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Research paper

Artur I. Taymazov,
Cand. Sci., Senior Researcher
Institute of History, Archeology and Ethnography
Dagestan Federal Research Center of RAS, Makhachkala, Russia
taymazov_artur@mail.ru

PALEOCHANNEL SITES OF THE EARLY PALEOLITHIC IN THE NORTHEAST CAUCASUS

Abstract. Excavations in the upper deposits of the multilayered Oldowan sites, Muhkai 1 and Muhkai 2, have yielded compelling evidence for the presence of sites associated with paleochannels and watercourses in the Caucasus during the late Early Pleistocene. Similar finds within an ancient watercourse bed were also discovered at the base of the lower stratum of the Ainikab 1 site. The incision itself was formed within bedrock comprising Cretaceous sandstones. This object is dated to no later than the Olduvai Subchron (1.95–1.78 Ma) of the Matuyama Chron and represents one of the earliest known instances of archaeological finds within paleochannels. Data from Muhkai 1, specifically layer 5b, indicates that the cultural remains from such sites contain a rich and diverse assemblage of lithic artifacts, including cores, core-like pieces, tools, and debitage. The qualitative composition of the lithic assemblage at this site is consistent with the remains of base camps, likely displaced from their original locations. Culturally, the lithic industry from the watercourse fill exhibits characteristics of the Early Pleistocene large-flake industry of the Caucasus, representing a transitional phase between the Oldowan and the Acheulean. The hominins responsible for this industry had mastered the technique of producing large flakes and regularly utilized these blanks to create large chopping tools (choppers), as well as cutting and scraping tools (large knives, scrapers). However, the development of large flake production did not lead to the emergence of hand axes in this region, unlike at the earliest East African sites.

Keywords: Early Paleolithic; Early Pleistocene; Northeast Caucasus; river and stream channel site; Oldowan; large flake industry

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АРХЕОЛОГИЯ

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Исследовательская статья

Таймазов Артур Исрапилович
к.и.н., старший научный сотрудник
Институт истории, археологии и этнографии
Дагестанский федеральный исследовательский центр РАН, Махачкала, Россия
taymazov_artur@mail.ru

СТОЯНКИ В РУСЛАХ ДРЕВНИХ РЕК В РАННЕМ ПАЛЕОЛИТЕ СЕВЕРО-ВОСТОЧНОГО КАВКАЗА

Аннотация. Археологические исследования в верхней части отложений многослойных стоянок олдована Мухкай 1 и Мухкай 2 предоставили убедительные доказательства о существовании на Кавказе в конце раннего плейстоцена памятников, связанных с участками древних русел рек и водотоков. Находки в русле древнего водотока были обнаружены и в основании нижней пачки слоев стоянки Айникаб 1. Сам врез был образован в коренной породе, представленной песчаниками мелового периода. Указанный объект датируется временем не позднее субхрона Олдувей (1,95–1,78 млн л.н.) палеомагнитной эпохи Матуяма и является одним из наиболее ранних известных нам свидетельств обнаружения археологических находок в палеоруслах. По данным одного из рассматриваемых памятников – стоянки Мухкай 1, слой 5б – культурные остатки таких памятников содержат богатый и разнообразный состав каменных изделий, включающий нуклеусы, нуклевидные изделия, орудия и дебитаж. По качественному составу находок каменный инвентарь указанного памятника соответствует остаткам базовых стоянок, вероятно, перемещенным из мест своего первоначального залегания. С точки зрения культурно-стадиальной позиции, каменная индустрия из заполнения водотока содержит признаки раннеплейстоценовой крупноотщеповой индустрии Кавказа, относящейся к стадии перехода от олдована к ашелю. Люди, оставившие данную индустрию, владели техникой получения крупных отщепов и регулярно использовали данный вид заготовки для получения крупных рубящих (чоппер), режущих и скобляющих (крупные ножи, скребла) орудий. Освоение техникой получения крупного отщепа, однако, не привело здесь к появлению рубила, как это случилось на древнейших восточноафриканских памятниках.

Ключевые слова: ранний палеолит; ранний плейстоцен; Северо-Восточный Кавказ; стоянки в руслах рек и водотоков, олдован; крупноотщеповая индустрия

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Introduction

At the beginning of the 21st century, H.A. Amirkhanov discovered a significant cluster of Oldowan sites in the northeastern Caucasus, specifically within the mountainous region of Dagestan. These sites are associated with alluvial deposits in the Akusha and Usisha watersheds. The stratigraphic sections of these sites are unique for the Early Pleistocene, both in terms of the thickness of the deposits and their chronological span. The Early Pleistocene deposits at some sites exceed 70 meters in thickness, and the strata collectively represent over a million years, ranging from approximately 2.3 Ma (but no less than 1.95 Ma) to 0.8 Ma [1, pp. 67–77]. These deposits contain numerous layers with archaeological remains, primarily in the form of lithic artifacts, and some layers also include abundant faunal remains. At just three of the excavated sites – Ainikab 1, Muhkai 1, and Muhkai 2 – a total of at least 100 cultural layers have been identified. The majority of these layers were investigated within the confines of exploratory trenches, while only a few were excavated over a larger area.

As new material was uncovered, significant differences between the sites emerged, notably in their taphonomic characteristics, composition, and density of archaeological material. This necessitated systematization and functional classification of the numerous sites discovered within the Early Pleistocene deposits, utilizing established classifications of the oldest sites based on functional features [2–5].

