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Use-wear analysis at the Gorbatka 3 and Ilistaya 1 sites in the Russian Far East

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Abstract: This paper aims at understanding not only the technologies and functions of lithic tools but also site function at the Gorbatka 3 and Ilistaya 1 sites. One of the goals of our research is the comparative evaluation of technology and function in the microblade industries between the Russian Far East and the Japanese archipelago.
Regarding site functions, the use of end scrapers distinguishes these two sites. There were more than twice the number of end scrapers at Gorbatka 3 than at the Ilistaya 1 site. In addition, 60% of the end scrapers were utilized for hide scraping at Gorbatka 3, although 5.4% of end scrapers had use-wear at the Ilistaya 1 site. Therefore, the hide scraping needed for longer stable settlements was chiefly carried out at the Gorbatka 3 site. Ten times more boat-shaped tools were discovered at Gorbatka 3 than at Ilistaya 1. They may be used as blanks for end scrapers in some cases. In lithic assemblage, bipolar cores and microblade spalls were mainly excavated from the Ilistaya 1 site, not from Gorbatka 3. These differences characterize the site functions of the sites. Burins were commonly used for bone/antler planing/whittling at both sites. Microblade removal and bone/antler tool manufacture coexisted because of composite tool production. This activity was organized as a basic component in their subsistence technology and hunting strategy.

1. Introduction

The Gorbatka 3 and Ilistaya 1 sites in the Maritime region were discovered by one of the authors, Anatoly Kuznetsov, in 1977 (Kuznetsov 1992, 1996). These sites were excavated in 1970s and 1980s. The Final Palaeolithic artefacts were discovered at the Gorbatka 3 site in 1979,'82, '85, and '86, and at the Ilistaya 1 site in 1978, '87, '88, and '89. The Gorbatka 3 site was re-excavated in 2003 but the materials in 2003 were out of our research scope in this paper.

From 19 April to 29 May 2019, use–wear research of lithic artefacts at the Gorbatka 3 and Ilistaya 1 sites was carried out by the second author (Kanomata), who studied many microblade industries in Japan from the viewpoint of lithic function. Technological analysis was also practiced by the third author (Aoki), who is studying microblade technologies in the northeastern region of the Japanese archipelago. Therefore, one of the goals of our research is the comparative evaluation of technology and function in the microblade industries between the Russian Far East and the Japanese archipelago. In addition, the present paper aims at understanding not only the technologies and functions of lithic tools but also site function at these sites. A traceological approach is very useful for getting information about what has happened at the site.

2. Experimental archaeology on local raw materials in the Russian Far East

Concerning the use–wear analysis, there is a problem to face in this region because of absence of basic experimental data. Since the main raw material here was local siliceous tuff, which has several characteristics that are different from siliceous shale in the Japanese Islands, it is probable that use–wear traces on siliceous tuff also has characteristics different from those on siliceous shale. Therefore, one of the authors (Kanomata) carried out experiments about use wear on local raw materials in the Russian Far East. Green and white siliceous tuff cobbles were collected from the riverbed near Ustinovka sites on 18 May 2019. After that, replicated lithic tools were manufactured at Far Eastern Federal University, and use experiments were conducted from 20–28 May 2019. Shell, antler, cowhide, reed grass, wood,

Table 1 List of experiments

Experiment No.	Operation	Worked Material	Condition	Minute	Storoke/Minute	Figure No.	Additional Information
1	saw	shell	dry	20	180	3-1, 2, 3	
2	saw	shell	wet	15	150	3-4, 5, 6	
3	saw	antler	dry	8	180		
4	saw	antler	wet	5	400	1-13, 14, 15	
5	scrape	hide (cow)	raw	30	140		
6	scrape	hide (cow)	raw	30	130	2-10, 11, 12	
7	saw	plant (reed grass)	dry	15	-	1-4, 5, 6	
8	saw	plant (reed grass)	wet	15	150	1-1, 2, 3	add water
9	scrape	hide (cow)	dry	10	180		
10	saw	wood	raw, dry	15	180	1-7, 8, 9	
11	plane	wood	raw, dry	10	180	1-10, 11	
12	saw	wood	raw, wet	15	180	12	
13	scrape	wood	raw, wet	10	180		
14	scrape	antler	wet	10	180		
15	cut	meat (cow)	raw	10	100	3-7, 8	
16	cut	meat (cow)	raw	18	100	3-9	removal from bone
17	plane	bone (cow)	raw	15	100	2-4, 5, 6	
18	plane	bone (cow)	raw	10	100		
19	saw	bone (cow)	raw	5	180		
20	saw	bone (cow)	raw	15	180	2-1, 2, 3	
21	scrape	hide (cow)	dry	30	180	2-9	
22	cut	hide (cow)	dry	15	180	2-15	
23	scrape	soft hide (cow)	dry	20	180	2-7, 8	
24	scrape	hide (cow) with hair	dry	10	150		
25	cut	hide (cow) with hair	dry	10	180	2-13, 14	

cow meat, and cow bone were selected as object materials. Twenty-five lithic tools were selected for these experiments. The results of experiments were summed up in Table 1 and Figures 1-3.

So-called ‘corn gloss’ was observed on an experimental flake, which was utilized to saw reed grass in a wet condition (Figs. 1-1 to 1-3). This polish is very bright, smooth, and shiny. It is accompanied with numerous dark pits and filled-in striations that show the direction of operation. In a dry condition, the use polish is not developed, as shown in photos (Figs. 1-4 to 1-6).

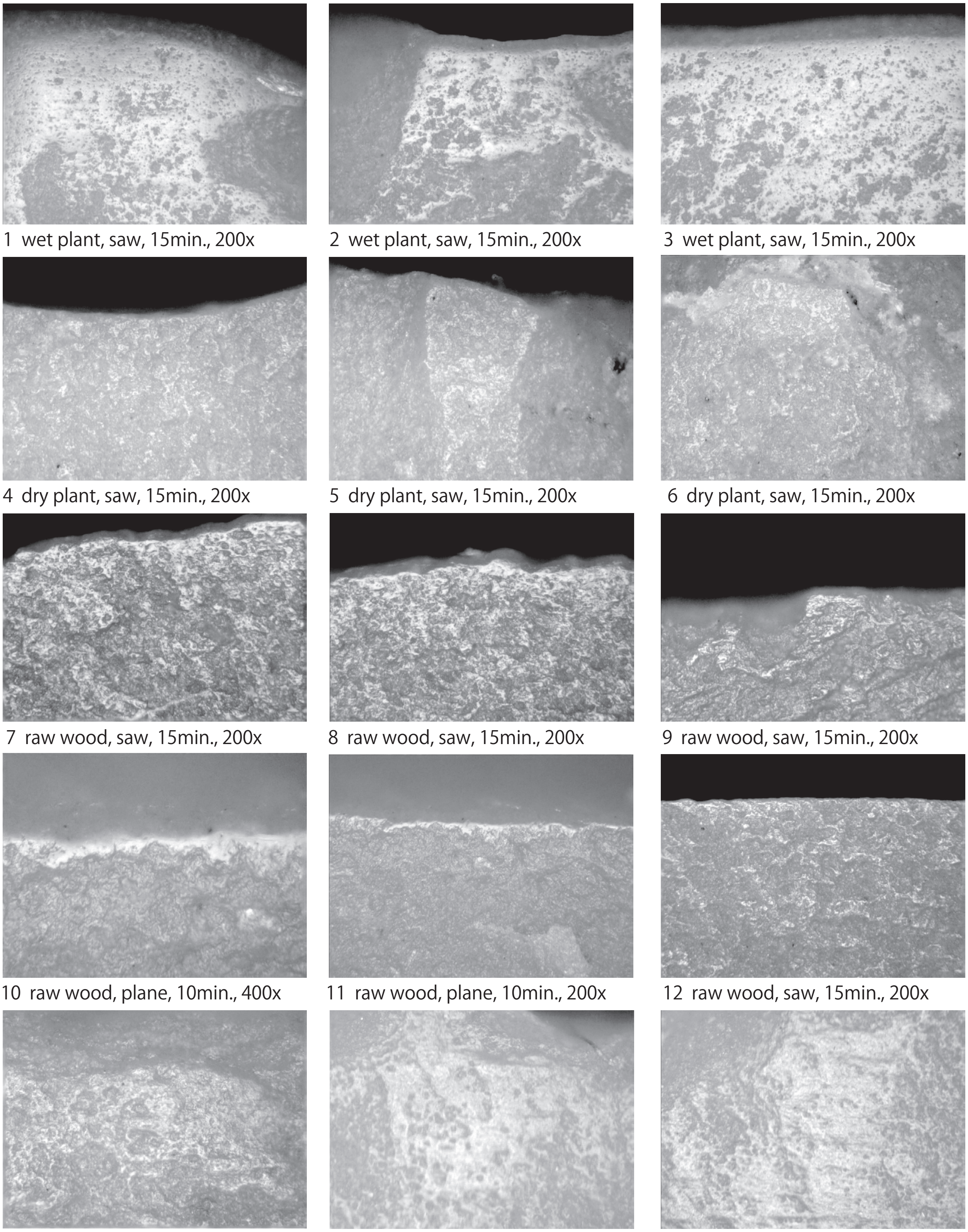
Wood polishes were caused by several wood operations. This polish is bright and smooth. Inner and outer contrasts are as high as corn gloss. The shape of the polish looks domed. In the case of sawing, parallel striations were limitedly recognized, and the polish development area connects the parallel zone to the use edge (Figs. 1-7 to 1-9). In contrast, the planing operation produced the same type of polish with vertical striations. It is situated near the edge (Figs. 1-10 to 1-12).

Bone and antler workings often produce similar types of polish. Antler sawing in wet conditions produced polish that is a little darker and rougher than corn gloss (Figs. 1-13 to 1-15). So inner and outer contrast are not so high as corn gloss. Raw bone sawing caused rugged polish with parallel striations (Figs. 2-1 to 2-3). Planing activity produced the same polish, accompanied by vertical striations (Figs. 2-4 to 2-6).

Dry hide scraping produced a rugged surface and round edges with vertical striations (Figs. 2-7 to 2-9). In contrast, the same activity in rawhide caused a less round edge and a darker polish (Figs. 2-10 to 2-12). It is characterized as dull, low contrast, greasy, and lustrous. Cutting dry hide made a similar polish with parallel striations (Figs. 2-13 to 2-15).

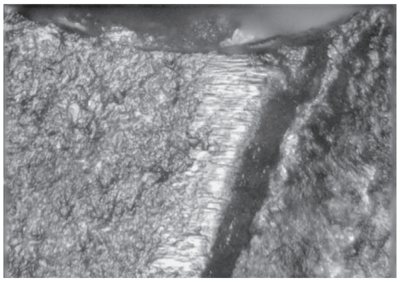
Dry shell sawing produced a flatter and higher contrast polish with a severely high density of striations (Figs. 3-1 to 3-3). In wet condition, the same activity made a similar polish (Figs. 3-4 to 3- 6).

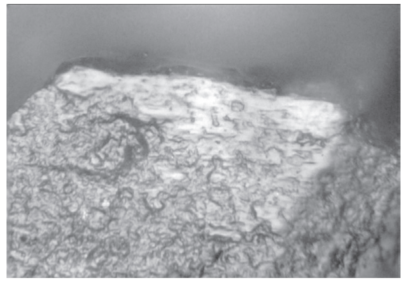
Cutting raw meat caused the dullest polish (Figs. 3-7 to 3-9). Inner and outer contrasts are small, and striations are

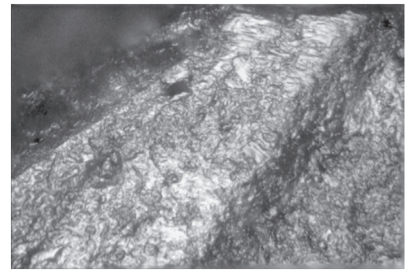


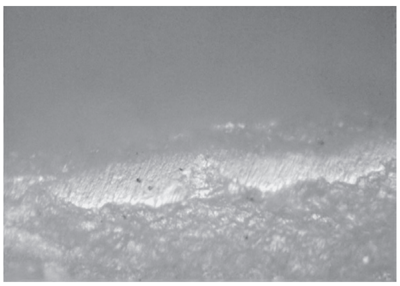
1 wet plant, saw, 15min., 200x
2 wet plant, saw, 15min., 200x
3 wet plant, saw, 15min., 200x
4 dry plant, saw, 15min., 200x
5 dry plant, saw, 15min., 200x
6 dry plant, saw, 15min., 200x
7 raw wood, saw, 15min., 200x
8 raw wood, saw, 15min., 200x
9 raw wood, saw, 15min., 200x
10 raw wood, plane, 10min., 400x
11 raw wood, plane, 10min., 200x
12 raw wood, saw, 15min., 200x
13 wet antler, saw, 5min., 200x
14 wet antler, saw, 5min., 200x
15 wet antler, saw, 5min., 200x

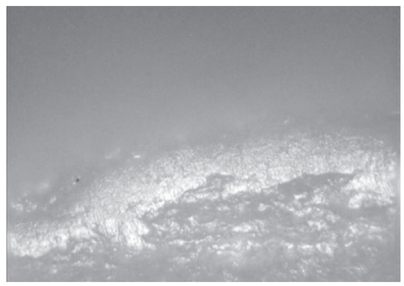
Fig.1 Use-wear polishes on experimental lithic tools.

