
Flaked stone tools and plant food production : a preliminary report on obsidian tools from Talasea, West New Britain, PNG

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RÉSUMÉ

Talasea est importante dans la Préhistoire du Pacifique parce qu'elle fut la source essentielle d'obsidienne pendant plus de 18 000 ans. On a identifié une classe d'outils distincte dans des niveaux antérieurs à l'apparition de la céramique de Lapita il y a 3 500 ans. Les analyses de traces d'utilisation et de résidus faites sur ces outils indiquent que le pédoncule retouché est probablement un manche et que les outils ont été utilisés pour une variété de tâches, dont le découpage de tubéreuses amylacées. On suggère que le coquillage a remplacé l'obsidienne comme matière première dominante pour le traitement des aliments végétaux.

ABSTRACT

Talasea is prominent in Pacific Prehistory because it has been a main source of obsidian for over 18 000 years. A distinctive class of tools has been identified in levels prior to the appearance of Lapita pottery about 3 500 years ago. Use-wear and residue analyses of these tools indicate that the retouched stem is probably a haft and that the tools were used for a variety of tasks including slicing starchy tubers. It is suggested that shell replaced obsidian as a dominant raw material for processing plant foods.

Despite notable exceptions such as sickle blades (see for example papers presented to table ronde CNRS Exploitation des Plantes), it has been widely argued on ethnographic grounds that flaked stone tools were mainly used in hunting and wood-working, and rarely used for processing plant

foods (*e. g.* Hayden, 1977, 1979 : 11). This argument may be flawed because of biased ethnographic evidence which neglects the role of women and tends to ignore the more amorphous stone artefacts which may be related directly or indirectly to plant food processing. For example, recent research in

North America and Europe has greatly expanded our knowledge of flaked stone tools in plant food production and various trends can be identified, notably that a shift towards amorphous expedient stone tools is the result of a change to agriculture (Torrence, 1989 : 58).

Amongst hunter/gatherer groups in the Australian region retouched tool types for processing plants seem to be rare (O'Connell, 1974), but similar shifts towards expedient tools may be associated with more intensive exploitation of plant food resources (Fullagar *et al.*, 1992). An approach integrating technological and functional analysis has important implications for areas where the distinctions between hunting/gathering/fishing and agriculture/horticulture are blurred in a geographical and temporal continuum such as Torres Strait, which separates Australia and the island of New Guinea (fig. 1 ; Harris, 1977). In this paper I present archaeological evidence, from a site in Talasea (fig. 1), which challenges the view that flaked stone tools were primarily used for woodworking and butchering. I argue that the role of stone tools in plant food production is identifiable archaeologically, and that a combination of technological and functional analyses can provide evidence of subtle subsistence changes even in the Australian-Pacific region (Beck *et al.*, 1989).

Bitokara (PNG site code, FRL)

The site, FRL, is located at Bitokara in the region of Talasea, West New Britain Province, PNG (fig. 1). The site is situated close to obsidian sources and contains a remarkable sequence of obsidian assemblages (Specht *et al.*, 1988 ; Torrence *et al.*, 1990). West New Britain is famous because it has been a supplier of obsidian for over 18,000 years, but particularly because the distributions of obsidian, spanning at least 6,000 km, provide evidence of human contact, exchange and colonisation (Ambrose, Green, 1972 ; Bird *et al.*, 1981 ; Specht 1981 ; Best, 1987 ; Kirch and Hunt, 1988 ; Allen *et al.*, 1989 ; Bellwood and Koon, 1989). Recent research has focussed on the nature of production at the obsidian sources, particularly tool manufacture, function, determinants of access and selection of raw materials (Specht *et al.*, 1988 ; Fullagar, 1990 ; Torrence *et al.*, 1990 ; Fullagar *et al.*, 1991).

The stratigraphy at FRL is dramatically clear

with separation of cultural layers by sterile tephra deposits (Specht *et al.*, 1988). These tephras are the subject of ongoing research and have been tentatively identified with several major volcanic eruptions in the last 10,000 years. Obsidian artefacts with distinctive retouch at one end, and described as stemmed tools (Specht, 1974), are found only below a distinct tephra associated with a major eruption of Witori, a volcano in the Hoskins Peninsula. Radiocarbon assays and thermoluminescence determinations indicate an age of c. 3500- 4000 for the main Witori eruption (Torrence *et al.*, in press ; Prof. H. Machida of Tokyo Metropolitan University, personal communication).