Investigations at the Muhkai 2, layer 80, and Muhkai 2a sites have yielded compelling evidence for the presence of butchering sites in the northeastern Caucasus during the Oldowan era [1; 6]. Sites with domestic features preserving the context of an occupation surface, rare for the Oldowan, were likely identified at the Ainikab 1 site at the base of layer 13 (corresponding to the lower part of layer 24 according to the new numbering system). This is indicated by the remains of a hearth discovered within the distribution area of stone artifacts, including tools, flakes, fragments, and nodules with single removals [7]. It is now possible to confidently assert the presence of base camps among the sites studied. The archaeological finds discovered in layer 7c of the Muhkai 1 site provide a clear example. The cultural remains at this site are not a random scattering of flint debitage, but rather organized clusters of artifacts indicating distinct functional areas. These areas reflect not sporadic, but relatively sustained (possibly seasonal) activity related to tool production and domestic life [8]. The existence of other functional site types (e.g., workshops, short-term campsites, flint raw material storage areas) has also been proposed [1].

Most of the cultural layers at the Oldowan sites of Central Dagestan are characterized by abundant stone tools but a complete lack of faunal remains. The stone artifacts are typically found within coarse-sized material deposits and are not confined to a single, lithologically consistent thin horizon, but are instead dispersed throughout the entire layer. This suggests that the finds were likely displaced from their original locations. However, the distance over which these stone artifacts were transported appears to have been relatively short. The lack of visible rolling of the worked edges of the artifacts supports this conclusion. The assemblage of finds from these layers, including various tools, cores, core-like fragments, and numerous flakes, generally corresponds to the assemblages found at base camps or long-term workshop sites.

Identifying *in situ* sites with the preserved ancient occupation surfaces within clastic layers, especially when lacking typical indicators like dense concentrations of stone tools, bones, or other objects of everyday life, presents a significant challenge. One potential indicator of such sites is the presence of large, heavy-duty tools (gigantoliths) weighing 5-6 kg. According to H.A. Amirhanov, they were used on-site for processing animal carcasses, specifically for cracking skulls and crushing long bones to extract marrow [1, p. 28]. He further suggests that layers containing these pick- and chopper-like gigantoliths represent base camps or sheltered locations where hominins brought their prey [1, p. 29].

Another identifiable site type within the Oldowan context of Central Dagestan is the river or stream channel site. This study aims to characterize one such site, associated with a section of a paleochannel. The site in question, designated Muhkai 1, layer 5b, was discovered within the upper deposits of the multilayered site Muhkai 1.

Muhkai 1, layer 5b: occurrence conditions of lithic tools and general information

Archeological site Muhkai 1, layer 5b, was explored in 2019 by the North Caucasian Paleolithic Expedition of the Institute of Archaeology of the Russian Academy of Sciences, led by Kh.A. Amirkhanov. This layer is situated in the upper portion of the multilayered Muhkai 1 site (Fig. 1; 2, *A-B*), stratigraphically above the Jaramillo subchron, a period of normal magnetic polarity, which allows to date it approximately 1 Ma. The complete 65.5m sequence of loose deposits at Muhkai 1 encompasses various periods within the Early Pleistocene, based on a combination of geological, geomorphological, paleomagnetic data, and comparisons with neighboring sites like Muhkai 1 and Ainikab 1 [1; 9].

Lithologically, layer 5b consists of unsorted pebble-boulder-gravel cutting into loam layers. In its genesis, it represents the alluvium of a former ephemeral or intermittent watercourse. The upper boundaries of the channel fill are documented in the southwest corner of the excavation at a depth of 6.63–6.84 m from the Muhkai sites' common datum, sloping down to -7 m towards the northeast. The layer lies 3.6–4 m below the surface of the modern slope facing the Tsianshuri River valley. While the channel incision begins higher up in the excavation wall profiles (Fig. 2, *B*), starting from the level of layer 5, it isn't planigraphically distinct at this elevation, since the incision formed within a debris field composed of boulders, pebbles, gravel, and a light-brown loam filler in the upper part (layer 6), that is, similar in lithological composition to the channel fill itself. Furthermore, at this level, the excavation area did not encompass one of the banks of the former watercourse. This bank was likely eroded away during the formation of the Usisha River valley and its tributary, the Tsianshuri. Therefore, layer 5 represents the upper portion of the watercourse fill. This interpretation is supported by the lithological similarity between layers 5 and 5b, indicating a conditional, rather than a distinct, boundary between them.

A section of the paleochannel, with clearly defined banks, was observed where it cut into the loam layers (Fig. 2, *C*). The channel's orientation ran southwest to northeast, mirroring the flow direction of the modern Akusha and Tsianshuri rivers in the Muhkai sites area. The channel measured 2.10 meters wide in the southwestern portion of the excavation and 3.50 meters wide in the middle. In the NE part of the excavation, the right bank of the paleo-river is cut by a slope. The width of the channel here before contact with the slope was 3.60 m. The paleochannel cuts into loam layers 7a, 7b, and 7c. Layers 7a and 7b are completely eroded, while layer 7c is cut down to its base. The channel also completely cuts through layer 7c in two areas of the excavation: near the western wall (square B-3) and the northern wall (square I-6). The depth of the erosional cut (Fig. 2, D) is 0.87 meters at the western wall, with the channel's bottom at -7.50 meters. In the central part of the excavation, near the edge, the cut reaches a depth of 1 meter, and the bottom is at -7.77 meters. At the northern wall, the cut is 0.97 meters deep, and the channel's bottom lies at -7.92 meters.

Following the sampling of the paleochannel's fill, it was decided to preserve a portion of the excavated object. A 3.50 x 4.30 meter section (15.05 m^2) in the southwestern part of the excavation was left intact for this purpose.

