Lithic Industry at Çayönü: Different Raw Material Used, Different Function(s) Done? The Lithic Assemblage of the Channeled Building DI.

Çayönü Kanallı Yapı DI Taş Buluntu Topluluğu: Çeşitli Hammaddeler, Çeşitli İş(ler) İçin mi Kullanıldı?

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Çayönü taş alet endüstrisi iki ayrı tür hammadde kullanılarak yapılmıştır; çakmaktaşı ve obsidien. Teknolojik ve tipolojik incelemeler, Akeramik Neolitik Devrin alt evrelerinde, bu iki hammaddenin oranlarında önemli değişikliklerin yer aldığını ortaya koymuştur. Erken evrelerde oldukça sınırlı bir yüzdeyle temsil edilen obsidien endüstri daha sonraki evrelerde giderek bollaşmaktadır. Kullanım etkenlerinin hammadde seçimini eğer/ yahut ne denli etkilediğini saptamak için Kanallı Yapıdan (DI) toplanan taş endüstrisine kullanım aşınması analizleri uygulanmış ve sonuçlar değerlendirilmiştir. DI Kanallı Yapıdaki çakmaktaşı ve obsidien taş alet endüstrisinin işlevsel verileri, bu hammaddelerin çok ayrı kullanım özelliklerine sahip olduğunu kanıtlamıştır. Taş ve deri işlemede bu hammaddelerin rolü çok tamamlayıcıdır. Nitekim, post çoğunlukla çakmaktaşından aletlerle tabaklanmış olmasına rağmen posttan ve deriden yapılan eşyalar obsidien aletlerle yapılmışlardır. Taş eşyalar,istisnasız, obsidien aletlerle biçimlendirilmiş ve tamamlanmıştır. Taş eşyaların delinmesi çakmaktaşı delicilerle sağlanmıştır. Sadece iki ayrı tip alette çakmaktaşı/obsidien hammadde ayırımı kesin belirlenmiştir; çakmaktaşından delicilerin post işlemede, obsidienden Çayönü aletlerin ise taş işleriyle ilgisinin olması. Uygulanan diğer işlevler sonucu obsidien ve çakmaktaşından dilgilerin kenarlarında aynı kullanma yoğunluğu görülmektedir. Buna rağmen, bu iki hammadenin belirgin kullanma alanlarını kesin saptamak için salt işlevsel veriler yeterli olmamaktadır. Kültürel kanıtlarda, özellikle, göz ardı edilmemelidir.

Introduction

Çayönü Tepesi, located in the district of Diyarbakır, is a fundamental point of reference for the chrono-stratigrafic organisation of the Pre-Pottery Neolithic in Anatolia. Its integrated architectonic sequence, the most complete among all those brought to light in the region, comprises by six major sub-phases - Round Building, Grill Plan,

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Channeled Building, Cobble-Paved Building, Cell Plan Building and Large Room Building. These all are included in a chronological arc between 10200 and 8100 BP (M.ÖZDOĞAN-A.ÖZDOĞAN,1989).Notably, from both the quantitative and qualitative points of view, the sequence of lithic industries collected in the several campaigns of digging has motivated the creation of a single integrated, typological, technological and functional (by use-wear analysis) plan of research in order not only to redefine the concept of " tool " in Pre-Pottery Neolithic lithic contexts of the Near East but also to propose a single chronological architectural sequence to integrate the two(I.CANEVA et alii,1994; I.CANEVA,1998,in press). While the typological approach is " traditionally " applied to the lithic industries of the Near East, the technological and functional approaches have only recently been introduced and used in relation to a limited number of contexts (F.ABBES,1997; P.C.ANDERSON,1994; M.-C.CAUVIN, 1993; P.J.WHITE - L.QUINTERO,1994).

The functional analysis by use-wear plays an important role for the understanding of the lithic tools. In fact, it establishes if and how lithic tools have been used by man. Moreover, it links the functional characteristics of the lithic tools with their morphological characteristics, emphasizing the correlation consequently establishing the degree of functional specialisation of their " shape ". Finally, the data acquired on activities reveiled by the lithic industry contribute to insights on the use of the spaces in the archaeological context (areas of specialised activities, sacred or inhabited areas etc...).

The lithic industry of Çayönü has been marked by two distinctive raw materials: flint and obsidian. Techno-typological analyses have established that the subphases of the Pre-Pottery Neolithic are characterised by important variations in their ratios. The obsidian industry, present in relatively limited percentage in the older phases (stage 1, Round Building and Grill House b,c, obsidian 11%) becomes more and more abundant in the most recent phases (stage 2: Channeled and Grill House Building, obsidian 20%; stage 3, Cell Building, and 4, Large Room Building, obsidian 50%) (I.CANEVA et alii, in press).

The quantitative and qualitative variation (beginning with the second stage observable as an always major presence of both débitage and instruments in obsidian) of the two raw materials could be due to many factors like, for example, to the type of circulation and exchange of the " exotic " obsidian whereas the supply of the flint, coming from a local source, was perhaps less subject to some conditions external to the human groups living in this site, to the techniques of production adopted, to functional requirements, to cultural factors and so on. In order to determine if and how much the functional factors can have influenced on the choice of the two raw materials, an appraisal of the result of the use-wear analysis has been carried out on the lithic industry from the Channeled Building DI. These functional data are, in this stage of the research, the ones processed in more detail.

The report will introduce a general picture of the range of activities carried out with the lithic industry, underlining both analogies and differences in the use of the two different types of raw material. The morphologic characteristics of the two groups of implements will be compared in order to estimate eventual meaningful distinctions at a functional level. Moreover, it will attempt to determine if and how much the different hardness of their respective crystalline structure - obsidian possesses, according to the values of the scale Mohs, a lessers hardness of approximately one/two degrees in comparison with flint - has conditioned the characteristics of resistance and functional duration.

