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Standard use-wear chart of TUMRT (2): Microflaking (2)

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INTRODUCTION

The present paper is the second part of the results of microflaking analysis by Tohoku University Microwear Research Team (TUMRT). It is the continuous and expanded explanation of standard identification criteria of a category of use-wear traces, that is, microflaking. The part 1 was published in the Bulletin of the Tohoku University Museum, No. 13 (Akoshima and Hong 2014). The present article is to be utilized with part 1 which is available through the Tohoku University Library website (TOURS). Part 1 mainly explains overall experimental framework of microflaking analysis by TUMRT, typical patterns of microflaking scar appearance, and variables in experimental control.

Part 2 here expands the range of microphotographs in order to accommodate various different appearances of microflaking scar patterns which are observable on actual experimental artifacts. The reader may recognize representative chipping phenomena (flaking phenomena) and the varieties of chipping scars which are observable on the same working edges used in the same task (the motion and the worked materials). Part 2 also explains the method of analyzing the actual wide range of microflaking varieties by counting frequencies and classifying attributes of chipping scars. Methodological explanation is presented with tables and graphs for the basis of statistical analysis of flaking scar variability, as was already summary published in Japanese (Akoshima 1981) and English (Akoshima 1987).

The theoretical basis of the present article is experimental archaeology as one realm of "Middle Range Research" by Binford (1981, pp.21-30, 1983, pp.19-30, ed. 1977, pp.1-10). Binford argues that all archaeological records exist in the present world and also in the shape of static facts. It is necessary to transform archaeological facts into statements about the past. The criteria of adequate interpretation derive from "actualistic" studies where movements of cultural systems and resultant static facts from them both can be observed in real cases. Such a situation might be studied in three fields of research, that is, ethno-archaeology, experimental archaeology, and historical archaeology. Our lithic use-wear study duly purports to this epistemological premise in that "actualistic" situations in the controlled experiments provide concrete basis for interpretations of static microwear traces which are existent on the surface of stone artifacts excavated in the present world.

We reiterate here that the study of prehistoric lithic artifacts entails three fundamental realms of research, namely, typological, technological, and functional analysis. All these areas of course need to establish robust methods of meaning assignment in the sense of Binford, to any patterns in archaeologically observed records. In the case of the use-wear analysis, experimental replication plays critical roles for bridging arguments between wear patterns and human activities, in other words, between the statics and the dynamics. It is essentially important to construct extensive databases of experimental use-wear formation for the purpose of reliable interpretation of archaeological patterns.

A prevalent problem lies in the gap or discrepancy between experimentally produced use-wear patterns and actually excavated archaeological patterns. Binford recognizes that this sort of ambiguity would be the cause of learning for scientists (Binford 1987). Use-wear patterns on experimental artifacts do not always coincide with archaeological wear patterns. Empirical archaeologists in favor of inductive reasoning often criticize experimental use-wear study because of this discrepancy and ambiguity, for example, in the history of Japanese archaeology in 1970s (c.f., Akoshima 2008). However, we are aware that fundamental linkage between stone tool using activities and resultant wear patterns had to be constructed as prerequisite to reliable behavioral reconstruction.

EXPERIMENTAL DATABASE

The present paper continues to introduce essential criteria of micro-wear interpretation accumulated by TUMRT since 1976. The team was initiated by the late Prof. Chosuke Serizawa and has been active up to the present (for its history, e.g. Akoshima 2008). This is to be the second of a series of presentations resulting from the TUMRT inferential criteria. We apologize for not having presented our inferential standards due to various circumstances in our Tohoku University Archaeological Laboratory since 1983, even if we were repeatedly requested to publish openly our criteria for functional interpretation especially by use-wear analysts nationwide. The data presented here focus on characteristics of replicated microflaking scar patterns. Although our inferential method of microflaking was published in summarized way (e.g., Akoshima 1981, 1987, 1989), and a number of actual analysis of excavated artifacts have been conducted widely in Japan, basic database for interpretation has yet to be fully presented. We hope the microphotographs presented in this volume will assume a role of standard use-wear chart for references.

The database presented here is a part of the first series of TUMRT project directed by Serizawa. Microflaking data were analyzed by Akoshima (Akoshima 1981, 1989) and the data have been utilized by TUMRT members since then. Microphotographs were printed and served on file at the Department of Archaeology, Faculty of Arts and Letters.

The procedure of photographic data presentation in the present publication is the same as our previous "Part 1" report (Akoshima and Hong 2014), so only short descriptions are repeated here for readers' reference. The paper photo-micrographs in the TUMRT file were scanned at 600 dpi and colour digitized for adjusting gray tones. For the Part 1 report, representative images were chosen for presentation of "typical microflaking patterns", but here wider varieties of microflaking patterns are shown for better recognition of overall wear patterns. By referring the present data and previous data, the range of flaking patterns are roughly knowable.

On the other hand, the microflaking scars were numerically described in statistical graphs in Akoshima (1987, after 1981). Thus, the pictures compiled here are the photographic version of inferential criteria. The data are the same, but their expression is different. (They are shown as Figure 1 to Figure 28 in the previous volume, and as Figure 36 to Figure 88 for the present volume. In addition, from Figure 29 to Figure 35, explanatory remarks and calculating methods are provided for more concrete understanding of microflaking phenomena.) Microphotographs are arranged in the order from working soft materials (meat, rawhide, leather, soft plant) to medium (wood, bamboo), to hard materials (bone, antler). Within the category of similar hardness, they are sub-divided and arranged by the method of use, from parallel motions (cutting, sawing) to perpendicular motions (scraping, whittling).

The raw materials in the experimental project were the shale collected from the riverbed of the Mogami River in Sagae City, Yamagata Prefecture. It is notable that the shale in the Japanese terminology of lithic analysis denotes a type of fine grained sedimentary rock with breaking feature of conchoidal fracture. The rock type was in wide use throughout prehistory in northeastern part of the Honshu Island of Japan. Out of about 160 experimental artifacts, 80 specimens were photo-presented in this volume, including the same specimens in the previous volume. They are flake tools utilized without any secondary retouch along the edge. Thus, the micro-sized scars seen on these photos are produced exclusively by utilization. They are presented with the scale bar for 2 mm, because the size of microflaking scars has concrete relationships with the hardness of the worked materials and the direction of use motion (Akoshima 1981).

The order of presenting these photographic data is as follows. Basically, they are arranged so that the general patterns of groups of microflaking scars are recognized according to the numerical presentation as in Akoshima (1987). The Figures are captioned with the category of worked materials and working edge motions. From Figure 36 on, they are shown in the following order (the same order as Akoshima and Hong 2014). It is presented here again for quick reference of the reader :

1. Meat, 1.1 cattle (beef), 1.2 pig (pork), 1.3 lamb (mutton), 1.4 duck, 1.5 chicken
2. Plant, 2.1 grass, 2.2 wheat crop, 2.3 rice crop, 2.4 reed, 2.5 pampas grass
3. Hide, 3.1 rawhide, 3.2 half dried hide, 3.3 dry hide
4. Wood, 4.1 paulownia, 4.2 cedar, 4.3 pine, 4.4 alder, 4.5 zelkova, 4.6 others
5. Bamboo
6. Gourd
7. Shell
8. Bone, 8.1 raw, fresh, 8.2 wet and boiled, 8.3 boiled
9. Antler, 9.1 soaked, 9.2 dry, 9.3 others

For the third digit of each photo caption number, the type of motion in use is indicated as follows.
Longitudinal, -1 cutting, -2 sawing
Transversal, -3 whittling, -4 scraping
Varied, -5 chopping, -6 butchering
Incising, -7 graving

Microphotographs were taken using a macro-photo equipment of Olympus OM-2 camera system. The magnification shown in the caption is at the time of photography.

In the photo caption, "d" means the dorsal surface, while "v" means the ventral surface (the main flake surface) of the working edge of the experimental flake.

NUMERICAL AND PHOTOGRAPHIC EXPRESSIONS

For the analysis of microflaking scars, a variety of attributes were recorded and classified. A total of 3840 flaking scars were counted one by one and recorded for 72 specimens. They were statistically investigated and summary published in Akoshima (1981). Major attributes of analytical interests include the shape of microflaking scar, the size of microflaking scar, the initiation of microflaking scar breakage, the termination of microflaking scar breakage, the density of microflaking scar per centimeter, the degree of concentration of scars to one face of the tool, ventral or dorsal. The summary of conducted experiments is shown in Table 1 to Table 3 in the previous report (Akoshima and Hong 2014). Also, other than the information in the table for each controlled experiment, thirty conditions were recorded on experiment recording sheets which are available on file at Tohoku University. Experimental recording system was presented in the previous report and not repeated here.

Actual appearances of microflaking are rich in variety even along one working edge, but there are portions which are evaluated as representing typical patterns. For each experiment, two micro-photos are selected, one on dorsal aspect and one on ventral aspect. They are presented as Figure 1 to Figure 28 in our first report, as basic representation of scar patterns. Explanation of identifying scar patterns is given in Figure 29. Scar patterns are more adequately recognized when they are analyzed collectively as a group of numerous scars. A method of recognizing numerical attributes as statistical graphs is presented. Six cases are explicated from Figure 30 to Figure 35, namely for soft, medium, hard worked materials in longitudinal and transverse motions. In order to recognize actual variations in chipping scar patterns, other micro-photos of the same experiment are abundantly shown from Figure 36 to Figure 88.

IDENTIFICATION OF MICROFLAKING SCARS

Microflaking is, needless to say, a microscopic version of flaking that occurs to conchoidally fracturing rocks. The mechanical principles involved in the fracturing process of microflaking is expected to be essentially the same as that in manufacturing process of lithic artifacts. Classification in general, in a sense, ignores diversity existing among classified objects or phenomena. Classification of microflaking in order to get quantitative data is of course no exception. Each microflaking scar has individual characteristics that would be disregarded when it is classified into a type, or categorized coding. In order to alleviate this missing feature, microphotographs were taken and presented, rather than simply categorizing scars into types. The diversity of microflaking scars is evaluated from them. It should be borne in mind, however, that these microphotographs do not necessarily represent all types of microflaking that occurred on the edge of flakes that were used in the particular work.

Microphotographs only partially exhibit the area ranging over a few millimeters depending on the magnification, while a working edge usually spans as long as several centimeters or more. However in spite of the areal limitations, distinctive patterns are recognized in many cases. In Figure 29, three microphotographs are shown for soft, medium, and hard worked materials as was mentioned above. Over the photographed area, examples of description of the scars are presented as characterizing scar patterns. In the photos, thin white lines indicate each identified flaking scars. They are of course overlapped with one another and formerly produced scars are crosscut by later formed scars. The formerly produced scars changed their shapes accordingly.

ATTRIBUTES AND GRAPHIC PATTERN RECOGNITION

Every experimental specimen was observed for all the resultant microflaking scars. They were recorded one by one for attributes such as shape and size. They were then counted as cross tabulation (Figure 30 to 35 for the left side tables). Numbers cross tables were converted to bar graph diagrams for scar pattern recognition (Figure 30 to 35 for the right side bar graphs). Here 6 cases are explained as examples of collective scar patterns due to limitation of space. In this analysis, actually 72 numerical tables and graph diagrams were made, and they indicate that concrete patterns virtually exist among microflaking. The patterns are partially presented as statistical tendencies as were described in Akoshima (1981), in such expression as “degree of concentration of scars to ventral aspect”.

The analyzed attributes are as follows. They are, so to speak, characterization as collective group of scars by making combined bar graphs from cross tabulations of attributes type categorization.

The Shape of Microflaking

The “shape” is the horizontal shape of the microflaking scar. Although there are many intermediate shapes, they are classified into the following “shapes”. Their variations were illustrated in Akoshima (1981, p.10).

“Scalar” (“S”). Semi-circular shape and its variations.

“Rectangular” (“R”). Either side of the scar runs parallel to each other.

“Trapezoidal” (“T”). The sides of the scar broaden toward the inside.

“Triangular” (“Tr”). When the axis of rectangular or trapezoidal scar becomes oblique to the edge, one side of the scar often protrudes from the edge line of the flake, and as a result, triangular scar occurs.

“Irregular” (“I”). Several types of complicated or overlapped scars are often found. It can be termed “others”.

“Sliced” (“Sl”). It looks “crescent” in horizontal shape. Thin edge is often snapped off and as a result, sliced scar occurs. When any overhang is observed, it is counted as “stepped sliced scar”.

The Size of Microflaking

It is problematic to define the size of flaking scars. Its ratio of length and width are diverse and the area is difficult to measure. However, considering the characteristics that most scars occur along the edge between ventral and dorsal aspects, the size is here measured as the distance between two ends of the scar on the edge line. The size was defined as follows. It was measured with a lattice scale (which was printed on glass plate), under the magnification of 10 X.

“Micro” (“mi”). A scar which is smaller than 0.5 mm in width.
“Small” (“s”). A scar which is between 0.5 mm and 1.0 mm in width.
“Middle” (“m”). A scar which is between 1.0 and 2.0 mm in width.
“Large” (“l”). A scar which is larger than 2.0 mm in width.

The Termination of Microflaking

Microflaking scars as the result of breakage of the edge entail attributes as “conchoidal fracture”. In case of stone knapping, usually “feather end”, “step fracture” or “step flaking” (and “hinge fracture”) is conventionally used as criteria of termination. But also the negative “curvature” of flaked scar surface is an important feature to evaluate the depression of the surface. So here the termination is classified into three categories, as follows.

“Deep” (“D”).
“Shallow” (“Sh”).
“Step” (“St”).

“Deep” and “Shallow” scars terminate with feather ending. Hinge fracture was included in “Step”. Absolute quantitative definition was not made between D and Sh, though the curvature of scars can be observed three dimensionally with a stereoscopic microscope.

The “Initiation” of scars as well as termination has been employed widely as a standard of scar classification. Initiation can be divided into two major categories, that is, “Cone” and “Bending”. Systematic analysis of initiation was not carried out in the present article, though it was observed that both initiations actually occurred and scars can be divided by the standard.

Edge angle was measured at several points of the edge for each experimental specimen. Edge width is the length of edge that was analyzed for microflaking phenomena. It does not mean the length of edge that was actually in contact with the worked material.

Converted graph diagram

The above mentioned attributes and classification results were converted to the bar graph diagram for each specimen. Some cases are exemplified here as Figure 30 to Figure 35 on the right side of the chart. The cross tabulation frequencies and the bar charts are self-evident, but it is emphasized that the bar graphs on symmetric framework denote particular characteristics of microflaking scar patterns. The diagnostic bar graph patterns correspond to numerical summary of scar attributes which were explained in Akoshima (1981 and 1987). The same relationships are recognized between microflaking attributes and working conditions (hardness of the worked materials and the direction of working motion). For example, such characteristics are expressed in the bar graph diagrams as the diversity or homogeneity of scar shapes, the ratio of step flaking, the size variation of scars, and the degree of concentration of scars to one aspect of the edge (or relatively symmetric distribution between both faces), scar pattern differences between ventral and dorsal faces. In the former publications, the method of finding diagnostic statistical summary was not fully presented, and we would apologize for the inconveniences there of, up to the present.

CHARACTERISTIC APPEARANCES OF SCARS

Combination and disposition of microflaking scars sometimes exhibit certain characteristic appearances as a group along the working edge. Here some examples of such particular characteristic patterns are described for explanation. The figure numbers denote both our previous article (Akoshima and Hong 2014) and this volume.

Soft Worked Materials.

1) SH55 [Figure 1(6), Figure 2(1), Figure 37(2)(3)]
Meat cutting, 1600 strokes. Scalar micro deep (SmiD for short) is predominant type of scar. Scars are intermittent or scattered.
2) SH108 [Figure 3(5)(6), Figure 39(5)(6), Figure 40(1)(2)]
Wild ducks butchering. Scars of various shapes and sizes are found on both aspects. Their dispositions are irregular.
3) SH20 [Figure 4(3)(4), Figure 41(3)(4)(5)]
Grass cutting – chopping, 1700 strokes. Scars of various shapes and sizes are found on both aspects, and their dispositions are irregular. A good example of Triangular (Tr) scar (middle) is shown in Figure 4(3). An example of Scalar large shallow scar is shown in Figure 41(4). This is the same pattern as SH108.
4) SH42 [Figure 6(5)(6), Figure 45(4)(5)]
Reed cutting – chopping, 2650 strokes. A number of intermittent micro size scars are shown. The edge is a little rounded.
5) SH121 [Figure 7(6), Figure 8(1), Figure 50(1)(2)]
Rawhide scraping, 2000 strokes. All scars are Micro sized,

and concentrate on dorsal aspect intermittently. There are also some Trapezoidal (T) scars.

6) SH122 [Figure 8(2)(3), Figure 50(3)]
Rawhide scraping, 2000 strokes. The predominant type is Scalar micro deep (SmiD), continuous or intermittent, concentrating on one aspect. This pattern of microflaking is also seen above mentioned SH121.

7) SH124 [Figure 8(6), Figure 9(1), Figure 48(6), Figure 49(1)(2)]
Rawhide scraping, 800 strokes. A handful of soil was sprinkled on the hide. Continuous scalar scars were found on both aspects. There are more frequency on ventral than dorsal. Most common type is Scalar micro deep (SmiD), but there are also Scalar small deep (SsD) type scars. The edge is heavily abraded. The abrasion blurs the shape of microflaking.

8) SH126 [Figure 9(4)(5), Figure 51(6), Figure 52(1)]
Rawhide scraping with sand, 2000 strokes. This is the same patterns as SH124. Heavy abrasion even produced the rounded edge. Continuous or intermittent scars consist mainly of Scalar micro deep (SmiD).

Medium Worked Materials

9) SH114 [Figure 12(5), Figure 58(1)(2)(3)(4)]
Wood whittling, 1000 strokes. Continuous Scalar micro deep scars (SmiD) are shown in Figure 12(5), Rectangular middle step (RmSt) is shown in Figure 58(4).

10) SH111 [Figure 12(6), Figure 13(1)(2), Figure 58(5)(6), Figure 59(1)(2)(3)(4)]
Wood scraping, 1000 strokes. It is characterized by Rectangular or Trapezoidal step scars of micro, small and middle size (mi, s, m), concentrating on one aspect (in this case, on dorsal). This pattern often occurs in case of scraping of medium or hard materials. Step scars often overlap vertically [Figure 59(3), 58(5)]. In Figure 59(2), Rectangular (R) scars are similarly oblique to the edge in their axes.

11) SH96 [Figure 14(1)(2), Figure 60(1)(2)(3)(4)]
Wood whittling, 1000 strokes. The texture of the shale is very fine grained. Various types of scars (mainly Scalar) are irregularly disposed.

12) SH150 [Figure 14(3)(4)(5), Figure 60(5)]
Wood scraping, 500 strokes. There are scar concentrations on dorsal aspect, continuous Scalar or Rectangular scars, step but shallow.

13) SH149 [Figure 16(6), Figure 17(1), Figure 64(4)(5)]
Wood scraping, 500 strokes. Continuous scars including many large ones concentrate on dorsal aspect. They are Rectangular step or Scalar deep type, but when termination is step, the curvature of scar surface is rather flat [Figure 64(4)]. Many small or middle vertically overlapping step scars on the edge crosscut these scars. Scars are rare on ventral aspect. The pattern is similar to the case of SH150.

14) SH80 [Figure 21(3)(4), Figure 75(5)(6), Figure 76(1)(2)]
Bamboo sawing, 4000 strokes. Continuous Scalar or Rectangular small shallow scars are horizontally overlapping. Various shapes and sizes of scars are also found, Scalar large deep (SlD) [Figure 75(5)], Continuous Rectangular [Figure 76(2)], Trapezoidal middle step (TmSt) [Figure 21(4)], and so on.

15) SH77 [Figure 22(6), Figure 23(1)(2), Figure 78(2)(3)(4)(5)]
Gourd sawing, 5000 strokes. A number of continuous tiny scars consisting mainly of Scalar micro deep (SmiD) type are shown. Several small size scars on ventral aspect are also shown (intermittent).

Hard Worked Materials

16) SH86 [Figure 23(4)(5), Figure 78(6), Figure 79(1)(2)(3)(4), Figure 81(2)]
Bone sawing, 3000 strokes. Scars occur on both aspects similarly. They are of various types, Scalar deep, Triangular [Figure 79(3)], overlapping step [Figure 78(6)]. Their dispositions are irregular. Slight abrasion is found on the edge.

17) SH93 [Figure 24(4)(5), Figure 82(4)(5)(6), Figure 83(1)]
Bone scraping, 1500 strokes. Almost all scars are on dorsal aspect. Large step or shallow scars are crosscut by a number of vertically overlapping step scars. These overlapping scars give a “crushed” appearance.

18) SH92 [Figure 25(1)(2), Figure 81(3)(4)]
Bone sawing, 5000 strokes. Various types of scars are found on both aspects. Continuous Scalar small deep (SsD) scars are shown in Figure 81(3). This specimen exhibits a similar pattern to SH86.

19) SH48 [Figure 26(2)(3), Figure 84(6), Figure 85(1)(2)(3)]
Antler sawing, 15000 strokes. There are mainly intermittent Scalar scars. They are irregularly disposed. Slight abrasion is found on the edge.

20) SH68 [Figure 26(4)(5)(6), Figure 86(2)(3)(4)(5)(6)]
Antler sawing, 4300 strokes. Sawing dry antler gives a very angular appearance. Various types of scars are irregularly overlapping. “Alternate flaking” like microflaking scars are found [Figure 26(4), 86(3)], consisting of Scalar scars.

21) SH70 [Figure 27(3)(4), Figure 87(1)(2)(3)]
Antler whittling, 2000 strokes. The angular appearance is also caused by dry antler. Scars are of various types, with no predominant type.

22) SH153 [Figure 27(5)(6), Figure 87(4)(5)]
Dry antler scraping, 100 strokes. Large or middle step but flat (in curvature) scars are crosscut by irregularly, vertically overlapping step scars, on dorsal aspect. Few scars are found on ventral aspect.

CONCLUSIONS

The databases presented here as a main addition to our previous database in 2014 will serve for a means of fundamental pattern recognition of the category of use-wear which can be observable with a standard equipment of low magnification microscope. So far, it seems there has been a common understanding in Japan that the “high power approach” is always superior to the “low power approach” in their interpretative power. However, we take a methodological position that each category of use-wear, namely micro-polish (or microwear polish), striation, micro-edge damage (here referred as microflaking), and even macro-wear such as “impact fracture” of projectile weapons (often observable with a hand magnifier), has its own potential strength and weakness.

For instance, micro-polish is difficult to identify when heavy patination, or “post-depositional surface modification” phenomena, affected the working edge of the tool. Another restriction of micro-polish is the quality of raw materials. Very coarse-grained lithic materials, or extra-hard materials such as quarts and quartzite in the Paleolithic period of the Korean peninsula, prevent from reliable identification of micro-polishes. The other way around is very soft materials such as rhyolite, fine-grained mud-stone, or acidic volcanic rocks. Surface alteration and abrasion of the edge often makes polish identification a difficult endeavor. Our conclusion has been that all types of use-wear should be paid enough attention as long as they are observable along the working edge. This article of database presentation is an effort for this problem oriented methodological thinking.

This collection of microphotography and presentation of calculating method of varied scar patterns, we believe, will play some essential roles in the future development of use-wear analysis in general. Extra-hard lithic raw materials, or very soft lithic raw materials, both require considerable amount of additional experimental research, because our standard charts presented here only entail raw materials typically utilized in the Tohoku District of Japan during prehistoric times, namely, siliceous hard shale. Also, meticulous experimental researches are further necessary concerning the relationship between use-wear microchipping scars and technological secondary retouch micro scars, such as those produced along the backed edges of knife blades. The two sorts of microchipping scars were conventionally treated as indistinguishable from each other. Is the distinction so difficult that there would be no means to identify these? We are still in need of serious experimental endeavors toward this direction.

It is again emphasized here that the actual looks of microchipping phenomena are very variable. The appearances of microflaking scars exhibit wide ranges of variation, even in the case where the tool was utilized in the same task. It was a reason why Akoshima (1989) adopted a statistical approach to reduce such weak points in use-wear identification. Utility of the category of micro-scale chipping as the “diagnostic feature” of use of lithic artifacts needs to be properly evaluated. In research history, microflaking has been considered as a major criterion for functional interpretation since the inception of experimental research (e.g., Tringham, et al. 1974) in American archaeology (e.g., Odell 1996), and has been recently applied to Asian countries (e.g., Gao and Chen eds. 2008). We wish in Japan too, this category of use-wear will be given appropriate importance in functional analysis of lithic artifacts, and the study will be integrated with other categories of wear such as microwear polishes and striations, for the purpose of elucidating the processes of prehistoric human adaptations to the given environments.

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Prof. Hiroshi Kajiwara of Tohoku Fukushi University actually conducted many of the replicative experiments together with the first author while he was at Tohoku University. We are grateful to Prof. emeritus Toshio Yanagida of the Tohoku University Museum for recommending publication in its Bulletin series. The database publication of this page size sometimes faces difficulties to find places to be accommodated. We hope that in the future Bulletin series, essential parts of TUMRT research standards may find their places, as our functional database so far served for basic reference purposes nationwide. Lastly, this article is a result of KAKENHI (Grant-in-aid for Scientific Research) by the Japanese government, which was granted to Akoshima (2015, number 25370885).

ERRATA

In the previous article (2014), there was miss-printing of figure caption as follows.
(wrong) Figure 22 (6) 5.0-2. bamboo saw 2000st (SH79d) 8x.
(correction) Figure 22(6) 6.0-2 gourd saw 5000st (SH77d) 8x
We sincerely apologize for the error.

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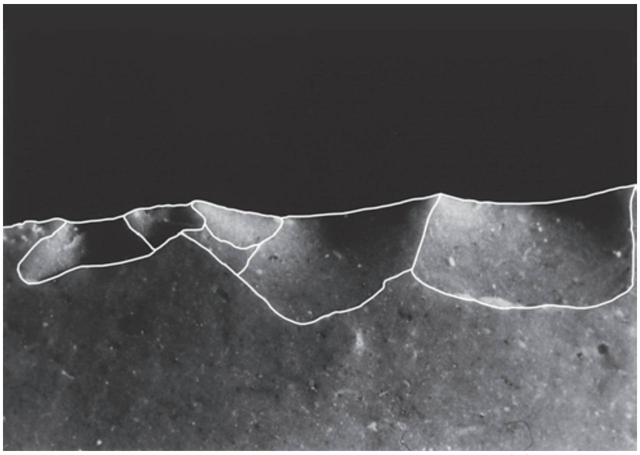
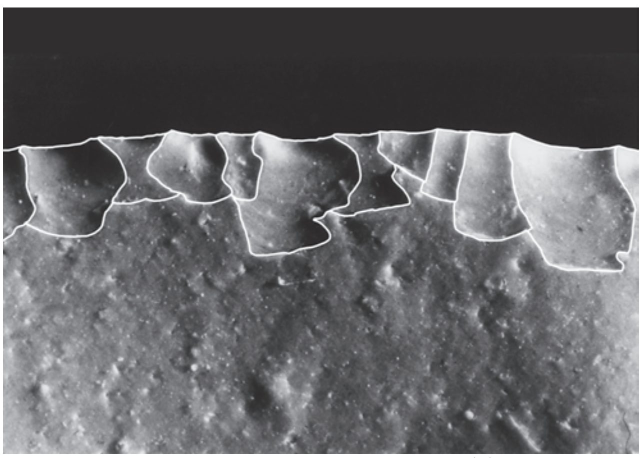

SH148d, dry hide chop, 306st, from Fig.11(6)

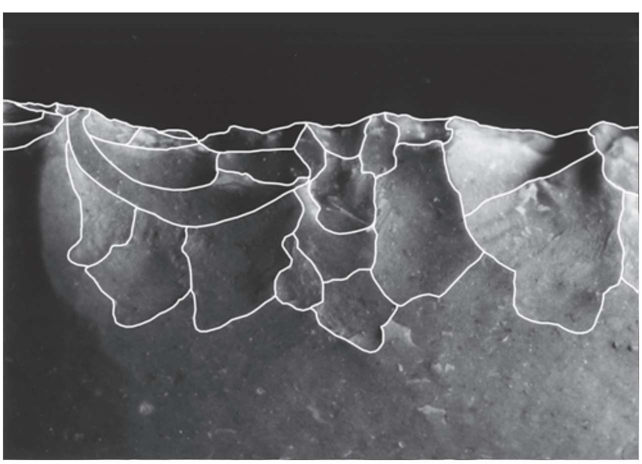
(1) Example of soft worked materials

The working edge was used to chop dry hide surface. Strong impact onto the edge produced irregularly arranged scars of various shape, size, and termination on both facets of the edge. On the photo from right, rectangular, scalar, smaller scalar overlapping on rectangular, then smaller rectangular, and trapezoidal scars, are arranged side by side. Some rectangular and trapezoidal scars have step flaking termination. On the other side of the same edge [Figure 12(1)], very large deep scalar scar is observed indicating the impact of chopping motion.


SH150d, wood scrape 500st, from Fig.14(4)

(2) Example of medium worked materials

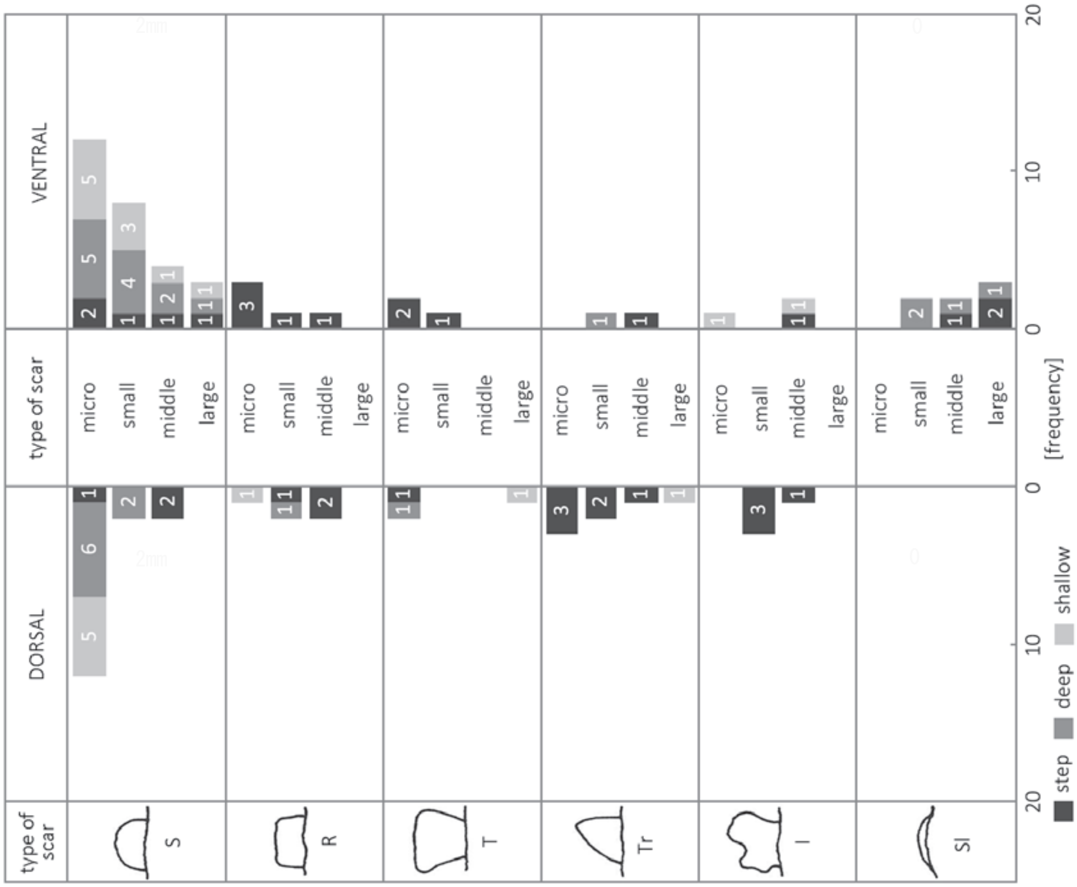
The working edge was used to scrape fresh cedar branch, with this dorsal surface being the rear side of movements. Relatively flat microflaking scars are arranged regularly along the edge. Most of them are of rectangular shape but also there are some trapezoidal shape scars. Terminations of these rectangular and trapezoidal scars are step flaking in most cases. However, the scars are flat and shallow, and the negative bulbs of percussion of scars are not deep.


SH153d, dry antler scrape 100st, from Fig.27(5)

(3) Example of hard worked materials

The working edge was used to scrape dry antler surface. The extreme hardness of the worked material is reflected on the pattern of microflaking. That is, very irregular arrangement of various shape and size of many scars which are overlapping one another. In addition, the edge line is affected with vertically overlapping step termination scars. Some scars are large and deep, some are small and flat. The shapes of scars are also varied, and many are of irregular type with both step and feather terminations. The other side of the same edge [Figure 27(6)] shows only sporadic small microflaking scars. In such cases, the concentration of microflaking scars onto only one face of the working edge is prominent.

Figure 29. Identification of microflaking scars.

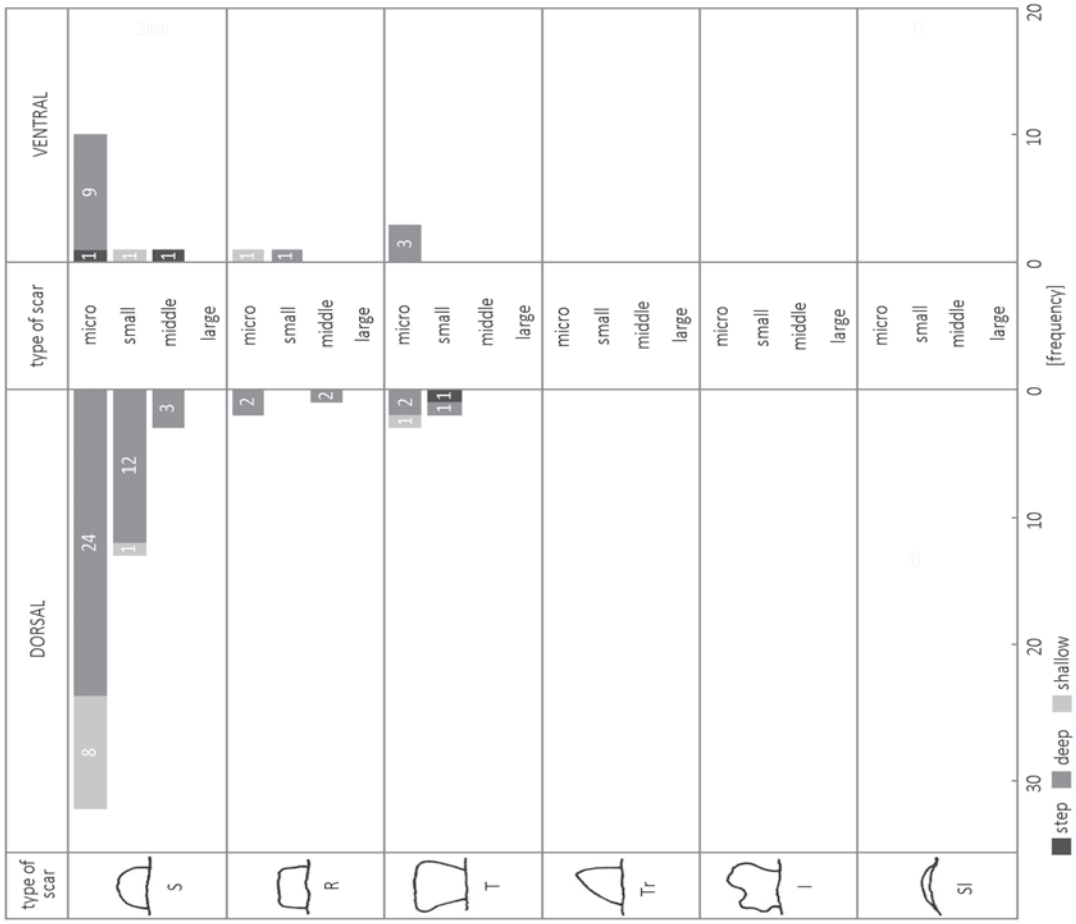


type of scar		step D	step V	step T	deep D	deep V	deep T	shallow D	shallow V	shallow T	total D	total V	total T	total
S	micro	1	2	3	6	5	11	5	5	10	12	12	24	43
	small		1	1	2	4	6		3	3	2	8	10	
	middle	2	1	3		2	2		1	1	2	4	6	
	large		1	1		1	1		1	1		3	3	
R	micro		3	3								3	3	10
	small	1	1	2	1		1		1	1	2	2	4	
	middle	2	1	3							2	1	3	
	large													
T	micro	1	2	3	1		1	1		1	3	2	5	6
	small		1	1								1	1	
	middle													
	large													
Tr	micro	3		3							3		3	9
	small	2		2		1	1				2	1	3	
	middle	1	1	2							1	1	2	
	large							1		1	1		1	
I	micro								1	1		1	1	7
	small	3		3							3	0	3	
	middle	1	1	2					1	1	1	2	3	
	large													
Sl	micro													7
	small					2	2					2	2	
	middle		1	1		1	1					2	2	
	large		2	2		1	1					3	3	
total		17	18	35	10	17	27	7	13	20	34	48	82	82

D=dosal. V=ventral. T=total

Figure 30. Characteristics of microflaking scars (soft worked materials)

SH20 grass cutting-chopping, 1700 strokes(various kinds of weeds) edge angle 30° 35° 35° edge width 52 mm

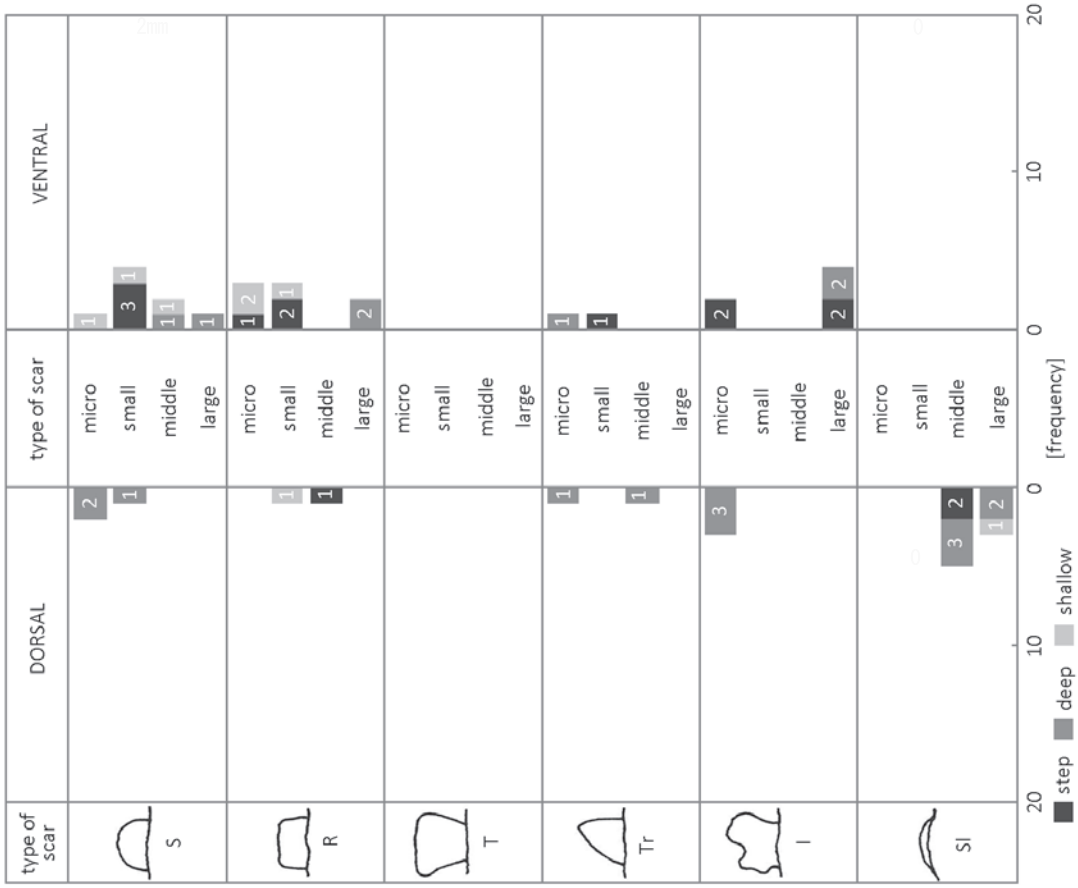


type of scar		step D	step V	step T	deep D	deep V	deep T	shallow D	shallow V	shallow T	total D	total V	total T	total
S	micro		1	1	24	9	33	8		8	32	10	42	60
	small				12		12	1	1	2	13	1	14	
	middle		1	1	3		3				3	1	4	
	large													
R	micro				2		2		1	1	2	1	3	5
	small					1	1					1	1	
	middle				1		1				1		1	
	large													
T	micro				2	3	5	1		1	3	3	6	8
	small	1		1	1		1				2		2	
	middle													
	large													
Tr	micro													0
	small													
	middle													
	large													
I	micro													0
	small													
	middle													
	large													
SI	micro													0
	small													
	middle													
	large													
total		1	2	3	45	13	58	10	2	12	56	17	73	73

D=dosal. V=ventral. T=total

Figure 31. Characteristics of microflaking scars (soft worked materials)

SH123 rawhide scraping, 2000 strokes (pig, +soil) edge angle 45° 50° edge width 30 mm



type of scar		step D	step V	step T	deep D	deep V	deep T	shallow D	shallow V	shallow T	total D	total V	total T	total
S	micro				2		2		1	1	2	1	3	11
	small		3	3	1		1		1	1	1	4	5	
	middle					1	1		1	1		2	2	
	large					1	1					1	1	
R	micro		1	1					2	2		3	3	10
	small		2	2				1	1	2	1	3	4	
	middle	1		1							1		1	
	large					2	2					2	2	
T	micro													0
	small													
	middle													
	large													
Tr	micro				1	1	2				1	1	2	4
	small		1	1								1	1	
	middle				1		1				1	0	1	
	large													
I	micro		2	2	3		3				3	2	5	9
	small													
	middle													
	large		2	2		2	2					4	4	
Sl	micro													8
	small													
	middle	2		2	3		3				5	0	5	
	large				2		2	1		1	3	0	3	
total		3	11	14	13	7	20	2	6	8	18	24	42	42

D=dosal. V=ventral. T=total

Figure 32. Characteristics of microflaking scars (medium worked materials)

SH115 wood sawing, 1000 strokes (paulownia) edge angle 40° 40° 45° edge width 45 mm

type of scar		step D	step V	step T	deep D	deep V	deep T	shallow D	shallow V	shallow T	total D	total V	total T	total
S	micro	1		1	3	4	7	2	1	3	6	5	11	19
	small		1	1	3		3				3	1	4	
	middle							1		1	1		1	
	large							3		3	3		3	
R	micro	12	3	15		1	1		1	1	12	5	17	28
	small	5		5				1		1	6		6	
	middle	4		4							4		4	
	large	1		1							1		1	
T	micro	6		6				1		1	7		7	12
	small	4		4	1		1				5		5	
	middle													
	large													
Tr	micro													2
	small				1		1				1		1	
	middle	1		1							1		1	
	large													
I	micro	8		8							8		8	8
	small													
	middle													
	large													
Sl	micro													0
	small													
	middle													
	large													
total		42	4	46	8	5	13	8	2	10	58	11	69	69

D=dosal. V=ventral. T=total

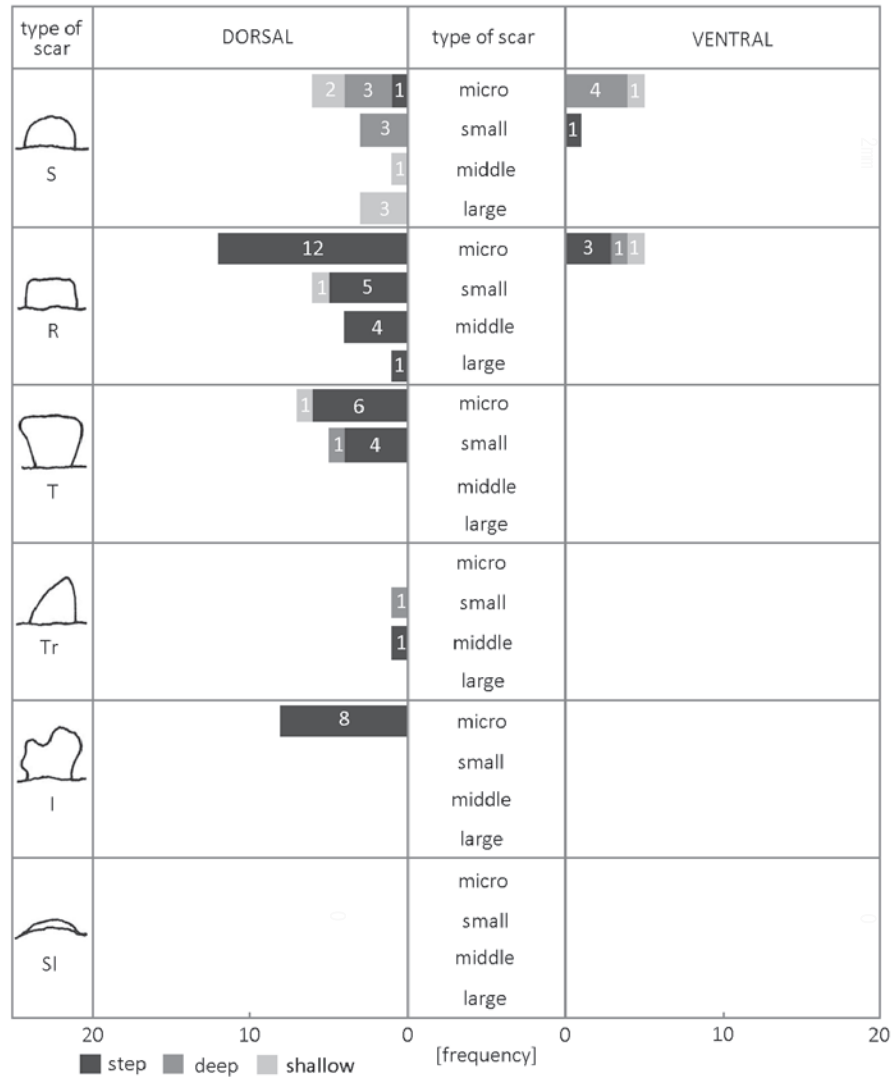


Figure 33. Characteristics of microflaking scars (medium worked materials)

SH111 wood scraping, 500 strokes (paulownia) edge angle 60° edge width 40㎜

type of scar		step D	step V	step T	deep D	deep V	deep T	shallow D	shallow V	shallow T	total D	total V	total T	total
S	micro	1		1	1	1	2	3	1	4	5	2	7	34
	small	1	1	2	3	4	7	2	3	5	6	8	14	
	middle		1	1	6	3	9				6	4	10	
	large				1	2	3				1	2	3	
R	micro		1	1		1	1					2	2	8
	small	1	2	3		1	1		1	1	1	4	5	
	middle				1		1				1		1	
	large													
T	micro	2		2							2	0	2	7
	small	4	1	5							4	1	5	
	middle													
	large													
Tr	micro	2	1	3					1	1	2	2	4	6
	small		2	2								2	2	
	middle													
	large													
I	micro		3	3								3	3	4
	small											0	0	
	middle		1	1								1	1	
	large													
Sl	micro													11
	small	3		3	2		2				5		5	
	middle	2	2	4							2	2	4	
	large				1	1	2				1	1	2	
total		16	15	31	15	13	28	5	6	11	36	34	70	70

