RIBAR HIGH 2 GROUND STONE TOOL ANALYSIS

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In 2006, while building a road for timber harvesting on a ridge in Humboldt County, California, the construction crew turned up a scatter of Native American artifacts. A rescue excavation and survey conducted by the Cultural Resources Facility headquartered at Humboldt State University collected several hundred lithic artifacts. Most of these were debitage associated with flintknapping, but 29 ground stone tools were also recovered. Archaeological information about northwest coastal tribes is scant, especially information on ground stone technology. Obsidian hydration studies and diagnostic projectile points revealed that the site was used from approximately 3,000 to 260 years before present. Using methods advocated by Jenny L. Adams in her book Ground Stone Analysis: a Technological Approach, *nine representative ground stone forms were selected for in-depth analysis. This paper reports both a synopsis of Adams' methods and the result of their application to this assemblage. Furthermore, the analysis is tied to ethnographic information which places the tools and their users in cultural context with the intent to illuminate subsistence, craft, and occupation patterns.*

In 2006 while building a road for timber harvesting, a construction crew working for Green Diamond Resource Company turned up a scatter of Native American artifacts. The site, dubbed Ribar High 2 (CRF-RH-02; THP 1-06-056 HUM), was excavated as a rescue operation in June and July of that year by the Center for Indian Community Development - Cultural Resources Facility (CICD-CRF) headquartered at Humboldt State University (HSU). Obsidian hydration studies done on 13 lithic flakes gave dates ranging from 3246 B.P. to 259 B.P. (Whiteman et al. 2007). This paper focuses on the 29 ground stone artifacts recovered from the site. Laboratory analysis and methodology are emphasized, with the intent to illuminate subsistence, craft, and occupation patterns.

Ribar High is located on a ridge near tiny Fieldbrook, California, in Humboldt County, with the nearest water source, a spring, approximately 70 m (as the crow flies) down a 50- to 60-degree hillside from the roadbed. The CICD-CRF crew surveyed an 11-acre site by transects and collected artifacts mainly from the surface. The collection criteria were threefold: 1) the artifact was diagnostic, 2) it was visually obvious (this is to deter probable looting at a later date), and 3) it helps to preserve a substantial surface record. The CICD-CRF crew also dug three types of subsurface units: nine shovel test pits, two controlled manual excavation units, and one rapid-recovery unit, all in the vicinity of the timber road. While these units were excavated to a maximum depth of 100 cm, most of the artifacts were found from 0 to 60 cm. The preponderance of artifact types were flakes, fragments, and shatter resulting from flake tool manufacture. Only two small ground stone artifacts were collected from the excavation units; the rest were surface collections (Whiteman et al. 2007).

ETHNOGRAPHIC BACKGROUND

This site is located in an area near the boundary between the traditional Wiyot and Whilkut territories (Whiteman et al. 2007). Both were sedentary hunting and gathering societies who lived in villages along watercourses and took advantage of the varied resources of the surrounding countryside. The Wiyot territory was around Humboldt Bay with its associated estuaries and prairies and at the mouths of the Mad and Eel rivers. Fishing in the rivers and ocean figured prominently in their subsistence strategy, but they also made forays into the hills to hunt and gather (Wiyot Tribe 2010). The Whilkut territory was on the middle and north forks of the Mad River and along Redwood Creek. They lived in broken, rugged, heavily forested country. They also fished in the rivers running through their territory as well as taking advantage of terrestrial resources. These two peoples were hostile to each other. According to Wallace, this hostility was often over the trespass of Wiyot women into oak groves considered to belong to the Whilkut. The Whilkut would go so far as to kill Wiyots found gathering in their territory, which led to reprisals by the Wiyot men and spawned blood feuds (Wallace 1978). The site is on a ridge far from a river or creek; therefore Ribar was most likely a seasonal work camp situated to take advantage of hill country resources. This pattern of village living combined with offsite seasonal working camps was practiced by the nearby Hupa (Wallace 1978).

The Hupa and Whilkut were both Athapaskan speakers, with Whilkut considered a dialect of Hupa. It is probable that Athapaskan speakers migrated from the north into the Humboldt area approximately A.D. 1300 (Wallace 1978). The site was probably used by either the Whilkut or Wiyot (but not shared) in the latter portion of the use dates. This would be the time period called the Late or Emergent period (1100 to 150 B.P.), which is characterized by Tuluwat-pattern projectile points identified ethnographically with the Wiyot, Yurok, Tolowa, and other Northwest Coast tribes. Tuluwat points were found at Ribar High 2 (Whiteman et al. 2007).

The Wiyots and Yuroks both spoke Algic languages which belong to a widespread group extending from Massachusetts across the northern U.S. and Canada to northern California (with only Wiyot and Yurok on the west coast) (Elsasser 1996). According to Whistler (1979), the Wiyot most probably migrated to California from the north around A.D. 900 and settled in the lower Klamath River area. They were later displaced by a subsequent southward migration of the Yurok and moved to their historic Humboldt Bay territory ca. A.D. 1100 (as cited in Moratto 1984).

Since both the obsidian dates and diagnostic projectile points found at Ribar demonstrate a much deeper chronology, there were undoubtedly other, older groups who also used the site. The diagnostic points include Borax Lake Widestems (6000-3000 B.P.), Oregon series points, Willits series points, and Trinity Variants (3000-1500 B.P.). In the site report, the authors assert that based on their analysis it is most likely that Ribar was used primarily during the Lower Archaic to Middle Archaic periods (6000-1300 B.P.), with less intensive occupation during the Late period (1300 B.P. to contact) (Whiteman et al. 2007).

RESEARCH GOALS

If the site was a seasonal work camp, what was the nature of the work? This question was uppermost on my mind when I undertook to study the ground stone artifacts collected at Ribar High 2. The most common artifact types recovered were flake shatter and debitage, with a few cores, unifaces, bifaces, and finished projectile points in various stages of repair. It was obvious that they were making flaked stone tools at the site, but what of the ground stone? Some could be hammer stones used to strike the obsidian and chert material used in the production of the flake tools. Some could be manos, while others were obviously nether stones used for seed or acorn processing. But most of them were somewhat mysterious. From the 29 tools in the assemblage, I selected nine which represent different design types for detailed analysis. With the direction of Jenny L. Adams (2002) in her book *Ground Stone Analysis: A Technological Approach*, some ethnographic sleuthing, and a dash of imagination, I will endeavor to solve some of the mystery.

METHODS

The basic ideas behind Adams' analytical method are that through microscopic examination of the surface of the artifacts and consideration of design, one can induce their original use, leading to information about the technological traditions and cultural behavior of the society represented by the archaeological site. This is done by experimental archaeology in which the researcher replicates the probable use of the tool with new stone modified by traditional techniques and then looks at the pattern of smoothing, breakage, fracturing, etc. on the grains in the rock. Another way to determine use signatures and design analogs is by examining stone tools currently used by native peoples—that way the researcher knows exactly what functions were performed with the tools which resulted in a specific use-wear pattern. Adams also advocates standard classification of artifact types and descriptions so that finds may be compared over regions and time. She cautions the reader about interpretation: all that we know about these tools and their usage is based on analogy and is therefore a best guess, and form does not always dictate function. For instance, one time she was classifying manos according to size and number of used surfaces, calling one type one-hand and the other two-hand manos when she received a visitor in the lab. The visitor was a Hopi, Willie Coin, a colleague from another division of their enterprise. He observed her efforts and remarked that he had not seen tools like the one-hand manos since he stopped making moccasins. She asked him how he would have used manos to manufacture moccasins. He replied that they were not manos, but were used to remove hair and soften hides. This made her think about how to distinguish hide-processing stones from manos, or, for that matter, mortars from bowls (similar size and shape) (Adams 2002:7).

The technological approach to artifact analysis is based on three underlying paradigms: design theory, fuzzy set theory, and damage patterns due to use-wear. Design theory addresses how form reflects function. It entails considerations of materials, how they were altered (or not), and how a tool was used or reused. For instance, costs of manufacture, how far to the stone source, and how much time the tool maker wants to invest in manufacture will dictate design. How the tool would be used, either intensively, which is for a long period in any one work session, or extensively, which is for shorter durations over a larger number of work sessions, may dictate the presence of comfort features. A comfort feature, such as hand grips, is an indication of intensive use. There are also tools of expedient design, for which the native stone had the right shape and was collected and used with very little pre-use modification. This is contrasted with strategically designed tools which are specifically manufactured for their functions. Design considerations can guide the analyst in determining if a tool was redesigned or reused after its original function was exhausted or if the tool had two concomitant functions (Adams 2002:8-9).

