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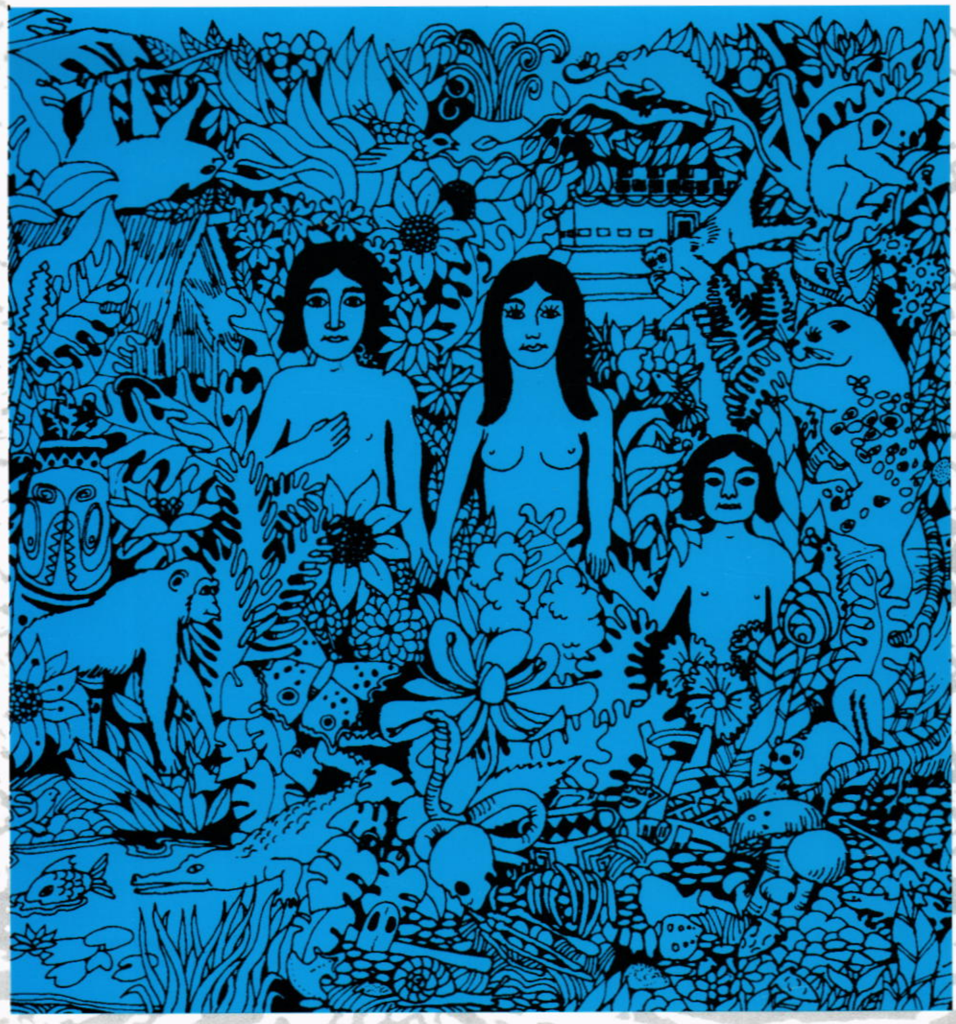

FIFTY YEARS IN THE FIELD. ESSAYS IN HONOUR AND CELEBRATION OF RICHARD SHUTLER JR'S ARCHAEOLOGICAL CAREER

Edited by Stuart Bedford, Christophe Sand and David Burley

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NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION MONOGRAPH

OBSIDIAN, COLONISING AND EXCHANGE

Jim Specht

INTRODUCTION

Among the many finds at Site 13 (WKO013) in New Caledonia was a single piece of obsidian about which the excavators commented that it "is significant because there is no known source of obsidian on New Caledonia" (Gifford and Shutler 1956:67). In the 50 years since that discovery, additional finds of obsidian in New Caledonia have been sourced to the Willaumez Peninsula region of New Britain, about 3000km to the north in the Bismarck Archipelago of Papua New Guinea (Ambrose 1976:Table 2; Sand and Sheppard 2000). Obsidian from sources in the West New Britain and Manus Provinces of the Bismarck Archipelago is now recognised as a regular component of Lapita assemblages of Near Oceania and in the Santa Cruz-Reef-Tikopia islands on the margin of Remote Oceania (Fredericksen 1997), with small quantities also being reported from Vanuatu (Ambrose 1976:Table 2) and Fiji (Best 1987), as well as in New Caledonia (Figures 1-2). This widespread distribution and the presence of other exotic materials in many sites have led to proposals about the movement of goods through exchange networks in Near and Remote Oceania during the Lapita period (see review by Green and Kirch 1997).

This paper to honour one of the discoverers of that first flake at Site 13 explores some aspects of the obsidian component of these hypothesised networks within the

