also clays from other Huon Peninsula sources, though the high pyroxene Sio clay is still prominent.

KBQ Sio. Site KBQ is a complex of mounds up to 4 m high and spread over an area of about 400 m N–S by 200 m E–W on the western side of Sio Lagoon. Two pits were excavated here, separated by some 200 m. Pit I was dug in the highest part of the complex. The stratigraphy consists of inter-fingering layers of ash, dense shell midden and coarse sands to about 2.5 m depth, overlying about 50 cm of very dark brown clayey sand. Below this was increasingly coarse and pale-coloured sands grading into very coarse, clean beach sand. Excavation ceased about 4 m below surface, some 50 cm into the basal sand. In contrast, Pit II was only about 1.5 m deep, with pebbly coarse sands to about 1 m depth overlying up to 30 cm of less-coarse pebbly sand above very coarse clean beach sand. Fourteen dates were obtained from the site. They indicate two periods of activity. The first is represented by the lowermost levels in both pits and dates from 800–1000

to 1300 cal. BP. The second period, represented by the layers above the dark clayey sand in Pit I and by the upper pebbly sands in Pit II, dates from 500–600 to 350 cal. BP. It seems likely the site was abandoned after that, with the entire local population moving to Sio Island immediately offshore and remaining there until European contact.

The two excavations yielded 2,357 Sio rim and decorated sherds weighing 13 kg. These quantities make up 58% by number and 62% by weight of all excavated Sio rims and decorated pottery. Rims and body sherds occur in all layers in both pits. In that excavation there are approximately equal densities by number and weight throughout the upper ash and midden layers followed by a dramatic decline in the dark clayey sand and a further drop in the lower coarse sand. In Pit II there are approximately equal densities by number and weight in the upper levels, then a 50% decrease in the much-older lower sand.

Rim forms. Pit I contained 330 Sio rims, 75% of which are Class 1 forms. Class 1 occurs in all levels except the lowermost sands and dominates by a substantial margin in the ash and shell layers, while Class 2 is represented in all layers but dominates in the lowermost sands. Pit II yielded 145 Sio rims, 87% of which are Class 2 forms. Both Class 1 and Class 2 are represented in all layers and Class 2 is almost completely dominant throughout.

Decoration. There are 1,736 decorated Sio body sherds totalling 8.5kg from Pit I. All decorative techniques are represented in all layers, with the most marked difference in proportions occurring between the ash and shell layers and the underlying dark clayey sand. DTI dominates overall in the former, while in the latter STI makes up the largest fraction. The pattern in the lowermost sand is different again but is likely to be distorted by sample error, as there are only seven sherds in the level. There is a similar pattern of variation with depth in surface decoration on Class 1 rims from Pit I. DTI dominates in the ash and shell layers, while most sherds in the clayey sand are undecorated. Unnotched Class 1 rims dominate in all levels of Pit I except in the surface layer, where notched forms are in a slight majority. There are several clear changes with depth in the relative proportions of surface decorative techniques exhibited by notched and unnotched Class 1 rims. All techniques except “other techniques” occur in similar proportions on notched rims in the shallow surface layer, while in the upper part of the ash and shell levels DTI is dominant. In the lower part of the ash and shell layers and in the clayey sand most rims are undecorated. The pattern in the surface layer may be caused by disturbance, while the total domination by undecorated sherds in the clayey sand is almost certainly the result of sampling error as there are only two rims there. Thus the shift in dominance between the upper and lower ash and shell layers is the only change likely to be of any moment. The overall pattern for unnotched rims is similar.

As regards surface decoration on Class 2 rims from Pit I, STI dominates in all levels except the surface layer and the uppermost ash and shell levels. In the surface layer DTI and “no decoration” are co-dominant, while DTI constitutes the largest fraction in the upper ash and shell levels. Change with depth in the relative proportions of notched and unnotched variants of Class 2 is less coherent than it is for Class 1, probably because of the small subsamples from each layer.

Overall, notched and unnotched variants occur in broadly similar proportions throughout. Variations between layers in the surface decoration exhibited by notched and unnotched Class 2 rims are limited to the fact that a slight majority of the former exhibit DTI while the latter generally feature STI. As only limited numbers of both variants are represented, little significance should be attached to patterns of variation based on lip decoration.

KBQ Pit II contained 146 decorated Sio body sherds totalling 1 kg. STI, DTI and G-P are represented in all layers, while gashing and “other decorative techniques” occur only in the more recent pebbly sand. STI is dominant in all levels while DTI and gashing occur in lesser but broadly similar proportions throughout. The small size and uneven distribution of Class 1 rims in the Pit II sample have distorted patterns of variation with depth in surface and lip decoration and association of surface decoration and notched and unnotched variants. It can be noted that 63% of Class 1 sherds are unnotched and 42% exhibit DTI, 47% “no decoration” and 11% other techniques. The patterns for Class 2 rims are more coherent. Undecorated rims dominate the Class in all layers, albeit by a reduced margin in the lower sands. Notched and unnotched Class 2 forms occur in similar proportions throughout. Most notched Class 2 rims in all levels are undecorated while most unnotched Class 2 rims in the more recent sands are undecorated and in the older sands exhibit “other decoration”.