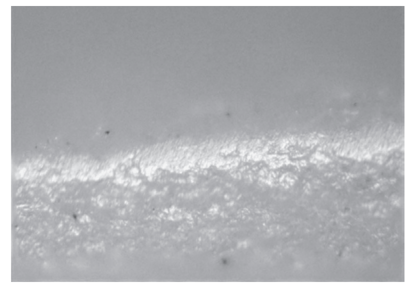

1 raw bone, saw, 15min., 200x

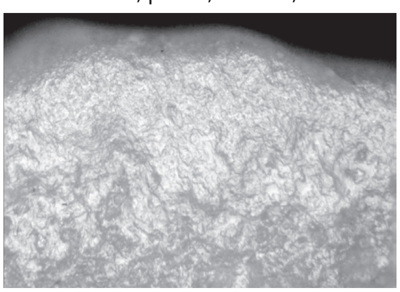

2 raw bone, saw, 15min., 400x

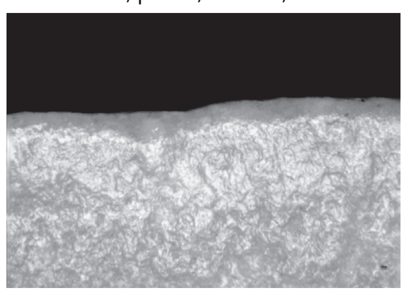

3 raw bone, saw, 15min., 200x

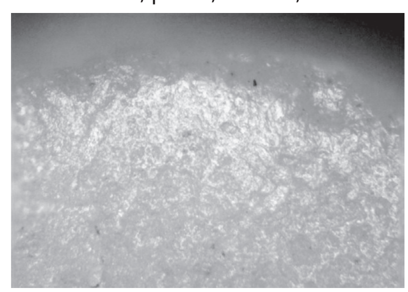

4 raw bone, plane, 15min., 200x

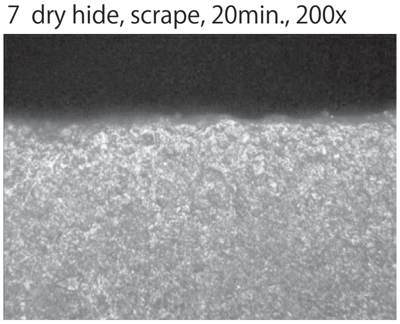

5 raw bone, plane, 15min., 200x

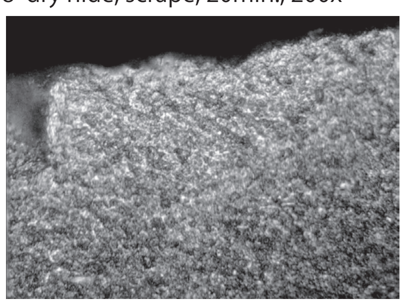

6 raw bone, plane, 15min., 200x

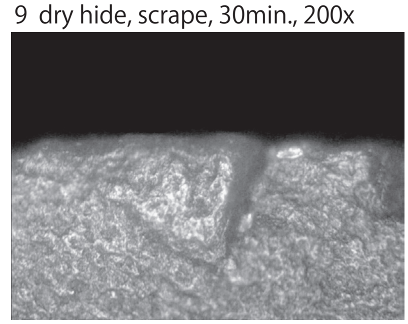

7 dry hide, scrape, 20min., 200x

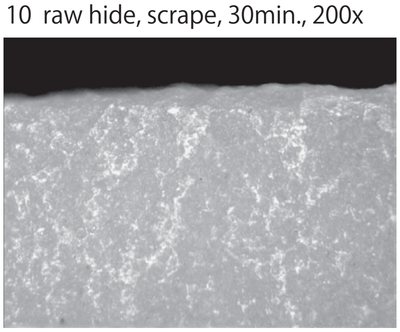

8 dry hide, scrape, 20min., 200x

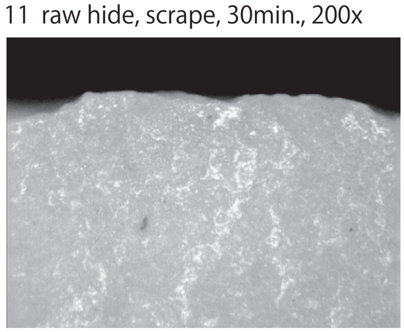

9 dry hide, scrape, 30min., 200x


10 raw hide, scrape, 30min., 200x


11 raw hide, scrape, 30min., 200x


12 raw hide, scrape, 30min., 200x


13 dry hide, cut, 10min., 200x


14 dry hide, cut, 10min., 200x

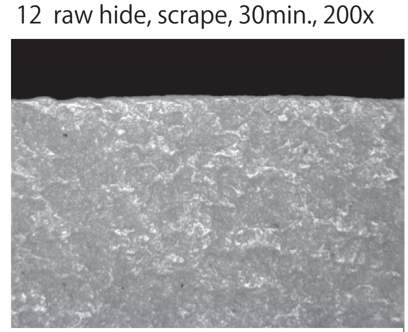

15 dry hide, cut, 15min., 200x

Fig.2 Use-wear polishes on experimental lithic tools.

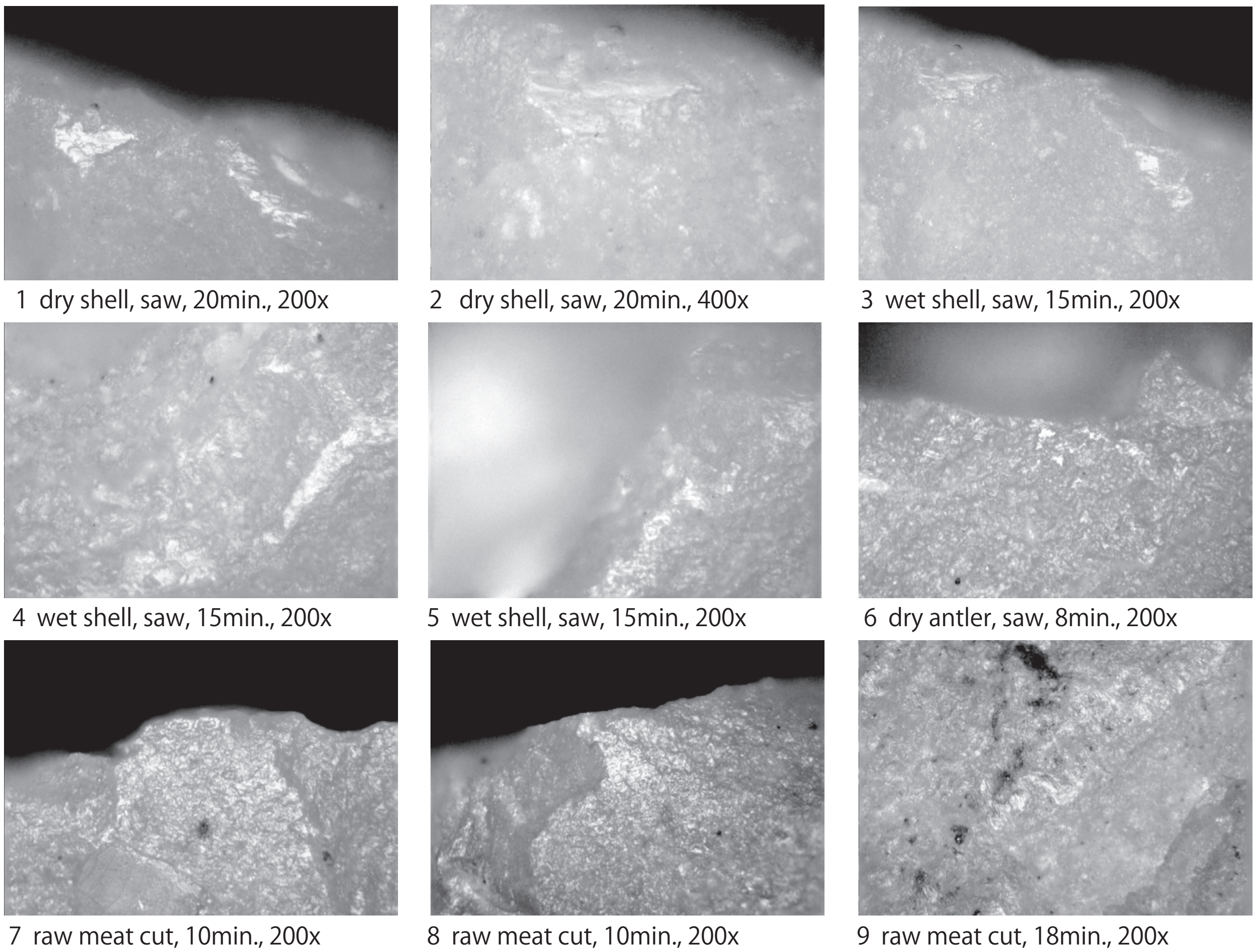


Fig.3 Use-wear polishes on experimental lithic tools.

not clear.

As a result, use polish on siliceous tuff formed in a few minutes with more than one hundred strokes per minute. Though characteristics of use–wear polishes on siliceous tuff are basically the same as those on siliceous shale in Japan (Akoshima & Hong 2017, 2018 etc.), they are somewhat flatter and smoother than polishes on shale. Since these differences are so small, the author could apply the method of use–wear analysis in Japan.

3. Outline of the Gorbatka 3 and Ilistaya 1 sites

These sites are located on the terrace-like surfaces of the left bank of the Gorbatka River in the Russian Far East (Fig. 4). Stratigraphy in the Ilistaya River area is basically composed of light loam (whitish-greyish-yellow in color, 8 to 30 cm thick) in the upper layer and heavy loam (brownish-blackish, 80 cm thick) in the lower layer. The most complete stratigraphic sequence was discovered in a central part of the Gorbatka 3 site. Because water-worn artefacts were found at the Gorbatka 3 and Ilistaya 1 sites in the same stratigraphy position, a kind of water effect was caused in these sites. For example, stratigraphy at the Gorbatka 3 site is composed of a first layer (humus, 8–15 cm thick, without cultural remains), a second layer (greyish-white light loam, 10–25 cm thick, with numerous Palaeolithic artefacts and a number of pot sherds of the Bronze and early Iron Ages), a third layer (brown, brown-black, red-brown, and black heavy loams, 80 cm thick, with Palaeolithic artefacts), a fourth layer (yellow loam, 40–60 cm thick, without cultural remains), and a fifth layer (detritus mantle–basalt bedrock). The excavated area at the Gorbatka 3 site was 400 m^2 in total. In addition, Palaeolithic artefacts were contained in the second layer and in ice-wedge deposits that crushed the upper part of the heavy loam unit of the excavated area of 400m^2 at the Gorbatka 3 site.

Several radiocarbon ages were proposed in these sites. The ^{14}C date of the charcoal from light loam at Gorbatka

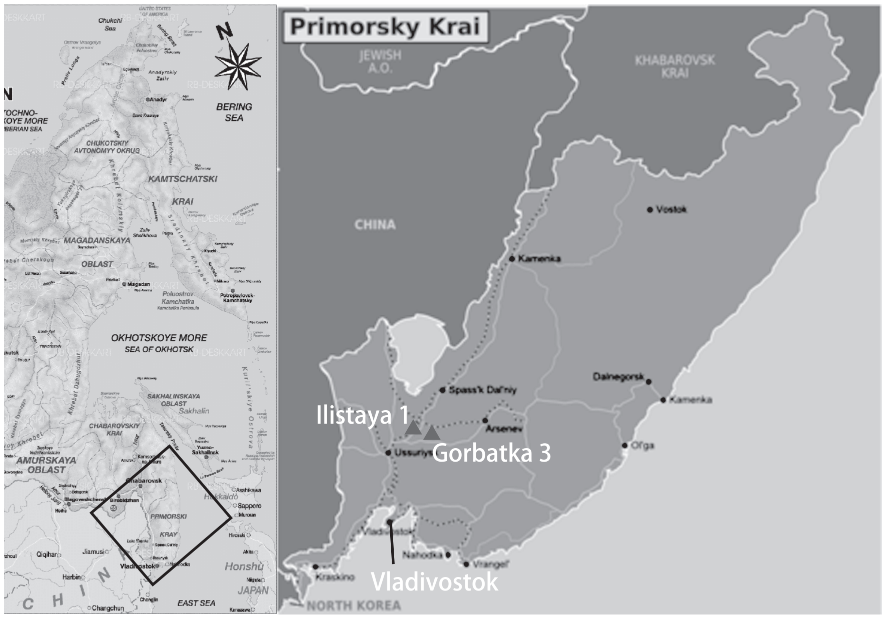


Fig.4 Map of the Gorbatka 3 and Ilistaya 1 sites

3 is 2,590 ±85 BP (SOAN-1921), and the ^{14}C date from the bottom of the dark heavy loam unit is 13,500 ±200 BP (SOAN-1922). In addition, the ^{14}C date from the light loam at the Ilistaya 1 site is 7,840 ±60 BP (Ki-3163). Therefore, the chronological position of lithic materials from these sites would be between 7,840 ±60 and 13,500 ±200 BP, which ranges from the end of Pleistocene to the early Holocene.

Basic lithic assemblage was reported in an earlier article (Kuznetsov 1996). The number of total materials in the upper layer of the Gorbatka 3 site is 38,272, and 84% of the total are flakes. The total number of the lower layer of the Gorbatka 3 site is 6,238, and flakes occupied 77% of the total. Lithic artefacts from the Ilistaya 1 site is 24,781, and flakes occupied 87% of the total. In addition, there were numerous blade cores and bipolar cores in these sites. These lithic assemblages simply represent that these sites were formed as lithic manufacture workshops. There was no organic material in these sites except for some charcoal. Therefore, it is impossible to reconstruct the utilization of animal and botanical resources at the site.

4. Research objects

The first aim of our research is to understand the actual functions of lithic tools, especially burins and end scrapers, at the Gorbatka 3 and Ilistaya 1 sites by the practice of use–wear analysis. In these sites, the classification of items between microblade core, burin, and end scraper is occasionally confused because simplified microblade removal technologies were carried out to cope with the unsuitable size and form of their blanks, which were sometimes produced from a bipolar manufacture sequence. In addition, the so-called “Togeshita-type” microblade core and burin, the “Horoka-type” microblade core, the boat-shaped tool, and the end scraper have similar technological sequences in some cases. Therefore, the precise classification of tool types needs to be constructed not only from a technological perspective but also from a functional aspect through microscopic observation. Concerned to raw materials, silicified tuff, rhyolite, obsidian, chert, and jasper were utilized in these sites. There was no local raw material in these areas. Obsidian sources were in the upper part of the Ilistaya River valley. The relationships between raw materials and lithic assemblages represent their foraging strategies and raw material exploitations. Since the size and quality must have influenced lithic manufacture technologies, each manufacturing sequence must be understood according to differences in raw materials. Finally, the authors propose a new insight to evaluate the chronological position of the microblade industry in the Primorye region from the perspective of Northeast Asia, including northern China and the Japanese archipelago.

5. Research procedure

The objects of this study are materials from the Gorbatka 3 and Ilistaya 1 sites excavated from 1978 to 1989. Chief artefacts except for flakes and irregular cores were selected by the previous studies. At the first step of our research, we counted the number of stone tools in each box according to

Table 2 Lithic assemblage at the Gorbatka 3 site

Tool type	Bipolar core	End scraper	Blade	Boat shaped tool	Micro blade core	Side scraper	Core	Burin	Flake	Biface	Cobble	Retouched blade	Retouched flake	Micro blade	end/side scraper	Microblade core preform	Bifacial point	Bifacial knife	Bifacial tool	Ski spall	Total
Number	321	180	173	168	84	64	59	45	26	13	9	9	7	5	3	3	2	1	1	1	1174

Table 3 Use wear of lithic tools at the Gorbatka 3 site

Tool type	Artifact no.	Raw material	Location of facet	independent use zone	Polish	Striation	Microflaking	Use degree	Figure
burin	69	obsidian	left(u&l)	burin facet	-	vertical	-	heavy	6-5,6,7
	302	green siiceous tuff	left(u&l)	-	-	-	-	-	5-1
	307	chert	left and right	burin facet	-	-	+	-	-
	328	chert	left and right	left facet	bone/antler	vertical	-	light	5-2,3,4
	366	obsidian	left	burin facet	-	vertical	-	light	6-1,2
	1105	obsidian	left	burin facet	-	vertical	-	light	5-7,8,9,10
	1182	obsidian	left	burin facet	-	vertical	-	-	6-8
	1194	obsidian	left	burin facet	-	vertical	+	light	6-3,4
	1977	obsidian	left	burin facet	-	vertical	-	light	7-1
	3646	green siliceous tuff	left	burin facet	bone/antler	vertical	-	light	7-4,5
	B1-1-6	obsidian	left	-	-	-	-	-	-
	B1-1-18	obsidian	left	burin facet	-	vertical	-	heavy	6-9,10,11
	B1-1-29	chert	left(right-small)	-	-	-	-	-	-
	B1-1-34	obsidian	left	-	-	-	-	-	-
	B1-1-55	siliceous tuff	left	burin facet	?	parallel & vertical	-	light	7-2,3
end scraper	113	agate	-	scraper edge	?hide	vertical	-	light	8-4,5,6,7
	139	green siiceous tuff	-	scraper edge	?hide	vertical	-	light	10-9,10
	211	obsidian	-	scraper edge	?	vertical	-	light	10-3,4
	323	chert	-	scraper edge	dry hide	vertical	-	heavy	8-8,9,10,11,12
	426	chert	left and right	scraper edge	dry hide	vertical	-	heavy	7-6,7,8
	431	chalsedony	-	scraper edge	?	vertical	-	light	-
	1220	obsidian	-	scraper edge	dry hide	vertical	-	heavy	9-5,6,7
	1642	obsidian	-	scraper edge	wood	vertical	-	light	9-8,9
	3644	siliceous tuff	-	scraper edge	dry hide	vertical	-	heavy	10-7,8
	B5-2-1	chert	-	scraper edge	hide	vertical	-	light	7-9,10,11
	B5-2-2	chert	-	scraper edge	dry hide	vertical	-	heavy	8-1,2,3
	B5-2-9	chert	-	scraper edge	dry hide	vertical	+	heavy	9-1,2,3,4
	B5-2-42	obsidian	-	scraper edge	?	vertical	-	light	9-10,11
	B5-2-44	obsidian	-	scraper edge	?	vertical	-	light	10-1,2
	B5-2-65	obsidian	-	scraper edge	?	vertical	-	light	10-5,6
microblade core	3605	green siiceous tuff	right	-	-	-	-	-	-
	B1-1-1	obsidian	right	-	-	-	-	-	5-5,6
	B1-1-2	obsidian	left and right	left facet	-	vertical	-	light	-

raw material and tool type (Tables 2 and 4), and took photos of all the materials.