Fuzzy set theory addresses classification of artifacts. Adams makes a distinction between classifying, which is creating categories and sorting objects into them, and analysis, which is "the act of examining a complex item, and, on the basis of the relationship of its individual elements, deciding to which category or categories it belongs" (Adams 2002:12). Classic "crisp" set theory is based on the idea of dichotomous classification: the characteristics of the object either fits it to the set or it doesn't; everything is either yes or no, black or white, no maybe or shades of grey. There is always uncertainty surrounding the original use of artifacts collected at archaeological sites, especially those of peoples with no direct ethnographic data, so that the analyst must necessarily deal with many shades of grey; this is where fuzzy sets can help. Fuzzy set theory allows an artifact to be placed in multiple categories depending on its varied characteristics. She starts with two broad sets, hand stones and nether stones, which overlap in the middle to create the fuzzy set of lap stones. Nether stones are stones which are worked against and are generally larger than the other two sets (there are exceptions such as handheld pebble mortars). Lap stones can easily be transported, can fit in one's lap, and may be worked with or against. The hand stone set includes stones worked against something else and are generally cobble-sized or smaller. These larger sets may be as far as one can categorize some items based on gross morphology; further analysis is needed which leads us to the concept of use-wear patterns (Adams 2002:13-14).

Use-wear is based on the macroscopic and microscopic observation of the asperity and topography of an artifact. Asperity is a combination of the texture and granularity of a material and is influenced by its durability. A coarsely grained rock will naturally have more asperity than a fine grained stone. A loosely cemented sandstone will retain its asperity longer than a harder, fused volcanic stone because the grains of the sandstone are constantly dislodged by use so the surface asperity is renewed as the stone wears away. The more durable volcanic stone, by virtue of its grains being fused to each other, resists losing grains so that they are simply worn smooth by use and its asperity must be restored by pecking if the tool is to remain an efficient abrader. Also, each individual grain jutting up from the basal matrix of the stone as seen microscopically is termed an asperity, with the spaces between grains called interstices. The patterns resulting from use are seen in both the interstices and the asperities and give clues about the nature of the interacting substances. For instance, a stone used to process soft materials, such as hides, will show smoothing in the interstices because the soft hide can conform itself to fit between asperities. Conversely, a stone used to process hard materials, such as ceramic fluxes, will show mostly damage to asperities because the hard materials only graze the highest points of the surface microtopography. Topography is an expression of the relief of the surface of the artifact, that is, the difference between the lowest point and highest point on the surface (Adams 2002:27-28).

There are four basic types of wear: adhesive, abrasive and fatigue wear, which are reductive; and tribochemical, wear which is additive to the surface. When two surfaces come into contact, even if they are stationary, molecular bonds are formed. Movement of one surface against another creates and breaks these bonds which in turn releases energy in the form of frictional heat and loosens rock grains on one or both surfaces: this is *adhesive wear*. The loosened rock grains either become attached to another part of their original surface or are transferred to the other surface, but add to the abrasive quality of the interaction. As pressure or continuing stress of movement is applied to the surfaces, the asperities may crush under the weight and press of the load. This results in the characteristic pattern of fractures, cracks, pits, and a frosted appearance seen in *fatigue wear*. Adams calls this impact fracture or pecking, and it is seen both micro- and macroscopically, respectively. *Abrasive wear* results from the scratching and gouging by loose particles rolling between the surfaces. Harder grains or a more durable surface will cause a greater degree of abrasion on a softer, less durable surface, resulting in striations forming in the direction of movement (Adams 2002:29-30).

As these three processes work on the stones moving against each other, one must also consider environmental factors contributed by intermediate substances between the surfaces. Industrial societies often use lubricants to facilitate the movement of one machine part against another to ameliorate the deteriorating factors of abrasion and friction. In terms of traditional technologies involving ground stone tools, these intermediate substances are the materials processed between the stones such as grain, meat, or clay. They may also be properties of one of the surfaces, for instance, the oils of hide or bone, or silicates from botanicals. Other environmental factors are if the contacting surfaces were used wet or dry, or in a clean or dirty context. Adhesive, abrasive, and fatigue wears, combined with the attributes of environment in which the stones are used, create the chemical interactions of *tribochemical wear*. The products of these reactions are films and oxides which build up on surfaces, filling in the interstitial spaces and creating a sheen or polished appearance (Adams 2002:31-32).

To analyze the artifacts, I first measured their dimensions and weights and removed as much dirt as possible. Because the dirt clinging to the stones may yield important data during future analysis, one must carefully and separately clean each artifact. Sutton and Arkush (2009) recommend wearing clean gloves and using deionized water to scrub soil and related debris from the surface of ground stone tools. I used toothbrushes, a stiff plastic household cleaning brush, and wore unpowdered latex examination gloves. The dirty water was centrifuged at 3,500 rpm for 15 minutes, and the supernatant was decanted. The wet sediment was poured into individual marked petri dishes (glass works the best) to dry inside of a closed cabinet at room temperature. These soil fractions were then scraped into glass screw-top vials for storage.

After revealing the unobscured surface of the stones, I examined them closely both macroscopically and microscopically using 7X to 40X magnifications of the Meiji EMZ-TR dissecting microscope in the HSU archaeology laboratory. I looked for the use-wear signatures described and shown in *Ground Stone Analysis* and was able to distinguish several types. It is always important to distinguish anthropogenic signatures from natural ones, so I included a river rock of the same type (greywacke sandstone) as the stone tools, which was collected from the landscaping outside a science building on the HSU campus. This control stone was processed by washing, scrubbing, and brushing just like the stone tools to account for any wear signatures introduced to the artifact surfaces. It was also examined microscopically to determine its microtopography for comparison with the artifacts.

All light microscopic pictures were taken with an Infinity camera using Infinity Analyze software run on a Dell PC with Windows XP Professional programming. Macro pictures were taken via a

Visioneer One Touch 8600 scanner attachment and a Canon PowerShot SD 1200 IS digital camera. The scanning electron microscope (SEM) specimens were mounted on SEM stubs and coated with gold using a Denton Vacuum model Desk II Cold Sputter Etch Unit. Using a TopCon Scanning Electron Microscope, model ABT-32, to survey the specimens for use-wear, the final images were captured on an Olympus SP-55OUZ digital camera.

FINDINGS

When I first unpacked the assemblage, I discovered that some of the stones had been damaged in storage. They were all crammed into one archive box and had jostled and rubbed each other through the plastic bags which contained them (some bags had holes in them). Fortunately, microscopic examination shows this "bag wear" as a white powdery substance (ground plastic) which looks entirely different from any other part of the surface, so I cannot confuse it with archaeological evidence. Some of the specimen number tags inside the bags were with the wrong artifact as seen when I checked the stones against the site report description and dimensions. There were even two different artifacts with the same number! I consulted with William Rich of the Cultural Resources Facility about these discrepancies and he told me that they had many people helping them and sometimes people make mistakes. He suggested that I assign another set of numbers unique to this study in order to keep them all straight; these are the "S" numbers. The nine artifacts selected for detailed analysis for this paper were S1, S2, S4, S7, S8, S11, S12, S17, and S26.

Table 1 shows the basic descriptions and dimensions of each artifact. Sorting the artifacts into sets is tentative at this stage of analysis: nether stones and hand stones are the only sets I can be sure of until analysis is done on more of the tools. The smallest set to date is that of nether stone and comprises S1, S2, S3, S8, S12, S16, S18, S19, and S26.

S12 is emerging as a lap stone/nether stone in that it seems to be a hopper mortar base which may also have been used as a lithic anvil and a hammer stone. It is an intermediate size between hand and nether stones. Subgroups of hand stones are emerging: S17 is in the subgroup of abraiders/polishers and S4 is likely a hide processor. S26 has been moved from its initial grouping with hand stones into the nether stone set which was confirmed for S1, S2, and S8. S7 is definitely a mano, whereas S11 may be a manuport and not a tool at all.

It is important to know the materials used in any artifact, so let me define some geologic terms used in the tables. Rocks are sized by both their gross dimensions and the dimensions of the individual grains which make up the rock matrix. Gross sizes are: 1) boulder, >256 mm diameter, 2) cobble, >64 mm to 256 mm, 3) gravel, >2 mm to 64 mm (further subdivided into pebble, >4 mm to 64 mm and granule, >2 mm to 4 mm), 4) sand, >0.0625 mm to 2 mm, and 5) silt, <0.0625 mm. Individual grains making up the matrix are either coarse, sand, or fine textures. Coarse is pebble size and readily apparent; sand is sand size and feels rough to the touch. Fine textured rocks are made of silt or clay particles. A rock can be a mixture of all or several of these types, which is called poorly sorted, or can be all or mostly one type, which is called well sorted. Most of these ground stone artifacts were made of a poorly sorted local sandstone called greywacke (Lehre 2010). Greywacke is formed by the cementing of marine sediments and is characterized by angular grains of quartz and feldspar with random rock fragments in a matrix of clay, chlorite (another marine stone), quartz, and pyrite (Pellant 2002). It is common in the Humboldt area because much of the landscape has been pushed up from the ocean bed by multiple tectonic plate intersections off the coast. One stone is granite, which is a local plutonic stone made of quartz, feldspar, and mica grains fused together (Lehre 2010).