Methodology

The functional study of the lithic industry of DI building has been carried out by means of assessing the macro traces (or edge removals) and the micro traces of use (see as general references of the method, A.L.vanGIJN, 1990, L.HURCOMBE, 1992; M.R.IOVINO, 1996; L.H.KEELEY, 1980; C.LEMORINI, 1997; E.MANSUR-FRANCHOMME, 1992; J.J.SHEA, 1991; R.TRINGHAM et alii, 1974). Both methods of surveying are based on observation under the microscope of modifications of the edge of the lithic implements, because of contact with the worked material.

The macro-traces are breakage and/or rounding off of the edge, visible also by means of the naked eye. Their morphology and distribution allow one to determine the action made and, broadly, the worked material (soft, medium hard, hard). Observation was carried out by means of a Zeiss stereomicroscope with magnifications from 10X to 64X and by photographic recording by means of a 35mm Canon camera.

It should be emphasise that during the study of the flint industry of DI, and in a generalised manner, of all the Çayönü flint industry studied up to now, the analysis of macro-traces has been used in order to distinguish implements showing use from those not used or altered. In fact, it has been archaeologically observed and experimentally(2)confirmed that the raw material used in this site has been easily modified in contact with the worked material. Particularly, breakage and very clear rounding off of the edges develop also during the working of " soft " materials like soft animal or plant tissue. These worked materials, generating only a little friction , do not produce, on types of flint that are more resistant, any type of diagnostic macro-traces. Thus, the systematic appraisal of the flint artefacts by means of the stereomicroscope has allowed separation with a good level of precision, the used artefacts from those not used or strongly mechanically altered.

Micro traces of use are modifications of the flint and obsidian micro surface that, in kind, are not visible to the naked eye. Polishes, striations, attrition, rounding of the edges. Their combination and morphology, make it possible to determine the action involved and, with a very high precision, the worked material. Micro traces were observed by means of a metallographic reflected light microscope Nikon Optiphot with eyeglasses 15X and objectives Plan Acromat 10X, 20X and 40X. The photographic recording was carried out by means of a 35mm Nikon camera.

The obsidian implements from DI were selected by means of a metallographic microscope. The choice of this methodological approach was determined from various factors. First, it was experimentally(3) observed that often the working of soft materials (for example: wool, fresh skin, green grasses) do not produce appreciable macro traces on obsidian. On the contrary, the working of hard material like stone, horn or wood with compact fibres, can generate macro traces very similar to those produced by an intentional retouch. Keep in mind that obsidian possesses a hardness of approximately one/two degrees in less then flint, this causes, on the same worked materials, a different development of macro traces due to use; and also a difference in the morphology and the distribution, in compared with modifications observable on the flint edges. With a specific experimentation (4), it is however also possible to determine both the category of worked materials and the type of action involved on obsidian artefacts through analysis of the morphology and of the disposition of macro use traces and through the typology and the distribution of striation. In this phase of the work, the use of the metallographic microscope in the search for the micro traces has permitted a high level of precision in distinguishing used edges from those not used, independently from the development lesser or greater of macro traces.

Selection of the material and state of conservation
Flint industry

All the flint artefacts, tools and débitage, have been observed through a stereomicroscope. Cores were excluded from the appraisal because they do not exhibit any functional interest *a priori*; fragments because of the strong alteration from trampling and/or post-depositional modifications, and burnt implements were excluded too. Of 637 blades and flakes comprising the débitage, 339 (54%) have been discarded because they suffered alterations mostly due to thermal action which irremediably compromised the functional evaluation; 203 (32%) do not show traces of use; and, finally, 95 (14%) have been the object of a deep functional analysis because of their potentially diagnostic traces.On the contrary, of 239 tools, only 16 (6%) do not show traces of use; 100 (42%) have been discarded because of their alteration; and 123 (52%) have been the object of a deep functional analysis.

The data here shown emphasises important differences between débitage and tools. In fact, while a rather low percentage of retouched blanks seems to have no traces of use, a considerable percentage of flakes and blades looks not used, supposing firstly that they might constitute a reservoir " kit " on a functional level, and/or secondly that there was a strong discard of the produced implements due to the abundance of local raw material.

Obsidian industry

In addition to making a specific determination of the artefacts with diagnostic micro traces, 539 pieces of obsidian were observed by means of a metallographic microscope of which 418 constituted the *débitage* and 121 the tools, all coming from the inner area of DI Channeled Building. The first phase of the work was addressed towards the selection of the implements with an interpretable functional potential. This means we searched the tool edges for presence of micro traces of use. Nearly all fragments with the exception of two, have been discarded because they lacked the characteristics adapted to being analysed. Also cores, varia and the crested core revival pieces did not show characteristics which could be associated with their use within human activities. However, a great number of burnt implements was found; also examples with the distal edges fractured, those often trod on and those covered by on removable concretions. These all of course, affected the final data. Of 5% of the 418 artefacts from the débitage, 32 edges worth functional examination were characterised. Of 121 tools, 36 (23%) have 48 edges showing traces of use. Of remaining material, a high incidence of heavy post-depositional surface modifications (concretions, trampling and burning) was observed. The comparison of this data with those relative to the alterations of the flint implements demonstrates that, conditions being equal, the more fragile obsidian endured, in general, the greatest damage from part of the post-depositional agents.

Because of the high percentage of altered implements, it was not possible to establish if the débitage was more used than the use that in fact, emerged as a result of this analysis. The use of the flakes is really significant. This data demonstrates a use of core revival pieces not typological defined but with functionally useful edges. This is made on a visual basis, opposed to that characterised for the flint. In the most complete possible exploitation of the products from this particular raw material.