Then, lithic artefacts were selected for technological and use–wear analyses. Microblade technologies were grasped objectively by one of the authors (Aoki). A functional analysis of lithic tools was conducted by another author (Kanomata) with a metallurgical microscope (Olympus BHM). The result is summed up in Tables 3 and 5. We also made drawings of lithic artefacts needed for the analyses (Figs. 17 to 20).

6. Analyses at the Gorbatka 3 site

a. Technological analysis

In total, 1,174 lithic materials were selected from the Gorbatka 3 site for this study. The assemblage of selected materials at Gorbatka 3 is as follows (Table 2): bifacial tools (N=17), bipolar cores (321), microblade cores (84), microblade core preforms (3), blades (173), microblades (5), boat-shaped tools (168), burins (45), cores (59), end-scrapers (180), end/side scrapers (3), side scrapers (64), flakes (26), cobbles (9), retouched blades (9), retouched flakes (7), and a ski spall (1).

We looked at 84 microblade cores and three microblade preforms. From the viewpoint of Japanese archaeologists, microblade core types were composed of Togeshita (Figs. 16-4, 16-6, 20-7, 20-9, 20-11 and 20-13), Horoka (Figs. 16-9 to 16-11), wedge-shaped (Figs. 16-1 to 16-3, 20-1 to 20-4 and 20-6), and those made from blank flake without a secondary retouch (Figs. 16-8, 16-10, 20-12 and 20-14). The number of simple microblade removal technology is so outstanding that we had a problem classifying microblade cores from burins. This problem will be considered in a cooperative analysis between technological and functional studies. To be precise, the microblade core type should be strongly related with a special chronological and regional position. Therefore, we can point out similarities but should reconstruct each microblade technology individually.

Average size of end scraper is 36.2 mm in length, 21.9 mm in width, 8.86 mm in thickness (Figs. 17-16 to 17-25, 18-1 to 18-4, 21-14 to 21-23). The average edge angle is 69.3°. Average size of burin is 36.5 mm in length, 18.1 mm in width and 6.7 mm in thickness (Figs. 17-1 to 17-24, 21-1 to 21-13). The average edge angle between burin facet and ventral face is 97.9°.

The most frequently produced material are bipolar cores (N=321). Small obsidian pebbles (from 3 to 6 cm in diameter) were the main raw material for the bipolar technique. They must have been taken from the Ilistaya River gravel. The experimental workshop on the bipolar technique was carried out in Tohoku University in November 2019. We will reconsider the characteristics of bipolar technology at the Gorbatka 3 and Ilistaya 1 sites in the next paper. Blade technology is characterized by the existence of platform preparation retouch and crested ridge formation (Fig. 22). Relatively larger blades were produced in this site.

b. Use–wear analyses

There are several kinds of raw materials at the Gorbatka 3 site. The quality and sustainability against post-depositional surface modification relate to how suitable the raw material is for use–wear analysis. The most suitable raw material is chert and/or chalcedony. Because their surface sustains the original, worked material and the direction of operation can be assumed. The second one is highly silicified green tuff that worked material, and the direction of operation can be also assumed. In the case of obsidian, the direction of operation can be assumed on a limited basis except for a few obsidian samples that kept their original surfaces. The usual siliceous white/grey tuff that occupied the larger portion of the raw materials is not suitable for use–wear analysis because their original surfaces were completely changed in the post-depositional modification. Rhyolite and andesite are commonly unsuitable for a use–wear analysis. Therefore, our object materials were restricted.

In total, 15 utilized end scrapers and 11 used burins were found at the Gorbatla 3 site by microscopic observation (Table 3). Then, 26 lithic tools with use wear became objects of precise observation under a microscope from a traceological viewpoint. The most utilized tool at the site was the end scraper. The edge was used for scraping (N=10) and worked material would be dry hide (N=6), hide (N=3), and wood (N=1). Burins were chiefly utilized to whittle/plane (N=9). Only one worked material was assumed to be of the bone/antler variety (N=2). The use rate of the end scraper is higher (60.3%), and that of burin is not as high (44%).

Figure 5-1 shows a photo of the edge of lithic artefact no. 302. This tool has three burin facets (Fig. 17-2) and no use-wear on all these facets. Burin (no. 328) made from chert has the D1-type of micro polish accompanied by vertical striations (Figs. 5-2 to 5-4). This burin must have been utilized for planing bone/antler.

Obsidian tools have unfamiliar striations in our research experience. Numerous striations composed of a line of pits were recognized on the edge between the burin facet and the ventral surface (Figs. 5-5 and 5-6). These traces must have been caused by post-depositional effects. Usual use–wear striations on obsidian tools were as shown in the photos (Figs. 5-7 and 5-8). On the base of this burin (no. 1105), wider striations were formed probably by hafting activity (Figs. 5-9 to 5-11).

Striations composed by a line of pits were commonly observed on burins nos. 366, 1194, 69, 1977, and b1-1-18 (Figs. 6-1 to 6-6, and 7-1). Such striations extend to the opposite side of the burin facet (Figs. 6-9 to 6-11). No use–

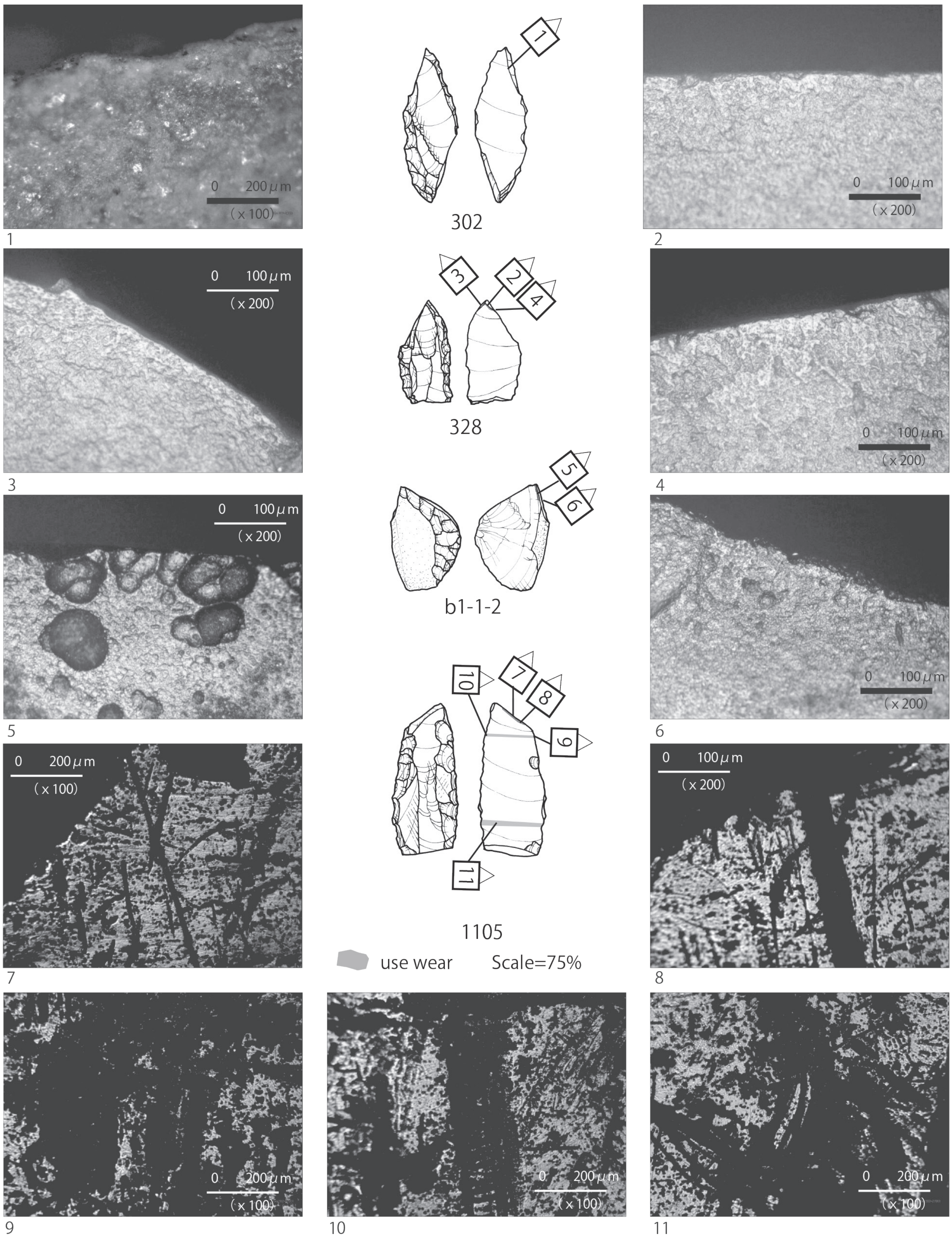


Fig.5 Use-wear on lithic tool at the Gorbatka 3 site.

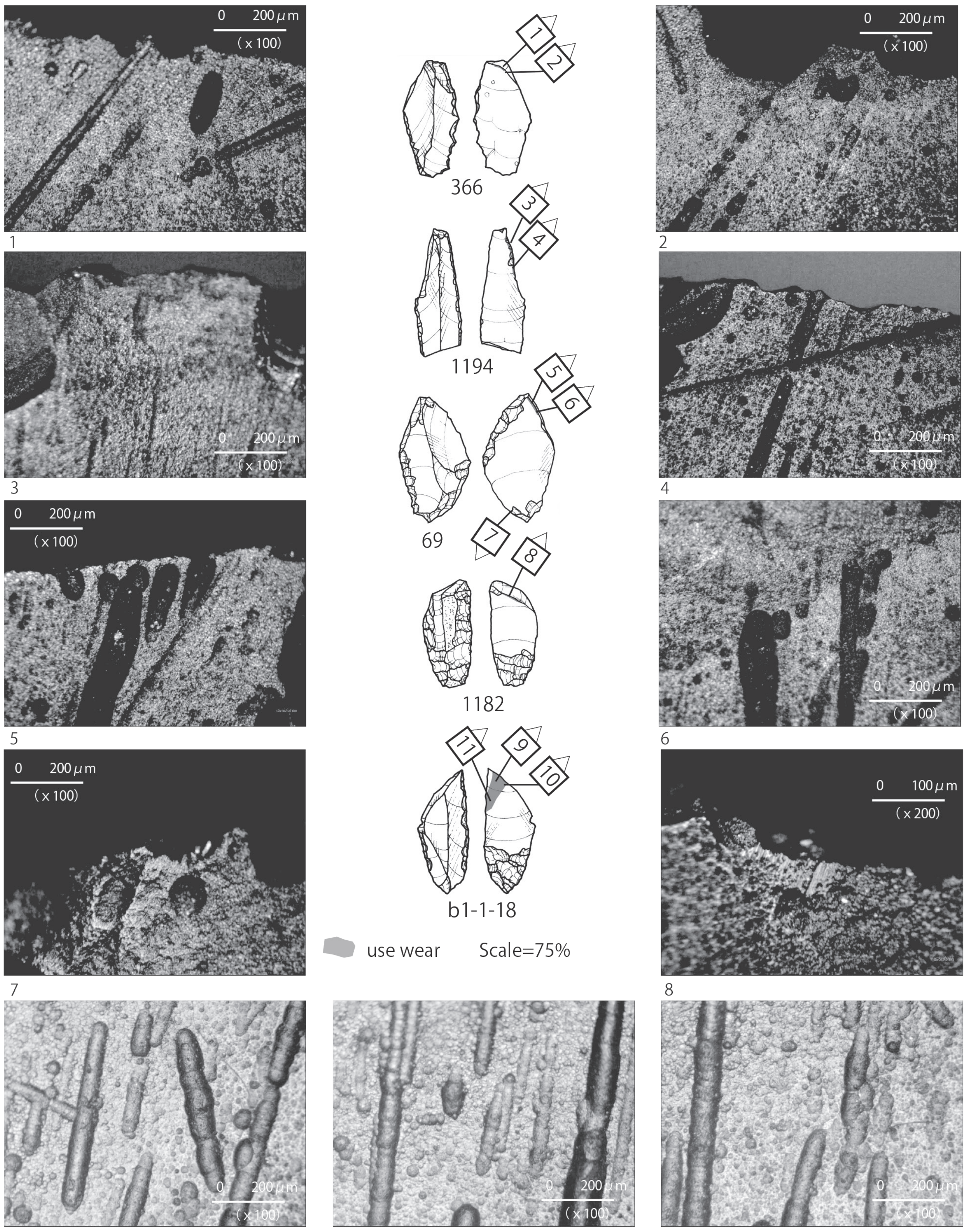


Fig.6 Use-wear on lithic tool at the Gorbatka 3 site.

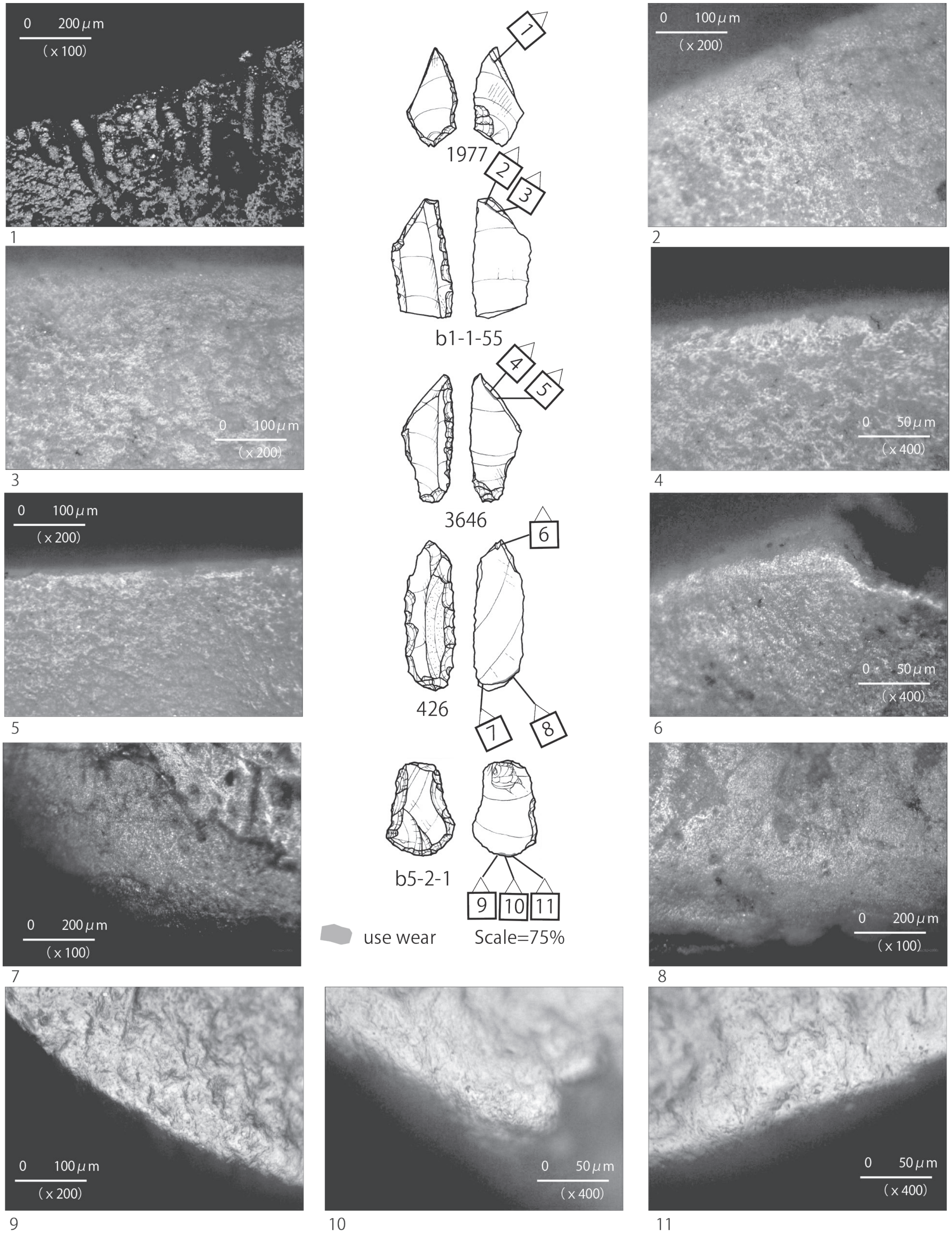


Fig.7 Use-wear on lithic tool at the Gorbatka 3 site.

