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OBSIDIAN BUTCHER KNIVES: THE FORMATION OF EDGE DAMAGE ON UNMODIFIED BLADES

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ABSTRACT

Analysis of backed obsidian blade skinning tools shows that even this light butchering activity will leave traces of edge damage on the working edge. However, it is possible that post-depositional modification of the tool may partially or totally mask these traces.

Introduction

The analysis of edge damage on lithic tools is a rapidly expanding field in lithic technology, aimed at explaining either the function of a formal tool type, or the use of unmodified flake/blade tools (Semenov 1964; Keller 1966; Frison 1968; Hester 1970; Ahler 1971; Nance 1971). This experiment was conducted to examine the type(s) of edge damage that could result on butchering tools during the primary stage of the butchering sequence, that of skinning. Previous work with obsidian flake tools has shown that the average use life of any single flake is low (Brose 1975; Walker 1978). Therefore, given an adequately large supply of raw materials, this low use life would permit flake/blade skinning tools to enter the archaeological record (be discarded) before the heavier butchering tasks (i.e., disjointing) were undertaken.

Two large male goats (approximately 80 kg [175 lb.] each) were skinned, using stone tools. The tools used in this experiment were backed obsidian blades, produced by direct free-hand percussion using material from Glass Buttes, Oregon. The working edge of the blade was unmodified. Blades were used until the user (who had long experience in skinning) felt that the edge had grown dull, at which time a new blade was selected for use. No attempt was made to standardize the length of the working edge, to control for time of utilization, or to maintain a single working direction.

Skinning Procedure

Both goats were skinned using the same sequence. First, a circular cut was made in the hide around the neck. Next, the forelegs were skinned and a slit was made down the underside of the animal. At this point, the muscles and tendons around the neck were severed, and the head was removed (using a steel axe to sever the vertebrae). Once the head had been removed, the hind legs were skinned and the animal was hung by its hind legs. The hide was then removed from the sides and back of the carcass.

In this skinning procedure, certain steps can be identified as having a high probability of contacting bone. Due to the brittle nature of obsidian, it can be assumed that any contact with bone would result in damage to the working edge.

The two most probable areas for bone contact are the fore and hind legs, since only thin muscle layers cover the bone near the hock. Blades used to sever the muscles and tendons overlying the vertebrae, and to slit the hide down the chest, may have come into contact with bone. There are, however, thick muscle layers at both these points, so this is only a possibility. Blades used in the area of the abdominal cavity, and the sides and back of the animal, should have had little or no chance of contact with bone (Table 1 lists areas where blades were used).

TABLE 1

Area of Utilization for the Experimental Sample

Blade number	Area of utilization	Probability of contact with bone
1	cutting hide around neck	low
2	slit down chest/belly and one foreleg	medium/high
3	hind leg	high
4	muscle and sinew around neck	low
5	skinning chest and neck area	low/medium
6	skinning chest/belly and part of hind leg	medium/high
7	skinning fore leg	high
8	skinning belly	low
9	skinning fore leg	high
10	skinning belly and hind legs	medium/high
11	skinning hind legs around rectum	high
12	skinning back	low
13	skinning back	low
14	cutting hide around neck	low
15	skinning down chest and around fore legs	medium/high
16	skinning fore legs	high
17	splitting down belly	low
18	skinning hind leg	high
19	skinning belly	low
20	skinning of chest/belly and around neck	low/medium
21	skinning around neck, muscle, and sinew around neck	low/medium
22	skinning chest area	medium
23	skinning back	low

Analytical Procedures

Before analysis, blades were washed in a warm water detergent bath, to remove organic residue. This proved to be an unreliable method of removal, so the blades were further washed with acetone before photographing. The acetone bath successfully removed all traces of organic remains from the surface of the blades.

The blade edges were then inspected under a binocular microscope, at 30x magnification. This low magnification was deemed sufficient, since edge damage alone was under consideration. Analyses for striations and edge polish were not attempted due to the high magnification needed for such analyses and the high probability that such features would not be present. The short use life of the blades (generally less than five minutes), and the soft material on which they were used, led to this assumption. Previous analysis of obsidian tools (Brose 1975; Fedje 1977) has involved tools used for the disarticulation of limb elements (Brose 1975), and the scraping and sawing of bone and wood (Fedje 1977). These tools were then examined using a Scanning Electron Microscope for the presence of use striations. Analysis of this kind does not appear to be applicable to tools that were utilized strictly on soft tissue, with only incidental bone contact.

