IMPLICATIONS OF PREHISTORIC OBSIDIAN TRANSFER IN SOUTH POLYNESIA

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ABSTRACT

The discovery of obsidian from Mayor Island (New Zealand) at several outlying island groups indicates that, as in the case of Talasea (New Britain) obsidian, the range of distribution is correlated with quality: high quality material is carried furthest. The gap between the distributions of material from these two sources is now very small, but crucial, for it lies in the subtropical zone between long-settled East Melanesia and the much more recently settled South Polynesia. Quite different implications would be drawn if Talasea obsidian were to be found further south, or Mayor Island obisidian further north. The present distribution reinforces the appearance of post-colonisaion isolation in South Polynesia.

INTRODUCTION

Source characterisation of exotic lithics, including basalts (Weisler 1997a), cherts (Sheppard 1996) and obsidians is now an established technique for inferring prehistoric connections between Pacific islands. Obsidians,[1] are especially useful because the sources are widespread, the material was highly prized, likely to be used frequently and transferred over long distances (Green and Kirch 1997), and the characterisation methods have been comprehensively tested (e.g., Duerden *et al.* 1980, Leach and de Souza 1979, Leach 1985). In addition, most obsidians are conspicuous in appearance and amongst all lithics are least likely to be missed during site recording and excavation. With growing confidence in obsidian hydration rim dating (Stevenson *et al.* 1996), the material may carry a further advantage of direct rather than contextual age estimation.

In Remote Oceania, deposits of volcanic glasses, including obsidian, are variably distributed. The main sources are in the Banks Islands (northern Vanuatu), northern Tonga (Tafahi, Niuatoputapu), northern New Zealand, Hawaii, the Kermadecs, Pitcairn Island and Easter Island. Other deposits occur in Tutuila in Samoa, Aitutaki in the southern Cook Islands and in Mangareva (Leach *et al.* 1986, Allen and Steadman 1990, Clark and Wright 1995, Clark *et al.* 1997, Weisler 1990, 1997b).

This paper focuses on the obsidians of the marginal southwest Pacific islands, a region which has no commonly-agreed name. The subtropical (south of the Tropic of Capricorn) and temperate islands of New Zealand, the Chathams, Kermadecs, Norfolk and Lord Howe, together with the subantarctic islands, belong in terms of prehistoric culture to East Polynesia (insofar as they had been colonised prehistorically, but even the first historical colonisation of Lord Howe was by whalers with Maori families and of the subantarctic Auckland Islands by Maori and Moriori). However, they are very distant from the other East Polynesian archipelagoes and this raises, incidentally, a question of terminology. While accepting that there is strong evidence of a common cultural ancestry in East Polynesia, the southern islands are situated not only far to the west of the remainder of East Polynesia but even southwest of West Polynesia. The geographical terminology makes little sense. I have grouped them together as South Polynesia on geographical grounds, and other arguments might be made for doing so in terms of historical ecology as well as by consideration of relative interaction, to which I will refer later.

Within South Polynesia there are substantial and, on the whole, readily accessible reserves of obsidian in the North Island of New Zealand. At least 18 sources are recorded coastally and inland from Lake Taupo and the Bay of Plenty to Northland, but the most prominent of them is Mayor Island. It is almost an island of obsidian and often the most abundantly represented source in New Zealand archaeological sites from the earliest period onwards (Leach and De Souza 1979). The Kermadec Islands comprise a second source area. Most important is Raoul Island where obsidian of a general similarity, but with small differences

indicative of several sources, is highly abundant on the north coast. There are further sources on Macauley Island 120 km to the south. A possible source of volcanic glass, which has never been relocated and probably does not exist, has been reported for Chatham Island (Leach *et al.* 1986:143). No volcanic glasses are known from Norfolk Island, Lord Howe Island or any of the subantarctic islands.

Considering that there are sources of obsidian in Vanuatu and Tonga, not to mention those further afield, from which material could have been widely distributed, then there are two sets of material transfer possible:

1. Obsidians from New Zealand or the Kermadecs may have been taken to other islands within South Polynesia and also beyond it.
2. Obsidians from tropical Remote Oceania may have been transferred into South Polynesia.