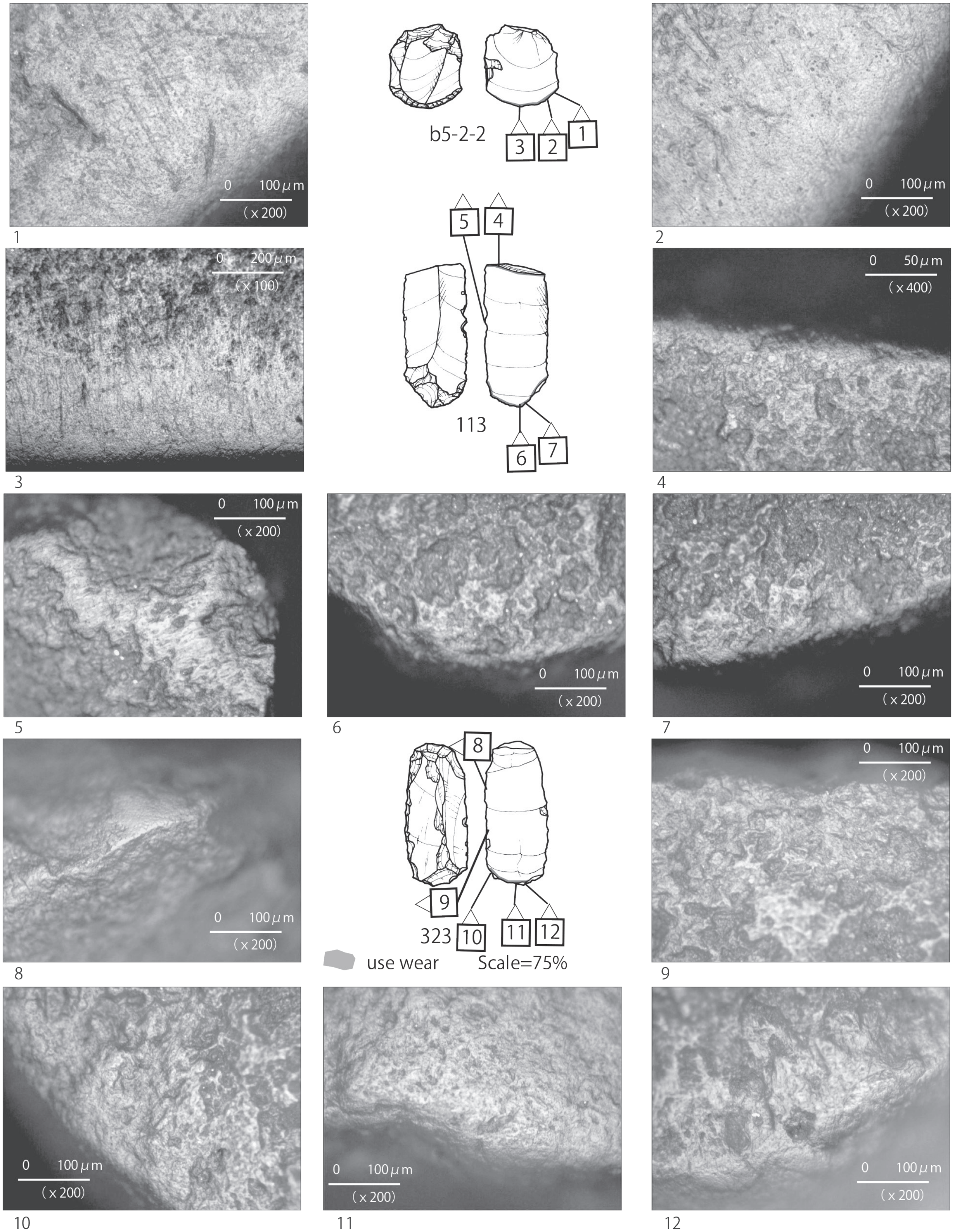


Fig.8 Use-wear on lithic tool at the Gorbatka 3 site.

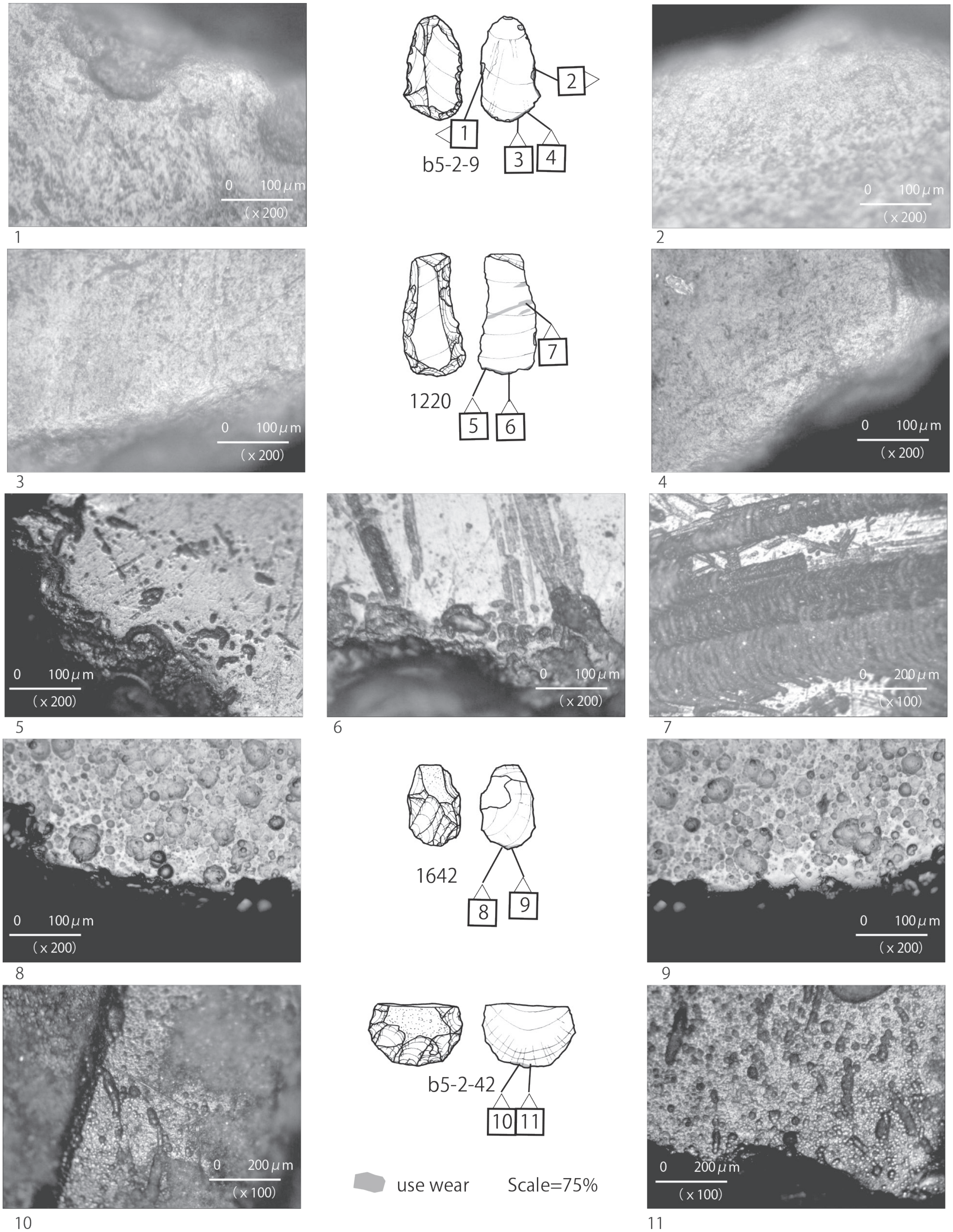


Fig.9 Use-wear on lithic tool at the Gorbatka 3 site.

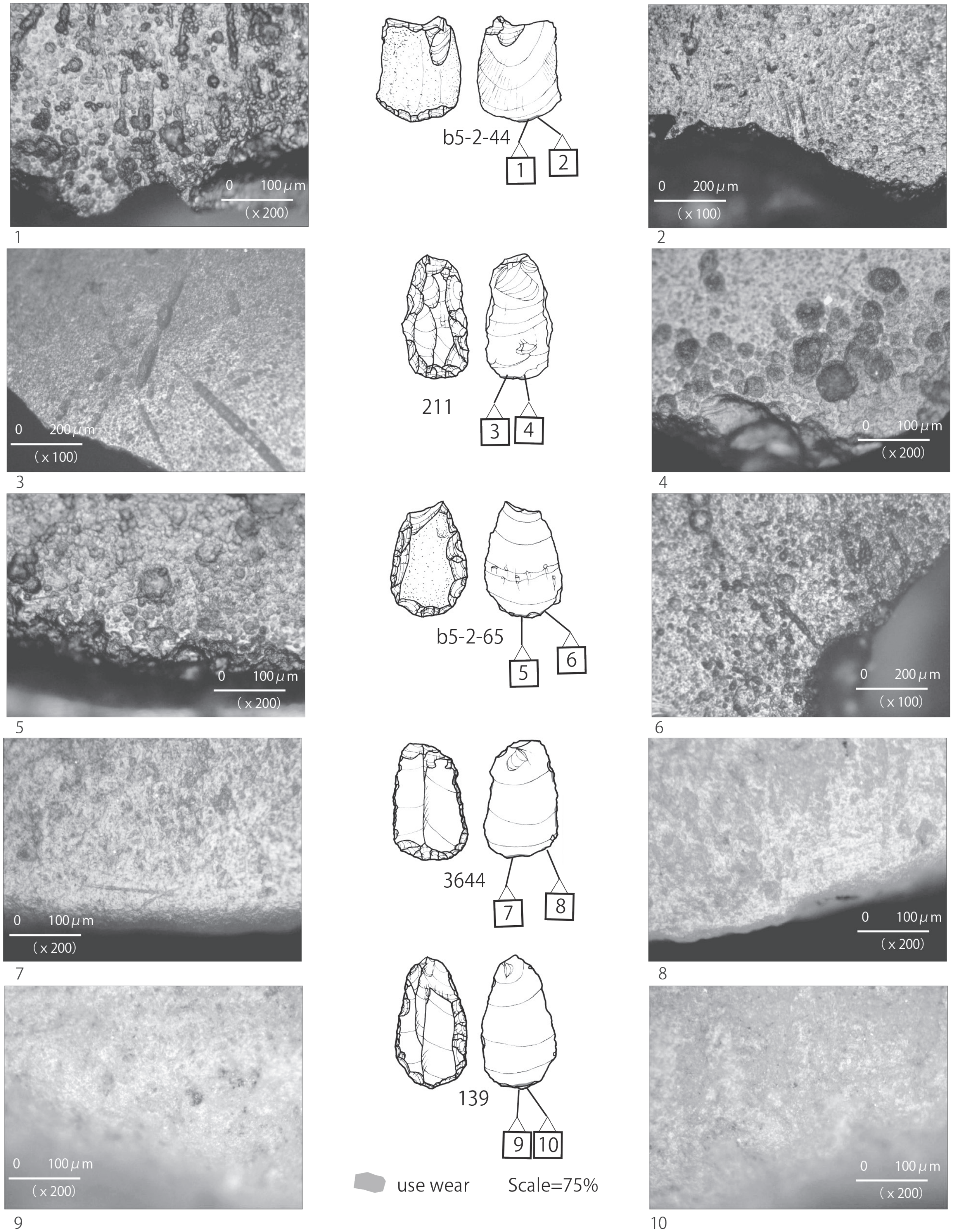


Fig.10 Use-wear on lithic tool at the Gorbatka 3 site.

wear polish is recognized accompanying these striations. It would be related to post-depositional effects and the use degree of each tool. A relatively apparent polish was found on the burin edge of no. 1182 (Fig. 6-8). Vertical and density striations were formed on the light and flat micro polish. This kind of polish is usually formed by the contact with a hard material such as bone/antler.

Use-wear on silicified tuff has similar characteristics. The distribution of polish was limited on the edge between the burin facet and the ventral face. Striations were basically vertical to the edge. The polish profile is principally flat with minute, dense striations (Figs. 7-2 to 7-5). These burins might have been used for planing bone/antler.

An end scraper with two burin facets was excavated from the Gorbatka 3 site. It is difficult to classify whether this was a burin or an end scraper. Despite the absence of use wear on the burin facets (Fig. 7-6), a well-developed polish with vertical striations was recognized on the distal end of the scraper edge (Figs. 7-7 and 7-8). Micro polish is characterized by the existence of numerous micro pits, a rough surface, and a round profile. This polish (the E2-type) has a strong relationship with dry hide working.

End scrapers were generally utilized for scraping hide. In case of end scrapers made from chert, silicified tuff, and chalcedony, the E2-type of micro polishes were situated on the distal end of scraper edges (Figs. 7-9 to 7-11, 8-1 to 8-12, 9-3, 9-4, 10-7 to 10-10). This polish type is generally caused by scraping dry hide. Abrasive wear and bright spots were occasionally formed on the base and the middle of lateral edges (Figs. 8-4 to 8-9, 9-1 and 9-2).

Vertical striations were often recognized on the use edge of obsidian end scrapers (Figs. 5-10, 5-11, 6-1 to 6-4). Striations were sometimes composed of continuous pits. Abrasive polish accompanying numerous pits were found on several end scrapers (Figs. 9-5, 9-6, 10-5 and 10-6). This is an E-type of polish that is basically caused by the contact with hide/leather. Round and bright polish is found on the edge of end scraper no. 1642 (Figs. 9-8 and 9-9). Since distribution of the polish is limited near the edge, and its border is clearly lined, this polish is regarded as a B-type, usually caused by woodworking. In addition, vertical and narrow striations in the polish on this scraper would be utilized for scraping wood. Wide and apparent striations were crossed on the base of some end scrapers (Fig. 9-7). Such traces would be caused by hafting activities.

47 microblade cores (56% of the total) also became objects of precise observation under a microscope. 15 of them were unsuitable for the analysis because of the post-depositional surface modification. 34 microblade cores have no use-wear on their expected use edges. That is to say, microblade cores weren't utilized basically and had a role limitedly for microblade manufacture.

7. Analyses at the Ilistaya 1 site

a. Technological analysis

In total, 1,406 lithic materials were selected from the Ilistaya 1 site for this study. The assemblage at the Ilistaya 1 site is as follows (Table 4): bifacial tools (N=36), bipolar cores (596), and microblade cores (72), microblade core preforms (15), cores (3), blades (11), microblades (41), boat-shaped tools (16), burins (52), burin spalls (22), end-scrapers (68), a pointed scraper (1), side scrapers (53), drills (4), flakes (179), pebbles (6), chunks (122), a perforated flake (1), a hummer stone (1), retouched flakes (16), first spalls (47), ski spalls (43) and an unifacial tool (1).

We observed 72 microblade cores and 15 microblade core preforms. Although microblade technologies in Ilistaya 1 were basically similar to those in Gorbatka 3 site, the Hirosato-type of microblade core was absent from this site.