Petrology. Samples from the ash and shell levels and clayey sand in Sio Pit I were submitted for petrological analysis. The principal inter-layer variations in the proportions of the different Paste and Source Groups in the distribution of both Paste Groups and Source Groups is between the ash and shell levels on one hand and dark clayey sand on the other. In the former the dominant paste is the low-pyroxene Source Group 1 variant of Sio Paste Group 11, while in the dark clayey sand it is the high-pyroxene Source Group 6 variant. In the first group the upper levels separate from the lower ones because in addition to its low-pyroxene Paste Group 11/Source Group 1 component, there is an appreciable proportion of high-pyroxene Paste Group 11/Source Group 6 material present. These patterns should be viewed with caution given the small number of sherds examined. However, it can be suggested that the petrological differences between the dark clayey sand and the ash and shell layers may relate to the stylistic shift from a predominance of Class 2 rims and STI to Class 1 rims and DTI.

KBQ discussion. The sample of Sio pottery at KBQ comprises about 60% of all excavated material in the Style Group. In Pit I the principal stylistic differences are between the more recent ash and shell layers on one hand and much older underlying sands on the other. In the upper levels, very finely made unnotched Class 1 rims are prevalent, and these rims and most decorated body sherds exhibit DTI. In the lower sands, highly variable and generally much coarser Class 2 rims dominate, and these rims and most body sherds exhibit STI. The stylistic shift is matched by a change in paste composition. Sherds in these ash and shell levels are typically made on the low-pyroxene Source Group 1 variant of Sio clay, whereas pottery in the lower sands is dominated by the high-pyroxene Source Group 6 variant. This latter material I describe as “Ancestral Sio” pottery.

Past patterns of Sio pottery production and distribution

The foregoing indicates a three-phase sequence for the production and distribution of Sio pottery.

- 1 The first phase dates from around 1700 cal. BP until to an undetermined time between 1,000 and 500–600 cal. BP. During this period, very small amounts of Ancestral Sio pottery were deposited at the KLK site on Tuam and larger but still only moderate quantities of the ware were deposited at the KBQ site at Sio. The Sio pottery from this time is characterized by Class 2 rims with lips of highly variable but generally substantial widths, decoration by single-tool incision and the high-pyroxene clay from the *lakakulu* source at Sio.
- 2 There follows a second phase of activity dating from 500–600 to 300–350 cal. BP. During this period increasing and ultimately very substantial quantities of Sio pottery were deposited at Sio. The pottery from this period is typified by unnotched Class 1 rims with very finely made lips of a highly standardized width, decoration by double-tool incision and the low-pyroxene variant of *lakakulu* clay. This pattern is similar to the ethnographic situation, and when considered in relation to the quantities of pottery that were excavated, undoubtedly reflects the beginning of high-volume production for trade.
- 3 The final phase of activity dates from 300–350 cal. BP and extends through to recent times. It can be divided into two subphases, the later of which dates to within the last 200 years. In the first subphase (3, 350–300 to 200 cal. BP), a minute quantity of Sio pottery was deposited in KLK on Tuam and relatively small quantities of the ware were deposited in KLJ on Malai. Sio pottery from this subphase looks basically the same as that from the previous period and is made from either Sio’s own high-pyroxene *lakakulu* clay or one of several shelly clays from the Huon Peninsula coast. During the later historic subphase (3, 200 cal. BP to present), very large quantities of Sio pottery were deposited in KLJ on Malai. The pottery is basically the same as that from the earlier part of the phase, but is characterized by notched rather than unnotched Class 1 rims and body sherds decorated by single-tool rather than double-tool incision. At the start of the subphase, Sio Style pottery is made from both high- and low-pyroxene variants of *lakakulu* clay, but by the end is made from clay from a wider range of Huon Peninsula sources, including *lakakulu*.

The emergence of a standardized trade ware in late prehistory follows the same sort of patterns described for the Mailu area by Irwin (1985) and the Port Moresby region by Allen (1984) and others (cf. Harding, 1994). Allen (1985) has presented a general explanatory model for such patterns which, up to a point, seems to account for the situation in the Vitiaz Strait region. The only problem is that his model can be seen to imply (though does not explicitly prescribe)

a level of continuity between developments such as those described here and the earlier Lapita phenomenon that is absent in the Vitiaz region (and indeed on the Papuan south coast). The model actually fits the situation in island Melanesia much better than the ones he, Irwin and I describe for the New Guinea mainland region. In island Melanesia there is demonstrable continuity between Lapita and what follows, whereas in the New Guinea region there is a significant temporal gap, most pronounced in the northern areas described in this paper. Clearly this issue awaits further detailed exploration. As a working hypothesis, I have argued (Lilley, 2004) that the gap reflects the impact of catastrophic volcanism in the Vitiaz-west New Britain region.

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