These potential patterns of distribution, and implications drawn from them, are the subject of this paper (Figure 1).

SOURCE IDENTIFICATION

I will not dwell here on the methods of source characterisation applied to the South Polynesian materials. Interest in these goes back to the 1960s (Green 1964), and the literature is extensive. It is sufficient to say that the new character-isations reported by Anderson *et al.* (n.d.) and discussed in this paper were carried out by Wal Ambrose (ANU), looking at major element distribution by the SEM energy-dispersive (EDAX) technique; and trace element analysis, using the PIXE-PIGME system by Foss Leach (Museum of New Zealand). The main comparative data from South Polynesia discussed here are also from PIXE-PIGME sourcing (Leach *et al.* 1986), and the analyses of chemical profiles draw upon extensive archives of comparative material and source data for the Pacific Islands as a whole.

THE DISTRIBUTION OF SOUTH POLYNESIAN OBSIDIANS

Distant offshore transfer of mainland New Zealand obsidians was reported initially by Leach (1973). In the Chathams, obsidian pieces had been surface-collected for some years, mostly on Pitt Island; 73 of 74 surface-collected pieces examined by Leach *et al.* (1986). Excavations by Sutton (1980) at the large 16th century settlement site complex at Durham Point on Chatham Island produced seven obsidian artefacts. Of the total Chathams collection of 81 pieces, 77 proved to be of Mayor Island origin; two pieces were of other New Zealand sources and the remaining two of an unknown source which was closest in character to Rapanui, Easter Island, although probably not from there.

Test excavations during 1978 in the newly-discovered 14th century settlement site at Low Flat on Raoul Island produced numerous pieces of an almost opaque black glass

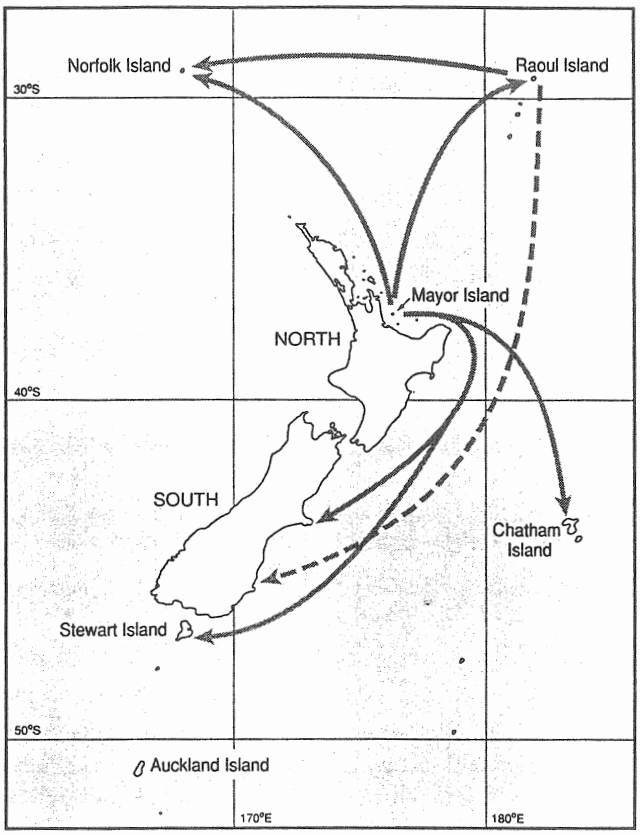

Figure 1: South Polynesia, showing the known distributions of Mayor Island and Raoul obsidian (solid lines), plus a possible Raoul obsidian find in the South Island.