D=dosal. V=ventral. T=total

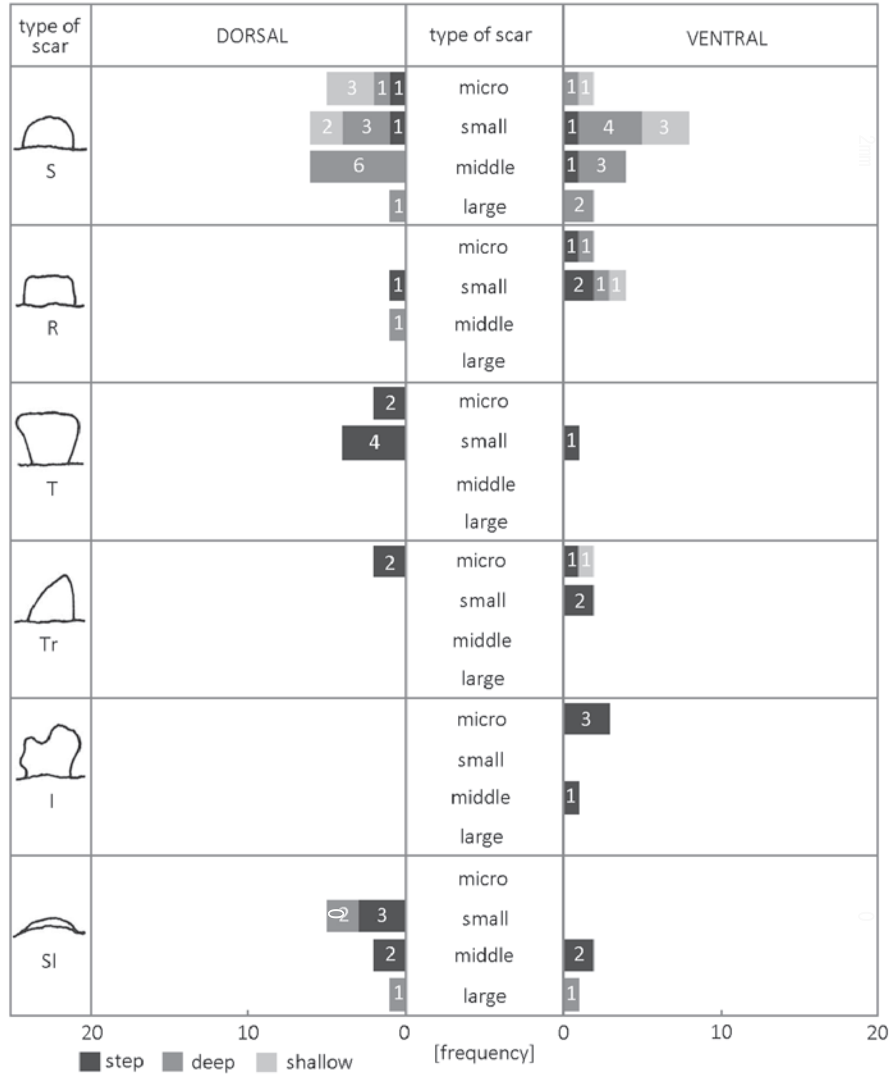


Figure 34. Characteristics of microflaking scars (hard worked materials)

SH68 antler sawing, 4300 strokes (dry) edge angle 50° 50° 55° edge width 45 mm

type of scar		step D	step V	step T	deep D	deep V	deep T	shallow D	shallow V	shallow T	total D	total V	total T	total
S	micro	3		3	11	1	12	2		2	16	1	17	27
	small	2		2	6		6				8		8	
	middle				1		1				1		1	
	large							1		1	1		1	
R	micro	6		6	1		1				7		7	18
	small	8		8	1		1				9		9	
	middle	2		2							2		2	
	large													
T	micro	2		2	1		1				3		3	21
	small	12	1	13	1		1				13	1	14	
	middle	2		2	1		1				3		3	
	large	1		1							1		1	
Tr	micro			0										3
	small	3		3							3		3	
	middle													
	large													
I	micro	1		1	1		1				2		2	10
	small	2		2				1		1	3		3	
	middle	4		4							4		4	
	large	1		1							1		1	
Sl	micro													3
	small													
	middle	2		2							2		2	
	large	1		1							1		1	
total		52	1	53	24	1	25	4	0	4	80	2	82	82

D=dosal. V=ventral. T=total

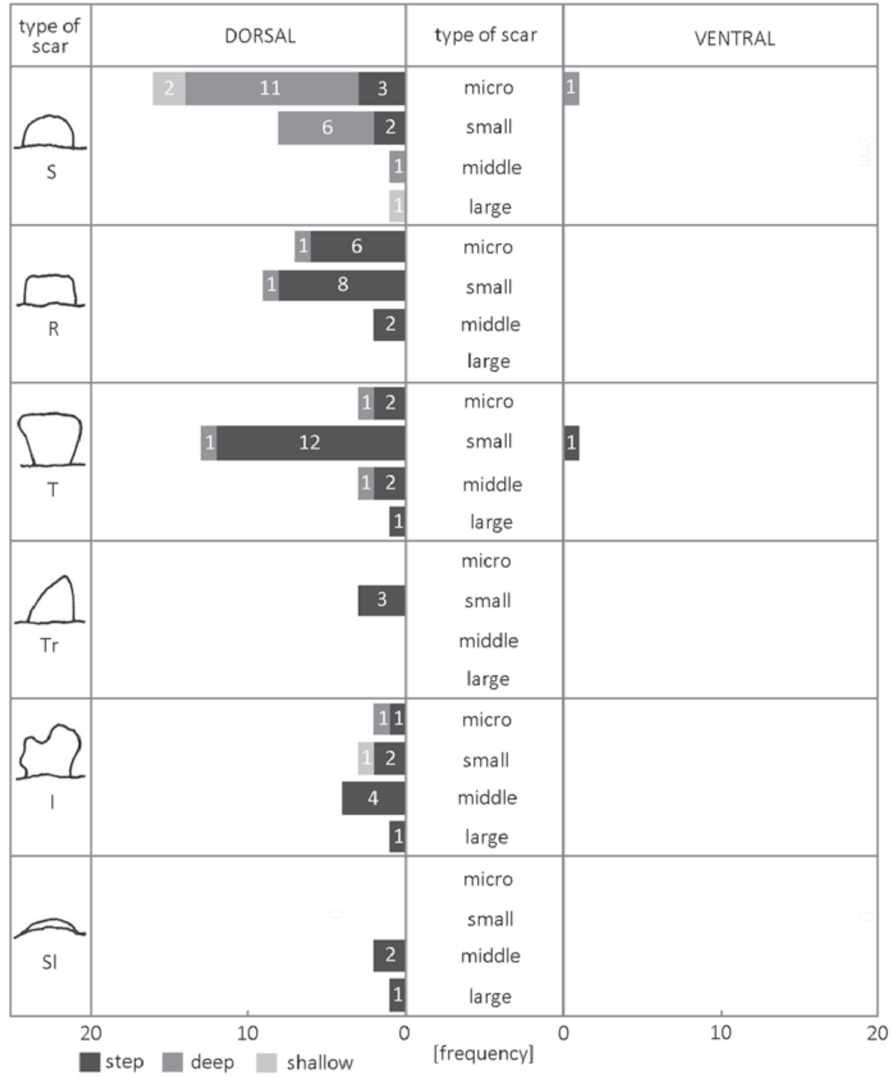
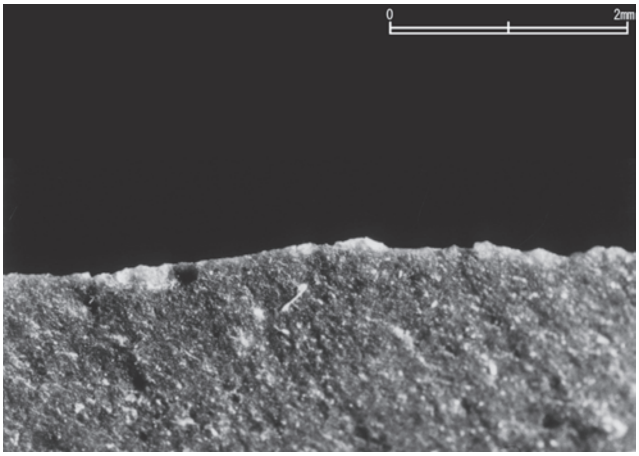
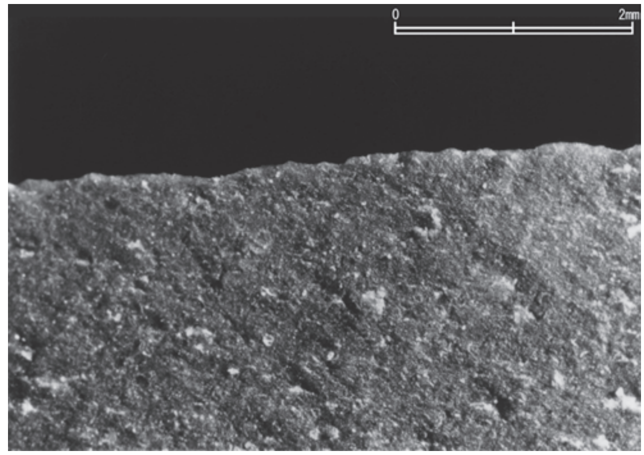


Figure 35. Characteristics of microflaking scars (hard worked materials)

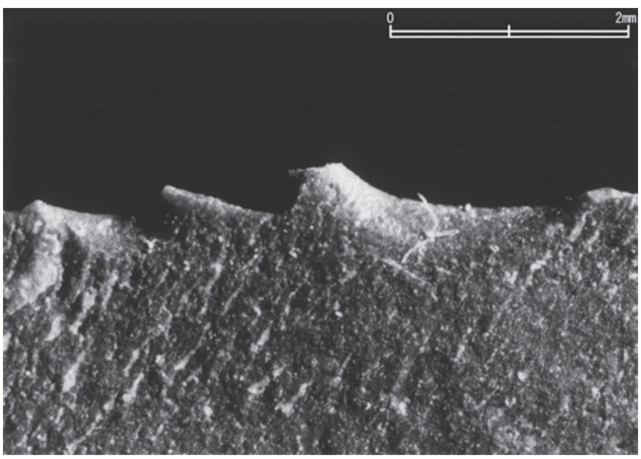
SH93 bone scraping, 1500 strokes (pig, boiled) edge angle 65° edge width 36 mm



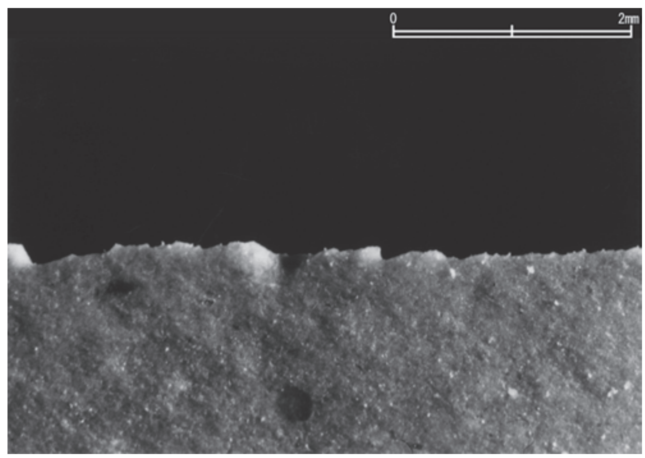
(1) 1.1-1. meat cut 800st (SH26d) 8x



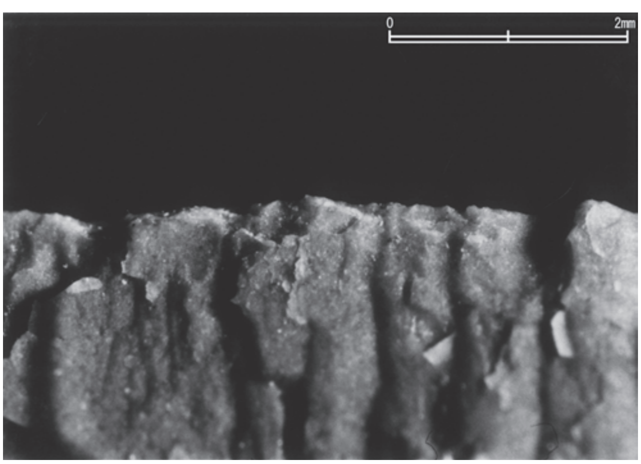
(2) 1.1-1. meat cut 800st (SH26v) 8x



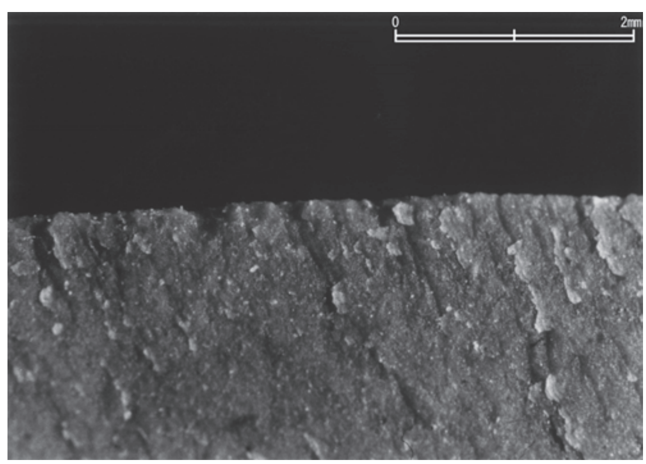
(3) 1.1-1. meat cut 800st (SH26v) 8x



(4) 1.2-1. meat cut 1300st (SH54d) 8x

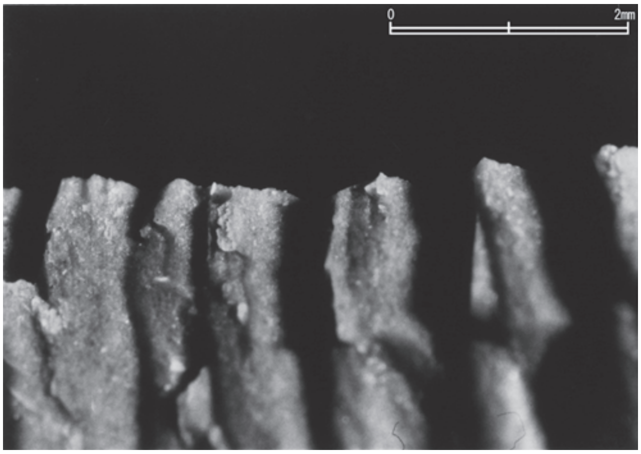


(5) 1.2-1. meat cut 1300st (SH54v) 8x

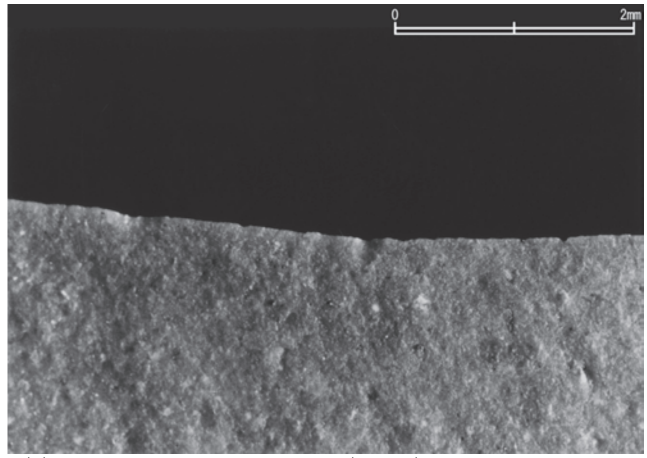


(6) 1.2-1. meat cut 1300st (SH54v) 8x

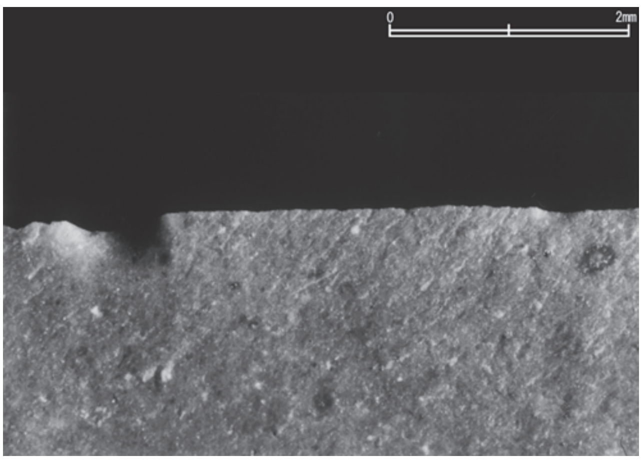
Figure 36. Experimental microflaking scars. (soft worked materials)



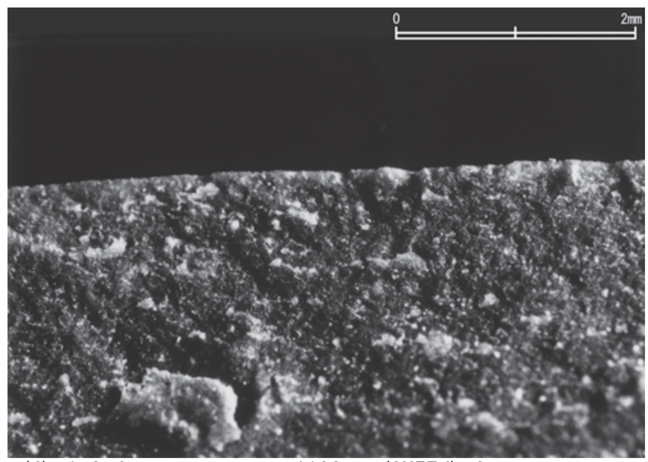
(1) 1.2-1. meat cut 1300st (SH54v) 8x



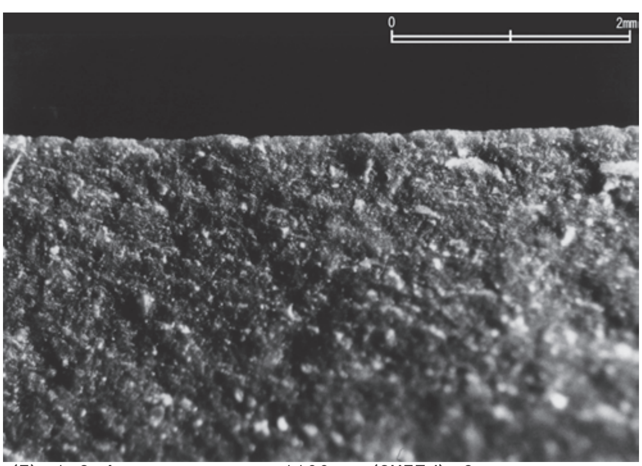
(2) 1.2-1. meat cut 1600st (SH55v) 8x



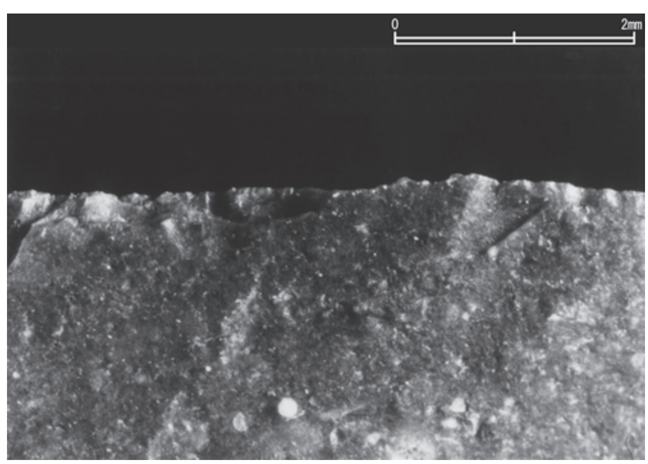
(3) 1.2-1. meat cut 1600st (SH55v) 8x



(4) 1.2-4. meat scrape 1100st (SH57d) 8x

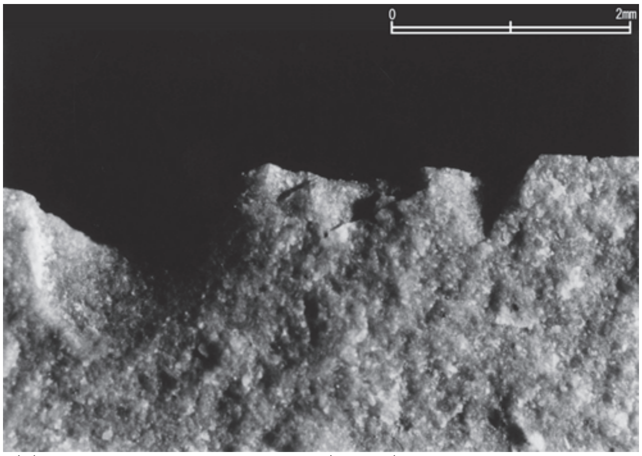


(5) 1.2-4. meat scrape 1100st (SH57d) 8x

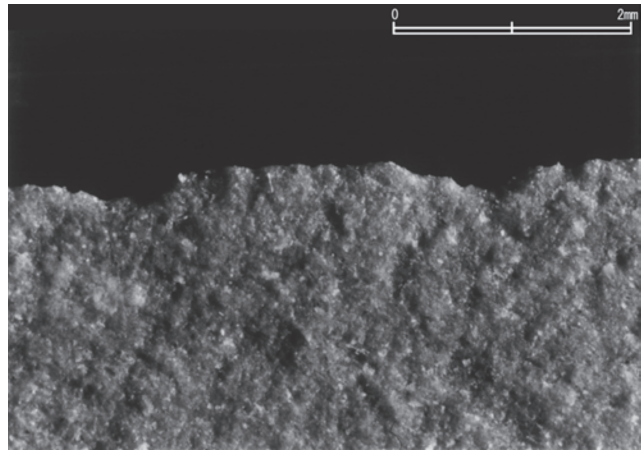


(6) 1.4-6. meat butcher (KSM5d) 8x

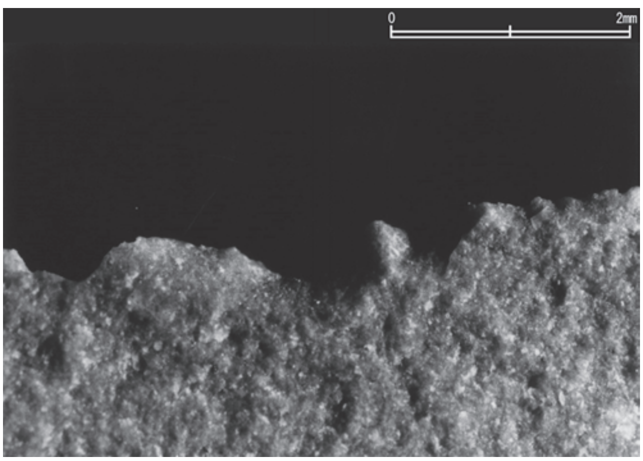
Figure 37. Experimental microflaking scars. (soft worked materials)



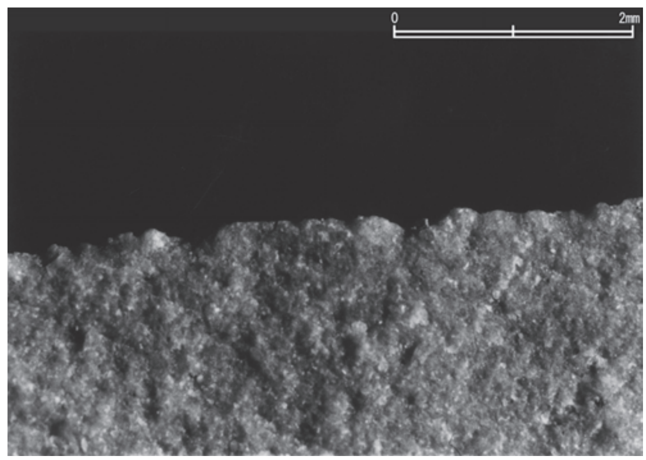
(1) 1.3-1. meat cut 500st (SH15d) 8x



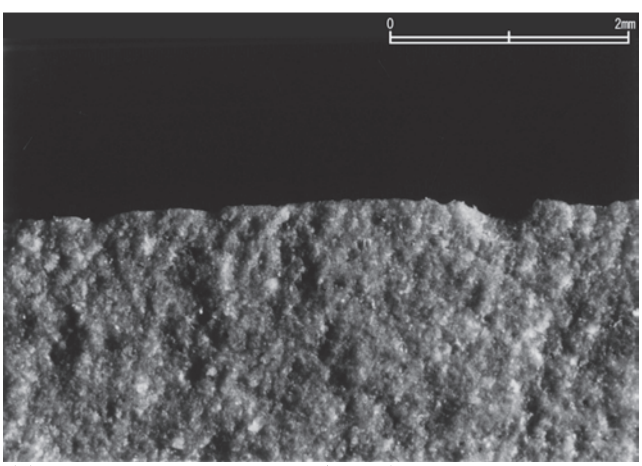
(2) 1.3-1. meat cut 500st (SH15d) 8x



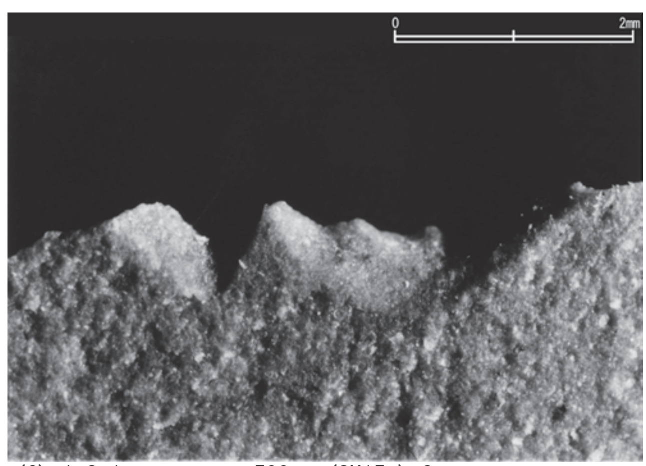
(3) 1.3-1. meat cut 500st (SH15d) 8x



(4) 1.2-1. meat cut 500st (SH15d) 8x

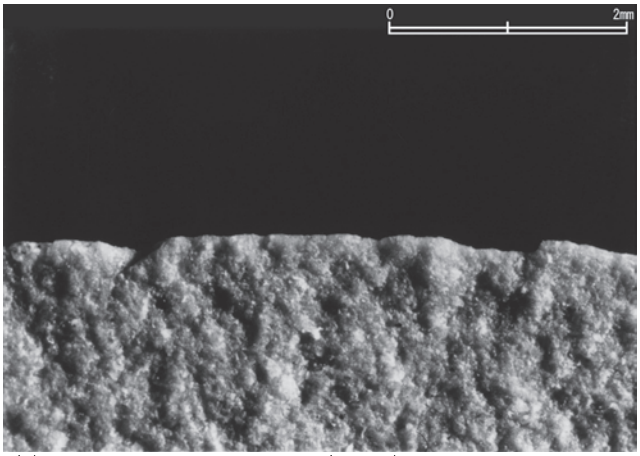


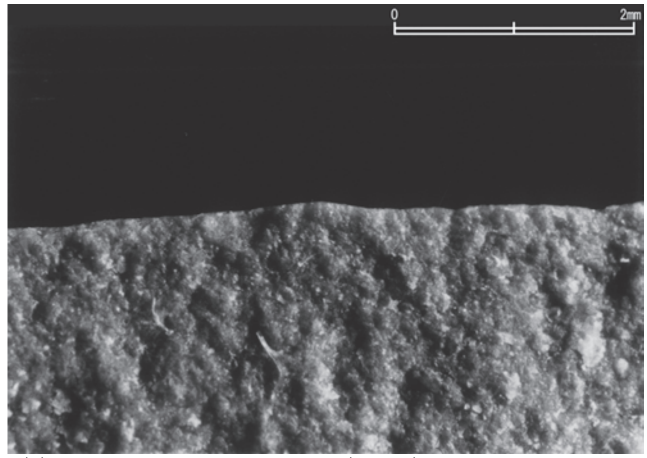
(5) 1.3-1. meat cut 500st (SH15v) 8x

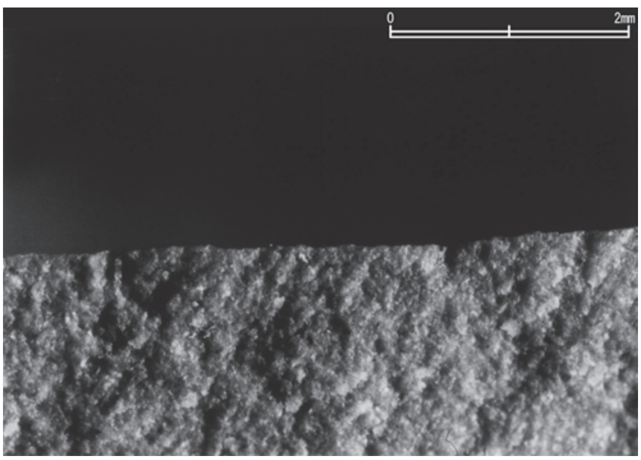


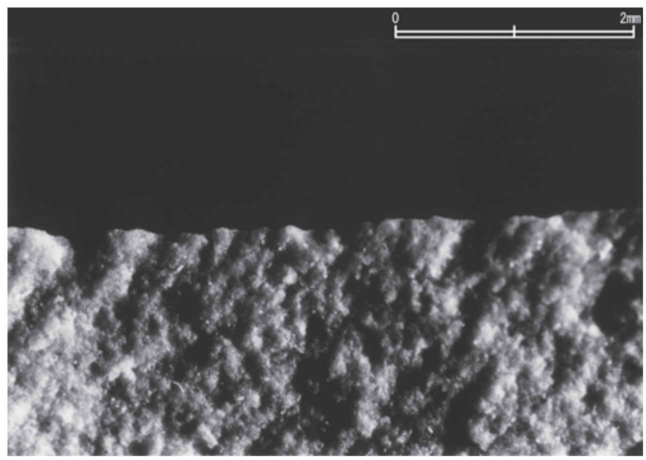
(6) 1.2-1. meat cut 500st (SH15v) 8x

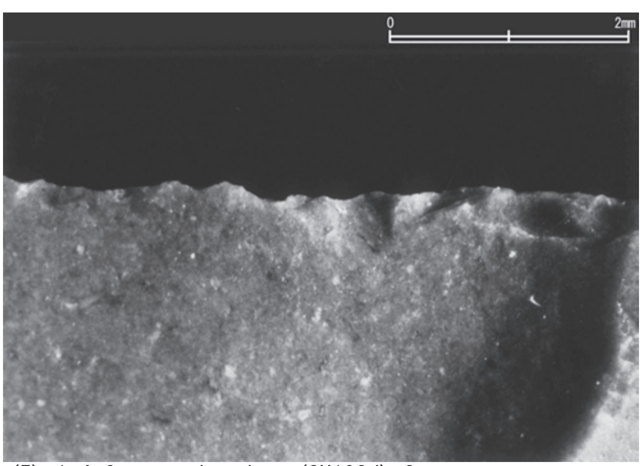
Figure 38. Experimental microflaking scars. (soft worked materials)


(1) 1.3-1. meat cut 500st (SH17d) 8x


(2) 1.3-1. meat cut 1000st (SH17d) 8x


(3) 1.3-1. meat cut 1000st (SH17v) 8x


(4) 1.3-1. meat cut 1000st (SH17v) 8x


(5) 1.4-6. meat butcher (SH108d) 8x

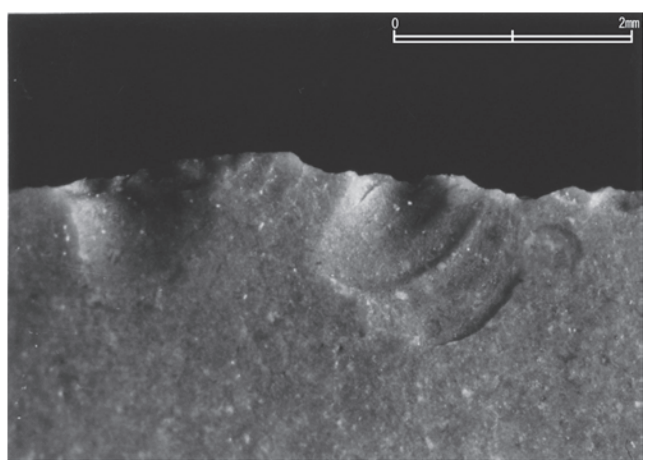
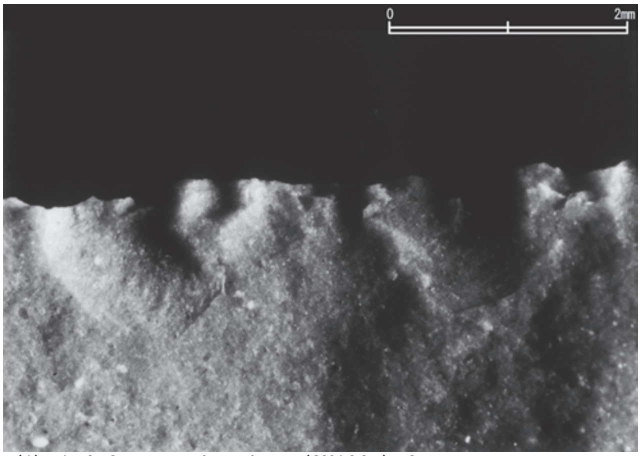
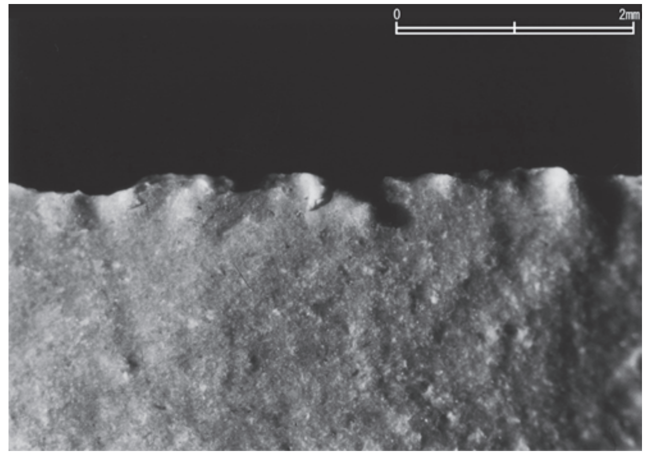

(6) 1.4-6. meat butcher (SH108d) 8x

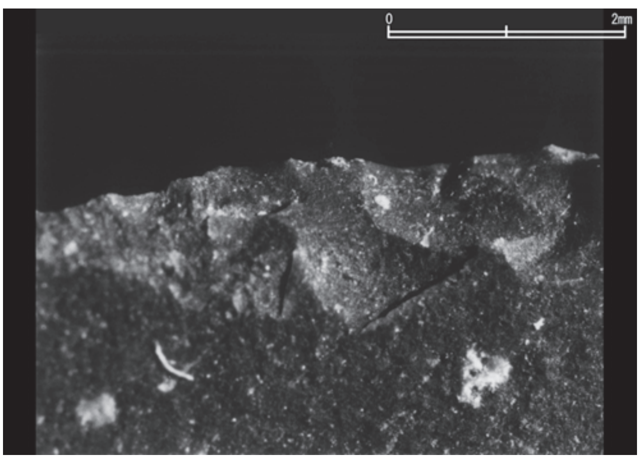
Figure 39. Experimental microflaking scars. (soft worked materials)



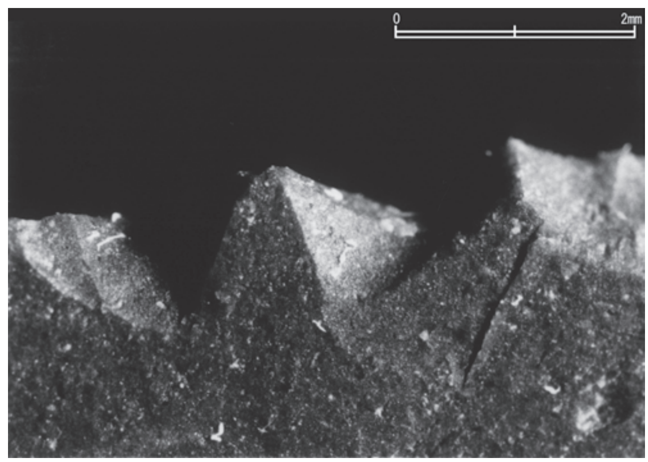
(1) 1.4-6. meat butcher (SH108v) 8x



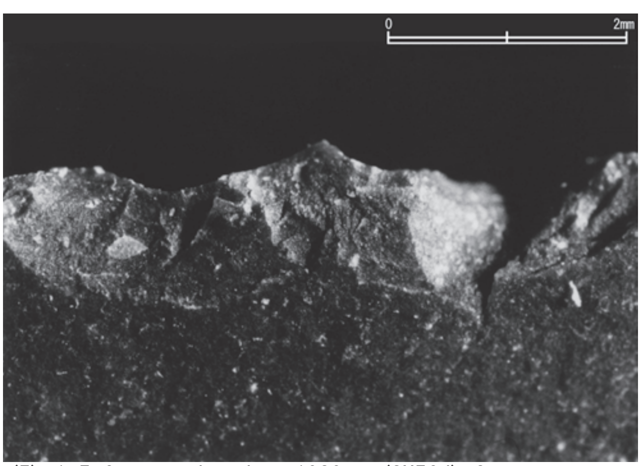
(2) 1.4-6. meat butcher (SH108v) 8x



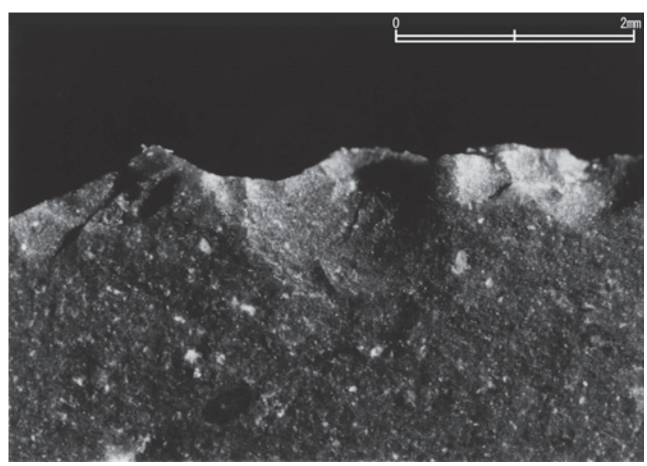
(3) 1.5-6. meat butcher 1020st (SH56d) 8x



(4) 1.5-6. meat butcher 1020st (SH56d) 8x

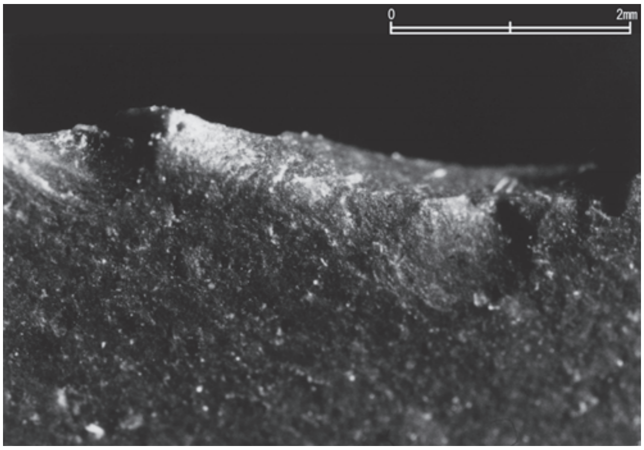


(5) 1.5-6. meat butcher 1020st (SH56d) 8x

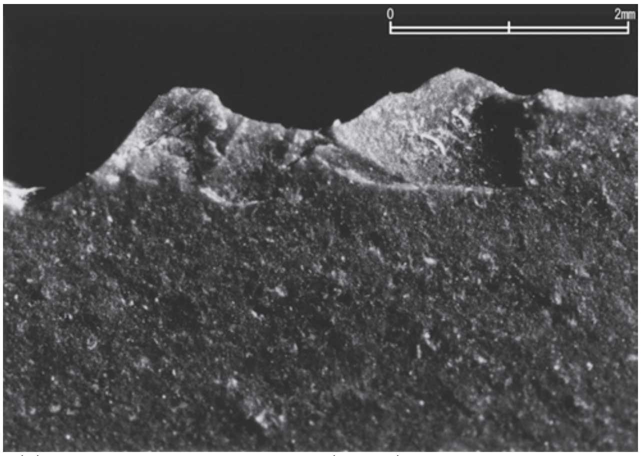


(6) 1.5-6. meat butcher 1020st (SH56d) 8x

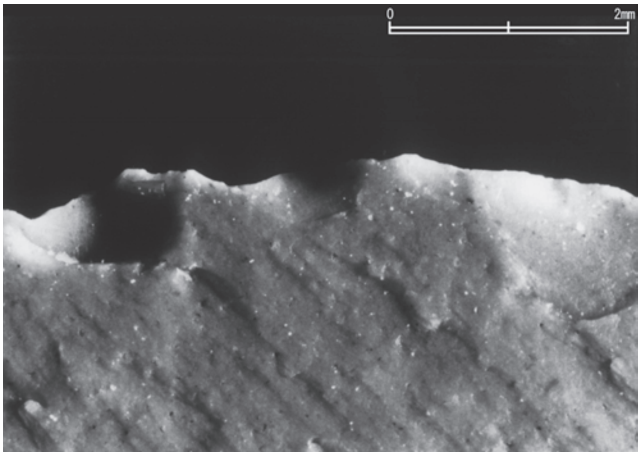
Figure 40. Experimental microflaking scars. (soft worked materials)



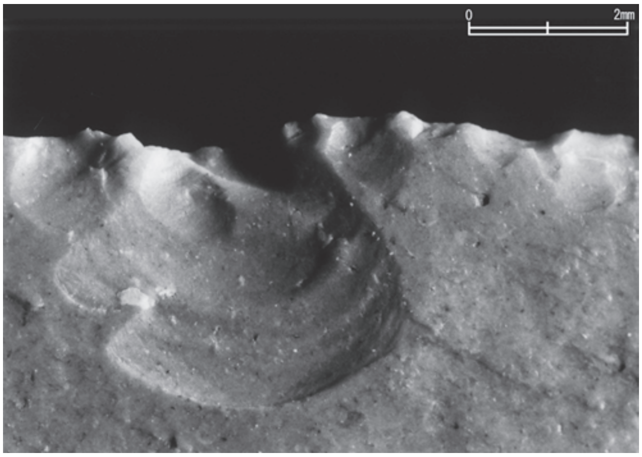
(1) 1.5-6. meat butcher 1020st (SH56v) 8x



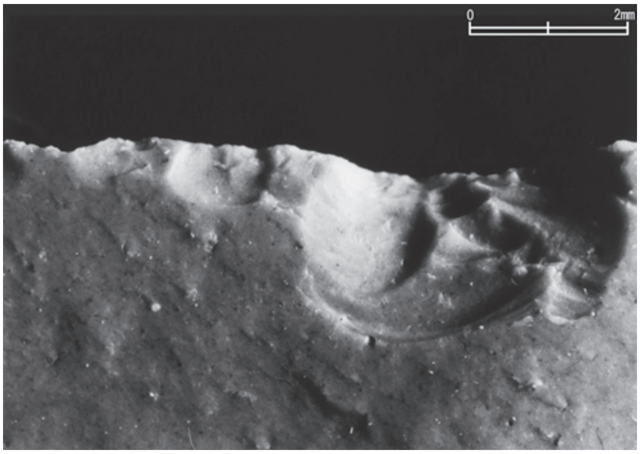
(2) 1.5-6. butcher 1020st (SH56v) 8x



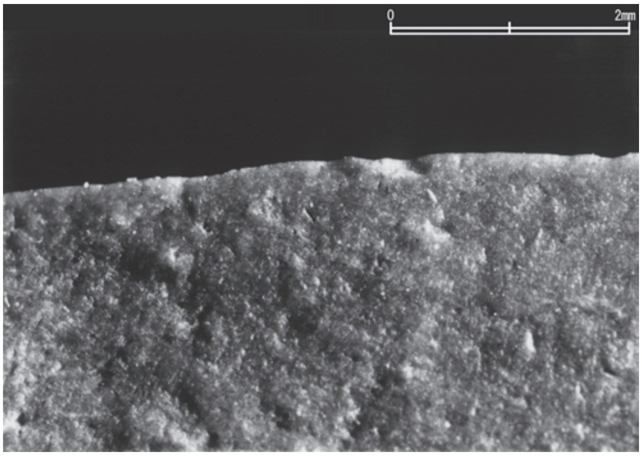
(3) 2.1-1. plant cut 1700st (SH20d) 8x



(4) 2.1-1. plant cut 1700st (SH20v) 5x

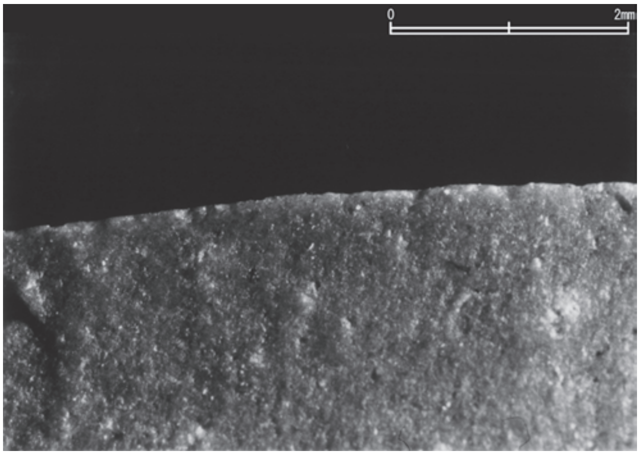


(5) 2.1-1. plant cut 1700st (SH20v) 5x

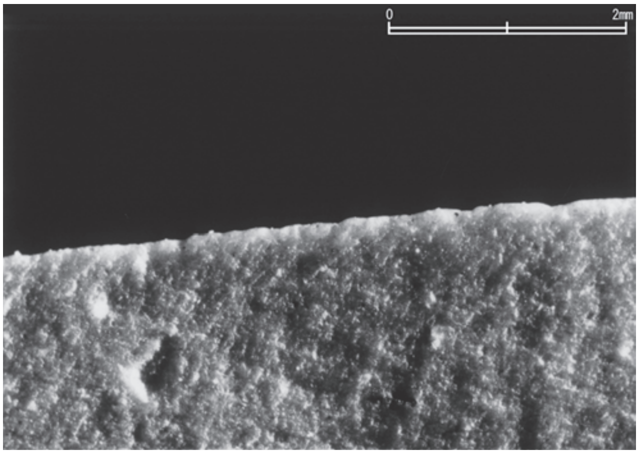


(6) 2.1-1. plant cut 2200st (SH140d) 8x

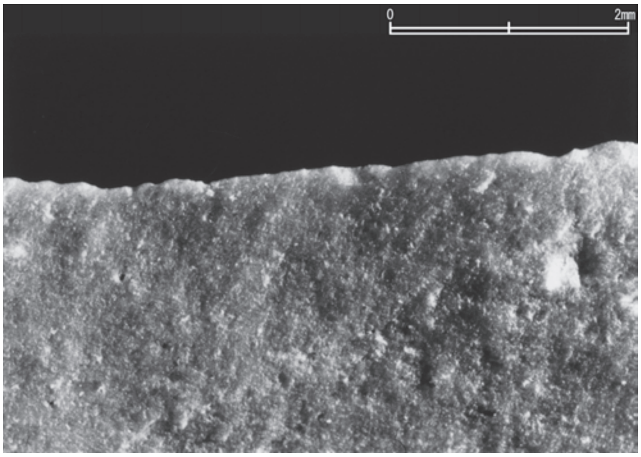
Figure 41. Experimental microflaking scars. (soft worked materials)