The functional interpretation

Of the 218 flint artefacts (débitage and tools) functionally analysed 114 (52%) show diagnostic traces of use with a total of 127 used edges (tab.1). Several types of actions were carried out on different materials. Evidence included the processing of tissue of animals like meat and hide (16%), mostly fresh but also in states of dryness (fig.1-2), and also with or without additives. In particular, a fragment of a small end-scraper showed dry hide traces to which was added a mineral substance whose trace had strong analogies to that produced during the experimentation by adding ochre onto the hide, in a finishing phase. In smaller measure, the working by antler (4%) was observed. Its use was also testified to the hafting since a trace of this was found, on a proximal fragment of a blade. On the other hand, the working of bone (2%) is practically non existent. The scarce presence of hard material of animal derivation could also be proven by the low percentage of hard material, characterised by the macro traces of a use (6%). The contact with the plants is widely evidenced (28%). In the majority of the cases the trace of use (26%) appears glossy, an indicator of the working of the plants with high siliceous content. Among these the graminaceous plants , in particular cereals; but there were also reeds and rushes whose glossy, very clear morphologic characteristics, occured very rarely (2%). The nearly total absence of striations inside the glossy polish suggests that the used edges cut these plants not at ground level but in a higher zone of the stem. In this way, earth particles did not " scratch " the surface of the used edges and the polish in particular, was developed. There was very little contact with the non siliceous plants - only 2%. To this one could add, in part, the percentage of little resistant material (11%): this was determined only through macro traces of use. These, however, might be associated with other soft materials. Also the working of wood is present but in smaller percentage (7%) compared with the plants. The contact with the stone (fig.3-4) is evidenced but not particularly abundantly (5%). In general, the actions were involved mostly for cutting (80%), and were associated above all with the working of plants and soft animal tissue. The very few scraping actions (29%) arguably were connected to resistant materials like old hide. The working of wood is associated to actions of cutting, scraping and engraving. Working of stone was carried out by varied types of actions: sawing, scraping, smoothing and piercing.

To inhance the above described functional picture it is useful to emphasise that in an adjacent external area to DI (area 20M), a lot of débitage was found, little used and with a smaller number of tools also relatively little used. These data suggest the presence of an atelier. However, this specific area could also have been used for some specialized and limited functional activities, including the development of one particular type of stone working. In fact, one specific percentage of stone working was observed related to the perforation by specialised tools, the drills (fig.5). The specific function of this place was also confirmed by the recover of bladelet fragments that could be, according to preliminary experimental technological appraisals, associated with the preparation and production of drills.

On 58 (28%) obsidian artefacts coming from the inner area of DI, 80 functionally interpretable edges was observed (tab.2). These tools showed micro traces developed as a result of the working of bone/antler, hide, leather and stone. Contrarily to what was observed for the flint implements, on the obsidian specimens there are no micro traces caused by activity linked to primary subsistence, for example the collection of edable plants or the butchering of animals. In this specific context, this seems to delineate one particular function attributable to the obsidian artefacts. Bone/antler working activity was recognised but with the same truly low values (4%) analogous to flint tools. The relative traces to this material is characterised by one stage of not advanced development. This data leads to the assumption that these tools were used only for finishing or repairing. The actions executed were longitudinal, and transverse but also transverse continuations of longitudinal action. As for the rest, the functional picture in connection with the working activities is, very defined: a production of stone objects and manufacture of hide and leather products; on 54% of the edges used for working stone with different degrees of hardness. The trace of stone working introduces many peculiar characteristics (P.C.ANDERSON, 1994) on 54% of the edges used for working stone with different degrees of hardness. In the case of working with a longitudinal movement (to cut or engrave, for example), a black polish is developed. It is composed of numerous striations of varied type, like sleeks and rough bottomed but above all fern-like. If the worked lithic material has a high hardness, it is also possible to notice several canyons. Within this black polish it is possible to find, in the cases in which the activity has been continued for a long time, spots of light polish. The same type of polish, but greater intensity, is observed on some implements - the so-called Çayönü Tools - used for smoothing and polishing (fig. 5-7):and these seen above all with longitudinal actions, on stone products(for example, bracelets, beads and containers). Within the stone working activity, actions of scraping or shaping have also been identified. Two tools, coming from DI 7-14/7-17 and from DI 7-4, show on their end and in their tip morphology traces of perforation, perhaps a process of refinishing or adaptation of holes. Micro traces on 26% of the edges with result from cut and/or reduceing leather material. The observed actions are mostly longitudinal(fig. 8); but also transverse as well as longitudinal arranged with transverse and transverse and mixed actions. The evidence for longitudinal and transverse actions on the same edge proves that these artefacts were multi-functional tools.

In this way, the craftsmen of Çayönü, using the same edge of an artefact, succeeded covering several phases within the operating chains of transformation of the materials they worked. In 16% of cases, the edges have had contact with material like hide already tanned. Micro traces, both those deriving from the working of leather and those deriving from the working of hide, show a good rounding of the edge. Bright polishes, very smooth and with the presence of numerous sleeks striations have been recorded. Abrasion has been found mainly in the cut of skin already tanned. It is in fact nearly always absent in the cut of leather. These functional data in DI evidence that, through the use of obsidian artefacts manufacturing activities connected with the working of stones materials, hide and/or leather were carried out. As far as the working of stone is concerned, obsidian artefacts, especially blades, bladelets, flakes and some Çayönü tools, were predominantly used in order to cut, to reduce, to scrape and to smooth .

Morphologic characteristics of the used edges.

The flint artefacts: hide processing

The observed traces of use allow one to suppose that flint artefacts were probably used in order to carry out several phases of the processing of hides, from cleaning of fleshy tissues to scraping of the drying or already dry hide(tanned). People working in DI carried out one type of distingtive morphology for the treatment of fresh hide in comparison with the almost dry hide or the fully dry hide. In fact, the edges used in order to remove, above all with cutting movements, the fleshy tissues were straight in profile and straight-straight or straight-concave in section. Moreover, the edge-angle of such edges, virtually not retouched, is rather somewhat modified (the angle is mostly between 40° and the 60°). According to data from functional experimentation, these morphologic characteristics create sharp edges adapted to working not particularly resistant materials, such as the fleshy tissues of the inner part of the hide. Instead the retouched used edges, during the successive phases of scraping the drying hide and/or the dry hide, have a notworthy edge-angle between 70° and 80°, This characteristic renders them particularly adapted to activity on resistant materials, whereas less thick and more cutting edges would be of little use and the materials would be more easily damaged.

