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The restricted function of Neolithic obsidian tools at grotta Filiestru, Sardinia

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Résumé

Les outils en obsidienne des niveaux néolithiques de la grotte de Filiestru, Sardaigne, ont montré une série de fonctions restreintes. Les pièces examinées étaient pour la plupart des types d'outils non classiques, et pourtant une grande partie d'entre elles ont servi à travailler spécialement les matières tendres. Les interprétations de fonctions sont tirées des résultats d'un programme expérimental. L'association de l'usure et des résidus présents sur certains outils montre qu'il ont été utilisés sur peau et viande. Les artefacts en obsidienne qui ne se trouvent qu'à environ 75 km de leur source géologique étaient donc utilisés pour une série d'activités spécialisées. Certains résidus sont répartis près du bord utilisé et suggèrent qu'ils se rattachent aux matières travaillées ; d'autres ont des positions évoquant l'emmanchement et la préhension.

Abstract

Obsidian artefacts from Neolithic levels at the site of Grotta Filiestru, Sardinia, showed a restricted range of functions. Even though the pieces examined were mostly not formal tool types, a high proportion were used especially for working softer materials. Interpretations of function were based on the results of an experimental programme. The combination of wear and residues present on some of the tools showed that they had been used on hide and flesh. Obsidian artefacts only c 75 km from their geological source are therefore used for a specialised series of activities. Some of the residues are distributed near the used edge, suggesting they are use-material related, others are in positions suggesting they are related to hafting and holding.

Introduction

Functional information can illuminate the role of artefacts within the society which made them. Obsidian has long been considered an important indicator of long-distance prehistoric exchange or contact in the Neolithic. Less attention has been paid to any functional roles for obsidian and indeed to its exploitation near the geological sources. Functional analyses addressing these issues are long overdue and the material presented here should be seen as the first steps towards filling this gap. One of the Mediterranean's obsidian sources lies on the island of Sardinia. The results reported in this paper will suggest that even in the early Neolithic and at sites fairly close to the obsidian sources on Monte Arci the functional role of obsidian could have been restricted.

The Sardinian site of Grotta Filiestru (fig. 1 provides a location map) was chosen because a recently-excavated set of dated material with good contextual information was needed. Grotta Filiestru was published (Trump 1983) and formed part of a larger project in the Bonu Ighinu Valley (Trump, 1991). The site had stratigraphical dated relationships and there were sufficient numbers of artefacts within these contexts to provide a reasonable microwear sample. A drawback was that the site was not totally excavated and so the assemblage may be culturally biased as if there were distinct activity areas at the site for one or several tasks the excavated material might show only a limited range of functions. However, the stratigraphy spans over a thousand years, so any bias would have to be constant over this period in order to affect the results. As about 15 % of the main cave floor area had been excavated and the obsidian was concentrated within this excavated area chiefly to trench D, despite the deep stratigraphy, the sample was felt to reflect an area with denser artefact yields for most of the period of occupation of the cave and hence be a reasonable sample for the functional analysis.

Fig. 1. Location map showing the position of the site of Grotta Filiestru and the obsidian source of Monte Arci in relation to modern Sardinia.

In order to evaluate the functional interpretations and patterns obtained by the microwear study of this material, it is essential to appreciate the contexts of the stone tools as a whole, the role of obsidian within this, and the nature of the sample subjected to microwear analysis. This discussion is based on Trump's (1983) excavation report and an archive report for Sassari Soprintendenza on further detailed study of technology and function undertaken later (Phillips, Hurcombe, 1990).