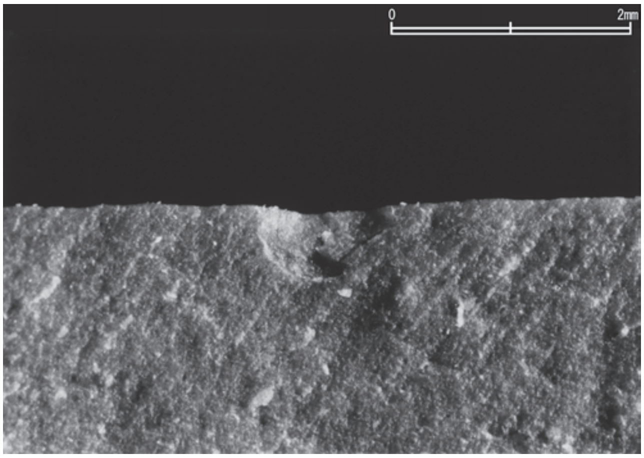
(1) 2.1-1. plant cut 2200st (SH140d) 8x



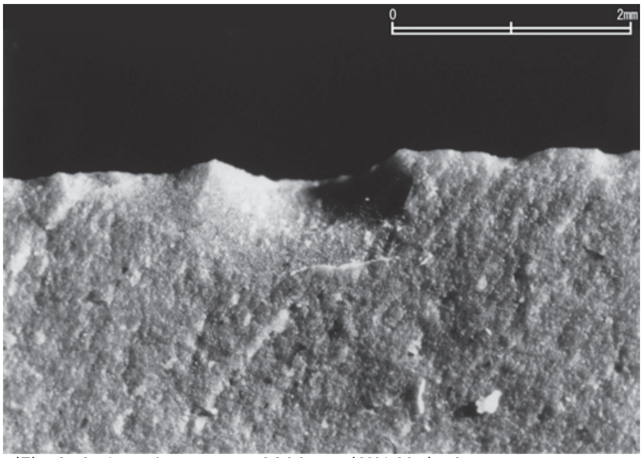
(2) 2.1-1. plant cut 2200st (SH140v) 8x



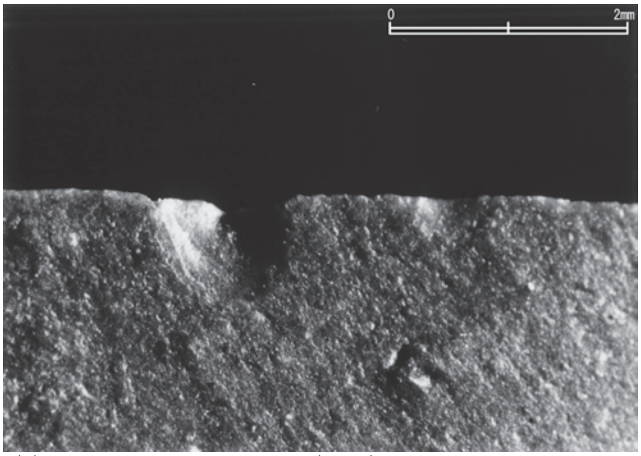
(3) 2.1-1. plant cut 2200st (SH140v) 8x



(4) 2.1-1. plant cut 2200st (SH140v) 8x

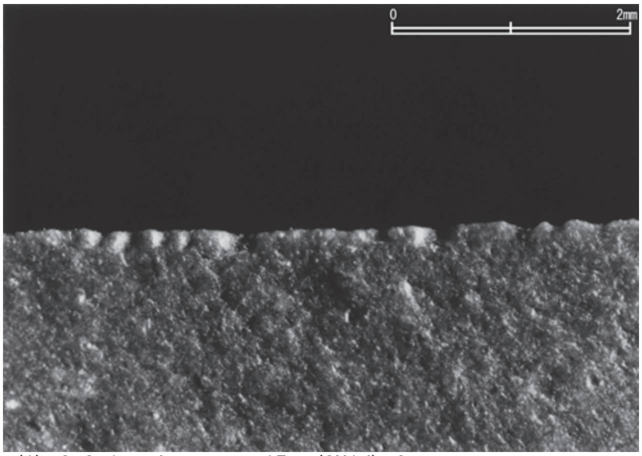


(5) 2.2-1. plant cut 2200st (SH140v) 8x

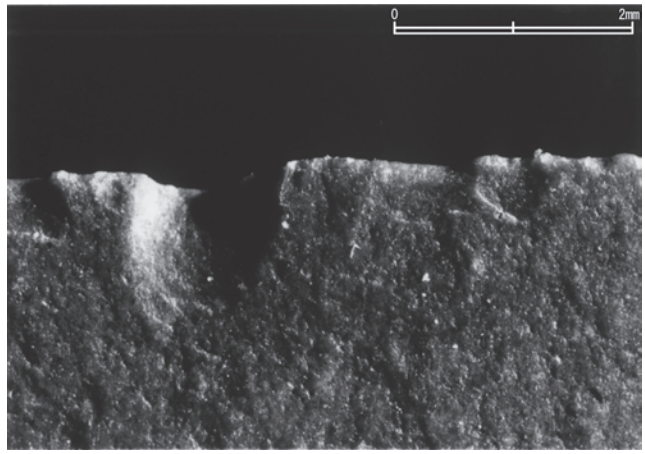


(6) 2.2-1. plant cut 15m (SH1d) 8x

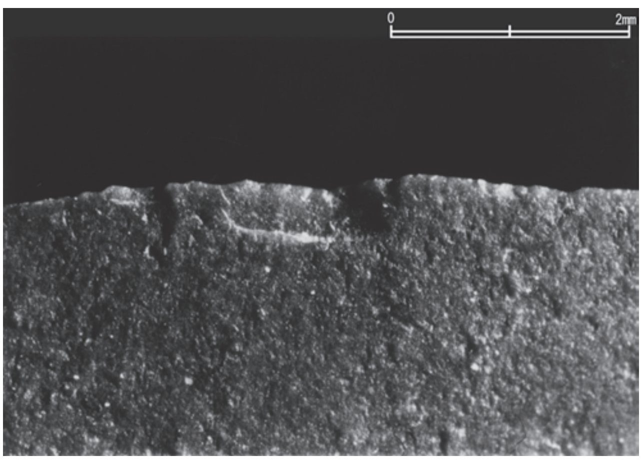
Figure 42. Experimental microflaking scars. (soft worked materials)



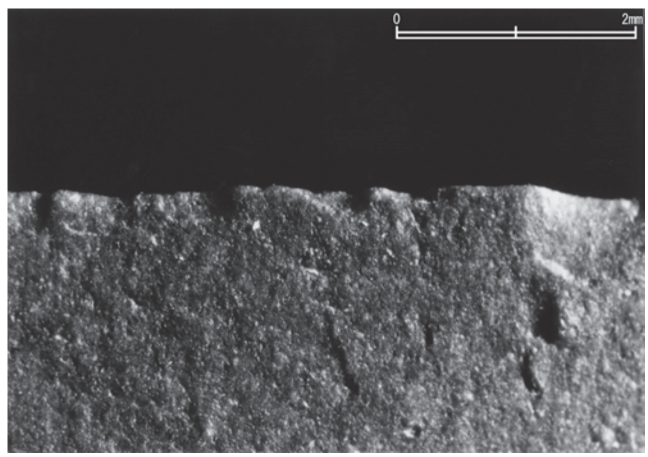
(1) 2.2-1. plant cut 15m (SH1d) 8x



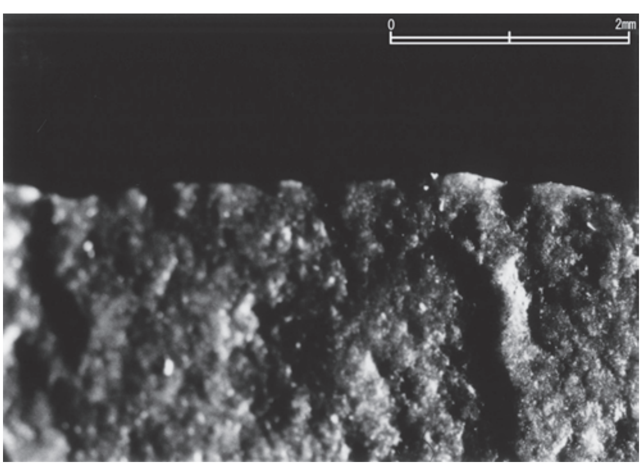
(2) 2.2-1. plant cut 15m (SH1v) 8x



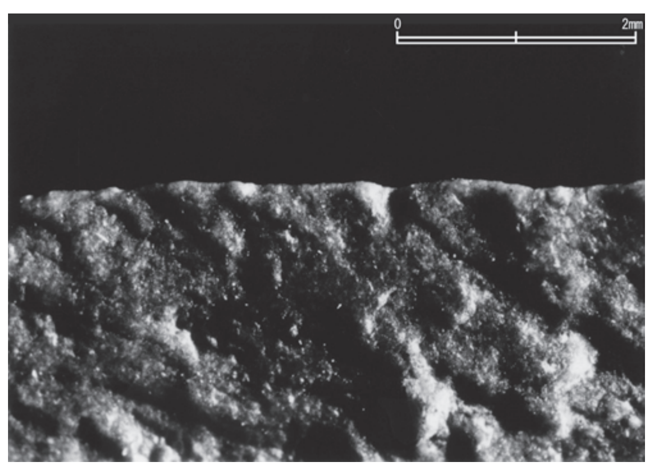
(3) 2.2-1. plant cut 15m (SH1v) 8x



(4) 2.2-1. plant cut 15m (SH1v) 8x

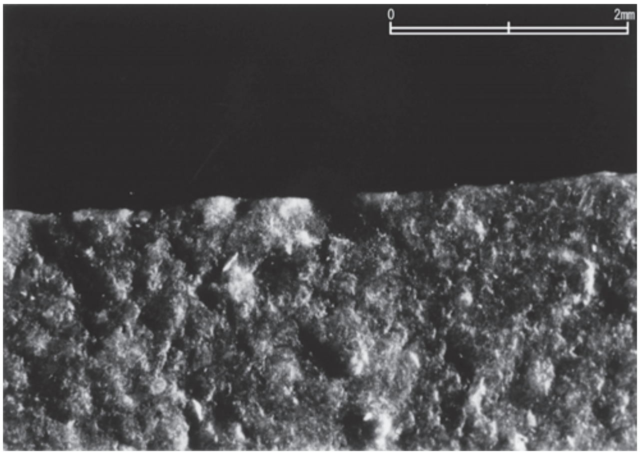


(5) 2.2-1. plant cut 25m (SH11d) 8x

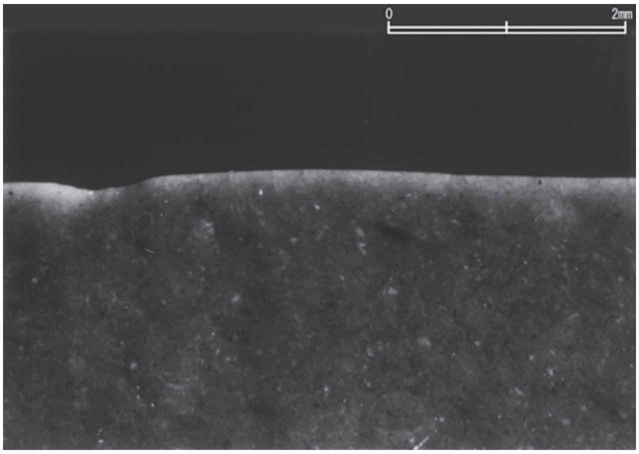


(6) 2.2-1. plant cut 25m (SH11d) 8x

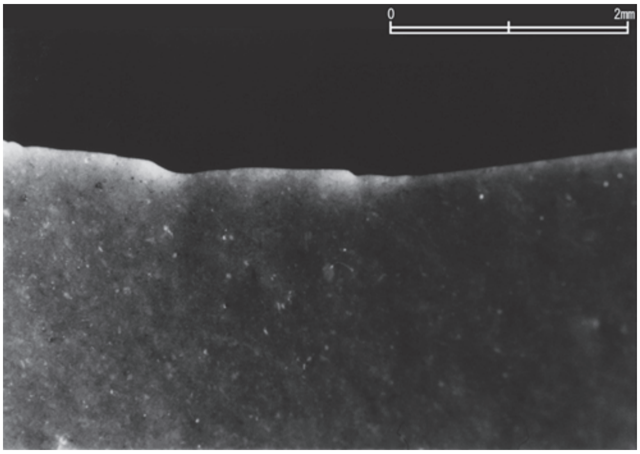
Figure 43. Experimental microflaking scars. (soft worked materials)



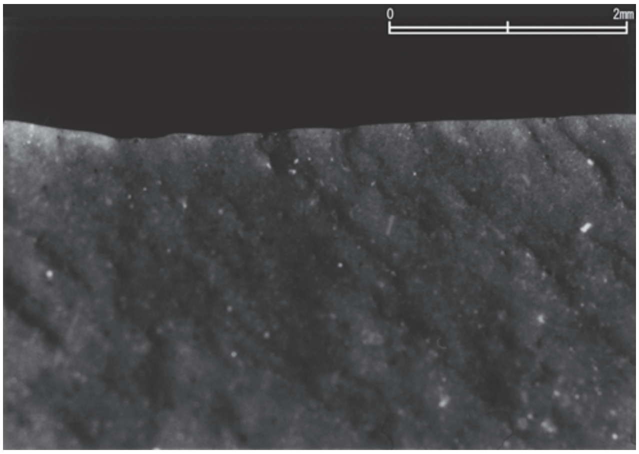
(1) 2.2-1. plant cut 25m (SH11v) 8x



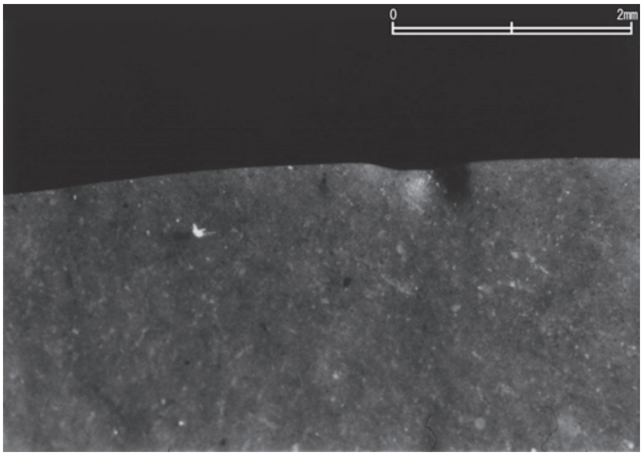
(2) 2.3-1. plant cut 3000st (SH43d) 8x



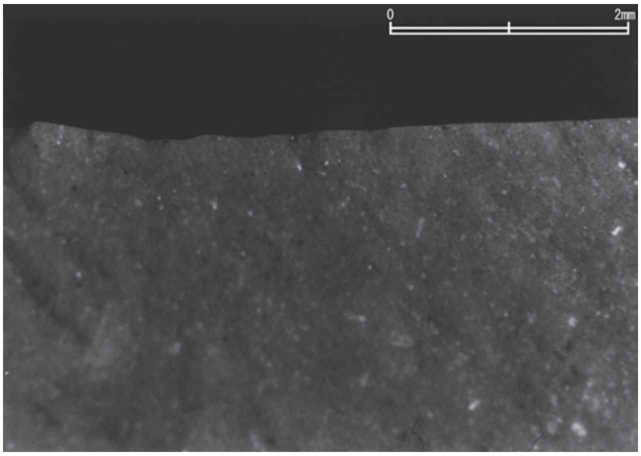
(3) 2.3-1. plant cut 3000st (SH43d) 8x



(4) 2.3-1. plant cut 3000st (SH43v) 8x

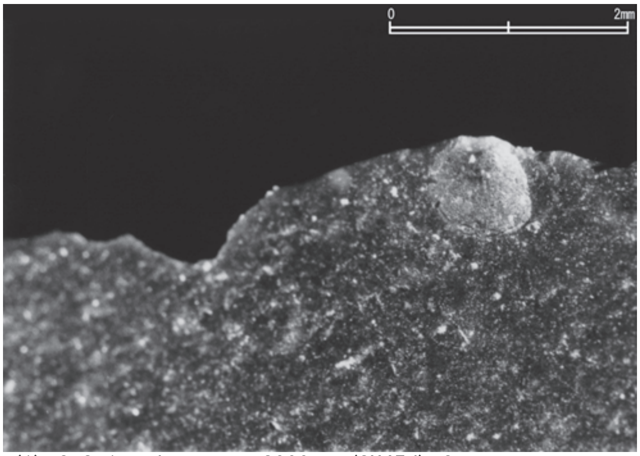


(5) 2.3-1. plant cut 3000st (SH43v) 8x

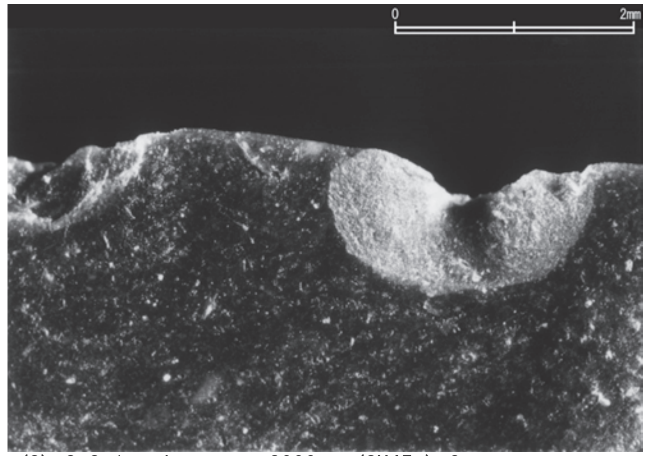


(6) 2.3-1. plant cut 3000st (SH43v) 8x

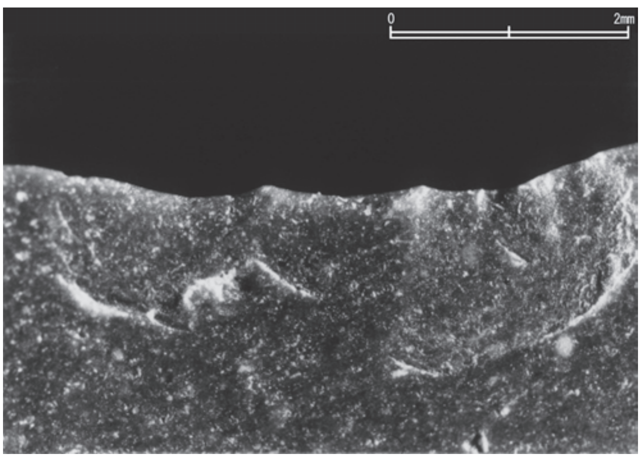
Figure 44. Experimental microflaking scars. (soft worked materials)



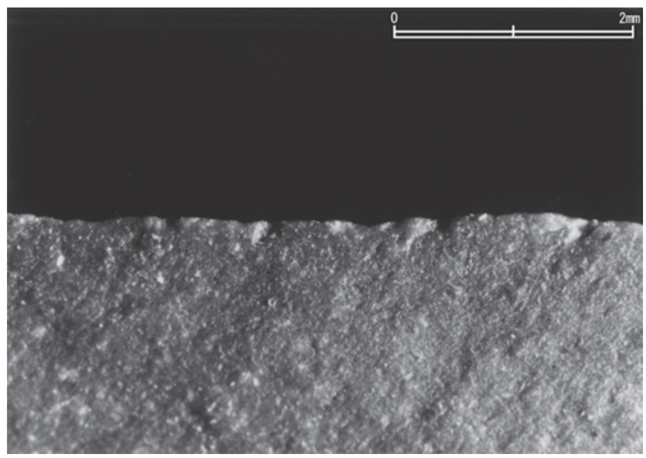
(1) 2.3-1. plant cut 3000st (SH45d) 8x



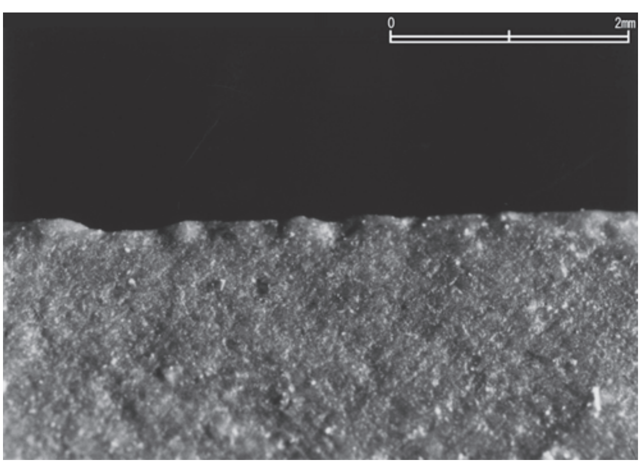
(2) 2.3-1. plant cut 3000st (SH45v) 8x



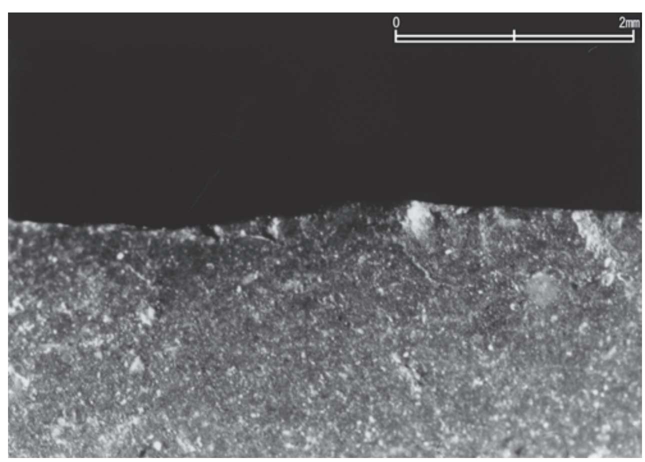
(3) 2.3-1. plant cut 3000st (SH45v) 8x



(4) 2.4-1. plant cut 2650st (SH42d) 8x

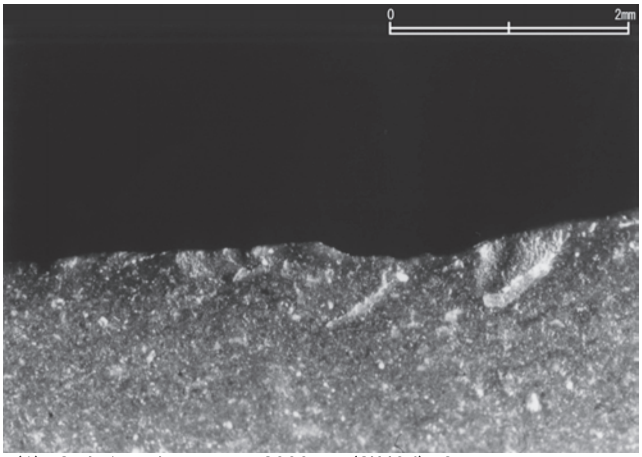


(5) 2.4-1. plant cut 2650st (SH42v) 8x

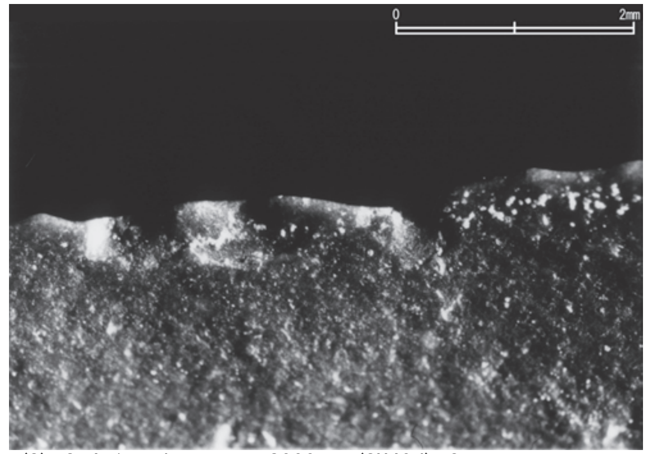


(6) 2.4-1. plant cut 3000st (SH40d) 8x

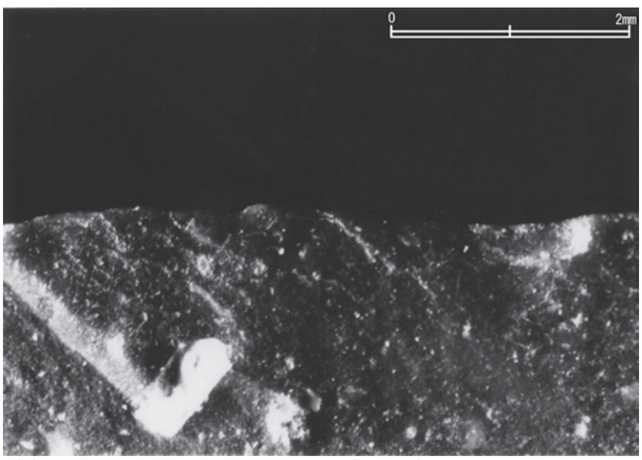
Figure 45. Experimental microflaking scars. (soft worked materials)



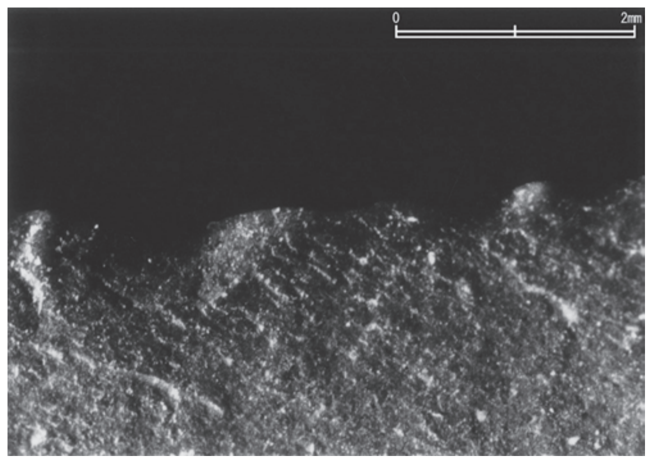
(1) 2.4-1. plant cut 3000st (SH40d) 8x



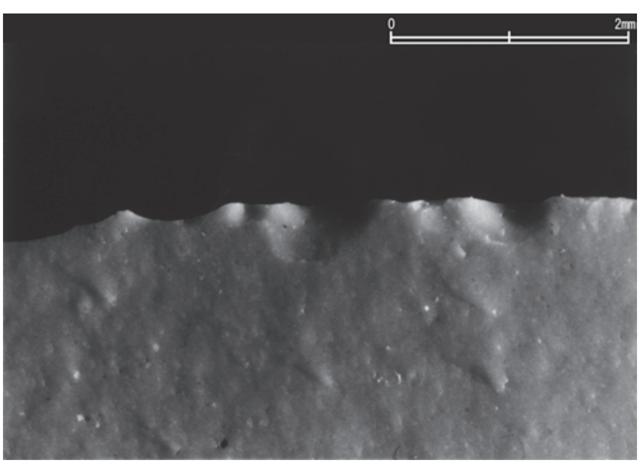
(2) 2.4-1. plant cut 3000st (SH40d) 8x



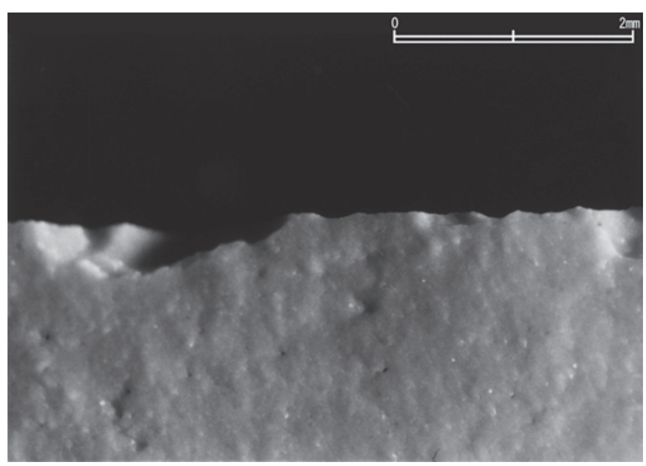
(3) 2.4-1. plant cut 3000st (SH40v) 8x



(4) 2.4-1. plant cut 3000st (SH40v) 8x

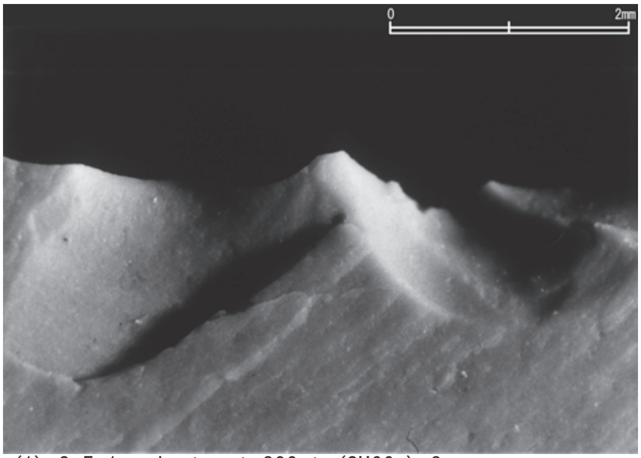


(5) 2.5-1. plant cut 800st (SH66d) 8x

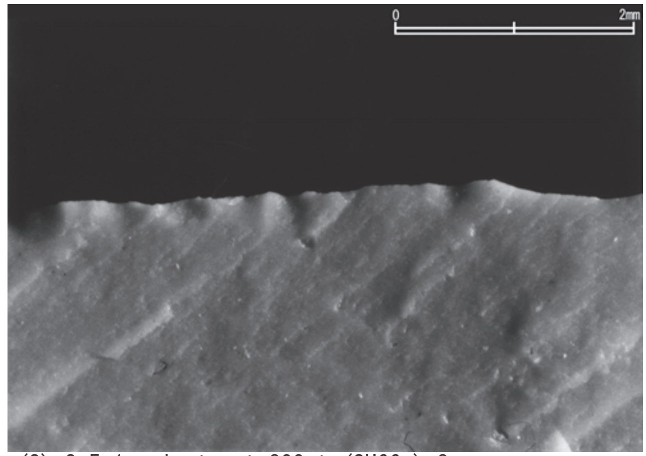


(6) 2.5-1. plant cut 800st (SH66d) 8x

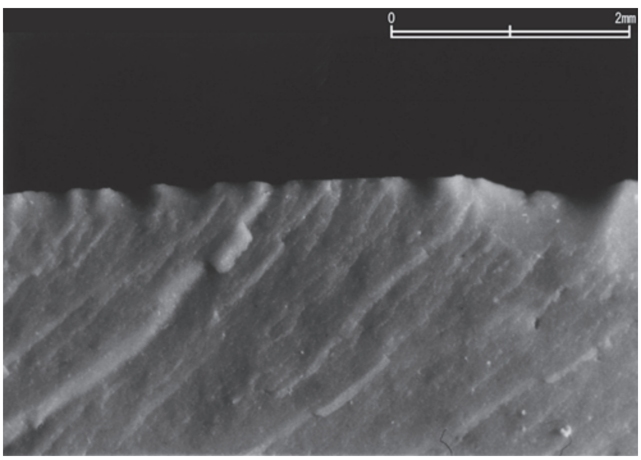
Figure 46. Experimental microflaking scars. (soft worked materials)



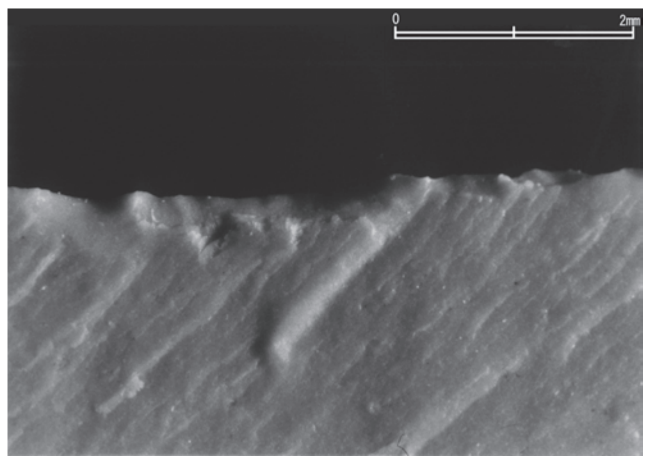
(1) 2.5-1. plant cut 800st (SH66v) 8x



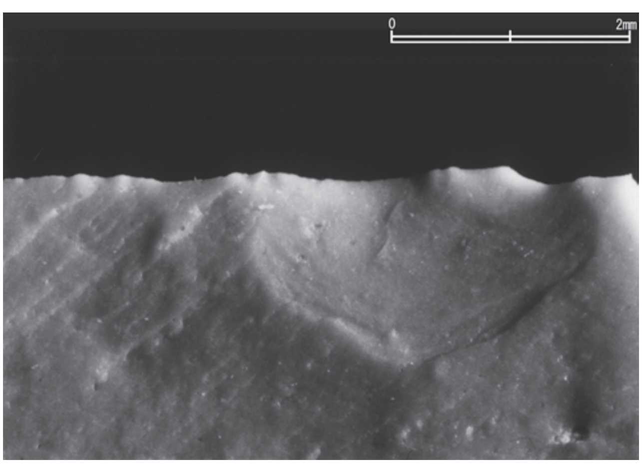
(2) 2.5-1. plant cut 800st (SH66v) 8x



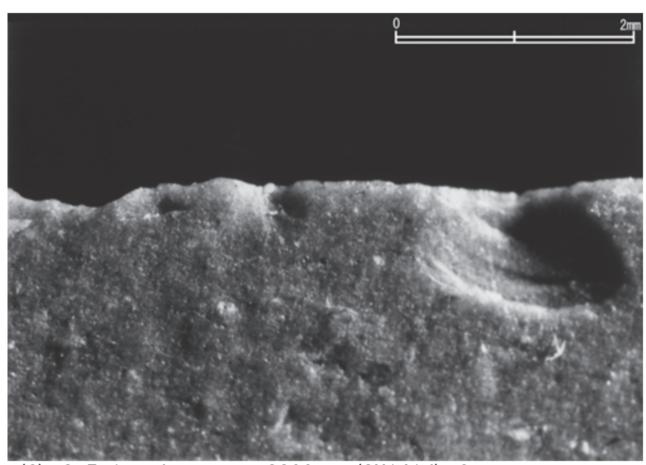
(3) 2.5-1. plant cut 800st (SH66v) 8x



(4) 2.5-1. plant cut 800st (SH66v) 8x

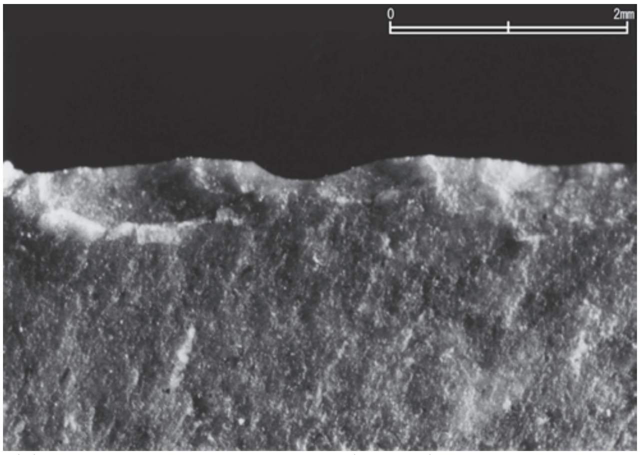


(5) 2.5-1. plant cut 800st (SH66v) 8x

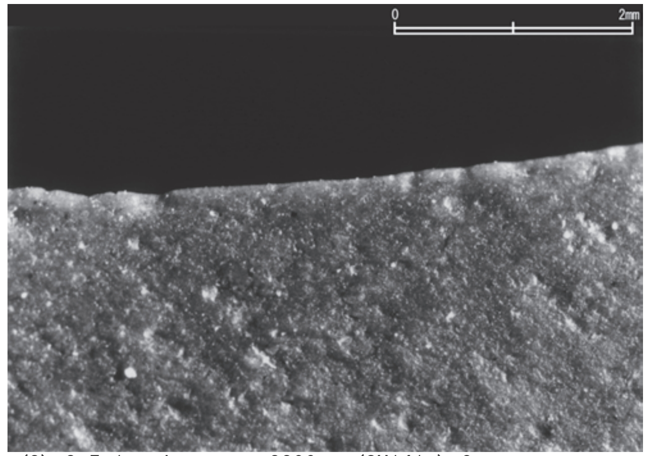


(6) 2.5-1. plant cut 2200st (SH141d) 8x

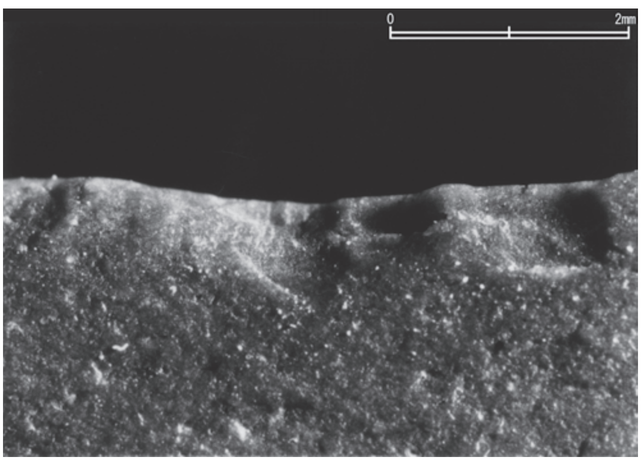
Figure 47. Experimental microflaking scars. (soft worked materials)



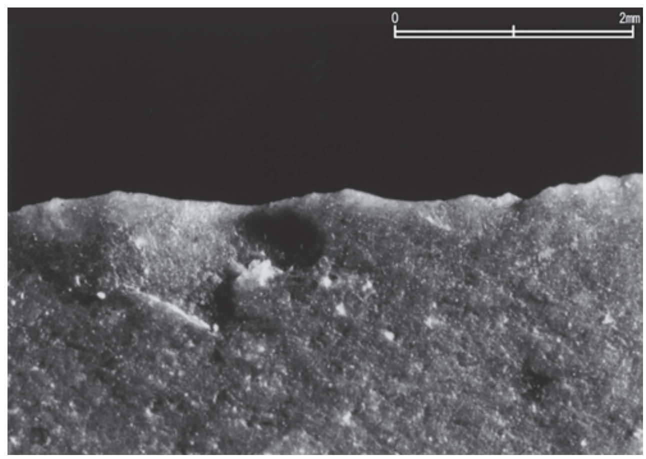
(1) 2.5-1. plant cut 2200st (SH141d) 8x



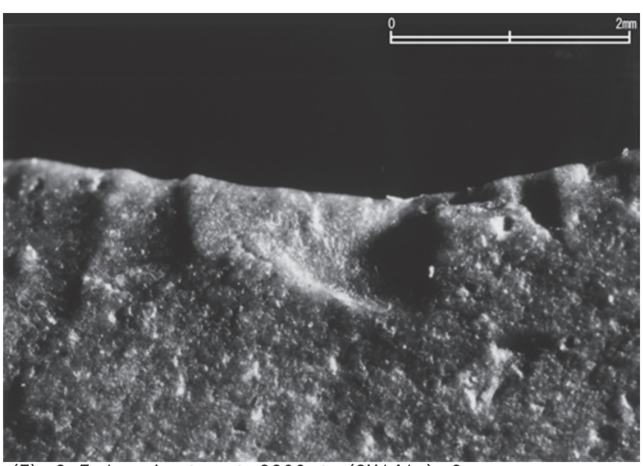
(2) 2.5-1. plant cut 2200st (SH141v) 8x



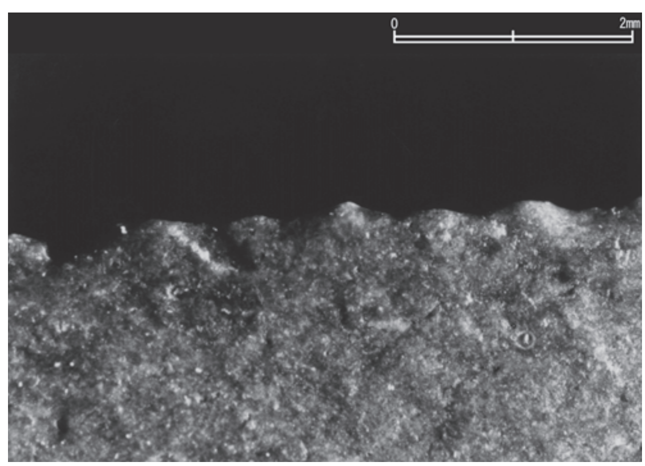
(3) 2.4-1. plant cut 2200st (SH141v) 8x



(4) 2.5-1. plant cut 2200st (SH141v) 8x

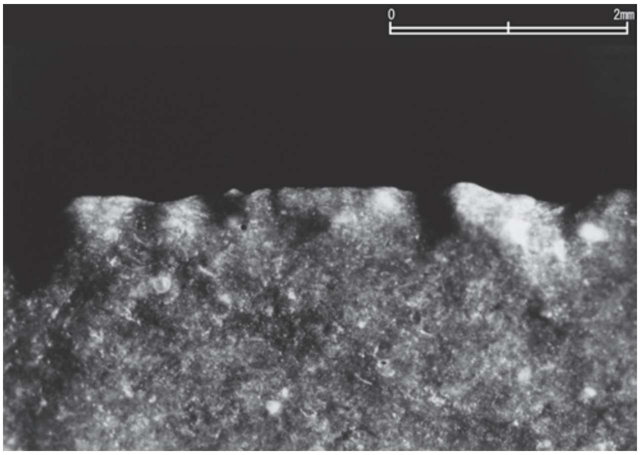


(5) 2.5-1. plant cut 2200st (SH141v) 8x

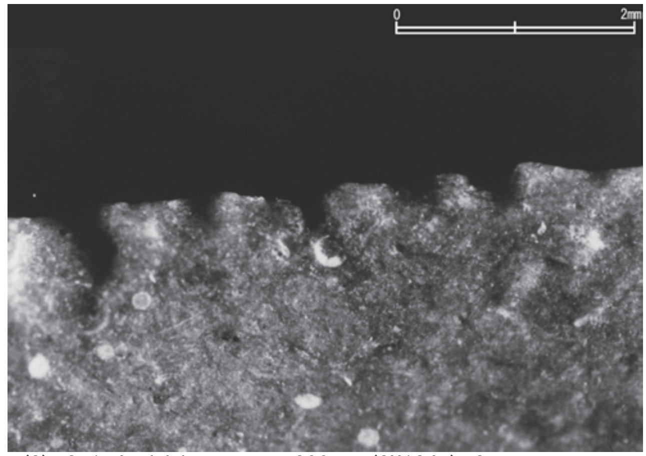


(6) 3.1-4. hide scrape 800st (SH124d) 8x

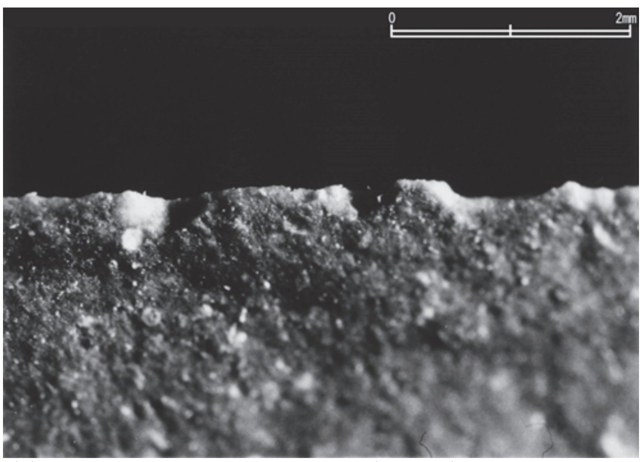
Figure 48. Experimental microflaking scars. (soft worked materials)



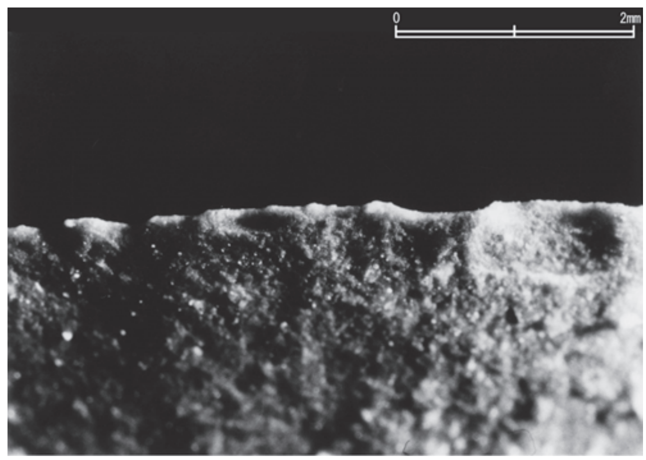
(1) 3.1-4. hide scrape 800st (SH124v) 8x



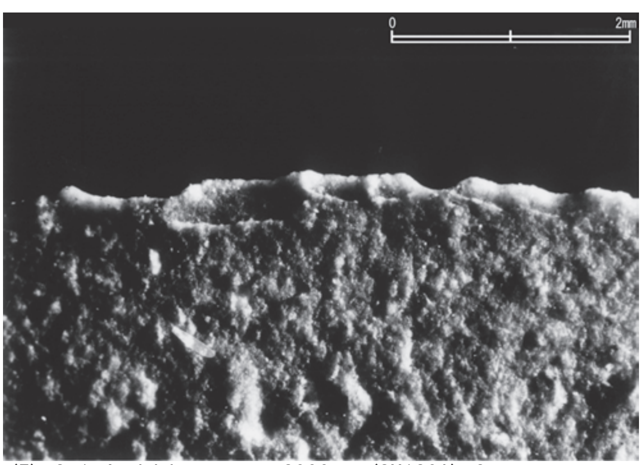
(2) 3.1-4. hide scrape 800st (SH124v) 8x



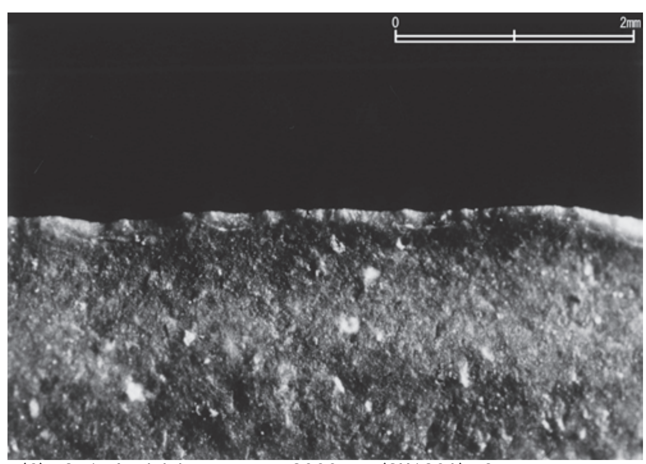
(3) 3.1-4. hide scrape 2000st (SH120A) 8x