Microblade cores were typologically composed of Horoka (N=20) (Figs. 23-9, 23-12, 24-1 and 24-2), Togeshita (N=3) (Figs. 23-1 and 23-4), wedge-shaped (N=12) (Figs.23-2, 23-3, 23-5, 23-7, 23-8, 23-10 and 23-11), and simple flake blank (N=36). Although wedge-shaped microblade cores were regarded as cores made using the Yubetsu technique in some previous papers (Pantukhina 2007 etc.), we regarded it as one of the final shapes using Fukui technique known in Kyushu island around 15,000 calibration BP. We recognized retouching on the platform at the top of the microblade removal face and removal of core tablets to renew the platform on such cores.

Compared to the assemblage at the Gorbatka 3 site, there are larger number of bipolar cores, microblade core preforms, and microblade spalls (first and ski spalls). In contrast, the numbers of end scrapers and boat-shaped tools at Ilistaya 1 were smaller than those at the Gorbatka 3 site. It must be reflected by the difference in site function and/or distance from raw material sources.

Average size of end scraper is 35.9 mm in length, 24.5 mm in width and 8.68 mm in thickness (Figs. 19-14 to 19-16, 24-3 to 24-16). Average edge angle of end scraper is 70.3°. Average size of burin is 34.4 mm in length, 17.7 mm in width and 6.8 mm in thickness (Figs. 19-2, to 19-16, 24-17 to 24-19). Average edge angle between burn facet and ventral face is 98.3°.

b. Use–wear analysis

In total, 37 end scrapers, 22 burins, and a utilized retouched flake became objects of the analysis from a traceological viewpoint under a microscope at the Ilistaya 1 site. Then, 15 lithic tools (two end scrapers, 12 burins, and a retouched flake) with use-wear were recognized. Therefore, the most utilized tool was the burin at this site (use rate = 48%). Despite the discovery of numerous end scrapers, they

Table 4 Lithic assemblage at the Ilistaya 1 site

Tool type	Bipolar core	Flake	Chunk	Microblade core	End scraper	Side scraper	Burin	First spall	Ski spall	Micro blade	Biface	Burin spall	Boat shaped tool	Retouched flake	Microblade core perform	Blade	Bifacial point	Pebble	Bifacial point preform
Ilistaya1	596	176	122	72	68	53	52	47	43	41	23	22	16	16	15	11	6	6	6

Tool type	Drill	Core	Retouch flake from MC	Bifacial tool	Hummer stone	Perforated flake	Pointed scraper	Unifacial tool	Total
Ilistaya1	4	3	3	1	1	1	1	1	1406

Table 5 Use wear of lithic tools at the Ilistaya 1 site

Tool type	Artifact no.	Raw material	Location of facet	Independent use zone	Polish	Striation	Microflaking	Use degree	Figure
burin	B5-1-1	green siliceous tuff	left	burin facet	?bone/antler	vertical	-	light	11-5,6
	B5-1-5	chert	left	burin facet	bone/antler	vertical	-	light	11-1
	B5-1-6	green siliceous tuff	left	burin facet	?bone/antler	vertical	-	light	11-7,8
	B5-1-7	chert	left	tip of burin facet	bone/antler	parallel	-	heavy	11-2,3,4
	B5-1-8	obsidian	left	burin facet	-	vertical	-	light	12-1,2
	B5-1-9	obsidian	left	burin facet	-	vertical	-	heavy	12-3,4
	B5-1-10	obsidian	left	burin facet	-	vertical	-	light	12-5,6,7,8
	B5-1-11	obsidian	left	burin facet	-	vertical	-	light	12-9,10
	B5-1-13	obsidian	right	burin facet	-	vertical	-	light	13-1,2
	B5-1-14	obsidian	right	burin facet	-	vertical	-	light	13-3,4
	B5-1-15	obsidian	right	burin facet	-	vertical	-	light	13-5,6
	B1-2-22	jasper	left	burin facet	?bone/antler	vertical	-	light	11-9,10
end scraper	B4-3-31	obsidian	-	scraper edge	hide	vertical	+	light	13-9,10
	B4-3-33	chert	-	scraper edge	dry hide	vertical	-	light	13-7,8
retouced flake	B4-5-1	agate	-	broken face like burin facet	wood	vertical	-	light	14-1,2,3,4

were seldom used in the site (use rate = 5.4%). Compared with the Gorbatka 3 site, the absence of end scraper utilization is the most apparent feature at the Ilistaya 1 site.

Figure 11 shows use traces of burins made of chert, green siliceous tuff, and jasper. It is possible to distinguish the micro-polish type on the burins made from these raw materials. Use–wear polish is commonly flat and bright with vertical and narrow striations (Figs. 11-1, 11-5 to 11-10). They would be used for whittling/planing bone/antler. A burin with a sharp edge of burin facet was utilized for cutting/sawing bone/antler (Figs. 11-3 and 11-4).

Figure 12 shows use wear on obsidian burins at the Ilistaya 1 site. In the case of obsidian, micro-polish is not apparent because of post-depositional effects and developed striations. Vertical striations were commonly observed on the edge between the burin facet and the ventral face (Figs. 12-2 to 12-10, 13-1 to 13-6). Micro-polish was recognized to a limited extent on the edge of a better condition (Fig. 12-1). Hafting traces as wide striations and abrasion were occasionally formed on the base of the burin (Fig.12-8).

The E2-type of polish was recognized on the use edge of an end scraper (Figs. 13-7 and 13-8). This would have been used for scraping dry hide. Vertical striations were formed on the edge of an obsidian end scraper (Figs. 13-9 and 13-

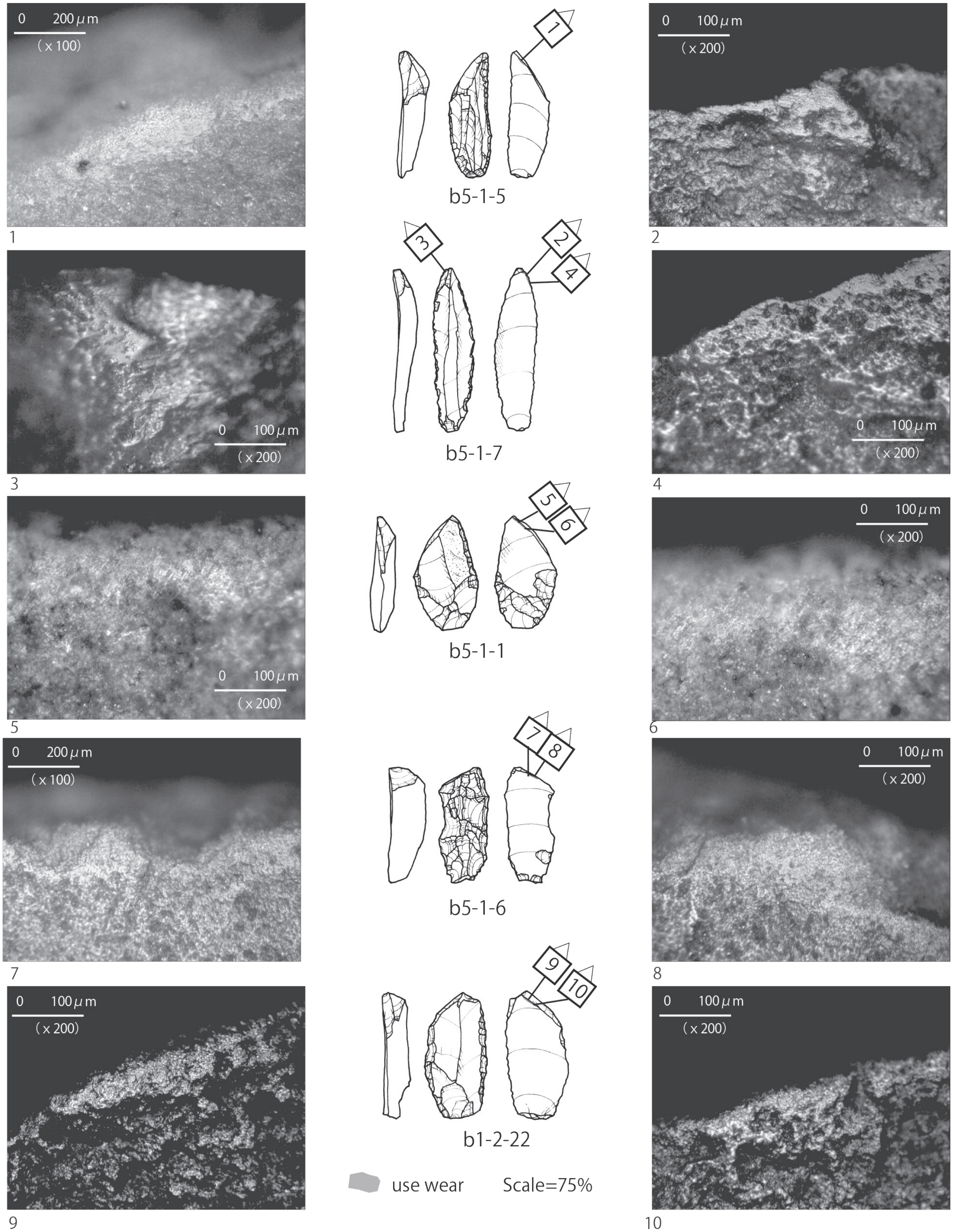


Fig.11 Use-wear on lithic tool at the Ilistaya 1 site.

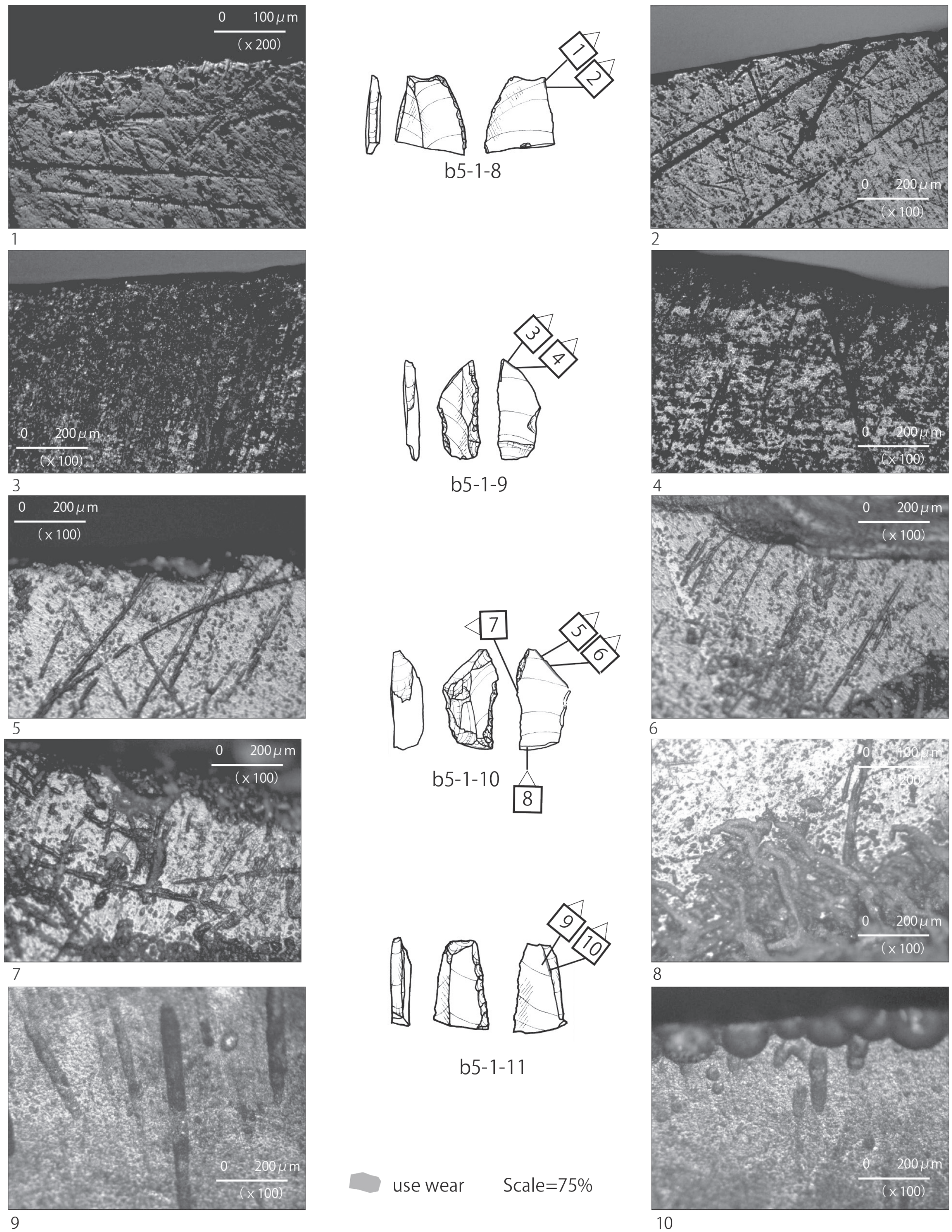


Fig.12 Use-wear on lithic tool at the Ilistaya 1 site.

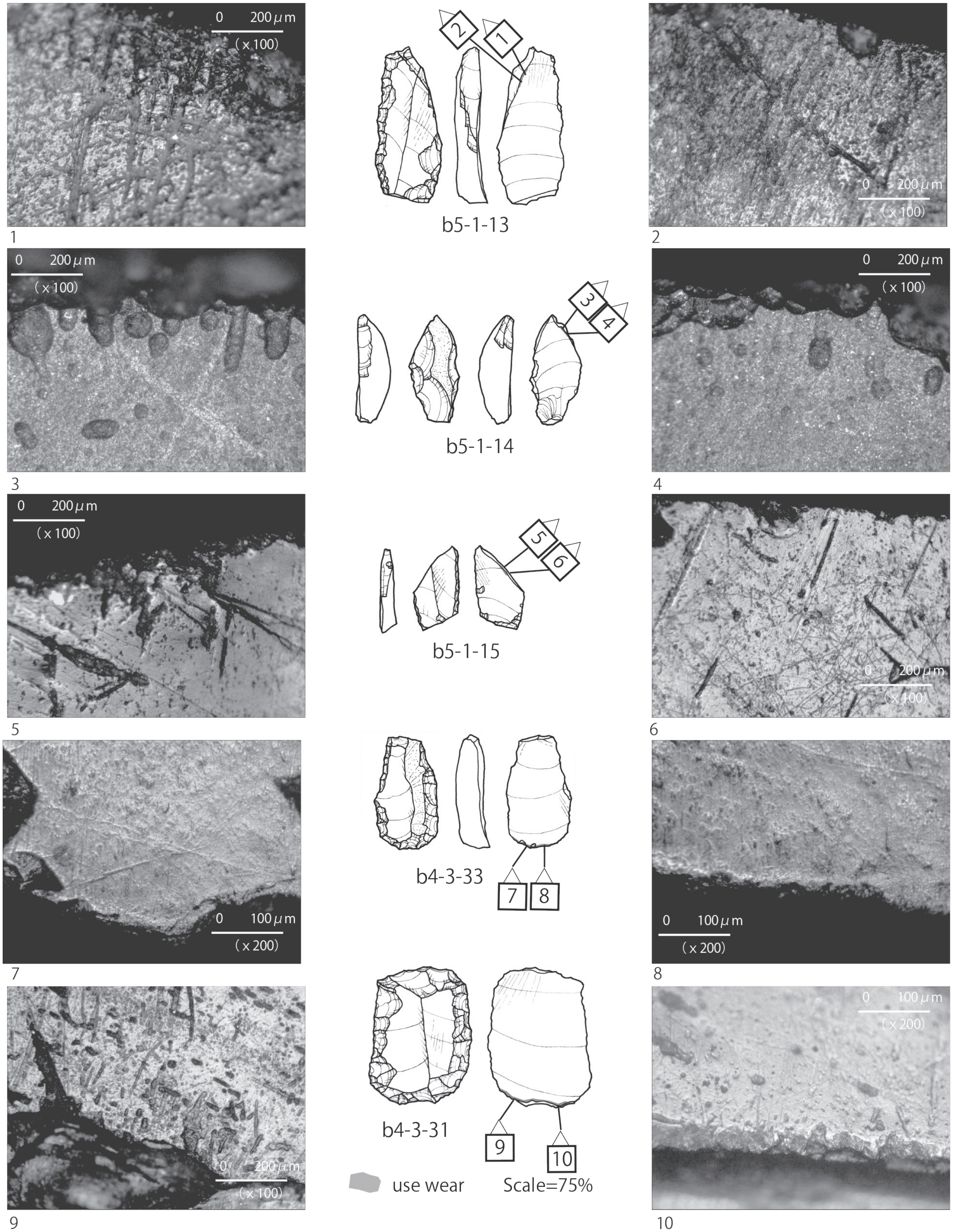


Fig.13 Use-wear on lithic tool at the Ilistaya 1 site.