Grotta Filiestru and its obsidian assemblage

The site is a limestone cave which was thought to be used as a residential base for at least part of its prehistoric occupation (Trump, 1983). The stratigraphy spans the Early Neolithic 4760 ± 75 bc to the Copper Age Ozieri level. Levels 6 (Filiestru level c. 4000 bc) and 5 (Bonu Ighinu level c 3730 bc) had sizeable lithic assemblages and were chosen for further study. A variety of lithic materials were employed, *e.g.* flint, obsidian and rhyolite. The flint assemblage included long blades and the obsidian assemblage contained some blades and arrowheads. Hence the technology and the objects produced by it differed slightly according to the lithic raw material. Of the lithic types found at the site, obsidian is the most brittle, produces the sharpest flake edges, and has the best conchoidal fracture properties. Moreover, the size of the raw material nodules available from the Conca Cannas and Perdas Urias sources on Monte Arci (12 cm in length is not uncommon) would not restrict the production of longer artefacts if the knappers were reasonably skilled. Obsidian would be a good raw material for the knapping of precise shapes due to its predictable and easily-flaked properties, and would pressure flake well. Its use for producing the arrowheads and small blades is therefore not surprising. Instead it demonstrates that the use of lithic materials was well-suited to the tasks performed *versus* the lithic variety available.

Given the properties of obsidian, the expected range of tasks the obsidian could perform as well as or better than the flint or rhyolite include the following : cutting meat, fish and hide where its sharp edge gives longevity and precision ; reaping activities ; working soft plant materials ; fine detail on the working of woody plants, wood, bark and cork. The other materials would be better for heavier tasks requiring more robust edges, *e. g.* working wood, bone, and antler. Furthermore, an unmodified obsidian edge is more effective for the slicing of flesh and hide whereas a retouched edge could increase the robustness of the working edge. All of the above comments stem from personal observation while knapping and using stone tools. There is of course no need for lithic materials to be used economically unless there is some pressure on the availability of raw materials, time, or at a more social and personal level the skill and quality of stone tool production or use. Bearing these factors in mind, the results of the functional analysis of the obsidian were in some ways no surprise.

Functional analysis

The method of functional analysis used is described in Hurcombe 1992 but is based on a combination of factors such as edge-scarring, polish (surface smoothing at 250x magnification), striations (linear arrangements of surface alterations), attrition (surface roughening at 250x magnification), residues and other features, all interpreted with reference to an experimental programme. The processes of interpreting the wear features to give information on the use-action, use-material and in some cases use-time is the same as that described for other archaeological artefacts (Hurcombe, 1992 : chapters 4 and 7). Some sets of wear allow a specific use-material to be inferred but this is not always the case. In general, weak use-actions, low use-times and soft use-materials wear the tool surface less and thus can cause wear sets attributable to a range of functions (see Hurcombe, 1992 : chapter 4). As obsidian has a naturally bright shiny surface the smoothing of the surface is more subtle and scanning a piece for microwear evidence takes more time than might be the case for flint, but residues show very clearly against this bright background and are thus of greater interest on obsidian tools. Other than these features the technique of obsidian microwear analysis is generally similar to that for flint (*e. g.* Keeley, 1980 ; Vaughan, 1985 ; van Gijn, 1990). The complexity and time consuming nature of the technique limit the sample size for analysis but for this material there was a further consideration. All the material had to be exported to Britain for the study using a licence kindly granted by the Soprintendenza. This did not include any of the small finds such as retouched recognisable tool types nor whole blades. The sample was further reduced by not exporting cores which had no macroscopic evidence of wear. The resulting collection of artefacts was thus heavily biased towards flakes, broken or segmented blades and irregular fragments. It was precisely this category of material that is least often studied for functional information and yet could be expected to show the pressures of the availability and use of the raw material.

The sample available for study in Britain was composed of 294 pieces from level 5 and 153 pieces from level 6. These were numbered and studied macroscopically (Phillips, Hurcombe, 1990). These levels had been dug in spits and so additional numbers indicating their spit and artefact number within this context were assigned. A subset of the material was examined microscopically on the basis of two samples. As the use or otherwise of simple unretouched flakes in both levels needed to be established, a grab sample was selected of 20 pieces from the first spit of each level, irrespective of the type of artefact and whether it seemed to be used or not. Thus, sample A consisted of pieces D5+1 numbers 1-20 and D6+1 numbers 1-20. A further sample of 35 pieces with retouch/edge damage or other features of particular note formed sample B. The latter was by no means an exhaustive list. In comparison to the rest of the assemblage the sample selected for microwear was generally representative.