(4) 3.1-4. hide scrape 2000st (SH120A) 8x

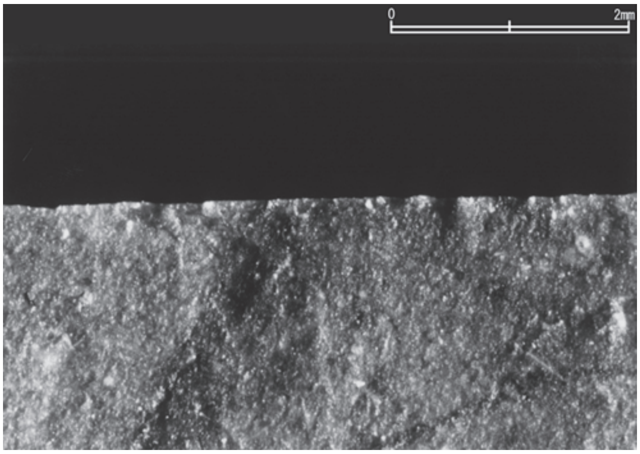


(5) 3.1-4. hide scrape 2000st (SH120A) 8x

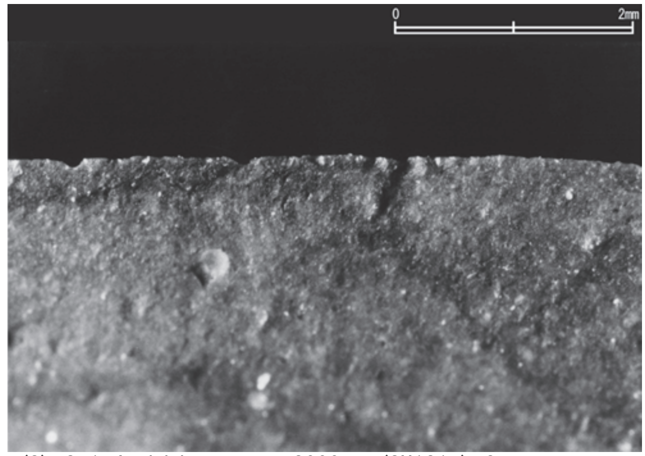


(6) 3.1-4. hide scrape 2000st (SH120A) 8x

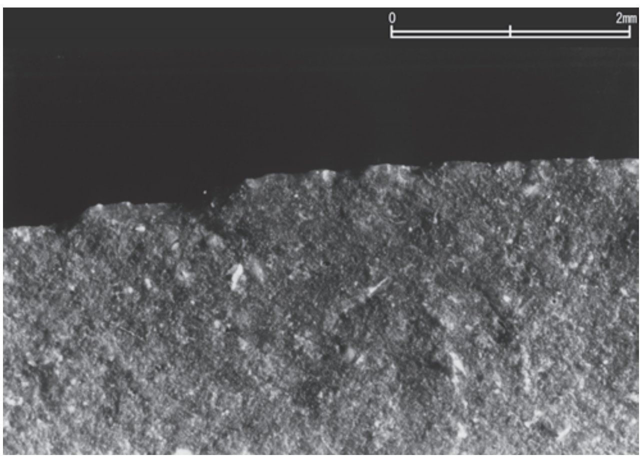
Figure 49. Experimental microflaking scars. (soft worked materials)



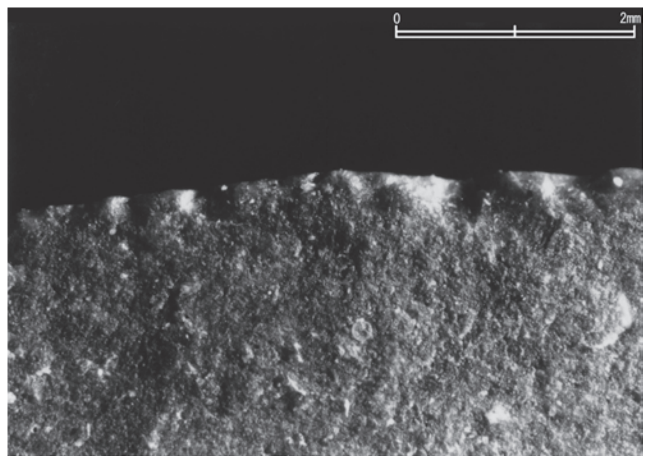
(1) 3.1-4. hide scrape 2000st (SH121d) 8x



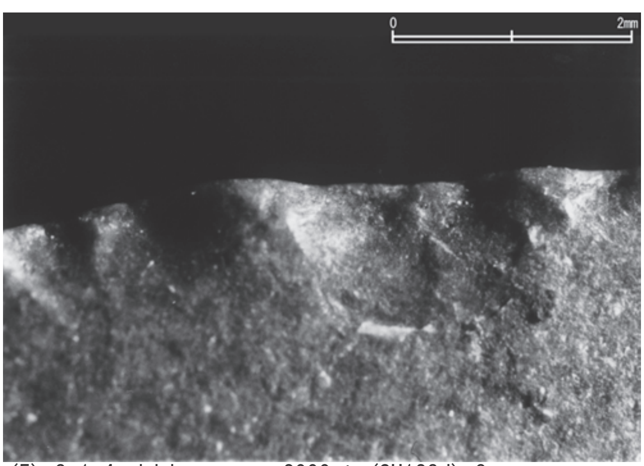
(2) 3.1-4. hide scrape 2000st (SH121v) 8x



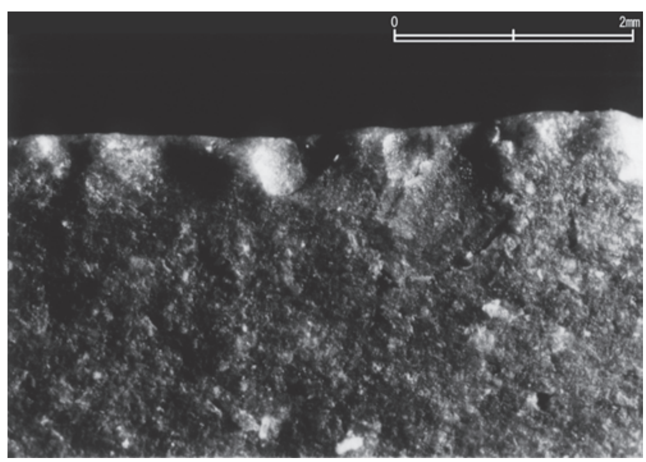
(3) 3.1-4. hide scrape 2000st (SH122v) 8x



(4) 3.1-4. hide scrape 2000st (SH123d) 8x

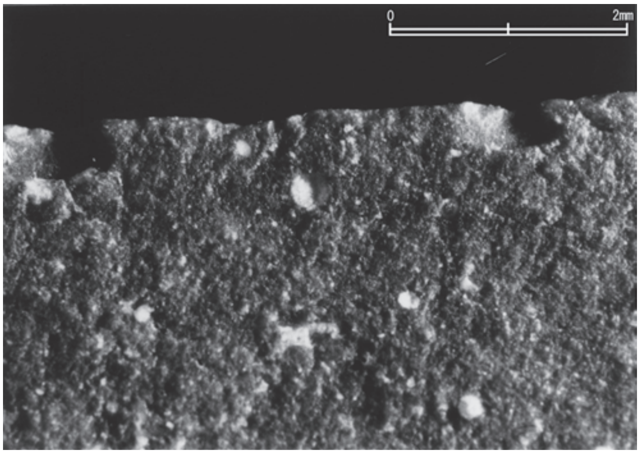


(5) 3.1-4. hide scrape 2000st (SH123d) 8x

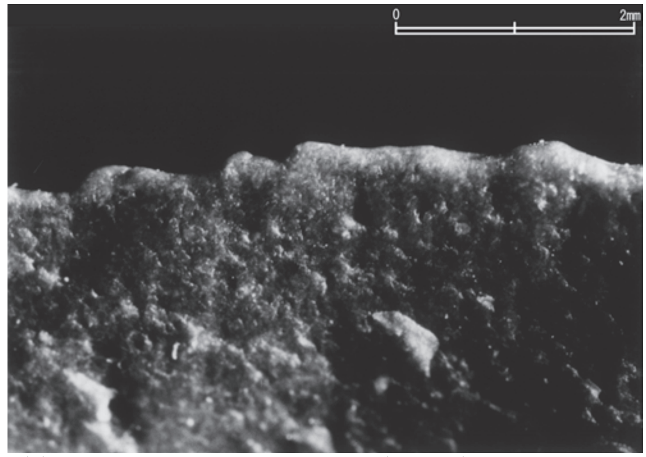


(6) 3.1-4. hide scrape 2000st (SH123d) 8x

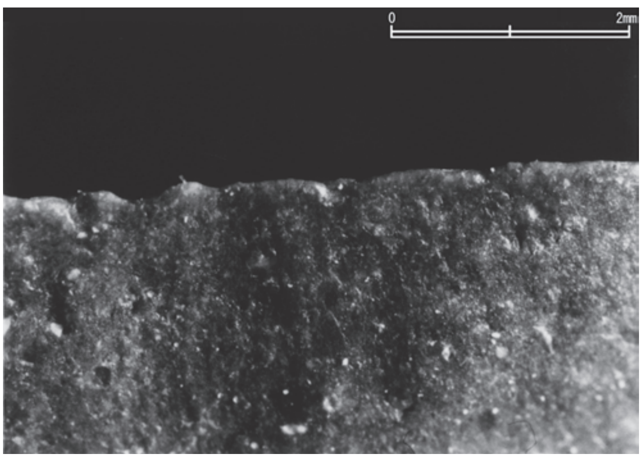
Figure 50. Experimental microflaking scars. (soft worked materials)



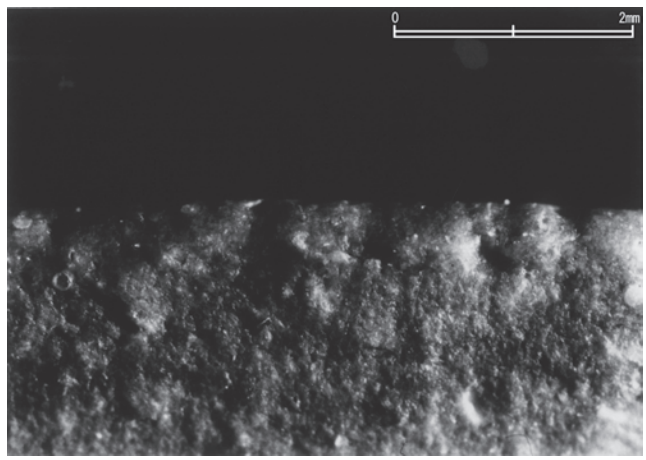
(1) 3.1-4. hide scrape 2000st (SH123d) 8x



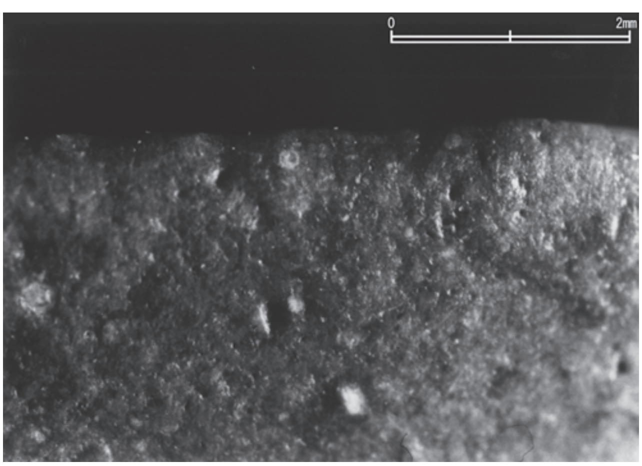
(2) 3.1-4. hide scrape 2000st (SH123v) 8x



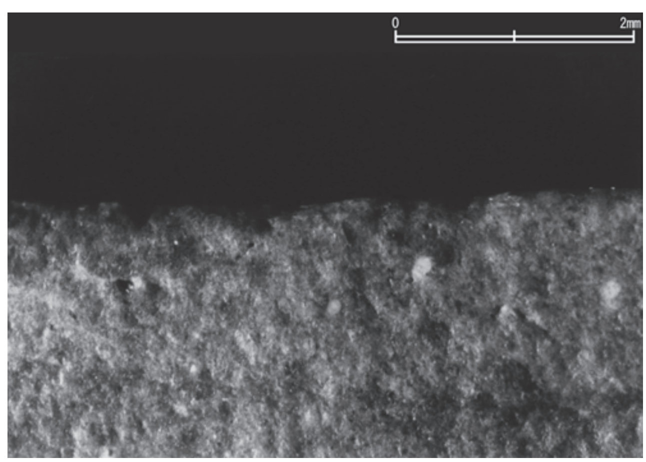
(3) 3.1-4. hide scrape 2000st (SH123v) 8x



(4) 3.1-4. hide scrape 2000st (SH125A) 8x

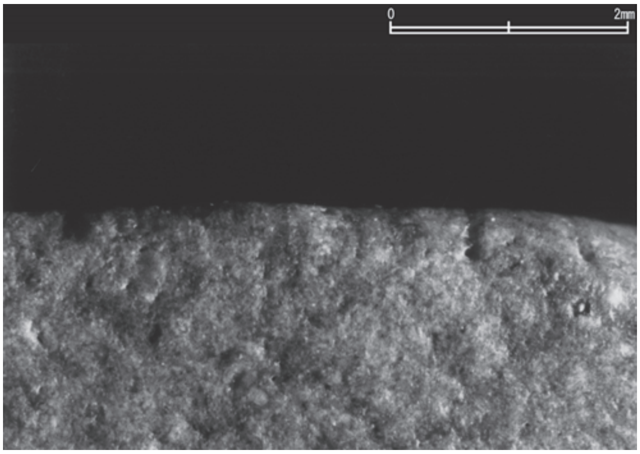


(5) 3.1-4. hide scrape 2000st (SH125B) 8x

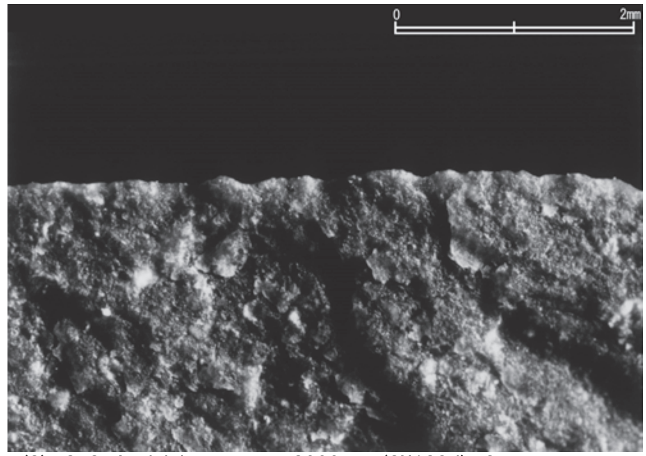


(6) 3.1-4. hide scrape 2000st (SH126d) 8x

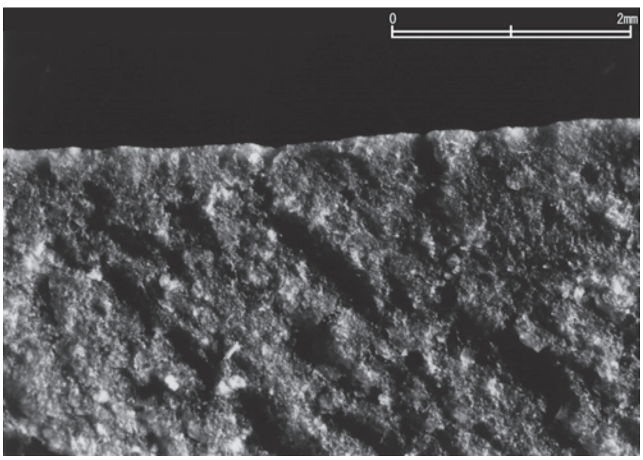
Figure 51. Experimental microflaking scars. (soft worked materials)



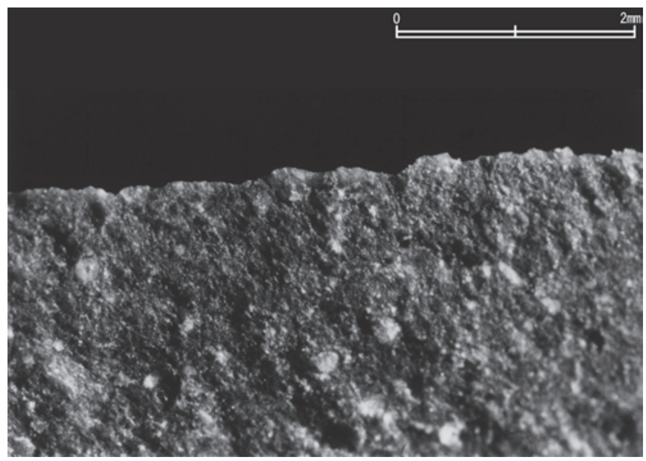
(1) 3.1-4. hide scrape 2000st (SH126v) 8x



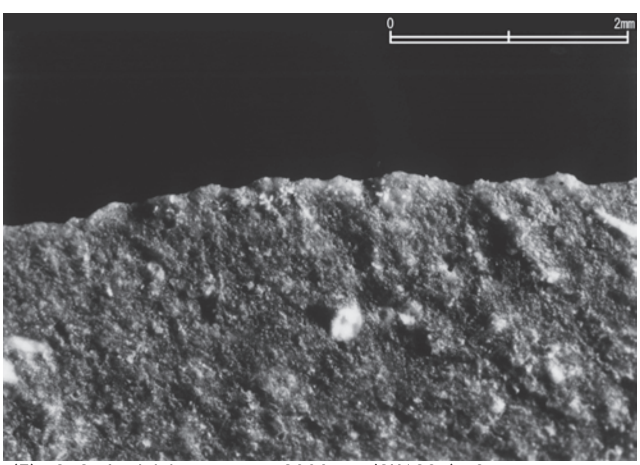
(2) 3.2-4. hide scrape 2000st (SH128d) 8x



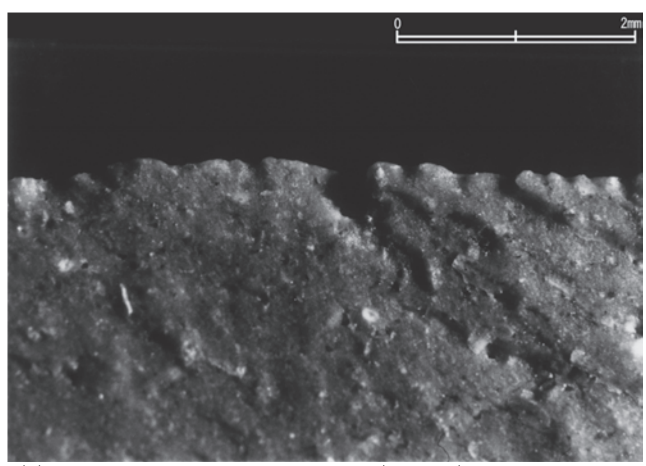
(3) 3.2-4. hide scrape 2000st (SH128d) 8x



(4) 3.2-4. hide scrape 2000st (SH128v) 8x

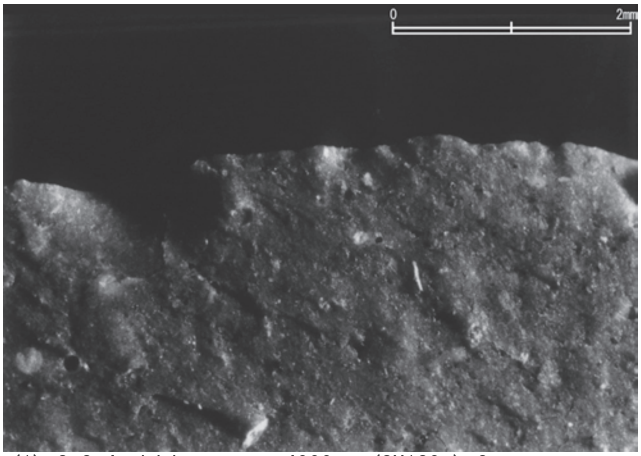


(5) 3.2-4. hide scrape 2000st (SH128v) 8x

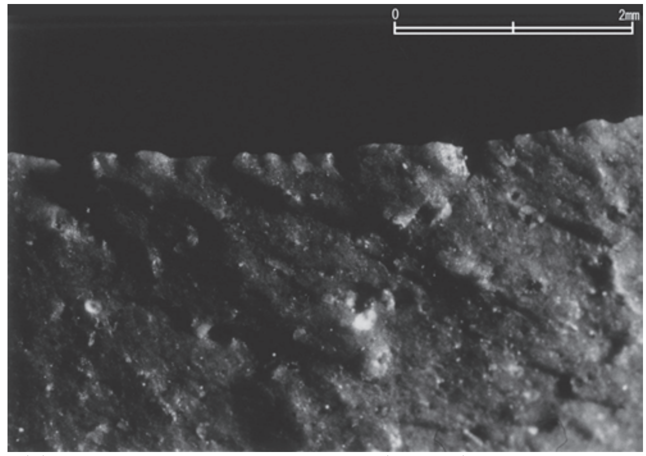


(6) 3.2-4. hide scrape 4000st (SH129v) 8x

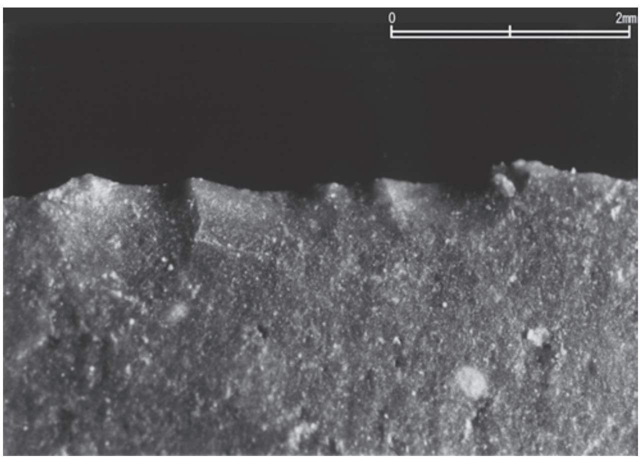
Figure 52. Experimental microflaking scars. (soft worked materials)



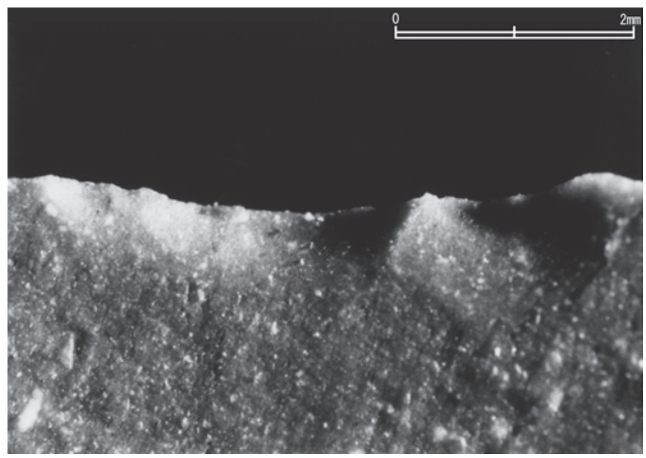
(1) 3.2-4. hide scrape 4000st (SH129v) 8x



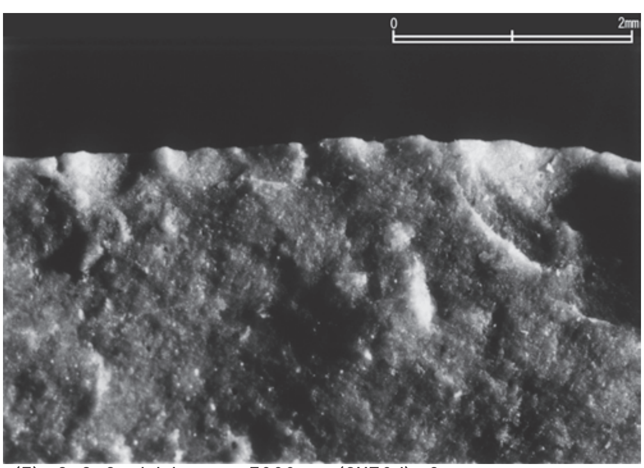
(2) 3.2-4. hide scrape 4000st (SH129v) 8x



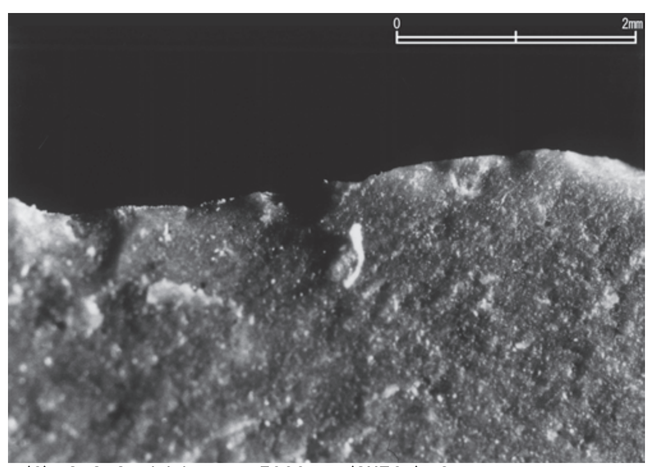
(3) 3.3-2. hide saw 5000st (SH76d) 8x



(4) 3.3-2. hide saw 5000st (SH76d) 8x

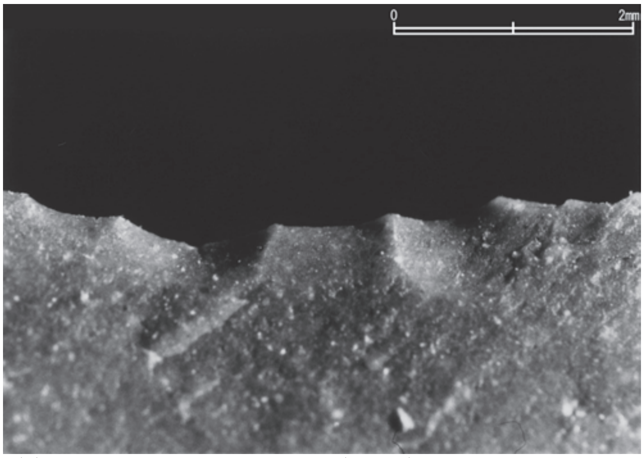


(5) 3.3-2. hide saw 5000st (SH76d) 8x

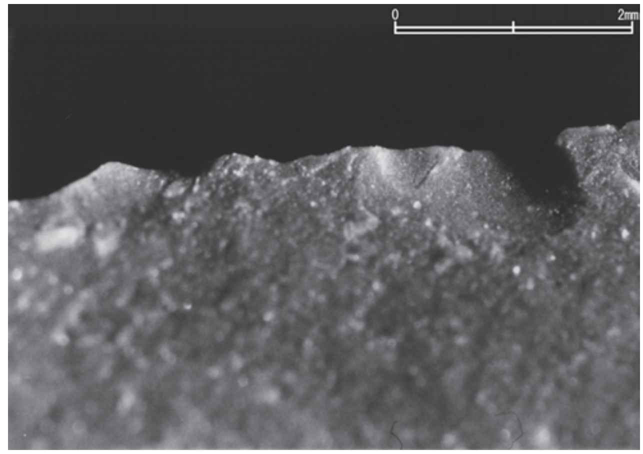


(6) 3.3-2. hide saw 5000st (SH76v) 8x

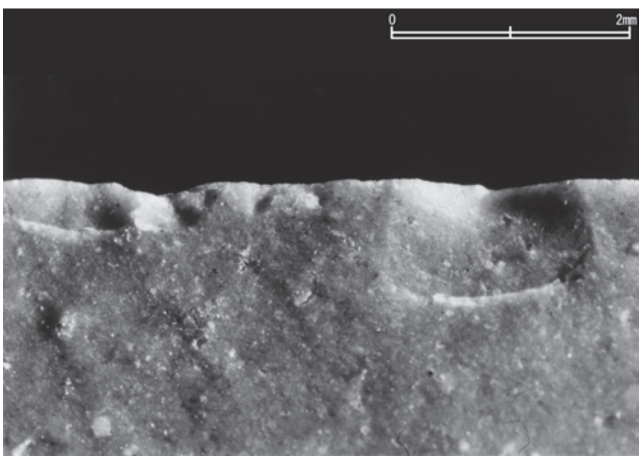
Figure 53. Experimental microflaking scars. (soft worked materials)



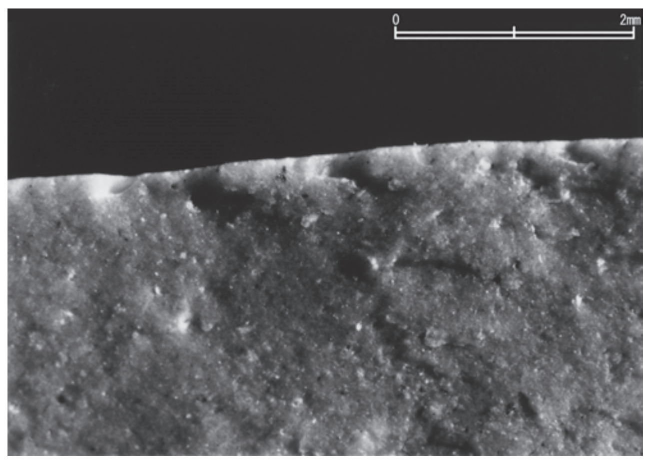
(1) 3.3-2. hide saw 5000st (SH76v) 8x



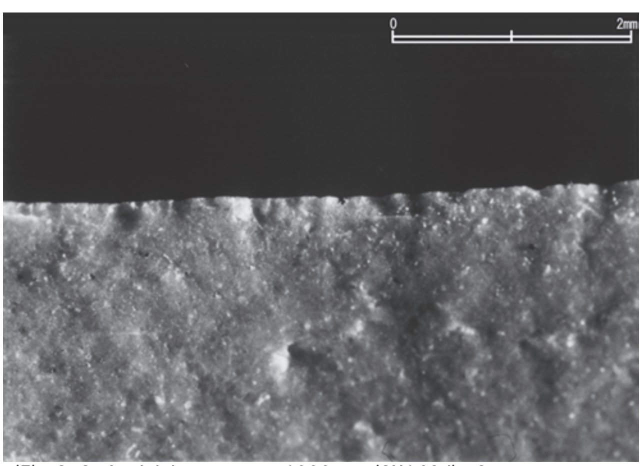
(2) 3.3-2. hide saw 5000st (SH76v) 8x



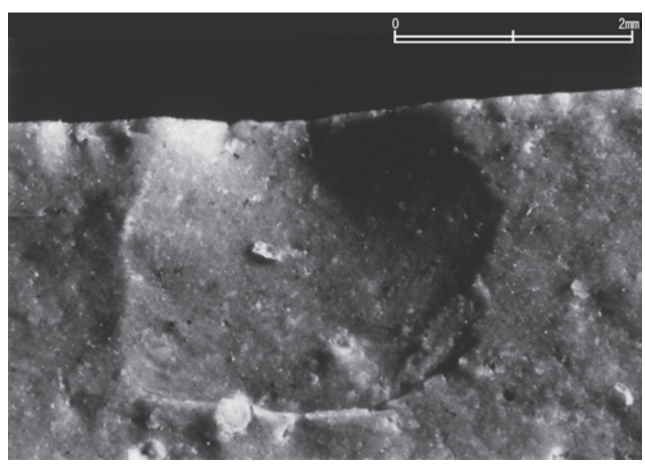
(3) 3.3-4. hide scrape 1000st (SH146d) 8x



(4) 3.2-4. hide scrape 1000st (SH146d) 8x

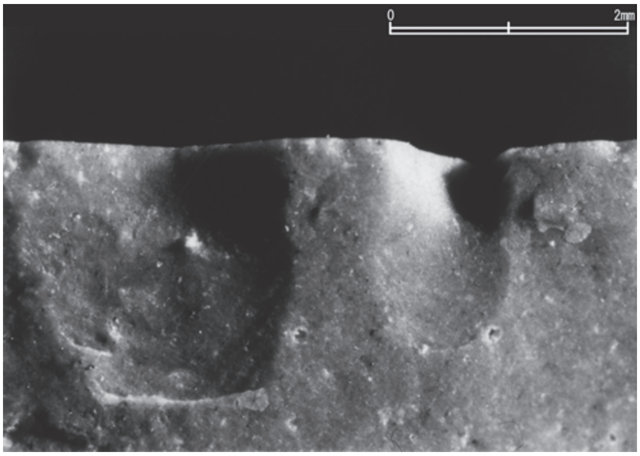


(5) 3.3-4. hide scrape 1000st (SH146d) 8x

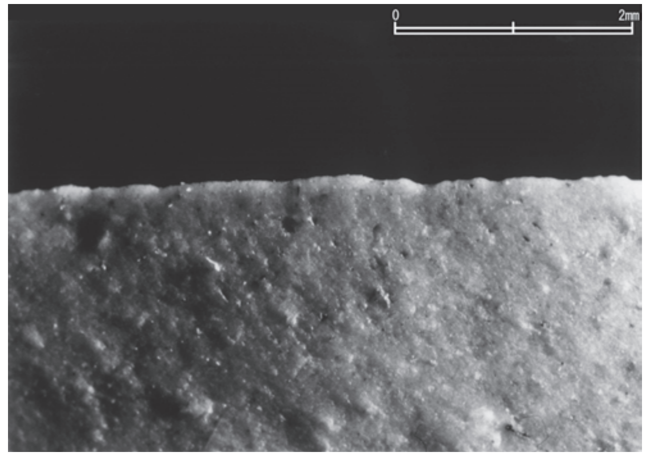


(6) 3.3-4. hide scrape 1000st (SH146d) 8x

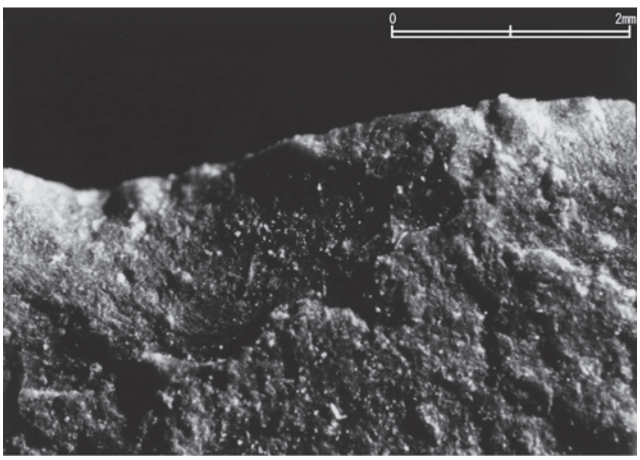
Figure 54. Experimental microflaking scars. (soft worked materials)



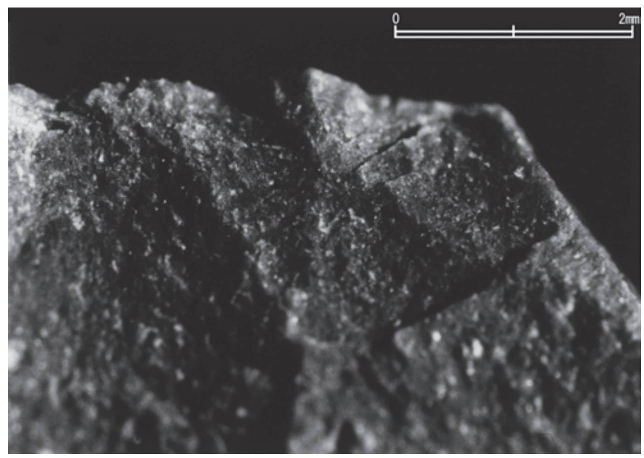
(1) 3.3-4. hide scrape 1000st (SH146v) 8x



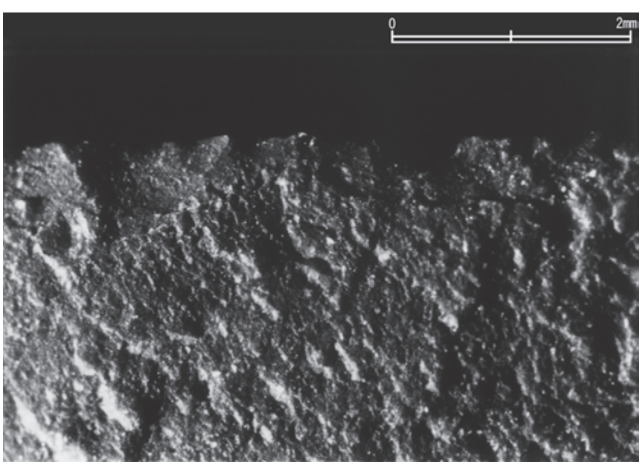
(2) 3.3-4. hide scrape 1000st (SH146v) 8x



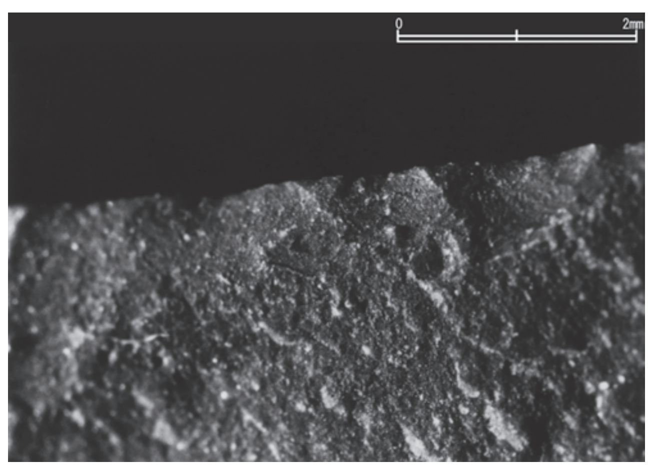
(3) 3.3-4. hide scrape 1500st (SH130A) 8x



(4) 3.3-4. hide scrape 1500st (SH130A) 8x

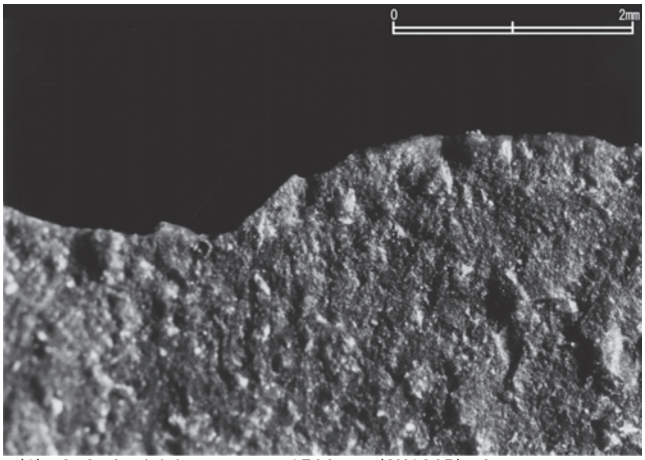


(5) 3.3-4. hide scrape 1500st (SH130A) 8x

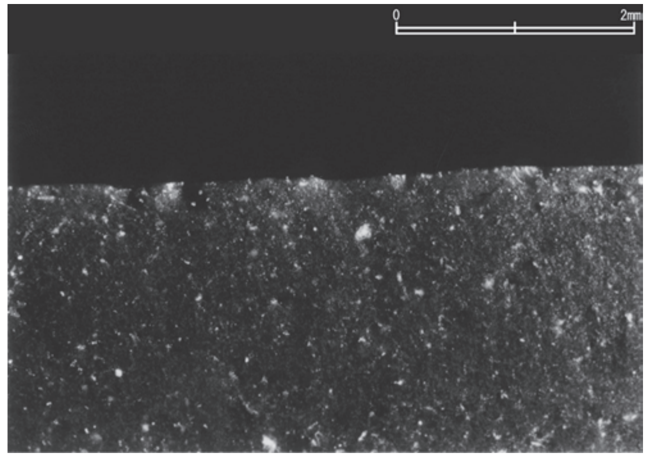


(6) 3.3-4. hide scrape 1500st (SH130A) 8x

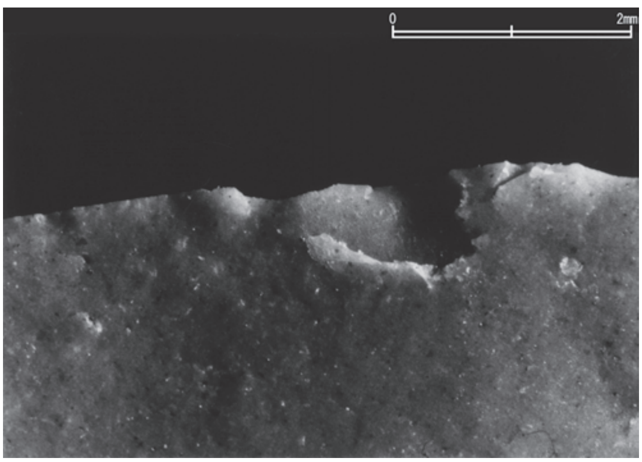
Figure 55. Experimental microflaking scars. (soft worked materials)



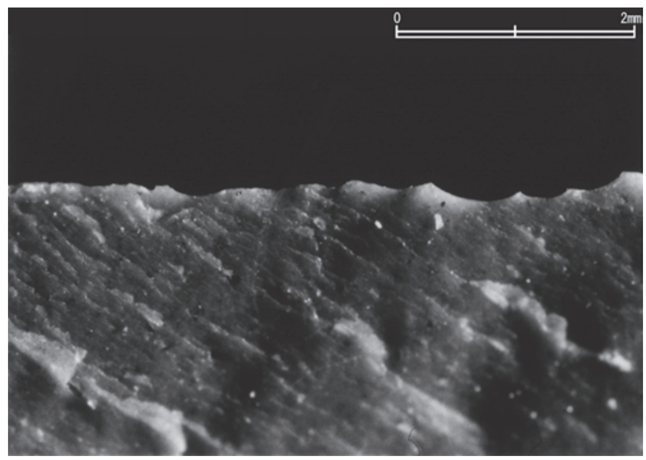
(1) 3.3-4. hide scrape 1500st (SH130B) 8x



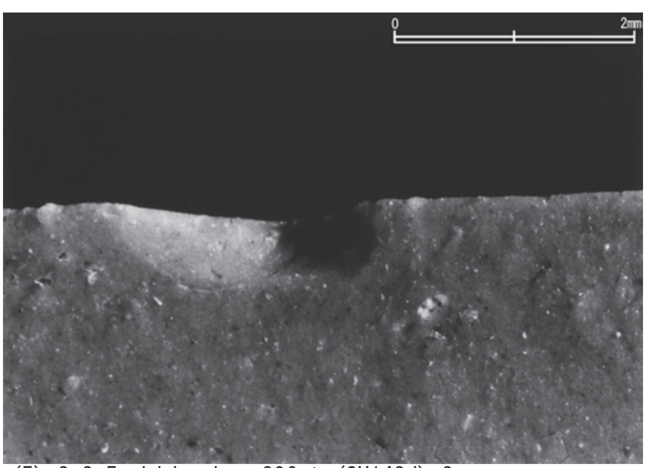
(2) 3.3-4. hide scrape 1500st (SH131) 8x



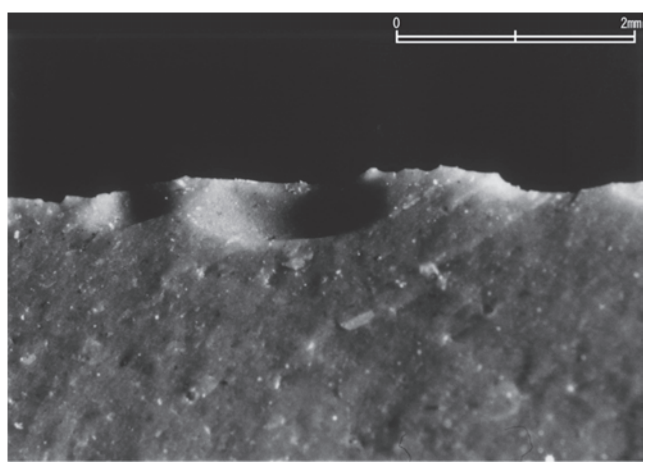
(3) 3.3-5. hide chop 306st (SH148d) 8x



(4) 3.3-5. hide chop 306st (SH148d) 8x

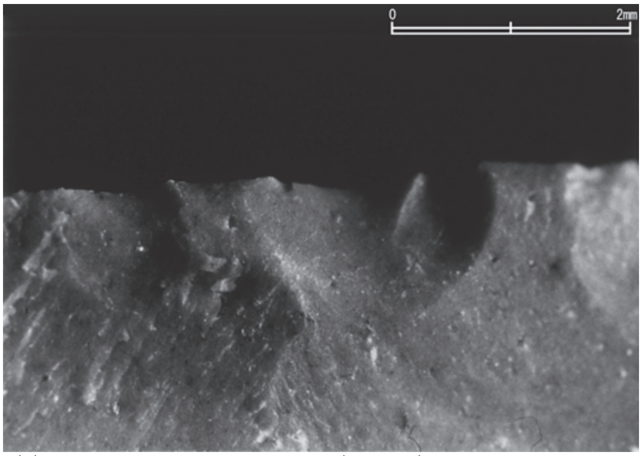


(5) 3.3-5. hide chop 306st (SH148d) 8x

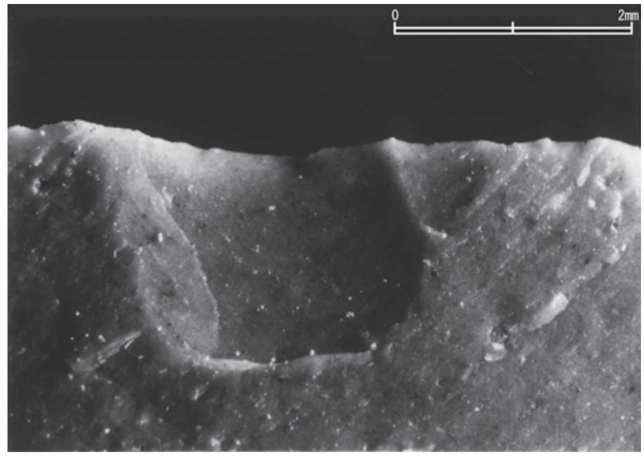


(6) 3.3-5. hide chop 306st (SH148v) 8x

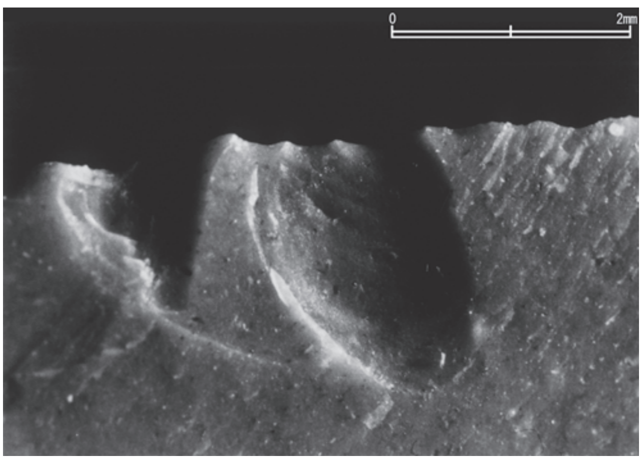
Figure 56. Experimental microflaking scars. (soft worked materials)