Table 1. Dimensions and general descriptions of ground stone artifacts.

S #	CRF #	CONDITION	DESCRIPTION, POSSIBLE USE	ROCK TYPE	LENGTH (MM)	WIDTH (MM)	THICKNESS (MM)	WEIGHT (G)
S1*	001-041	fragment	flat on both sides; metate fragment?	sandstone	75	50	30	136
S2*	001-043	fragment	broken slab	sandstone	205	170	80	(TH)
S3*		fragment	broken with flat surface on one side	sandstone	101	82	59	427
S4	001-045	complete	elongated cobble; three working faces?	sandstone	142	63	49	661
S5	001-046	complete	cobble	sandstone	103	74	50	559
S6	001-047	complete	cobble, black spots (soot/mold); cooking stone?	sandstone	130	94	75	1327
S7	001-048	complete	cobble, wear on both sides, pecked ends; mano?	sandstone	130	97	79	1548
S8*	001-049	fragment	largest artifact: broken slab; nether stone, basin or flat type (metate)	sandstone	355	231	80	9856
S9	001-050	fragment	cobble, cracked across length	sandstone	106	92	55	600
S10	001-051	complete	long, narrow, flat, slight groove on one surface; straightener?	sandstone	185	53	17	257
S11	001-052	complete	cobble, one flat side	sandstone	131	89	67	1184
S12*	002-053	complete	round, flat, concave on one side, edge scars: anvil? hopper mortar base?	sandstone	200	180	44	2629
S13	001-054	complete	cobble	sandstone	128	87	70	1184
S14	001-055	fragment	cobble frag, 2 cracks, some ground surfaces	sandstone	104	77	41	390
S15	001-056	complete	elongated cobble, scars on both ends, flattened side; pestle?	sandstone	137	70	62	872
S16*	001-057	complete	slab, slight concavity in middle; hopper mortar base?	sandstone	232	215	68	(TH)
S17	001-058	complete	oval to egg-shaped stone	sandstone	75	20	18	36
S18*	001-059	fragment	broken, slight concavity; metate fragment?	sandstone	82	70	36	277
S19*	001-060	fragment	flattened on one side	sandstone	67	53	44	183
S20	001-061	complete	cobble	sandstone	69	68	42	338
S21	001-062	complete	cobble: 2 pecked and 1 smooth surfaces	sandstone	136	91	69	1192
S22	001-063	complete	elongated cobble, possible ground surface	sandstone	134	59	39	488
S23	001-064	fragment	cobble fragment, one flat side	sandstone	50	58	42	171
S24	001-065	complete	cobble with scar	sandstone	115	62	55	515
S25	001-066	complete	cobble	granite	137	81	60	1124
S26*	001-067	fragment	cobble fragment	sandstone	80	45	36	130
S27		fragment	cobble fragment	sandstone	95	57	66	356
S28	005-006	complete	pebble	sandstone	67	42	34	134
S29	005-006	fragment	pebble fragment	sandstone	38	28	19	28

S#: asterisk (*) indicates a nether stone.

Weight: (TH) means the specimen was too heavy to weigh with the lab scale.

ANALYSIS OF INDIVIDUAL ARTIFACTS

S12 (Length 200 mm, Width 180 mm, Thickness 44 mm, Weight 2,629 g)

Adams terms the worked side of a tool to be the ventral aspect and the side toward the hand or on the ground, depending on tool usage, to be the dorsal aspect. In terms of design, this tool is expedient in that it shows no manufacturing signatures and was probably collected because it is a convenient size and flatness. The ventral side is the most used and contains a slight central depression formed by many pecking marks and characterized by fractures on asperities, especially the hard, brittle points of quartz grains (Figure 1). It also has long scars outside the central depression. One edge shows the signs of being used as a hammer against a hard surface. All these marks are those of fatigue wear resulting from hammering blows either by a hard object or on a hard surface.

This tool was initially classified as a hopper mortar by CICD-CRF based solely on its flatness with the central depression. Hopper mortars are composite tools. They are described in the ethnographic literature as composed of a flat stone with a shallow central depression (the mortar) with a funnel-shaped or open-ended basket (the hopper) placed over the depression. The materials to be worked in the mortar were placed in the basket, which kept them from scattering as they were hammered by a pestle from above (Curtis 1907-1930; Elsasser 1978). Elsasser (1978) tells us that pine pitch or asphaltum (natural tar) was often used to secure the attachment of the hopper basket to the mortar by various California tribes. Alternatively, the user, generally a woman, placed the mortar base into a basketry tray with the hopper on top. She then held the hopper basket in place with her legs thrown over the top and worked the pestle between them (Moser 1989).

There was no sign of any adhesive residue on S12. This does not exclude its use as a hopper mortar. However, because of the scarring outside the central depression and along the edge, it may have had dual uses, one of which could be as a lithic anvil. Interpretation as a lithic anvil is consistent with all the debitage and shatter from flake tool manufacture found at the site. Also, because of its greater weight than the rest of the hand stones which show fractures consistence with hammering, it may have been pressed into service against a particularly stubborn core. However, the hammer marks on the edge are not extensive, which shows that this concomitant use was short-lived.

S7 (L 130, W 97, T 79, Wt 1,548)

This tool was strategically designed for intensive use, as seen in the pecked manufacturing scars around its edges. It was originally a cobble-sized river rock which was modified by gouging out pieces of stone on the ends in a definite pattern and also along the narrow sides lengthwise. I believe these pecked areas are hand grips introduced into the surface of a relatively smooth native stone so that the user's hand(s) did not slip while grinding. Such modification indicates intensive use. The broad sides both show abrasive striation patterns on worn-down asperities (Figure 2). One side could have been used to grind seeds or acorns and then flipped over when the tribochemical films resulting from oil build-up degraded the efficiency of the mano—that way the tool could be used for some time before cleaning. It belongs in the hand stone set, subset mano.

S4 (L 142, W 63, T 49, Wt 661)

This tool is an elongated cobble with a roughly triangular cross-section and end fractures. There may have been three working faces, although it is possible that there was only one working face and the other two were smoothed by holding the stone in the hand. One face has a broken section (Figure 3) which gave me a control area right on this stone. The predominant use-wear pattern is that of smoothing both of the asperities and interstitial spaces while the broken section is uniformly rough. There is a definite sheen on some of the smooth areas which suggest tribochemical interactions, and the smooth