Each piece selected for microwear analysis was drawn and the location of wear and other features marked on the drawing. The features describing the polish, striations, attrition and residues were noted systematically on a recording form (Hurcombe, 1992 : fig. 4). These were interpreted according to methods explained at the same time.

Results

The results of the functional analysis are presented in appendix A and summarised in table 1. In brief, the study indicates that obsidian tools are strongly associated with flesh and hide related activities, a new tool category was identified as a knife with particular use for butchery, some of the pieces were neither formal tool types nor retouched. These results are discussed in detail below.

The interpretations of use-material are dominated by the flesh (fig. 2) (including both animal and fish) and hide (fig. 4) categories representing 42.7 % of the assemblage. This figure is strengthened by a number of arguments. Firstly, flesh and butchery activities form wear slowly as the materials (other than bone and tendons in butchery) are soft and the actions involve relatively little force. Hence, wear traces identifiable to flesh processing are slow to form and are likely to be under-represented in the interpretations of the wear analysis. Furthermore, some of the categories may include tools which have been used for hide and flesh related activities but have left traces which can be attributed to a range of functions. Thus, the soft, *soft/resilient* and *plants/hide* categories may all include artefacts used for flesh and hide working, and an unknown portion of the 22.5 % accounted for by these categories may be added to the known 42.7 % of the assemblage associated with animal processing. On the other hand there are very few specific use-material identifications of other material types. *Plants* are the most numerous (6.7 %) and only one interpretation of *bone/antler* exists as the use-material category for one of the used areas on a multiple use tool (fig. 5). Moreover, three projectiles are also included but as arrowheads were deliberately excluded from the use-wear sample, the small number of projectiles here represent solely those pieces which were not immediately recognisable as projectiles. Since projectiles are also associated with animals then again the link of obsidian with these kinds of activities is strengthened.

Taken altogether, the evidence shows obsidian was used on softer materials and seems to be especially associated with the processing of animal carcasses. This statement holds true for both the stratigraphic levels and the two types of sample. There are small variations however. The flesh, butchery and hide activities are better represented in the sample A group because sample B was chosen on the basis of macroscopic indications of likely use such as edge damage or retouch, which are not good indicators of cutting tools on soft materials. Hence, sample A is a fairer reflection of these activities than sample B.

Figures 8 and 9 illustrate a specific group of artefacts and the more varied and smaller flakes which make up most of the sample and have been used on a variety of materials. Two points deserve attention. Firstly, the knives in figure 8 stand out

Usematerial	Level 5		Level 6		Total		Sample A		Sample B	
	N°	%	N°	%	N°	%	N°	%	N°	%
Projectiles	2	5.0 %	1	2.9 %	3	4.0 %	0	0.0 %	3	8.6 %
Flesh/Butchery	5	12.5 %	5	14.3 %	10	13.3 %	7	17.5 %	3	8.6 %
Flesh/Hide	5	12.5 %	6	17.1 %	11	14.7 %	7	17.5 %	4	11.4 %
Hide	3	7.5 %	5	14.3 %	8	10.6 %	4	10.0 %	4	11.4 %
Subtotal	15	37.5 %	17	48.6 %	32	42.7 %	18	45.0 %	14	40.0 %
Not identified	7	17.5 %	5	14.3 %	12	16.0 %	7	17.5 %	5	14.3 %
Soft	2	5.0 %	4	11.4 %	6	8.0 %	3	7.5 %	3	8.6 %
Soft/Resilient	3	7.5 %	2	5.7 %	5	6.7 %	3	7.5 %	2	5.7 %
Hard	4	10.0 %	0	0.0 %	4	5.3 %	1	2.5 %	3	8.6 %
Plants	4	10.0 %	1	2.9 %	5	6.7 %	4	10.0 %	1	2.9 %
Plants/Hide	4	10.0 %	3	8.6 %	7	9.3 %	2	5.0 %	5	14.3 %
Multiple	1	2.5 %	3	8.6 %	4	5.3 %	2	5.0 %	2	5.7 %
Totals	40	100.1 %	35	100.1 %	75	100.0 %	40	100.0 %	35	100.0 %

Table 1. Comparisons of the use-material interpretations for level 5 against level 6 and for samples A and B.

