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Research paper

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NEOLITHIC/NEO-ENEOLITHIC GEOMETRIC MICROLITHS OF RAKUSHECHNY YAR

Abstract. Geometric microliths have been found at various Mesolithic and Neolithic sites throughout the Ponto-Caspian region. Analysis of assemblages from the Rakushechny Yar settlement, including those excavated by T.D. Belanovskaya (Excavations I and II) and more recent excavations, reveals consistent typologies of geometric microliths. The production technologies for these microlith groups share several common features, particularly regarding raw material selection (likely constrained by limited availability), blank production, and secondary treatment. New excavation areas and recording methods have enabled the correlation of individual microlith types with chronological microhorizons, permitting their division into complexes associated with the early Neolithic (c. 5720–5620 and 5670–5520 BC), the final phase of the early Neolithic (c. 5620–5520/5410–5310 BC), and the late Neolithic/Eneolithic (c. 5474–5046/5010–4549 BC). Microliths constitute approximately 4-6% of the lithic assemblage within individual layers at Rakushechny Yar. Recent excavations, facilitated by improved methodologies, have significantly expanded the identified range of geometric microliths. While further excavation may yield a greater quantity of microliths, their proportional representation within the overall lithic assemblage is expected to remain consistent. This study aims to present a typology of geometric microliths recovered from Rakushechny Yar, encompassing both those excavated by T.D. Belanovskaya (Excavations I and II) and those from more recent investigations. The study establishes the chronological placement of microliths, reconstructs the cultural and historical context of their production and use, and presents the results of macro-wear analysis. Furthermore, the study considers geographic distribution of the various geometric microliths. Geometric microliths with thinned edges are predominantly found in the western Ponto-Caspian region. Simple trapezes are a common Neolithic type, frequently co-occurring with trapezes with thinned backs in the region, or alternatively, predating them. Neolithic sites featuring microliths with pressure-flaking retouch are widespread across a vast area of the Ponto-Caspian region.

Keywords: geometrical microliths; trapezes with thinned edges; trapezes with thinned backs; Neolithic; Neo-Eneolithic; Ponto-Caspian region; macro-wear traces

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ГЕОМЕТРИЧЕСКИЕ МИКРОЛИТЫ ПОСЕЛЕНИЯ РАКУШЕЧНЫЙ ЯР ИЗ СЛОЕВ НЕОЛИТА/НЕО-ЭНЕОЛИТА

Аннотация: Геометрические микролиты были найдены на различных мезо-неолитических памятниках Понто-Каспийского региона. Проведенные исследования на поселении Ракушечный Яр позволили выявить устойчивые серии геометрических микролитов, происходящих из раскопок Т.Д. Белановской (раскоп I и II) и полученных в ходе исследований последних лет. Технология изготовления выделенных групп геометрических микролитов имеет ряд общих черт в области специфики выбора сырья, определяемого ограниченностью доступного материала, получения заготовки, вторичной обработки. Новые раскопки и методика фиксации позволили сопоставить отдельные типы с хронологическими микрогоризонтами и разбить их по комплексам раннего (примерно 5720–5620 и 5670–5520 л. до н.э.), заключительного этапа раннего неолита (около 5620–5520/5410–5310 л. до н.э.) и позднего неолита-энеолита (около 5474–5046/5010–4549 л. до н.э.). Процентное содержание микролитов в орудийном наборе составляет примерно 4–6% для отдельных слоев п. Ракушечный Яр. В результате новых раскопок была значительно дополнена серия геометрических микролитов, что во многом связано с методикой раскопов. Можно предположить значительное увеличение их количества с расширением исследованной площади, но с сохранением порядка выявленного соотношения в общей кремневой индустрии стоянки. Цель этого исследования – представить типологию геометрических микролитов, полученную в ходе раскопок Т.Д. Белановской (раскоп I и II) и исследований последних лет, с хронологической позицией отдельных типов, реконструкцией культурно-исторического контекста и результатами исследования макросследов. В статье рассматривается ареал распространения различных геометрических микролитов. Геометрические микролиты с подтеской тяготеют к западной части Понто-Каспийского региона. Простые трапеции – широко распространенный тип для неолита, часто совстречается с трапециями со струганной спинкой в данном регионе, либо занимает более раннюю хронологическую позицию. Неолитические памятники, орудийный набор которых включает в себя микролиты, обработанные сострогивающей ретушью, нанесенной отжимным способом, распространены на обширной территории Понто-Каспийского региона.