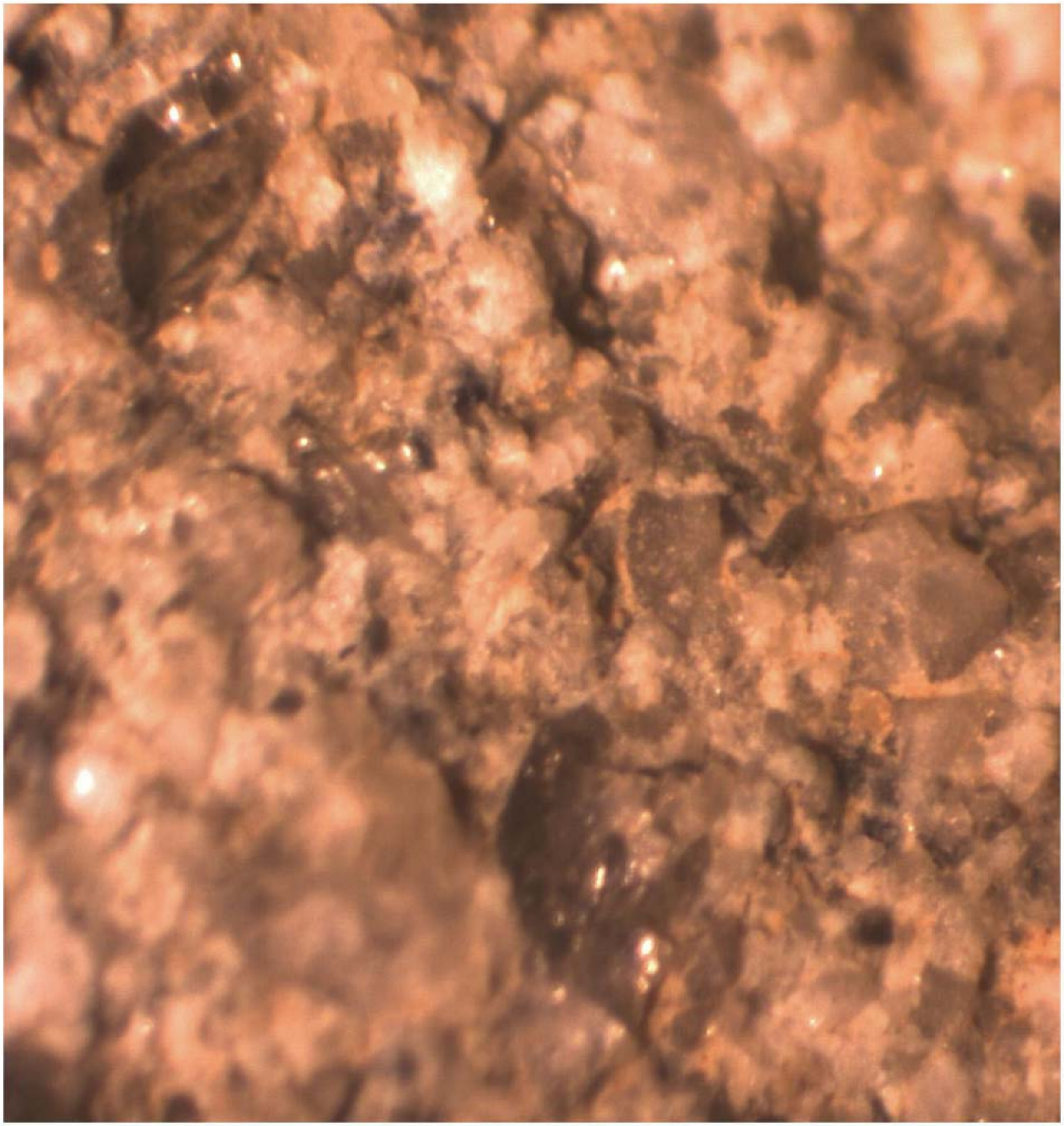

Figure 1. These glass-like shattered grains demonstrate fatigue use-wear. Note the sharp peaks and ridges especially prominent on the upper left grain. The grains are approximately 2 x 3 mm.

nature of the microtopography is unmistakable (Figure 4). This leads me to believe this tool may have been used to process hides. Leather is soft and would deform itself into the interstitial areas resulting in such a smooth appearance as well as provide fats and oils to build up a microscopic sheen. It was a tool with either a secondary or concomitant use in that there are hammering fractures on both ends. Possibly after it was exhausted as a hide processor, it was used as a hammer stone. While its overall appearance suggests a possible use as a pestle, when holding it, the stone only extends beyond the palm about 2 cm. This is short for an efficient pestle and would preclude a two-handed grip as documented

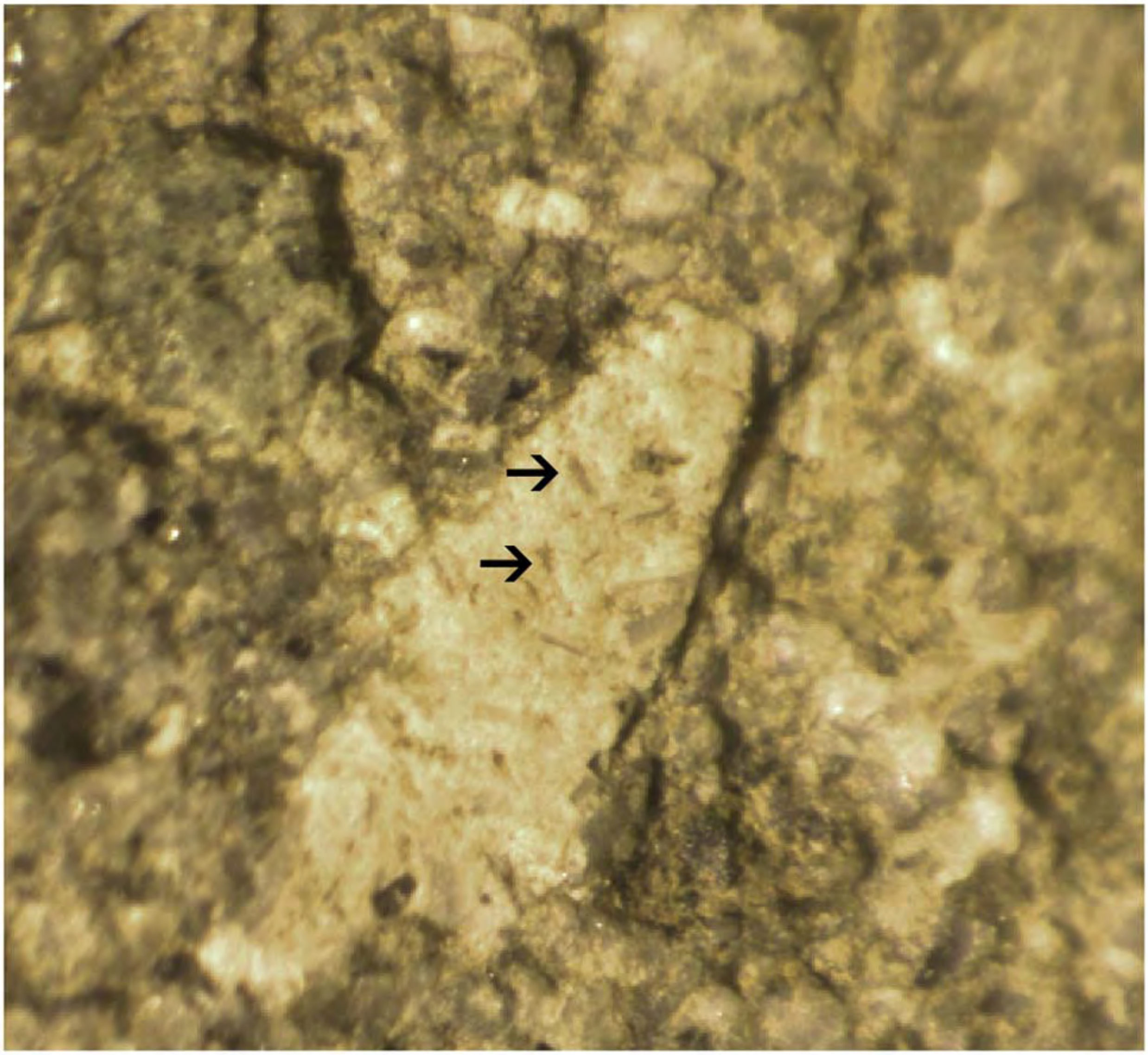

Figure 2. The arrows point to two of many striations worn into this flattened grain as evidence of abrasive wear from grinding. Note that there are more grooves on this asperity and that they run in several directions, which may be due to circular grinding motions.

ethnographically (Moser 1989). It belongs in the hand stone category, subsets hide processor and hammer stone.

S17 (L 75, W 20, T 18, Wt 36)

This is the smallest intact artifact analyzed. It is rounded at one end and tapered at the other. Figure 5 shows its general aspect. It does not have specifically flattened sides and is instead cylindrical and smooth all around. There are definite scratches or grooves which are perpendicular to its long axis (Figure 6). This tool most closely resembles an abrader/polisher used to either widen holes or smooth their edges after initial boring. The fact that it tapers makes it useful as a finisher of holes or openings of various diameters. I imagine it was used to finish fishing weights so that the net lines could be pulled through smoothly or to finish holes in wooden objects, again, so that whatever was threaded through the hole would not catch on its edges.