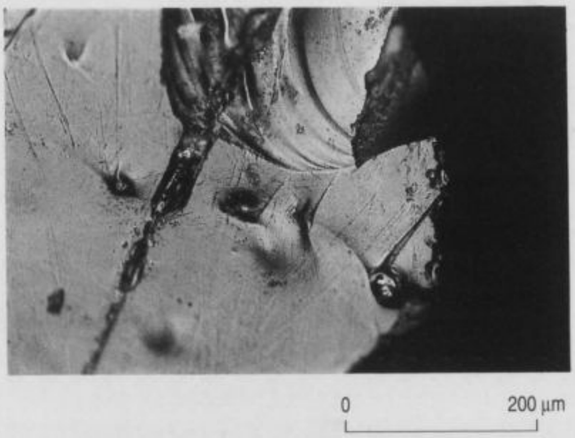

Fig. 2. Slightly altered surface texture and sleeks caused by contact with flesh and occasional hard contact giving large flaked striations and edge damage (D6+3.3 original magnification 250x).

Fig. 3. Cutting flesh and hide leaving slight polish and damage plus deep sleeks with a folded sub-angular feature arrowed (D6+1.5 original magnification 250x).

Fig. 4. Hide scraping has worn a rounded edge with many striations (D5+2.5 original magnification 250x).

Fig. 5. Dull grainy texture and striations from working bone parallel to the edge on a tool with several wear types (D5+2.40 original magnification 250x).

Fig. 6. Ridge showing polish and striations from holding wear, together with folded sub-angular residues (arrowed) (D5+2.40 original magnification 250x).

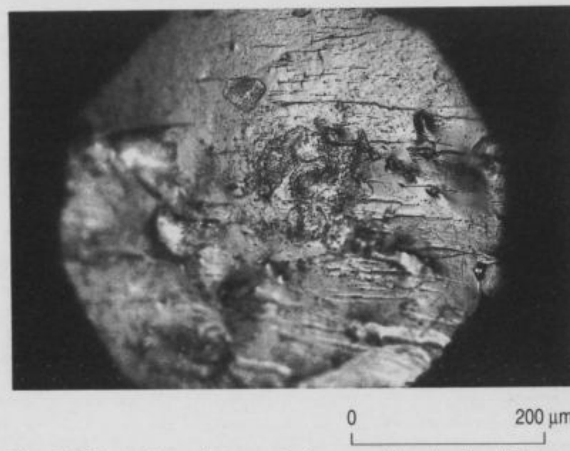

Fig. 7. This tool was interpreted as used for piercing hide and the surface shown has several flat sub-angular residues laid flat and adjoining one another (D5+1.13 original magnification 250x).