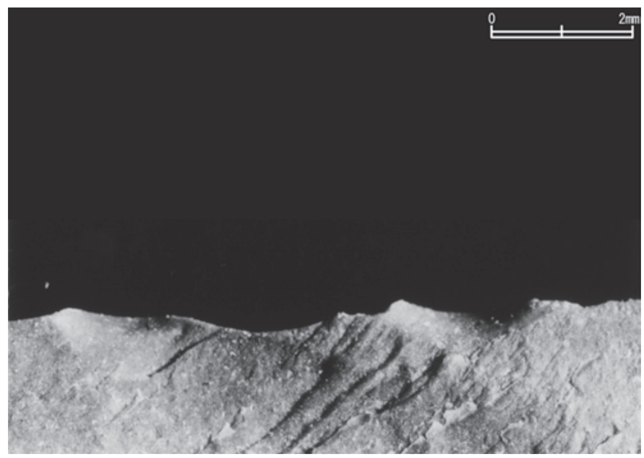
(1) 3.3-5. hide chop 306st (SH148v) 8x



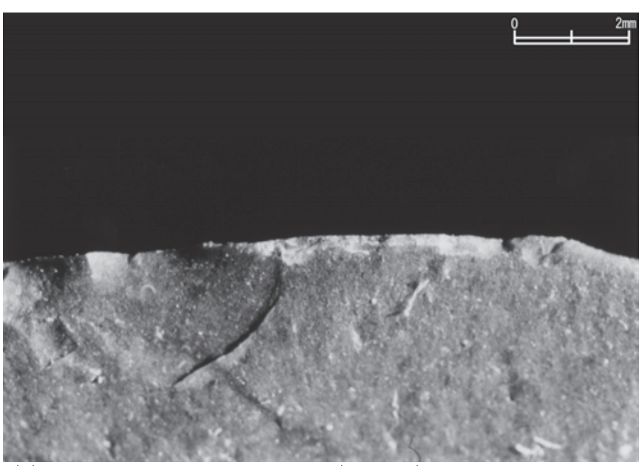
(2) 3.3-5. hide chop 306st (SH148v) 8x



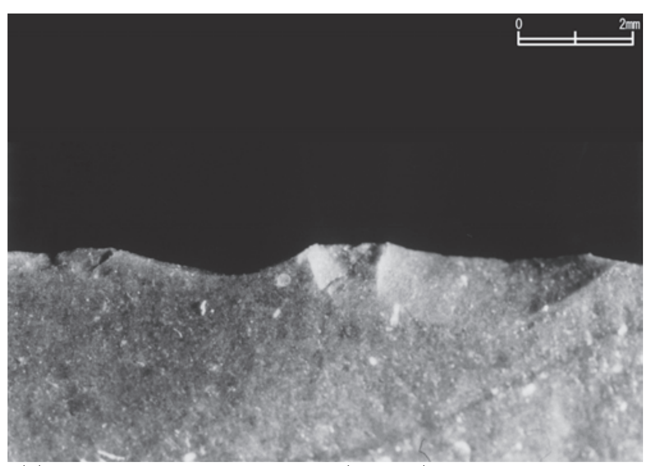
(3) 3.3-5. hide chop 306st (SH148v) 8x



(4) 4.1-2. wood saw 1000st (SH115d) 4x

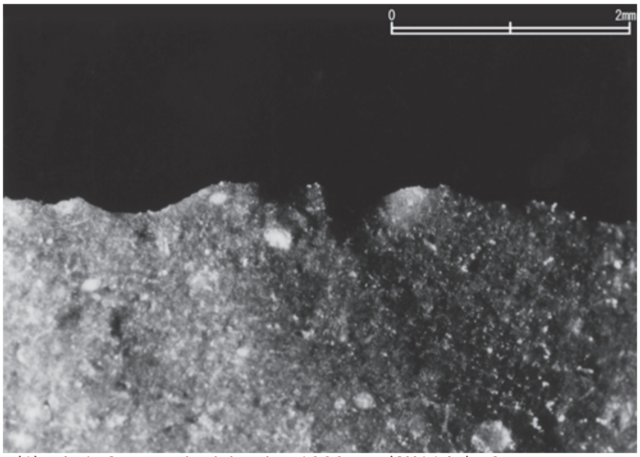


(5) 4.1-2. wood saw 1000st (SH115v) 3x

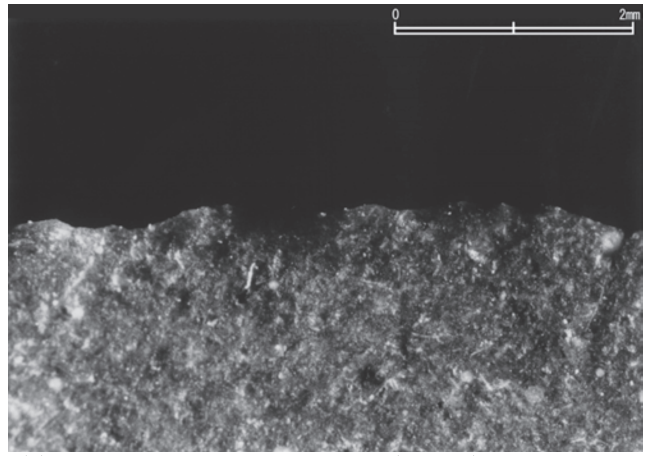


(6) 4.1-2. wood saw 1000st (SH115v) 3x

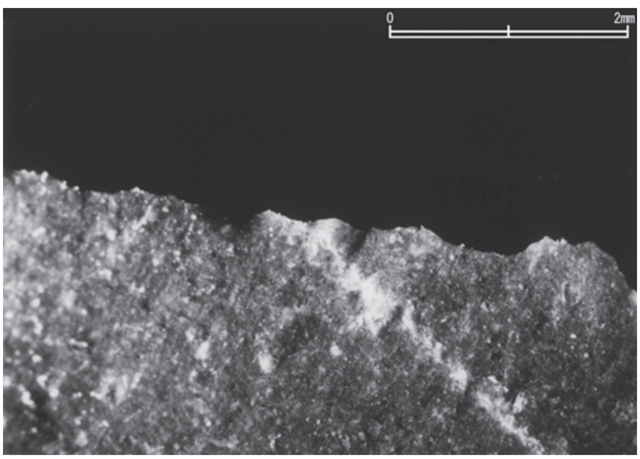
Figure 57. Experimental microflaking scars. (soft to medium worked materials)



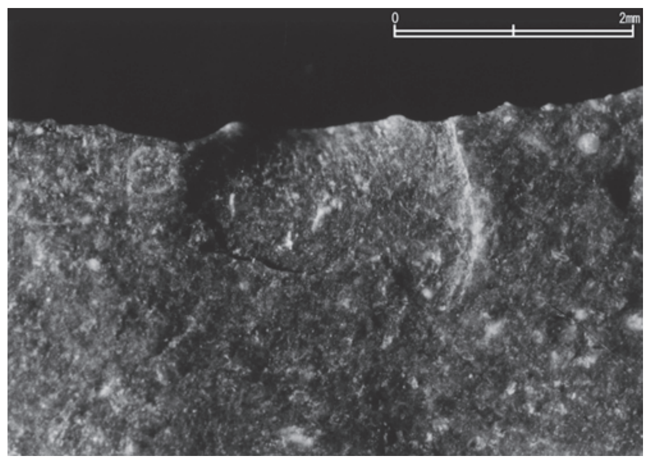
(1) 4.1-3. wood whittle 1000st (SH114v) 8x



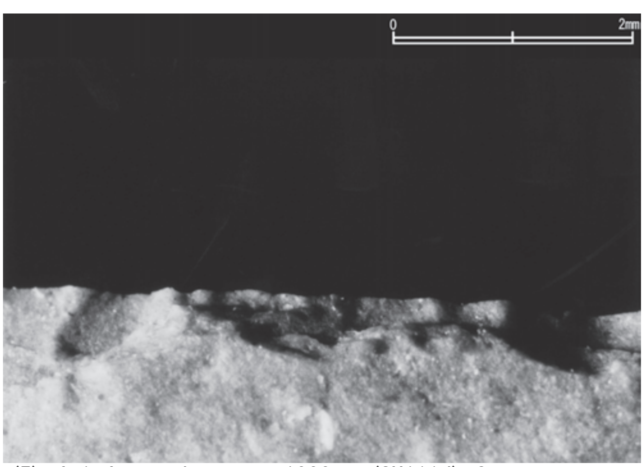
(2) 4.1-3. wood whittle 1000st (SH114v) 8x



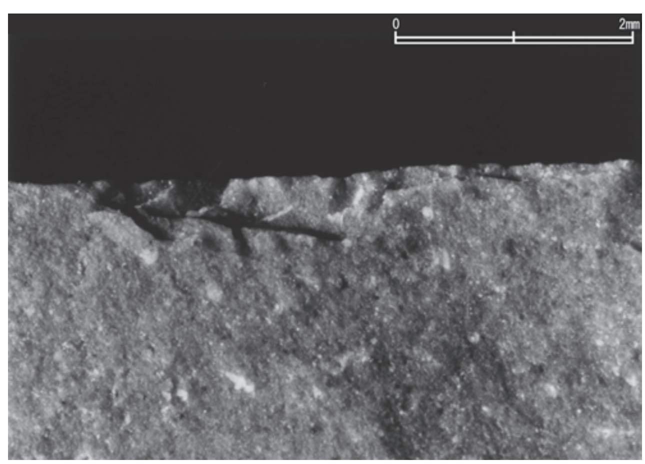
(3) 4.1-3. wood whittle 1000st (SH114v) 8x



(4) 4.1-3. wood whittle 1000st (SH114v) 8x

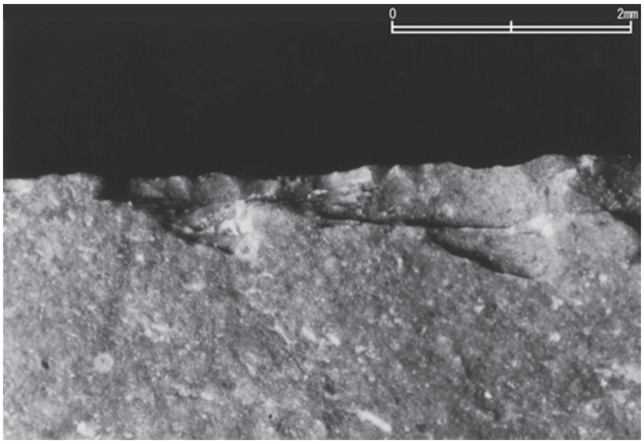


(5) 4.1-4. wood scrape 1000st (SH111d) 8x

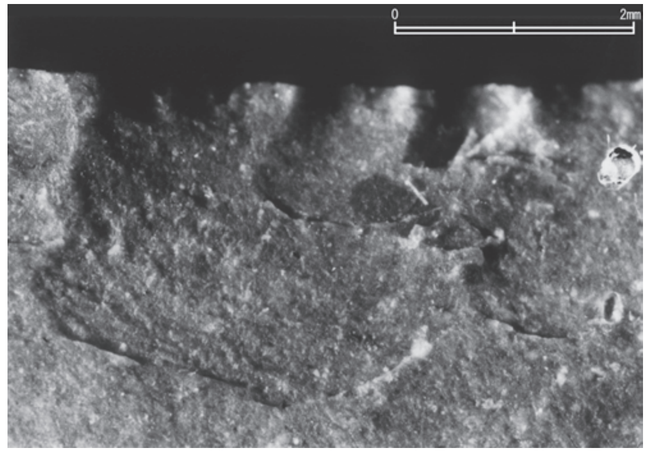


(6) 4.1-4. wood scrape 1000st (SH111d) 8x

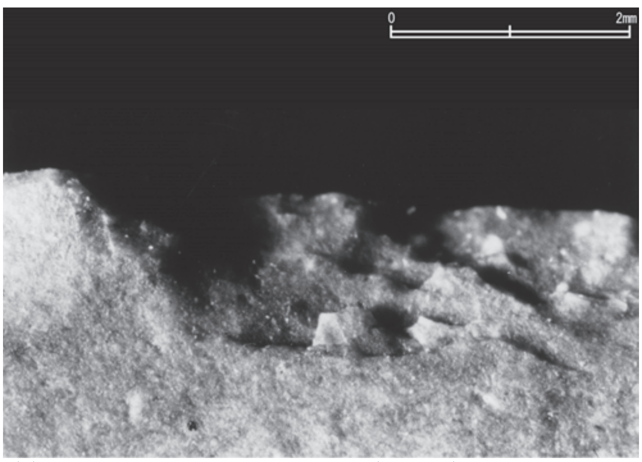
Figure 58. Experimental microflaking scars. (medium worked materials)



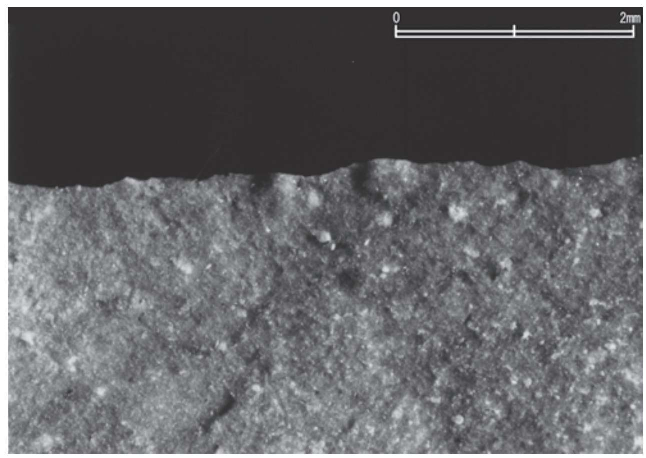
(1) 4.1-4. wood scrape 1000st (SH111d) 8x



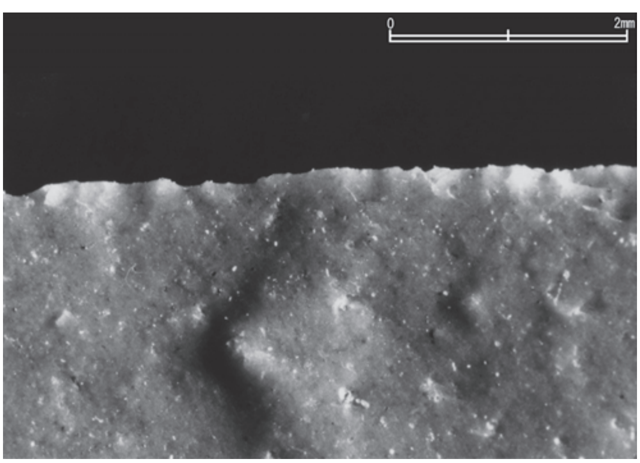
(2) 4.1-4.wood scrape 1000st (SH111d) 8x



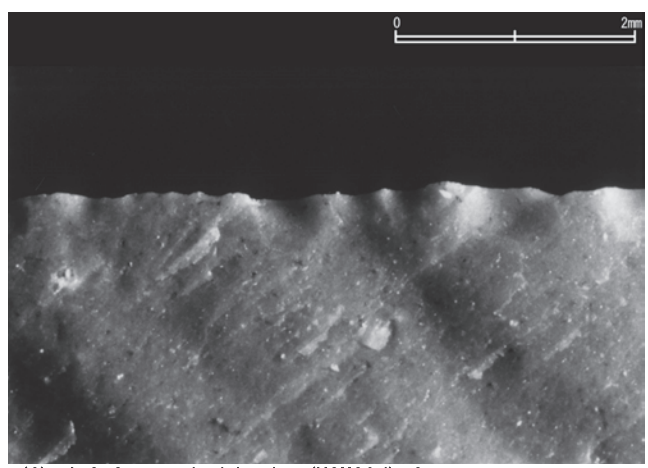
(3) 4.1-4. wood scrape 1000st (SH111d) 8x



(4) 4.1-4. wood scrape 1000st (SH111v) 8x

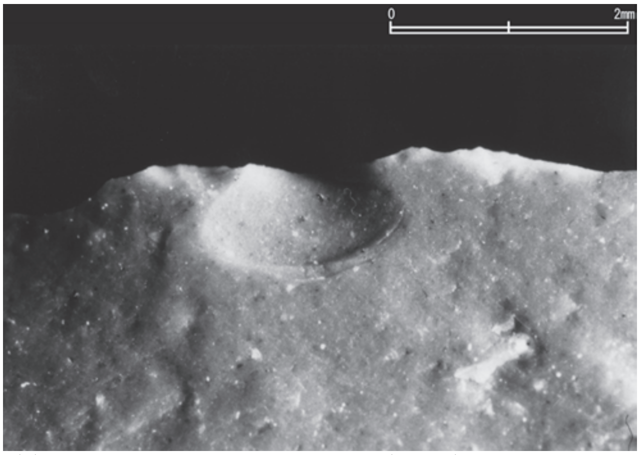


(5) 4.2-3. wood whittle (KSM20d) 8x

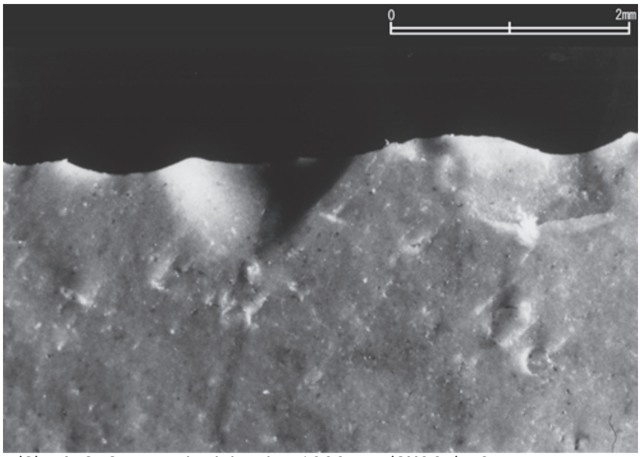


(6) 4.2-3. wood whittle (KSM20d) 8x

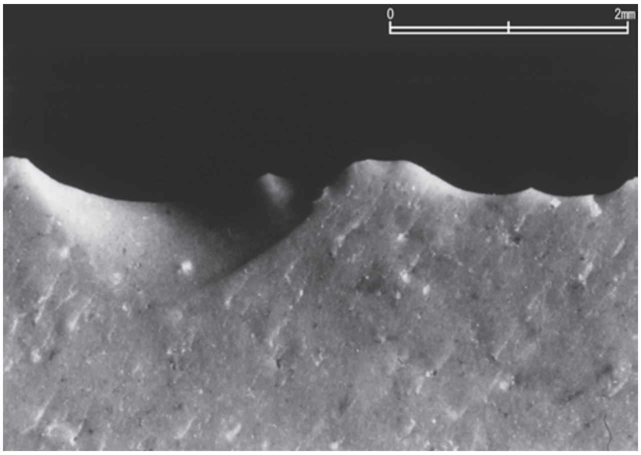
Figure 59. Experimental microflaking scars. (medium worked materials)



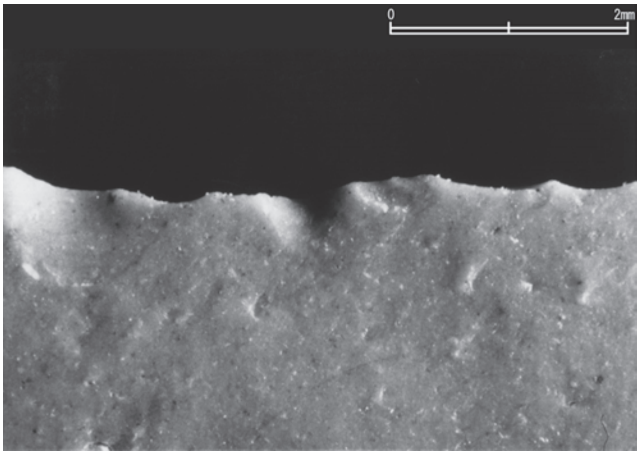
(1) 4.2-3. wood whittle 1000st (SH96d) 8x



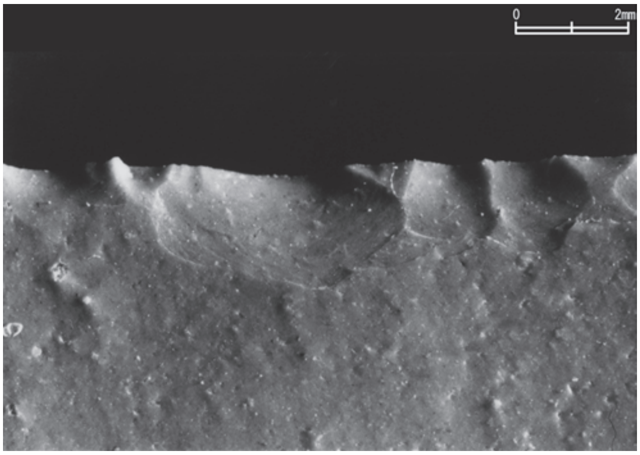
(2) 4.2-3. wood whittle 1000st (SH96v) 8x



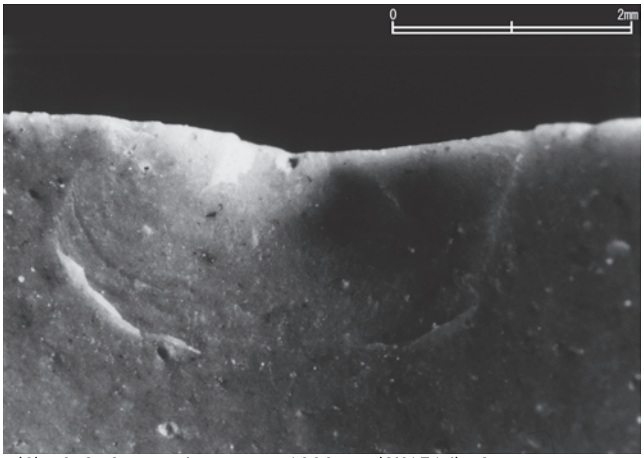
(3) 4.2-3. wood whittle 1000st (SH96v) 8x



(4) 4.2-3. wood whittle 1000st (SH96v) 8x

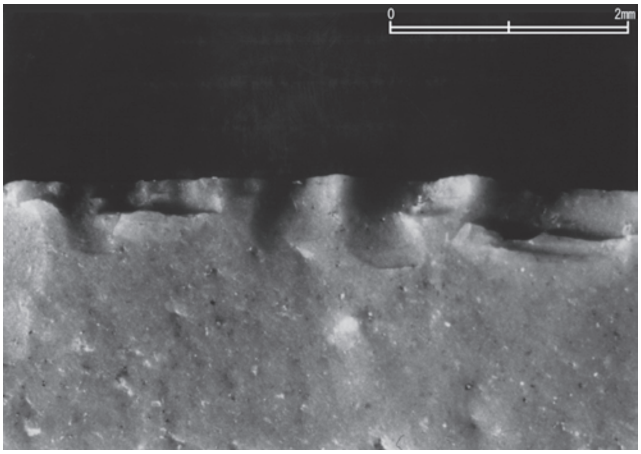


(5) 4.2-4. wood scrape 500st (SH150d) 3.5x

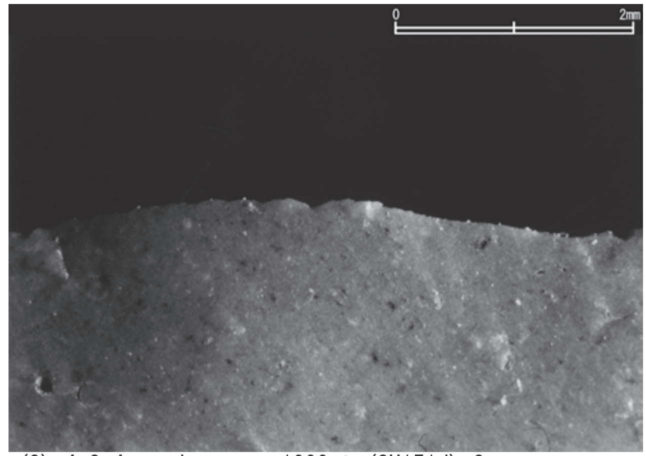


(6) 4.2-4. wood scrape 1000st (SH151d) 8x

Figure 60. Experimental microflaking scars. (medium worked materials)

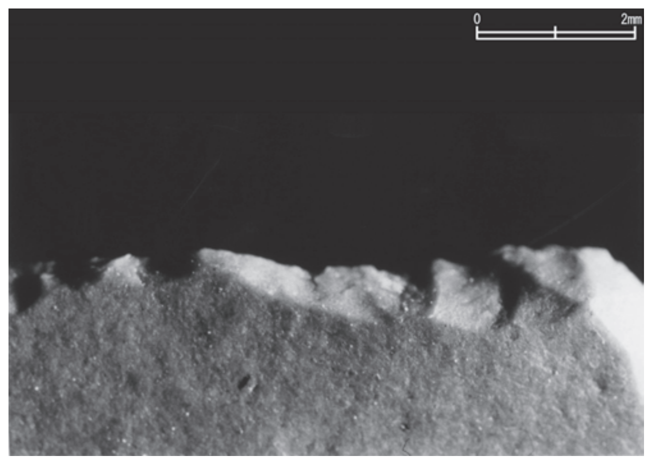


(1) 4.2-4. wood scrape 1000st (SH151d) 8x

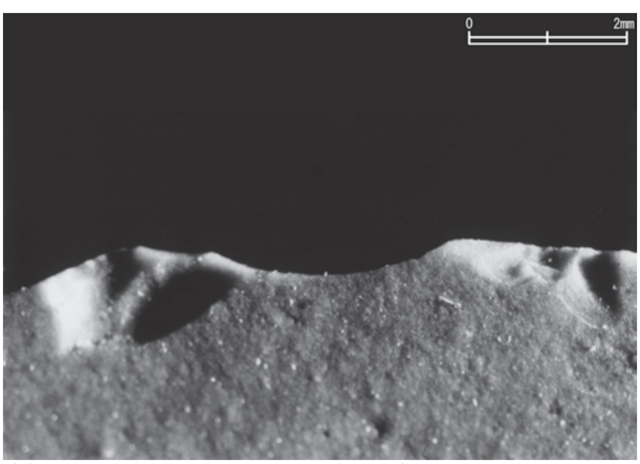


(2) 4.2-4.wood scrape 1000st (SH151d) 8x

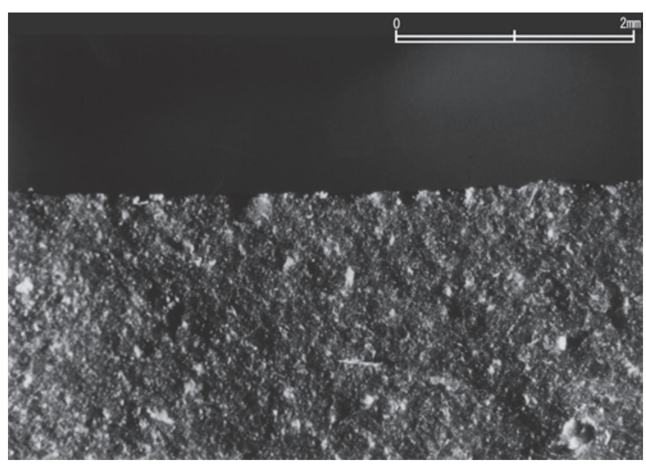
(3) 4.3-2. wood saw 2000st (SH44d) 3x



(4) 4.3-2. wood saw 2000st (SH44v) 5x

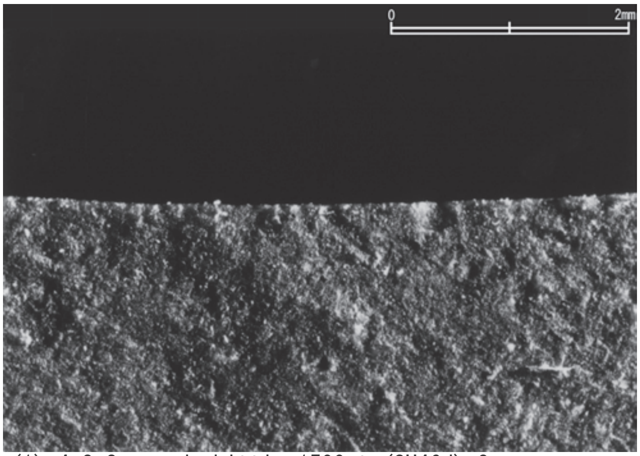


(5) 4.3-2. wood saw 2000st (SH44v) 5x

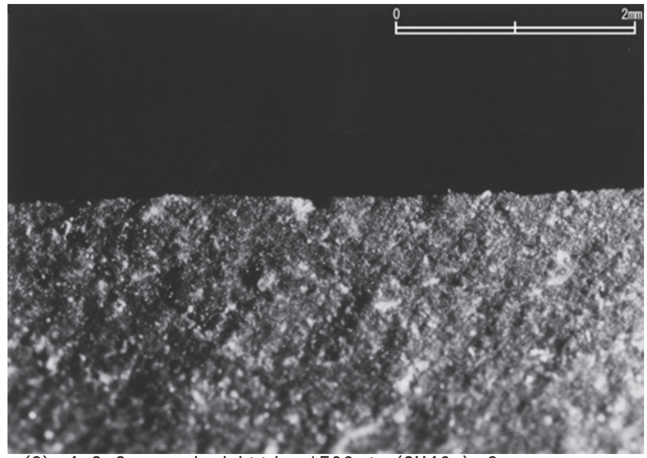


(6) 4.3-3. wood whittle 1500st (SH46d) 8x

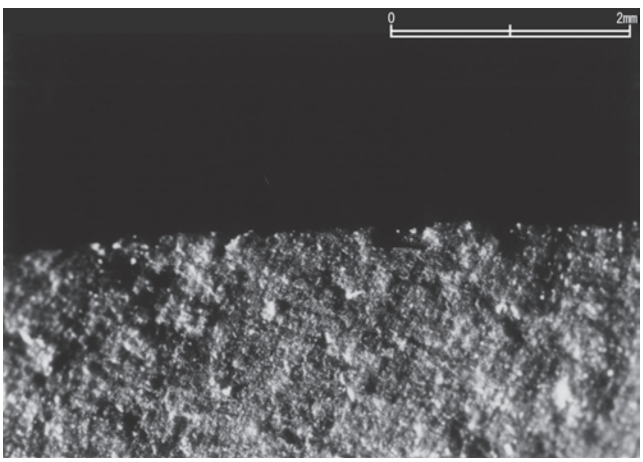
Figure 61. Experimental microflaking scars. (medium worked materials)



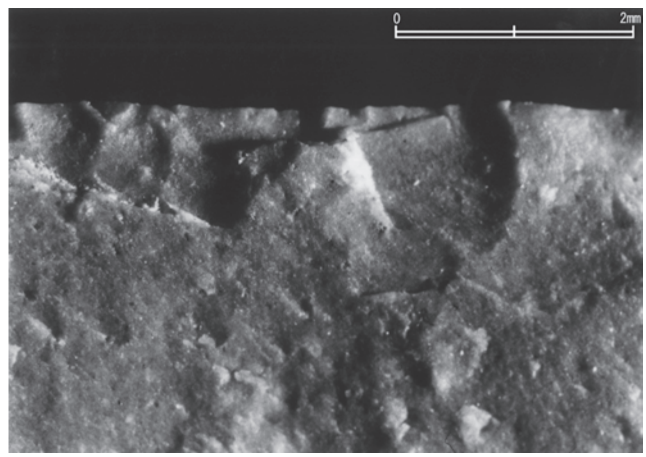
(1) 4.3-3. wood whittle 1500st (SH46d) 8x



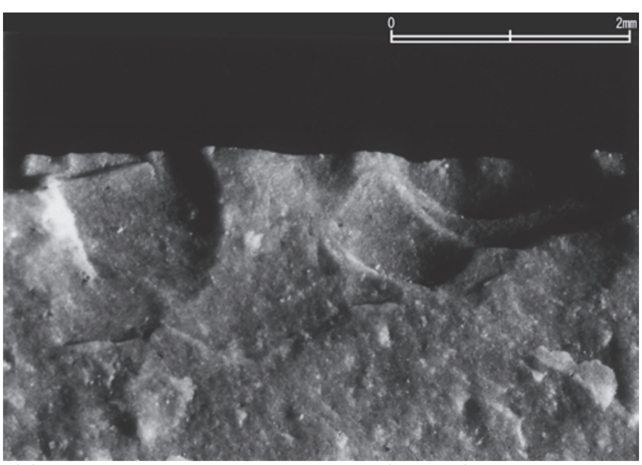
(2) 4.3-3. wood whittle 1500st (SH46v) 8x



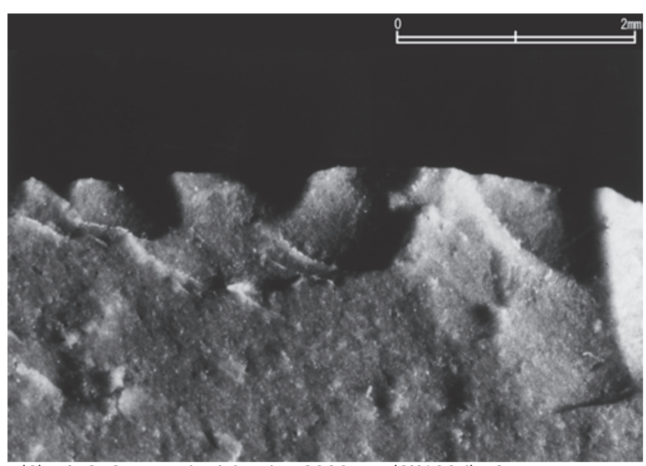
(3) 4.3-3. wood whittle 1500st (SH46v) 8x



(4) 4.3-3. wood whittle 2000st (SH100v) 8x

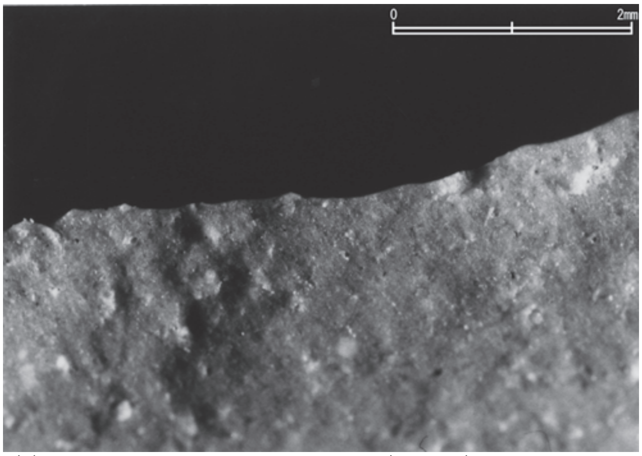


(5) 4.3-3. wood whittle 2000st (SH100d) 8x

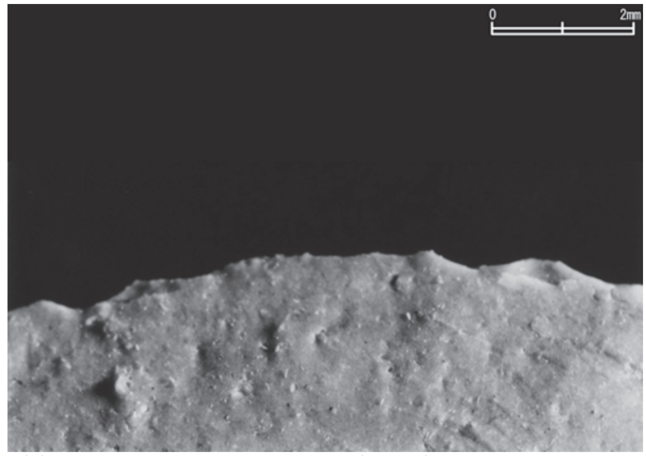


(6) 4.3-3. wood whittle 2000st (SH100d) 8x

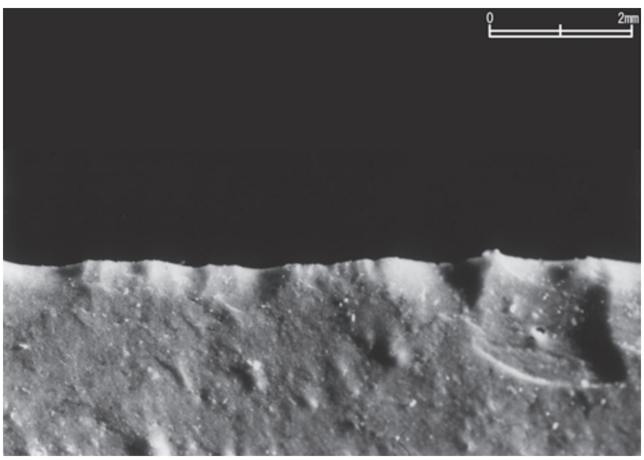
Figure 62. Experimental microflaking scars. (medium worked materials)



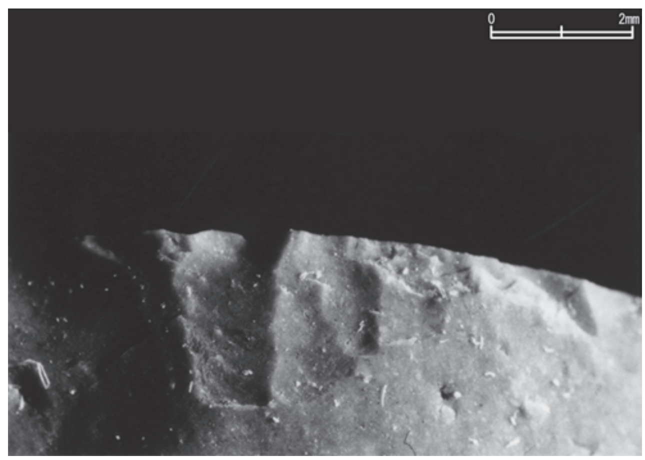
(1) 4.3-3. wood whittle 2000st (SH100v) 8x



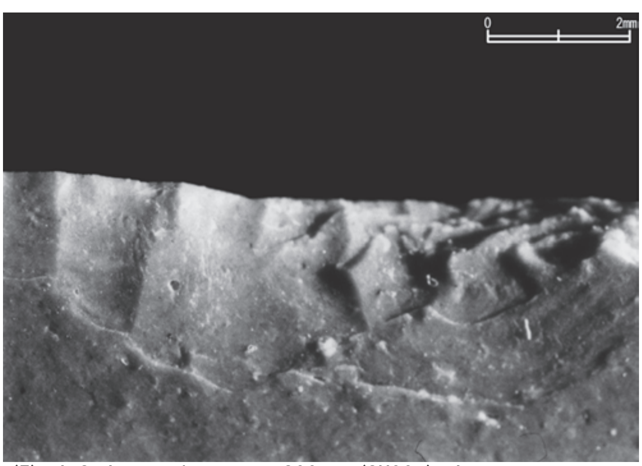
(2) 4.3-4.wood scrape 300st (SH90d) 4x



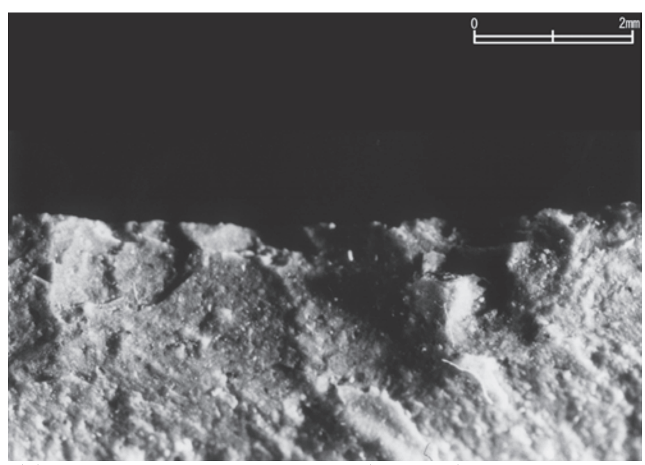
(3) 4.3-4. wood scrape 300st (SH90v) 4x



(4) 4.3-4. wood scrape 300st (SH90v) 4x

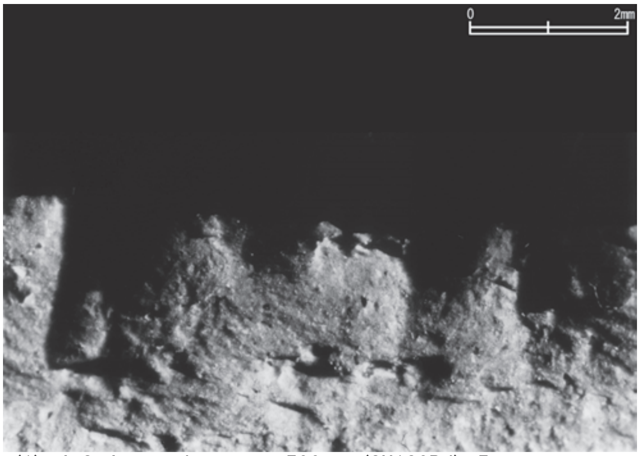


(5) 4.3-4. wood scrape 300st (SH90v) 4x

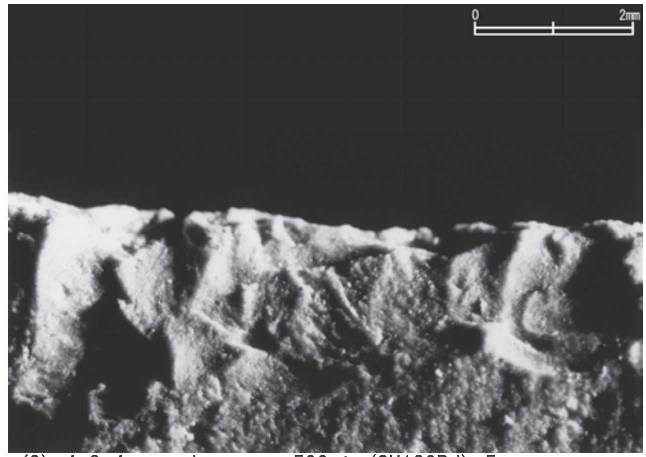


(6) 4.3-4. wood scrape 500st (SH120Bd) 5x

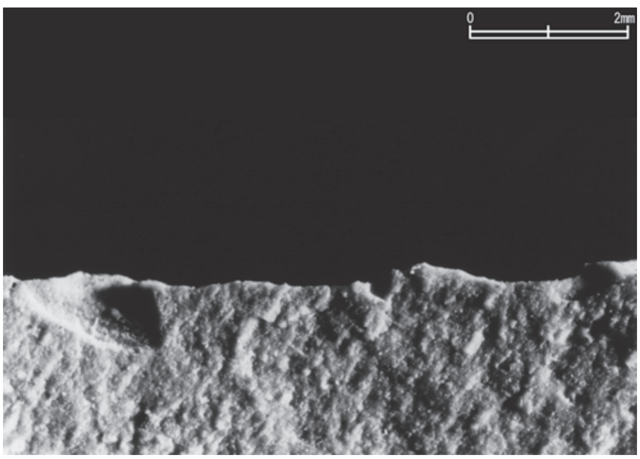
Figure 63. Experimental microflaking scars. (medium worked materials)



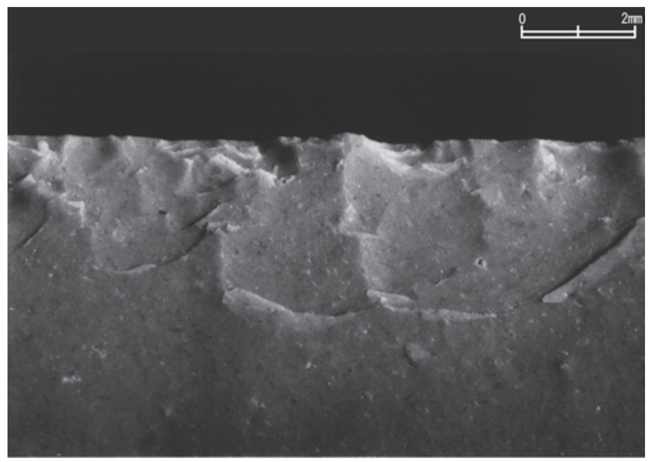
(1) 4.3-4. wood scrape 500st (SH120Bd) 5x



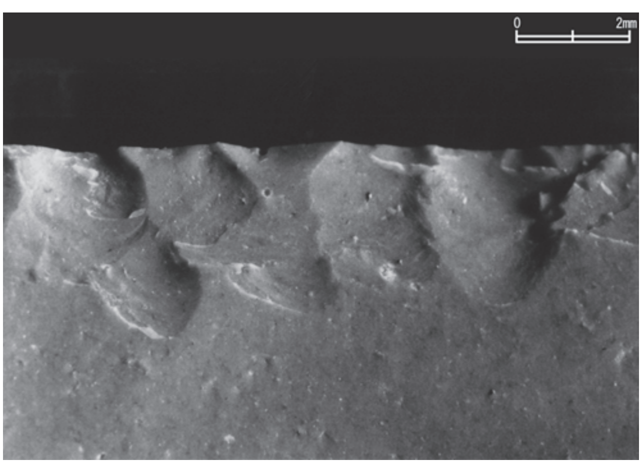
(2) 4.3-4. wood scrape 500st (SH120Bd) 5x



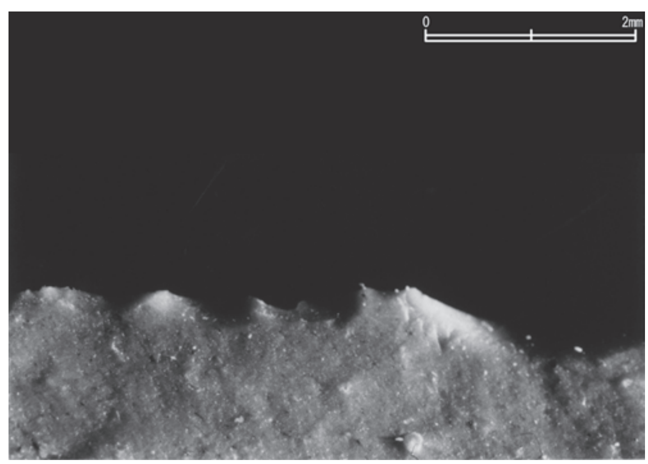
(3) 4.3-4. wood scrape 500st (SH120Bv) 5x



(4) 4.3-4. wood scrape 500st (SH149d) 3.5x

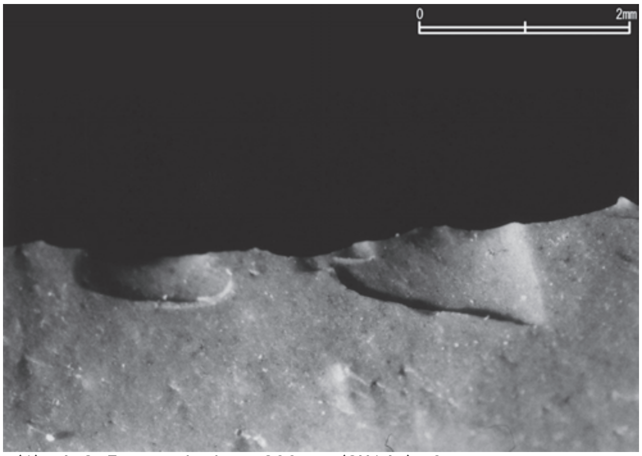


(5) 4.3-4. wood scrape 500st (SH149d) 3.5x

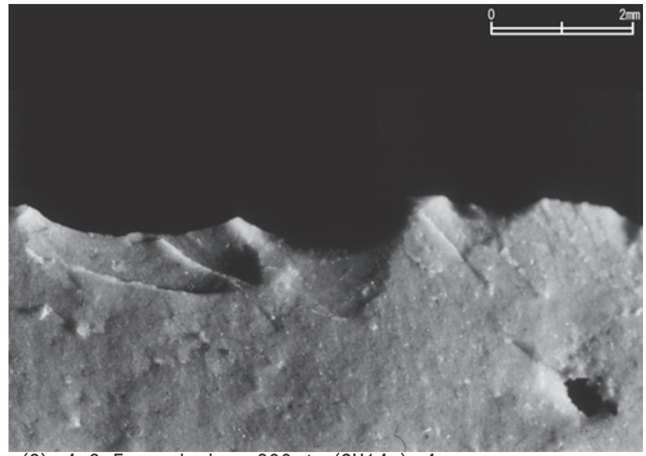


(6) 4.3-5. wood chop 200st (SH14d) 6x

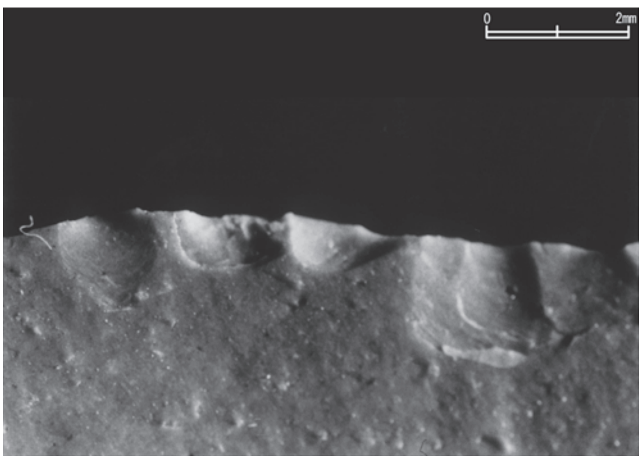
Figure 64. Experimental microflaking scars. (medium worked materials)