The flint artefacts: working of siliceous plants

Since the morphology determination of the edges used in order to cut the siliceous plants will have to be integrated from ulterior data, the preliminary evaluation of a part of the functional areas analysed, shows strong analogies with the morphology of the used edges in order to remove the fleshy tissues of the fresh hide. In fact, the choice of the edges straight in profile and straight-straight or straight-concave in section demonstrate the requirement of sharp edges even though not particularly fragile because of the used edge-angle is rarely inferior to the 40°.

The flint artefacts: stone working

Probably because of the variety of actions carried out (to engrave, scrape, cut) and, perhaps, also because of the type of worked stone, the morphology of the used edges turns out to be rather heterogeneous as regards edge-angle and their delineation. The small degree of morphologic standardisation could also have been due to the lack of the need to carry out particular actions, except in the case of the use of drills (from external area 20M) that, on the contrary, have one extremely standardised and specific morphology.

The obsidian artefacts

It is important to underline the plentiful presence of straight edges (57%), due to the standardisation in detaching laminar in obsidian artefact production. The presence of used edges with concave (10%), convex (22%), irregular (8%) and point (3%) morphology in shape (tab.3) is alsoexemplified. Also in the case of the profile of edges one way observe this tendency towards the regularity. A greater diversity is observed in the spectrum of the sections, where the presence of straight-straight edges is only 47%. The edge-angle varies little: 25°-30°(23%), 31°-35° (44%), 36°-40° (24%) and 41°-45° (9%). In effec, this value represented corresponds mostly to the tendency toward regularity already noted in the prevailing choice of straight edges. An instrument with a straight edge and an edge-angle between 30°-35° shows remarkable multifunctional characteristics and can be used with optimal yield indescriminately in order to cut, engrave, saw or to reduce or scrape. The obsidian implements employed in bone/antler working, in hide and leather manufacture, and stone working do not present particular characteristics as far as the choice of the shape of the used edges is concerned. The edges are mostly straight. This is very significant: a straight edges, above all for obsidian, represent greater effectiveness in relation to the worked materials. For example, experimental activity shows that it is more effective to scrape a horn with a straight edge than with a concave or convex one. The straight edge, when it has to work a very hard material, adapts its morphology, like a negative, to the shape of the working material. In this way it obtains a greater contact and a greater facility of work. In the case of the working of leather and hide, the activities mainly represented are cutting and shaping or scraping; and in this case straight edges were preferred, even though the major presence of convex ones is observed. For stone working, cutting activities are the ones that have been mostly characterised. Also present are the activities of cutting and reducing, reducing or scraping alone or mixed; and, in very small percentage perforation and smoothing. Also in this case straight edges are the onces more represented . In the cutting activities, edge-angle shifts from 25° to 40°. On the contrary, the activities where longitudinal movement is combined with the transversal one the edge-angle shifts from 32° to 45° whereas an exclusively transversal movement is noted the edge angle is not ever under the 30°.

This means that, even though a high standardisation in the shape of the edges is noted, there is a precise set of morphological characteristics on the artefacts in relation to the materials worked but particularly in relation to the actions carried out.

Conclusions

The functional data show that flint and obsidian artefacts from DI Channeled Building possess wery distinctive functional features. In the inner area of DI, flint imple-

	boring	longitudinal mot	cutting	sawing	transversal motion	planing	whittling	scraping	mixed motion	engraving	indetreminated	total	%
meat	-	-	5	-	-	-	-	-	-	-	1	6	%5
meat/bone	-	-	2	-	-	-	-	-	-	-	-	2	%2
fresh hide	-	-	3	-	-	-	-	3	-	-	-	6	%5
drying hide	-	-	-	-	-	-	-	2	-	-	-	3	%2
dry hide	-	-	-	-	-	1	-	-	-	-	-	1	%1
not siliceous vegetables	-	-	1	-	-	1	-	-	-	-	-	2	%2
siliceous vegetables	-	-	30	-	-	-	-	-	-	-	-	30	%23
reed	-	-	2	-	-	-	-	-	-	-	-	2	%2
wood	-	2	3	-	-	1	-	1	-	2	-	9	%7
bone	-	-	2	-	-	-	-	-	-	-	-	2	%2
antler	-	1	3	-	-	-	-	-	1	-	-	5	%4
stone	1	-	-	2	1	1	-	-	-	-	1	6	%5
soft material	-	4	5	-	2	-	-	1	-	1	1	14	%11
medium hard material	-	5	8	1	4	4	2	3	-	-	1	28	%22
hard material	2	1	1	-	1	2	-	-	-	-	-	7	%5
indetreminated	1	-	-	-	-	-	-	-	-	1	2	4	%3
total	4	13	65	3	8	10	2	11	1	4	6	127	%100
%	%3	%10	%51	%2	%6	%8	%2	%9	%1	%3	%5	%100	

Table 1: Çayönü Tepesi, Channeled Building DI flint assemblage, materials worked and actions performed.