Stemmed tools

Stemmed tools are widely distributed in the Pacific spatially and chronologically but these tools have not been systematically examined microscopically (see references to tanged tools in Glover, 1986 :134, 137, 139, 140, 210). In West New Britain most have been found close to the obsidian sources near Talasea and Mopir, and all dated specimens have been found close to the obsidian sources at Talasea in archaeological levels older than the main Witori eruption. Preliminary studies suggest that stemmed tools are not common in the FRL site (table 1).

Layer Number	Layer volume (m ³)	Flakes (n°)	Cores (n°)	Stemmed tools (n°)
12	0.800	479	7	0
11	0.210	182	5	0
10	0.350	35	0	0
9	0.350	1	0	0
8	0.330	17	1	0
7	0.406	1644	6	0
6	0.532	72	3	0
5	0.490	0	0	0
4	0.722	9750	27	12
3	0.106	228	0	0
2	0.308	5731	24	15
1B	0.380	195	1	0
1A	0.053	1	0	0

Table 1. FRL obsidian artefacts > 1 cm, per layer.

There is no ethnographic evidence of the use of stemmed tools but preliminary microscopic analyses show that use-wear and residues are identifiable on 29 out of the 43 artefacts analysed (table 2). Preservation of the obsidian surfaces is poor, and