with grey banding, a waxy lustre and abundant phenocrysts which exactly resembled material occurring in great abundance as cobbles and boulders on the nearby beach (Anderson 1980). PIXE-PIGME analysis showed that the archaeological and shoreline materials were from the same source (Leach *et al.* 1986). In addition, the archaeological excavations produced six pieces of a translucent, olive-green material which, upon analysis, was shown to have come from Mayor Island (Leach *et al.* 1986:166). Data obtained by a different method (x-ray induced fluorescence) on the same samples produced similar results but also went on to suggest that two additional pieces of volcanic glass from an Archaic phase site in the South Island of New Zealand (Tai Rua) might have originated on Raoul Island (Anderson and McFadgen 1990). The case is not as clear cut as might be wished, however, and re-analysis by PIXE-PIGME is needed to bring the results into comparison with current evidence. More recent research at Low Flat and also at two other prehistoric sites on Raoul Island has added an additional 357 pieces of volcanic glass to the archaeological assemblage, all of local material (Johnson 1995).

In 1997 a much stronger case was established for offshore transfer of Raoul Island obsidian. Excavations in 1996 at the newly-discovered East Polynesian settlement site at Emily Bay, on Norfolk Island – a site which seems to date to about 500-700 bp – produced a section of obsidian blade which, in hand specimen, exactly resembled material from Raoul Island. This identification was confirmed by Anderson *et al.* (1997) on major elements and by PIXE-PIGME analysis. Further research at the Emily Bay site recovered an additional 21 pieces of obsidian. Twenty of these appeared to be from the distinctive Raoul Island source and three which have been characterised by major elements and PIXE-PIGME are confirmed in that identification. All of these came from a discrete area of paving which is possibly a religious structure. In addition to these pieces, a single flake of translucent, olive-green obsidian was recovered. This has a specific gravity and major elements distribution typical of Mayor Island obsidian, and has been attributed to that source by PIXE-PIGME analysis.[2] So material from both Raoul Island and Mayor Island reached the same site on Norfolk Island, probably in the 13th or 14th century. Research on Lord Howe Island, including extensive drilling and coring in 1996 has failed to disclose any evidence of pre-European settlement and no obsidians have been reported from archaeological sites in the subantarctic Snares or Auckland Islands, nor were any recovered in my recent excavations there.

The present situation within the region, then, is that New Zealand obsidians were carried by prehistoric East Polynesians to the Chatham Islands, the Kermadecs and Norfolk Island, and that Kermadecs obsidian was carried to Norfolk Island and possibly to New Zealand (Figure 1). What implications for South Polynesian prehistory may be sketched from this evidence?

IMPLICATIONS OF OBSIDIAN TRANSFER

The minimum set of connections implied by the obsidian source data is a single voyage each from New Zealand to the Chathams and Raoul Island plus single voyages to Norfolk from both Raoul and New Zealand. However, since Mayor Island obsidian occurred in a number of pieces at Raoul, but as only one piece at Norfolk, where Raoul Island obsidian was relatively abundant, it is more likely that both obsidians were taken to Norfolk from Raoul soon after the arrival on the latter island of a quantity of Mayor Island obsidian.

It is interesting to note that a small quantity of exotic obsidians was recovered during the first systematic investigation of a large settlement site on each of the three archipelagoes concerned, which suggests that exotic obsidians could be expected to occur routinely in other large settlement sites of East Polynesian type, as is certainly the case throughout mainland New Zealand. The fact that exotic material turned up even where excavations were of limited scope, as at Low Flat (15 m^2) in 1979 and in 1996 at Emily Bay (16 m^2), shows that South Polynesian obsidian was transported in some quantity, not just as single flakes, and could be expected in archaeological excavations of small sample size elsewhere. More extensive excavations should produce larger sample sizes and perhaps greater source variety, as happened at Emily Bay, Norfolk, in 1997, but the simple presence-absence of any obsidian from the South Polynesian sources on any of the other islands in the region is a matter of relatively high archaeological expectation.