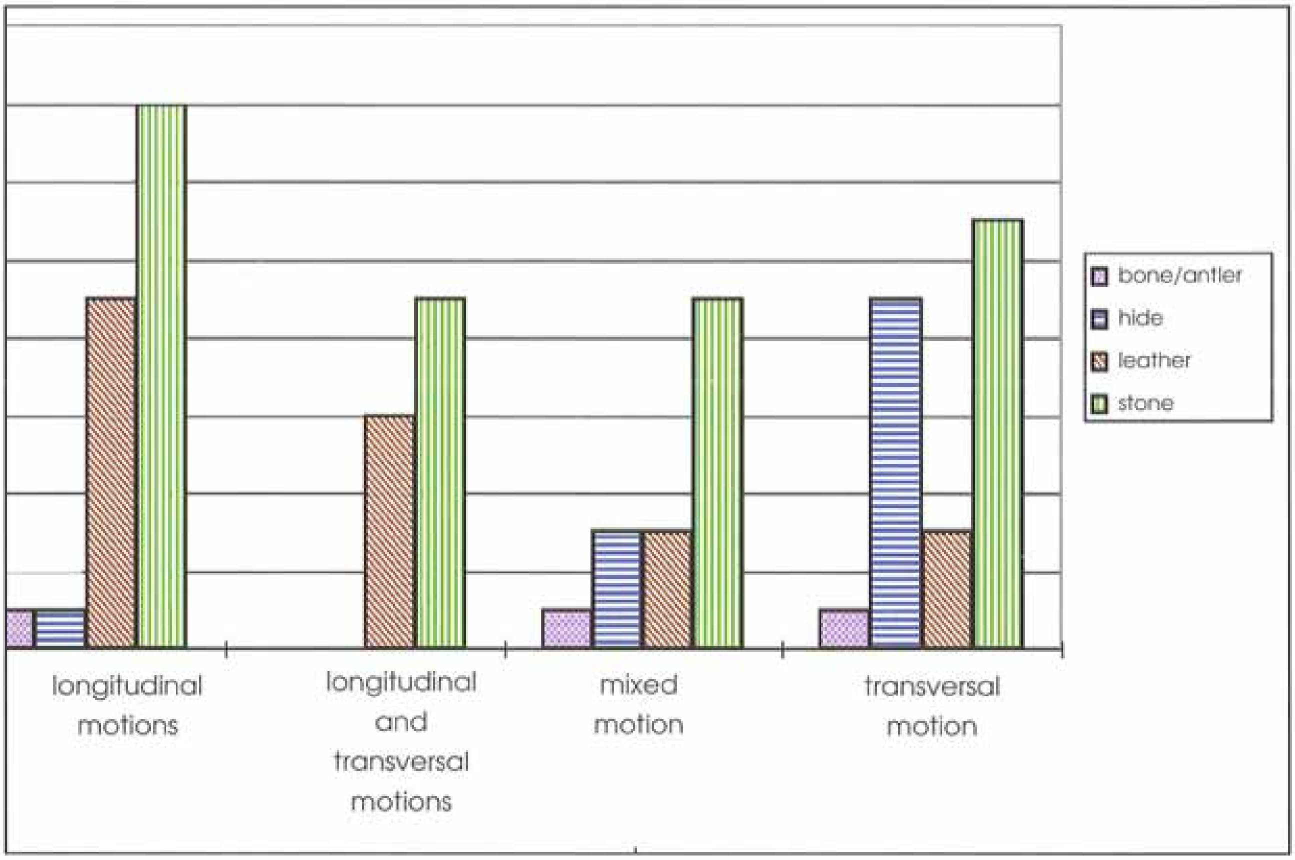

Table 2: Çayönü Tepesi, Channeled Building DI obsidian assemblage, materials worked and actions performed.

	pointed	straight	convex	convav	irregular	total	%
stone	1	24	10	5	3	43	%54
hide	1	6	3	1	2	13	%16
leather	-	14	5	1	1	21	%26
bone/ant	-	2	-	1	-	3	%4
total	2	40	18	8	6	80	%100
%	%3	%57	%22	%10	%8	%100	

Table 3: Çayönü Tepesi, Channeled Building DI obsidian assemblage, conditions of used edges shape in relation to worked materials.

Figure 1: Çayönü Tepesi, Channeled Building DI. Flint artefact (DI 7-15 n°194) used to scrape drying hid