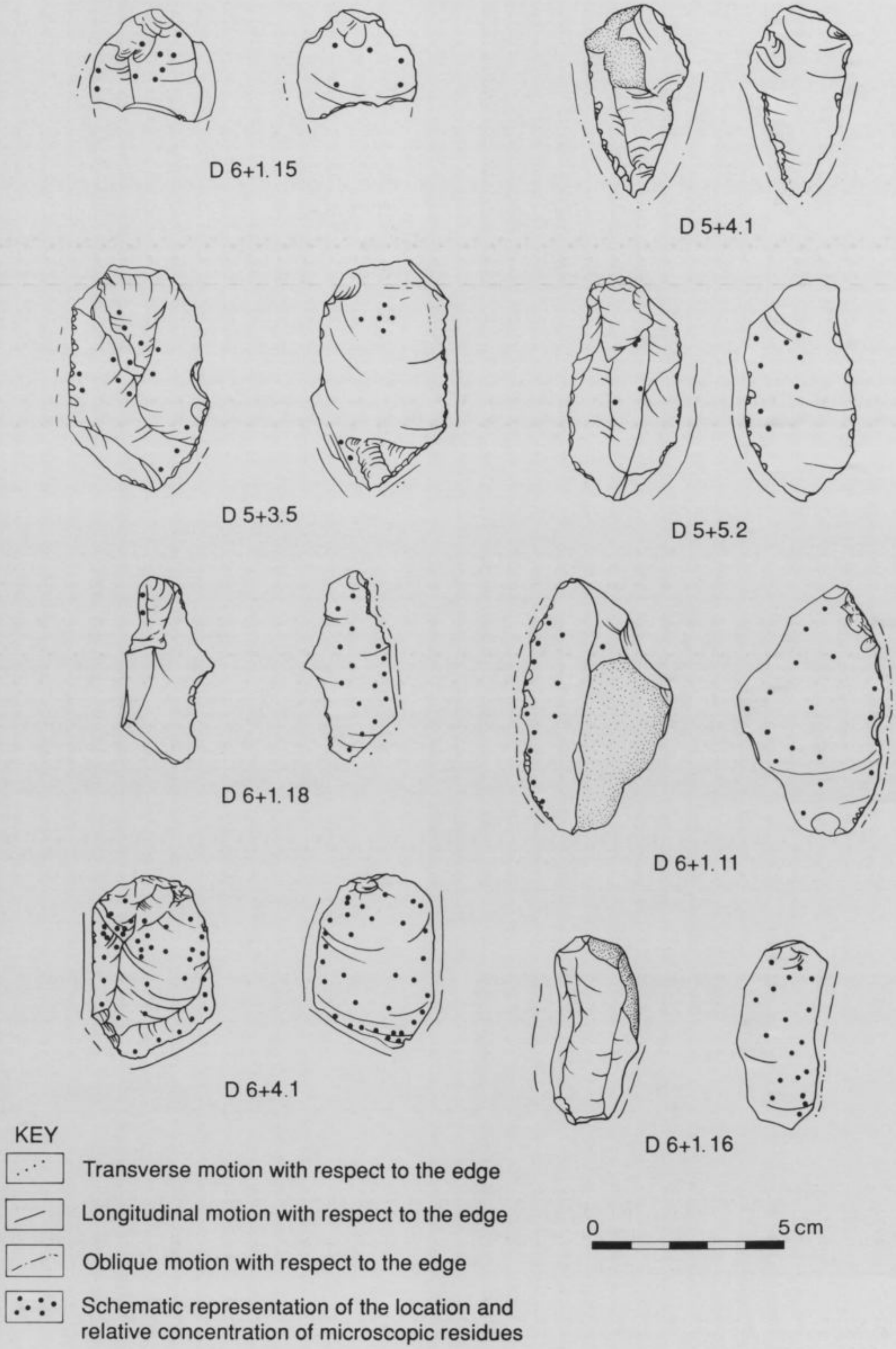

Fig. 8. A new type group of artefacts used as knives indicating the position of wear and residue traces.