Looking further afield, the current data show that Mayor Island obsidian had an area of distribution with a simple radius of about 1500 km, but considering that the most likely routeway to Norfolk was through Raoul Island, then the actual distance travelled was about 2300 km. Raoul Island obsidian was transferred over at least 1300 km and possibly 2000 km. If South Polynesians were prepared generally to carry obsidians from source to these distances then the material could have reached New Caledonia, Vanuatu, Fiji and Tonga rather easily and it was only a few hundred kilometres further to the southern Cooks. Given the general desirability of obsidian and its known scarcity in central East Polynesia, given the quality and abundance of obsidian at source, and considering that there are no intervening islands to deplete an obsidian load from South Polynesia, it is very probable that any return voyage into central East Polynesia would have carried obsidians amongst its cargo as a high priority.

In light of the archaeological visibility of obsidians in south Polynesian sites, it is worth comparing the occurrence of obsidians in excavations of prehistoric settlement sites in the Cook and Society Islands. In the latter, the large waterlogged site at Vaito'otia-Fa-ahia on Huahine contained no obsidian but its dates of occupation are uncertain. Three dates on short-lived material from the lower layer fell into the 12th century, so it is possible that occupation extended into the period following colonisation of New Zealand (Sinoto 1979, Anderson 1991, Spriggs and Anderson 1993). The same might be true of the Motu Pae'ao burial and settlement site on Maupiti where obsidian is absent (Emory and Sinoto 1964), but there are no reliable radiocarbon dates available.

The situation in the southern Cooks, geographically and culturally the nearest tropical East Polynesian archipelago to South Polynesia, is especially interesting. At the large Urei'a settlement site on Aitutaki, excavations have disclosed several pieces of volcanic glass, probably from a known local source, in layers dated between 500 and 200 bp, but there is no exotic obsidian (Allen and Steadman 1990). No obsidian occurred as well amongst the concentrated lithics

from a rockshelter of similar age at Moturakau, nearby (Allen and Schubel 1990). At Anai'o on Ma'uke Island a large settlement site dated to the 14th and early 15th centuries has been extensively excavated by Walter (1987, 1993). It contained a variety of imported materials, but no obsidian. This is true also of substantial excavations at the Ngati Tiare site on Rarotonga (Bellwood 1978) and for excavations at Tangatatau, a large rockshelter site on Mangaia where there is evidence of other exotic materials, including adzes from Samoa, being imported during the period AD 1000-1500 (Kirch *et al.* 1995).

Further east, in the Australs, there are no reports of South Polynesian obsidians, although not much systematic archaeology has occurred in this important group. In the Mangareva and Pitcairn groups, Weisler (1997b) reports the transfer of volcanic glass from the Down Rope, Pitcairn source, but no other obsidians (Figure 2). Looking back towards the west, where direct landfalls might have occurred in southern Tonga, Fiji, Vanuatu or New Caledonia, archaeological research has tended to concentrate on periods earlier than that in which the settlement of South Polynesia occurred, but within the more limited evidence from the last 1000 years there is no report of South Polynesian obsidians.

Comparison of these data as a whole with the archaeological visibility of exotic obsidians in New Zealand settlement sites generally and in the first settlement sites to be investigated on Norfolk, Raoul and Chatham Islands, suggests rather strongly, therefore, that South Polynesian obsidian was never transferred as far as central East Polynesia or to anywhere else north of the Tropic of Capricorn. Without dwelling on the negative evidence of the reverse case, it too is similar. Despite extensive archaeological research in South Polynesia, especially in mainland New Zealand, no obsidians from the tropical sources in Remote Oceania have ever been recovered from archaeological sites.

The crucial question thus becomes, why should no obsidian have been transferred between South Polynesia and anywhere else in the Pacific? There is no *a priori* reason