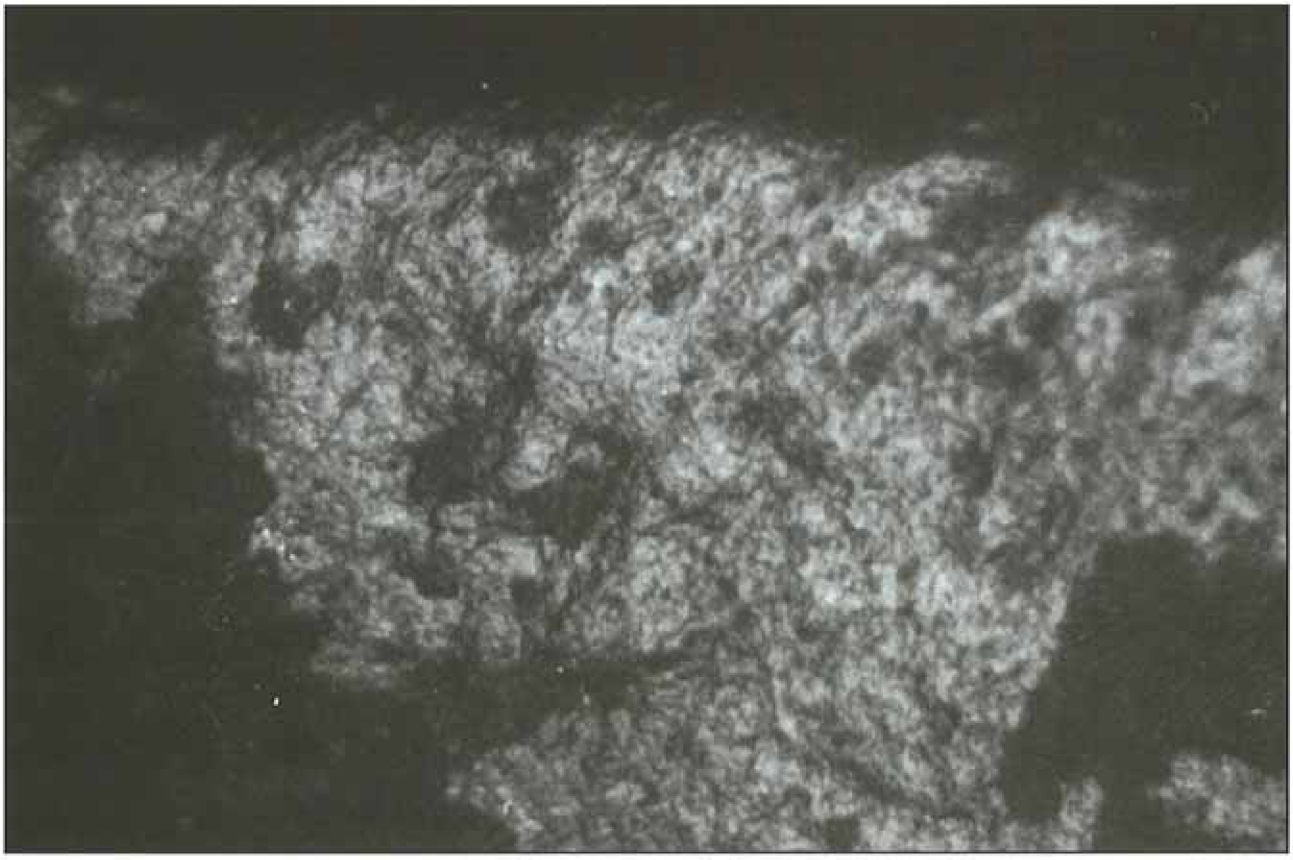

Figure 2: Çayönü Tepesi, Channeled Building DI. Micro traces from dry hide (flint artefact DI 7-4 n°246) (magnifications 150X).

Figure 3: Çayönü Tepesi, Channeled Building DI. Flint artefact (DI 7-13 n°77) used to saw soft stone.

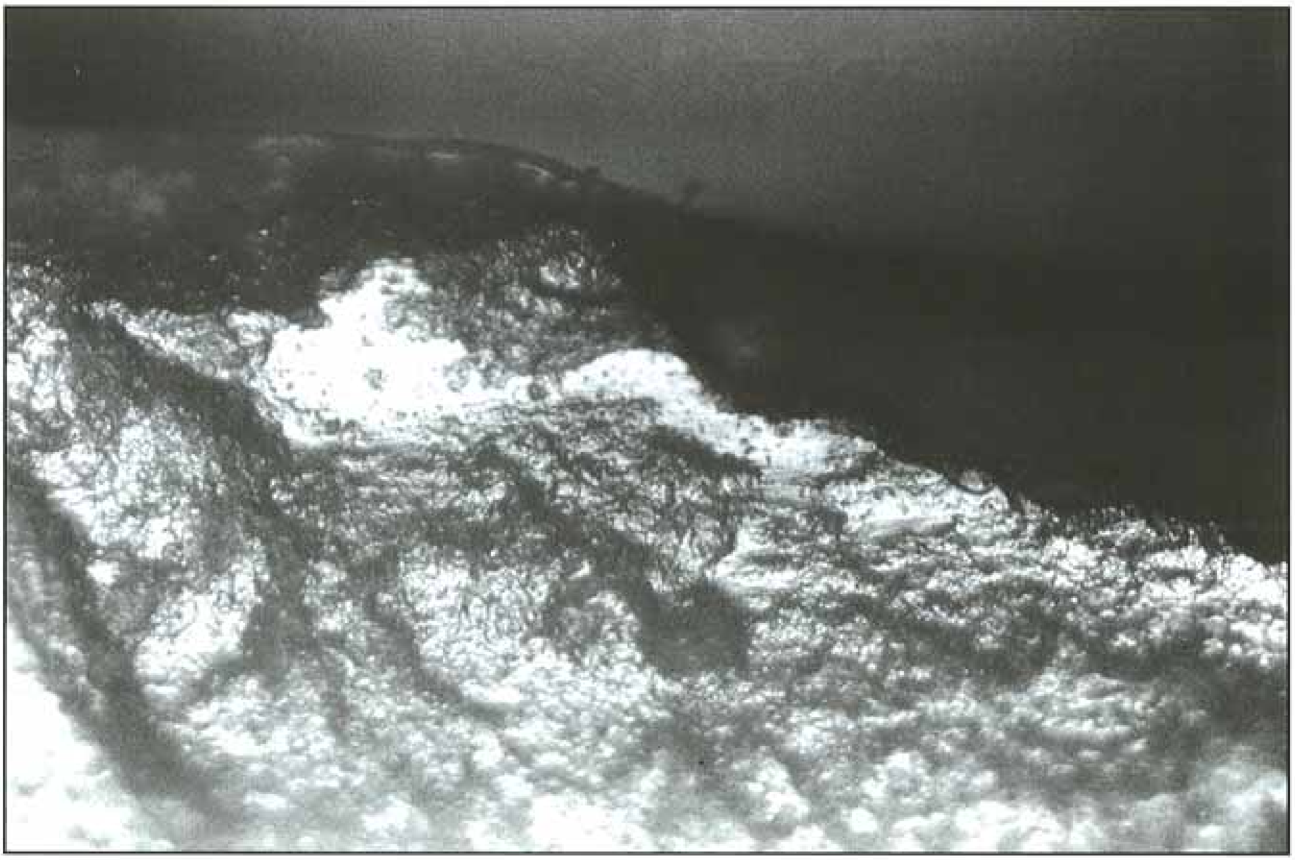

Figure 4: Çayönü Tepesi, Channeled Building DI. Micro traces from working soft-stone (flint artefact DI 7-13 n°77) (magnifications 150X).