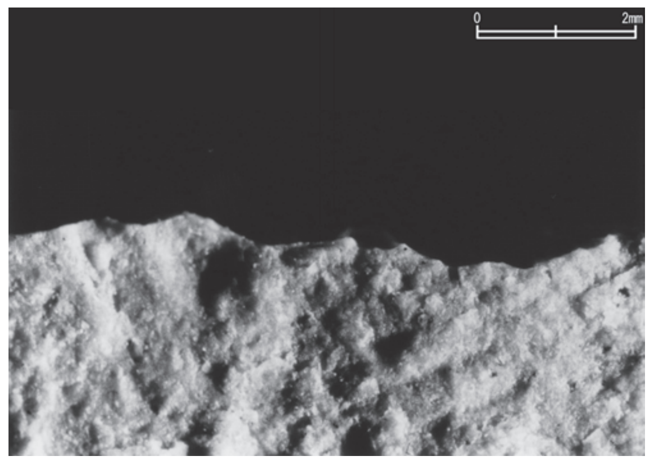
(1) 4.3–5. wood chop 200st (SH14v) 6x



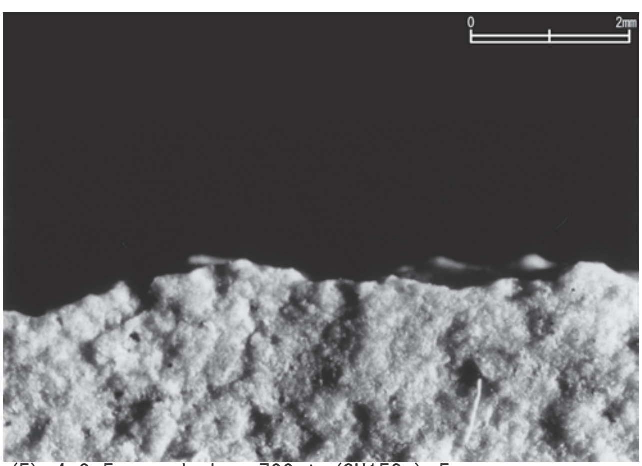
(2) 4.3–5. wood chop 200st (SH14v) 4x



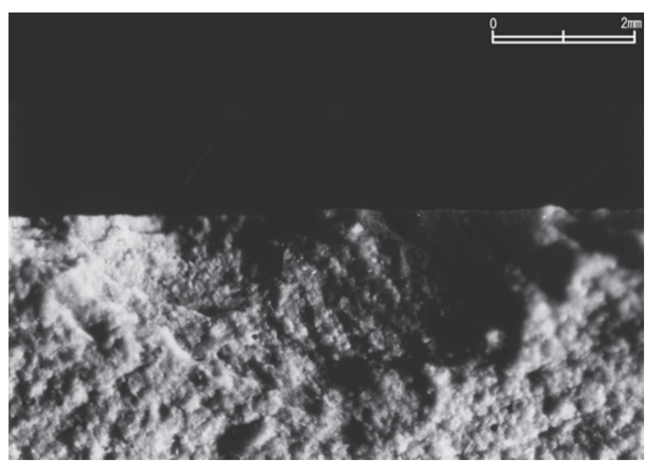
(3) 4.3–5. wood chop 200st (SH14v) 4x



(4) 4.3–5. wood chop 700st (SH152d) 5x

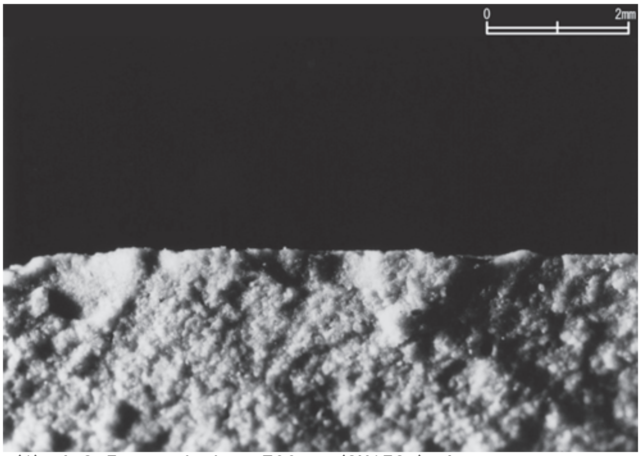


(5) 4.3–5. wood chop 700st (SH152v) 5x

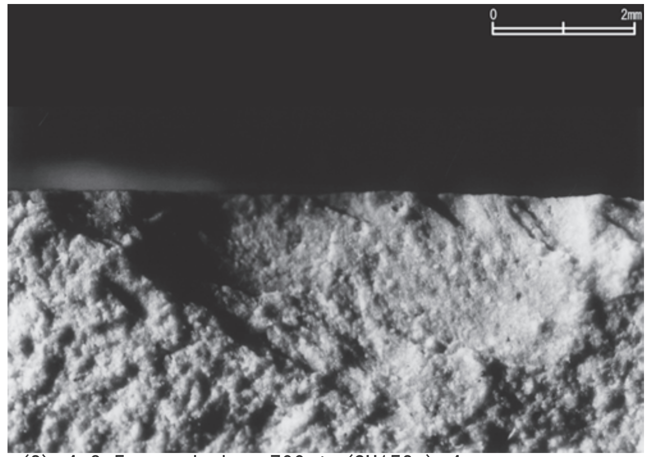


(6) 4.3–5. wood chop 700st (SH152v) 4x

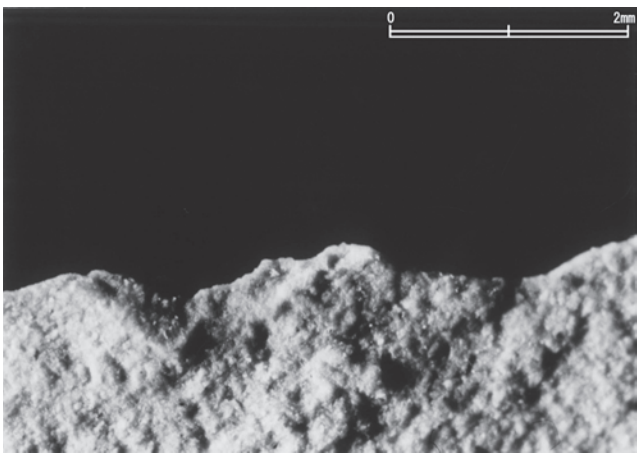
Figure 65. Experimental microflaking scars. (medium worked materials)



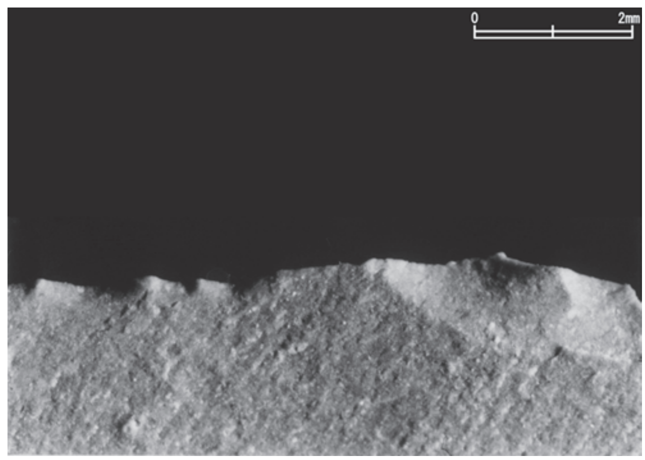
(1) 4.3-5. wood chop 700st (SH152v) 4x



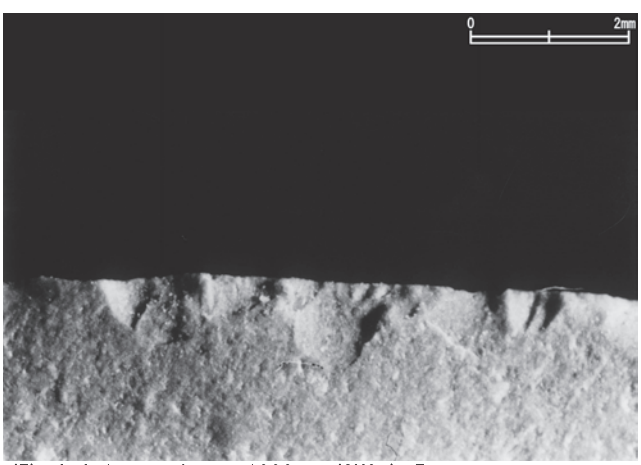
(2) 4.3-5. wood chop 700st (SH152v) 4x



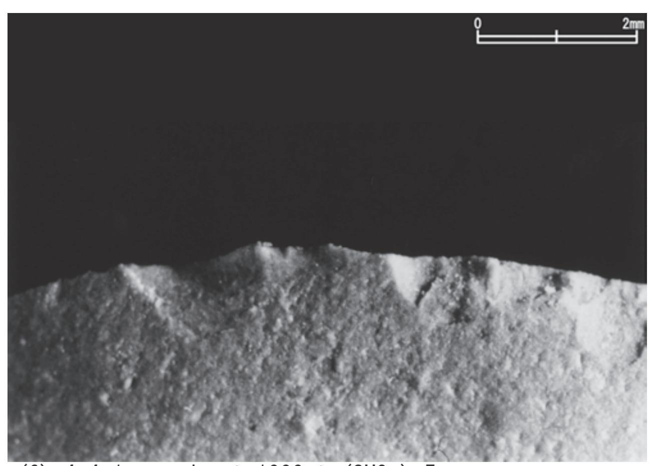
(3) 4.4-1. wood cut 1000st (SH9d) 8x



(4) 4.4-1. wood cut 1000st (SH9v) 5x

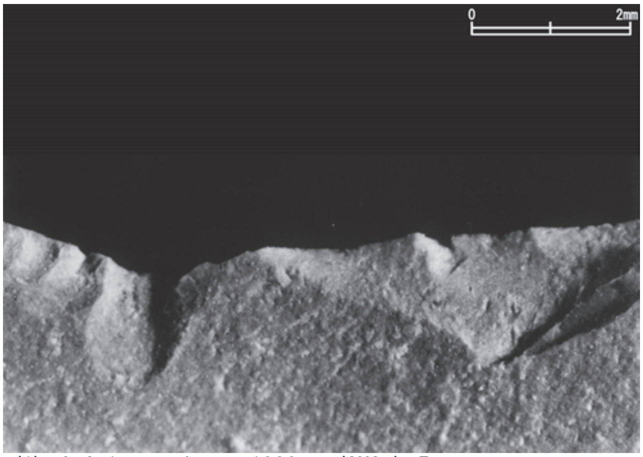


(5) 4.4-1. wood cut 1000st (SH9v) 5x

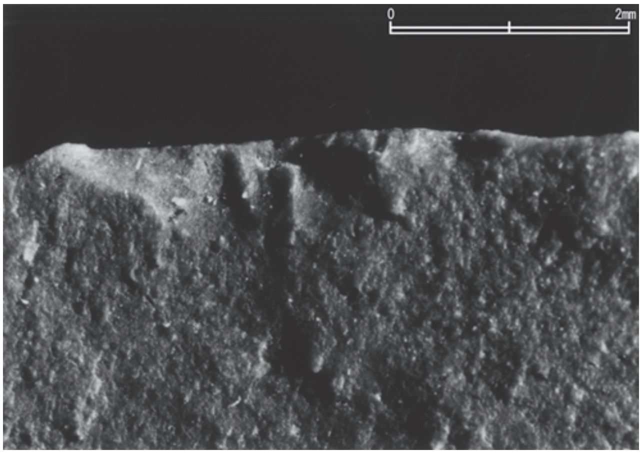


(6) 4.4-1. wood cut 1000st (SH9v) 5x

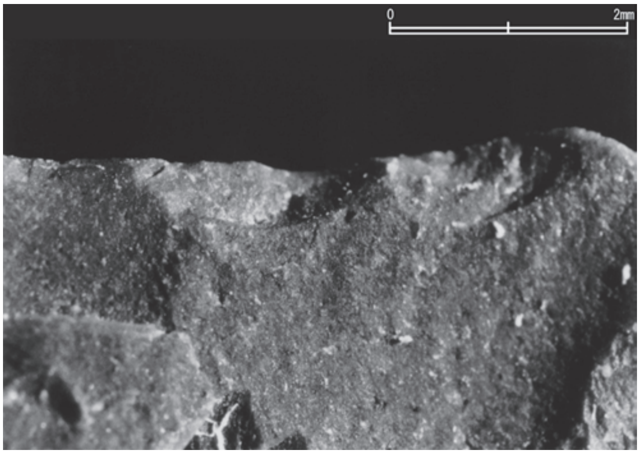
Figure 66. Experimental microflaking scars. (medium worked materials)



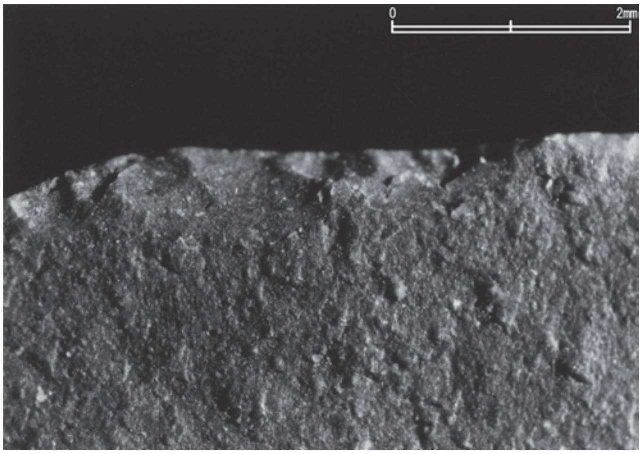
(1) 4.4-1. wood cut 1000st (SH9v) 5x



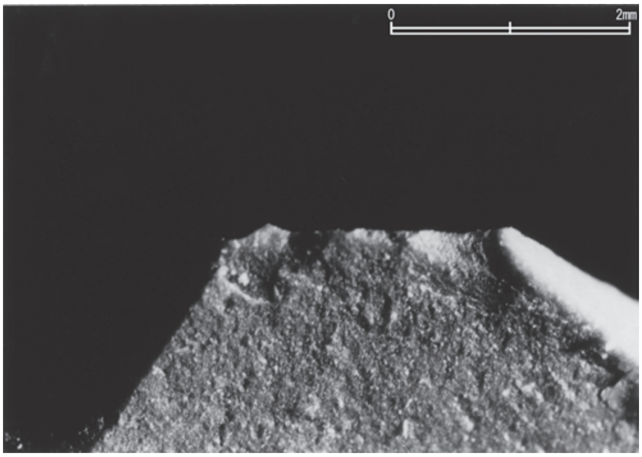
(2) 4.4-1.wood cut 1400st (SH7d) 8x



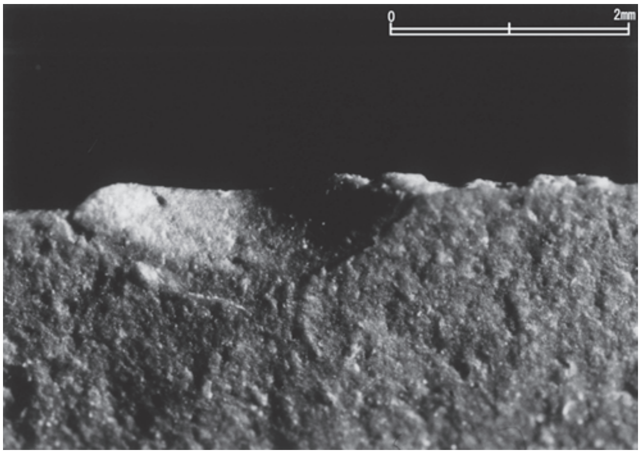
(3) 4.4-1. wood cut 1400st (SH7d) 8x



(4) 4.4-1. wood cut 1400st (SH7d) 8x

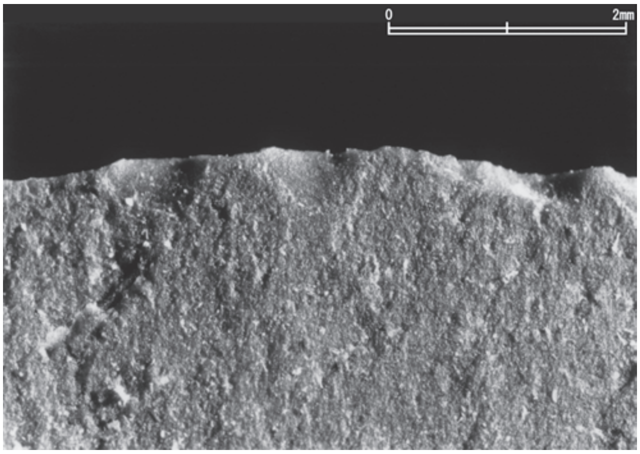


(5) 4.4-1. wood cut 1400st (SH7v) 8x

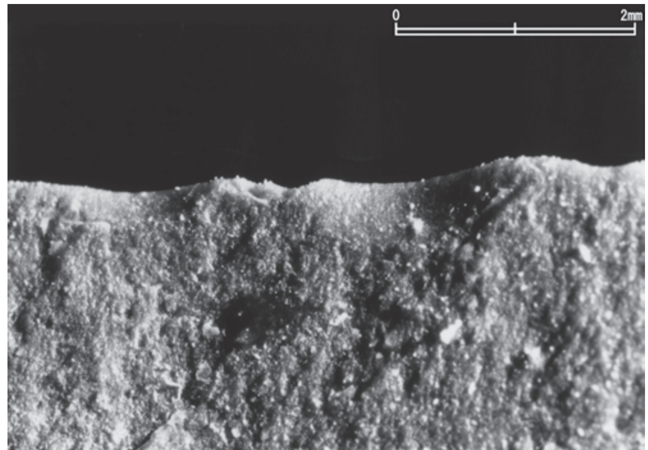


(6) 4.4-1. wood cut 1400st (SH7v) 8x

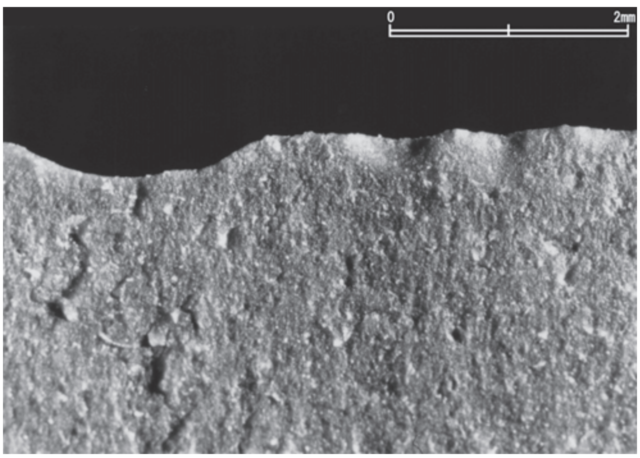
Figure 67. Experimental microflaking scars. (medium worked materials)



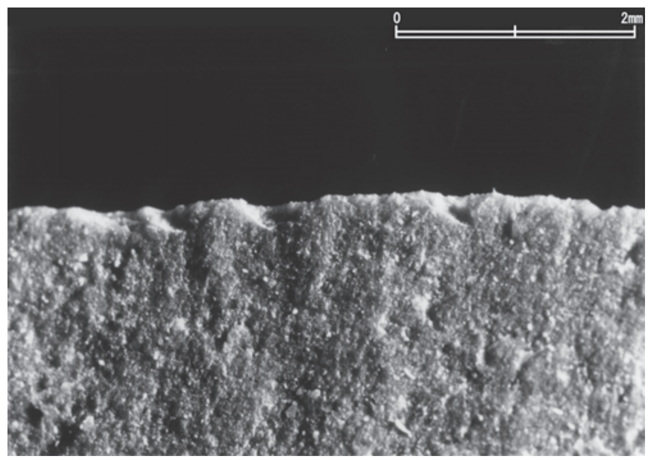
(1) 4.4-1. wood cut 2000st (SH10d) 8x



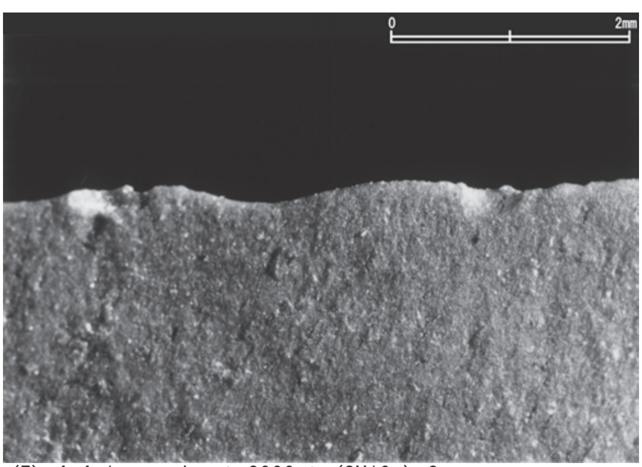
(2) 4.4-1. wood cut 2000st (SH10d) 8x



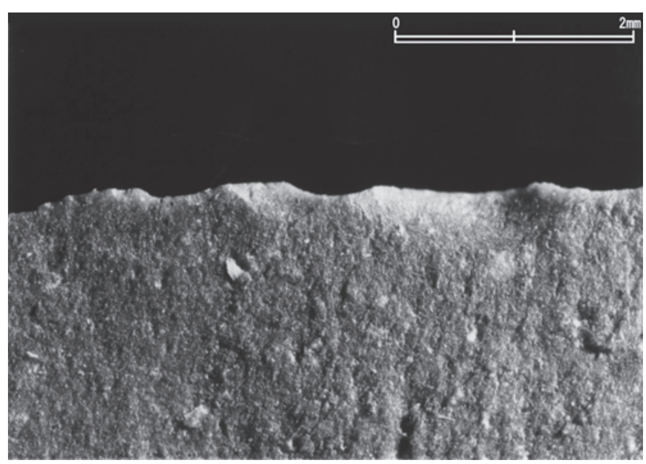
(3) 4.4-1. wood cut 2000st (SH10d) 8x



(4) 4.4-1. wood cut 2000st (SH10d) 8x

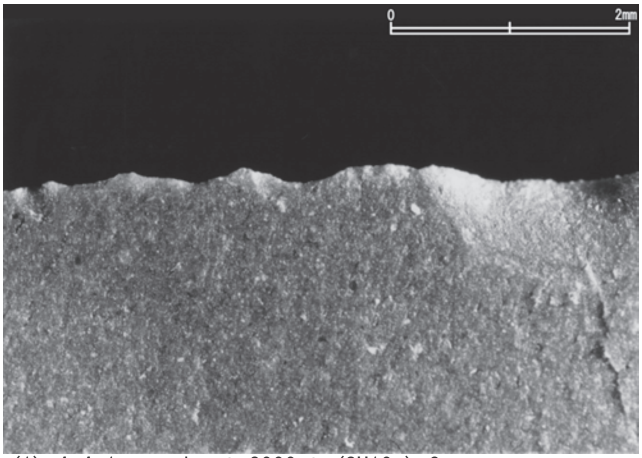


(5) 4.4-1. wood cut 2000st (SH10v) 8x

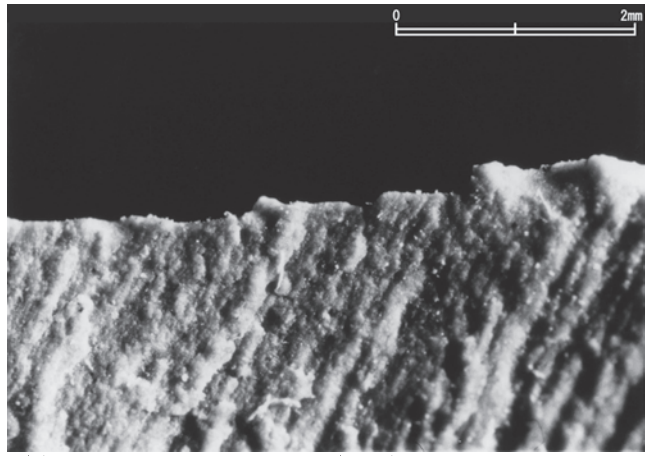


(6) 4.4-1. wood cut 2000st (SH10v) 8x

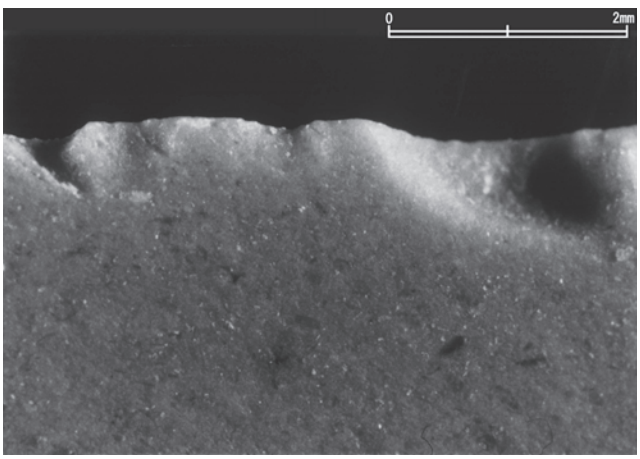
Figure 68. Experimental microflaking scars. (medium worked materials)



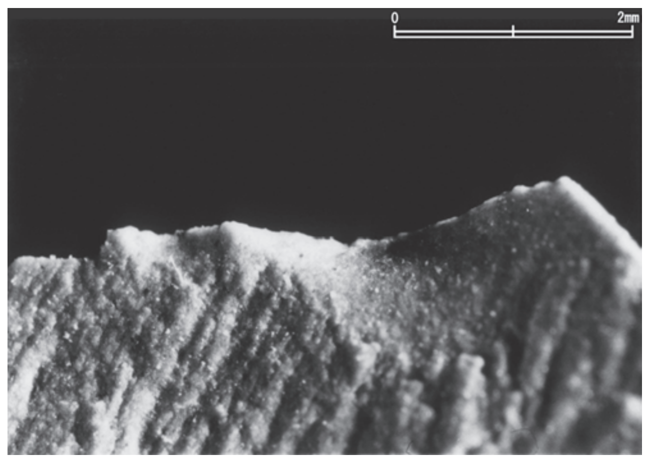
(1) 4.4-1. wood cut 2000st (SH10v) 8x



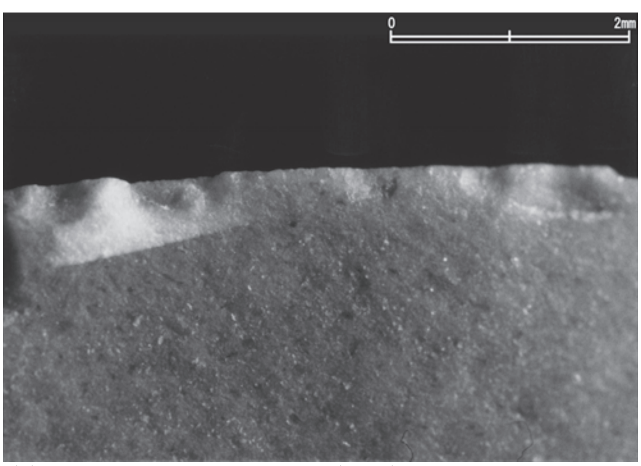
(2) 4.4-1.wood cut 2500st (SH8d) 8x



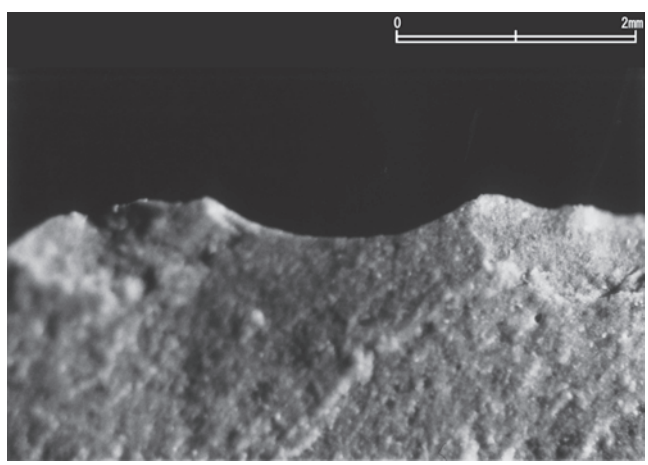
(3) 4.4-1. wood cut 2500st (SH8d) 8x



(4) 4.4-1. wood cut 2500st (SH8d) 8x

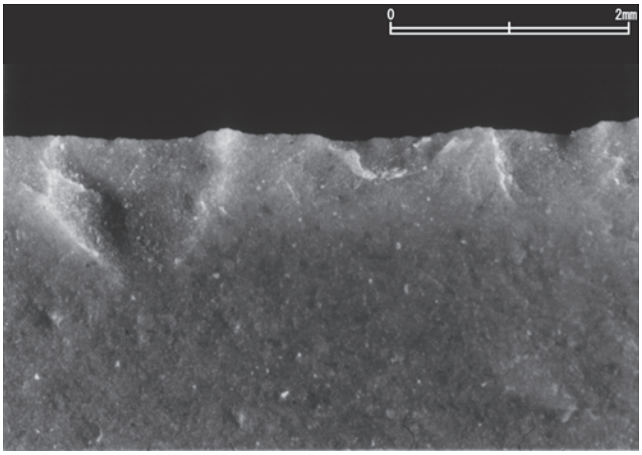


(5) 4.4-1. wood cut 2500st (SH8d) 8x

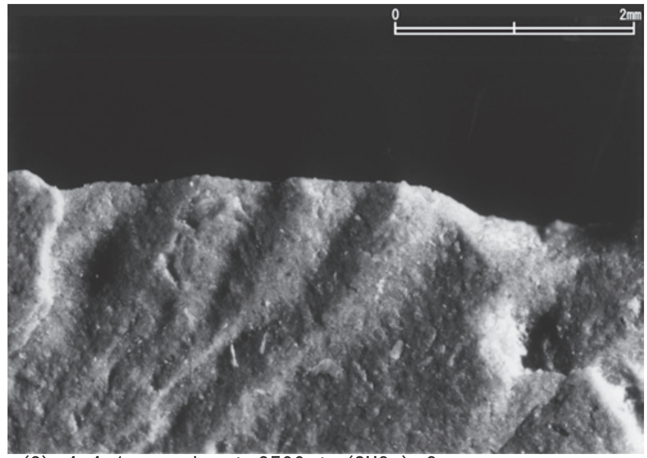


(6) 4.4-1. wood cut 2500st (SH8d) 8x

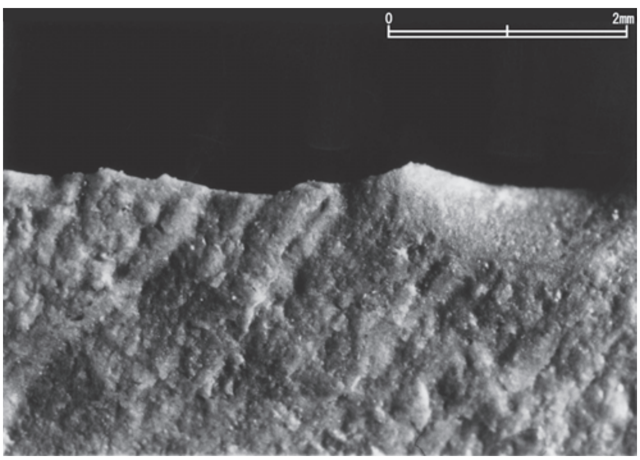
Figure 69. Experimental microflaking scars. (medium worked materials)



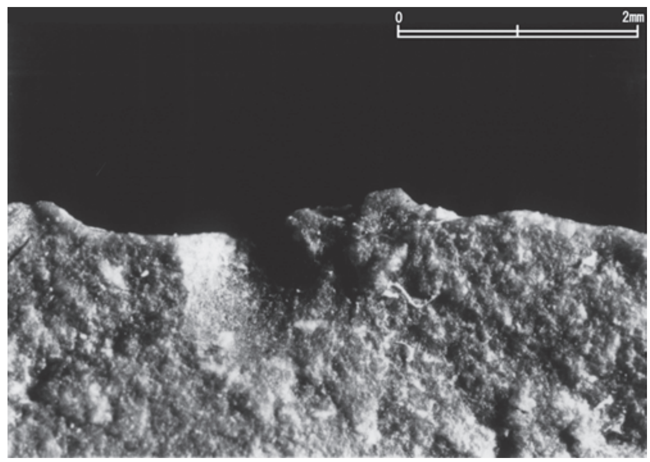
(1) 4.4-1. wood cut 2500st (SH8d) 8x



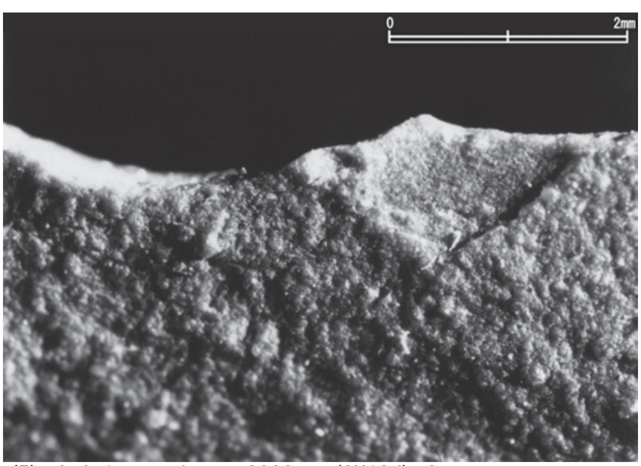
(2) 4.4-1. wood cut 2500st (SH8v) 8x



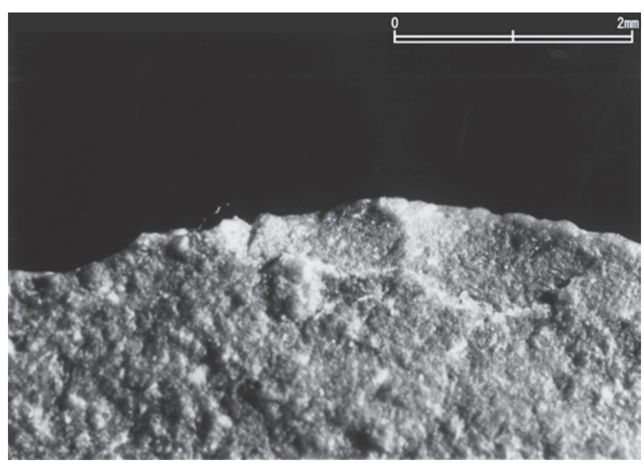
(3) 4.4-1. wood cut 2500st (SH8v) 8x



(4) 4.4-1. wood cut 3000st (SH12d) 8x

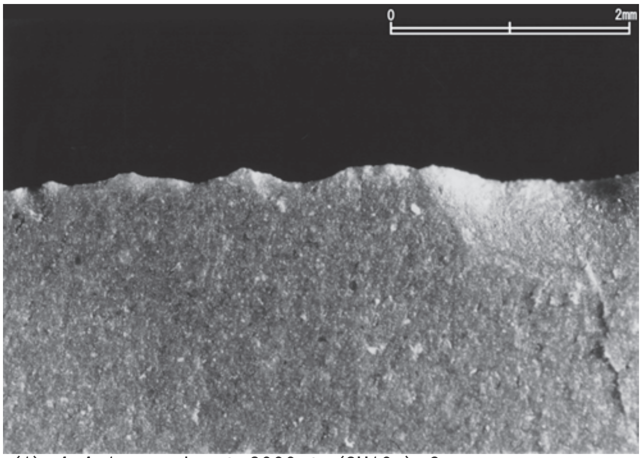


(5) 4.4-1. wood cut 3000st (SH12d) 8x

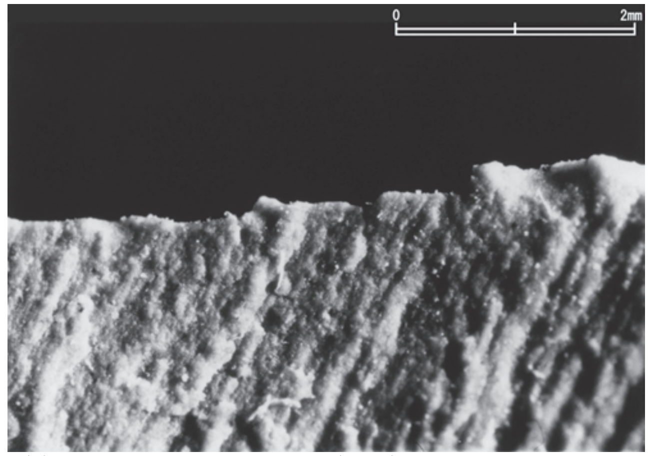


(6) 4.4-1. wood cut 3000st (SH12d) 8x

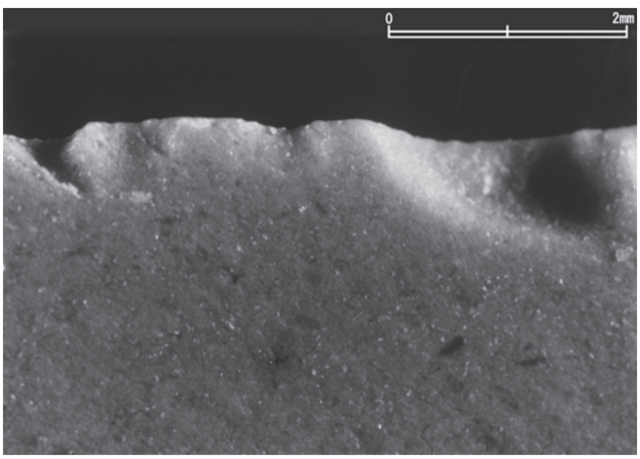
Figure 70. Experimental microflaking scars. (medium worked materials)



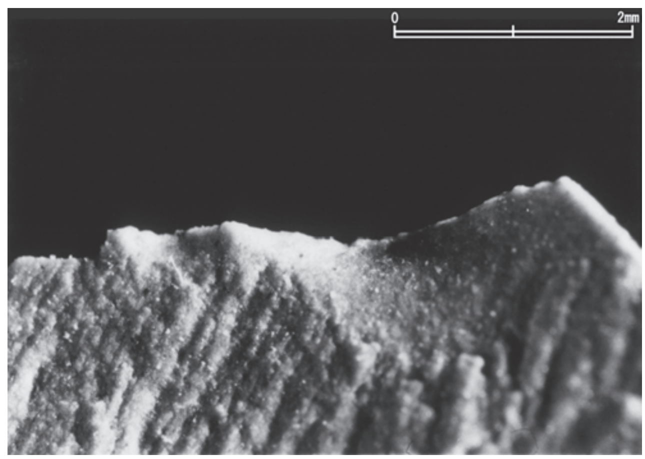
(1) 4.4-1. wood cut 2000st (SH10v) 8x



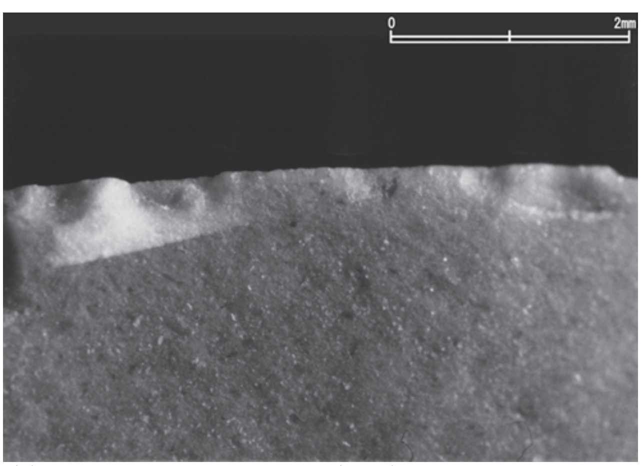
(2) 4.4-1.wood cut 2500st (SH8d) 8x



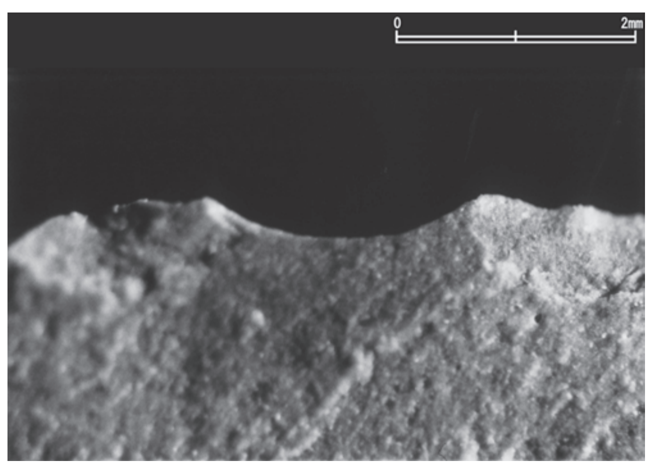
(3) 4.4-1. wood cut 2500st (SH8d) 8x



(4) 4.4-1. wood cut 2500st (SH8d) 8x

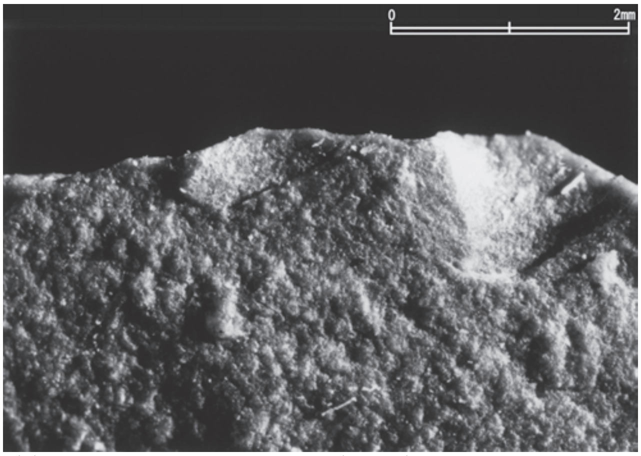


(5) 4.4-1. wood cut 2500st (SH8d) 8x

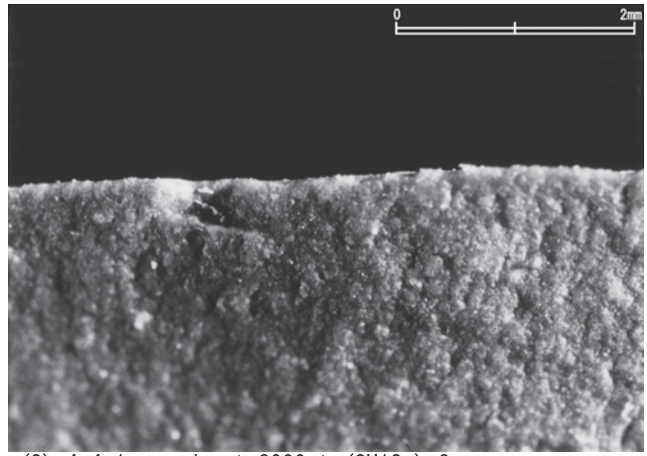


(6) 4.4-1. wood cut 2500st (SH8d) 8x

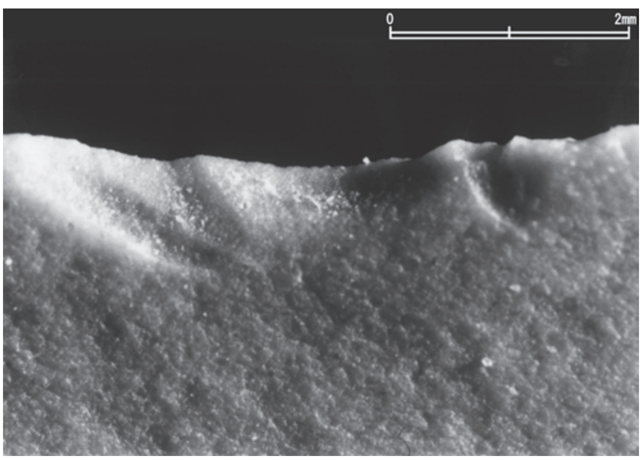
Figure 71. Experimental microflaking scars. (medium worked materials)