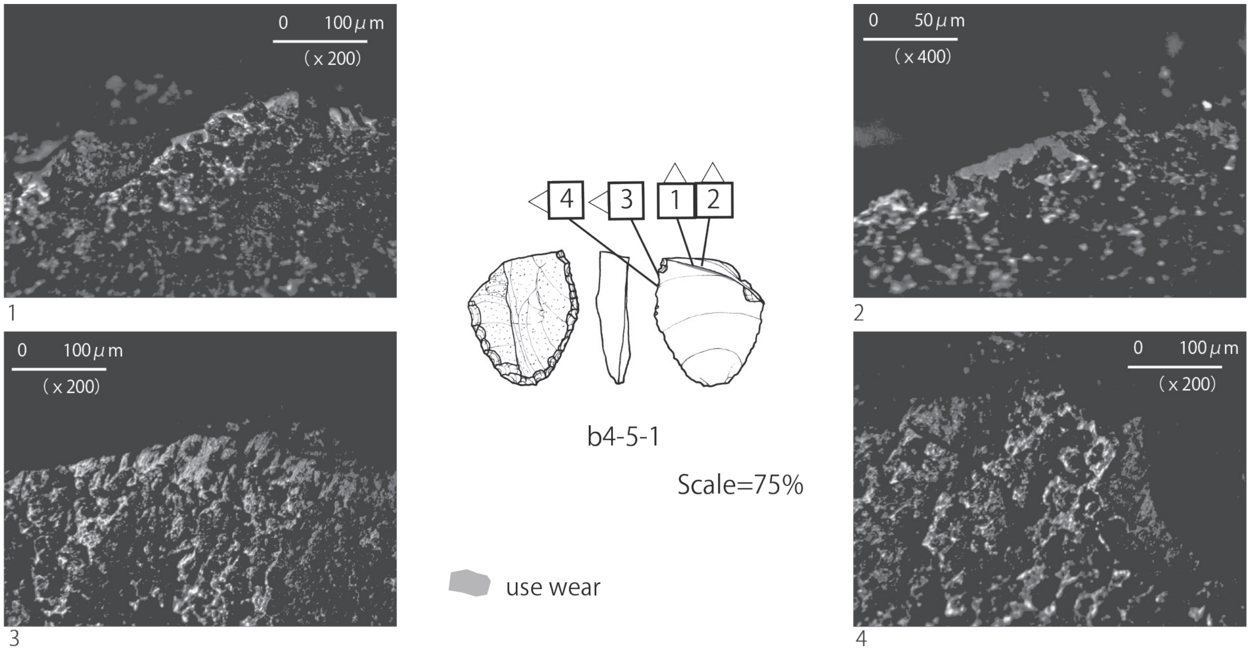


Fig.14 Use-wear on lithic tool at the Ilistaya 1 site.

10). This was also used for scraping activity.

A retouched flake has a broken face like a burin facet. Since this edge has a B-type polish (Figs. 14-1 and 14-2), this would have been used for planing wood. The other edge with retouch has a D1-type polish with vertical striations. This edge would be used for whittling/planing bone/antler. This was a multi-function tool.

8. Considerations

Technological approaches at these sites presented us with some criteria to distinguish between microblade cores (of the Hirosato and Tougeshita-types) and burins. When a blank is a flake or blade, they sometimes have similar morphological characteristics (Fig. 15). The angle between the ventral face and the burin facet (microblade removal face, in the case of a microblade core) is one of the most important criteria. The average angle of the microblade core is 135.5° and that of the burin is 97.9° at the Gorbatka 3 site. The edge angle of burins at Ilistaya 1 site is 98.3°on average. The second criterion is the position of the burin facet and the microblade removal face. The facet of the burin is situated on the left shoulder of a blank flake/blade. In contrast, the microblade removal face is basically located on the right shoulder of the blank flake/blade. From a functional aspect, there is no use-wear on the microblade removal face. Traces of use are found a half of burin facets.

Short and thick flakes were used for the microblade core and end scraper blanks. Since both the scraper edge and the microblade removal face are situated on the distal end of the blank, it is sometimes difficult to distinguish between the microblade core (Horoka-type) and the end scraper. From a technological aspect, microblades were removed by the pressure technique, and end scraper edges were retouched by direct percussion with organic hummers. The angle between the microblade removal face and the ventral face of a blank flake is about 50°on average. In contrast, the edge angle of end scrapers is around 70° on average. Functionally, there is no use-wear on the edge of microblade cores. More than a half of the use edges of end scrapers have use-wear. Through these approaches, microblade cores, burins, and end scrapers were correctly categorized.

Regarding site functions, the use of end scrapers distinguishes these two sites. There were more than twice the number of end scrapers at Gorbatka 3 (N=180) than at the Ilistaya 1 site (N=68). In addition, 60% of the end scrapers were utilized for hide scraping at Gorbatka 3, although 5.4% of end scrapers had use-wear at the Ilistaya 1 site. Therefore, the hide scraping needed for longer stable settlements was chiefly carried out at the Gorbatka 3 site. Ten times more boat-shaped tools were discovered at Gorbatka 3 than at Ilistaya 1 (Fig. 24-22). They may be used as blanks for end scrapers in some cases. In lithic assemblage, bipolar cores and microblade spalls were mainly excavated from the Ilistaya 1 site, not from Gorbatka 3 (Figs. 24-21, 24-23 and 24-24). These differences characterize the site functions of the sites. Burins were commonly used for bone/antler planing/whittling at both

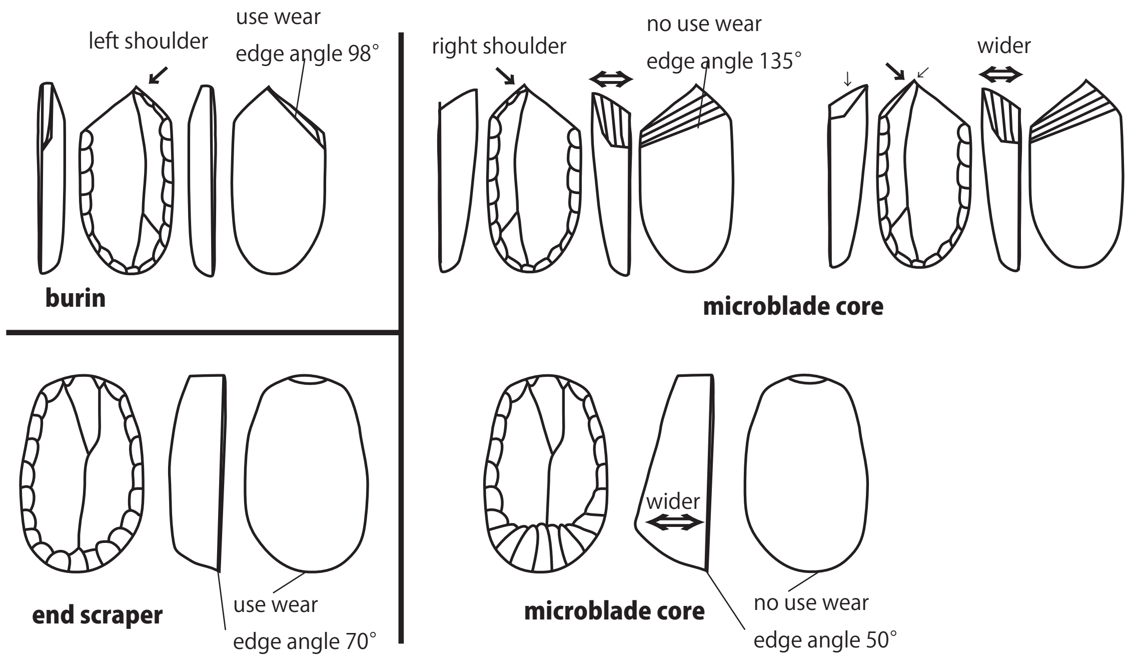


Fig.15 Characteristics of burins, end scrapers and microblade cores

sites. Microblade removal and bone/antler tool manufacture coexisted because of composite tool production. This activity was organized as a basic component in their subsistence technology and hunting strategy.

Acknowledgement

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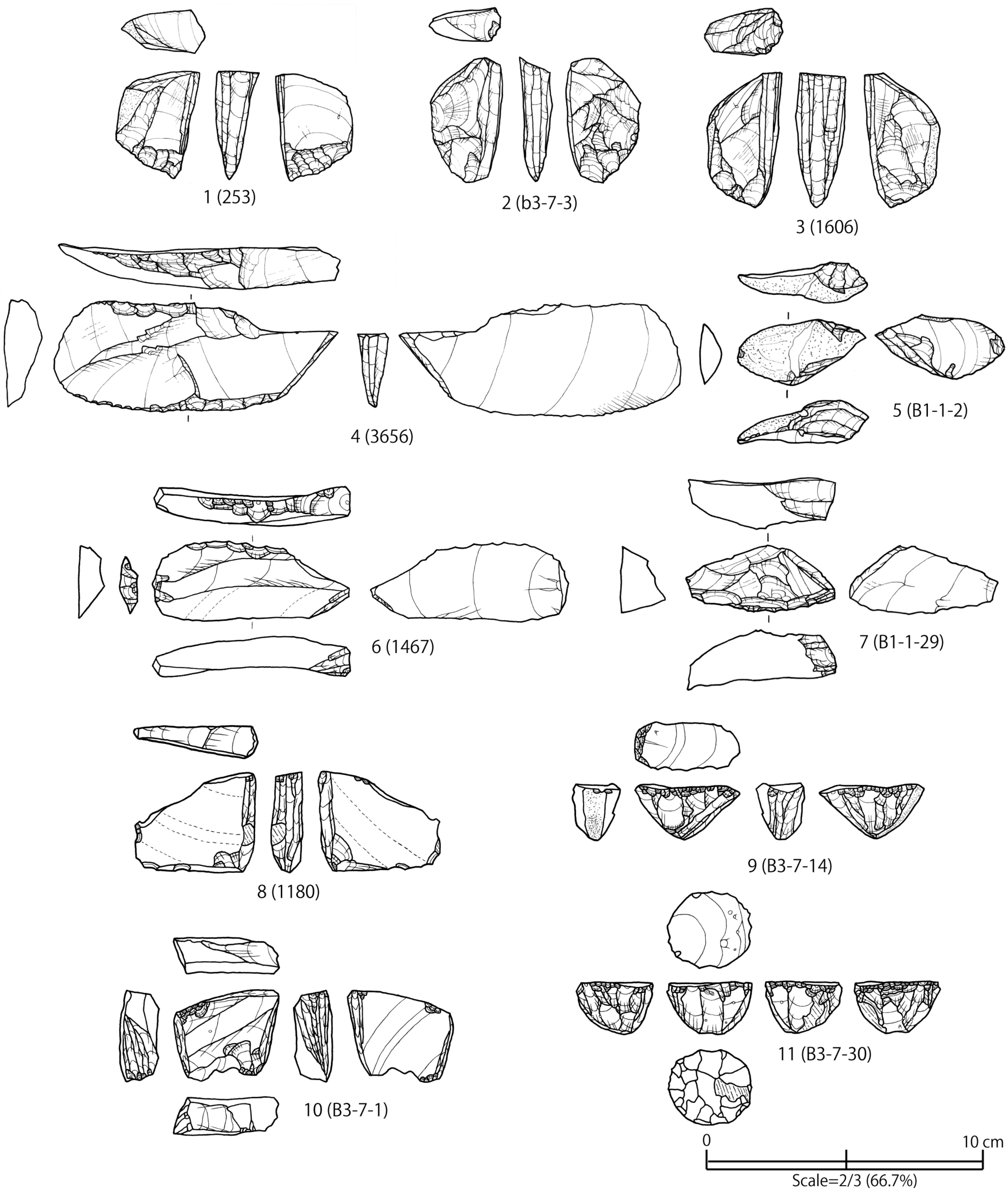