Figure 5: Çayönü Tepesi, Channeled Building DI. Çayönü tool (DI 7-4 n°68) used to shape and smooth soft stone. The photo shows the ventral side of the tool with a clear, visible to the naked eye, well developed band of attrition caused by stone working,i.e. shaping and smothing.

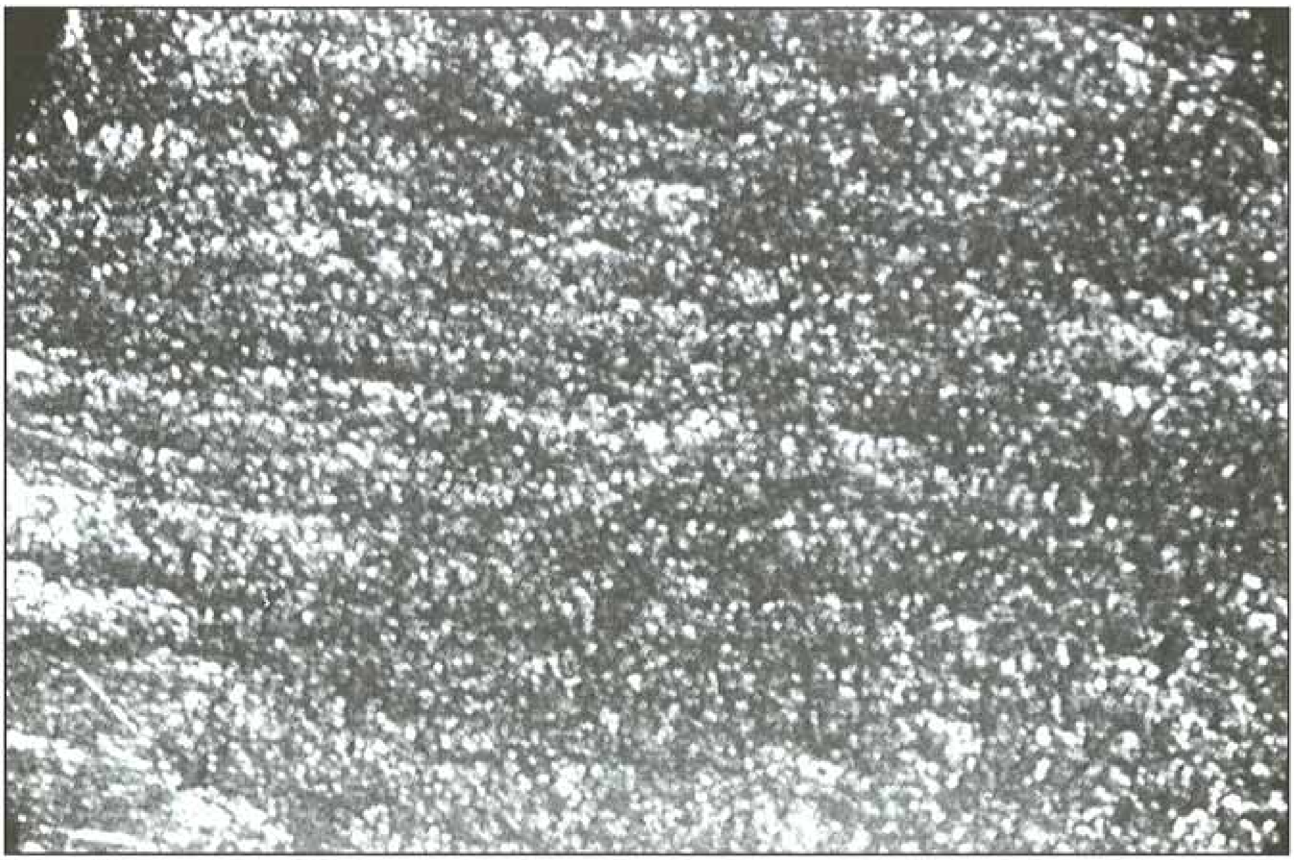

Figure 6: Çayönü Tepesi, Channeled Building DI. Obsidian artefact (DI 7-2 n°51), micro traces developed by soft stone working (magnifications 150X).