The edge damage observed can be divided into five categories: lunate fractures, scalar fractures, step/hinge fractures, edge nibbling, and edge crushing. Lunate fractures are high angle flakes with feathered terminations, and a crescentic outline (Fig. 1). Lunate fractures can be oriented to either the dorsal or ventral face, and appear to be caused by the application of pressure approximately perpendicular to the edge. The term "scalar flake" was used by Tringham and others (1974:188) to designate a microflake bearing all the normal flake characteristics, and similar to pressure retouch, being distinguished only by its small size (Fig. 2). These flakes can be oriented to either the dorsal or ventral face of the edge. Step/hinge flakes can be distinguished from scalar flakes by their terminations (Fig. 3); they can be oriented to either face. Edge nibbling consists of extremely small scalar flakes, which are generally distributed in clusters along the edge (Fig. 4), orientation is to either face. Edge crushing is the result of mechanical overloading of the working edge, and results in a very ragged, roughly serrated, edge which is easily distinguished from areas of edge nibbling (Fig. 5). Since this is a feature of edge collapse, there is no orientation to either the dorsal or ventral face.

Experimental Results

In order to check for types of damage present on unused blades, three control blades were made, using the same manufacturing technique, and type of obsidian. These blades were then examined using the same analytical procedure employed for the experimental sample, though cleaning of the blades was not necessary. Upon examination, two of the three control specimens did exhibit small amounts of edge damage (Table 2, specimens A-C). In both cases, small numbers of lunate flake scars were found along the edge of the blade. These flake scars were most common in areas of high edge curvature, and may be related to stresses induced during the separation of blades from the core, and/or to force applied perpendicular to the edge of the blade

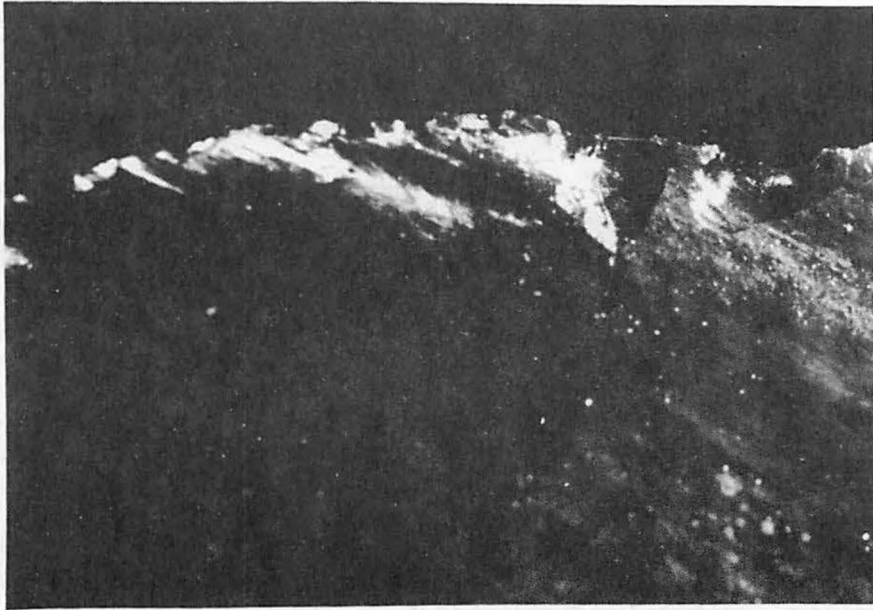


Fig. 1. Lunate fractures, note the crescentic outline for which these features were named (magnification 7x).

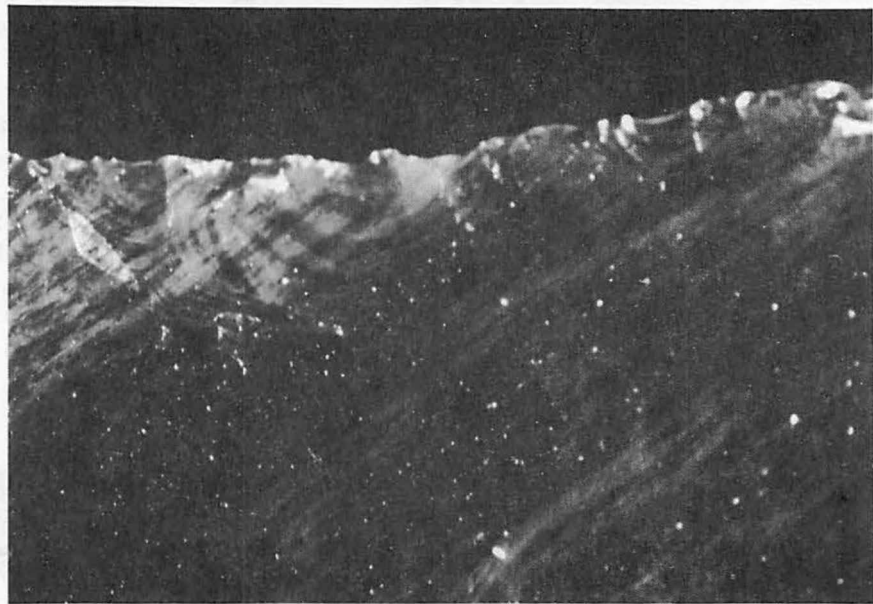


Fig. 2. Scalar fractures (magnification 7x).