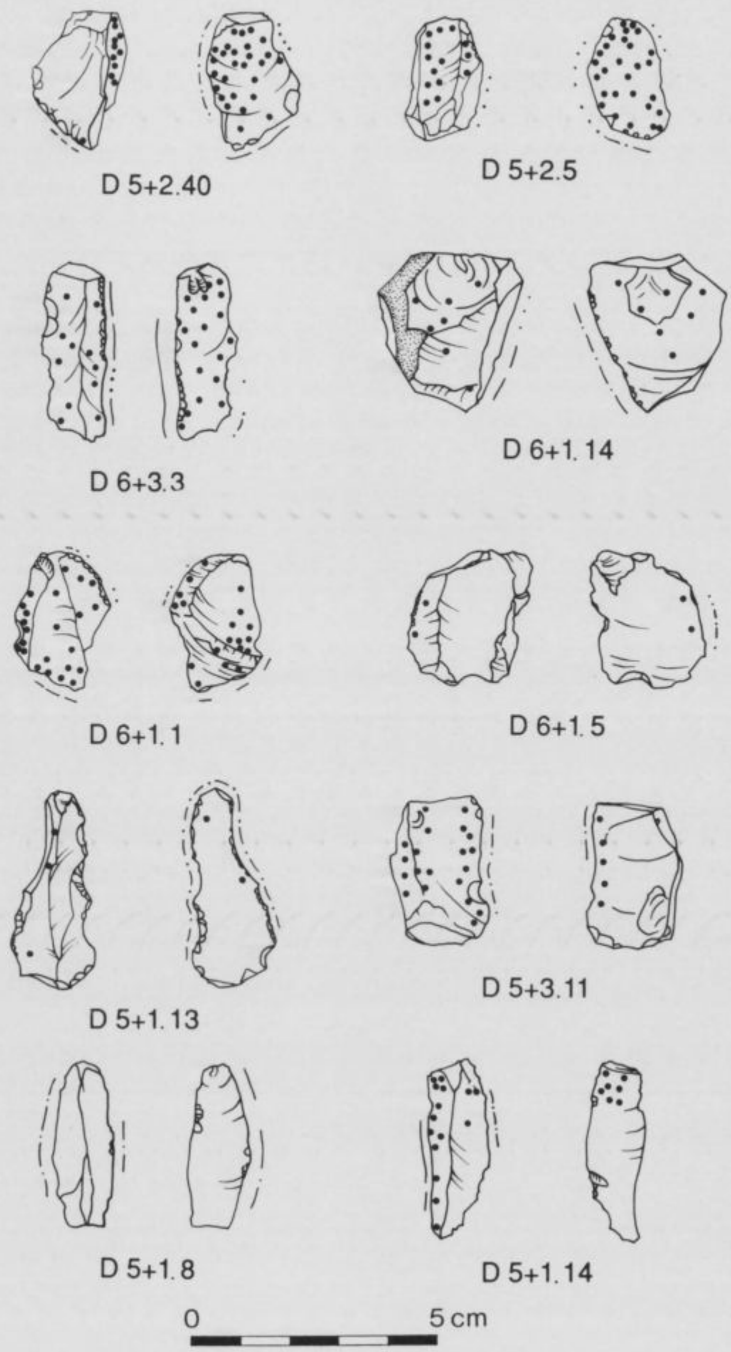

Fig. 9. A variety of artefacts showing wear and residue traces.

from the other artefacts for their size and regularity. Secondly, the material from Grotta Filiestru shows that small and irregularly shaped flakes of obsidian were used and sometimes intensively so (*e. g.* artefact D5+2. 40). These flakes do not have obvious signs of use for the most part. These results thus emphasise the bias likely in microwear samples chosen on the basis of shape or macroscopic wear. In particular, the restriction of wear analysis to formal tool categories would discriminate against artefacts used on softer materials and, in this case at least, against flesh/butchery and flesh/hide activities.

The results indicated a new tool type : a group of broad long flakes (fig. 8) used for cutting. Where the use-material can be specified these show flesh, butchery and hide traces (*e.g.* fig. 2). It is tempting to call them butchery knives, but their use on dry hide and possibly other materials makes this slightly inaccurate. Rather, they could be seen as « knives », but used especially for carcass processing. The length (4.5-7.0 cm) and width (2-4 cm) make these flakes easy to hold in the hand. The most clearly recognisable examples of this group come from the later level 5. The examples from level 6 use more irregular shapes and in one case part of the dorsal surface is still cortex. One tool (D5+5.2) appears to be retouched at its proximal end to facilitate hafting but in general the edge scars are use-related rather than deliberate retouch. Some have two usable sides increasing the amount of time the tools could have been used. Experimental work (Hurcombe, 1986b : 160 and table 11) shows that wear traces are not distinct for cutting meat until after almost an hour of use and a tool used for three hours was still cutting well. Thus, the artefacts in this knife class represent a considerable period of use. Their longevity as butchery tools would depend upon how the carcasses were cut up. For example, cutting meat into a number of shares, or into small pieces for drying and storage, would both result in higher processing time per carcass than simply removing skin, viscera, limb extremities and head.