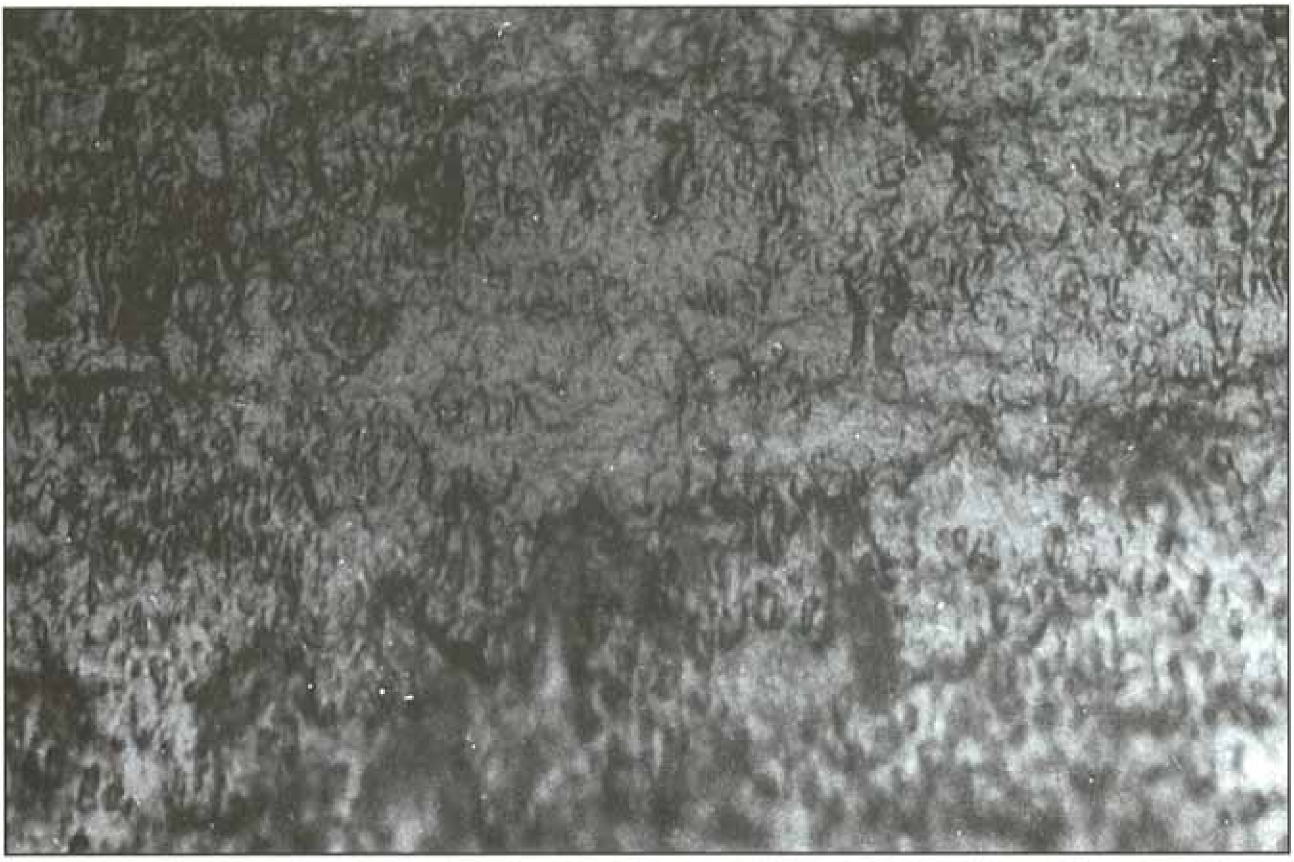

Figure 7: Çayönü Tepesi, Channeled Building DI. Obsidian artefact (DI 7-2 n°51), particular of the micro traces by soft stone working (magnifications 300X).

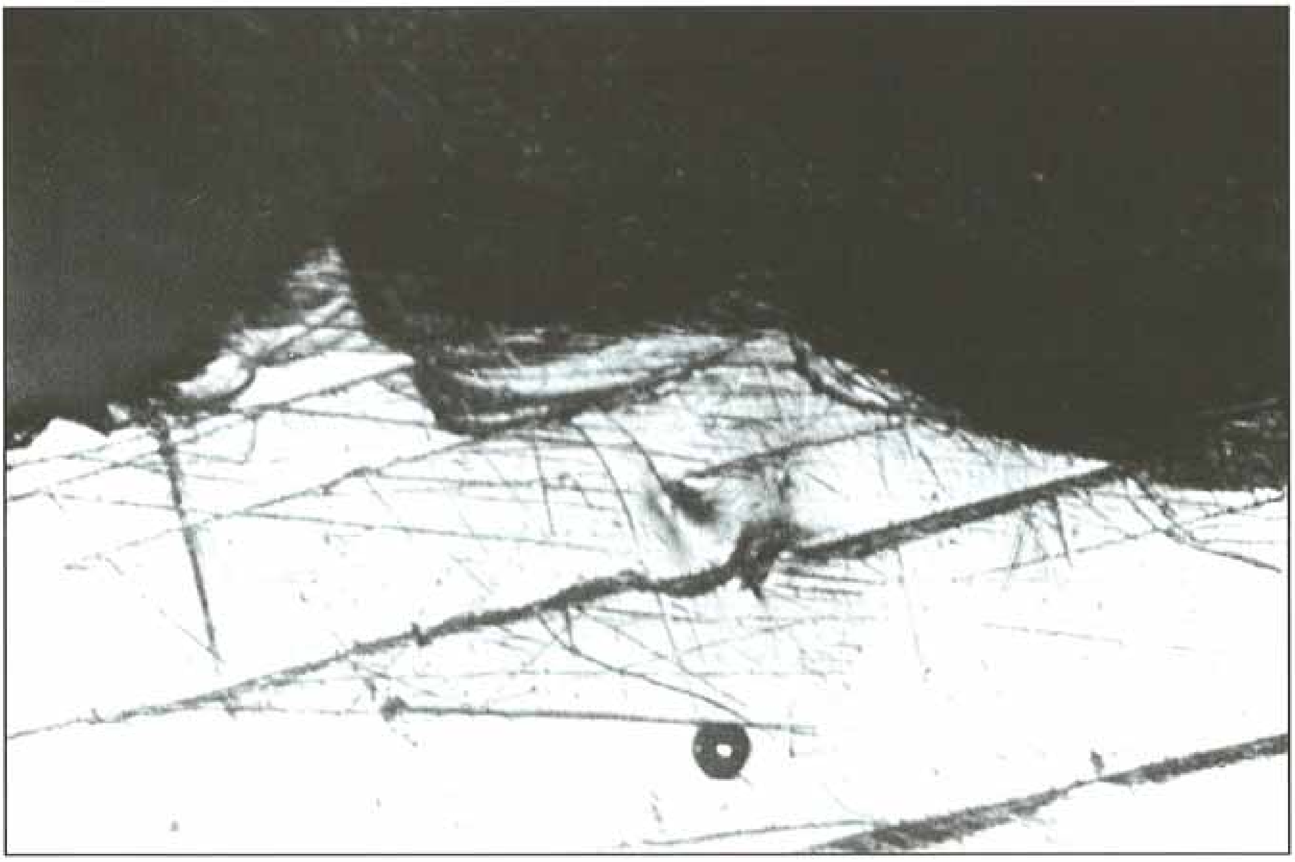

Figure 8: Çayönü Tepesi, Channeled Building DI. Obsidian artefact (DI 7-4 n°54), micro traces by leather manufacturing.