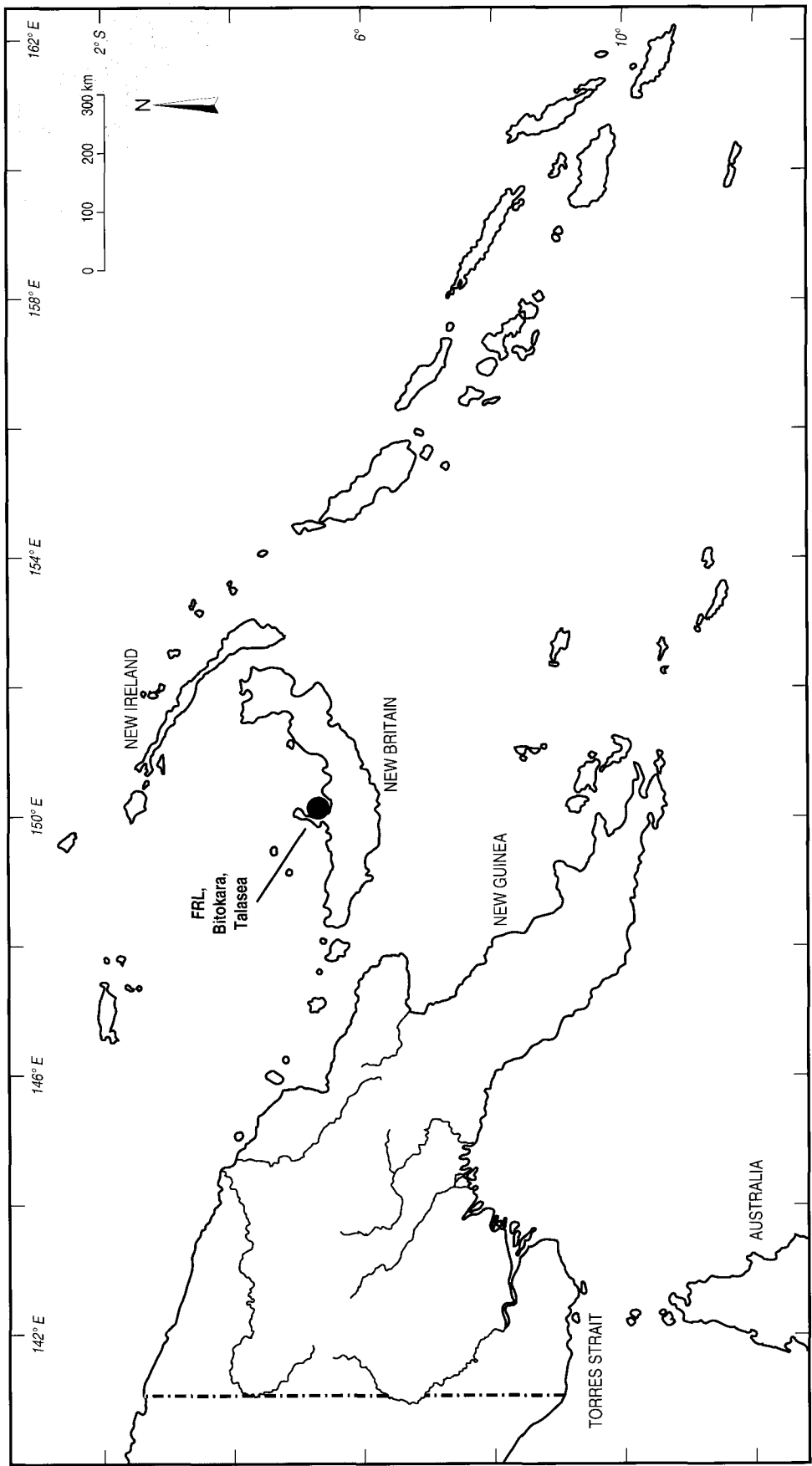


Fig. 1. Map showing main islands, Torres Strait and site location of FRL (DAO : M. Clatot, CRA-CNRS).

numerous pits appear to be the result of chemical reactions in the sediment, which is in an open setting and receives over 6 m of rain *per annum*. Nevertheless, less than 50 % of the obsidian surface is affected in this way and well-preserved fresh fracture surfaces are visible. This suggests that polishes are not likely to be highly altered. Recent controlled studies of experimental blood residues on stone suggest that open high rainfall sites have very low potential for the survival of blood residues (Palmer, 1991). Identification of blood residues on such tools is therefore likely to under-represent original quantities. Residues and use-wear were studied under a combination of stereo- and metallographic microscopes.

	Unre-touched	Retouched		
		Stemmed	Other	Total
Plant	3	7	5	15
Animal	0	0	1	1
Both	6	5	2	13
Uncertain	2	1	5	8
Unused	5	0	1	6
Total	16	13	14	43

Table 2. Summary of preliminary use-wear and residue analysis.

Edge scarring was present mostly in the form of small bending and feather terminated scars along sections of unretouched acute edge (opposite the retouched stem). Polishes on these acute edges were present but not highly developed, suggesting the lack of sustained use for processing siliceous plants (Fullagar, 1991).

The main features for distinguishing plant *versus* animal tool functions were residues with distinctive structures in association with use-wear (fig. 2) : cellular tissue, starch grains, phytoliths, calcium oxalate crystals (raphides), and yellow-red plaques (blood) which reacted positively to Hemastix reagent strips. The most common residues were starch grains (mostly 2 microns maximum dimension) and phytoliths. Blood residues were identified but not in association with any other animal tissue such as bone or collagen. This may not be significant since bone and shell were not preserved in any layers, which is not surprising in these volcanic sediments.

The retouched stem on many of the tools has abundant plant residues but the use-wear on retouched stems includes rounded ridges away from the edge and is more consistent with haft-



Fig. 2. Plant residue and use-wear on stemmed tools from 1981 trench, FRL. Width of field : 2 mm.

wear than tool-use. To further investigate the issue of hafting and to resolve the nature of possible contamination from organic materials in the sediment, one stemmed tool was investigated in detail (Fullagar, Bowdery, 1991). The aim was to quantify the phytolith residues from three locations on one tool and to compare the results with phytolith residues from a sample of sediment from the same layer. After brushing loose sediments from the tool shown in figures 3A and 3B, remaining sediments were removed with a more coarse brush from nine locations along the tool edge (table 3).

	dorsal	ventral	Combined ventral and dorsal
A : retouched stem	1	1	1
Area B : centre of tool	1	1	1
Area C : distal end	1	1	1

Table 3. Sample locations on stemmed tool for residue analysis.

D. Bowdery (Australian National University) prepared each sample by centrifuging, sieving and specific gravity separation so that microscope slides were prepared of particles less than 250 microns and less than 2.3 specific gravity. The combined samples from dorsal and ventral surfaces were similar to results for dorsal and ventral separately, and only combined results are presented here.