Archaeological remains from the paleochannel's filling

Layer 5b yielded exclusively flint artifacts, which were distributed throughout the various levels of the channel fill. This layer stands out for its abundance of artifacts. The high concentration of stone tools within the former watercourse is notable. A total of 339 flint items were recovered from the excavated portion of the paleochannel, which covered an area of 23.5 m^2. The finds are concentrated primarily in the center of the channel, rather than along its banks (Fig. 3). This distribution likely results from the central area having the thickest fill deposits. The depositional context of the artifacts suggests that they were redeposited by water currents from other stratigraphic levels, indicating that the assemblage within this layer is not a homogenous collection. However, upon inspection, the artifacts don't exhibit significant mechanical wear that would suggest they were transported over long distances. Furthermore, the observed damage, primarily bruising, is located on the raw, unworked edges of the flint pieces, rather than on the working edges. This suggests that at least some of

the raw flint was redeposited before being picked and used by prehistoric hominins. Overall, the artifacts are well-preserved and comparable to those from other layers at the Muhkai 1 site. This observation excludes, of course, artifacts found *in situ* within the fine earth layers, which exhibit sharper edges than those recovered from the coarse-sized material. The evidence suggests that if the artifacts within the channel were transported, it was likely over a short distance from their original occurrence, and their overall structure remains largely unaltered.

The stone inventory recovered from the channel fill is notably rich and diverse. The archaeological materials from layer 5b, in terms of their qualitative composition, are consistent with those found at base camps. The assemblage includes items related to the primary processing of raw material, finished tools, and debitage, including small production waste such as chips (~1 cm) and debris (~1 cm in diameter) (see Table). This collection deserves a dedicated study, but we will briefly highlight its most significant features here.

Lithic assemblage from the Muhkai 1, layer 5b

Seq. No.	Tool type	Qty.
1	Bifacial choppers	14
2	Bifacial choppers on large flakes	5
3	Unifacial choppers	5
4	Unifacial choppers on large flakes	3
5	Choppers with narrow cutting edge	3
6	Chisel-choppers	7
7	Chisel-choppers on large flakes	2
8	Double-choppers	2
9	Double-choppers on large flakes	3
10	Choppers with a broken edge	2
11	Picks	5
12	Flat picks	3
13	Pick-like tools	1
14	Chisel-like tools	1
15	Side-scrapers on fragments	2
16	Side-scrapers on medium flakes	1
17	Side-scrapers on large flakes	3
18	Scrapers	15
19	Scrapers on large flakes	2
20	Carinated scrapers	7
21	Carinated scrapers on large flakes	1
22	Naturally backed knives	5
23	Naturally backed knives on large flakes	2
24	Knives with butts on the side	4
25	Knives with retouched butts	1
26	Knives with transverse edges on large flakes	2
27	Tools with narrow retouched notches	5
28	Tools with wide retouched notches on large flakes	1
29	Awls	1
30	Retouched flakes	14

	Tools in total:	122
31	Unidirectional cores with flat working surfaces	3
32	Large unidirectional cores with flat working surfaces	1
33	Unidirectional cores with two adjacent working surfaces	3
34	Unidirectional cores with semi-circular working surfaces	2
35	End cores	2
36	Core-shaped fragments	6
37	Flakes (excluding tools)	29
38	Flake fragments	20
39	Chips	6
40	Fragments and nodules with single removals	60
41	Fragment	83
42	Stone debris	2
	Finds in total	339

The assemblage of tools related to the technological aspects of the collection is quite representative. In addition to numerous fragments and nodules with single removals, which may have functioned as cores, there are also definitively identifiable cores, indicating the intentional production of flake blanks.

Nodules and nodule fragments of varying sizes and shapes were used to produce blanks. Striking platforms were not specifically prepared and consisted of the natural cortical surfaces of the nodules or natural fracture planes. The cores are primarily unidirectional unifacial and unidirectional bifacial. In the bifacial cores, the working surfaces are located on adjacent planes. This knapping method sometimes resulted in a semi-circular working surface. Notably, there are no multidirectional cores characteristic of the Oldowan industry among the definitively identified cores. The absence of such cores suggests a shift from specific-situational knapping towards systematic unidirectional flake removal, aimed at producing specific flake blanks. This characteristic, in turn, distinguishes the layer 5b industry from the Oldowan. The presence of large flakes (>10 cm) and correspondingly sized cores within the layer's lithic assemblage is the most striking evidence of this distinction. Half of the cores from this layer are large, with long, extended striking platforms. Among these, end cores (Fig. 4) are particularly noteworthy, exhibiting removals along the long axis of flat flint nodules. Therefore, a key characteristic of this industry is the mastery of its creators in the technique of producing large flakes.

Another key technological feature of the layer 5b lithic industry is the preferential use of flakes as blanks, rather than nodules and nodule fragments. Flakes account for approximately 56% of all retouched artifacts in the layer. A high percentage (>40%) of flake blanks is characteristic of all studied layers in the upper part of the Muhkai 1 section that contain a substantial lithic assemblage. In contrast, the middle and lower layers of the Muhkai 1 site, as well as comparable deposits at the neighboring Muhkai 2 and Ainikab 1 sites, show a significantly lower proportion of flake tools, representing no more than 30% of the typologically recognized tool types [10–14]. Furthermore, in these layers, flakes were utilized only for the production of small tools. The primary blank material consisted of nodules and nodule fragments. Small fragments, in particular, were used to produce side-scrapers, scrapers, notched tools, awls, and other tools.

The hominins responsible for the layer 5b industry demonstrated a clear preference for large flakes. This is evident in the maximal use of this blank type for tool production. All 25 large flakes uncovered from the layer were found as morphologically complete tools. The proportion of this tool group within the overall assemblage is also notably high. Within the layer in question, tools made on large flakes comprise over 20% of all retouched artifacts and approximately 37% of the tools manufactured on flakes. These figures reflect a pattern observed across many layers in the upper portion of the Muhkai 1 site [15; 16]. The appearance of large flake blanks and isolated instances of their use at Oldowan sites in Central Dagestan are noted in layers immediately predating the Jaramillo subchron (1.07–0.99 Ma) [15]. However, a significant increase in the frequency of these large flake blanks is observed by the end of the Early Pleistocene. These facts suggest an evolution of the lithic industry in Central Dagestan during the late Early Pleistocene, exhibiting a developmental trajectory towards the Acheulean.