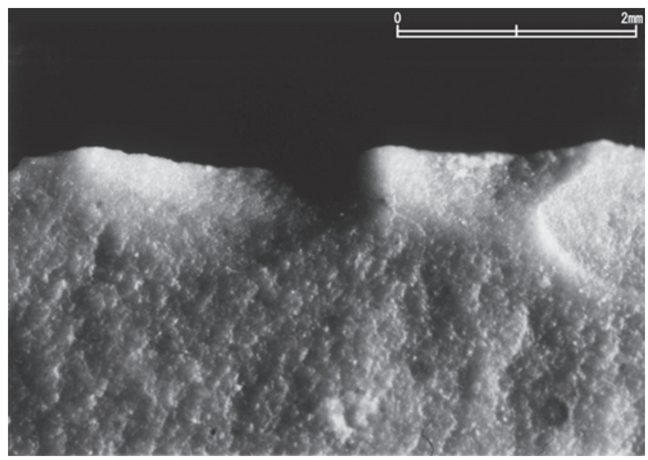
(1) 4.4-1. wood cut 3000st (SH12d) 8x



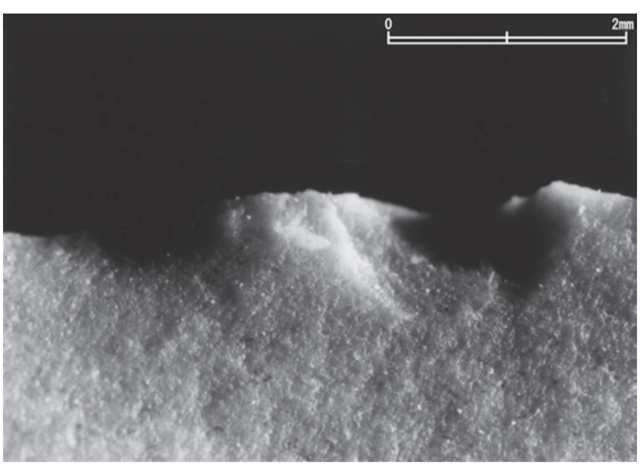
(2) 4.4-1. wood cut 3000st (SH12v) 8x



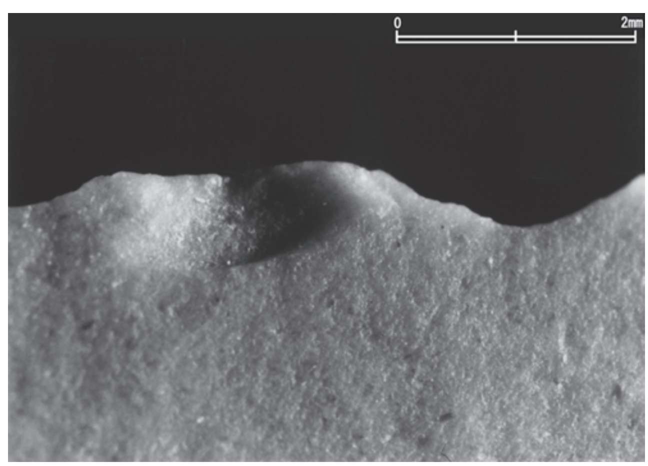
(3) 4.4-2. wood saw 5000st (SH49d) 8x



(4) 4.4-2. wood saw 5000st (SH49v) 8x

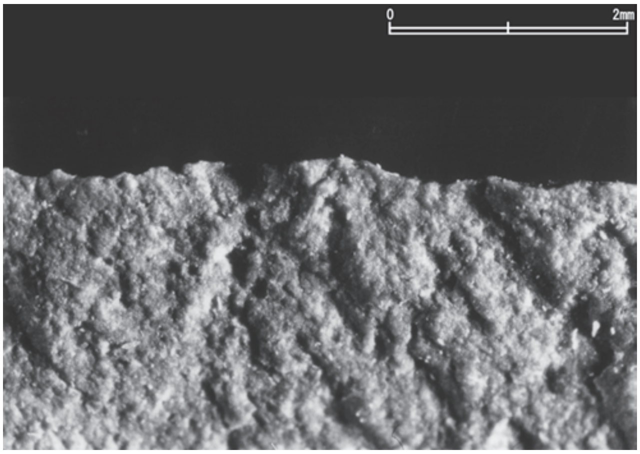


(5) 4.4-2. wood saw 5000st (SH49v) 8x

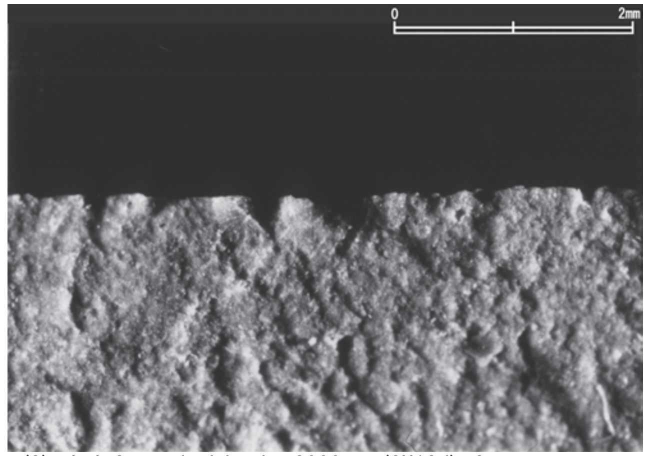


(6) 4.4-2. wood saw 5000st (SH49v) 8x

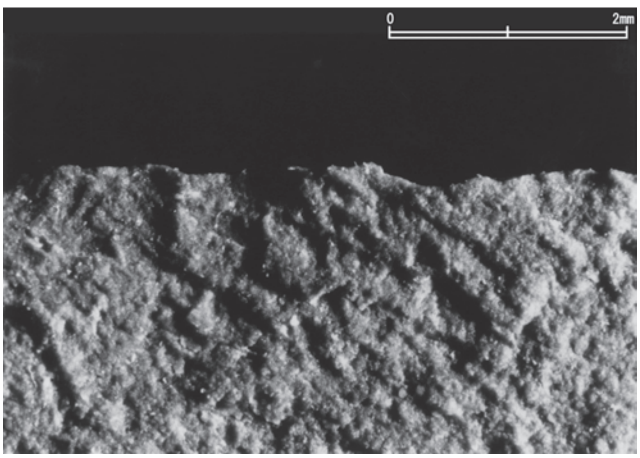
Figure 72. Experimental microflaking scars. (medium worked materials)



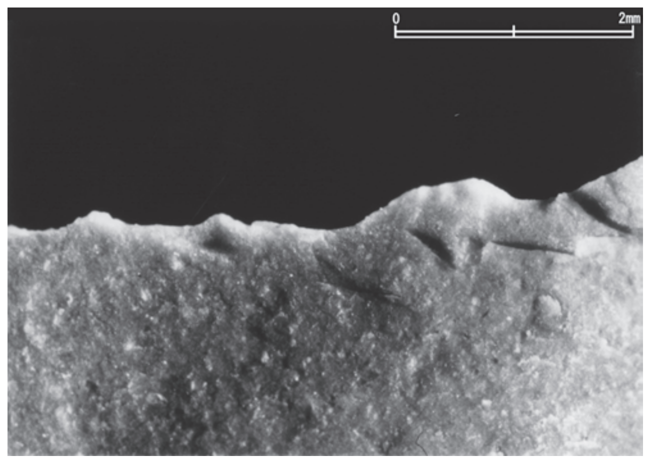
(1) 4.4-3. wood whittle 2000st (SH13d) 8x



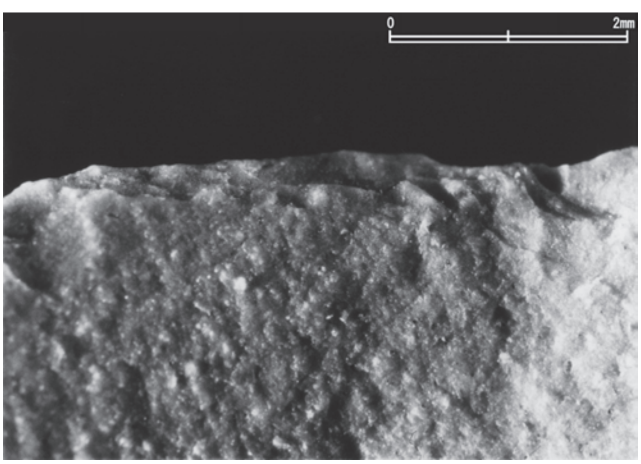
(2) 4.4-3.wood whittle 2000st (SH13d) 8x



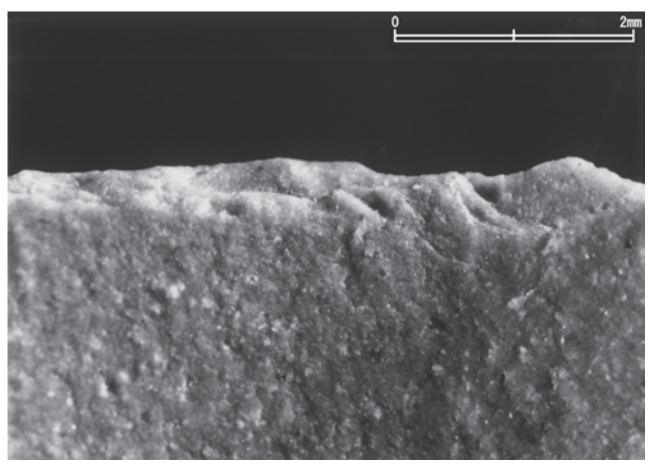
(3) 4.4-3. wood whittle 2000st (SH13v) 8x



(4) 4.4-3. wood whittle 2000st (SH99d) 8x

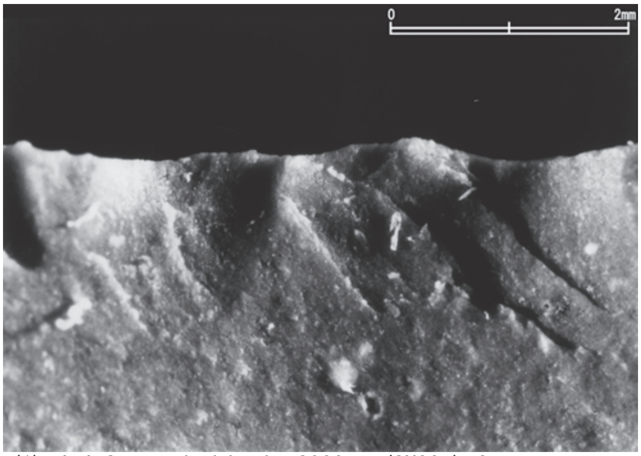


(5) 4.4-3. wood whittle 2000st (SH99d) 8x

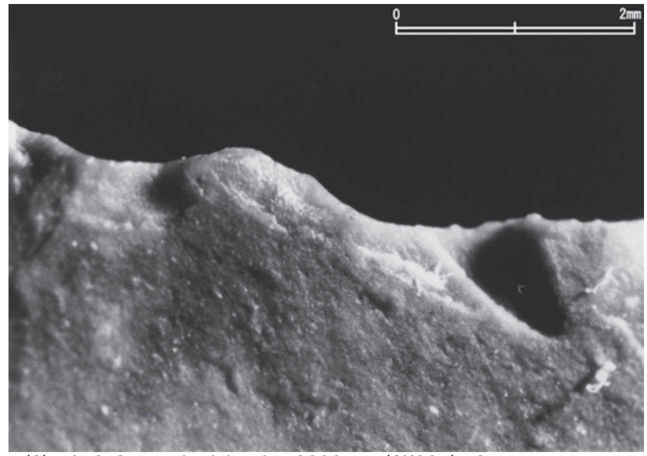


(6) 4.4-3. wood whittle 2000st (SH99d) 8x

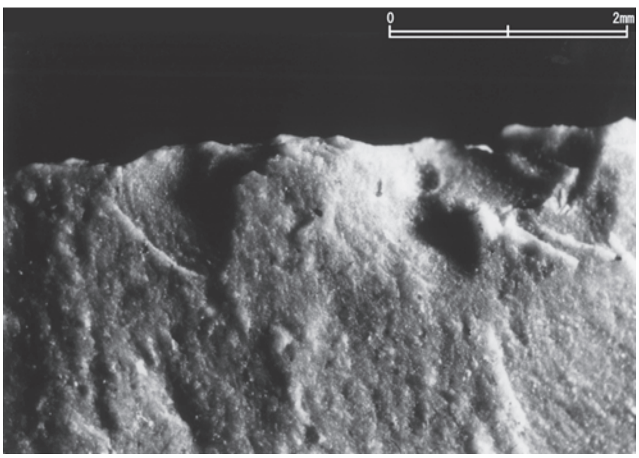
Figure 73. Experimental microflaking scars. (medium worked materials)



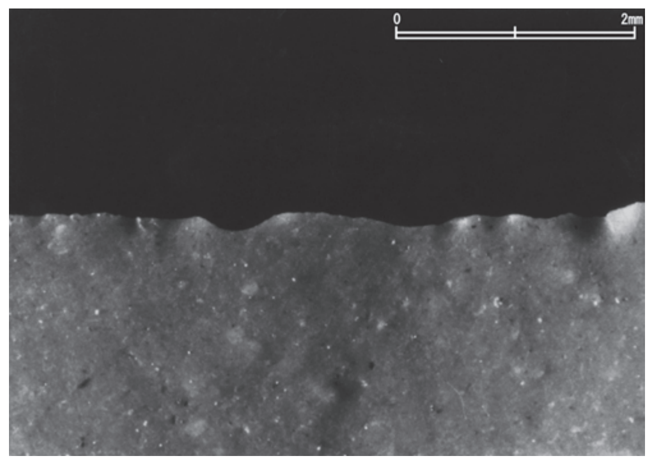
(1) 4.4-3. wood whittle 2000st (SH99v) 8x



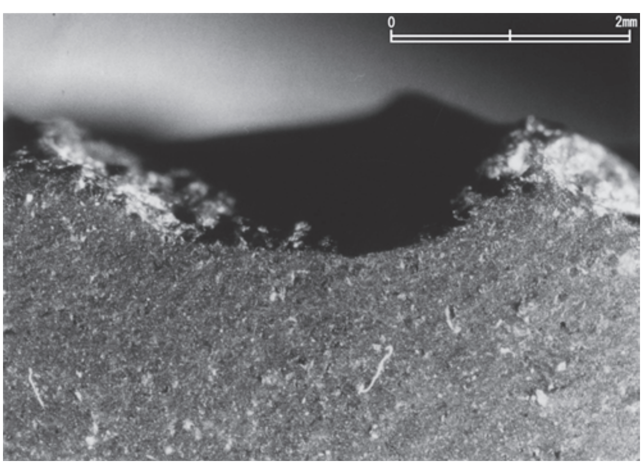
(2) 4.4-3.wood whittle 2000st (SH99v) 8x



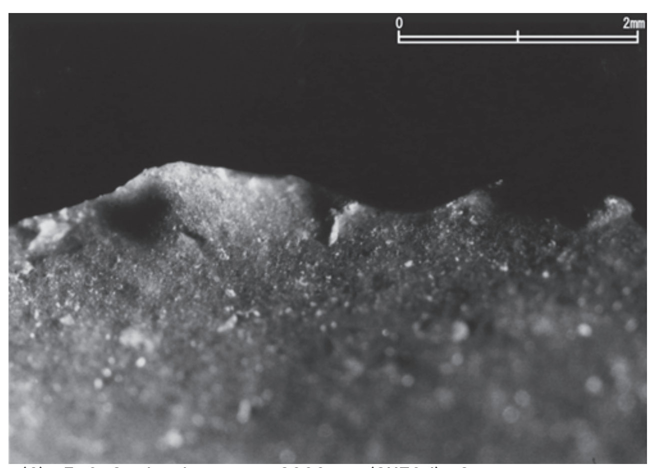
(3) 4.4-3. wood whittle 2000st (SH99v) 8x



(4) 4.6-1. wood cut 30m (KSM12d) 8x

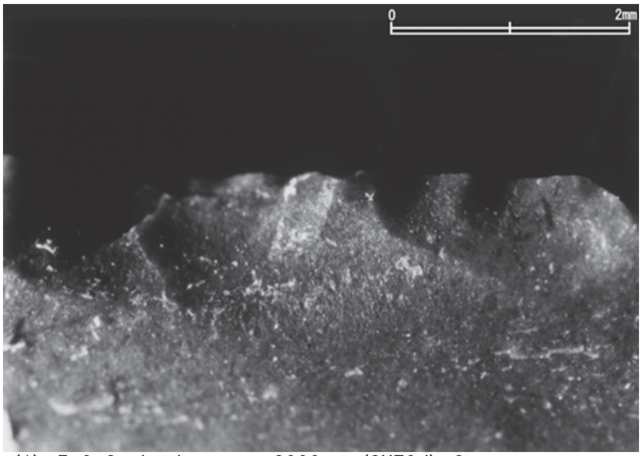


(5) 4.6-4. wood scrape 2000st (SH39v) 8x

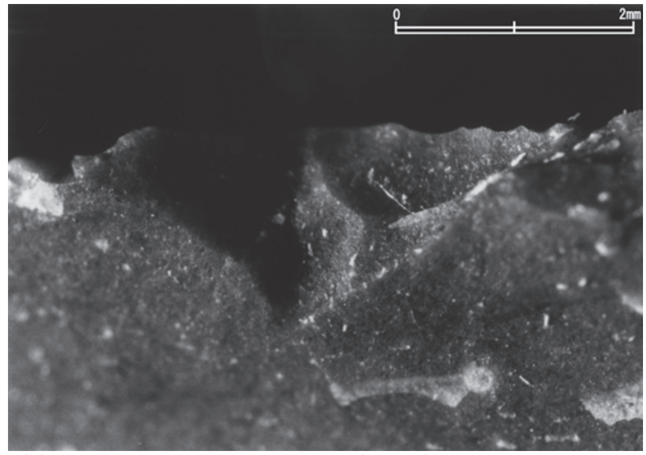


(6) 5.0-2. bamboo saw 2000st (SH79d) 8x

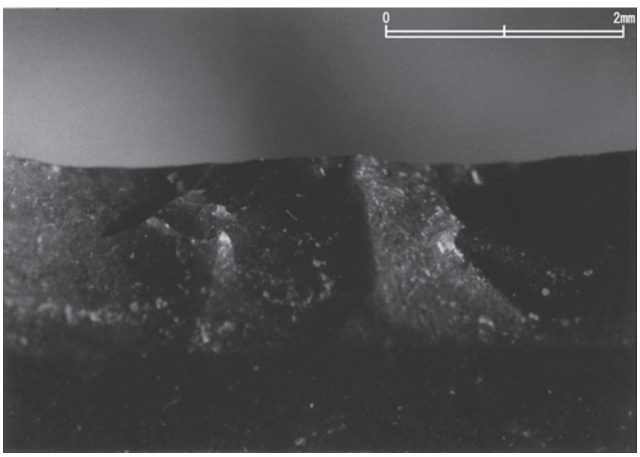
Figure 74. Experimental microflaking scars. (medium worked materials)



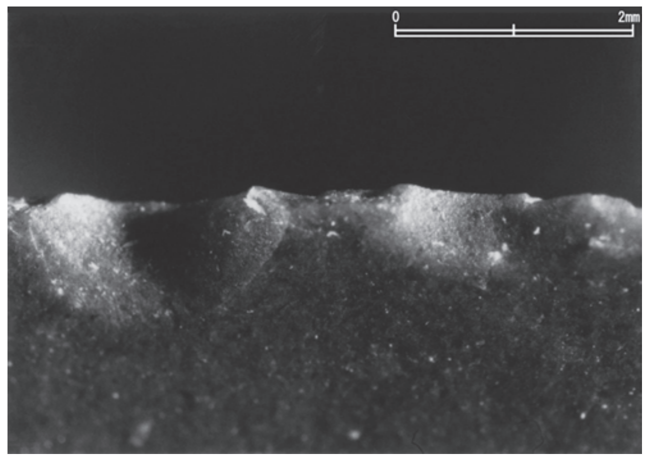
(1) 5.0-2. bamboo saw 2000st (SH79d) 8x



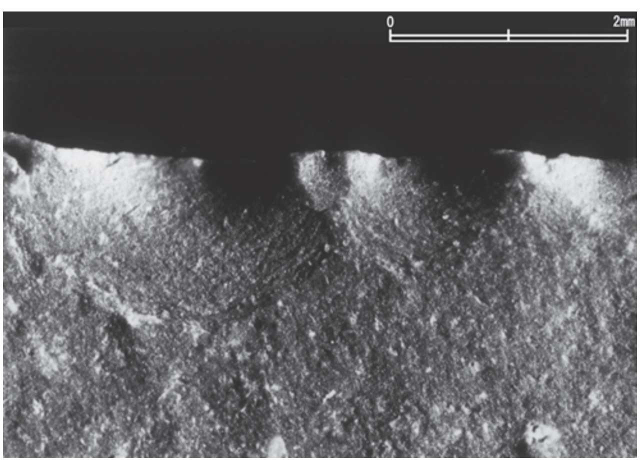
(2) 5.0-2.bamboo saw 2000st (SH79d) 8x



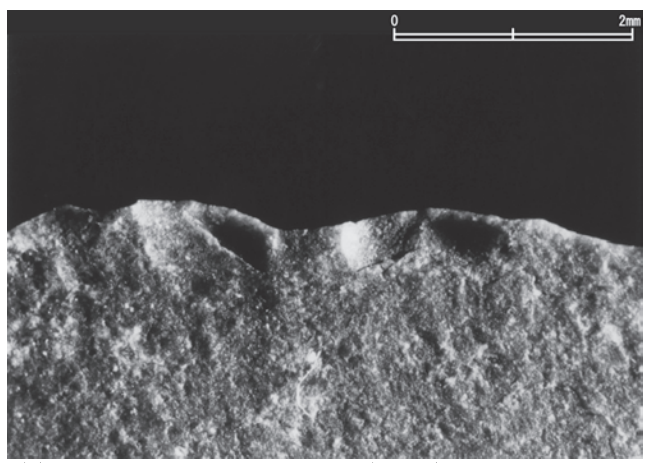
(3) 5.0-2. bamboo saw 2000st (SH79v) 8x



(4) 5.0-2. bamboo saw 2000st (SH79v) 8x

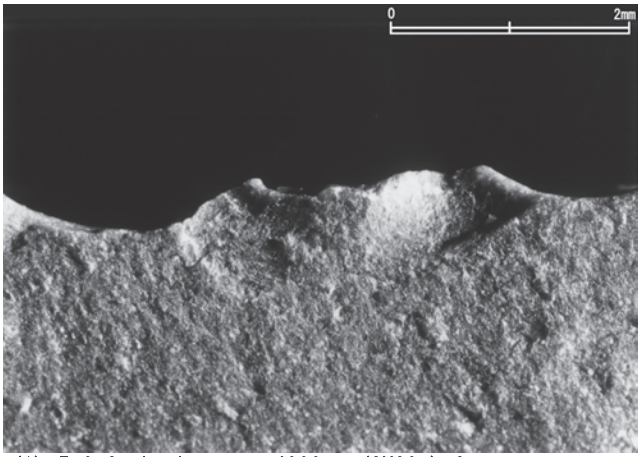


(5) 5.0-2. bamboo saw 4000st (SH80d) 8x

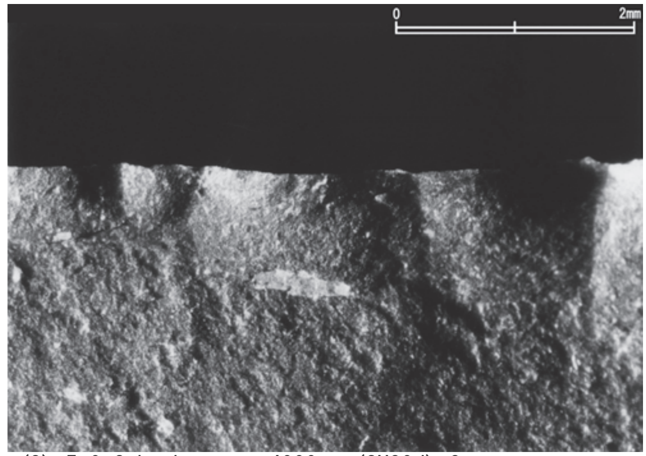


(6) 5.0-2. bamboo saw 4000st (SH80d) 8x

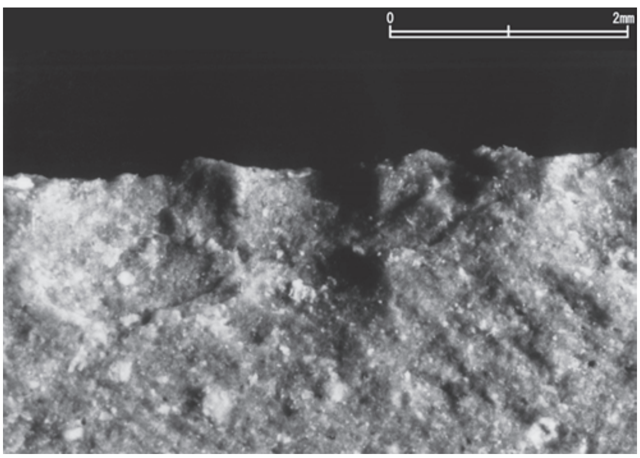
Figure 75. Experimental microflaking scars. (medium worked materials)



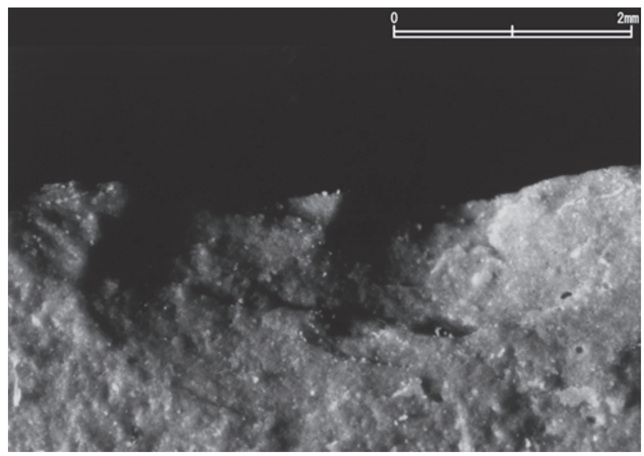
(1) 5.0-2. bamboo saw 4000st (SH80v) 8x



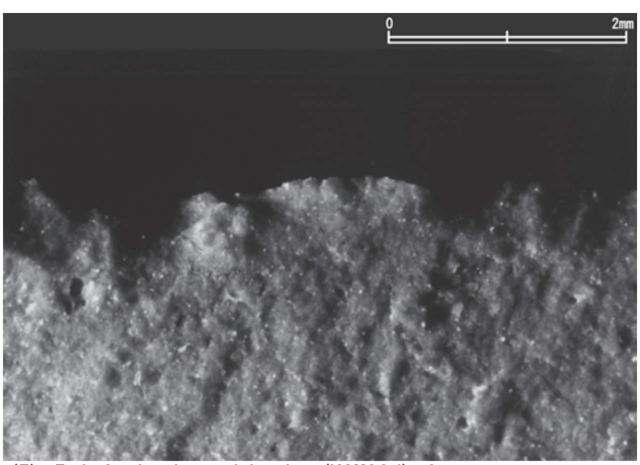
(2) 5.0-2. bamboo saw 4000st (SH80d) 8x



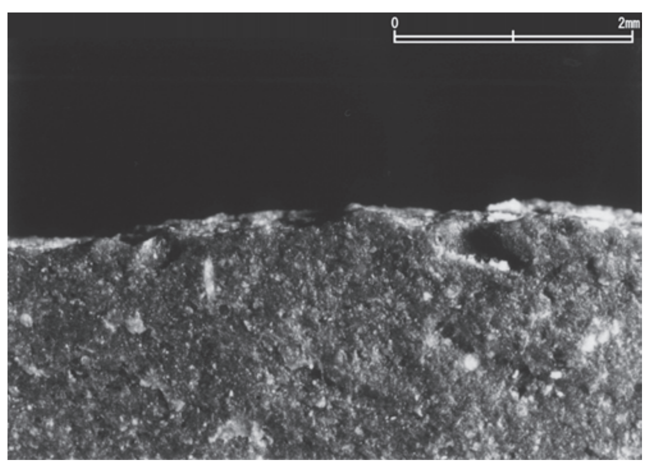
(3) 5.0-3. bamboo whittle (KSM21d) 8x



(4) 5.0-3. bamboo whittle (KSM23d) 8x

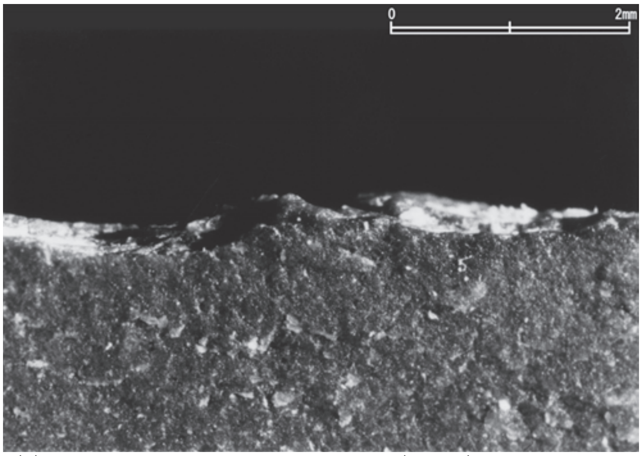


(5) 5.0-3. bamboo whittle (KSM23d) 8x

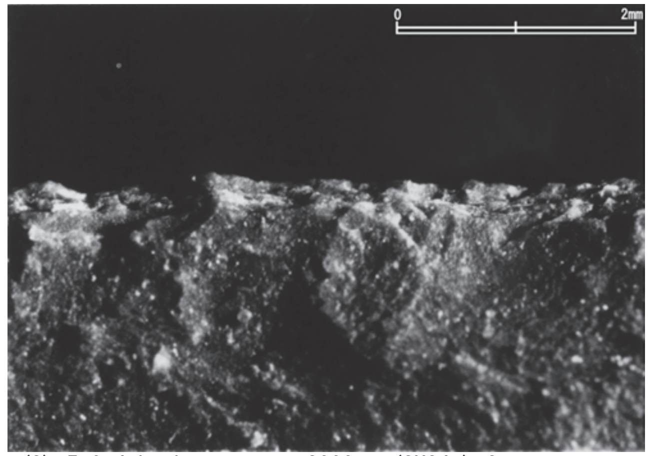


(6) 5.0-4. bamboo scrape 2000st (SH84d) 8x

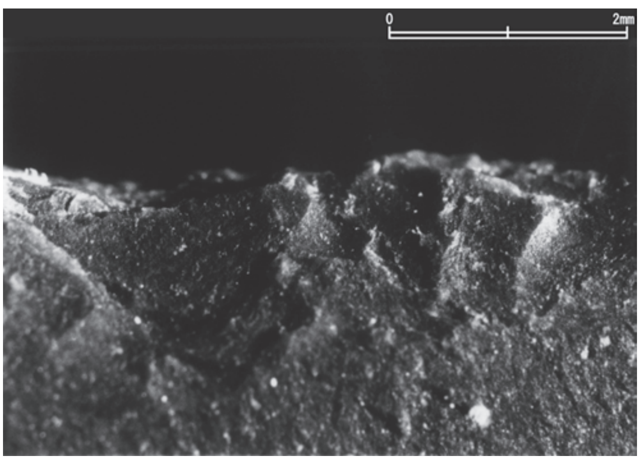
Figure 76. Experimental microflaking scars. (medium worked materials)



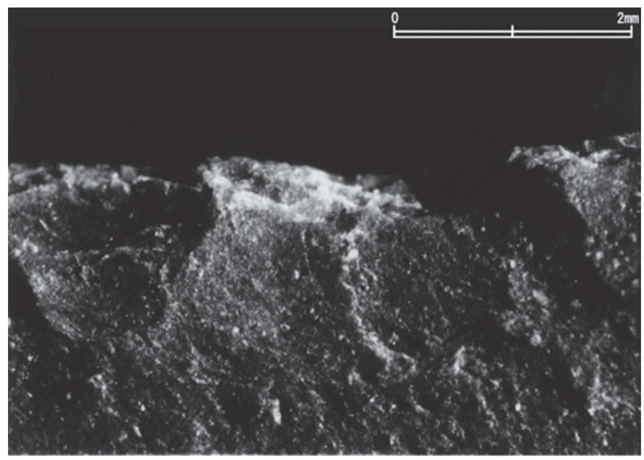
(1) 5.0-4. bamboo scrape 2000st (SH84d) 8x



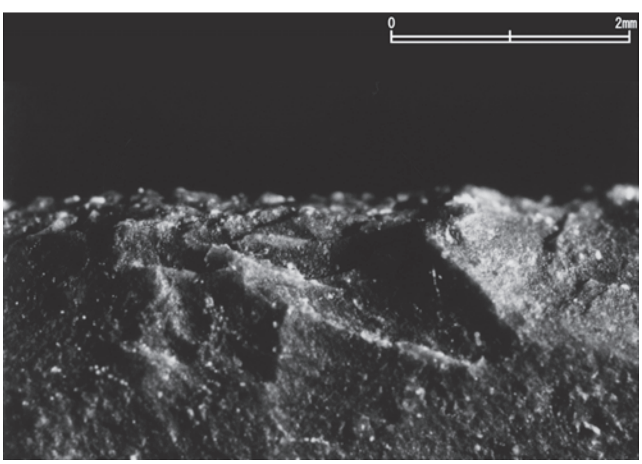
(2) 5.0-4. bamboo scrape 2000st (SH84v) 8x



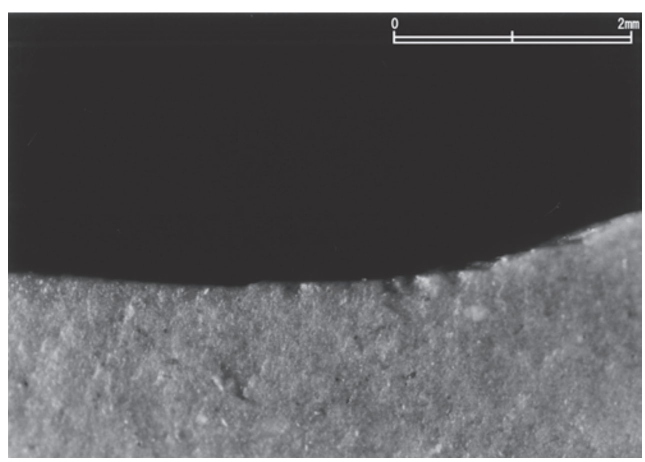
(3) 5.0-4. bamboo scrape 2000st (SH84v) 8x



(4) 5.0-4. bamboo scrape 2000st (SH84v) 8x

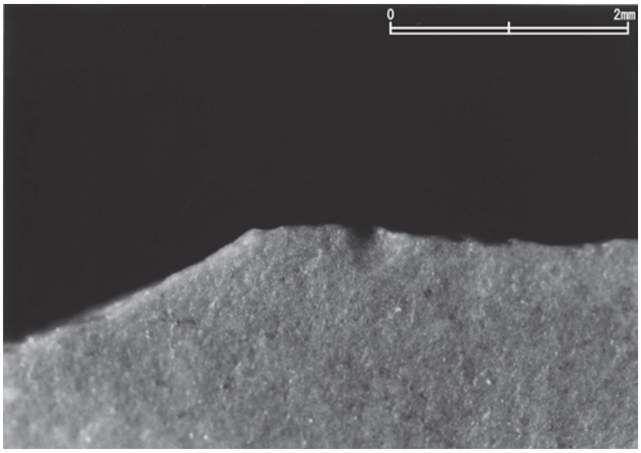


(5) 5.0-4. bamboo scrape (SH84v) 8x

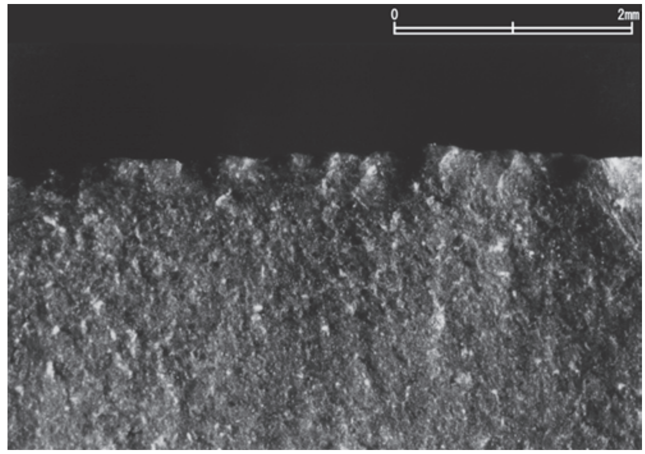


(6) 5.0-4. bamboo scrape 4000st (SH82d) 8x

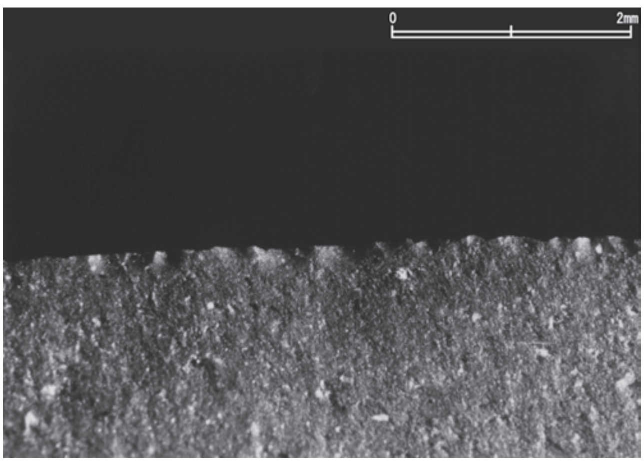
Figure 77. Experimental microflaking scars. (medium worked materials)



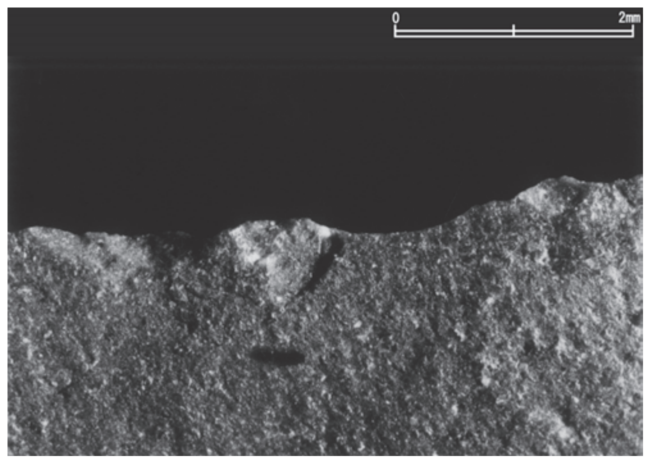
(1) 5.0-4. bamboo scrape 4000st (SH82d) 8x



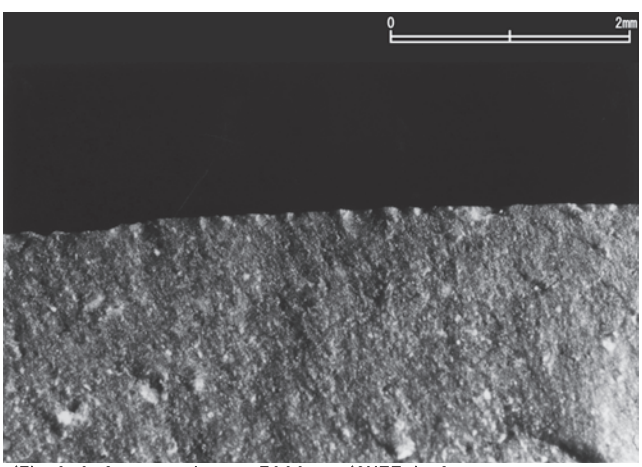
(2) 6.0-4. gourd saw 5000st (SH77d) 8x



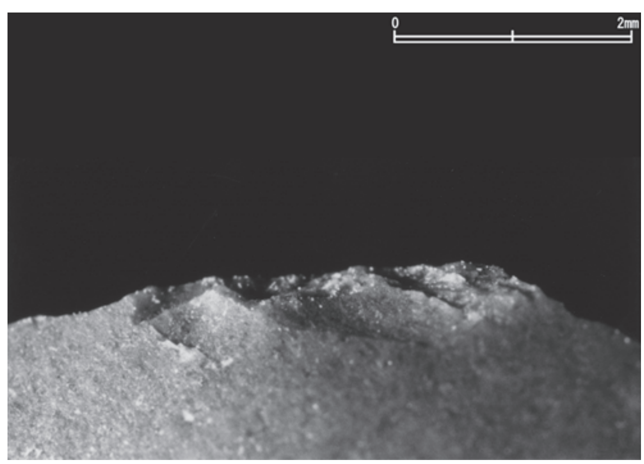
(3) 6.0-2. gourd saw 5000st (SH77d) 8x



(4) 6.0-2. gourd saw 5000st (SH77v) 8x

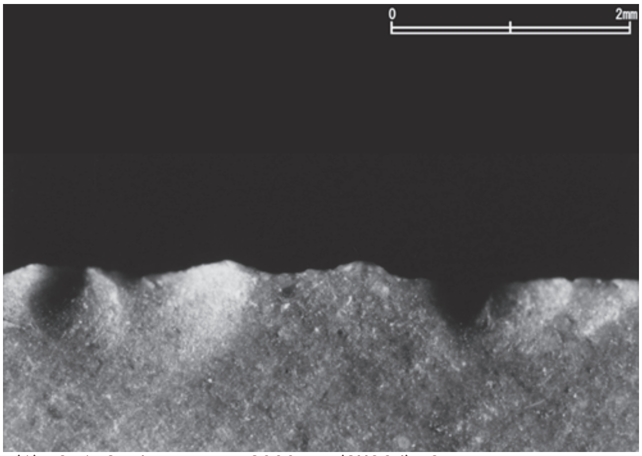


(5) 6.0-2. gourd saw 5000st (SH77v) 8x

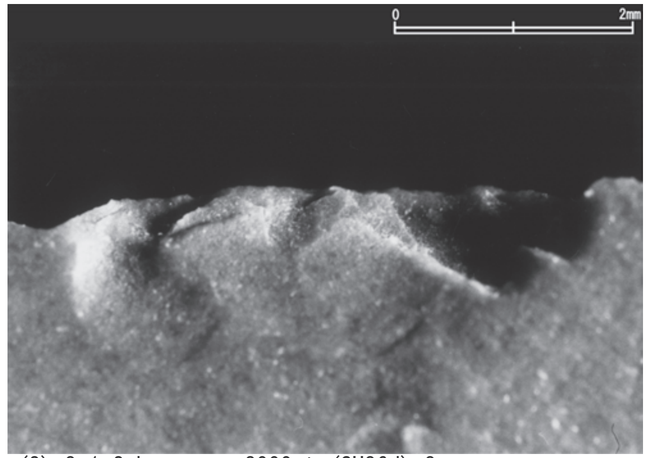


(6) 8.1-2. bone saw 3000st (SH86d) 8x

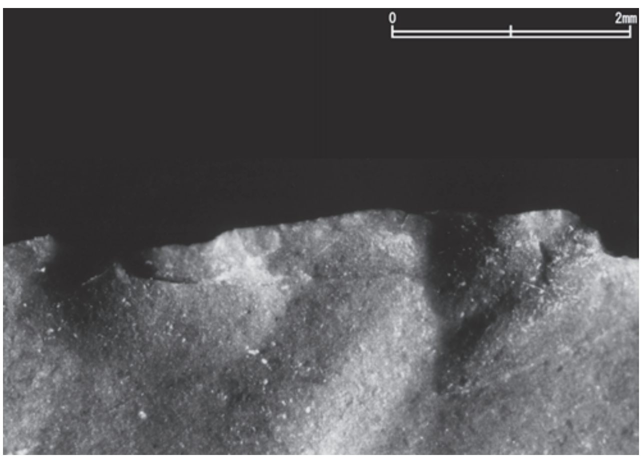
Figure 78. Experimental microflaking scars. (medium to hard worked materials)



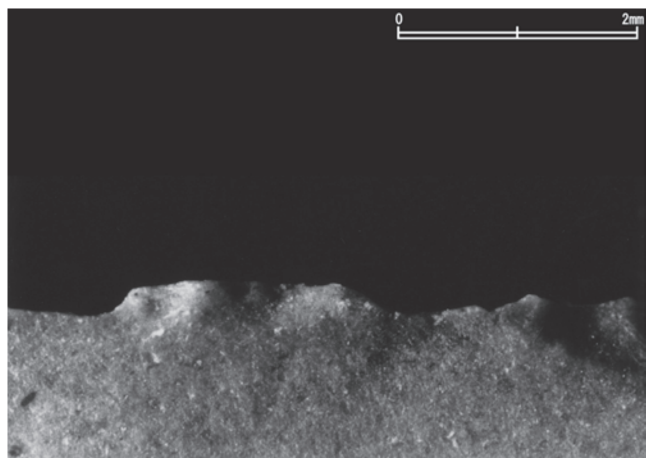
(1) 8.1-2. bone saw 3000st (SH86d) 8x



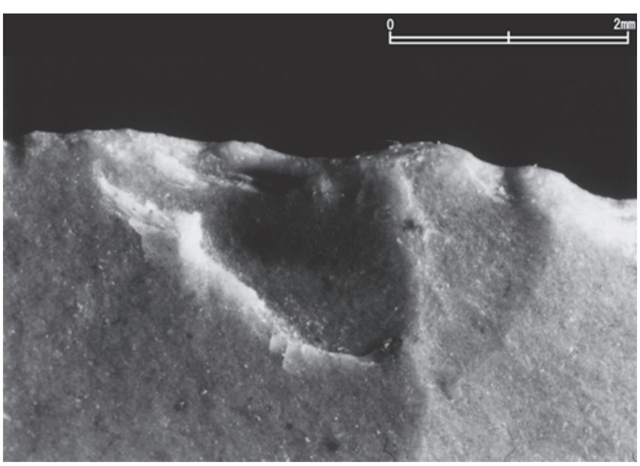
(2) 8.1-2. bone saw 3000st (SH86d) 8x



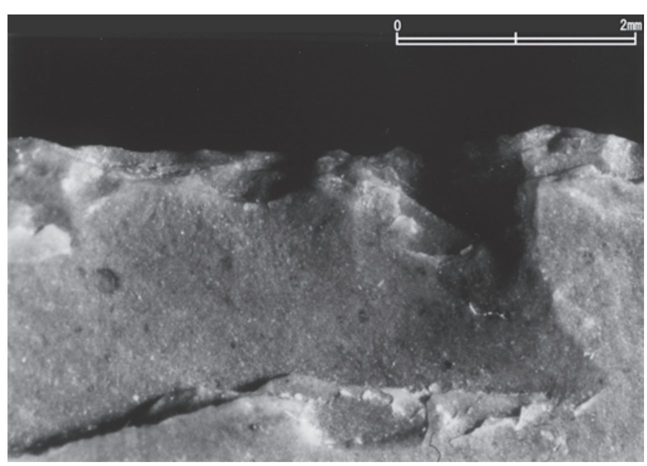
(3) 8.1-2. bone saw 3000st (SH86v) 8x



(4) 8.1-2. bone saw 3000st (SH86v) 8x

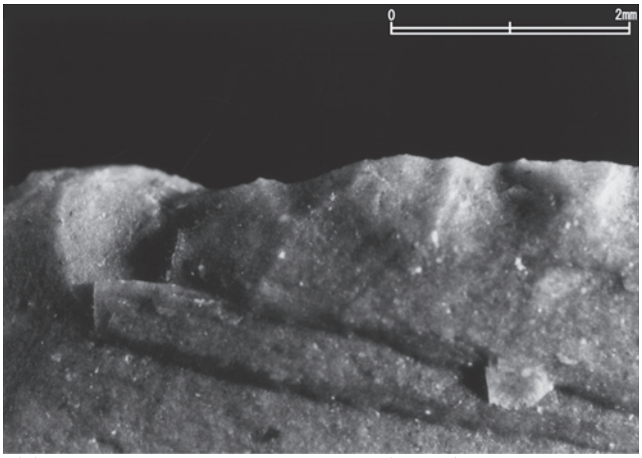


(5) 8.1-3. bone whittle 1100st (SH89d) 8x

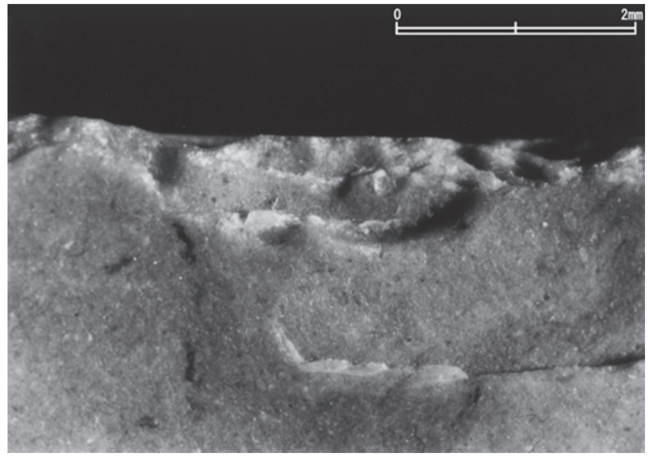


(6) 8.1-3. bone whittle 1100st (SH89d) 8x

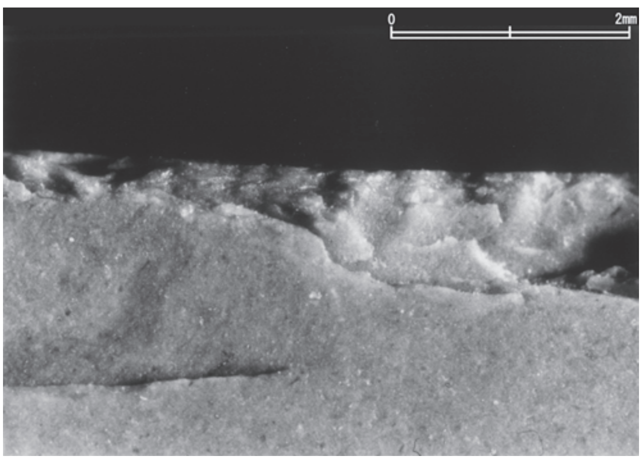
Figure 79. Experimental microflaking scars. (hard worked materials)