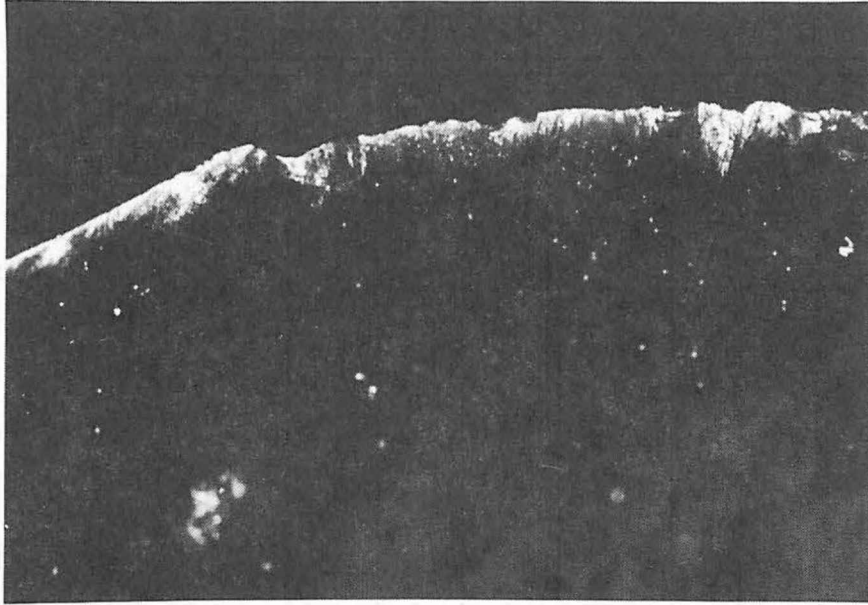


Fig. 3. Step fractures along the working edge (magnification 7x).

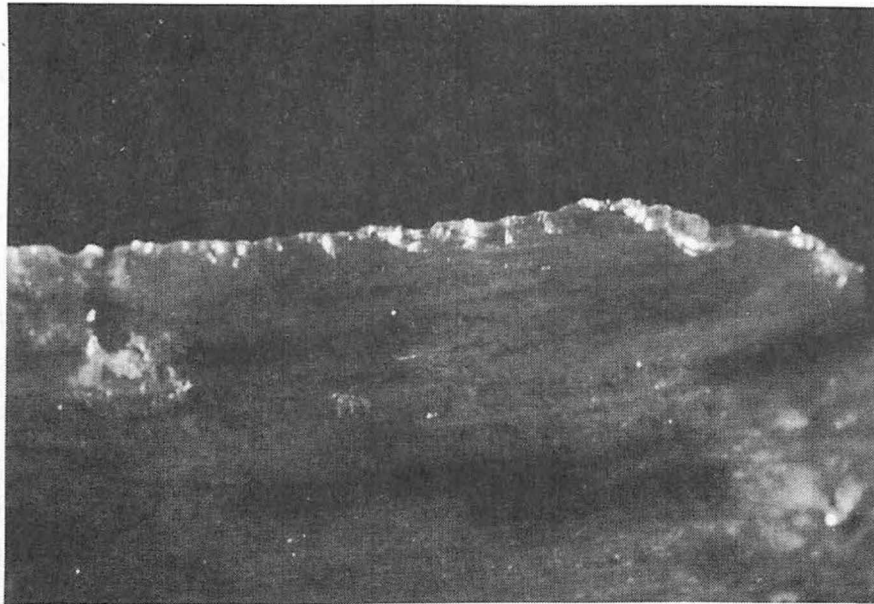


Fig. 4. Nibbled section of blade edge (magnification 7x).