The tool kit from this layer contains categories typical of a developed Oldowan industry in its traditional sense. Choppers with various edge modifications (Fig. 5; *6, 2–3*) constitute the most numerous group. Double-sided choppers with a wide working edge are predominant among them. Chisel-like choppers are also notably frequent in this layer. Significantly, a key characteristic of this tool category is the widespread use of large flakes as blanks. Over 28% of the choppers in the Layer 5b collection were manufactured on large flakes.

Another category of large heavy-duty tools well-represented in the layer's assemblage is comprised of picks and pick-like tools. These vary in outline, size of the original blank, and massiveness. Flat and platy nodule fragments, including some very large examples, served as the primary blanks for these tools. The largest of these tools have the following dimensions (length × width × thickness): 24 × 13.5 × 7.4 cm; 19.6 × 8.6 × 3.8 cm; and 18 × 8 × 10.7 cm. The use of flat/platy pieces of raw material likely influenced the morphology of the tools. This probably explains the absence, within this layer's assemblage, of artifacts that fully match the description of picks with a triangular cross-section and a symmetrical longitudinal dorsal ridge, typical of Oldowan sites in Central Dagestan [17]. The tools found in this layer, while similar to the described type, exhibit working limited to the formation of a sharp triangular point at the distal end of the blank. The majority of the edges remain unworked, and consequently, a median longitudinal ridge on the back is not formed. Conversely, the use of flat/platy nodules and their fragments as blanks explains the notable presence of tools within the layer's assemblage that could be classified as flat picks. Similar to the picks described above, the working of these artifacts is also focused on creating a point at one end of the blank (Fig. 6, *1*). Consequently, these items share little in common with the picks identified at Early Acheulean sites in East Africa and the Middle East, and even less with the bifaces among which they are classified [2; 18]. For this reason, S.A. Kulakov, a researcher of the Early Paleolithic of the Caucasus, proposes classifying these pick-like tools as large massive points, rather than including them within the pick category [19, pp. 76–79; 20, pp. 90–92].

Retouched pieces on flakes and medium-sized fragments comprise the majority (~55%) of the tool kit recovered from the watercourse infill (Fig. 7). Flakes were used as blanks far more frequently than small fragments. Among the retouched tools, scrapers, side-scrapers, notched tools (both narrow and wide), knives with various backing types, and carinated scrapers are readily identifiable. The presence of tools fashioned on large flakes within these categories is particularly important for establishing the cultural and chronological context of the industry. Chisel-like and awl-like tools are represented by only a few examples. A significant portion of the smaller tools consists of flakes with marginal retouch.

A general assessment of the stone inventory from the watercourse infill, compared with materials from the underlying Muhkai 1 layers and corresponding deposits at other Early Pleistocene sites in the Akushinsky Basin, as well as with assemblages from the oldest sites in East and North Africa, the Arabian Peninsula, the Middle East, and the Caucasus, reveals that this industry differs in its technical and typological characteristics from a typical Oldowan industry. It demonstrates more developed methods of blank production and stone treatment techniques. A significant difference between this industry and the Oldowan is the mastery for producing large flakes and their systematic use as blanks for manufacturing large chopping and cutting tools. The adoption of large flake technology is considered a key technological boundary separating the Oldowan from the subsequent Acheulean era (or marking the beginning of the transition between the two). Unlike the earliest African sites, where this shift to large flake utilization coincided with changes in tool assemblages, primarily the emergence of the hand axe as the defining tool of the Acheulean techno-complex, such tools are absent in the materials from the layer under study. While elements of bifacial technology are undoubtedly present in the tool kits from other upper layers of the Early Pleistocene deposits at these Central Dagestan sites, hand axes are also not represented in these collections. However, individual objects that could be classified as proto-axes have been found in the late Early Pleistocene deposits at all three excavated sites: Muhkai 1, Muhkai 2, and Ainikab 1 [1; 21; 22]. Although the production of large flakes influenced the composition of the tool assemblage, it didn't result in significant changes to its overall categorical makeup. The basic tool assemblage found in this layer is familiar from the Oldowan. However, some changes are observed, linked to the regular use of large flakes as blanks. These changes include the appearance of choppers, large knives, scrapers, notched tools, and carinated scrapers on large flakes. These tools indicate a typological divergence of this industry from the Oldowan. Therefore, from a cultural-stage perspective, the lithic industry from the watercourse fill exhibits characteristics of the Early Pleistocene large-flake industry of the Caucasus, representing a transitional stage between the Oldowan and the Acheulean [21; 23].

Conclusion

The research conducted on the upper deposits of the multilayered Muhkai 1 site indicates the presence of a site type associated with a paleochannel in the Northeastern Caucasus during the late Early Pleistocene. A section of what is likely the same channel was also identified in the upper deposits of the neighboring Muhkai 2 site. These two sites are not isolated examples of finds within ancient watercourse fills. Similar finds were discovered at the base of the lower layer bed of the Ainikab 1 site. The channel itself was incised into bedrock composed of Cretaceous sandstones. Within the site's stratigraphy, this incision lies below a level exhibiting normal magnetic polarity, interpreted as the Olduvai Subchron [9, p. 90]. This places the artifacts no later than the Olduvai Subchron (1.95–1.78 Ma) within the Matuyama Chron. This represents one of the earliest known instances of archaeological finds within paleochannels. The known Olduvai Gorge sites associated with ancient river channels (SHK, TK, BK) originate from the upper portion of Bed II, corresponding to the chronostratigraphic horizon of the developed Oldowan B [2], or the early Acheulean according to current understanding.

