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

Revised Dating of Type X Pottery, Morobe Province

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ABSTRACT. Type X is a distinctive post-Lapita pottery on Huon Peninsula and its adjacent islands in Papua New Guinea, for which Lilley originally proposed a time span from about 1600 to 850/550 cal. BP. The paper reviews this chronology in the light of new dates and the original data, and proposes that the duration of Type X should be shortened to about 1000–500 cal. BP. This revised chronology possibly lengthens the post-Lapita aceramic period on Huon Peninsula, and has implications for the history of trading across Vitiaz Strait.

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Archaeological excavations in the Siassi Islands and at Sio on northeast Huon Peninsula, Morobe Province, Papua New Guinea (Fig. 1), have yielded evidence for five prehistoric pottery styles starting with the dentate-stamped phase of the Lapita ceramic series at about 3000 years ago (Lilley, 1988a, 1988b, 2002, 2004). The most distinctive of the four post-Lapita styles is Type X, which is now known from 33 localities on Huon Peninsula, its adjacent islands and New Britain (Table 1). Petrographic and limited geochemical studies suggest a probable origin for Type X somewhere on Huon Peninsula (Watchman, 1986; Lilley, 1988a; Specht *et al*., 2006). Lilley (1988a) assigned Type X to the period c. 1600–850/550 cal. BP, spanning about 750–1000 years and overlapping with the start of pottery traditions ancestral to the present-day industries of the Madang and Sio-Gitua areas of mainland New Guinea (cf. May & Tuckson, 1982).

This paper reviews the chronology of Type X in the light of dates obtained since Lilley's definition of the style or not available to him at the time, and reconsiders the original dating evidence. We conclude that Type X began around

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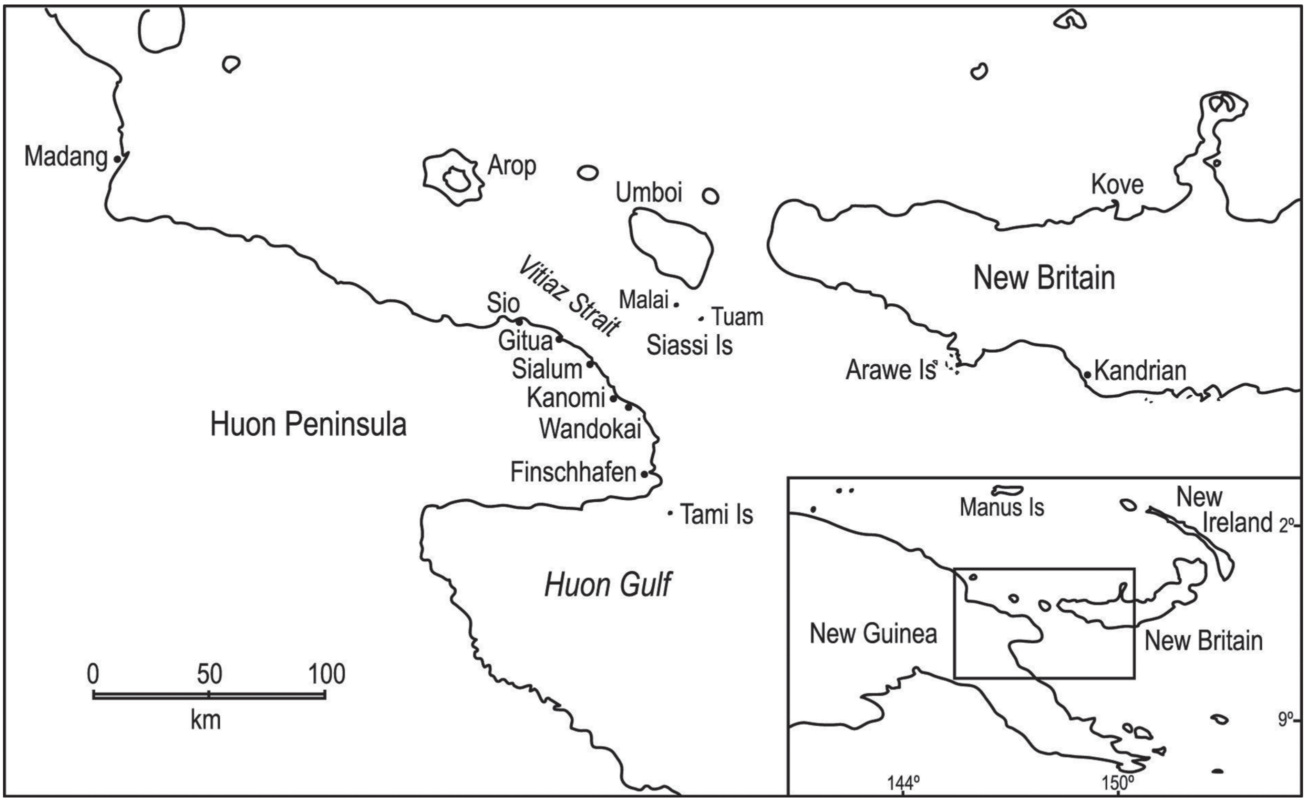

Fig. 1. Map showing the distribution of Type X sites mentioned in the text.