The residues represented on the artefacts in figure 8 are interpreted to indicate holding arrangements as well as use and are worth discussing further.

During experimental work sub-angular flat residues were noticed (Hurcombe, 1986b : 165-166) and interpreted as residues from skin. These skin residues had a ridged surface texture and sometimes appeared to be folded. They were most evident on tools used to work hide, fish and animal flesh, and occurred in relation to the used edge, but were also present from other activities where tools were handheld. The distribution of this same residue type (fig. 3, 6 and 7) on the Filiestru material is schematically indicated by stippling in figures 8 and 9. There are clear indications of two distribution patterns on some tools. One relates to the used edge of the tool (*e.g.* D6+1.11) and hence is assumed to originate from the use-material ; the other is on bulbar areas or mid-dorsal ridges (*e. g.* D5+3.5) and has been interpreted as residues from the hands which held the tools (fig. 6). Some further study of these *via* immunological and histological techniques are being investigated. Here, it is sufficient to present the residues and their distribution and to state that natural processes in the soil are unlikely to provide this type of patterned distribution nor are they similar in shape or texture to residues on experimental artefacts which have lain exposed to the elements, in agricultural soil and in undisturbed soils. The interpretation of these residues as skin components best fits a variety of experimental data including the extraction from suede of similar residues (Hurcombe, 1986b : 166). Thus the residues documented here potentially offer animal and human remains from the Neolithic of Sardinia. A preliminary attempt to extract DNA has proved unsuccessful so far. It is not known whether the preservation of such residues is exceptional due to the site lying within a cave, but use-related residues have survived rigorous cleaning techniques on experimental tools and been recorded on archaeological pieces from an open air Bronze Age site in Sardinia (Hurcombe, 1985, 1986a, 1992 : chapters 4 and 7). On present evidence it is likely that the Filiestru residues may not be the result of exceptional preservation conditions.

Finally, it should be stressed that the use-wear analysis of material from Grotta Filiestru showed that unretouched and irregular obsidian flakes were being used, and that the obsidian component of the site lithic assemblage was strongly associated with the processing of animal carcasses. This is a reasonable use of obsidian as a raw material which cuts these materials well because of its very sharp edge. If these features can be demonstrated for a Neolithic assemblage located only 75 km from the source of the obsidian, how much more specific a functional role might obsidian play further away from the source ? As techniques improve, the residues on the Filiestru obsidian tools may allow the types of animal processed with obsidian to be determined and may even document the genetic affiliations of both the Neolithic animals present in Sardinia and the people using the tools.

Acknowledgements

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APPENDIX

The material is grouped by use-material categories and within these groups the artefacts are ordered by layer spit and artefact numbers. The table indicates whether the tool was used or not, the use-action and the use-material interpretations. Finally the last column indicates whether there were residues visible on the surface. Artefacts forming sample B are shown in italics.