The evidence from the upper layer of the Muhkai 1 deposits suggests that the cultural remains from these sites are abundant and likely redeposited. The transport distance was probably short, indicated by the lack of significant mechanical damage to the worked edges of the flint artifacts. The composition of the cultural remains likely did not change substantially during transport. The finds from the watercourse are notable for their richness and diversity. They include objects related to raw material knapping, retouched pieces, and debitage, comprising flakes and fragments. The qualitative composition of the materials from Layer 5b suggests that they represent the remains of base camps. The rich and diverse nature of these finds makes them particularly valuable for investigating various aspects of the North-Eastern Caucasus culture at the end of the Early Pleistocene, especially the evolution of the Oldowan and the emergence of the Early Acheulean. The materials from Muhkai 1, Layer 5b, exhibit characteristics of the Early Pleistocene large-flake industry of the Caucasus, representing a transitional stage between the Oldowan and the Acheulean.

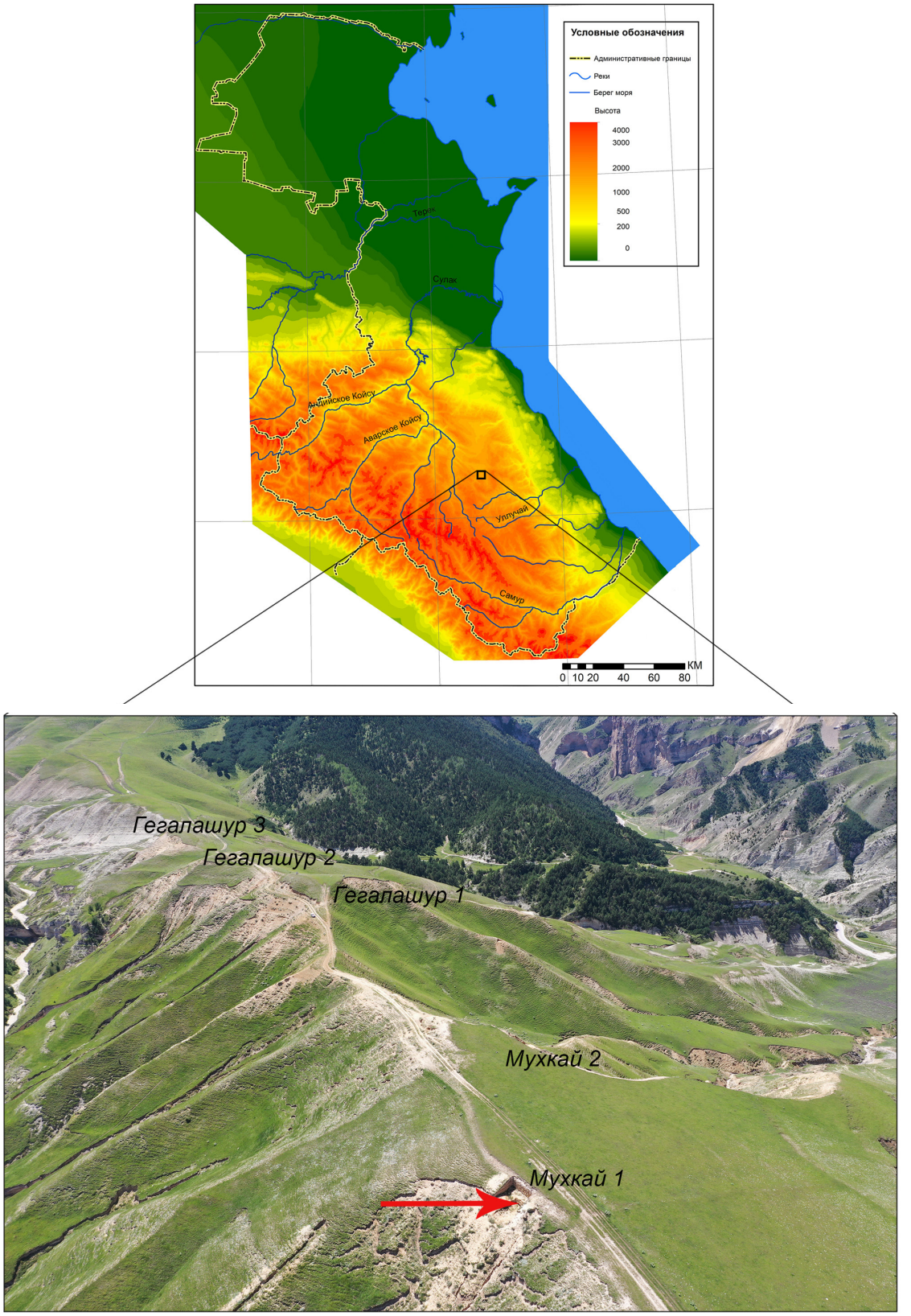

Fig. 1. Location and general view of Early Pleistocene sites in Central Dagestan. The arrow indicates the location of the Muhkai 1 site, layer 5b

Рис. 1. Местоположение и общий вид памятников раннего плейстоцена Центрального Дагестана. Стрелкой обозначено местоположение стоянки Мухкай 1, слой 5б

Fig. 2. A – Generalized stratigraphic profile of the Muhkai 1 section; B – Position of the Mukhkai 1 site, layer 5b, on the geological section; C – Section of the paleochannel before infill removal; D – Section of the paleochannel after infill removal

Рис. 2. A – обобщенный стратиграфический профиль разреза Мухкай 1;
B – позиция стоянки Мухкай 1, слой 5б на геологическом разрезе; C – участок древнего русла до выборки заполнения;
D – участок древнего русла после выборки заполнения