1000 cal. BP and probably lasted only about 500 years. Such a revision lengthens the period when pottery was not present on Huon Peninsula, and has implications for the chronologies of the Ancestral Sio and Madang pottery and the history of trading contacts across Vitiaz Strait.

Lilley's original dating of Type X gave it a duration longer than that confirmed for any pottery in the New Guinea-Island Melanesia region, where many styles underwent continuing change and lasted for only 200–600 years (e.g., Bedford & Clark, 2001). An even longer duration of about 1500 years was once accepted for Lapita pottery in the Bismarck Archipelago (Gosden *et al*., 1989: 561), though much depended on how Lapita was defined. In a recent analysis of a large suite of radiocarbon dates from the Mussau Islands, Kirch (2001: 219) now argues that Lapita pottery probably lasted there only 500 years, with a maximum duration of 700–800 years. During this period there were major changes in the pottery forms and decoration. Lapita pottery is now generally treated as a horizon with several regional traditions and phases of stylistic change extending over a millennium or more (Anderson *et al*., 2001; Summerhayes, 2000a, 2000b, 2001; Green, 2003). This contrasts with the claimed long duration of Type X, for which no developmental sequence can yet be defined, though it shows some stylistic diversity that might be time-dependent. The number of localities (33) with Type X sherds currently on record in a relatively small region (Table 1) may seem to rival the 70 or so sites with dentate-stamped Lapita pottery spread widely across the Bismarck Archipelago (Anderson *et al*., 2001: table 1), but the actual quantities of Type X pottery do not. More than half of the localities listed on Table 1 (18) have <10 sherds, and another six have <50. We suggest that what little is known about Type X makes it unlikely that it lasted 750–1000 years.

Dating issues

Tables 2–4 present 56 calibrated dating results (30 on shell, 26 on charcoal) relevant to the chronology of Type X. The conventional radiocarbon ages of charcoal samples were calibrated by using the IntCal04.14c data set of the CALIB Rev 5.0.1 program (Stuiver & Reimer, 1993 [version 5.0]; Reimer *et al*., 2004); the Northern Hemisphere curve is preferred because of the proximity of the research area to the Equator. We apply an arbitrary 10-year value for the growth span of the plant-derived samples, none of which have been identified, and a Laboratory error of 1. Marine shell samples are calibrated by the Marine04.14c data set (Stuiver & Reimer, 1993 [version 5.0]; Hughen *et al*., 2004), with $\Delta R = 0 \pm 0$ years, in preference to the -400 years correction and calibration by the atmospheric data set suggested for Huon Peninsula (Chappell & Polach, 1991). We use age ranges at 2σ in preference to 1σ or central tendency values, as the dates are probability distributions and not precise determinations (cf. Specht & Gosden, 1997: 187; Kirch, 2001: 198). Where the dating result has multiple intercepts and the relative area under the distributions is less than 1.0, we use within the text the range with the highest value, rounded to the nearest 10-year interval.

Use of marine shell for radiocarbon dating is fraught with problems arising from fluctuations in the oceanic reservoir of 14C, the feeding habits of different species of molluscs and the nature of seawater circulation, which can affect significantly the ΔR value appropriate to a marine shell sample (Kirch, 2001; Hughen *et al*., 2004; Petchey *et al*., 2004). The lack of empirically defined local ΔR values for the shell dates on Tables 2–4, therefore, may skew the calibrated results. Of the samples associated with Type X, for example, 13 shell dates (excluding Beta-63609) exceed

Table 1. Distribution of Type X sites based on Abramson (1969) for Tami; Araho (1995) for KIC and KID; Egloff & Spechtt (1982) for JCB; Gosden and Webb (1994) for FNY; Lilley (1988a, 1991) for FCL and FPR; Keysser (1911) for Jabim Mission; Summerhayes (2000a) for FOH and FOJ; and J. Chappell (pers. comm.) and Ota *et al*. (1997) for Paradise Springs. The other sites are recorded in Specht's fieldnotes for 1969, 1972 and 1991.