TABLE 2

Edge damage present on the blades

Blade number	lunate		scalar		step/hinge		nibbling		crushing	Probability of contact with bone
	D	V	D	V	D	V	D	V		
A*	1	2								none
B*										none
C*	1									none
1	2	1								low
2			1	3		1		2	3	med/high
3	2	1		2				3	1	high
4	1		1	1				2	1	low
5	2	1	3	2	2		3	2	3	low/med
6	1			1			2	1	2	med/high
7	1		3	2	3	1	3		3	high
8		2				1			3	low
9			1	2	1	1			3	high
10			1	1	1			1		med/high
11		1	1	1					2	high
12				1	1			2	2	low
13	3	1		1				1	1	low
14	1		1		1		2			low
15	3	1	3	3	1		3		3	med/high
16	1	1	1	2			1	2		high
17	1		1	1					1	low
18	2		3	2				2		high
19	1	1	2	2		1	1	1	1	low
20				1						low/med
21		1	2	1	1	1			1	low/med
22									1	medium
23	1								1	low

D: dorsal face
V: ventral face

*: control specimen

Degree of severity of damage:

1: light
2: moderate
3: heavy

from the hand or leg that prevented it from falling to the floor. In addition to edge damage, a regularized edge undulation which I have termed "scalloping" was present on all of the controls. This attribute was also observed on some of the experimental samples (Fig. 6). It appears to be related to the presence, and abundance, of radial striations that intersect the edge of the blade. Where radial striations are abundant, this scalloping of the edge resembles edge nibbling. However, the two can be told apart, since scalloping, unlike edge nibbling, shows no flake characteristics, being simply a regularized edge undulation. The amount of edge nibbling may, however, correlate with the amount of scalloping since these small protuberances would serve as foci for pressure being applied to the edge of the blade. It is at these foci that flaking of the edge could first occur, since a smaller amount of force would be necessary to achieve flake formation here, than at a point on the edge when there is no relief.

Both scalloping and edge nibbling, if extensive enough, result in portions of the edge acquiring a serrated appearance. This serration may result in a short-term increase in the efficiency of the cutting edge.

All blades composing the experimental sample exhibit some type of edge damage, with either larger amounts, or different types, than that exhibited by the control sample (Table 2, specimens 1-23). Edge damage is not restricted to either the dorsal or ventral face of the blade. Since the blade is used at approximately 90° to the surface of the hide, the distribution of damage on the dorsal and ventral faces is related to minor variations in the angle at which force is applied on the working edge.

There is general agreement between the probability of incidental contact with bone, and the amount of damage sustained by the working edge of the blade. Those blades used in skinning the fore and hind legs exhibit the greatest amount of damage, as well as a large amount of types of damage that indicate the heaviest load (i.e., step/hinge fractures, edge crushing). The greatest range in damage is shown by the blades which were used in areas where the possibility of bone contact is lower. This range indicates that only some of these blades contacted bone. The blades with the least damage are those which were used in the area where there is little or no chance of contact with bone.

Of the last group, two blades (Nos. 8 and 19) show anomalously large amounts of edge damage. This damage may partially result from torque applied to the blade while the incision was being made down the abdomen. The application of torque can account for the fractures present along the edge, however, it cannot explain the presence of edge crushing. This crushing may represent contact with bone in the pelvic region of the carcass.

It is possible to gain an idea of the direction in which blades were used, by examining the amount, and location, of the damage on protuberances along the edge of the blade. On a number of the blades, all types of damage on protuberances (with the exception of edge crushing) was found to be generally restricted to one or the other side of the protuberance. Restricted damage of this type is seen as indicating the direction of use, with edge damage concentrated on the side of the protuberance being drawn toward the user. If damage was high on both sides of the protuberance, it is hypothesized