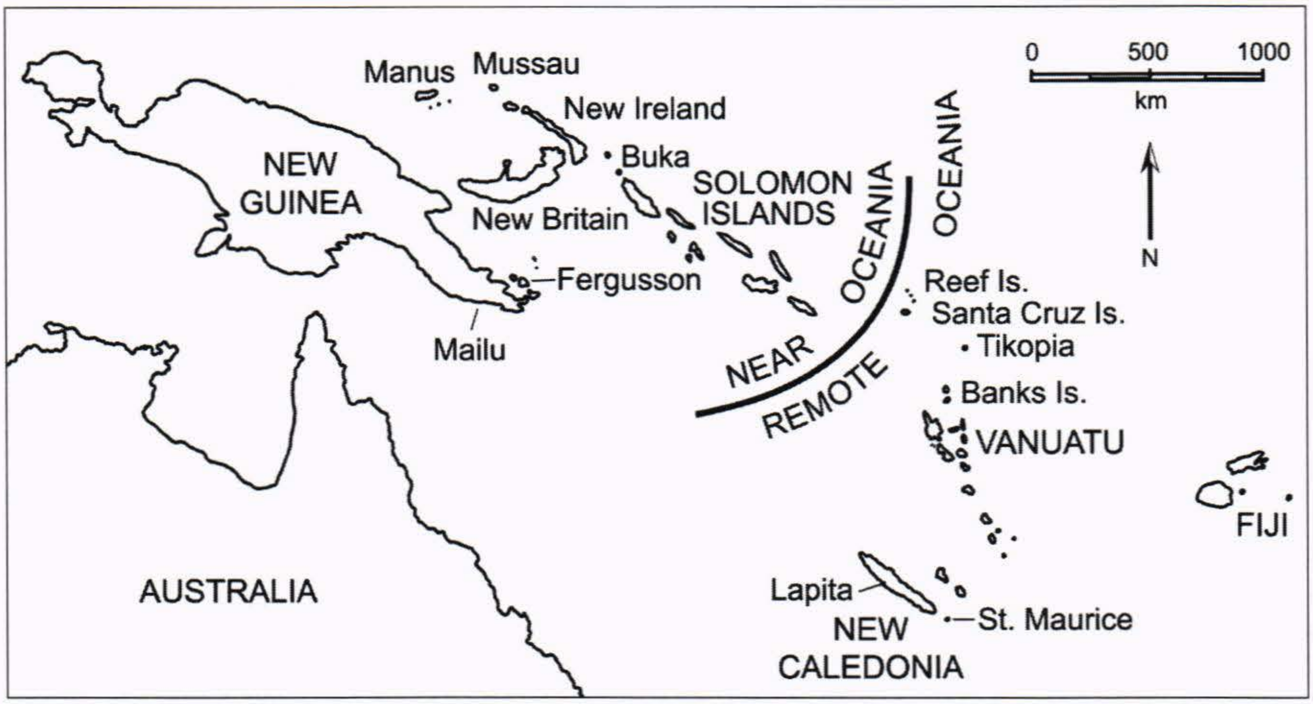

FIGURE 1. Map of the western Pacific showing the location of the main islands and sites mentioned in the text, other than those in the Bismarck Archipelago.

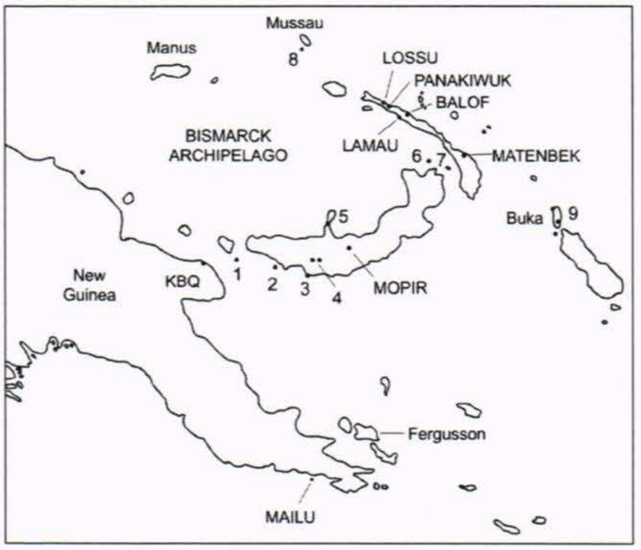

FIGURE 2. Map of the Bismarck Archipelago showing the location of sites and islands mentioned in the text. For the site codes, see Tables 1-3.
1. Siassi Islands: KLK, KLM; 2. Arawe Islands: FNY, FOF, FOJ; 3. Kandrian: FFT, FLE, FLF, FLQ; 4. Yombon: open sites, FHC, FYT; 5. Willaumez Peninsula: FAO, FCH, FDV, FDY, FEA, FRI, FRL, FAAY, FABK, FABN, FABO, FABT, FACC, Kulu
6. Watom: SAB, SAC, SAD, SAU, SDI; 7. Duke of Yorks: SDK, SDP, SDQ, SEE, SEO, SES/SET; 8. Eloaua: EHM, EKO, EKP; 9. Buka-Sohano: DAA, DAF, DJO, DJQ, DJW.

framework of a proposal by Irwin (1991:506; cf. Irwin and Holdaway 1996) regarding the nature of material availability and use in an initial colonising phase. It takes as its starting point Sheppard's (1993) study of Lapita obsidian assemblages in the Reef-Santa Cruz area, some 2000-2500km distant from the Bismarck sources. Sheppard (1993:123) applied a resource maximising model in which "with increasing distance from source and/or decline in supply, people should use the lithic materials more intensively". He concluded (1993:134-135) that, while the quantity of obsidian reaching the sites declined through time and there were changes in the size of cores and debitage, distance and material scarcity had a minor influence on the reduction process and discard behaviour. He attributed this to a "complex commodity value history" where value was maximised in social terms at the point of acquisition. Actual consumption, however, was "according to another set of commodity (utilitarian) values". Thus, the archaeological record reflects "only the mundane commodity part of the game and not the big picture where differential access and social economizing may have played an important role". Sheppard situated his results within Kirch's view (1988:113) of the exchange networks as a "lifeline" back to the homeland communities as a strategy to minimise risks "in the event of unpredictable environmental hazards (drought or cyclone), or to augment demographically small and unstable groups with marriage partners". For Kirch (1988:104), long-distance exchange was "an essential component of the Lapita dispersal and colonization strategy". Green (1976:258) had previously proposed that long-distance exchange permitted "the continuance in the Reef-Santa Cruz area of a cultural adaptation more in keeping with the physical resources of the larger continental islands to the west". He later suggested (1987:246) that Lapita people in the Reef-Santa Cruz area chose to import Bismarck obsidian as "a luxury and status-maintaining item with social and ideological significance" rather than rely on the closer sources in the Banks Islands that represented "a less prestigious import from a non-homeland community". These ideas of exchange as a lifeline and way of maintaining a cultural adaptation, and of obsidian as an item valued for status and prestige now sit at the core of writings about Lapita exchange networks.