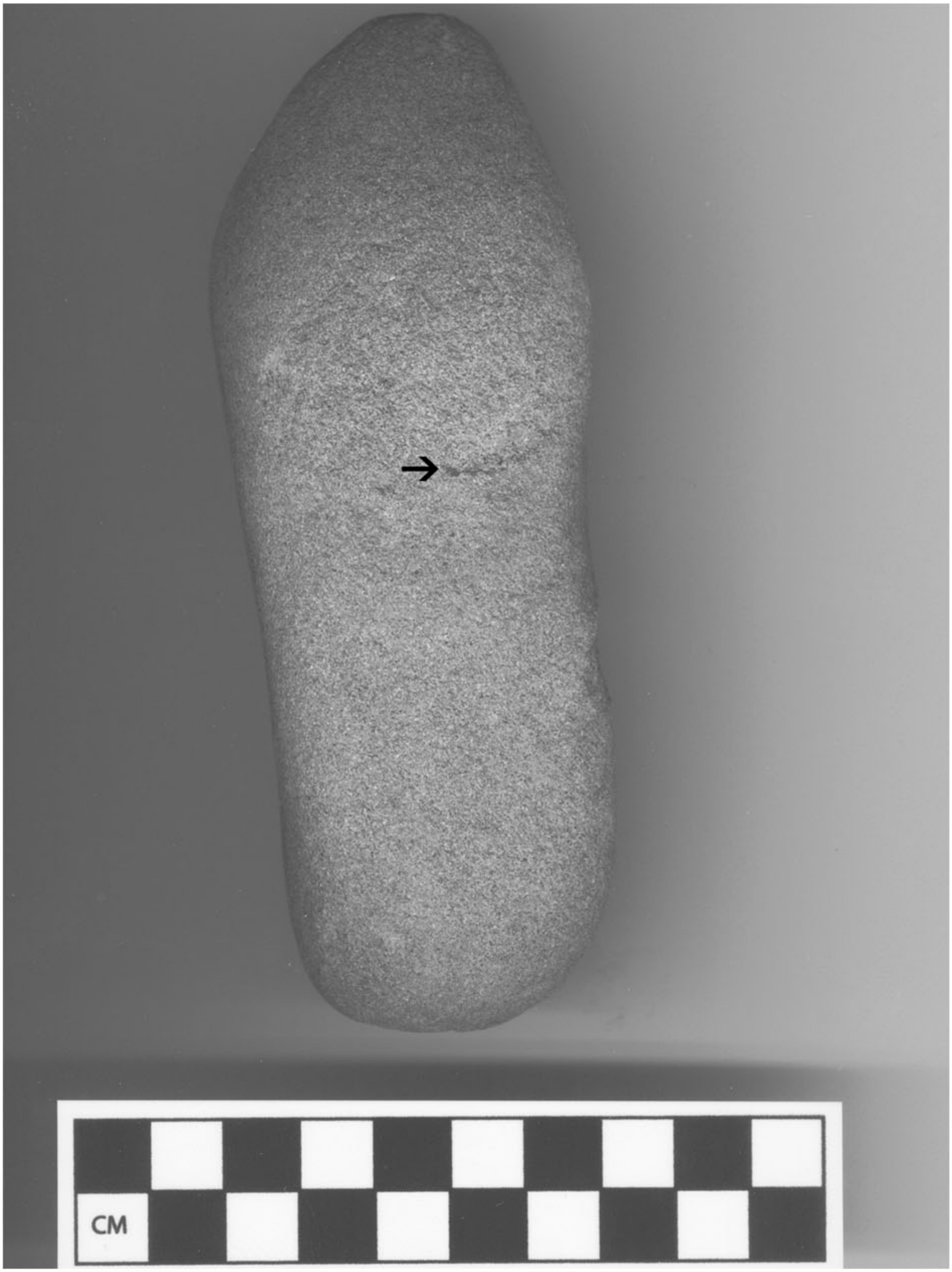

Figure 3. This is one aspect of S4 showing the broken control area (arrow).

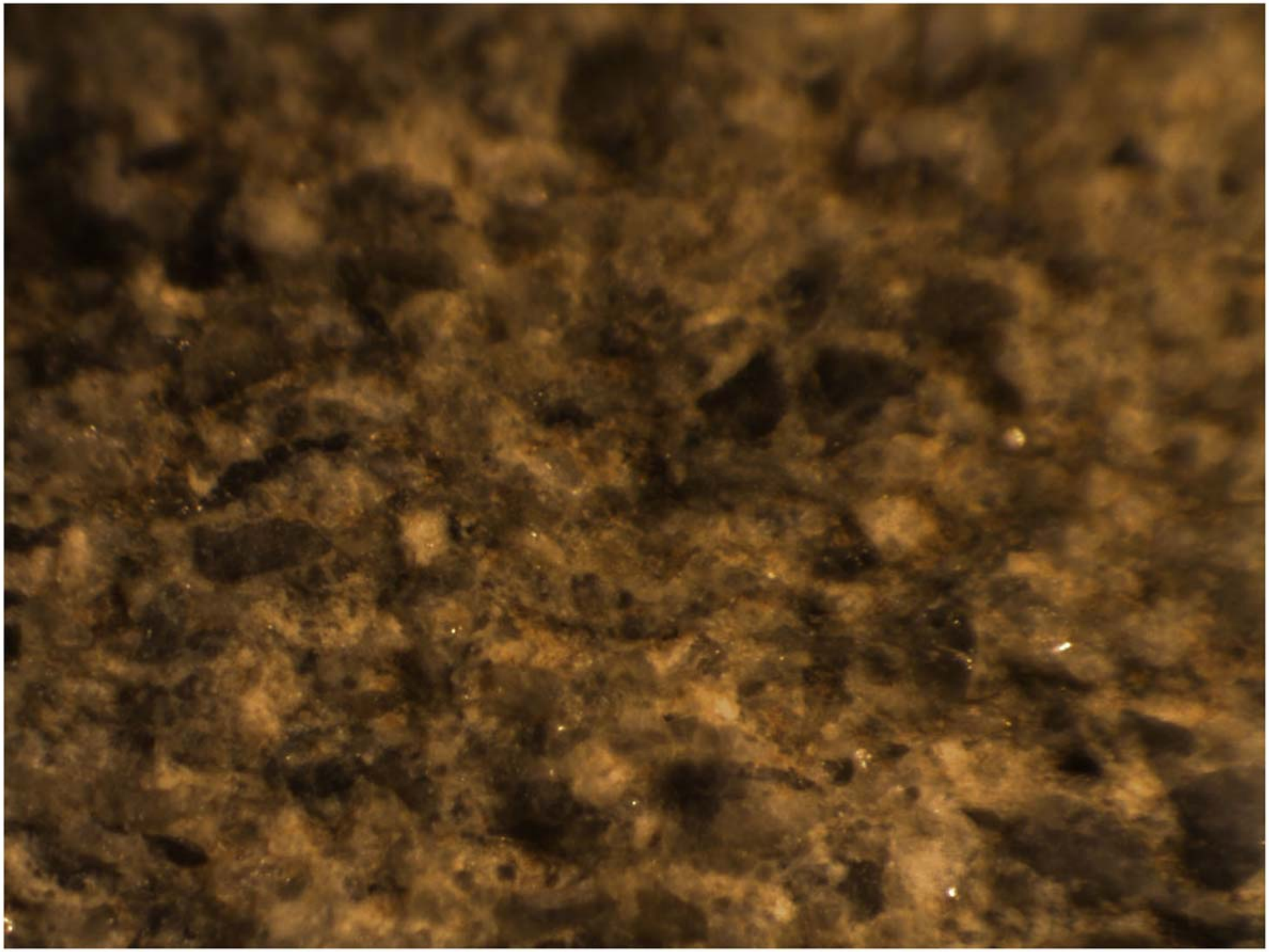

Figure 4. Both the asperities and interstitial areas are smooth, which is indicative of use on a flexible surface such as leather.

Figure 5. This is the overall appearance of S17.