Fig. 16 Lithic tools excavated from the Gorbatka 3 site

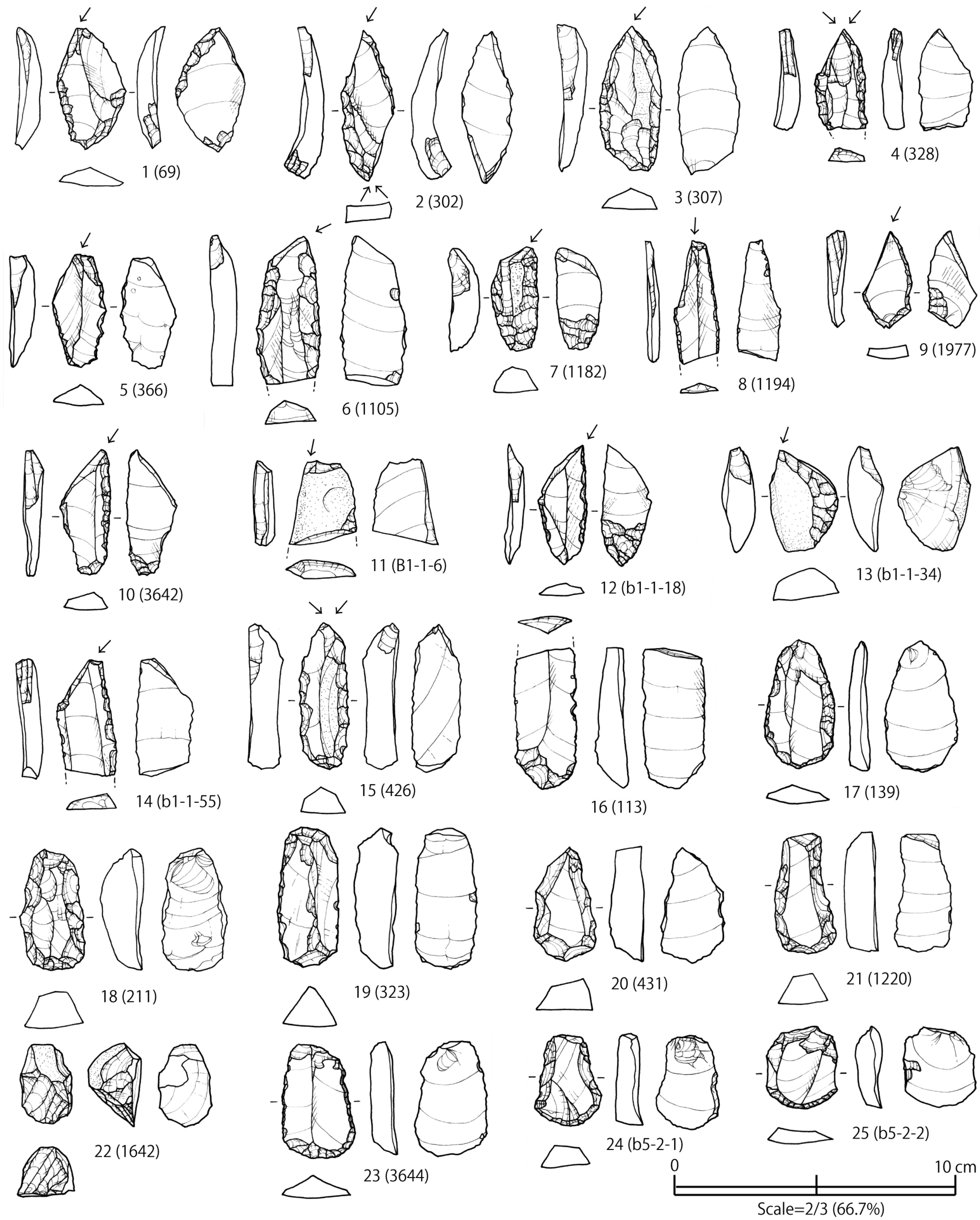

Fig. 17 Lithic tools excavated from the Gorbatka 3 site

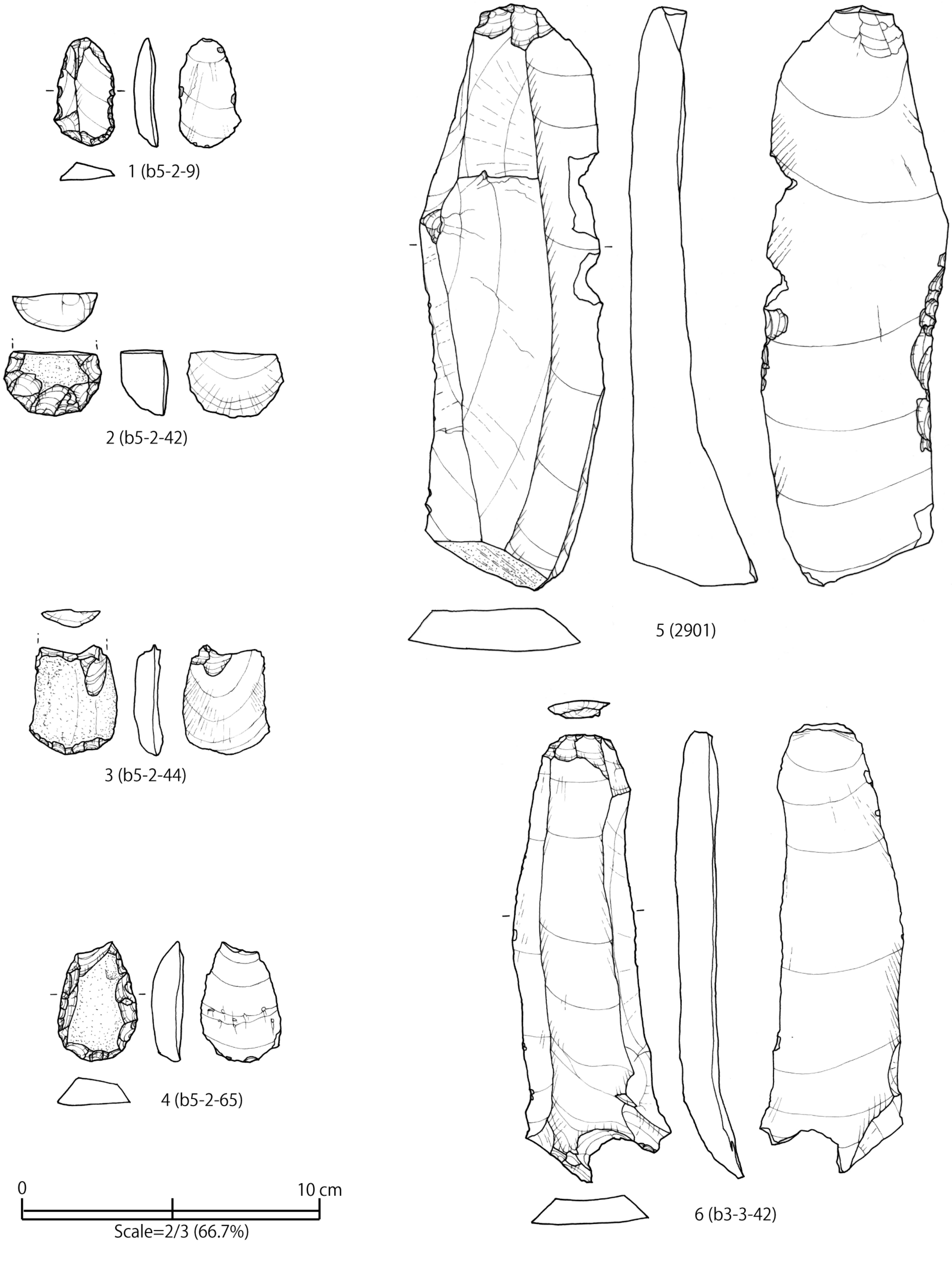

Fig. 18 Lithic tools excavated from the Gorbatka 3 site

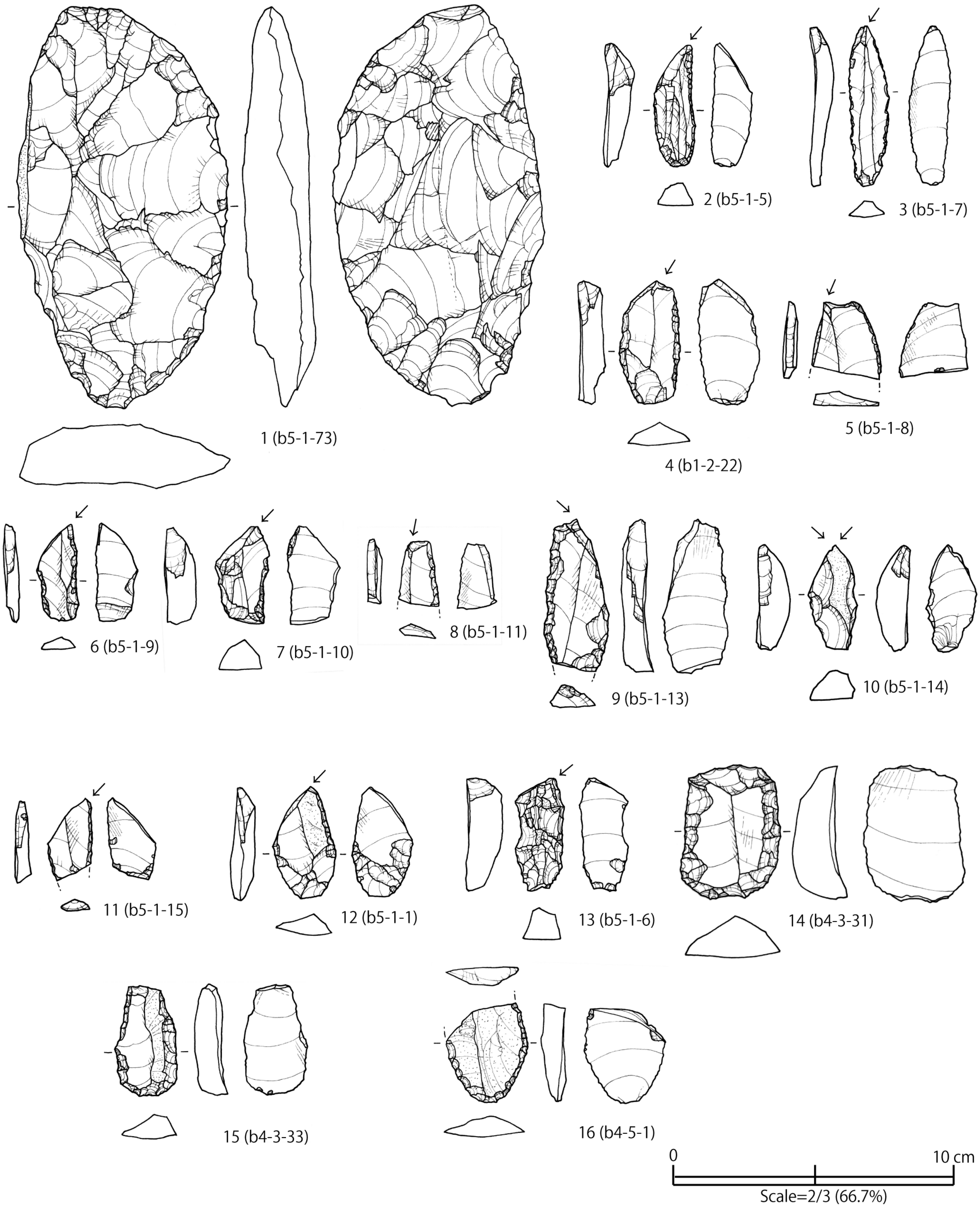

Fig. 19 Lithic tools excavated from the Ilistaya 1 site

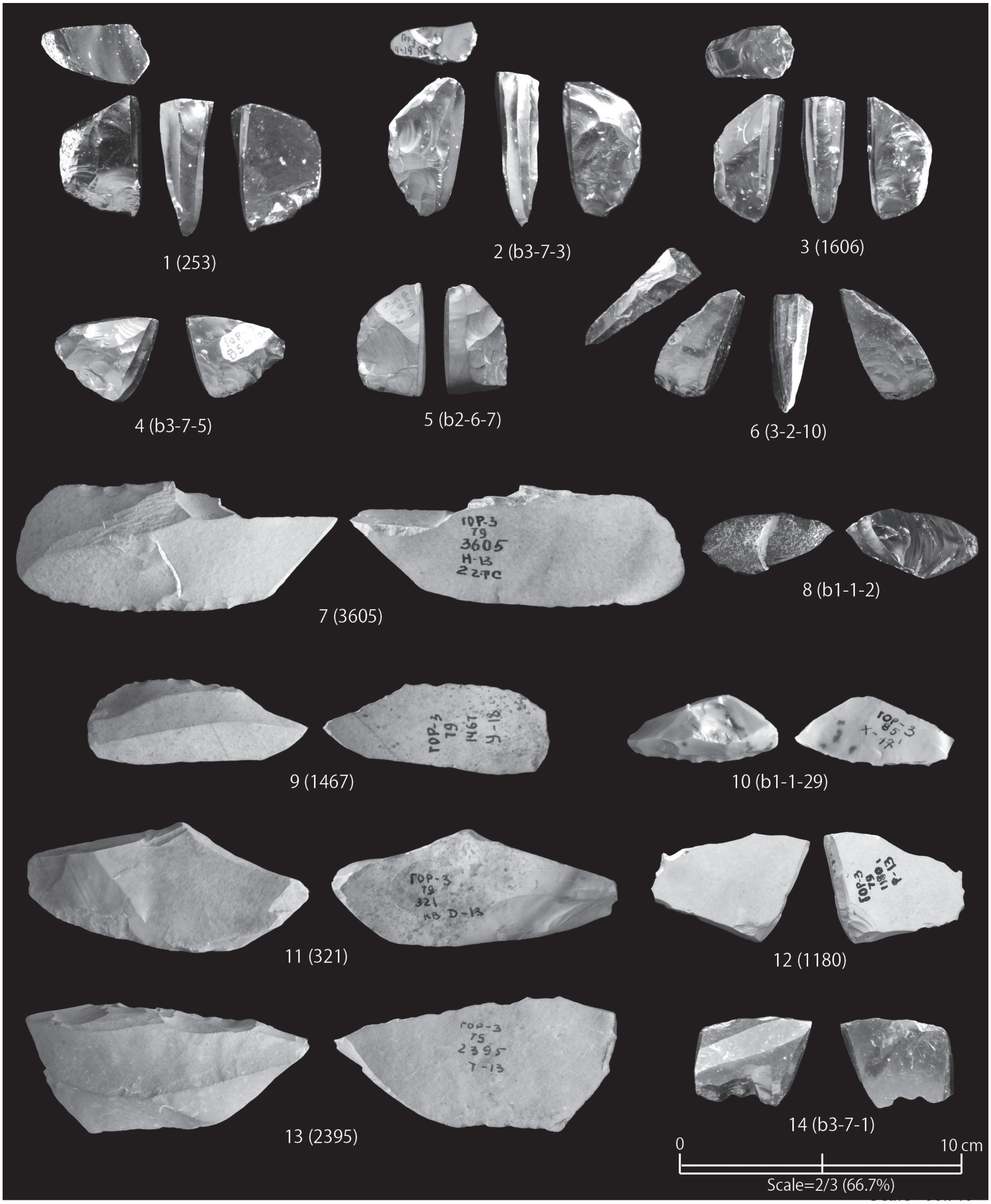

Fig. 20 Lithic tools excavated from the Gorbatka 3 site