Sheppard (1993:135) saw the need to place the Reef-Santa Cruz obsidian in a comparative framework, though at the time he could only refer to the small assemblage from Tikopia studied by McCoy (1982), who had also found little evidence for resource maximisation. Goulding's (1987) comparison of obsidian reduction at two Lapita sites in New Britain (Boduna near Talasea and Paligmete in the Arawe Islands) had found little difference between them, which was not surprising given Paligmete's relative proximity (~ 150km) to the Willaumez sources. Following Sheppard's publication, Halsey (1995) compared obsidian from the Makekur Lapita site, also in the Arawe Islands, with his results, and concluded that obsidian was treated in similar ways in the two areas, despite one being far from the sources. Such similarities and the lack of clear evidence for resource maximisation at points close to and distant from the sources raise the question whether there was a distinctively Lapita pattern of obsidian usage, irrespective of location or distance to sources.

Irwin and Holdaway (Irwin 1991; Irwin and Holdaway 1996) took the comparisons a step further in the study of obsidian at Mailu on the south coast of Papua during the post-Lapita period. In the colonising phase (c.2000-1750 B.P.), discarded obsidian pieces were up to four times heavier than in later periods when the amount imported was greater in absolute terms. Irwin suggested (1991:506; Irwin and Holdaway 1996:228) that "the initial thrust of colonisation could carry a pulse of a valuable non-bulky item, like obsidian, along with it to its early limit". This "pulse" might have been "incidental to high frequency of communication among related communities undergoing a phase of expansion," though "we cannot tell if these early imports were part of a reciprocal exchange" (Irwin and Holdaway 1996:233). Irwin and Holdaway (1996:232) suggested that early Mailu could be viewed as an analogue for the colonising phase of Lapita, especially in Remote Oceania. In both areas, the episodes of colonisation might have been "on-going processes lasting perhaps a few human generations".

This proposal for Mailu as an analogue has yet to be taken up in discussions of Lapita exchange networks. If it has value, then we should expect a "pulse" of obsidian in the earliest Lapita sites of a region expressed in the form of larger pieces than in later periods, as Sheppard noted for the Reef-Santa Cruz sites. A distinction between sites with large or small pieces of obsidian might then allow recognition of some sites as part of a colonisation front. Is there such a pattern among Lapita sites? To answer this question, we need comparative data from more Lapita sites, as well as from sites before and after Lapita.

	Count	Weight	Mean wgt	Distance (NB)
Zone 1				
WILLAUMEZ PENINSULA				
Bamba - FCH-FDV - flakes	62	663.4	10.2	
Bamba - FCH - cores	21	1352.2	64.4	
Bitokara - FDV, FDY - cores	7	2560.6	365.8	
Bitokara - FRL	864	4329.0	5.0	
Garua Island - FAO	1770	5344.4	3.0	
Zone 2				
WILLAUMEZ PENINSULA				
Walindi - FRI layer 5	22	62.7	2.9	30 (l)
Numundo - FABO	71	63.9	0.9	35 (l)
Numundo - FABK	141	225.6	1.6	40 (l)
Garu - FABN	12	92.4	7.7	45 (l)
Numundo - FAAY	25	45.0	1.8	50 (l)
Haella - FACC	60	48.0	0.8	55 (l)
Tili - FABT	4	4.8	1.2	65 (l)
Kulu	24	40.8	1.7	70 (l)
Zone 3				
ARAWE ISLANDS				200-300 (s+l)
Lolmo - FOF unit 5	148	84.5	0.6	
KANDRIAN				220-240 (s+l)
Alanglongromo, lumiello - FLF	189	112.0	0.6	
Alanglong, lumiello - FLQ/II	15	12.5	0.8	
Misisil - FHC/II	8	10.2	1.3	280-300 (s+l)
Yombon (6 sites)	107	65.4	0.6	280-300 (s+l)
NEW IRELAND				
Matenbek 18-20,000 b.p.	14	n/a	86% <1.00	360 (s+l)
Matenbek 6-9,000 b.p.	291	n/a	93% <1.00	
Zone 4				
NEW IRELAND				
Balof 1-2	23	32.3	1.4	760 (s+l)
Panakiwuk	1	0.6	n/a	840 (s+l)

The Bamba and Bitokara samples are undated collections assigned to this period on the basis of comparisons with dated samples elsewhere in the region. In the Distance column, 'NB' indicates New Britain sources; '(l)' is 'land only' distance; '(s+l)' is combined sea and land effective distance.

Arawe Islands: Gosden *et al.* 1994. Kandrian: Pavlides 1999; Specht unpub. data. Willaumez Peninsula: Araho 1996; Torrence and Summerhayes 1997; Symons 2001; Specht unpub. data. New Ireland: Downie and White 1978; White *et al.* 1991; Marshall and Allen 1991; Summerhayes and Allen 1993

TABLE 1. Obsidian from pre-Lapita contexts.

THE APPROACH AND THE DATA

Ideally, the comparisons should address quantities of obsidian imported, distance from sources, reduction processes, and use and discard patterns. Finding suitable measures for the comparisons, however, is hindered by the lack of consistency in the ways various authors have presented their data (Allen and Bell 1988:97-98), and the lack of controlled sampling at most sites (Sheppard 1993:135). Green (1991:Tables 1 and 2) presents a range of comparative data for the obsidian at his Reef-Santa Cruz sites, but some of these (e.g. frequency per cubic metre of excavated deposit) cannot be calculated for most other sites. Fredericksen (1997:383-385) used frequency of obsidian per excavated square metre, but was still limited in the number of sites available for his study. The only widely available data relate to numbers of obsidian pieces and their weight, from which the mean weight per piece can be calculated. This approach is not without problems, for it ignores the complex range of factors that influence the amount discarded or recovered archaeologically (Renfrew 1977:73; Torrence 1986:122-128), and the possibility of functional differences between sites (Fredericksen 1997:384). While these difficulties are acknowledged, mean weight is adopted here as a proxy for the relative abundance and patterns of reduction of obsidian in each site. Some support for this comes from Irwin and Holdaway (1996:232), who noted at Mailu that changes through time in several technological classes tended to support those seen in "more simple measures of artefact weight and frequency".