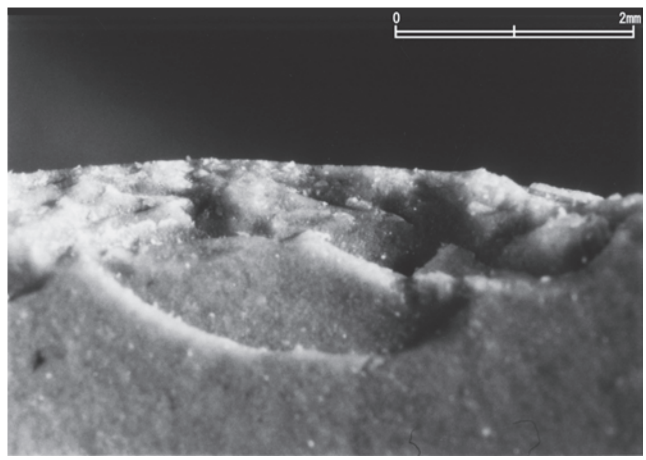
(1) 8.1-3. bone whittle 1100st (SH89v) 8x



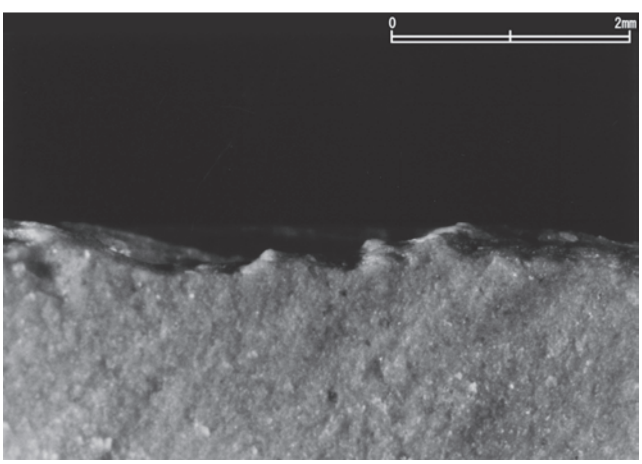
(2) 8.1-4.bone scrape 1000st (SH89d) 8x



(3) 8.1-4. bone scrape 1000st (SH89v) 8x



(4) 8.1-4. bone scrape 1000st (SH89d) 8x

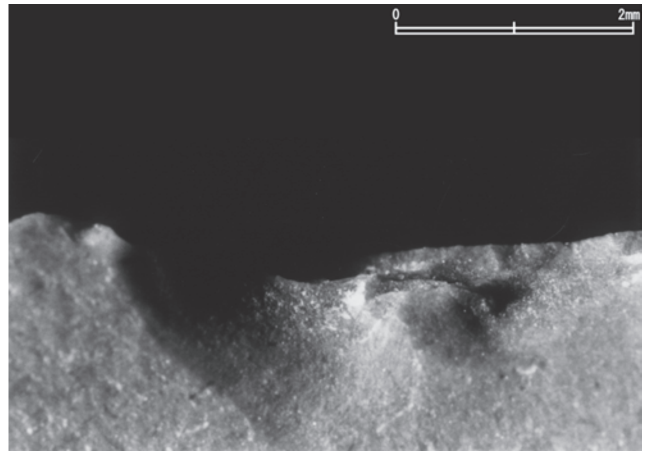


(5) 8.1-4. bone scrape 1000st (SH89v) 8x

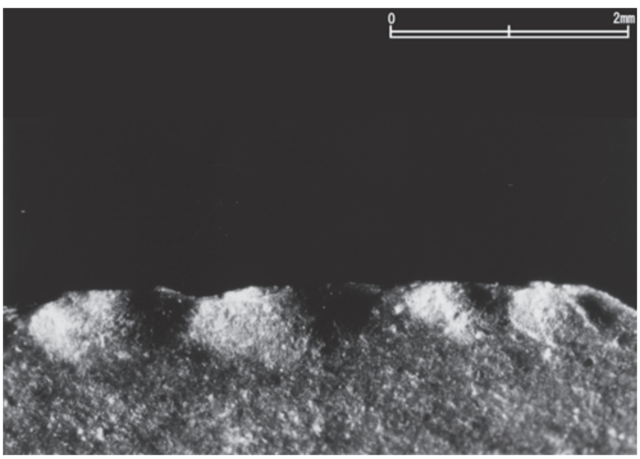
(6) 8.3-2. bone saw 500st (SH91) 3x

Figure 80. Experimental microflaking scars. (hard worked materials)

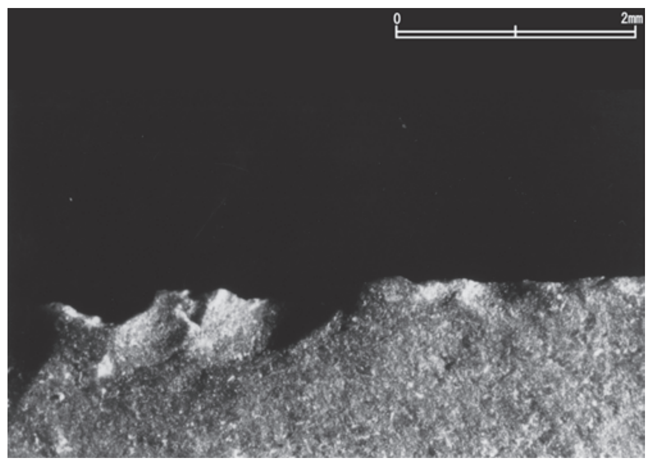
(1) 8.3-2. bone saw 500st (SH91) 3x



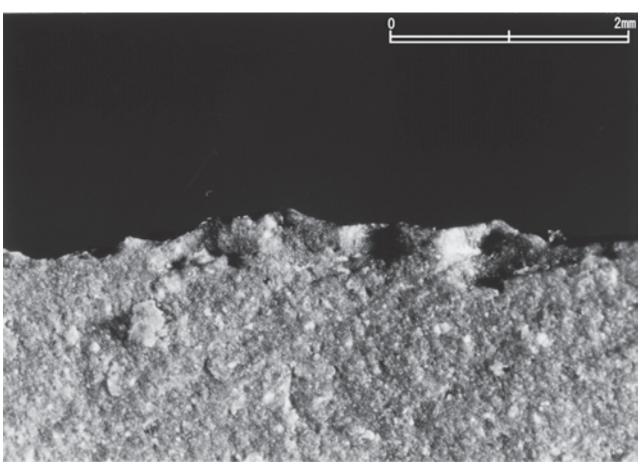
(2) 8.3-2. bone saw 3000st (SH86v) 8x



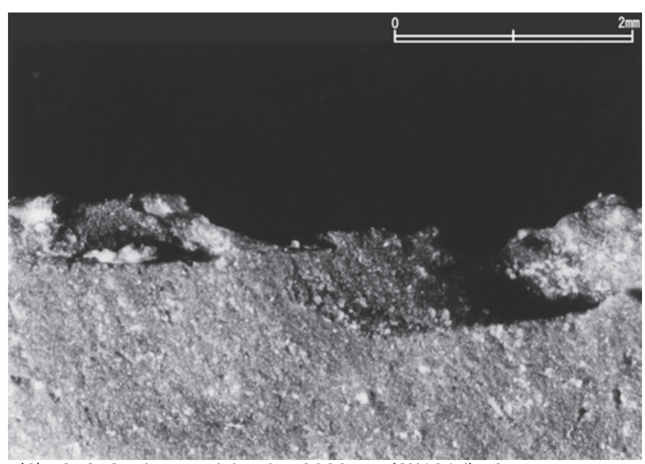
(3) 8.3-2. bone saw 5000st (SH92d) 8x



(4) 8.3-2. bone saw 5000st (SH92v) 8x

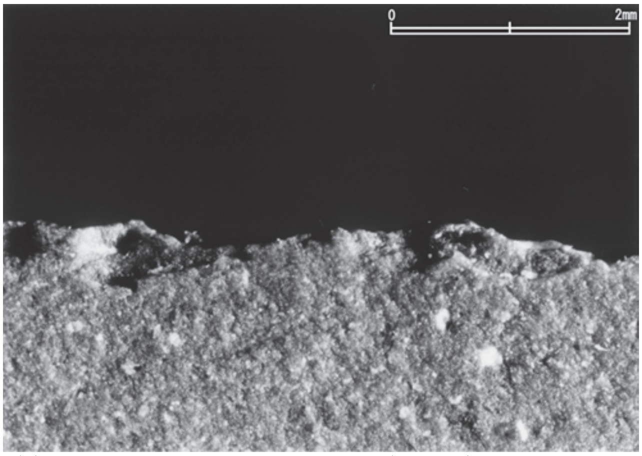


(5) 8.3-3. bone whittle 3000st (SH101d) 8x

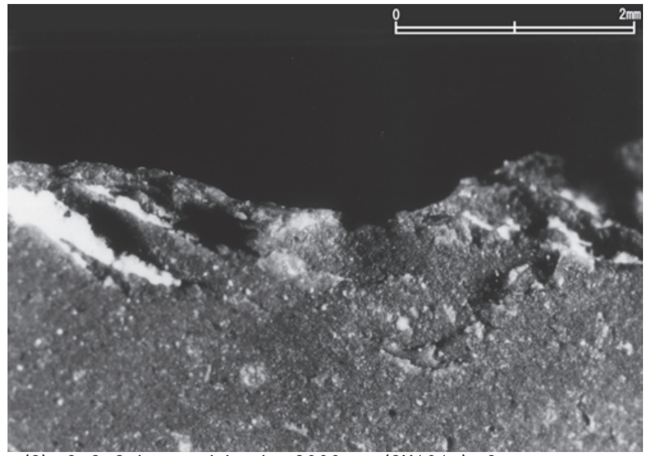


(6) 8.3-3. bone whittle 3000st (SH101d) 8x

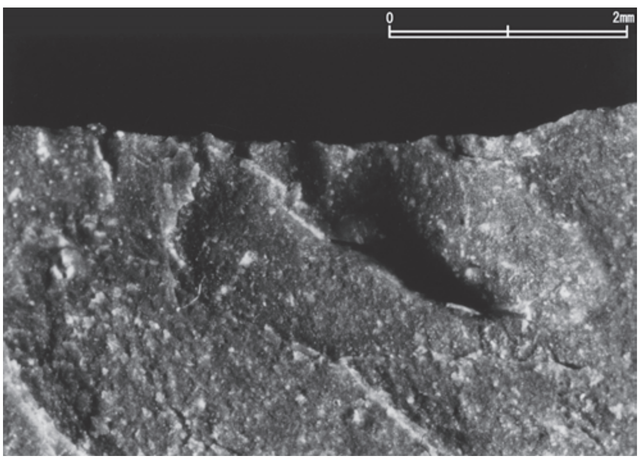
Figure 81. Experimental microflaking scars. (hard worked materials)



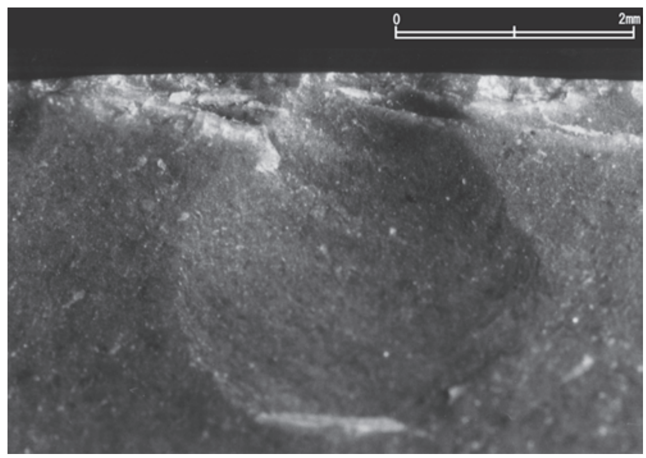
(1) 8.3-3. bone whittle 3000st (SH101d) 8x



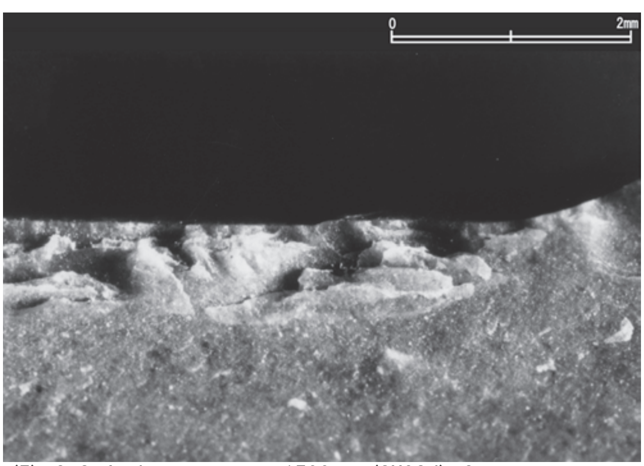
(2) 8.3-3.bone whittle 3000st (SH101v) 8x



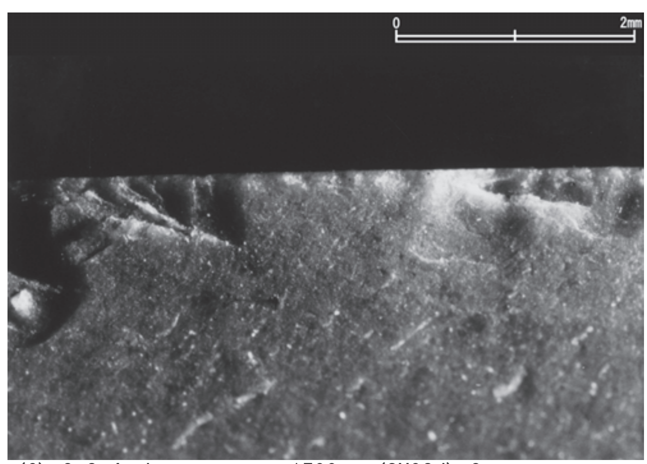
(3) 8.3-3. bone whittle 3000st (SH101v) 8x



(4) 8.3-4. bone scrape 1500st (SH93d) 8x

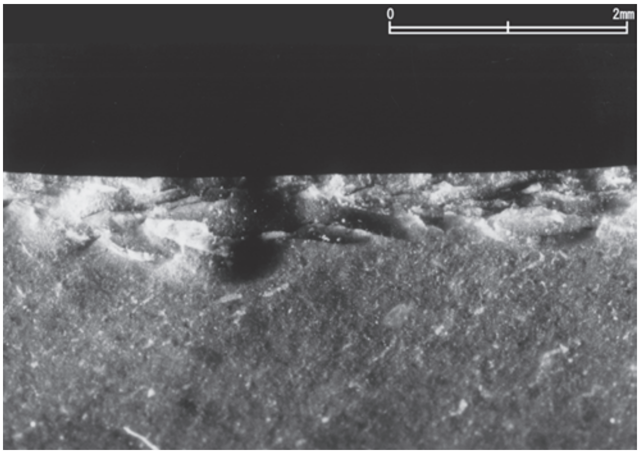


(5) 8.3-4. bone scrape 1500st (SH93d) 8x

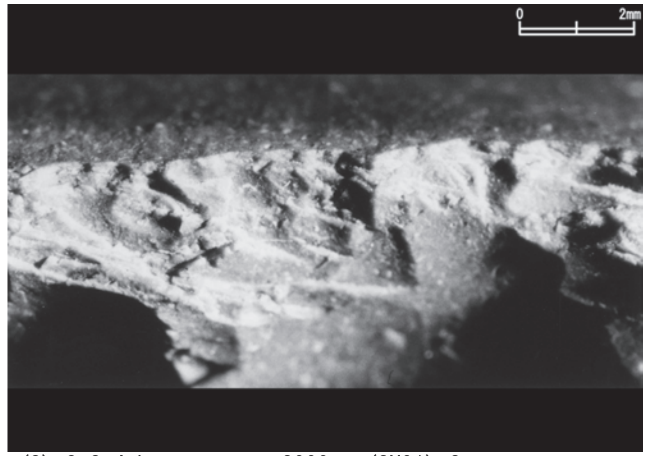


(6) 8.3-4. bone scrape 1500st (SH93d) 8x

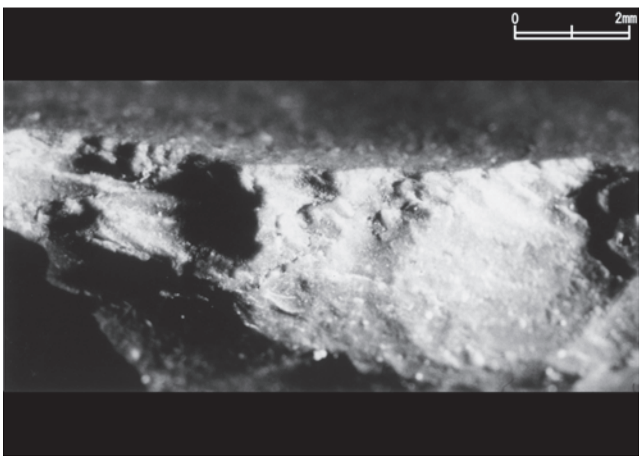
Figure 82. Experimental microflaking scars. (hard worked materials)



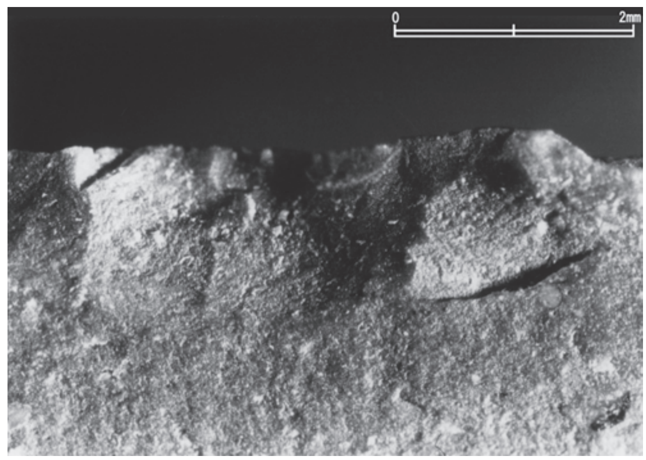
(1) 8.3-4. bone scrape 1500st (SH93d) 8x



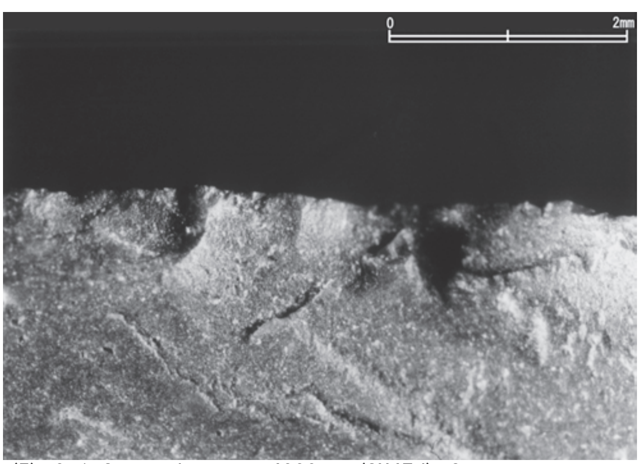
(2) 8.3-4. bone scrape 2000st (SH91) 3x



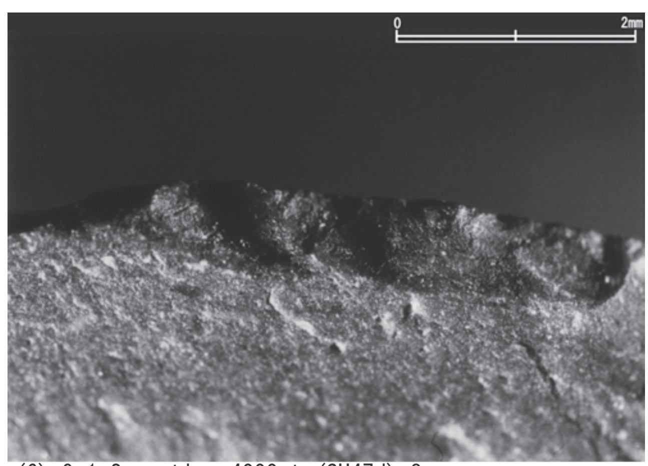
(3) 8.3-4. bone scrape 2000st (SH91) 3x



(4) 9.1-2. antler saw 4000st (SH47d) 8x

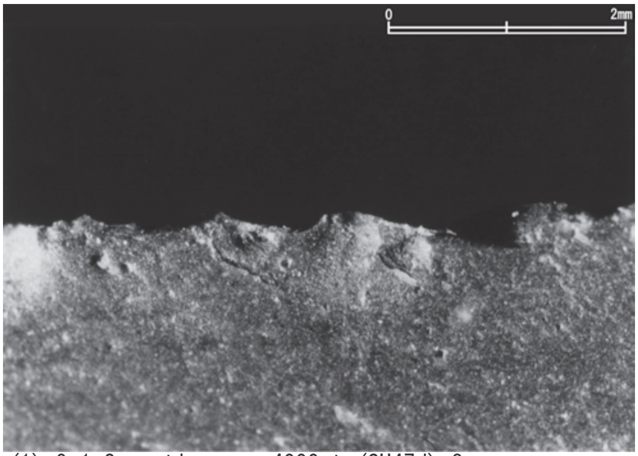


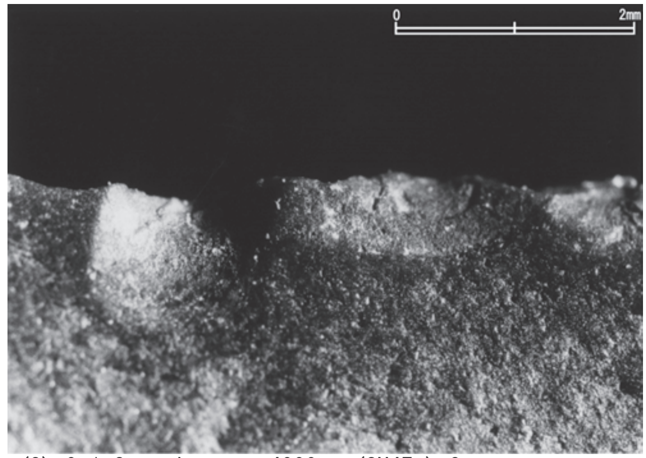
(5) 9.1-2. antler saw 4000st (SH47d) 8x

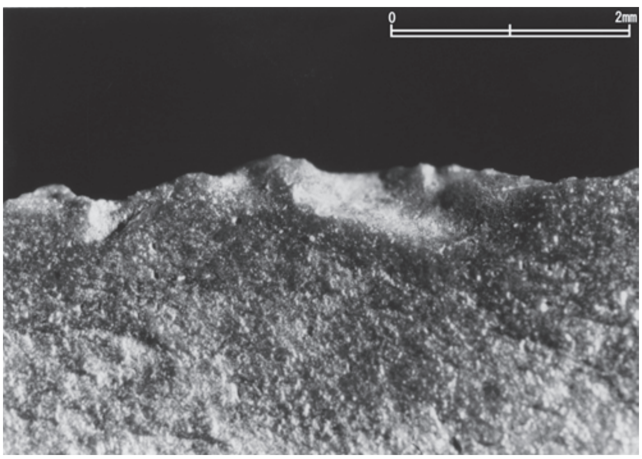


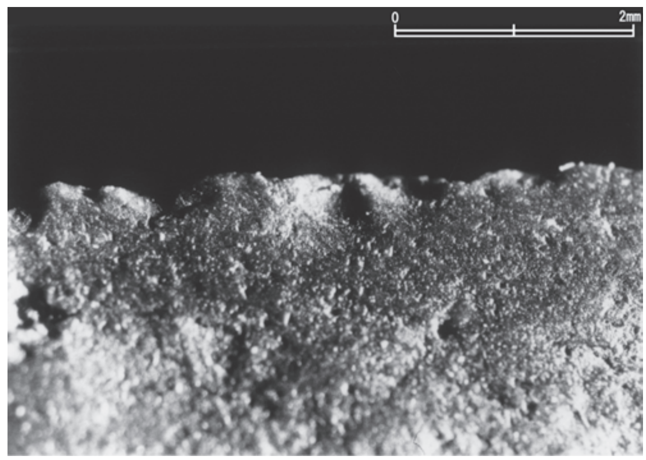
(6) 9.1-2. antler 4000st (SH47d) 8x

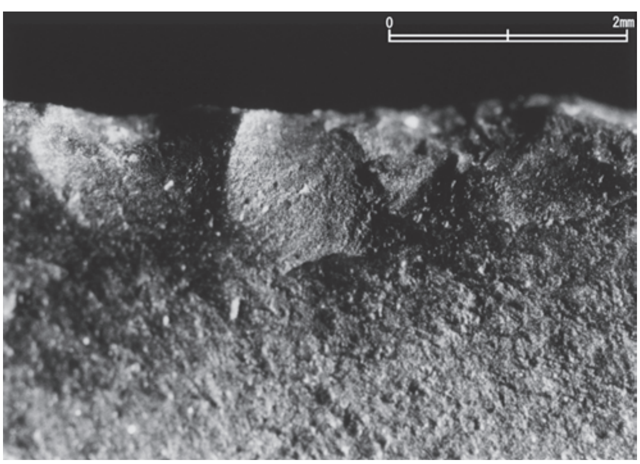
Figure 83. Experimental microflaking scars. (hard worked materials)


(1) 9.1-2. antler saw 4000st (SH47d) 8x


(2) 9.1-2.antler saw 4000st (SH47v) 8x


(3) 9.1-2. antler saw 4000st (SH47v) 8x


(4) 9.1-2. antler saw 4000st (SH47v) 8x


(5) 9.1-2. antler saw 4000st (SH47v) 8x

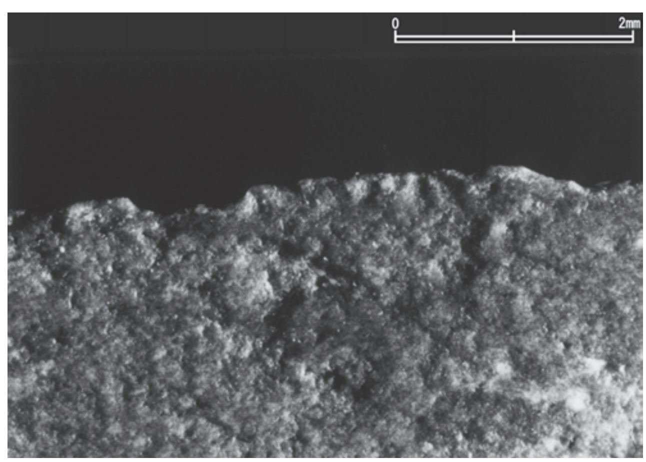
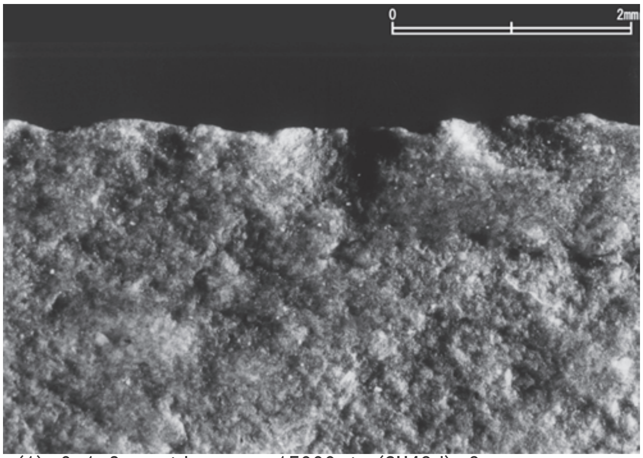
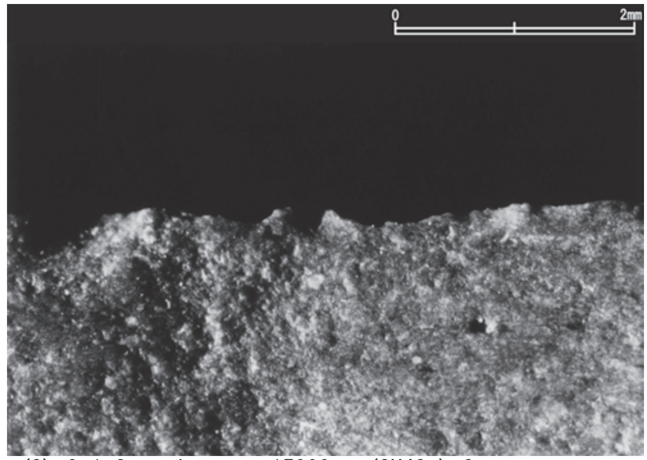

(6) 9.1-2. antler saw 15000st (SH48d) 8x

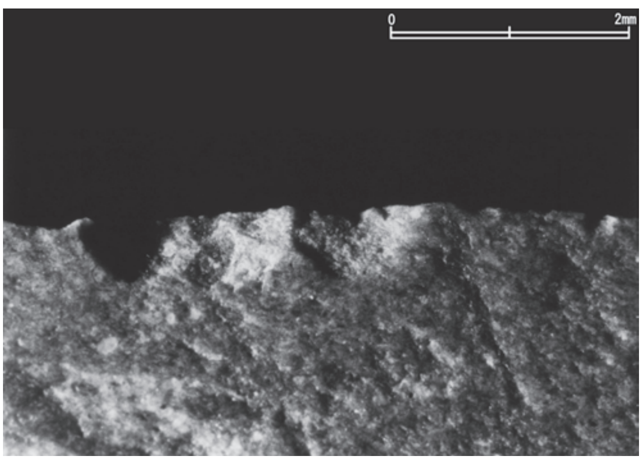
Figure 84. Experimental microflaking scars. (hard worked materials)



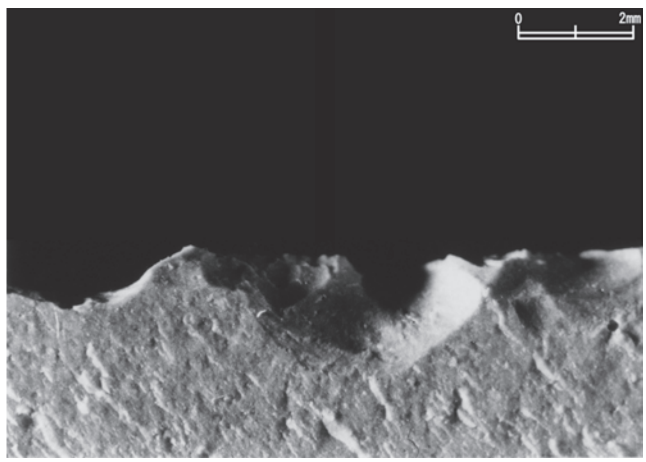
(1) 9.1-2. antler saw 15000st (SH48d) 8x



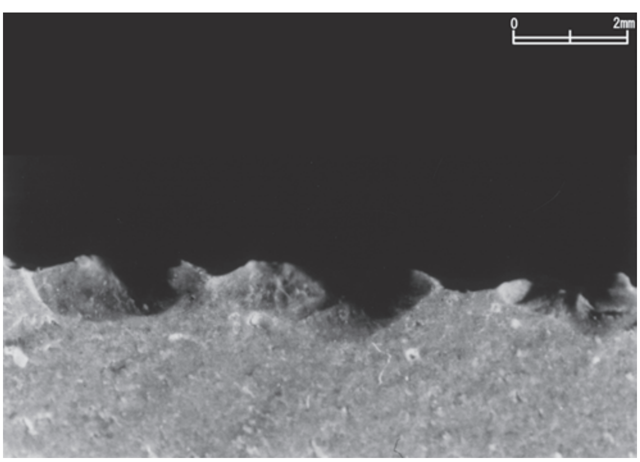
(2) 9.1-2. antler saw 15000st (SH48v) 8x



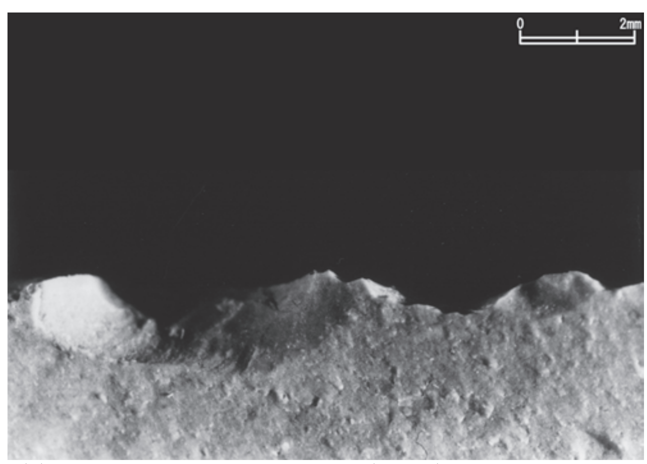
(3) 9.1-2. antler saw 15000st (SH48v) 8x



(4) 9.2-2. antler saw 1100st (SH71d) 3x

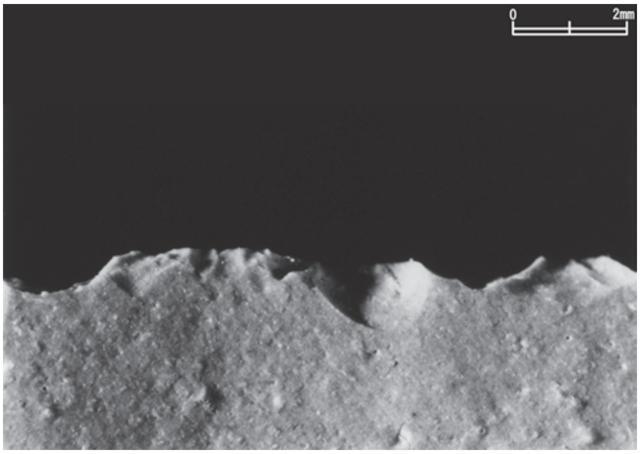


(5) 9.2-2. antler saw 1100st (SH71d) 3x

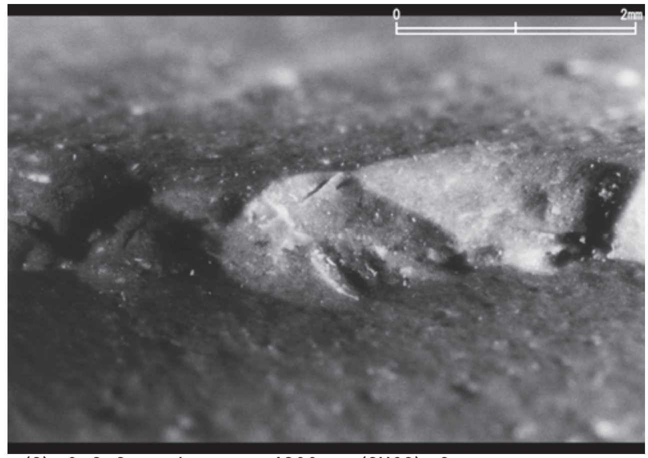


(6) 9.2-2. antler saw 1100st (SH71v) 3x

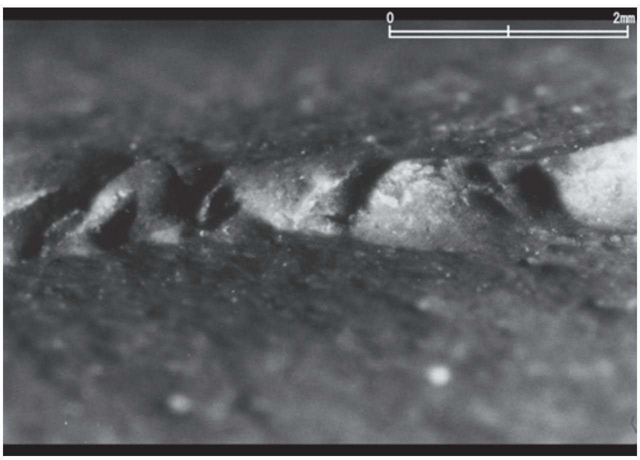
Figure 85. Experimental microflaking scars. (hard worked materials)



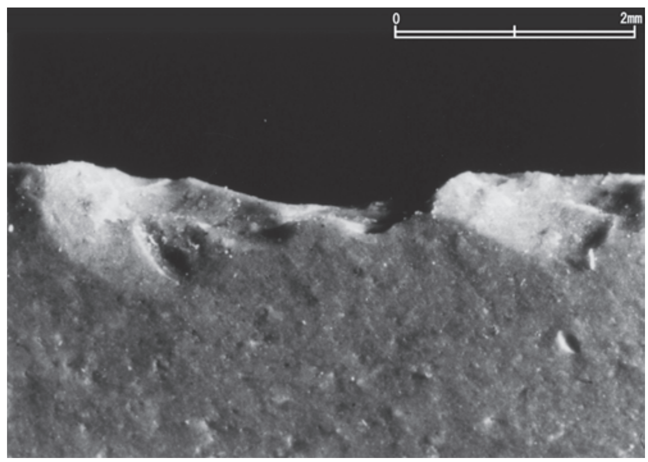
(1) 9.2-2. antler saw 1100st (SH71v) 3x



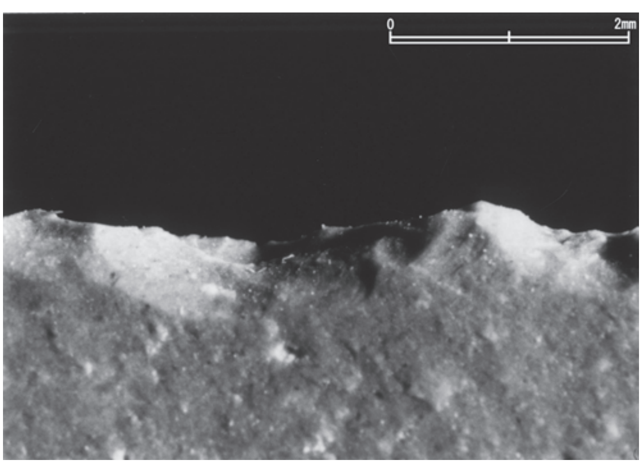
(2) 9.2-2.antler saw 4300st (SH68) 8x



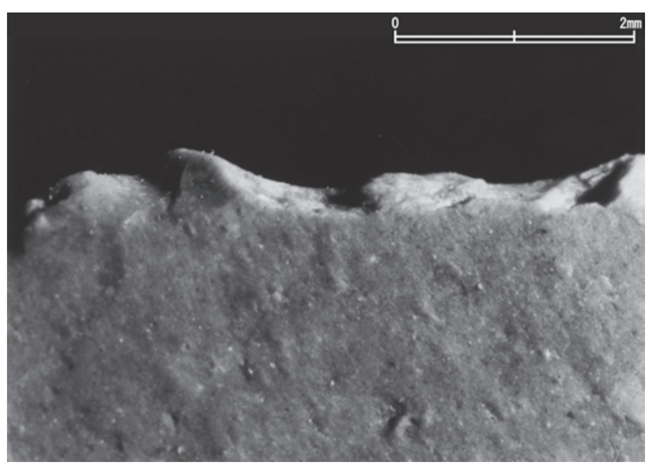
(3) 9.2-2. antler saw 4300st (SH68v) 8x



(4) 9.2-2. antler saw 4300st (SH68d) 8x

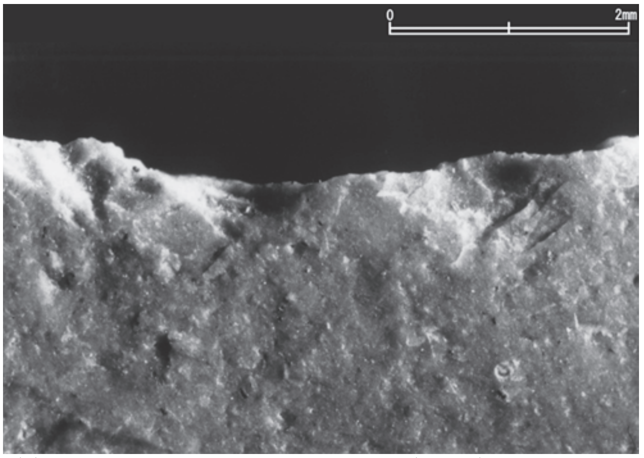


(5) 9.2-2. antler saw 4300st (SH68v) 8x

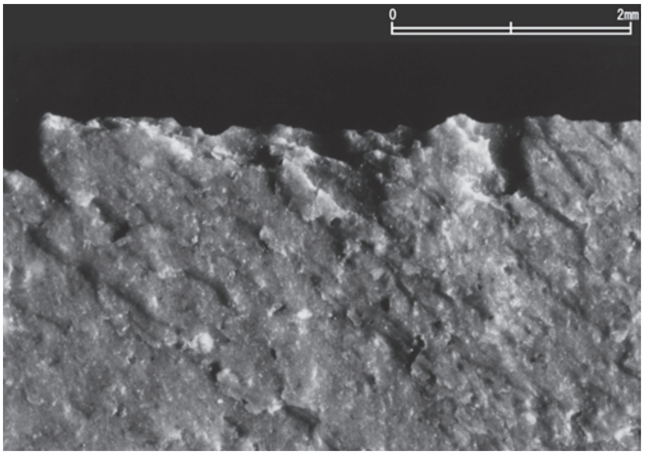


(6) 9.2-2. antler saw 4300st (SH68v) 8x

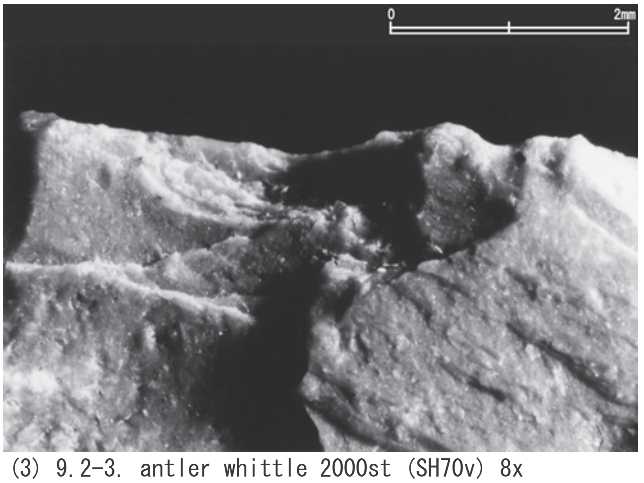
Figure 86. Experimental microflaking scars. (hard worked materials)



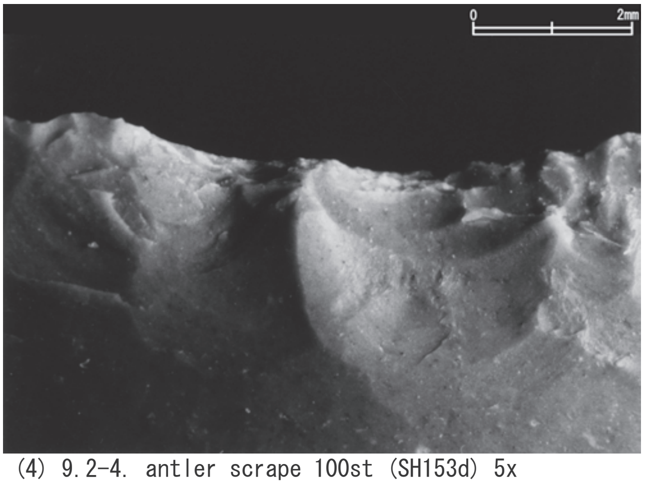
(1) 9.2-3. antler whittle 2000st (SH70d) 8x



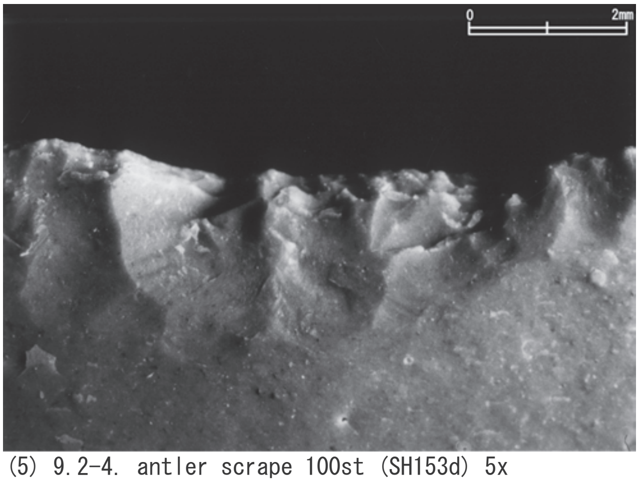
(2) 9.2-3.antler whittle 2000st (SH70v) 8x



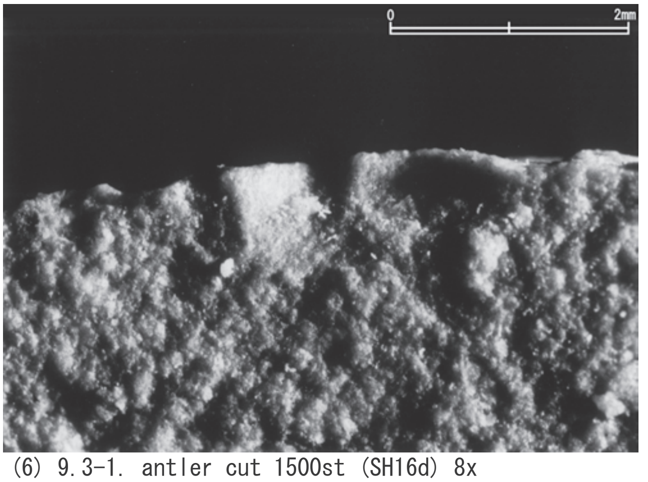
(3) 9.2-3. antler whittle 2000st (SH70v) 8x



(4) 9.2-4. antler scrape 100st (SH153d) 5x

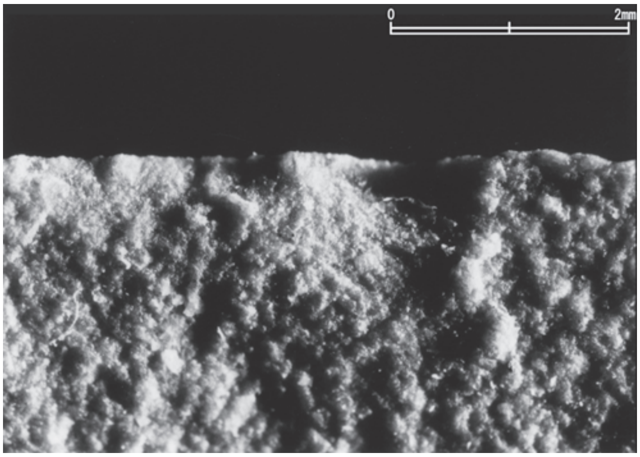


(5) 9.2-4. antler scrape 100st (SH153d) 5x

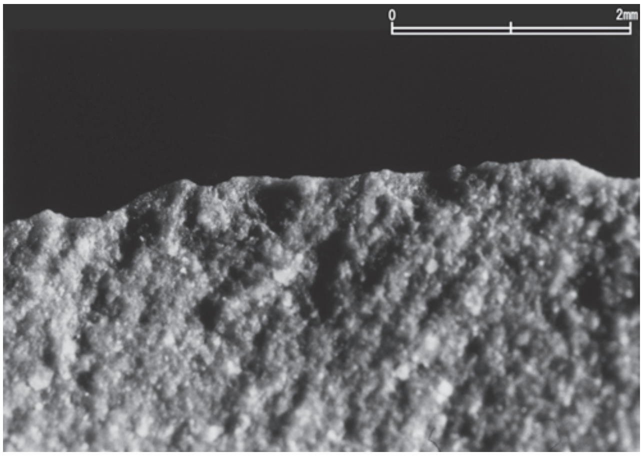


(6) 9.3-1. antler cut 1500st (SH16d) 8x

Figure 87. Experimental microflaking scars. (hard worked materials)



(1) 9.3-1. antler cut 1500st (SH16d) 8x



(2) 9.3-1. antler cut 1500st (SH16v) 8x

Figure 88. Experimental microflaking scars. (hard worked materials)