Ключевые слова: геометрические микролиты; трапеции с подтеской; трапеции со струганной спинкой; неолит; нео-энеолит; Понто-Каспийский регион; макросследы

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Introduction

Geometric microliths are prevalent in Mesolithic and Neolithic sites throughout the Ponto-Caspian region (Fig. 1). These artifacts represent several functional categories, with distinct dominant types characterizing the Mesolithic, Early Neolithic, and Late Neolithic periods, and exhibiting regional variations [1, 2]. The Lower Don and Azov regions are notable for the wide variety of geometric microliths discovered, particularly the prevalence of trapezes with thinned backs in later periods [3]. Constructing precise chronological frameworks for various types is often challenging due to the scarcity of datable material and the lack of clear stratigraphic context.

Excavations at the Rakushechny Yar site conducted by T.D. Belanovskaya between 1960 and 1979 [4], along with subsequent research [5, 6], yielded a substantial collection of Neolithic-Eneolithic lithic artifacts. Geometric microliths constitute a distinct category within this assemblage. Renewed excavations and improved recording methods have facilitated the comparison of individual microlith types with chronological microhorizons.

This study aims to present a typology of geometric microliths recovered from excavations conducted by T.D. Belanovskaya (Excavations I and II) and from more recent research, including the chronology of microliths types, a reconstruction of the cultural and historical context, and the results of macro-wear analysis.

Chronological complexes of Rakushechny Yar

Rakushechny Yar is a multi-layered, stratified floodplain settlement containing a series of buried soils. The unique formation of its cultural layers and the presence of sterile strata allow for the construction of a microchronology for various artifact types [7]. New dating evidence, derived from animal bone samples originating from early Neolithic layers, clusters within a narrow chronological timeframe of several decades around 5700/5600 BC. This suggests that the accumulation of artifacts within this complex (layers 12-23) occurred rapidly, with the sterile sand interlayers not representing substantial chronological hiatuses. The dating points towards continuous occupation of this area. During this time period settlement pattern focused on the shore zone, featuring small activity areas, some paved with shells, and associated storage pits. The Early Neolithic layers 7-11 exhibit clay floor pavements and plastered wall/roof surfaces. Changes in sediment accumulation patterns observed in the Late Neolithic–Eneolithic periods (layers 4, 5a) may be attributed to shifts in the landscape and the ways in which the site was settled and utilized. Stratigraphically, two distinct complexes can be attributed to the Early Neolithic: one dated to approximately 5720–5620 BC (layers 12–23) and another to 5670–5520 BC (layers 7–11). There is also a complex representing the final stage of the Early Neolithic (layers 6, 5b-c, ca. 5620–5520/5410–5310 BC) and a Late Neolithic-Eneolithic complex (ca. 5474–5046/5010–4549 BC, layers 4, 5a) (Fig. 2). Determining the cultural attribution and precise dating of this latter complex remains challenging due to the formation of its cultural layer within strata of *Viviparus* shells, which lack separating sterile layers.

Geometric microliths assemblage

Microliths were categorized based on their geometric shape (trapeze, rectangle). Their production involved a truncation method of a blank and the absence of a bulb of percussion [8, p. 127]. Trapezes were crafted from a section of a blade or flake. Abrupt or vertical retouch truncated the ends of the blank, ensuring that the orthogonal projection of the shorter side intersected, at least partially, with the line of the longer (unretouched) edge [9]. Rectangles are defined by nearly equal bases and angles approaching 90°. Within these microliths, subgroups were identified based on variations in dorsal surface treatment. These variations include: 1) percussion scaled/faceted retouch of the lateral edges and part of the dorsal surface; 2) pressure thinning flaking applied to the back of the microlith; and 3) abrupt or semi-abrupt retouch along the sides.