I have collected data from as many sites as possible with obsidian known to originate from sources in the Bismarck Archipelago and for which there is some indication of age (see Tables 1-3; Figs. 1-2). The sites range from the late Pleistocene to the second millennium A.D., and from Sabah in the west to New Caledonia in the south. A selection of sites on Willaumez Peninsula is included to provide a "snapshot" of obsidian use close to sources. Similarly, Table 3 includes the post-Lapita site of Pakea of northern Vanuatu (Ward 1979), where the obsidian derived from local Banks Islands' sources (Bird *et al.* 1981:78), to see whether this proximity is reflected in the mean size of the obsidian pieces. At the Bukit Tengkorak site in Sabah, obsidian originated both from the distant Willaumez

	Count	Weight	Mean wgt.	Distance (NB)	Distance (M)
Zone 1					
WILLAUMEZ PENINSULA					
Boduna - FEA (1985) all levels	161	568.5	3.5		
Boduna - FEA (1989) - layer 4	146	314.4	2.2		
Zone 3					
SIASSI ISLANDS				260 (s)	420 (s)
Tuam - KLK/I	n.a.	n.a.	2.7		
Tuam - KLK/II-III	n.a.	n.a.	0.9-1.3		
ARAWE ISLANDS				200-300 (s+l)	540 (s)
Makekur - FOH - Late Lapita	809	1051.5	1.3		
Makekur - FOH - Lapita	806	2083.0	2.6		
Lolmo - FOF units 3-4	328	172.1	0.5		
Paligmete - FNY	502	267.3	0.5		
KANDRIAN				220-240 (s+l)	600 (s)
Langpun, Apugi Island - FFT/I-IV	2579	846.1	0.3		
Alanglongromo, Iumiello - FLF	254	126.7	0.5		
Misisil - FHC/II - Lapita equivalent	10	14.0	1.4	280-300 (s+l)	
Yombon (5 sites) - Lapita equivalent	88	39.8	0.5	280-300 (s+l)	
WATOM ISLAND				260-280 (s)	580-960 (s, s+l)
Kainapirina - SAC/I-II zone C2	238	248.0	1.0		
Maravot - SAD/III, IV, V, VIII, IX	1045	1708.5	1.6		
Vunailau - SAU	33	53.8	1.6		
Vunavaung - SDI	46	77.0	1.7		
DUKE OF YORK ISLANDS				300-320 (s)	580-960 (s)
Urkuk - SDK	11	7.4	0.7		
Kabilomo - SDP	114	216.3	1.9		
Palpal - SDQ	17	7.9	0.5		
Kabakon - SEE	57	16.6	0.3		
Uraputput - SEO	113	52.6	0.5		
Nakukur - SES/SET	10	7.0	0.7		
NEW IRELAND					
Lamau - levels 2, 3 Lapita?	50	25.5	0.5	300-460 (s, s+l)	500-660 (s, s+l)
Eloaua - EKO	37	20.4	0.6	480 (s)	280 (s)
Zone 4					
NEW IRELAND					
Balof 1-2 - Lapita equivalent	26	10.7	0.4	760 (s+l)	460-540 (s+l)
BUKA ISLAND					
Sohano - DAA reef	12	19.6	1.6	590-680 (s+l)	900-1000 (s)
Sohano - DAF reef	334	830.7	2.5		
Sohano - DAF land	13	15.1	1.2		
Kessa - DJQ reef	11	18.7	1.7		
Zone 5					
SE SOLOMONS				~2000 (s)	~2500 (s)
Nanggu - SZ-8	335	864.5	2.6		
Nenumbo - RF-2	642	1315.2	2.1		
Ngamanie - RF-6	28	48.6	1.7		
NEW CALEDONIA				~3000 (s)	
Lapita WKO013/13a	2	3.6	1.8		
St Maurice/Vatcha KVO003	4	1.3	0.3		

In the Distance columns, 'NB' indicates New Britain sources, 'M' indicates Manus; '(s)' is 'sea only' distance; '(s+l)' is combined sea and land effective distance. Siassi Islands: Lilley 1986. Arawe Islands: Goulding 1987; Gosden *et al.* 1994; Halsey 1995. Kandrian: Pavlides 1999; Specht unpub. data. Willaumez Peninsula: Goulding 1987; Torrence and Summerhayes 1997; Specht unpub. data. Watom Island: Anson 2000; Hanslip unpub. data; Specht unpub. data. Duke of Yorks: White 1995. New Ireland: White 1992; Downie and White 1978; White *et al.* 1991; Weisler 2001. Buka Island: Wickler 2001. SE Solomon Islands: Green 1991; Sheppard 1993. New Caledonia: Gifford and Shutler 1956; Sand and Sheppard 2000.

TABLE 2. Obsidian from Lapita pottery sites and sites of equivalent age.

Peninsula sources and from local sources in the Indonesian archipelago (Bird 1989). The published data provide the mean weight per piece, irrespective of source (Bellwood 1989:149; Bellwood and Koon 1989:620). For Matenbek on New Ireland, the authors provide only the percentage of pieces weighing less than one gram (Summerhayes and Allen 1993:146). Standard deviations to allow assessment of size variability within each collection are not included, as they are rarely available (e.g. Halsey 1995:60, 65; Sheppard 1993:Tables 4 and 6; Symons 2001:Table 5.4, Fig. 5.4).