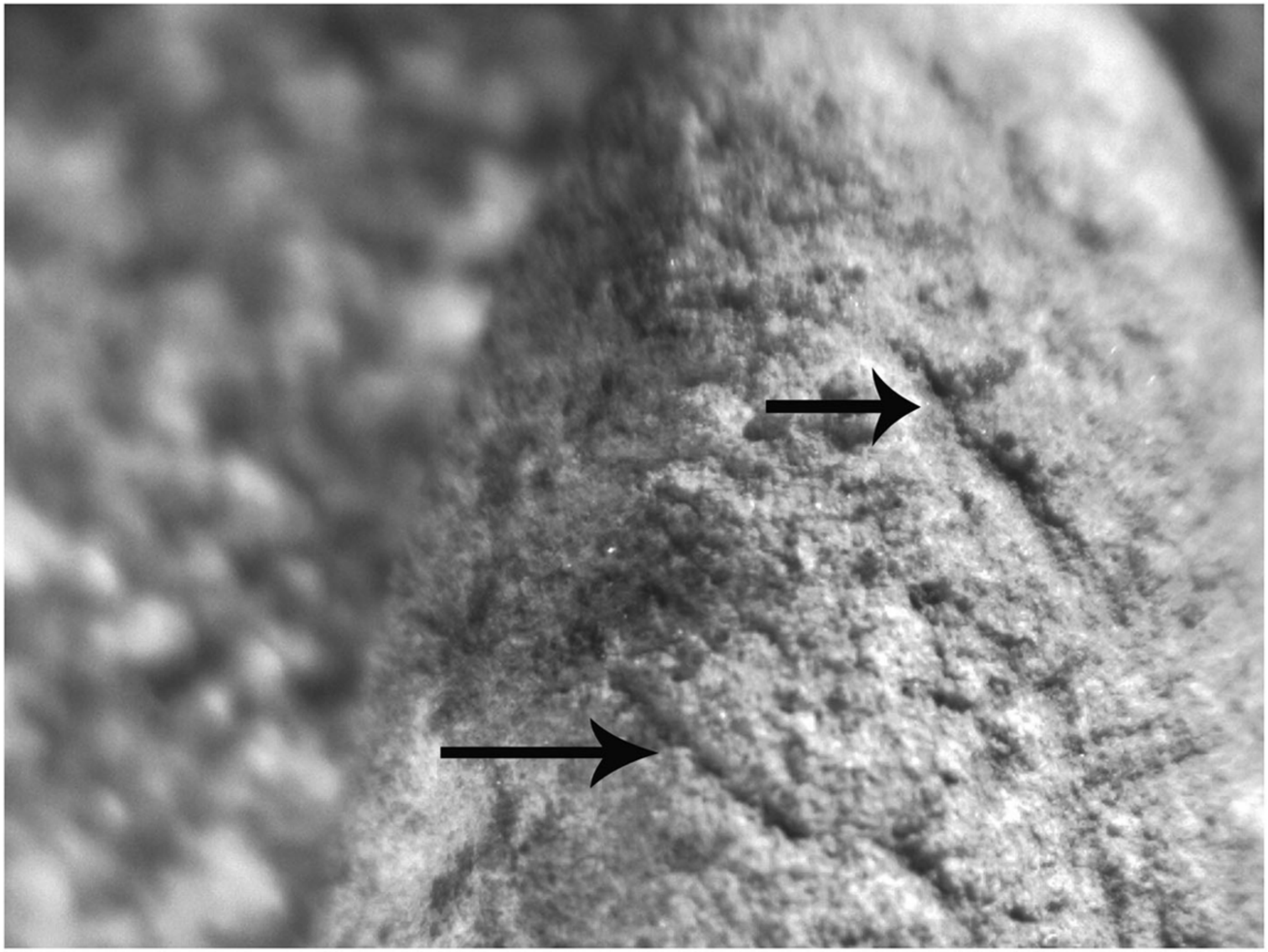

Figure 6. This area near the tapered end of S17 shows grooves roughly parallel to the long axis of the artifact. These were most likely made by a screwing motion when the tool was used to smooth the rough edges of holes.

S8 (L 355, W 231, T 80, Wt 9,856)

This is the largest artifact in the assemblage. There are depressions on both sides, but they differ significantly in design. One is large and shallow and has the distinct markings of a grinding surface. Figure 7 shows one such mark; it is of two asperities of different rock materials which have been ground together so that they have the exact same elevation. The other side shows a central pecked depression and is also pecked around the edges (Figure 8). It may have been manufactured to fit inside a confined area which was used to control the product of the grind—the meal or flour (Adams 2002). It is also possible that a broken metate was reused as a lithic anvil, which would account for both sides seeming to be ventral surfaces. My future plan for the dirt fraction from this tool is to test for plant starch as evidence of acorn or other plant food grinding (Pearsall 2000).

S2 (L 205, W 170, T 80, Wt n/a)

This artifact is also a broken slab and exhibits biconcave central depressions at the broken edge. It may have been a hopper mortar or a lithic anvil, as it is generally pecked in the central area and also toward the edges. The edge-ward pecking is less concentrated than that of the central portion. Both sides are worked such that ventral and dorsal designations cannot be determined. This may be a sign of serial reuse of a tool for another purpose. The one intriguing aspect of this artifact is a random splatter of a liquid black substance on one side. There are several droplet-shaped splatters, some of which have dirt specks on top of them which indicates that the material was applied (either intentionally or accidentally) before the tool was buried. In Figure 9, some of the asperities of the stone are sticking up through the black spot, which indicates that either the substance was very fluid and rolled down off of the micrograins or has been worn away in the intervening years between deposition and examination. However, the droplets are well formed and raised around the edges, indicating that the substance was originally viscous in nature. This supports the latter mechanism by which the grains are revealed. These spots could be the remains of a mastic substance, which would indicate that this tool was a hopper mortar at some time in the past.

S11 (L 131, W 89, T 67, Wt 1,184)

This stone is cobble-sized and was obviously formed by natural forces. When I examined it for wear-use signatures I could find no difference between it and the control stone analyzed below. This stone was found far from any creek or riverbed and as such had to be transported to the site. However, because of its apparent lack of use, I have to consider this one a manuport and not actually a tool. It is possible it was lost before it was used much or was left there by non-Indians.

S26 (L 80, W 45, T 36, Wt 130)

Originally placed in the hand stone set, upon further examination it is most likely a piece of a nether stone of some type. It possesses an unbroken outer edge which is curved in a wide arc, suggesting that it was part of a larger tool. The smoothed upper and lower surfaces exhibit flattened use-wear signatures like those of artifacts S1, S7, and S8.

S1 (L 75, W 50, T 30, Wt 136)

This one is also a broken nether stone piece. The exciting thing about this one, for me, is that I obtained permission to cut a piece out of the artifact such that the ground surface was preserved in a 1-x-1-cm cube. This cube was then mounted and examined by SEM. In Figures 10 and 11, one may see how flat the asperities on this surface have been worn. Figure 10 shows how these flattened signatures are repeated over and over in the stone surface. In Figure 11, one sees the characteristic step-like appearance of the ultrastructure of a ground asperity and that the interstitial areas are still rough due to adhesive wear

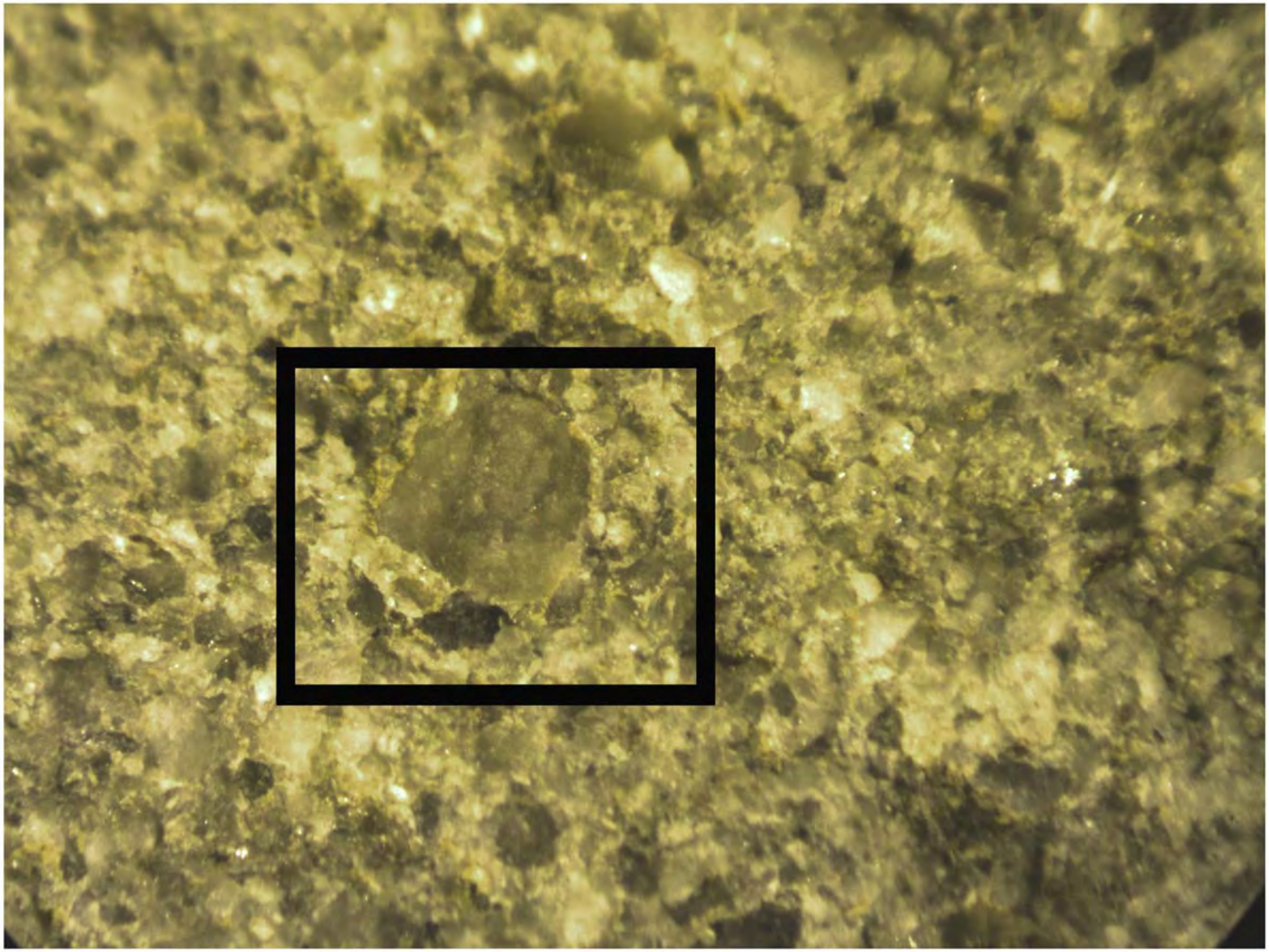

Figure 7. This micrograph of the grinding surface of S8 shows two asperities ground together (box). The lighter grain is quartz and the darker one is feldspar; the elevation of these grains is exactly the same.

Figure 8. This is the dorsal aspect of S8 with the metate grinding surface not seen. Note the central pecked depression on the middle bottom and that the edges have been shaped downward toward the photographic platform.