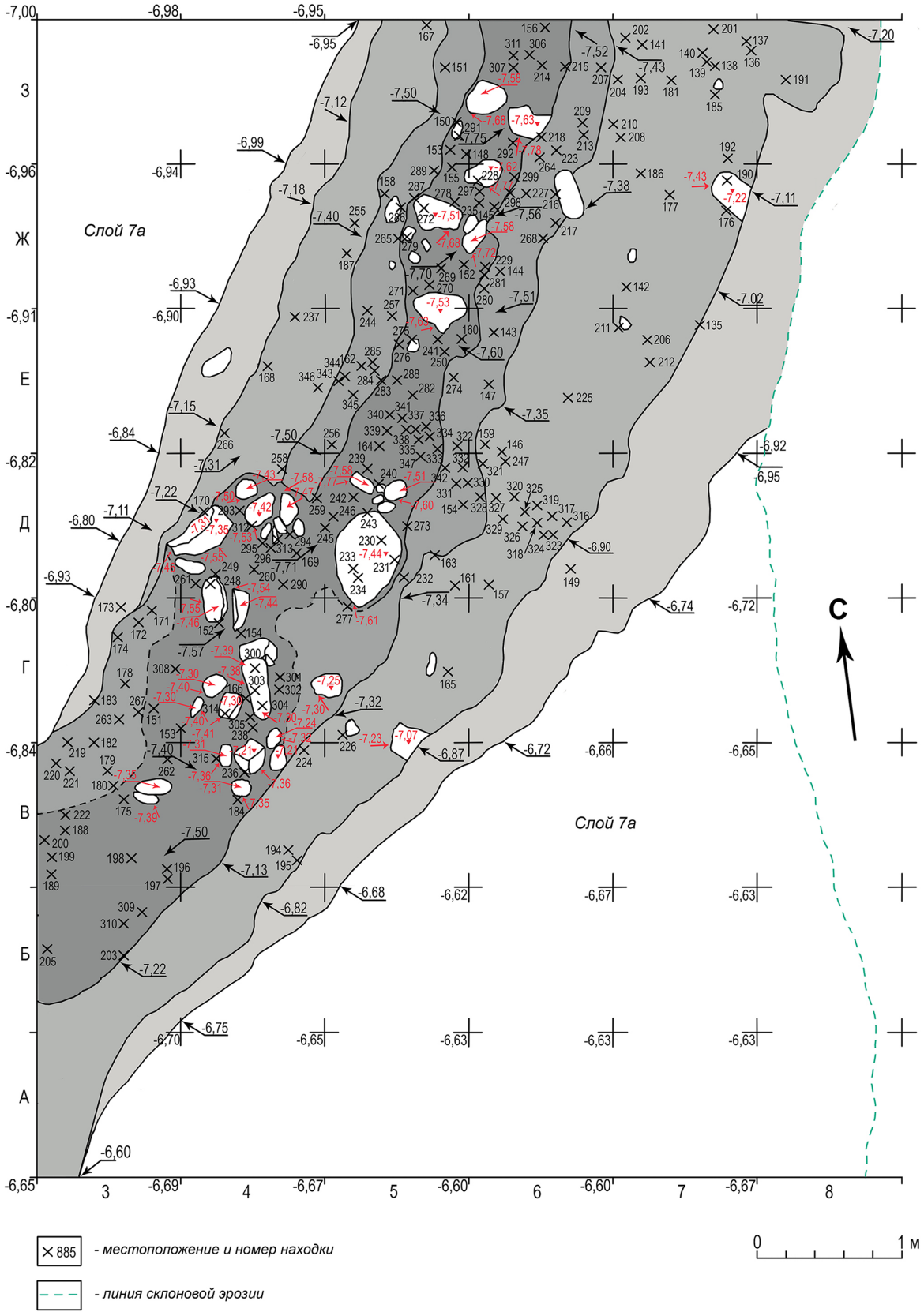

Fig. 3. Muhkai 1, layer 5b. General plan of finds

Рис. 3. Мухкай 1, слой 5б. Общий план находок

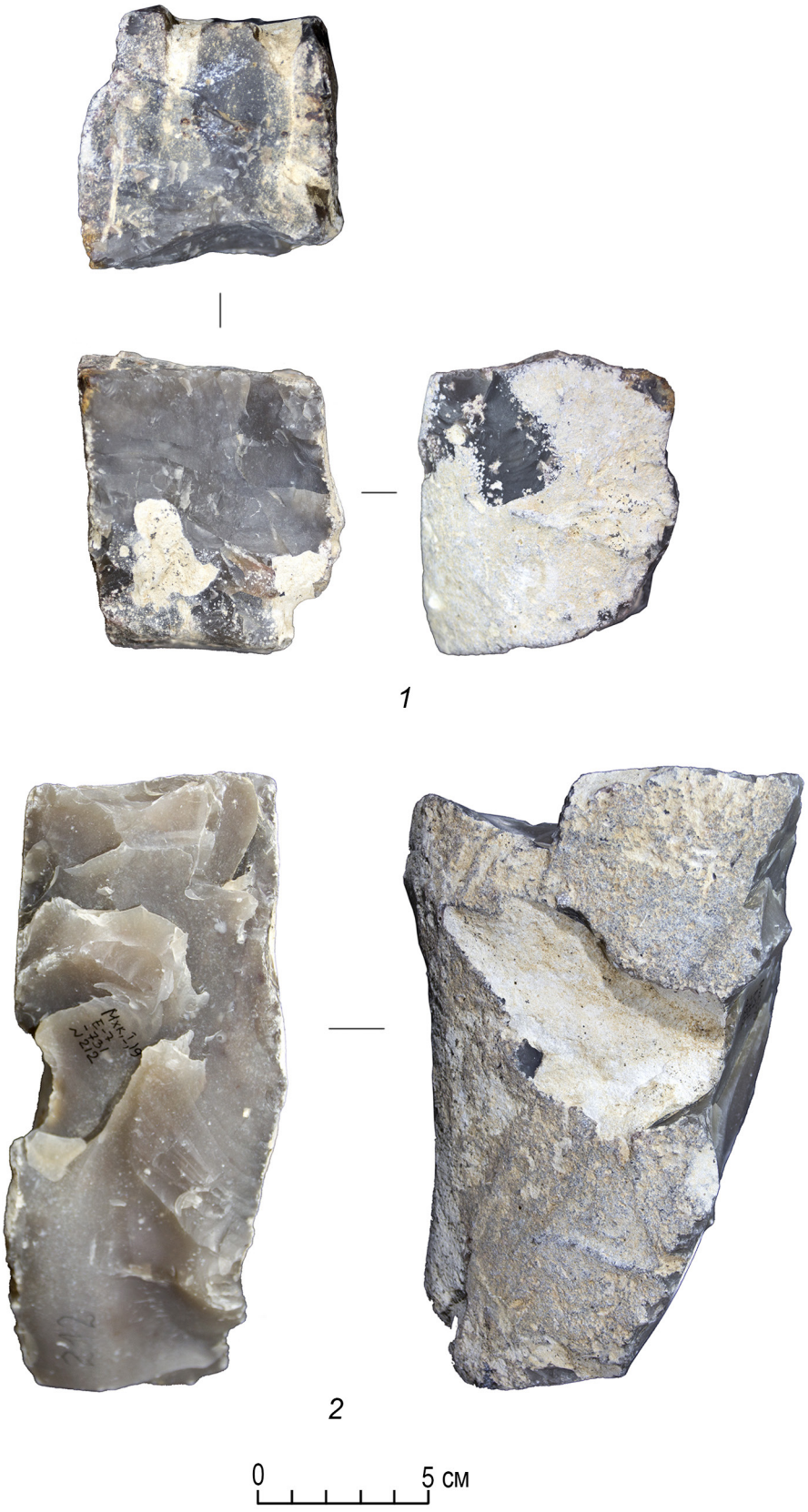

Fig. 4. Muhkai 1, layer 5b. Cores: 1 – Core for producing normal-sized flakes; 2 – End-core for producing large flakes

Рис. 4. Мухкай 1, слой 5б. Нуклеусы
1 – нуклеус для скалывания отщепов обычных размеров;
2 – нуклеус торцевого скалывания для скалывания крупных отщепов