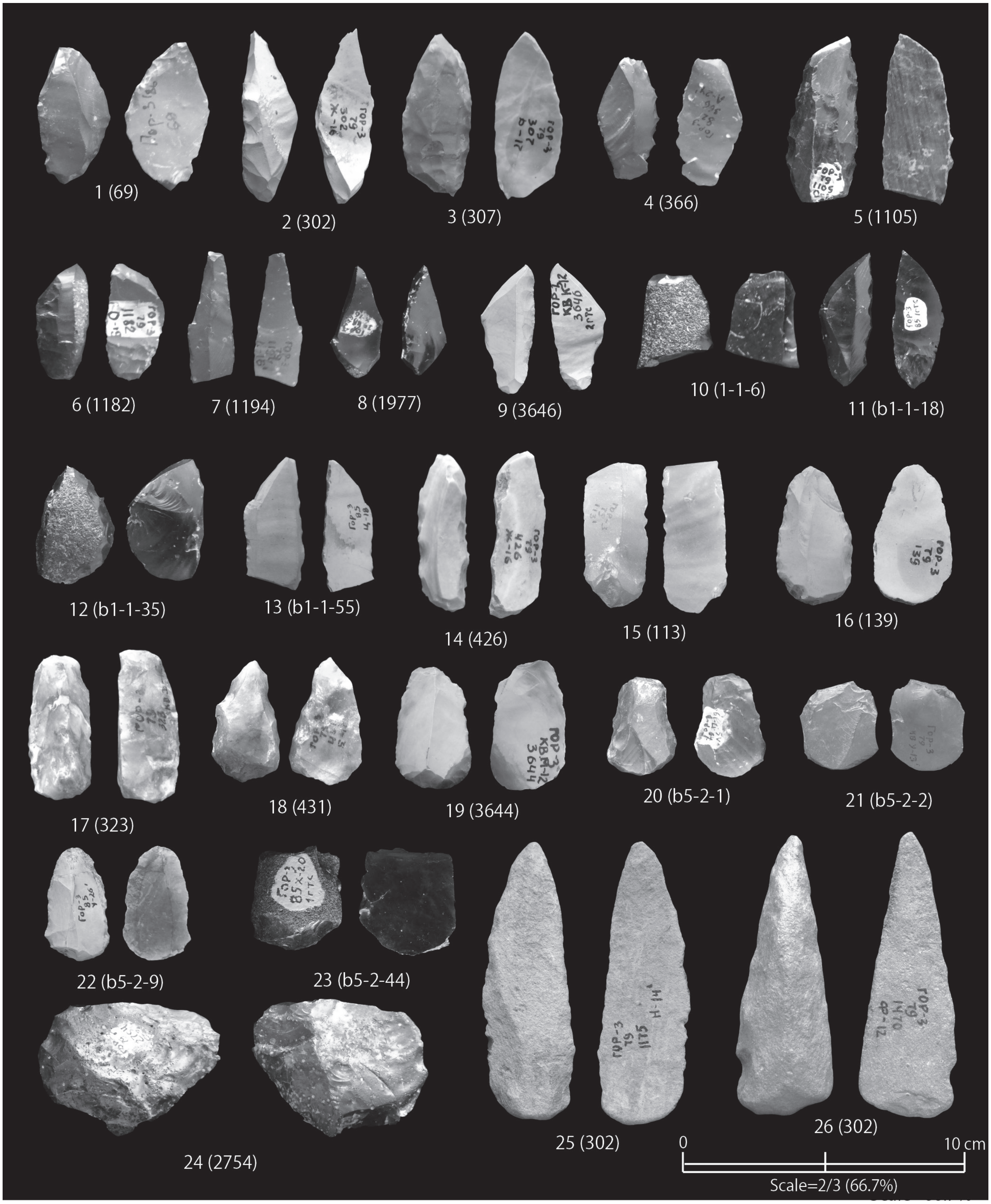

Fig. 21 Lithic tools excavated from the Gorbatka 3 site

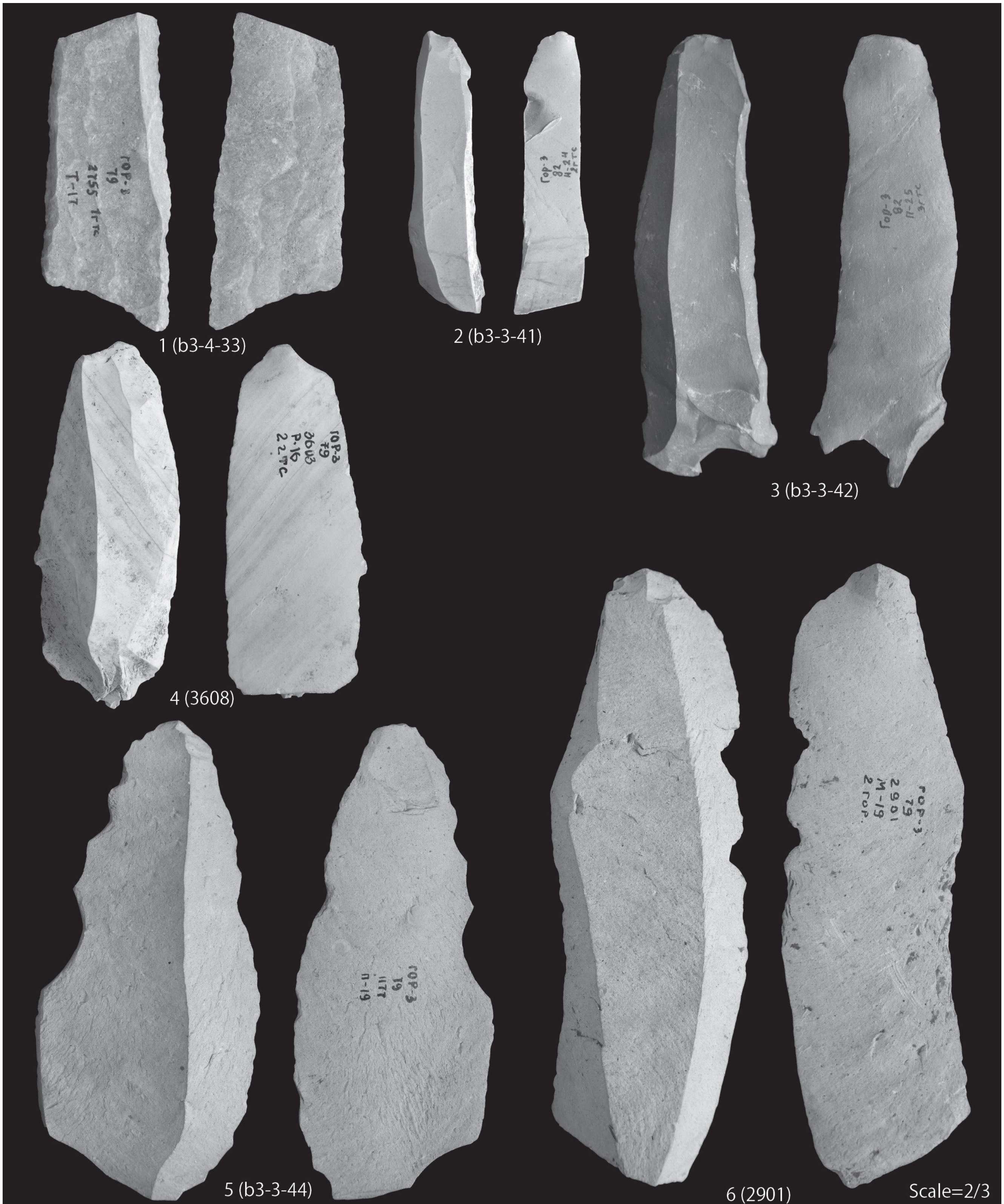

Fig. 22 Lithic tools excavated from the Gorbatka 3 site

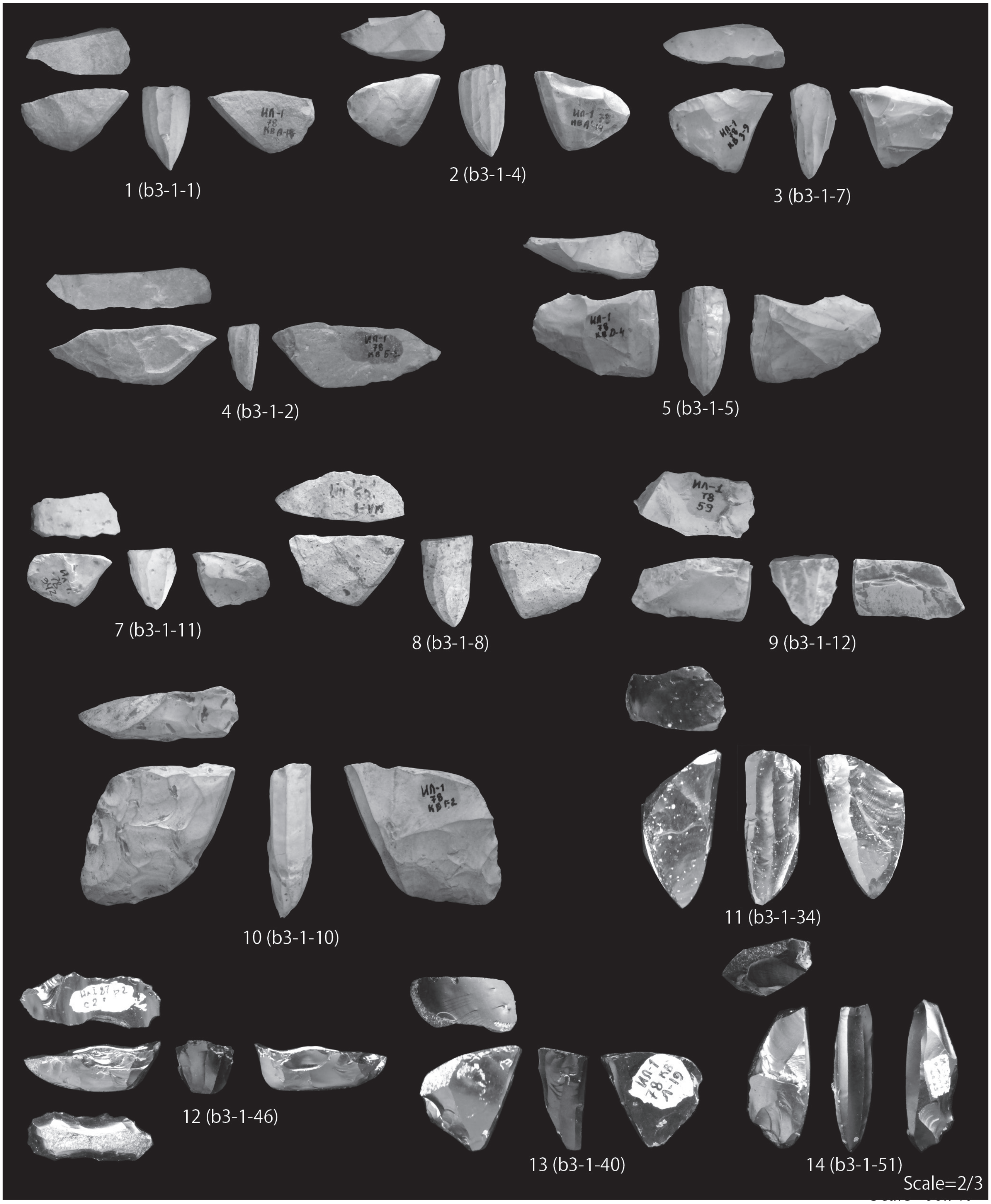

Fig. 23 Lithic tools excavated from the Ilistaya 1 site

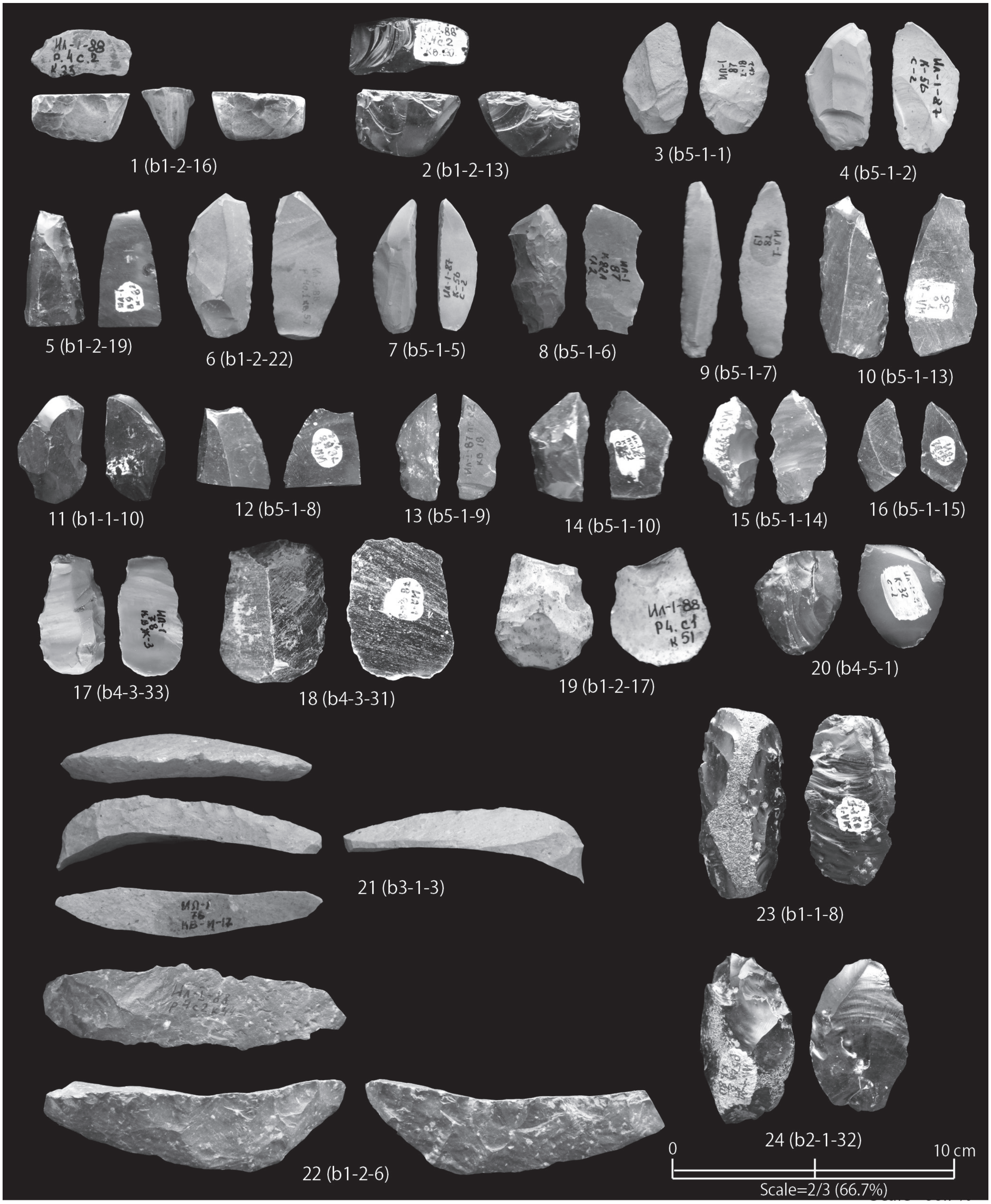

Fig. 24 Lithic tools excavated from the Ilistaya 1 site

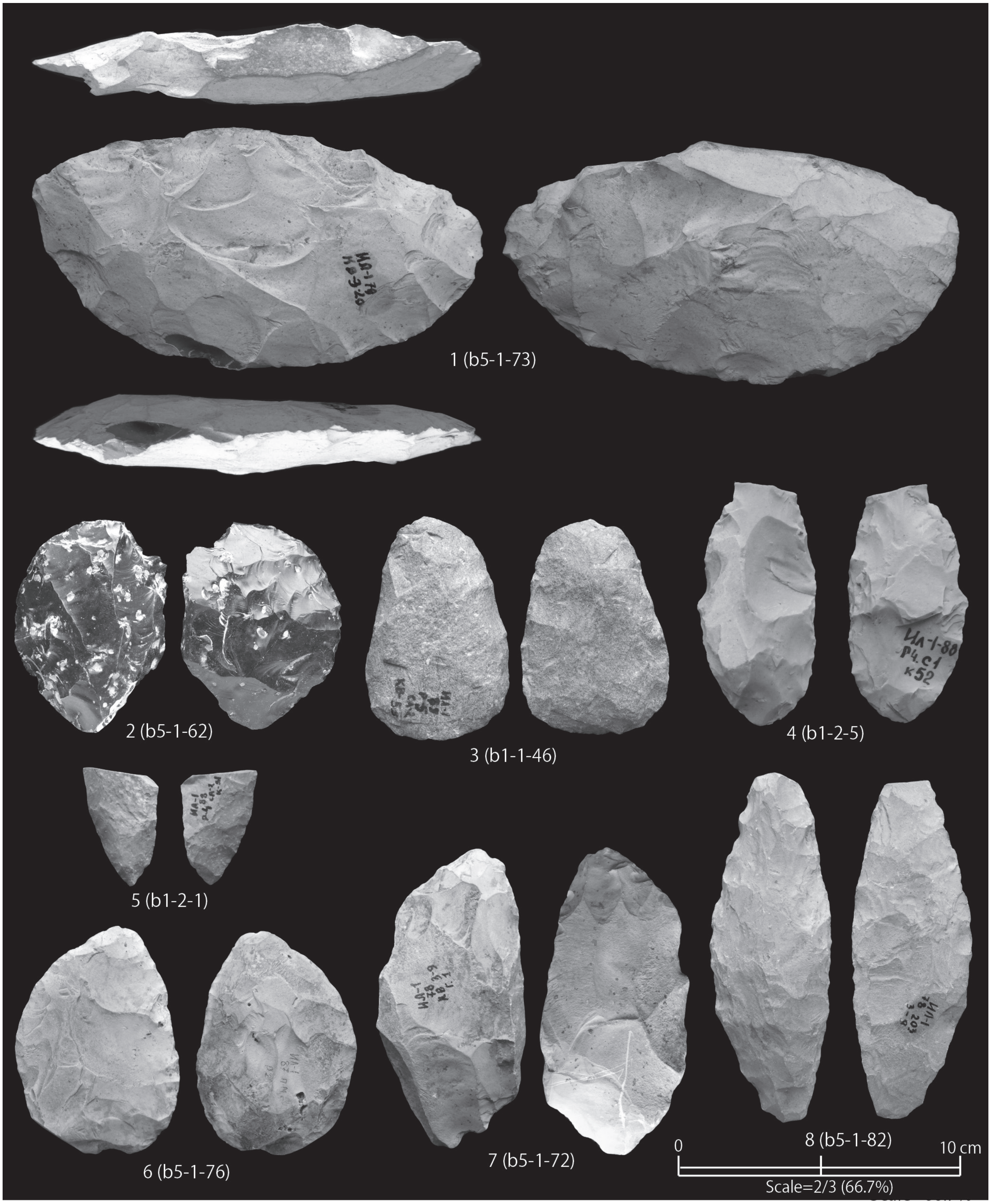

Fig. 25 Lithic tools excavated from the Ilistaya 1 site