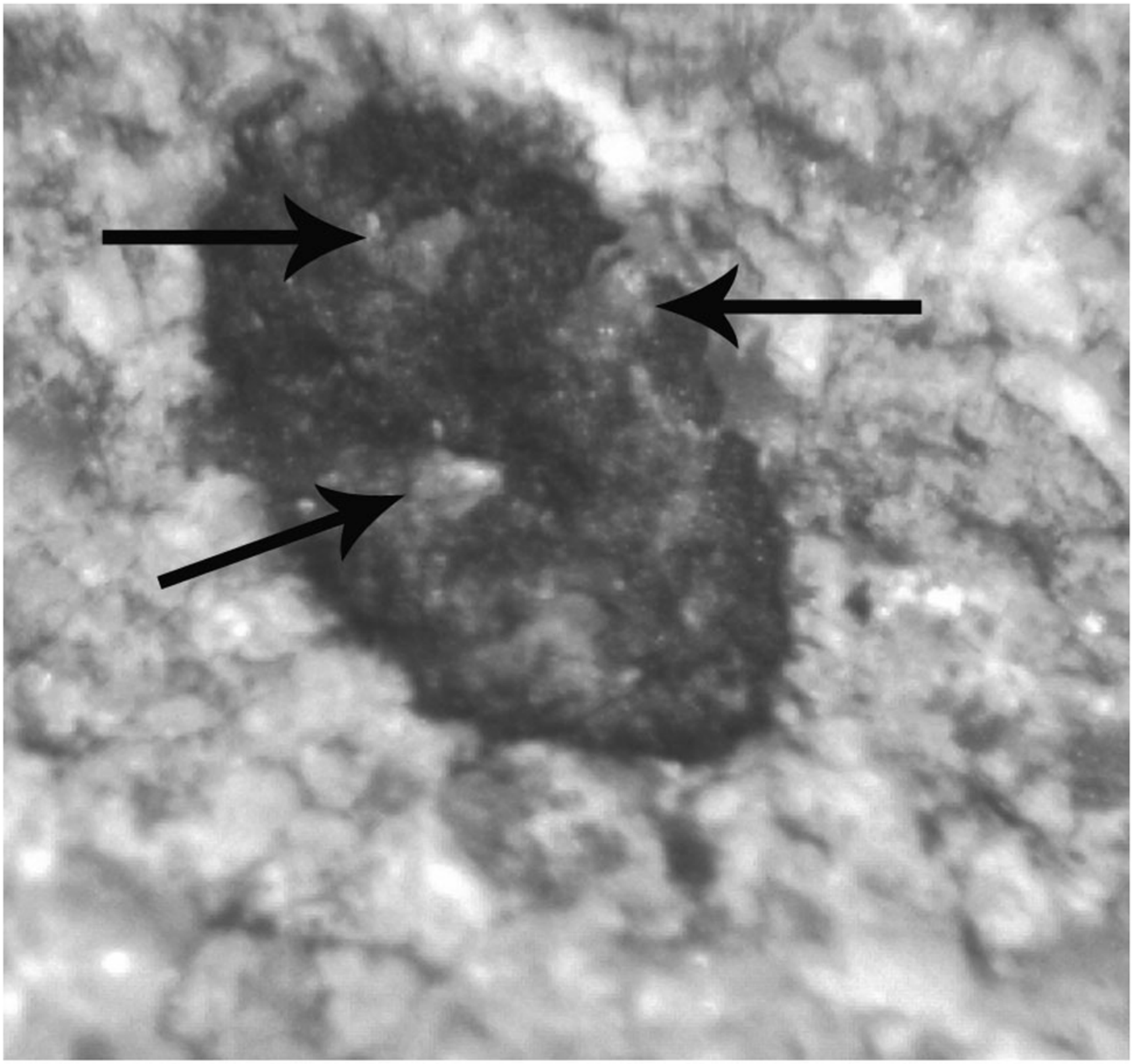

Figure 9. The arrows point to asperities rising through a black splattered droplet found on artifact S2.

forces and therefore able to continue in use as a grinding surface. The blue color of the pictures is an artifact of the SEM imaging process.

Control

As mentioned above, this sandstone was processed like the artifacts. When I examined it microscopically, I saw that although the surface feels smooth to the touch, like the standard, smooth river rock, the microtopography was very rough. Note the jagged top of the white quartz asperity photographed in Figure 12. The interstitial spaces were also angular and rough. I could see no anthropogenic signatures on this stone. There was an angularity on one edge that I compared with the pecked and hammered areas on the tools; it showed no sign of fatigue wear. Whenever this part of the stone was lost, it has since been subjected to the same forces (water and sand) which shaped the overall surface of this stone (Lehre 2010).

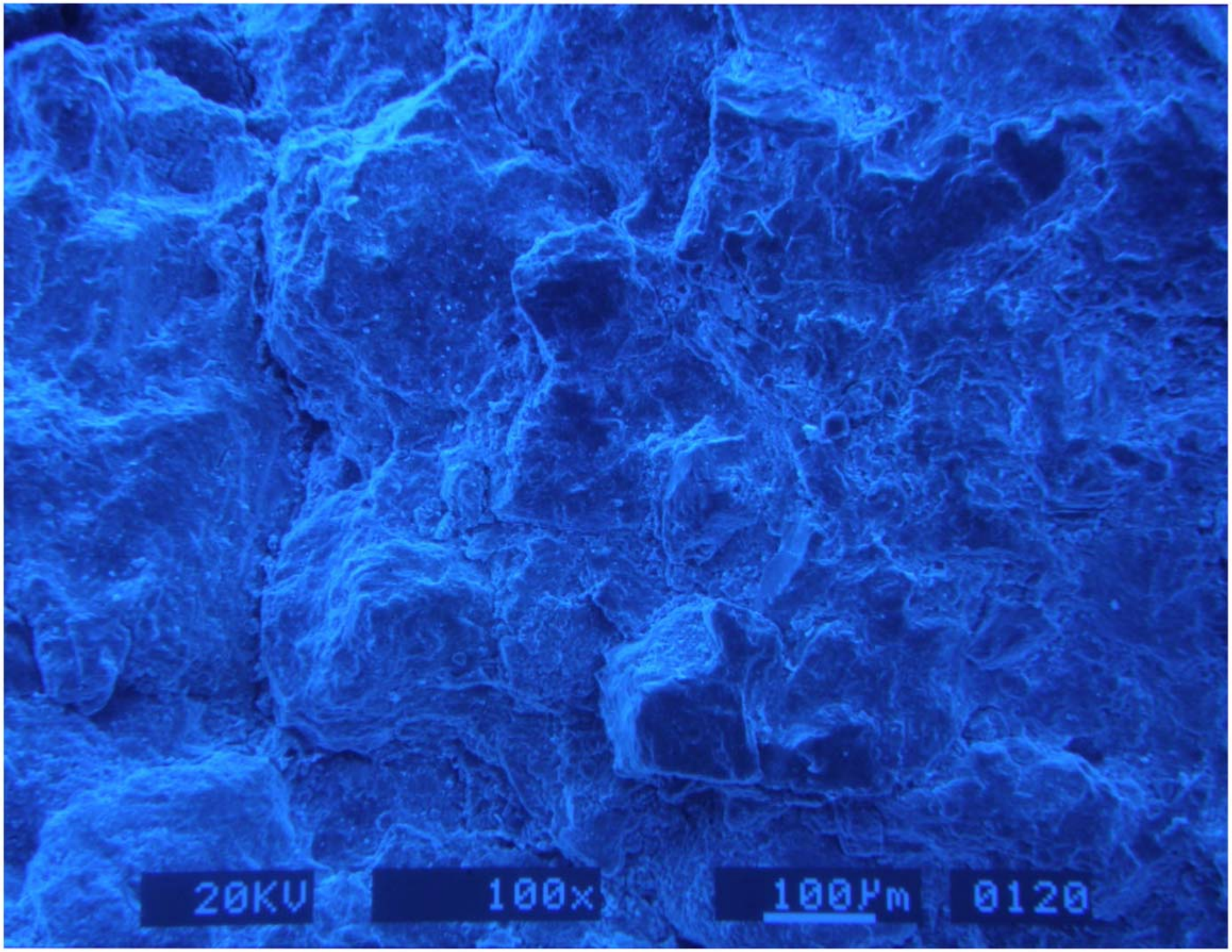

Figure 10. The flattened signatures of abrasive wear are repeated over and over on the ground-down surface of S1.