Site	location	type	Type X	Lapita	Type Y	Sio	Madang	other	total
Huon Peninsula (23)									
Finschhafen									
no code	Tami Islands	open	5	—	—	—	—	●	122
no code	Jabim Mission	open	3?	—	—	—	—	—	*n.a.*
KAM	Timbulim	open	43	—	—	—	—	●	56
no code	Peninsula	open	8	—	—	—	—	●	9
Wandokai/Kanomi									
KIC	Wandokai	shelter	15	—	—	—	—	●	16
KID	Wandokai	shelter	*n.a.*	—	—	—	—	*n.a.*	*n.a.*
Paradise Springs	Kanomi	open	*n.a.*	—	—	—	—	—	*n.a.*
Sialum									
KCJ	Sialum	open	6	—	—	●	—	—	10
KCM	Sia Island	open	3	—	—	—	—	—	28
KCN	Sialum	open	24	—	—	—	—	—	24
KCP	Sialum	open	1	—	—	—	—	—	1
KCR	Kwangum River	open	22	—	—	●	—	—	32
KCV	Sialum	shelter	1	—	—	—	—	—	1
KCX	Sialum	shelter	3	—	—	—	—	—	3
KDH	Sialum	shelter	3	—	—	—	—	—	3
KDJ	Sialum	shelter	1	—	—	—	—	—	2
KDS	Sialum	shelter	1	—	—	—	—	—	1
KDU	Sialum	open	3	—	—	●	—	—	12
KDV	Sialum	shelter	1	—	—	—	—	—	1
Gitua									
KBW	Gitua	open	3	—	—	●	—	—	40
KBZ	Gitua	open	21	—	—	●	●	—	129
Sio									
KBP	Sigawa Island	open	7	—	—	●	●	—	>1,000
KBQ	Teliata Point	open	261	—	—	●	●	—	~8,500
Vitiaz Strait (3)									
Arop Island									
JCB	NW coast	open	1	—	—	?	●	—	67
Siassi Islands									
KLJ	Malai Island	open	754	—	—	●	●	—	11,607
KLK	Tuam Island	open	285	●	●	●	—	—	1,139
New Britain (7)									
Willaumez Peninsula									
FABI	Numundo Plantation	open	1	—	—	—	—	1	2
Kove Islands									
FCL	Poi Island	open	*n.a.*	●	—	—	—	—	*n.a.*
FPR	Poi Island	open	*n.a.*	●	—	—	—	—	*n.a.*
Arawe Islands									
FNY	Pililo Island	open	76	●	—	—	—	—	2,420
FOH	Adwe Island	open	>150	●	—	—	—	—	>13,000
FOJ	Kumbun Island	open	1+	●	—	—	—	—	>7,000
Kandrian									
FLE	Awakuo	shelter	4	—	—	—	—	—	4

1000 BP at one or both ends of their ranges, whereas only three charcoal dates exceed this value. While in some cases this difference might arise because the shell samples indeed came from older contexts, for others the explanation may lie in the value used for ΔR or relate to issues of stratigraphic integrity. In the only situation where shell and charcoal samples from the same layer were dated (KBQ/I layer 2: ANU-4970, ANU-4332), the two samples were separated vertically by 60 cm of deposit and cannot be used to check the appropriateness of the ΔR value used here. An additional problem is that the beginning and end of the time range of Type X cover plateau regions on the radiocarbon calibration

Table 2. New Britain radiocarbon dates, calibrated by CALIB 5.0.1 (Stuiver & Reimer 1993; Hughen *et al*., 2004; Reimer *et al*., 2004), for sites with Type X pottery or with relevance to its chronology. Data from Lilley (1991), Gosden and Webb (1994), Summerhayes (2001), and Specht (unpublished data). For each sample the calibrated range with the highest probability value is in bold type.

site/level	lab. no.	material	context	CRA	cal. BP	prob.
Arawe						
FNY/1 base	ANU-4982	charcoal	Type X, Sio, Madang	900±140	1129–1108	0.008
					1089–632	**0.972**
					598–560	0.020
FNY/3 top	ANU-4989	charcoal	below Type X	1110±130	**1288–781**	**1.000**
FNY/3 top	ANU-4990	charcoal	below Type X	1150±200	**1408–683**	**1.000**
FOH/D3/3	ANU-11192	charcoal	below Type X	1350±160	**1565–930**	**1.000**
Kandrian						
FLE/I spit 4	Beta-63610	*Tridacna crocea*	Type X only	1010±60	**673–501**	**1.000**
FLE/I spit 4	Beta-79346	*Anadara antiquata*	Type X only	1880±80	**1609–1272**	**1.000**
FLE/I spit 6	Beta-79347	*Turbo* sp.	Type X only	1040±70	**720–504**	**1.000**
FLE/I spit 6	Beta-63609	*Chama pacifica*	Type X only	5320±70	**5868–5565**	**1.000**
Kove						
FCL 2/2	Beta-26260	shell	Type X, Lapita	2030±50	**1737–1492**	**1.000**
FPB 2/8	Beta-26262	shell	Lapita, no Type X	1170±70	**889–615**	**1.000**
FPD 1/5	Beta-26264	charcoal	Sio and Madang only	350±60	**506–302**	**1.000**
FPF 4/5	Beta-26268	shell	Sio and Madang only	750±50	**480–290**	**1.000**

curve that tend to widen the calendar age ranges, leading to uncertainty as to where within a plateau the true age of a sample should fall (cf. Blackwell *et al*., 2006: 411; Grave & Barbetti, 2001: fig. 3).

The long chronology for Type X depends on the interpretation of dates from layers of unconsolidated beach sands. This raises an important issue about the associations between the pottery and the dating samples, as coastal sites on beach sands are susceptible to disturbance by humans and a range of other agencies (cf. Specht, 1985; Kirch & Hunt, 1988: 28; White *et al*., 2002). A common problem is whether dating samples are directly related to the age of the cultural materials found in the same sedimentary unit, the formation of which might have taken place over several centuries. Dating samples in this category provide only a general guide to the age of the cultural materials. In unconsolidated sediments such as beach sands, shells and comminuted charcoal can be displaced vertically, both upwards and downwards, by various agencies for which there is no obvious evidence during excavation (cf. Lilley, 2002: 81–83). Such samples provide at best generalized and at worst possibly misleading dates for the formation of the sediments within which they were found, and might have little to do with the age of seemingly associated cultural materials. The problem can be further compounded with composite samples of unidentified charcoal, which might consist of fragments from several plants with different in-built ages that died at different times, as well as undergoing vertical displacement (Clark, 2004: 30–31).