Calculation of distance is problematic, for we do not know the routes along which obsidian was transported. Distance is calculated, therefore, as the "effective distance" in which the shortest distance by sea or combination of sea and land is used, with the land component multiplied by two to compensate for topographical variation (Torrence 1986: 18, 122-123; cf. Renfrew 1977:72). Table 1 refers only to New Britain, as no Manus material has yet been reported outside the source region before the appearance of Lapita pottery (Fredericksen 1997:379-380). Tables 2-3 provide estimates of effective distance between sites and both source regions. The three tables group the sites in five arbitrary zones, using Talasea on Willaumez Peninsula as the base point. Zone 1 (0-10km) covers samples from sites within the Willaumez Peninsula source region. Zone 2 extends from 10km to 200km, and Zone 3 from 200km to 500km. Zone 4, from 500km to 1000km, extends to Buka Island. Zone 5, between about 1000km and 3750km, includes the Reef-Santa Cruz sites, New Caledonia and Sabah. Where a site has obsidian from only one source region, the distance to this source is given.

The data in Tables 2 and 3 do not permit calculation of mean weights according to source region. We can be reasonably confident that obsidian at sites within a source region originated there (but see Torrence and Summerhayes [1997:Table 3] for Mopir obsidian in the Willaumez Peninsula area). On the south side of New Britain, both Willaumez and Mopir sources are represented, but Mopir obsidian is never present in large quantities (Summerhayes *et al.* 1998:Tables 6.4 to 6.6) and for most sites listed there is little difference in the effective distance to the source regions. Manus sources dominate at some sites, such as Lossu on New Ireland (Bird *et al.* 1981:74) and on Buka and Sohano Islands (Wickler 2001:178, Table 7.5). In the Reef-Santa Cruz sites of the southeast Solomons, three source regions are represented (Willaumez Peninsula, Manus and Banks Islands; Green and Bird [1989] also report a single piece possibly from Fergusson Island). Willaumez Peninsula sources account for 97.5% of all obsidian analysed (Green 1987:242; Sheppard 1992:147). For Watom Island, SAD is included despite known stratigraphic difficulties (Specht 1968:122-125), as part of this area probably represents a Lapita expression contemporary with that of zone C2 at SAC and the lower levels of SDI (Green and Anson 2000:85).

Tables 1-3 present the data in three periods: pre-Lapita, Lapita and post-Lapita, arranged in distance zones. Allocation to the Lapita period is made on the presence of dentate-stamped decorated pottery and ^{14}C dates between about 3350 and 2600 cal.B.P.. Site SAB and Zone C1 at SAC on Watom are assigned to the post-Lapita period on the basis of dates for SAC and pottery for SAB. For Walindi (FRI), Layers 1-3 are assigned to the post-Lapita period on account of the late dates (Specht and Gosden 1997: Appendix 1), though several sherds were recovered from Layer 3. At some sites, such as Lamau and in the Duke of York Islands (White 1992, 1995), it is not clear whether a particular level belongs to one period or another, and a best estimate is used to allocate them. Some contexts without Lapita pottery are included in Table 2 as "Lapita equivalent", indicating that the obsidian was deposited during the period of Lapita pottery.

RESULTS

In the pre-Lapita period, there are few sites and none beyond the Bismarck Archipelago (Tables 1, 4). The Zone 1 localities have the highest values for any zone or period; those for FCH, FDV and FDY are essentially surface collections from sites associated with the production of bifacially flaked stemmed tools (Araho 1996; Torrence *et al.* 2000). The means at FRL and FAO are lower because these are excavated samples that include shatter and small trimming flakes; the largest piece in the FRL sample weighs about 30g (Symons 2001: Table 5.4). Only two Zone 2 sites have means approaching those of Zone 1; the other six are essentially the same as those for Zones 3-4. There is, then, a general fall-off in mean size beyond Zone 1.

During the Lapita period (Tables 2, 4), the picture changes with the inclusion of Zone 5 (Lapita sites occur in Zone 2, but relevant data are not currently available). The highest mean value occurs at the disturbed site on Boduna Island near the Willaumez sources (Ambrose and Gosden 1991; White *et al.* this volume). The 1985 figures relate to the total trench finds, whereas those for 1989 represent only the less disturbed basal layer. With the exception of Boduna, Tuam-KLK/I, and Makekur, Zone 3 sites have means similar to those of the pre-Lapita period. KLK/I and the main Lapita level of Makekur, on the other hand, have values similar to Nanggu (SZ-8) in the Reef-Santa Cruz Islands in Zone 5, while Nenumbo (RF-2) is only slightly less than the lower end of the Boduna range. The Sohano DAF reef sample (Zone 4) has a mean weight similar to Boduna, KLK/I, Makekur and SZ-8, though this may reflect collecting bias or size sorting by wave action on the reef. Overall, six Lapita sites have means exceeding 2g, and only one of these lies within Zone 1. The few "Lapita equivalent" samples fall within the middle to lower Lapita range, suggesting that these sites had similar access to obsidian as those with Lapita pottery.

In the post-Lapita period, there are no sites listed for Zone 1. For Zones 2-5, there is a change towards uniformly small mean weights irrespective of distance from sources, with only five samples reaching or exceeding 1g (Table 3). The highest value of 1.5g (at EHM, where the two flakes both came from the Lou Island source in Manus Province, see Weisler 2001:147) is more than 1g less than the six highest in the Lapita period. Even at Pakea, which is within a few kilometres of the Banks Islands sources and located within the equivalent of Zone 1 on Willaumez Peninsula, the mean weights are 1.7g or less.

Table 4 summarises Tables 1-3 as mean weight ranges by distance zones (excluding Pakea). In the pre-Lapita period, there is a marked fall-off in mean values beyond Zone 2, but during the Lapita period the upper end of the ranges is consistently high at 2.5g or more irrespective of zone. For Zones 3 and 4, this upper end is around twice the size of the same zones before and after Lapita. The small ranges for Zones 3 and 4 in the post-Lapita period resemble those of the pre-Lapita period. The overall similarity between the lower ends of the ranges in all periods probably reflects the smallest size to which obsidian can be reduced and still have some utility (cf. Irwin 1991:506).