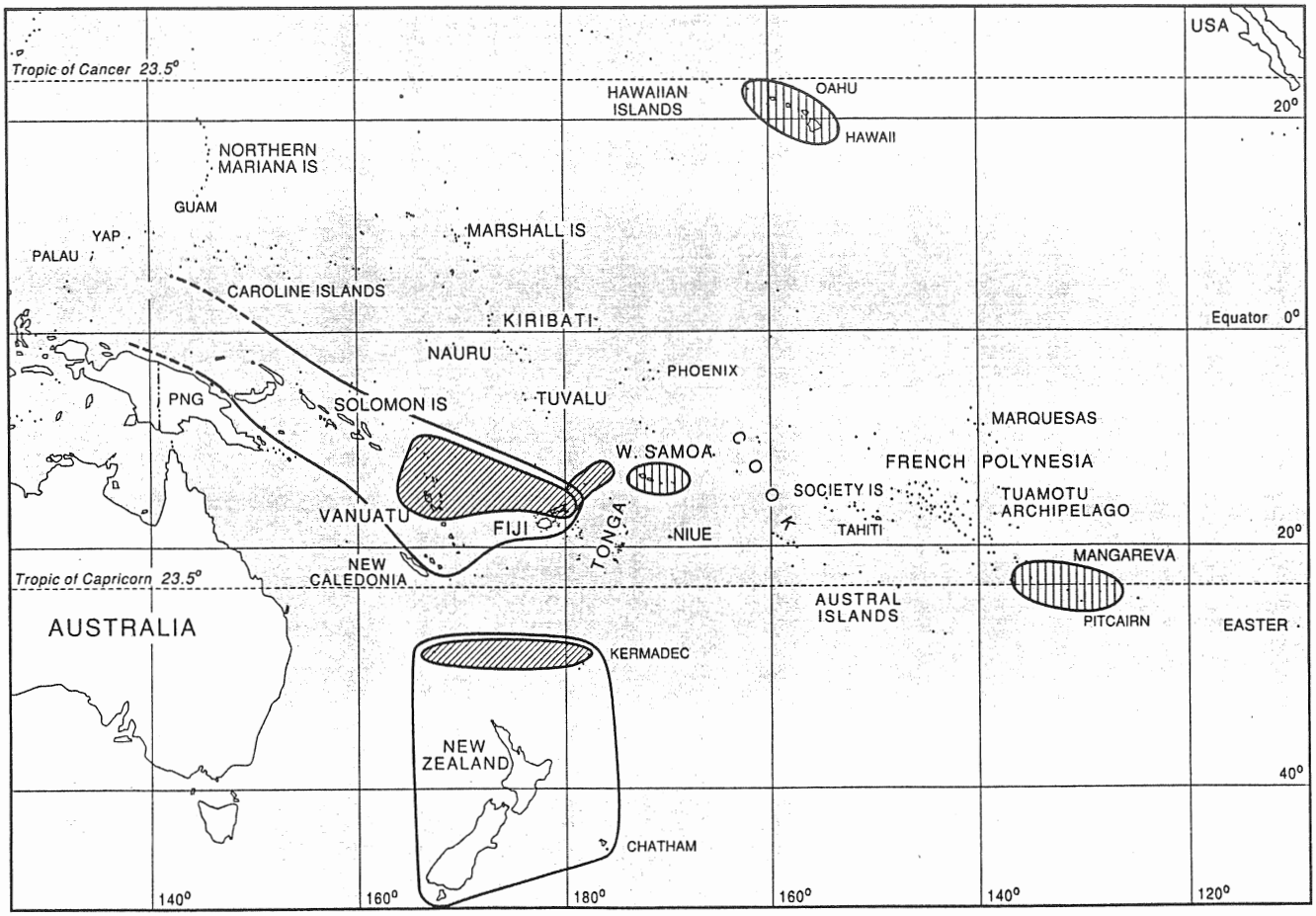

Figure 2: Prehistoric distribution of Talasea and Mayor Island obsidians (solid lines), and of Raoul, Banks and Tafahi material (oblique shading), plus that of some more localised sources (vertical shading).

why distance alone should have prevented it. As noted above, the known distribution of South Polynesian obsidians over distances of 1300-2300 km would take in virtually all the potential destinations of first landfall north of the Tropic of Capricorn. From the other direction, the Norfolk and Kermadec groups lie only 600 and 700 km respectively from the nearest points in New Caledonia and Tonga.