	A (stem)							
	A (stem)		B (centre)		C (distal)		Soil	
		%		%		%		%
33 selected shapes :								
Grass	52	(56)	59	(45)	66	(55)	62	(67)
Palm	0	(0)	3	(2)	1	(1)	0	(0)
Other	41	(44)	68	(52)	53	(44)	31	(33)
Total in 33	93	(100)	130	(100)	120	(100)	93	(100)
Other shapes	253		253		206		279	
Total phytoliths	346		383		326		372	
Exclusive shapes	4		5		1		1	
Starch grains on tool : estimated abundance	low		very high		low		low	

Table 4. Summary of phytolith and starch distributions on stemmed tool and soil sample (percentages of total in 33 selected shapes are in brackets).

In the absence of adequate reference phytolith collections only general trends can be outlined here, based on discrimination between grasses and dicotyledons with further discrimination of phytoliths from Palmae. A total of 33 phytolith shapes were selected for analysis and a total of 1 427 phytoliths were counted by Bowdery. Table 4 presents a summary of the data with significant variations.

The absence of developed silica polish on the tool suggests that phytoliths could not have contributed markedly to use-wear and therefore that the phytoliths are largely contaminants from surrounding soil. The variation in phytolith distribution suggests that the retouched stem was protected from surrounding sediments, supporting the hypothesis that it was wrapped in some kind of plant haft. The distribution of palm phytoliths suggests that palm tissue may have come in contact with the central part of the tool. Since palm generally has a high silica content it is unlikely that use-wear on the tool edge is due to sustained use on palms. Rather, it is possible that palm was used as a hafting material. The small size and distribution of starch grains strongly supports the hypothesis that the central part of the tool was used to process starchy plants. In the absence of developed silica polish, this plant must also have had a low silica content, which is consistent with our knowledge of starchy tubers, which do not have phytoliths. The presence of calcium oxalate crystals of long needle-like shape may indicate taro, but other starchy tubers, particularly yams are also likely.

The very detailed analysis of this one stemmed tool strongly supports the hypothesis that the

presence of starch grains on many of the stemmed tools indicates a primary function of the processing of plant foods in the period prior to the main Witori eruption 3 500 to 4 000 years ago. The general absence of stemmed tools after this eruption and the abundant ethnographic evidence indicate that the primary use of obsidian in the recent past was related to the human body, primarily shaving and surgery (Specht, 1981). More recently collected ethnographic data suggest that shell may have replaced obsidian for processing plant foods such as taro and yams (Specht, Fullagar, 1988).

Conclusions

Analysis of the obsidian artefacts from FRL is incomplete and, although stemmed tools are the only distinct class of retouched artefacts, the total number of artefacts which have been analysed microscopically is small. Nevertheless, use-wear and residue analysis have demonstrated that, for the FRL site area, the primary function of obsidian may have changed, despite continuity in the subsistence base. The reasons for this remain unclear, although it is tempting to relate this change to the onset of the Lapita cultural complex which postdates the main Witori eruption. The nature of such replacements of raw materials remains a rich area for future studies.

This study provides a significant methodological advance in its attempt to quantify residues, specifically phytoliths and starch grains on a single stone tool. Although grass phytoliths are probably contaminants from surrounding sediment, palm