Seven dates are published for the first time: Beta-63609, Beta-63610, Beta-79346 and Beta-79347 for FLE near Kandrian (Table 2); NSW–86, NSW–87 for KBP and KBQ at Sio, and ANU-5602 for KID at Wandokai (Table 4). The mid-Holocene sample Beta-63609 is clearly unrelated to Type X, but is included for completeness of the discussion of FLE. Most dates for the KBQ site at Sio and the KLJ and KLK sites in the Siassi Islands are included (Lilley, 1986: tables 5.2–5.5, Appendix 1; 2002: table 1). We exclude four dates from the basal levels of KLK/III and KLK/TP10 (ANU-4610, ANU-4620, ANU-4621, ANU-4664) that were not associated with cultural materials of any kind or only with Lapita pottery (cf. Lilley, 2002: 83). On the other hand, we include in our argument two samples associated with Lapita pottery only (ANU-4612 and Beta-26262).

Dating Type X: new evidence

There are eleven dating results pertinent to the chronology of Type X that have been obtained since Lilley's (1988a) original publication or were not available to him at that time. Seven of these are from New Britain sites, and four from sites on Huon Peninsula. At the FNY site in the Arawe Islands of New Britain two samples date the top of the brown clay of layer 3 to 1290–780 cal. BP (ANU-4989) and 1410–680 cal. BP (ANU-4990) (Table 2; Gosden & Webb, 1994: 45–47, fig. 12). This layer was sealed by black sandy clay and shell midden forming layer 1, the base of which is dated to 1090–630 cal. BP (ANU-4982) (Gosden & Webb, 1994: fig. 15.1). Type X sherds first appeared in this layer. At FOH on nearby Adwe Island, layer 3 below the first Type X sherds is dated 1565–930 cal. BP (ANU-11192) (Summerhayes, 2001: 32, table 3; Gosden & Webb, 1994: fig. 15.1). Type X must be younger than this. The wide ranges of these results (460 to 730 years) do not provide a tight date for the appearance of Type X, but suggest that it did not begin here before about 1000 years ago.

At the FLE rock shelter near Kandrian on New Britain Type X is the only pottery present, with one sherd (0.7 g) in spit 6 and three (59.2 g) in spit 4. These spits were separated by a light grey tephra (spit 5) of uncertain origin and age. Spit 6 has two shell dates of 5870–5565 cal. BP (Beta-63609) and 720–500 cal. BP (Beta-79347). Beta-63609 clearly does not

Table 3. Siassi Islands radiocarbon dates, calibrated by CALIB Rev 4.4.2 (Stuiver & Reimer, 1993; Hughen *et al*., 2004; Reimer *et al*., 2004), for sites with Type X pottery. Data from Lilley (1986). The calibrated range with the highest probability value for each sample is in bold type. "*n.a.*" indicates that an age result cannot be calibrated.