DISCUSSION

The imprecise dating of most Lapita sites generally hinders identification of those that may represent an initial colonising phase. Some sites are not dated or are not datable, or have insufficient age determinations to tie down their chronology with any confidence. The oldest Lapita levels in the Bismarck Archipelago listed here may be Boduna and Alanglongromo (Specht and Gosden 1997:Appendix 1), EKO on Eloaua (Weisler 2001:150), and Makekur (Summerhayes 2001a:55, 2001b:115, 2001c:Table 3). While Boduna and Makekur have high mean weights, those for Alanglongromo and EKO are at the lower end of the range, similar to younger sites in the Bismarck Archipelago; both are rock shelters where the activities requiring obsidian might have differed from those at open sites. Makekur is currently the only site in the Archipelago where it is possible to compare obsidian across two stages of Lapita, and here there is a decline in mean weight through time. Further south, the Buka-Sohano collections are not dated, but the dominance of Manus obsidian suggests an age within the range of Western (Middle) Lapita in the Bismarck Archipelago, where some sites of this period show a prominent occurrence of Manus sources at that time (Summerhayes 2001c:31). This is consistent with the stylistic attribution of the Buka-Sohano reef pottery to the Western (Middle) Lapita of the Bismarck Archipelago (Wickler 2001:127-129). While DJQ may be slightly older than DAF, they are more or less of the same age (Wickler 2001:121) and may represent the early Lapita presence in this area. In the Reef-Santa Cruz islands, Nanggu (SZ-8) and Nenumbo (RF-2) are slightly younger than Boduna and Makekur but are the oldest in the area (Green 1991; cf. McCoy and Cleghorn 1988), and may represent the colonising phase there. The younger site of Ngamanie (RF-6) has the lowest mean weight of the three sites. Limited as this evidence is, the mean weight of obsidian at six Lapita sites (Boduna, KLK/I, Makekur, DAF, SZ-8 and RF-2) that appear to be early in their local contexts are heavier than those at later Lapita sites and in most areas before and after Lapita, irrespective of distance from the sources. There is, then, some support for Irwin's "pulse".

While the higher mean weights in these sites may reflect their primacy in the Lapita colonising process, they may also indicate that these sites had access to larger quantities of obsidian than others, or that their supply was more assured. Lapita sites do not occur in ones and twos. In areas where intensive surveys have been carried out, there may be 10 or more sites with Lapita pottery in a relatively small area (Anderson *et al.* 2001); for example, Mussau (Kirch 2001), Duke of Yorks (Lilley 1991; Thomson and White 2000); Willaumez Peninsula/Talasea (Specht *et al.* 1991); Arawe Islands (Gosden 1989; Summerhayes 2000); Kandrian (Specht unpub. data); Anir (Summerhayes 2001a, 2001c); Buka (Wickler 2001); and the southeast Solomons (Green 1976, 1991; McCoy and Cleghorn 1988). Green (1991:201) has suggested that the Lapita sites in the southeast Solomons represent settlements of different periods, with five (SZ-8, layer VII of SZ-33, the basal layers of SZ-45 and SZ-47, and RF-2) roughly contemporary and somewhat earlier than RF-6 and layer VI of SZ-23. A similar situation holds for the Mussau area (Kirch 2001:Fig. 10.16) and the Arawe Islands and Anir group (Summerhayes 2001a, 2001c), and presumably elsewhere. As populations increased, there would have been splitting of communities and establishment of new settlements. The parent communities might have operated as distribution centres to the newer ones in their vicinity. Regular supplies meant that there was no need for these centres to maximise the reduction of each block, but sites at other points in the distribution had less assured or smaller supplies, so that more care was taken in the use of the blocks reaching them. Tempting as this idea may be, it cannot be tested, as the chronology of most sites is too poorly defined to identify contemporary sites that might have participated in such distribution networks.

In the Bismarck Archipelago and north Solomons, where there were clearly populations prior to Lapita pottery, some locations with Lapita pottery might have been non-Lapita communities that received pottery and obsidian, among other

	Count	Weight	Mean wgt	Distance (NB)	Distance (M)
ZONE 2					
Willaumez Peninsula					
Walindi - FRI layers 1-3	437	396.4	0.9	30(l)	
ZONE 3					
NEW GUINEA MAINLAND					
Sio - KBQ	4129	2200.0	0.5	300 (s)	
SIASSI ISLANDS				260 (s)	
Tuam - KLK/I-III	n/a	n/a	0.6-1.2		
Malai - KLJ	3271	3400.0	1.0		
ARAWE ISLANDS				200-300 (s+l)	540 (s)
Lolmo - FOF units 1-2	151	91.1	0.6		
Paligmete - FNY	267	348.2	1.3		
KANDRIAN				220-240 (s+l)	600 (s+l)
Alanglongromo, Iumiello - FLF	83	43.2	0.5		
Alanglong, Analo - FLQ/II-III	137	110.3	0.8		
Awakuo, Iumiello - FLE	76	45.9	0.6		
Misisil - FHC/II	130	109.9	0.9	280-300 (s+l)	
Hauwauyang - FYT	6	2.5	0.4	280-300 (s+l)	
Yombon (6 sites)	183	165.7	0.9	280-300 (s+l)	
WATOM ISLAND				260-280 (s, s+l)	580-960 (s, s+l)
Kainapirina - SAC/I-II zone C1	318	279.8	0.9		
Vunaburigai - SAB	36	28.6	0.8		
DUKE OF YORK ISLANDS				300-320 (s, s+l)	580-960 (s, s+l)
Kabilomo - SDP/1-2	310	136.2	0.4		
Kabakon - SEE	93	40.4	0.4		
NEW IRELAND					
Lossu - Mounds I, V and VI	1254	304.0	0.2	340-430 (s+l)	540-700 (s+l)
Lamau - level 1	35	11.6	0.3	300-460 (s, s+l)	500-660 (s, s+l)
Eloaua - EHM	2	3.0	1.5		280 (s)
Eloaua - EKP	8	3.4	0.4	500 (s)	280 (s)
ZONE 4					
NEW GUINEA MAINLAND					
Eastern Highlands - various sites	30	21.9	0.7	750-800 (s+l)	
NEW IRELAND					
Panakiwuk	9	2.5	0.3	840 (s+l)	440-500 (s+l)
Balof 1-2	14	6.7	0.5	760 (s+l)	480-540 (s+l)
BUKA ISLAND				590-680 (s+l)	900-1000 (s)
Buka - Kessa - DJO	8	5.9	0.7		
Pororan island - DJW	5	4.8	1.0		
ZONE 5					
SABAH				~3750 (s)	
Bukit Tengkorat	188	58.3	0.3		