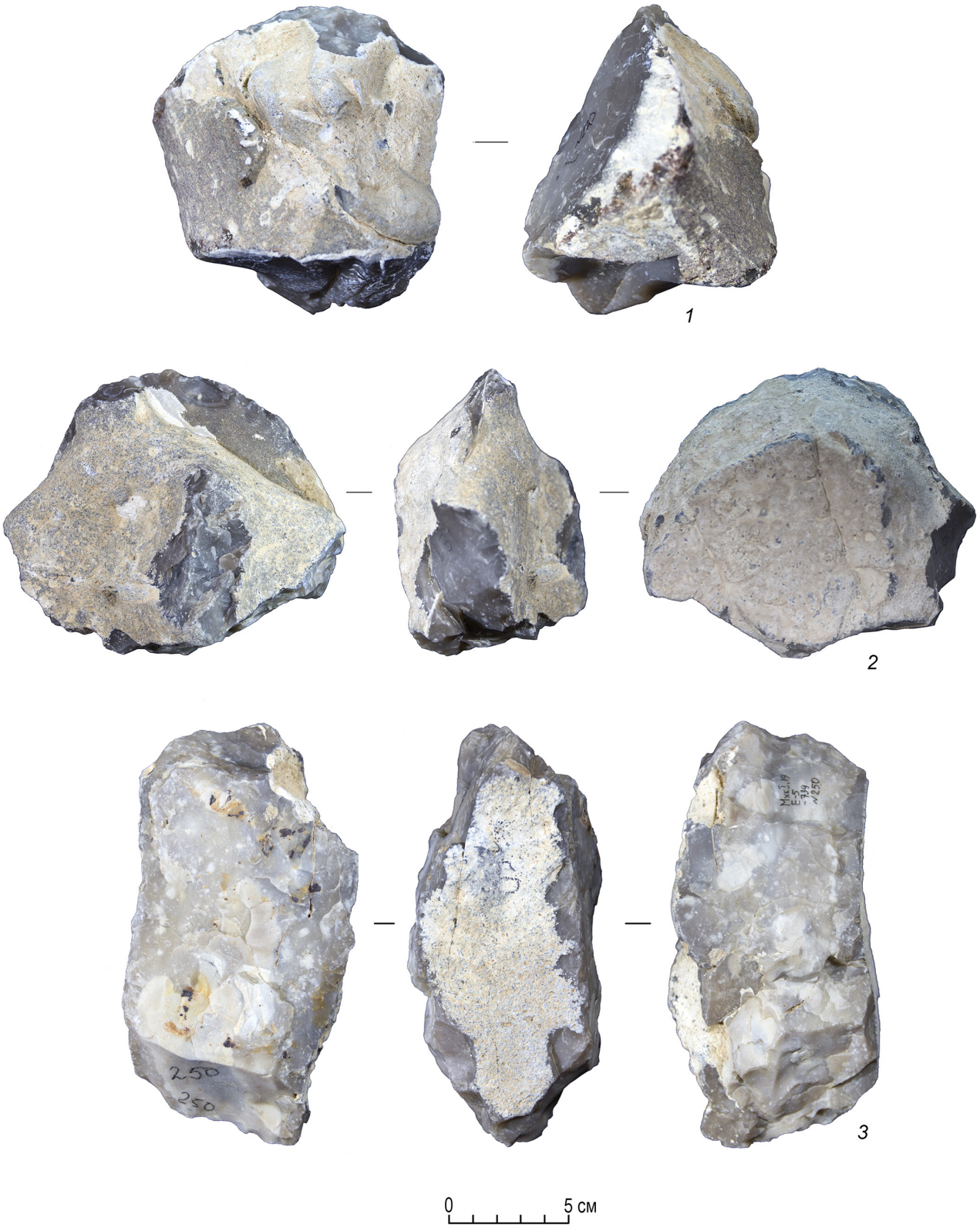

Fig. 5. Muhkai 1, layer 5b. Bifacial choppers on nodules and nodule fragments

Рис. 5. Мухкай 1, слой 5б. Чопперы двусторонние на желваках и обломках желваков

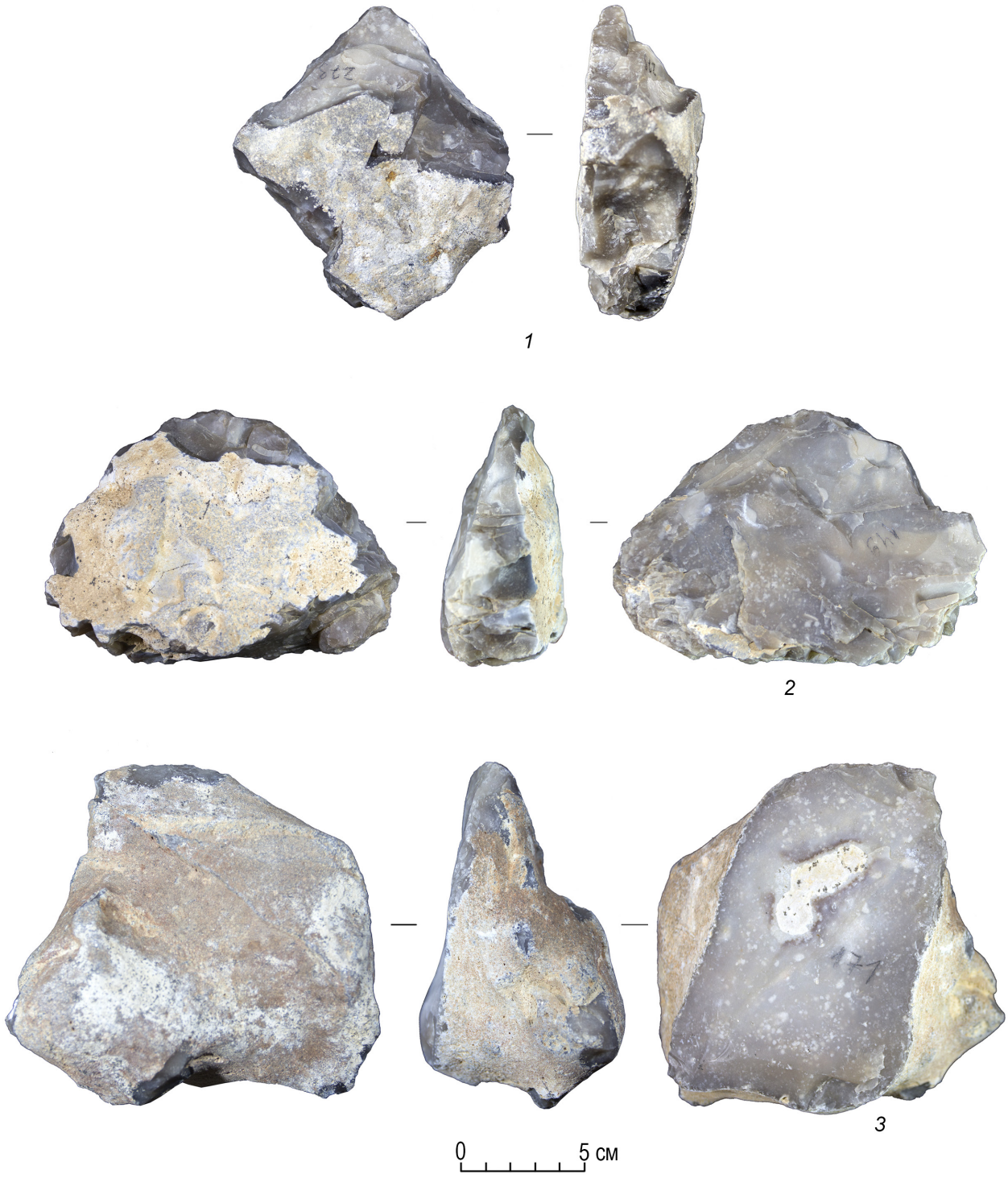

Fig. 6. Muhkai 1, layer 5b. Flat pick (1) and bifacial choppers on large flakes (2–3)

Рис. 6. Мухкай 1, слой 5б. Плоский пик (1) и чопперы двусторонние на крупных отщепах (2-3)

Fig. 7. Mukhkai 1, layer 5b. Flint tools: 1–3 – scrapers; 4 – knife on a medium flake; 5 – notched tool; 6 – awl; 7 – knife with a natural back on a large flake; 8 – transverse side-scraper on a large flake

Рис. 7. Мухкай 1, слой 5б. Образцы кремневых орудий
1 – 3 – скребки; 4 – нож на некрупном отщепе; 5 – орудие с выемкой; 6 – шиповидное орудие; 7 – нож с естественным обушком на крупном отщепе; 8 – скребло поперечное на крупном отщепе

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