site/level	lab. no.	material	context	CRA	cal. BP	prob.
Malai Island						
KLJ/TP/35 cm	ANU-3821	shell	Type X, Sio, Madang	680±70	**471–177**	**0.980**
					166–145	0.020
KLJ/TP/64 cm	ANU-3820	shell	Type X, Sio, Madang	800±70	**529–291**	**1.000**
KLJ/TP/75 cm	ANU-3819	shell	Type X, Sio, Madang	540±70	**285–0**	**1.000**
KLJ/TP/127 cm	ANU-3822	shell	Type X, Sio, Madang	680±70	**471–177**	**0.980**
					166–145	0.02
KLJ/TP/155 cm	ANU-3800	shell	Type X, Sio, Madang	990±70	**676–480**	**1.000**
KLJ/TP/191 cm	ANU-3801	shell	Type X, Sio, Madang	740±70	**496–264**	**1.000**
KLJ/I/2	ANU-4344	charcoal	Madang, Sio, some Type X	180±100	437–351	0.100
					334–0	**0.900**
KLJ/I/2 (67 cm)	ANU-4341	charcoal	Madang, Sio, some Type X	Modern	*n.a.*	*n.a.*
KLJ/I/2 (75 cm)	ANU-4333	charcoal	Madang, Sio, some Type X	Modern	*n.a.*	*n.a.*
KLJ/I/2 (83 cm)	ANU-4342	charcoal	Madang, Sio, some Type X	Modern	*n.a.*	*n.a.*
KLJ/I/2 (121 cm)	ANU-4343	charcoal	Madang, Sio, some Type X	Modern	*n.a.*	*n.a.*
KLJ/I/3 (191 cm)	ANU-4345	charcoal	Madang, some Type X, Sio	Modern	*n.a.*	*n.a.*
KLJ/I/4 (232 cm)	ANU-4346	charcoal	Madang, Sio, some Type X	270±170	**533–0**	**1.000**
KLJ/II/1 (17 cm)	ANU-4339	charcoal	Madang, Sio, some Type X	Modern	*n.a.*	*n.a.*
KLJ/II/5 (182 cm)	ANU-4340	charcoal	Madang, Sio, some Type X	Modern	*n.a.*	*n.a.*
Tuam Island						
KLK/TP (18 cm)	ANU-3870	shell	Type X and other	1300±70	**976–686**	**1.000**
KLK/TP (38 cm)	ANU-3871	shell	Type X and other	1610±70	**1293–1000**	**1.000**
KLK/TP (80 cm)	ANU-3803	shell	Type X and other	1400±70	**1115–781**	**1.000**
KLK/I/1 (17 cm)	ANU-4611	shell	Type X only	850±70	598–575	0.024
					570–317	**0.976**
KLK/I/3 (55 cm)	ANU-4612	shell	Lapita, trace Type X, Type Y?	1980±70	**1708–1362**	**1.000**
KLK/I/4 (76 cm)	ANU-4613	shell	Lapita only	2090±70	**1847–1506**	**1.000**
KLK/II/2 22 cm)	ANU-4614	shell	Type X, trace Lapita	780±70	**514–283**	**1.000**
KLK/II/3 (43 cm)	ANU-4615	shell	Type X, trace Lapita	1740±70	**1450–1143**	**1.000**
KLK/II/3 (63 cm)	ANU-4616	shell	Type X, trace Lapita	1920±70	**1635–1304**	**1.000**
KLK/II/4 (130 cm)	ANU-4617	shell	Lapita, trace Type X	3010±80	**3011–2599**	**1.000**
KLK/III/2 (18 cm)	ANU-4618	shell	Type X, Sio, Lapita trace only	1560±70	**1259–960**	**1.000**
KLK/III/3 (41 cm)	ANU-4619	shell	few Sio, Type X, Lapita	2630±70	**2532–2114**	**1.000**

relate to Type X, and must relate to shells derived from the mid-Holocene beach at the base of the shelter (Boyd *et al*., 1999). Beta-79347 is statistically the same as Beta-63610 (670–500 cal. BP) from spit 4, and most likely represents shell displaced downwards through the tephra from spit 4 into spit 6, together with the small Type X sherd. Beta-79346 (1610–1270 cal. BP) from spit 4 is much older than Beta-63610 but similar to the pre-Type X dates in the Arawe Islands. We suggest, therefore, that Beta-79346 represents aceramic re-use of the shelter after the tephra fall, with Type X pottery appearing at about 720–500 cal. BP.

Type X sherds have been reported from Paradise Springs near Kanomi Point on Huon Peninsula, where the sherds occurred on the surface and in the upper part of a palaeosol buried by a mudflow (J. Chappell, pers. comm.; Ota *et al*., 1997: 67). A *Strombus* shell from the palaeosol is dated 1780–1170 cal. BP (ANU-8673) (Ota *et al*., 1997: fig. 12 and table 2, where the dates represent the CRA minus 400 years and calibrated using the atmospheric curve). The 610-year range of ANU-8673 and the lack of information about its relationship to the pottery raise uncertainty about its relevance.

The first human use of the KIC and KID caves near Wandokai on Huon Peninsula appears to have been associated with Type X pottery. Although no sherds were found with charcoal sample ANU-5602 from KID (Araho, 1995: 19, 41), this sample was in the same stratigraphic position as Type X sherds in other trenches at KID. The result of 800–660 cal. BP (ANU-5602) provides a general age for the pottery in this area.

In 1972, Specht and J. Kamminga excavated test pits in the Sio area at KBP on Sigawa Island and at KBQ in the grounds of the Primary School on Teliata Point opposite Sigawa. In each trench there were only seven Type X sherds. Site KBP is extensively disturbed, and sample NSW–86 from about 25cm above the first Type X sherds yielded a date of 550–260 cal. BP. The reliability of this result is uncertain, but it is similar to ANU-4334 at KBQ/II and ANU-4611 at KLK/I on Tuam Island, and slightly younger than Beta-63610 at FLE at Kandrian. A test trench at KBQ in one of several low

Table 4. Huon Peninsula radiocarbon dates, calibrated by CALIB Rev 4.4.2 (Stuiver & Reimer, 1993; Hughen *et al*., 2004; Reimer *et al*., 2004). The dates are for sites with Type X pottery or with relevance to its chronology, and are taken from Lilley (1986), Araho (1995), and Ota *et al*. (1997). For each sample, the calibrated range with the highest probability value is in bold type. For ANU 4335, "*n.a.*" indicates that the age result cannot be calibrated.