Perhaps material quality was a more important consideration? There is some evidence that obsidians and volcanic glasses tend to be distributed over distances commensurate with their quality. Where material is scarce, occurs only in small pieces, or is especially brittle or flawed, it has a localized distribution (most of the East Polynesian volcanic glasses). Other material which is relatively scarce or not of the highest quality is transported over greater distances. The relatively low grade Banks obsidian reached Tikopia and Malo, the Pitcairn glass got to Mangareva, and the Tafahi obsidian into the Fijian Lau Islands – all distances of 400-700 km. The Raoul Island material is abundant, can be found in boulder-sized blocks and will carry the production of large blades, but in general it is comparatively unattractive and too phenocrystic for the ready manufacture of small flake or core tools. Its confirmed distribution is 1300 km. Other obsidians which are abundant, can be taken in blocks of any size, are of uniformly high quality and gloss and which generally lack phenocrysts, cracks or other flaws are likely to be transferred the furthest. High grade material from Manus (Lou Island source) reached Malo Island in Vanuatu, a distance of more than 3000 km (Spriggs 1997:140) while Talasea obsidian got to the Isle of Pines, in southern New Caledonia and also to Naigani, Fiji, distances of around 3500 km east of the source (Best 1987). There is no apparent reason why Talasea obsidian should not have reached Norfolk Island, or even New Zealand, if voyaging had extended that far during the Lapita era, nor any reason on grounds of quality to suppose that Mayor Island obsidian, and high-grade material from many other New Zealand sources, would not have been taken into the tropical Pacific, including East Polynesia. Indeed, it might be argued that this was rather probable, especially if voyaging had headed towards the Cooks, because of the absence of intervening opportunities to disperse the cargo (Figure 2).

CONCLUSIONS

The recent discoveries of exotic obsidian in widely-dispersed archaeological sites of the South Polynesian region, invite conjecture about the real extent of obsidian dispersal and its meaning in terms of Pacific colonisation, just as recent research on the distribution of basalts is opening new avenues for discussion about exchange and other kinds of interaction within the tropical Pacific.

So far at least, the sourcing of basalts has not disclosed any material transfer involving South Polynesia (Weisler 1997a), although the continuing discovery and characterisation of adze-making centres, as on Norfolk Island (Anderson *et al.* (1997), carries that potential. There are some adzes of probable New Zealand basalt and other lithics on Raoul Island (Anderson 1980), and possibly on Norfolk Island, but they are not from demonstrably secure archaeological contexts. Of the other attractive and distinctive New Zealand lithics, such as limestone and volcanic cherts, silcrete, soapstones and nephrites, none have been recorded in sealed archaeological contexts beyond mainland New Zealand (nor, indeed, have moa bone artefacts), so their absence further afield than within South Polynesia is likewise of no significance. In the present state of knowledge, then, it is probably only obsidian that is likely to carry the evidence of long distance connections with South Polynesia.

The discovery of exotic obsidian from a very distant source is unpredictable, of course, and might occur at any time – the Naigani case is a good example. Nevertheless, the absence in current archaeological evidence from the tropical Pacific of material from the relatively close and medium-quality Kermadecs sources or from any of the mainland New Zealand obsidians, especially from the distinctive, high-quality, early-discovered and much-used Mayor Island sources may be significant. Although they were available over only a relatively brief period (*c.*700 years), but probably as long as the era of Lapita expansion, they were of an abundance and quality comparable to the New Britain and Bismarcks sources that provided material over an area stretching up to 6500 km in extent, from Sabah to Fiji (Best 1987). Furthermore, the tropical Pacific north of New Zealand was a region deficient in obsidian, most especially in central East Polynesia.

If it was not on grounds of opportunity, quality or raw distance that the South Polynesian obsidians failed to be distributed to an expected extent, then it was probably a matter of relative difficulty in voyaging, expressed in low frequency or success of attempt. Current models of voyaging and episodes of approximately replicative sailing suggest relative ease of movement between South Polynesia and other regions, from which repeated contact in prehistory is often inferred. I doubt this on several grounds that I will not go into here, pointing out only that the hard data of lithic source characterisation do not, so far, support the model of repeated two-way voyaging.