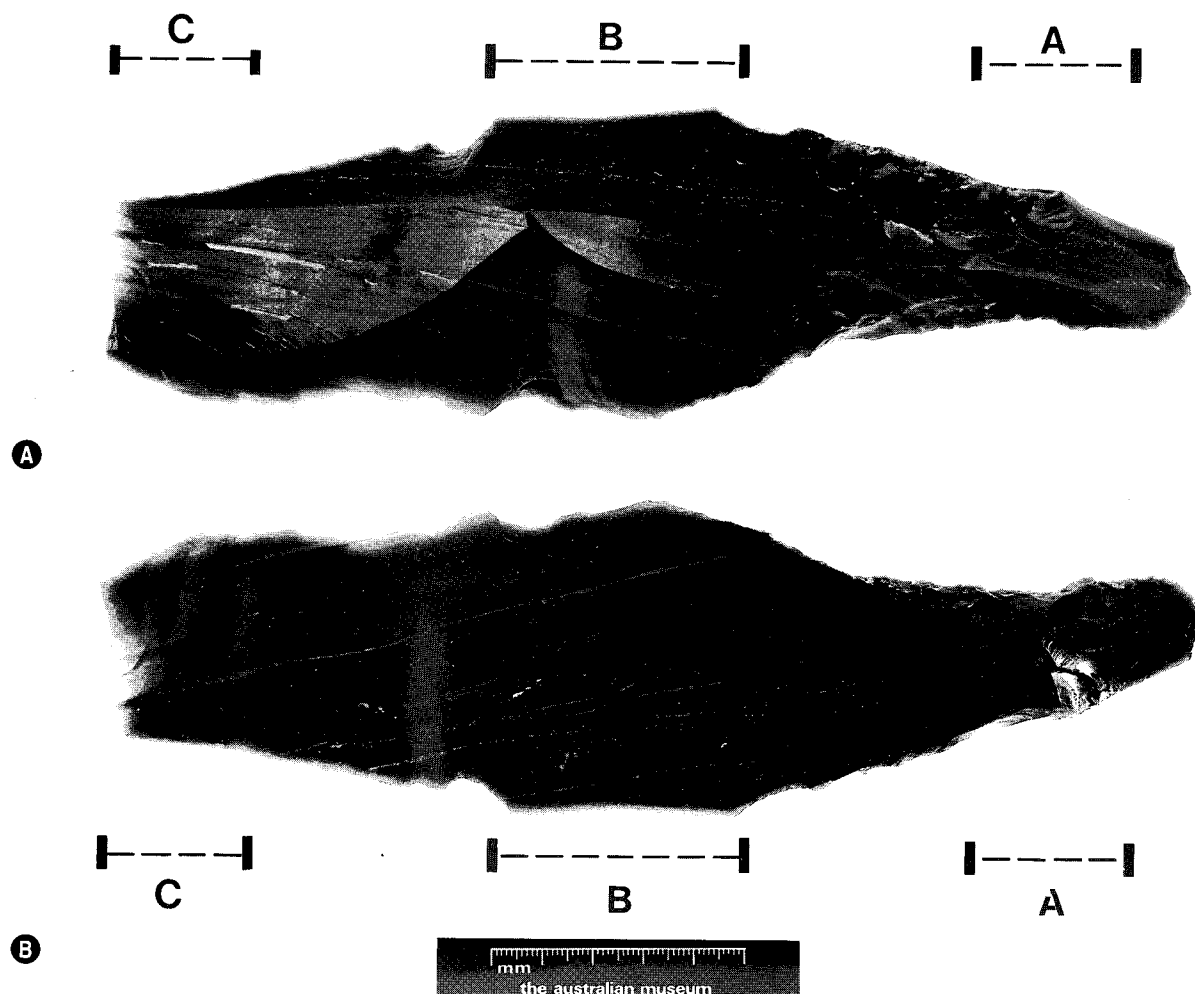


Fig. 3. Stemmed tools from 1988 trench, FRL (T1/C/1, artefact number M150), indicating areas along edge where samples were taken for phytolith and starch analysis. A. Dorsal surface. B. Bulbar surface.

phytoliths and starch seem to correspond with tool function. The identification of plant processing as a primary function of a particular class of flaked stone tools casts doubt on the ethnographically based notion that the primary function of flake tools is related to woodworking and butchering.

Limitations of this preliminary study require further resolution. Although plant-working is the most common tool function for both retouched and unretouched tools, the raw material itself (that is, obsidian) is perhaps unsuitable for many woodworking tasks (see Kamminga, 1982). However, many people living in the area have told me that obsidian was used for some woodworking activities such as carving wooden shields. The full range of ethnographic information

is currently being assessed, but I believe that a woodworking function for obsidian is extremely likely, especially since shell tools have been used for this task.

The study of a specific area such as Talasea with abundant obsidian outcrops may be a poor indicator of stone tool function generally. Study of obsidian tools at more distant locations away from the obsidian sources is currently under investigation.

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