site/level	lab. No.	material	context	CRA	cal. BP	prob.
Wandokai						
KID/B3/4A	ANU-5602	charcoal	Type X equivalent	800±60	904–858	0.066
					830–810	0.023
					802–657	**0.911**
Kanomi						
Paradise Springs	ANU-8673	*Strombus* sp.	Type X on buried soil	1890±140	**1779–1170**	**1.000**
Sio						
KBP/I/1972/spit K (75–80 cm)	NSW–86	charcoal	25 cm above first Type X	360±100	620–611	0.004
					554–263	**0.919**
					219–142	0.061
					24–1	0.017
KBQ/1972/spit G (60–70 cm)	NSW–87	charcoal	below first Type X	800±100	**927–632**	**0.949**
					598–560	0.051
KBQ/I/2 (57cm)	ANU-4970	shell	Sio, Madang, few Type X	940±80	**665–423**	**1.000**
KBQ/I/2 (115cm)	ANU-4332	charcoal	Sio, Madang, few Type X	670±60	**699–539**	**1.000**
KBQ/I/3 (152cm)	ANU-4330	charcoal	Sio, Madang, few Type X	340±90	**535–267**	**0.923**
					214–145	0.062
					17–1	0.015
KBQ/I/3 (175cm)	ANU-4329	charcoal	Sio, Madang, few Type X	300±100	**521–250**	**0.775**
					227–133	0.144
					116–70	0.032
					36–2	0.049
KBQ/I/3 (232cm)	ANU-4606	charcoal	Sio, Madang, few Type X	510±60	**653–467**	**1.000**
KBQ/I/4 (260 cm)	ANU-4607	shell	Sio, Madang, few Type X	1500±70	**1216–913**	**1.000**
KBQ/I/5 (303cm)	ANU-4608	shell	Sio, trace Type X, no Madang	1690±90	**1431–1038**	**1.000**
KBQ/I/5 (337cm)	ANU-4609	shell	Sio, trace Type X, no Madang	1810±70	**1517–1235**	**1.000**
KBQ/II/1 (20 cm)	ANU-4335	charcoal	Sio, some Madang and Type X	Modern	*n.a.*	*n.a.*
KBQ/II/2 (62cm)	ANU-4334	charcoal	Sio, Type X, some Madang	400±90	628–603	0.017
					558–284	**0.977**
					166–155	0.007
KBQ/II/3 (99cm)	ANU-4336	charcoal	equal Sio, Type X, Madang	950±70	1044–1039	0.003
					979–723	**0.994**
					716–711	0.003
KBQ/II/3 (109cm)	ANU-4337	charcoal	equal Sio, Type X, Madang	1290±100	**1362–978**	**1.000**
KBQ/II/3 (123cm)	ANU-4338	charcoal	equal Sio, Type X, Madang	1160±90	**1273–930**	**1.000**

mounds in the Primary School area indicated that the deposit was relatively undisturbed. Sample NSW–87 from about 10 cm below the first Type X sherds gave a result of 930–630 cal. BP. By the time of Lilley's visit in 1984, the mounds of the Primary School area had been leveled and dug over for rubbish pits, toilets and school buildings, and Lilley (1986: 144, fig. 5.15) did not conduct further excavations there.

With the exception of ANU-8673 at Paradise Springs and Beta-79346 at FLE, these new results suggest an age range for Type X from about 1100–1000 to 500–400 cal. BP. Re-examination of the original dating evidence supports this shorter duration.

Reinterpreting the Siassi and Huon dates

Here we review the dating evidence for Type X from Lilley's sites at Sio and in the Siassi and Kove Islands, where Lilley (1986, 1988a, 1991, 2002) consistently found Type X sherds associated with sherds of other styles. Our concern here is not with the temporal relationships between Type X and the wares ancestral to the Sio and Madang industries, but with cases where the apparent associations or dates are at odds with what might reasonably be expected or are suggestive of sediment displacement.

The Kove sites, north New Britain (Table 2). The Kove sites in general displayed considerable sediment disturbance, as the date of 890–615 cal. BP (Beta-26262) for two Lapita sherds at FPB (Lilley, 1991: 316) demonstrates. At FCL, Type X and Lapita sherds were also found "in severely disturbed contexts" (Lilley, 1988a: 90). Beta-26260 (1740–1460 cal. BP) for this site, therefore, cannot provide a reliable age for associated cultural materials, or support the claim for the presence of Type X about 1500 years ago (Lilley, 1991: 317). At FPD and FPF only Sio and Madang pottery were recovered. Beta-26264 and Beta-26268 bracket the period 510–290 cal. BP, and suggest that Type X was not present on the Kove Islands after c. 500 cal. BP.

The KLK site, Tuam Island (Table 3). Lilley (2002: 81–84) has discussed the dates for KLK at some length, and that discussion is not repeated here. This site yielded sherds of Lapita, Type Y, Type X and Ancestral Sio, but no Ancestral Madang pottery. The 1983 test pit at KLK produced mostly Type X sherds (Lilley, 1986: 113), and three dates of 980–690 (ANU-3870), 1290–1000 (ANU-3871), and 1115–780 (ANU-3803) cal. BP. Lilley (2002: 83) discounts the lowest sample (ANU-3083) on the grounds that it has probably been displaced downwards. All three results, however, broadly agree with the FNY and FOH dates, and suggest a start for Type X around or just before 1000 cal. BP. In 1984 Lilley (2002: table 2) excavated three trenches (Pits) in which he found Lapita, Type X, Type Y and Ancestral Sio sherds. Pit I had Type X mainly in layers 1 and 2, and only a trace (<10 sherds/m^3) in layer 3 (Lilley, 1986: fig. 8.1; cf. 2002: table 2). Assuming that the few Type X sherds in layer 3 were downwardly displaced, ANU-4612 for this layer places the main concentration of Type X after 1710–1360 cal. BP. Type X was the only pottery present in layer 1 of KLK/I, for which the shell date of 570–320 cal. BP (ANU-4611; Table 3) is almost identical to NSW–86 at KBP at Sio, and slightly younger than Beta-63610 and Beta-79347 at FLE near Kandrian.