In the Distance columns, 'NB' indicates New Britain sources, 'M' indicates Manus; '(s)' is 'sea only' distance; '(s+l)' is combined sea and land effective distance.
Sabah: Bellwood and Koon 1989; Bellwood 1989. Eastern Highlands: Watson 1986.
Sio: Lilley 1986. Siassi Islands: Lilley 1986. Arawe Islands: Goulding 1987; Gosden *et al.* 1994. Kandrian: Pavlides 1999; Specht unpub. data. Willaumez Peninsula: Torrence and Summerhayes 1997. Duke of York Islands: White 1995. New Ireland: Marshall and Allen 1991; Downie and White 1978; White and Downie 1980; White 1992, 1995; Weisler 2001. Buka Island: Wickler 2001. Banks Islands: Ward 1979.

TABLE 3. Obsidian from post-Lapita contexts.

goods, through exchange across "ethnic" boundaries from their Lapita neighbours (cf. Green 1996:121; Green and Kirch 1997:20; Terrell 1989:625). In the Duke of York group, for example, Lapita pottery was found at 21 locations (Thomson and White 2000:313). While some pottery was probably produced locally, most pieces appear to be exotic to the group and may represent imported pots (Thomson and White 2000:318), perhaps brought in along with obsidian. There are currently no criteria, however, to identify "ethnic" boundaries or exchange across them, and there is no necessary reason to view the Duke of York Lapita sites as representatives of a non-Lapita population. However, the "Lapita equivalent" sites on Table 2 may represent non-Lapita populations, but their values fall well within the overall Lapita range for the Bismarck Archipelago and may indicate that there was no difference in the amounts of obsidian reaching Lapita and non-Lapita sites.

Sheppard suggested (1993:135) that obsidian might have had a complex commodity history in which high value was attributed to the process of acquisition and possession, after which, as Green and Anson (2000:66) have said about the SAC site on Watom Island, "it was reduced, used and discarded in a most utilitarian way". This does not explain the "pulse" or apparent absence of economising reduction behaviour at sites both close to and distant from the sources. A more likely explanation is that obsidian was used in contexts, such as displays for prestige and status, in which profligacy was more important than economical use. Prestige goods are used for display of wealth, success and power in which conspicuous consumption rather than economical use is the aim (Hayden 1998:11). As the popular saying goes, "if you've got it, flaunt it". A "pulse" of obsidian in the early stages of establishing the new settlements would have assisted this by ensuring adequate supplies for the maintenance of what might otherwise be seen as wasteful behaviour. There was simply no need, socially or materially, for economising.

At this point we return to the hypothesised Lapita exchange networks. In his discussion about the Lapita exchange network in Western Polynesia, Kirch (1997:250; cf. Green and Kirch 1997:30) suggested that "the Eastern Lapita peoples recreated their social world in the islands of the Fiji-Tonga-Samoa archipelagoes" through this network, compensating for their isolation and separation from ancestral communities to the west. Perhaps we can view the movement of obsidian between the Bismarck Archipelago and Lapita communities in the Solomon Islands as conscious attempts to *replicate* the ancestral societies, rather than to recreate them. This replication included the social and ideological contexts within which obsidian and other goods were essential and valuable components. Such a process would have had much in common with the founding of "junior lines in new territories" suggested by Green and Kirch (1997:30; cf. Bellwood 1996), and may explain why at some sites, as in the Buka and Reef-Santa Cruz areas, obsidian from one Bismarck source area dominates. During the colonising phase, not only were goods transported to provision the fledgling communities and ensure their successful replication, but also these goods would presumably have reflected the regular sources supplying the ancestral communities. Thus, the prominence of Manus obsidian at the Buka sites might indicate that the ancestral communities had some kind of privileged (or restricted) access to Manus obsidian rather than to Willaumez sources. As a consequence, it was primarily Manus obsidian that reached the newly founded communities. In contrast, the communities ancestral to the Reef-Santa Cruz sites might have had links that derived obsidian primarily from Willaumez Peninsula. If this were so, the archaeological distributions of obsidian from the various source regions could have significant historical meaning indicating at least two originating ancestral communities or areas for the colonising process into Remote Oceania, each seeking to replicate itself. This differs from the idea of "the changing nature of social distance" (e.g. Summerhayes 2001c:31) invoked to explain the fluctuating representation of sources in some Bismarck sites, for the Buka-Sohano and Reef-Santa Cruz sites do not show comparable changes in source representation through time.

I turn now to another aspect of the Irwin "pulse". Sheppard (1993:127) estimates that the Lapita sites of SZ-8, RF-2 and RF-6 contain about 245kg, 9.5kg and 26.44kg of obsidian respectively. Allowing for the crudeness of these estimates, he notes that they probably "err on the high side" as the excavation strategy targeted surface concentrations of pottery, and the excavations at RF-2 showed a relationship between the surface and excavated distributions of pottery and obsidian (Sheppard and Green 1991). In the absence of information about the size of obsidian blocks transported, the precise duration of site use and the number of importing events, we can only speculate on the amounts that actually reached the three sites, and the rate of flow at which they did so. While the obsidian at RF-

	Pre-Lapita	Lapita	Post-Lapita
Zone 1: 0-10km	3.0-365.8	2.2-3.5	n/a
Zone 2: 10-200km	0.8-2.9	n/a	0.9
Zone 3: 200-500km	0.6-1.3	0.3-2.7	0.2-1.5
Zone 4: 500-1000km	0.6-1.4	0.4-2.5	0.3-1.0
Zone 5: 1000-4000km	n/a	0.3-2.6	0.3

TABLE 4. Summary of the range of mean weights of obsidian by distance zones.