Within South Polynesia, the evidence of obsidian transfer lends itself parsimoniously to only one conclusion – the possible Tai Rua case aside, there was only single, outward voyaging from mainland New Zealand, and where it might have been expected to continue northeast from the

Kermadecs towards the former homelands, the current data suggest that it actually moved further to the west. Instead of potentially supporting a case for return voyaging from New Zealand, the obsidian data tend to push the colonisation of South Polynesia even more into a blind alley of the Pacific sequence. The consequences of such a proposition for current hypotheses about the nature of voyaging and settlement in the colonisation era and of later interaction between South and central East Polynesia are, of course, far-reaching and beyond the scope of this paper. However it is at least an argument that is potentially and readily testable by future lithic discoveries and analyses in Pacific archaeology. Of particular interest will be whether the Talasea-Mayor Island gap in obsidian distribution, now perilously small, will be closed, and in which direction, or whether South Polynesia will maintain its prehistoric isolation.

NOTE

1. Natural glass deposits that are relatively high in silica and water content and low in iron, and which often occur in massive form are commonly described as obsidians, while others (low in silica and high in iron, often associated with trachytic basalts) are referred to as volcanic glass, which is also a valid generic term (Clark and Wright 1995). Since the main South Polynesian sources are specifically obsidians I have preferred that term here.
2. Note added in proof: additional analysis, by Neutron Activation Analysis, of the translucent obsidian from Emily Bay, casts doubt upon its origin in Mayor Island, but does not indicate any other known source (B.F. Leach pers. comm.).

REFERENCES

Allen, M.S. and S.E. Schubel. 1990. Recent archaeological research on Aitutaki, southern Cooks: the Moturakau rockshelter. *Journal of the Polynesian Society* 99:265-95.

Allen, M.S. and D.W. Steadman. 1990. Excavations at the Ureia site, Aitutaki, Cook Islands: preliminary results. *Archaeology in Oceania* 25:24-37.

Anderson, A.J. 1980. The archaeology of Raoul Island (Kermadecs) and its place in the settlement history of Polynesia. *Archaeology and Physical Anthropology in Oceania* 15:131-41.

Anderson, A.J. 1991. The chronology of colonization in New Zealand. *Antiquity* 65:767-95.

Anderson, A.J., W. Ambrose, B.F. Leach and M. Weisler. 1997. Material sources of basalt and obsidian artefacts from a prehistoric settlement site on Norfolk Island, South Pacific. *Archaeology in Oceania* 32:39-46.

Anderson, A.J. and B.G. McFadgen. 1990. Prehistoric two-way voyaging between New Zealand and East Polynesia: Mayor Island obsidian on Raoul Island and possible Raoul Island obsidian in New Zealand. *Archaeology in Oceania* 25:37-42.

Anderson, A.J., W. Ambrose and B.F. Leach. n.d. Origin of an obsidian artefact on Norfolk Island. Manuscript, in preparation.

Bellwood, P.S. 1978. *Archaeological Research in the Cook Islands.* Honolulu: B.P. Bishop Museum. *Pacific Anthropological Records* 27.

Best, S. 1987. Long distance obsidian travel and possible implications for the settlement of Fiji. *Archaeology in Oceania* 22:27-31.

Clark, J.T. and E. Wright. 1995. Volcanic glass in Samoa: a technological and geochemical study. *Journal of the Polynesian Society* 104:239-66.

Clark, J.T., E. Wright and D.J. Herdrich. 1997. Interactions within and beyond the Samoan archipelago; evidence from baslatic rock geochemistry. In M.I. Weisler (ed.), *Prehistoric Long-Distance Interaction in Oceania: an interdisciplinary approach,* pp. 68-84. Auckland: New Zealand, *Archaeological Association Monograph* 21.

Duerden, P., J.R. Bird, M.D. Scott, E. Clayton and L.H. Russell. 1980. PIXE-PIGME studies of artefacts. *Nuclear Instruments and Methods* 168:447-52.