In KLK Pit II, Type X occurred in layers 1–3, with only one sherd in layer 4 (Lilley, 1986: 256; not shown in Lilley, 2002: table 2). Layer 4 has a date of 3010–2600 cal. BP (ANU-4617) that is consistent with the presence of Lapita sherds in this layer, but is clearly too old for the Type X sherd, which must be vertically displaced. This may also apply to the Type X sherds in layer 3 (c. 50 sherds/m^3), which has two dates. The lower date of 1635–1300 cal. BP (ANU-4616) and the upper one of 1450–1140 cal. BP (ANU-4615) are both older than the revised starting date for Type X proposed above. Most Type X sherds in Pit II were from layer 2 (c. 100 sherds/m^3) and layer 3 (c. 180 sherds/m^3). Layer 2 is dated to 510–280 cal. BP (ANU-4614). On the basis of the shallow depth of this sample and its overlap with ANU-4611 for layer 1 in trench I, Lilley (2002: 83) suggests that the sample could have been moved downwards. If this is correct, then ANU-4614 may represent deposition after Type X.

Layer 3 of Pit III had low frequencies (<50 sherds/m^3) of Lapita, Type X and Ancestral Sio sherds (Lilley, 1986: 256, figure 8.3). The date of 2530–2110 cal. BP (ANU-4619) is too old for both Type X and Ancestral Sio, and suggests downwards displacement of these sherds from layer 2. Layer 2 had only a trace (<10 sherds/m^3) of Lapita but more Type X (c. 75 sherds/m^3) and Ancestral Sio (c. 25 sherds/m^3). This layer is dated 1260–960 cal. BP (ANU-4618), which is in line with the FNY and FOH evidence.

The KLJ site, Malai Island (Table 3). Lapita pottery was not present in KLJ but Type X, Ancestral Sio and Ancestral Madang sherds occurred throughout Pits I and II excavated in 1984. Considerable disturbance is indicated by the profile drawing for Pit I (Lilley, 1986: fig. 5.11), and the "Modern" results for samples from Pits I and II taken at 191cm and 182cm below surface support this. These two pits, therefore, are useless for dating Type X or any other pottery style. Of more interest are the six dates from the 1983 test pit (KLJ/TP), where the three pottery styles occurred throughout the deposit. While there is some stratigraphic inconsistency in the results, especially for ANU-3819, the others fall within the last 700 years cal. BP and provide general support for the results from FLE and KLK/I layer 1. We note that whereas KLK lacked Ancestral Madang pottery and its youngest dates (ANU-4611, ANU-4614) are in the 570–280 cal. BP range, only one sample (ANU-3800) at KLJ places Ancestral Madang pottery earlier than this.

The KBQ site, Sio (Table 4). Type X occurred in trace quantities (<20 sherds/m^3) in all layers of Pit I, but was particularly scarce in layer 5 (Lilley, 1986: fig. 8.26). If we accept layer 4 as the earliest possible start of Type X, then it began here around 1220–910 cal. BP (ANU-4607). There are five dates for layers 2 and 3, for which the age ranges with the highest probability values all fall within the last 750 years.

Pit II had a trace of Type X (<20 sherds/m^3) in layer 3, for which three samples date its top, middle and base. The lowest sample (1270–930 cal. BP; ANU-4338) is slightly younger than the middle one (1360–980 cal. BP; ANU-4337), but their ranges overlap substantially and place Type X at not earlier than 1360–930 cal. BP. The top sample (ANU-4336) has a range of 980–720 cal. BP. More Type X sherds (c. 50 sherds/m^3) occurred in layer 2, which is dated to less than 600 cal. BP (ANU-4334), comparable with the NSW–86 result from 1972 for a disturbed context at KBP. Layer 1 has more Type X (c. 80 sherds/m^3), but the date for this layer is Modern.

Taken together, the KBQ samples support the age range for Type X indicated by the Arawe, Kandrian and Siassi sites.