Artefact	Used	Action	Material	Residues
USE-MATERIAL NOT IDENTIFIED				
5+1.1	?	?	?	
5+1.3	?	?	?	yes
5+1.4	no	-	-	
5+1.12	no	-	-	
5+1.23	*yes*	*pierce*	*?*	
5+2.42	*?*	*-*	*surface too uneven*	
5+2.58	*yes*	*oblique*	*?*	
6+1.20	?	-	-	
6+1.6	yes	?	?	yes
6+1.9	yes	?	?	yes
6+2.60	*?*	*?*	*?*	
6+5.2	*?*	*-*	*-*	
SOFT				
5+1.9	yes	parallel	soft	yes
5+2.35	*yes*	*parallel*	*soft - flesh ?*	*yes*
6+1.4	yes	transverse	unknown but soft	yes
6+1.5	yes	transverse	soft ?flesh/hide	yes
6+2.17	*yes*	*parallel*	*soft*	*yes*
6+3.4	*yes*	*parallel*	*soft*	*yes*
SOFT/RESILIENT				
5+1.5	yes	parallel	soft/resilient	yes
5+1.6	yes	parallel	soft/resilient	yes
5+2.55	*yes*	*pierce*	*soft/resilient*	*yes*
6+1.17	yes	transverse	resilient ?	
6+2.48	*yes*	*parallel*	*soft/resilient*	
HARD				
5+1.7	yes	parallel	hard	
5+2.38	*yes*	*transverse*	*hard - hide ?*	*yes*
5+2.45	*yes*	*-*	*hard*	
5+3.7	*yes*	*transverse*	*hard-bone/antler ?*	*yes*
PLANTS				
5+1.8	yes	parallel	plants (reeds)	yes
5+1.10	yes	?	very soft (plant)	
5+1.15	yes	reap	plant	
5+1.19	yes	parallel	woody plant/reed	yes
6+2.26	*yes*	*parallel*	*plant*	*yes*
PLANTS/HIDE				
5+1.2	yes	parallel	plants/hide	yes
5+2.7	*yes*	*parallel*	*plant/flesh*	*yes*
5+2.10	*yes*	*parallel*	*flesh/hide+plants ?*	*yes*
5+2.31	*yes*	*parallel*	*plants-flesh/hide ?*	
6+1.19	yes	transverse	plant/hide	yes
6+3.24	*yes*	*transverse*	*plant(hide ?)*	*yes*
6+6.1	*yes*	*transverse*	*hide/plant*	*yes*

Artefact	Used	Action	Material	Residues
PROJECTILES				
5+3.6	*yes*	*broken*	*arrowhead*	
5+3.10	*?*	*-*	*arrowhead ?*	*yes*
6+4.3	*?*	*broken*	*projectile point*	
FLESH/BUTCHERY				
5+1.17	yes	parallel	flesh (butchery)	yes
5+1.18	yes	parallel	flesh (butchery)	yes
5+1.20	yes	parallel	? flesh	yes
5+3.5	*yes*	*parallel*	*flesh/butchery*	*yes*
5+4.1	*yes*	*parallel*	*flesh*	
6+1.2	yes	parallel	flesh/butchery	yes
6+1.10	yes	parallel	flesh ?	yes
6+1.11	yes	parallel	flesh/butchery	yes
6+1.15	yes	parallel	flesh ?	yes
6+3.3	*yes*	*parallel*	*flesh/butchery*	*yes*
FLESH/HIDE				
5+1.11	yes	parallel	fresh hide/meat	yes
5+1.14	yes	parallel	fish/gritty hide	yes
5+2.30	*yes*	*parallel*	*flesh/hide*	*yes*
5+3.11	*yes*	*parallel*	*flesh/hide*	*yes*
5+5.2	*yes*	*parallel*	*flesh/butchery/hide*	*yes*
6+1.1	yes	parallel	flesh/fresh hide	yes
6+1.12	yes	transverse	hide/fish	yes
6+1.14	yes	mixed	hide/flesh/bone	yes
6+1.16	yes	parallel	fresh hide/flesh	yes
6+1.18	yes	parallel	hide/flesh	yes
6+3.11	*yes*	*transverse*	*hide/flesh*	*yes*
HIDE				
5+1.13	yes	pierce?	hide	yes
5+1.16	yes	parallel	hide(fresh ?)	yes
5+2.5	*yes*	*transverse*	*hide*	*yes*
6+1.7	yes	parallel	hide	yes
6+1.8	yes	transverse	hide	yes
6+2.12	*yes*	*transverse*	*hide*	*yes*
6+2.62	*yes*	*transverse*	*hide*	*yes*
6+4.1	*yes*	*parallel*	*fresh hide*	*yes*
MULTIPLE USE-MATERIALS				
5+2.40	*yes*	*parallel*	*multiple*	*yes*
6+1.3	yes	parallel	soft & hard	
6+1.13	yes	transverse	mulitple	yes
6+3.18	*yes*	*parallel*	*multiple*	*yes*

Table. 2. The wear interpetations of the obsidian artefacts from Grotta Filiestru grouped by use-material.