Emory, K.P. and Y.H. Sinoto. 1964. Eastern Polynesian burials at Maupiti. *Journal of the Polynesian Society* 73:143-60.

Green, R.C. 1964. Sources, ages and exploitation of New Zealand obsidian: an interim report. *New Zealand Archaeological Association Newsletter* 7:134-43.

Green, R.C. and P.V. Kirch. 1997. Lapita exchange systems and their Polynesian transformations: seeking explanatory models. In M.I. Weisler (ed.), *Prehistoric Long-Distance Interaction in Oceania: an interdisciplinary approach,* pp. 19-37. Auckland: New Zealand, *Archaeological Association Monograph* 21.

Johnson, L. 1995. *In the Midst of a Prodigious Ocean: archaeological investigations of Polynesian settlement of the Kermadec Islands.* Auckland: Conservancy Historic Resources Series no. 11.

Kirch, P.V., D.W. Steadman, V.L. Butler, J. Hather and M.I. Weisler. 1995. Prehistory and human ecology in Eastern Polynesia: excavations at Tangatatatau rockshelter, Mangaia, Cook Islands. *Archaeology in Oceania* 30:47-65.

Leach, B.F. 1973. Obsidian in the Chatham Islands. *New Zealand Archaeological Association Newsletter* 16:104-6.

Leach, B.F. 1985. The source of prehistoric obsidian artefacts from the Polynesian outlier of Taumako in the Solomon Islands. *New Zealand Journal of Archaeology* 7:117-23.

Leach, B.F., A.J. Anderson, D.G. Sutton, R. Bird, P. Duerden and E. Clayton. 1986. The origin of prehistoric obsidian artefacts from the Chathams and Kermadec Islands. *New Zealand Journal of Archaeology* 8:143-70.

Leach, B.F. and P. de Souza 1979. The changing proportions of Mayor Island obsidian in New Zealand prehistory. *New Zealand Journal of Archaeology* 1:29-51.

Sheppard, P.J. 1996. Hard rock: archaeological implications of chert sourcing in Near and Remote Oceania. In J. Davidson, G. Irwin, F. Leach, A. Pawley and D. Brown (eds), *Oceanic Culture history: Essays in honour of Roger Green,* pp. 95-115. Dunedin North: New Zealand Journal of Archaeology Special Publication.

Sinoto, Y.H. 1979. Excavations at Huahine, French Polynesia. *Pacific Studies* 3:1-40.

Spriggs, M.T.J. 1997. *The Island Melanesians.* Oxford: Blackwell.

Spriggs, M.T.J. and A.J. Anderson. 1993. Late colonization of East Polynesia. *Antiquity* 67:200-17.

Stevenson, C.M., P.J. Sheppard and D.G. Sutton. 1996. Advances in the dating of New Zealand obsidian. *Journal of Archaeological Science* 23:233-42.

Sutton, D.G. 1980. A culture history of the Chatham Islands. *Journal of the Polynesian Society* 89:67-93.

Walter, R. 1987. Preliminary excavation report, Anai'o, Ma'uke, Cook Islands, 1987. *New Zealand Archaeological Association Newsletter* 30:239-48.

Walter, R. 1993. The community in Ma'uke prehistory. In N.W. Graves and R.C. Green (eds), *The Evolution and Organisation of Prehistoric Society in Polynesia,* pp. 72-86. Auckland: New Zealand, *Archaeological Association Monograph* 19.

Weisler, M.I. 1990. Sources and sourcing of volcanic glass in Hawai'i: implications for exchange studies. *Archaeology in Oceania* 25:16-23.

Weisler, M.I. (ed.) 1997a. *Prehistoric Long-Distance Interaction in Oceania: an interdisciplinary approach.* Auckland: New Zealand, *Archaeological Association Monograph* 21.

Weisler, M.I. 1997b. Prehistoric long-distance interactions at the margins of Oceania. In M.I. Weisler (ed.), *Prehistoric Long-Distance Interaction in Oceania: an interdisciplinary approach,* pp. 149-72. Auckland: New Zealand, *Archaeological Association Monograph* 21.