Discussion

As is common in coastal Pacific sites on calcareous sands, the excavated Type X locations display degrees of sediment disturbance resulting in the vertical displacement of sherds and presumably mixing of artefacts and dating materials. Coupled with the issue of plateaux in crucial parts of the calibration curve, and the uncertainty about appropriate ΔR values for marine shell samples, this creates a situation where the dating of pottery styles occurring together must be treated with caution. This does not necessarily mean that we should reject all dates from layers with several pottery styles as they may belong to different periods, but that perhaps more importance should be placed on those contexts where a particular style occurs by itself, or its first appearance is well controlled stratigraphically. For Type X, this means that perhaps the dates for FLE, FNY and KLK/I layer 1 are the most reliable. Slightly less reliable, but not inconsistent with the picture drawn from these three sites, are the dates for layers where Type X is present at more than trace levels (>20 sherds/m^3) and sherds of other styles are present, and where the dates do not suggest severe sediment disturbance. Finally, samples yielding short calibrated ranges (e.g., 150–250 years) are more useful for defining a sample's age than those with longer ranges (e.g., 400–600 years) (Kirch, 2001: 220). Using these criteria, we provisionally revise the Type X chronology to about 1000–500 cal. BP with both ends of this range requiring refinement, particularly as we do not know whether the beginning and end of Type X were part of a process or an event. Moreover, the stylistic diversity currently embraced by Type X needs to be related to both temporal and spatial factors (Specht *et al*., 2006).

This revised dating for Type X may require adjustments to the dating of other post-Lapita pottery styles of Huon Peninsula and the adjacent islands, though we do not explore this issue here. The revision also possibly extends the period when pottery was not used in the Huon Peninsula-Siassi Islands region. Although creating a longer gap in the sequence has its own problems, doing so would make the Huon/Siassi dates fit better with those for post-Lapita pottery on other parts of the north New Guinea coast and offshore islands, all of which are later than the Huon/Siassi interpretations published to this point. At site JCB on Arop (Long) Island to the north of Sio, the oldest of three palaeosols on the Biliau Beds is dated 1150–780 cal. BP (ANU-1308, charcoal), though the Type X sherd found on the beach there might have come from a younger palaeosol (Egloff & Specht, 1982: 428–429). At site JAB, also on Arop, a calibrated date on charcoal (ANU-1307) associated with possible Ancestral Madang pottery falls between 520–290 cal. BP (Egloff & Specht, 1982: 442). Around Madang, three charcoal dates for Ancestral Madang pottery at site JCA yielded results between 720–420 and 400–320 cal. BP (Egloff, 1975: 14). Type X is not represented in these sites, but given its apparent association with early occurrences of Ancestral Madang pottery on Huon Peninsula and the Siassi Islands, the three Madang dates do not conflict with the revised dating for Type X proposed above. In the Wewak area to the west of the Sepik River, pottery with rim profiles similar to those of Type X may be dated to around 700 BP (Terrell, pers. comm. 2005). Other pottery finds reported from the Wewak area and adjacent islands (e.g., Bulmer, 1971; Borrell, 1976) are undated and do not resemble Type X forms. The dating of pottery from sites in the lower Ramu River area is problematic (Swadling, 1997: 9–10; Spriggs, 2001: 238–239), but the sherds are not like Type X (Swadling, 1997: fig. 6, and pers. comm.). Further west from Wewak, Fichin ware from the Vanimo area and Sumalo ware found near Aitape are somewhat older than and also differ stylistically from Type X (Gorecki, 1992; Terrell & Welsch, 1997: fig. 3). In summary, slender though the evidence is for the north coast to the west of Huon Peninsula, it does not conflict with the revised dating for Type X proposed here.

In his original description of Type X, Lilley (1988a: 94) drew general comparisons between the appearance of Type X and Yap Laminated ware in western Micronesia, though at that time Yap Laminated ware was insecurely dated. More recent work has shown that this Laminated ware began around 600 cal. BP, towards the end of Type X, and continued into the twentieth century (Intoh, 1990: 44, 1992; Descantes, 2001). Apart from this Yapese pottery being later than Type X, its laminated nature is now regarded as the result of the production and firing processes (Intoh, 1990: 47), and the rim forms do not resemble those of Type X (Specht *et al*., 2006). The superficial resemblance between Type X and Yap Laminated pottery, therefore, should be disregarded. Type X is stylistically and technologically closer to Palauan pottery beginning about 1000 years ago or slightly earlier (Specht *et al*., 2006; Clark, 2005). These similarities in age, style and technology suggest that Type X might be derived from or related to this Palauan pottery (Specht *et al*., 2006).

The shorter chronology for Type X has implications for the history of trade across Vitiaz Strait, with the movement of goods across the Strait beginning later than 1600 cal. BP, as originally proposed (Lilley, 1986, 1988b, 2004). There is an obvious problem here with the archaeological invisibility of "soft" goods such as those that were moved through the historically known trading network (Harding, 1967, 1994), and which might have been included in the past. Currently, we have no means to identify such "soft" goods in the archaeological record, and they remain part of the "the ever-present missing record" (Green & Kirch, 1997: 30–31). The burden of evidence for trade across Vitiaz Strait thus rests on "hard" goods such pottery and stone artefacts, but secure dating of this evidence requires resolution of issues about the nature of samples and their stratigraphic associations, and the calculation of local ΔR values for marine shell samples that address local seawater conditions, the feeding behaviour of molluscs, and the variation of ΔR values through time (cf. Kirch, 2001: 219–220; Clark, 2004; Petchey *et al*., 2004). The presence of plateau regions on the calibration curve around the time of the beginning and end of Type X further complicates the issue. Thus, while the dating of Type X pottery is revised to about 1000–500 cal. BP, this range may require adjustment in the light of further research.

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