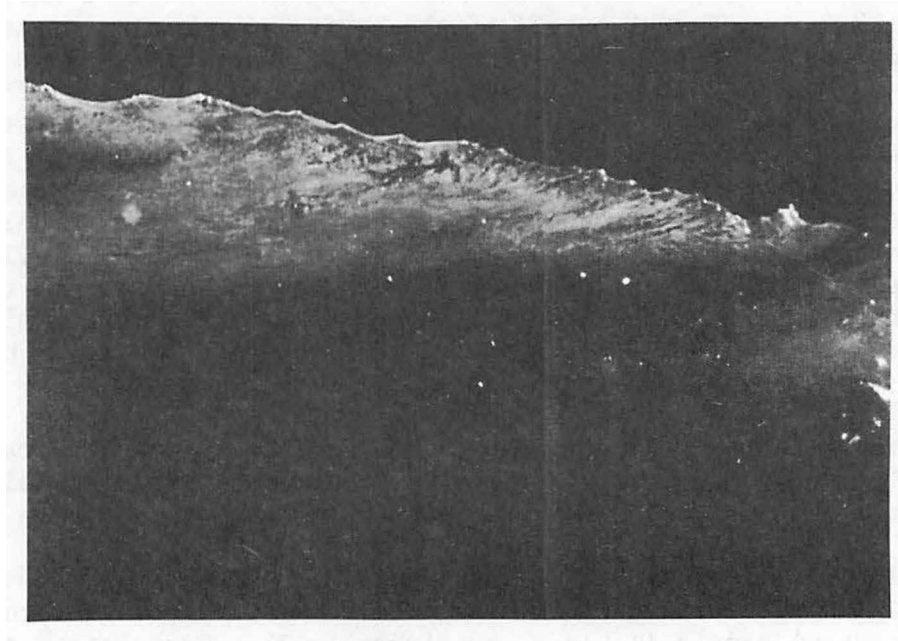


Fig. 5. Crushed section of blade edge (magnification 7x).

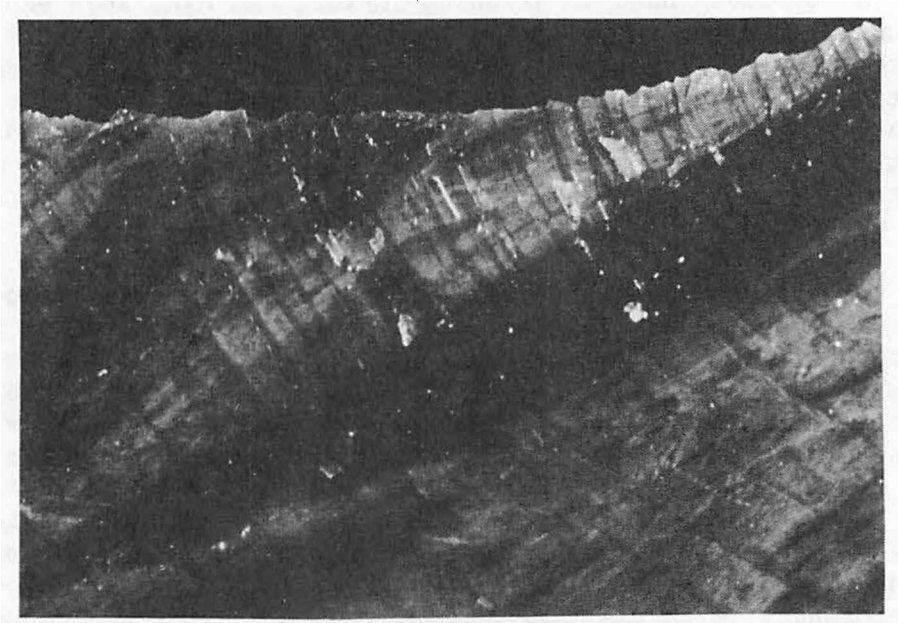


Fig. 6. Note the regular undulation present on the edge of this blade, and its relationship with the radial striations (magnification 7x).

that: 1) the blade had been used in a bidirectional sawing motion, or 2) the blade was used unidirectionally, but had been reversed in the hand when a portion of the edge became dull. Unfortunately, due to the small sample size, this trend cannot be tested for significance. This phenomenon, however, has been noted by other researchers (Tringham and others 1974:180).

Finally, edge damage, though sometimes extreme, was generally localized, and did not involve large areas of the cutting edge. The loss of cutting efficiency, which led to the rejection of the blades, was related to fat buildup along the edge, as suggested by Brose (1975).

Archaeological Visibility

Even though all experimental specimens show evidence of use, postdepositional modification may mask or distort this evidence. Most of the observed edge damage consists of small scars, which could easily be obscured by damage after deposition. Tringham and others (1974:192) state that damage caused by trampling can be distinguished from use wear, due to its nonpatterned distribution and location on only one face of the specimen. However, recent experiments at the Laboratory of Lithic Technology indicate that trampling not only results in patterns of flake distribution that can be interpreted as use wear, but that a large percentage of those trampled specimens can be typed as "tools" (Flenniken and Haggarty 1979). Postdepositional damage of this type would almost certainly destroy the actual edge damage which resulted from the use of obsidian blades on soft tissue.

Conclusions

Five conclusions can be drawn from the above results:

- 1) The cutting of even soft tissue results in the formation of edge damage on obsidian blades.
- 2) Heavy edge damage, such as the formation of step/hinge fractures and edge crushing, indicates contact with bone during butchering.
- 3) The direction of use can be inferred from the amount and location of edge damage on protuberances along the working edge.
- 4) The loss of cutting efficiency which resulted in the rejection of the blades during skinning is probably related to the buildup of fat along the working edge.
- 5) It is probable that the degree of damage resulting from the use of obsidian tools on soft tissue will not be archaeologically visible, if postdepositional modification of the tools has been extensive.

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