6 might be accounted for by material scavenged from older contexts (Sheppard 1993:128), the quantities estimated for SZ-8 and RF-2 might be fair representations of the volumes imported. We have no indication of the rate at which this took place, whether evenly or through a colonising "pulse", though we can make some estimates based on the estimated duration of use of the SZ-8 and RF-2 sites. Green (1991:203) suggests that SZ-8 was occupied for about 300 years. The estimated quantity would thus equate to an importation rate of less than 1kg per annum spread out over the duration of the site. At the other end of the scale, we can compare this to a large block of obsidian weighing about 11kg collected by A.B. Lewis in the Arawe Islands of New Britain in 1909-1910, and presumably brought there by canoe (Field Museum, Chicago, reg. no. 137384 sub. 4; Welsch 1998, Vol. I:179, Fig.3-19). The arrival of such blocks at SZ-8 would have required only one event every 12 to 13 years to account for the estimated quantity of obsidian in the site. Sheppard and Green (1991:89) interpret the evidence at RF-2 as pointing to a single occupation phase that "lasted for the lifespan of a large central structure". There is no indication of the length of that lifespan, but it may not have been more than one or two human generations (20-50 years?). Perhaps a single importation event of one large block was sufficient to provision the occupants for the duration of the site's use. If RF-2 received obsidian at the lower annual rate for SZ-8, then the quantity of obsidian could have been delivered in about 12 years. This figure takes no account of the possibility of the colonising "pulse" suggested above, but it suggests that RF-2 might well have been used for a very short time in line with the interpretation of Sheppard and Green (1991:89).

There are at least 12 Lapita sites in the Reef-Santa Cruz area, most of them with obsidian (Green 1976:Figs. 73 and 74; McCoy and Cleghorn 1988:106-110), so the total amount of obsidian reaching the area during Lapita times would have been larger than the total for SZ-8, RF-2 and RF-6. If we increase the quantity of obsidian in SZ-8, RF-2 and RF-6 by a factor of 3-4 to accommodate the other sites with obsidian, the amount that could have been transported to the region during Lapita times would be between 845kg and 1125kg. If we reduce the period of importation to 250 years, such volumes would have required the importation of about 3.5-4.5kg per annum. If we allow for an initial "pulse" in the colonising phase followed by a shift to lower quantities during a stable "trader mode" (Irwin 1991:506), the volumes imported initially could have been as much as 5-10kg per annum (one large block), with subsequent blocks averaging around 1-3kg.

Such number games do not provide "facts" about the movement of obsidian during Lapita times, but they provide a starting point for evaluating aspects of the long-distance exchange networks that are now an integral part of Lapita literature. The total amount of Bismarck obsidian reaching the Reef-Santa Cruz sites appears to have been relatively small. That at RF-2 could have arrived in a single transaction, perhaps as part of the founding event, while the possibility that the obsidian at RF-6 was scavenged from nearby localities suggests that, for some sites, we may not need to invoke long-distance exchange networks. Spriggs (2001:240-241) allows 400-500 years from the first appearance of Lapita pottery to the colonising of Tonga, and notes that the duration of Lapita gets shorter as one moves south and east from the Bismarcks. If the Lapita colonising process was a series of steps, each seeking to replicate the immediately ancestral society in both social and material terms, then the chronology of each step is critical. The Reef-Santa Cruz Islands were settled about 150-200 years after the first appearance of Lapita in the Bismarcks (about seven to ten human generations, if a woman gave birth to her first child at about 20 years of age), and arguably only 50-100 years (two to five generations) after the development of the Western (Middle) Lapita stage. The move to Vanuatu and New Caledonia occurred 100-150 years after that (five to seven generations), and Fiji-Tonga were reached about 100-150 years later. The scarce presence of Bismarck obsidian in Vanuatu, New Caledonia and Fiji, and its probable absence from Tonga, could indicate that these groups were settled after the flow of obsidian to the Reef-Santa Cruz area had ended, rather than reflect community isolation and disruption of exchange networks as distances between island groups increased. If importation of Bismarck obsidian to the Reef-Santa Cruz Islands lasted only 100-150 years, its presence in the more distant groups may represent an "occasional 'heirloom' or curated object" (Green and Kirch 1997:30; cf. Sand and Sheppard 2000: 240).

This exploratory paper has suggested that there is some evidence for an initial "pulse" of obsidian at some Lapita sites, where it may reflect colonising events replicating the ancestral society and the social contexts within which obsidian was regarded as a valuable, perhaps necessary, item. The apparent lack of economising behaviour in the reduction of obsidian at some sites reflects not its use and discard in a "most utilitarian way" (Green and Anson 2000:66), but the capacity of the colonists to continue using obsidian in the same way as in their ancestral home. In this sense, the movement of obsidian was indeed "an essential component of the Lapita dispersal and colonization strategy" (Kirch 1988:104) aimed at the continuance of the original cultural adaptation (Green 1976:258). Whether this movement was by reciprocal exchange in the generally accepted sense remains to be seen (cf. Irwin and Holdaway 1996:233). While this view would partly bring the "pulse" and exchange network models into line, much more detail is required to fully test the models presented in the seminal papers of Green, Kirch, Sheppard and Irwin. The kind of resource maximisation model employed so far is almost certainly over-simplified, and there are serious issues of sampling, description and dating to be resolved, as well as the problem of large geographical gaps in our knowledge (Sand 2001:73). While the existing models of Lapita exchange have provided insightful ways to view the data, it may be time to rework them by better incorporation of ideas about the nature of the colonising process, particularly the distinction between colonising and post-colonising phases (Irwin 2000:394). If the original purpose in transporting a good such as obsidian over long distances during the colonising phase was embedded in the replication of society (Irwin and Holdaway 1996:232-233; Kirch 1988; Sheppard and Green 1991:101), then current exchange models may prove to relate only to a secondary, post-colonising, phase and even then only to some parts of the Lapita distribution.

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