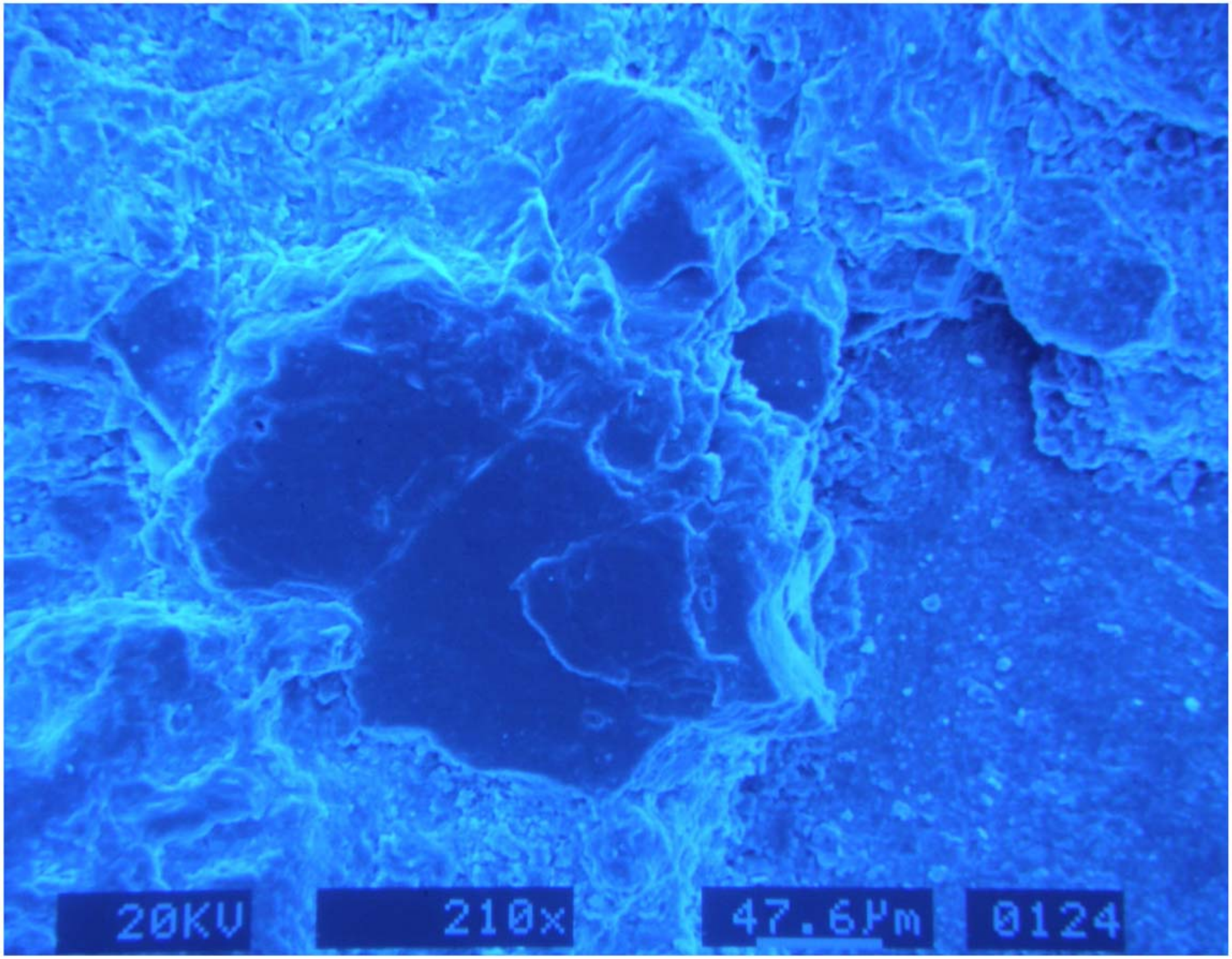

Figure 11. Here stepdown flattened areas are repeated in one asperity. Also note the granular appearance of the background, showing loose particles dislodged through adhesive forces which add to the abrasive nature of the surface.

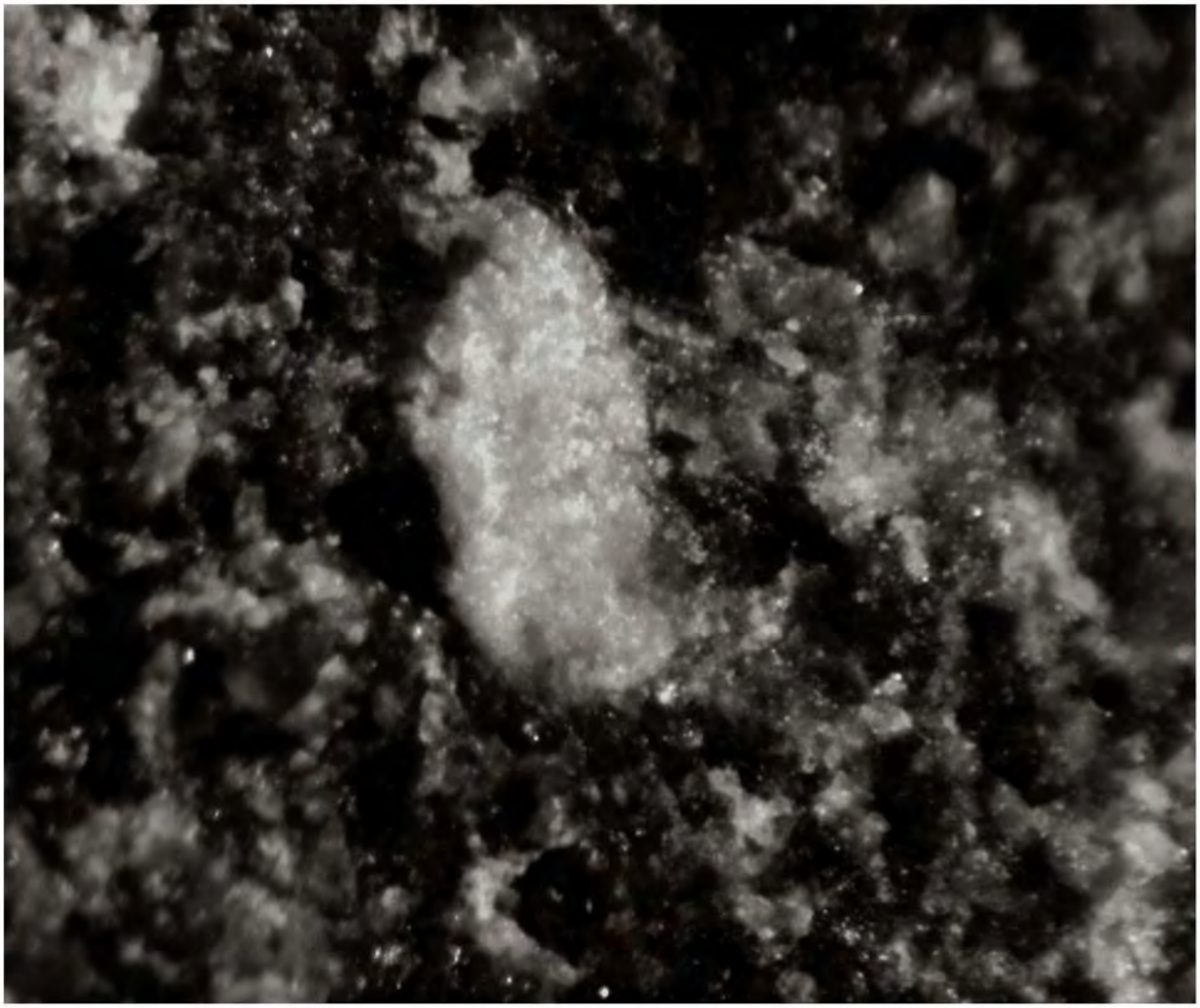

Figure 12. This micrograph of the control stone shows the uneven surface of a "smooth" river rock.

CONCLUSION

In the history of archaeology, ground stone tools have often been ignored as objects of study. This may be due to a frank patriarchal bias in the discipline. After all, the dominant idea of “Man the Hunter” enjoyed wide currency in both academic and lay circles well into the 1960s. It is unreasonable and misleading to ignore the contributions and activities of half the population of any group when trying to reconstruct a culture. With the feminist movement of the 1970s, tools and activities traditionally associated with women have been more closely studied, but more needs to be done (Moore and Sanders 2006). Projectile points are considered “diagnostic” in that they are used to build chronologies reflecting the succession of peoples over time through the landscape. More detailed study of ground stone design may also yield similar information, as these tools also reflect the cultural styles of those who made and used them.

The technological approach of Jenny Adams is a valuable one. Form can be deceiving and you cannot judge a book by its cover, which is why this approach is so useful. It allows one to truly look at artifacts in a more rigorous way, to apply scientific disciplines to discover their true functions. Although much of this is guesswork, following up on details found in the smallest parts of these artifacts will allow us a to make the best guess possible. After all, archaeology is ultimately concerned with information rather than just collecting artifacts.

Based on information gleaned from these artifacts, the Native Americans who used them were engaged in a variety of tasks up on that ridge near modern Fieldbrook. Not only were they making and using flake tools, they were grinding and pounding foodstuffs, processing leather, and polishing holes. One can just imagine the camp buzzing with activity—people working and living, the sounds of talking and laughter accompanying scraping and pounding—the sounds of a rich life which echo today in these artifacts.

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