Secondary treatment methods are identified by analyzing the negative flake scars left by retouch. Pressure flaking is indicated by facets twice as long as wide. Percussion retouch, on the other hand, leaves facets with a conical starting point and specific proportions of length, width, and thickness [10, pp. 68–69].

The Rakushechny Yar settlement's stone industry is characterized by blade and lamellar flake production, primarily using percussion techniques. The Neolithic tool assemblage is dominated by points and end-scrapers [4; 11; 12]. Significantly, a microlithoid industry (geometric microliths and microdrills) is one of particular features of this early Neolithic complex. Geometric microliths (trapezes and rectangles) were classified into five groups based on dorsal surface treatment. A total of 69 microliths were identified, with 46 coming from new excavations and 23 from T.D. Belanovskaya's Excavations I and II (Fig. 2). Within the new excavation area, these microliths represent 5.4% of the total tools in the Early Neolithic layers (layers 12-23), 7.4% in layers 7-11, 6.2% in the final stage of the Early Neolithic (layers 6, 5b-c), and 6.4% in the Late Neolithic-Eneolithic complex (layers 4, 5a). In T.D. Belanovskaya's Excavation Area I, the proportion of microliths varies: layer 4 – 6%; layer 5a – 2.5%; layers 5b-c – 3.9%; layer 7 – 2.4%; layer 11 – 1.5%; and layer 10 – 2.1%. The increased number of microlithoid products (geometric microliths and microdrills) recovered in the newer studies, despite a smaller excavation area, could be attributed to the excavation methodology, which included flotation of the entire cultural layer.

Type 1 – trapezes

1.1. The largest group consists of trapezes with thinned backs (Fig. 3: *1-22*), produced from truncated blades. Their dorsal surface is almost entirely shaped with pressure flaking retouch, with facets twice their width. There are 24 such specimens, with an additional two mentioned in [3]. Within layers 7-11 (8 specimens total), two tools were found produced from lamellar flakes blanks (Fig. 3: *19, 20*). One of these retains a section of cortex on its left lateral side. Except for one heavily fragmented piece, these are classified as medium-high trapezes (Fig. 4). Two of the trapezes exhibit semi-abrupt retouch applied from the back on the lateral sides of the ventral surface (Fig. 3: 15, 18). One of the tools displays retouch applied from the ventral surface on its lower base (Fig. 3: *15*). Sixteen trapezes from the Late Neolithic/Eneolithic layers are categorized as medium-high (11 pieces) or high shape (2 pieces, with a ratio of 1.5:1). All but one (Fig. 3: *8*) exhibit symmetrical outlines. One trapeze has semi-abrupt retouch applied from the front on the lateral sides of its ventral surface (Fig. 3: *1*). Two high-shaped trapezes have intensive abrupt retouch on their sides, narrowing the upper portion of the tool (Fig. 3: *9, 22*).

1.2. Trapezes with thinned edges (11 specimens) are defined by scaled retouch (facets) applied to the dorsal surface using a percussion method. Their lateral sides are treated with semi-abrupt flat retouch (Fig. 5: *1-5, 7, 9, 10, 12, 13*). This technique results in retouch only discrete areas of the dorsal surface. This is the most common type in the Early Neolithic layers (5720-5620 BC), with 6 specimens. Five trapezes were made on double-truncated blades, and one was made on a section of a triple-truncated blade. Most (5 specimens) are classified as medium-high trapezes, with one classified as a high trapeze. Two types of retouch were recorded on their sides: a bifacial, opposing semi-abrupt Helwan retouch was used on one side (2 pcs.) and on the upper base (1 pcs., Fig. 5: *2*); the sides were treated with an abrupt retouch to give shape (4 pcs.). Three trapezes with thinned edges made on double-truncated blades were found in the assemblage of the final stage of the Early Neolithic: two medium-high (Fig. 5: *9, 7*) and one low (ratio 1:2). The lateral sides are treated with abrupt retouch. One trapeze (Fig. 5: *7*) has its right lateral side treated with Helwan retouch. Two medium-high, trapezes with thinned edges from the Late Neolithic/Eneolithic layers (Fig. 5: *12, 13*) were made on blade sections with double truncations. One trapeze has lateral sides treated with semi-abrupt retouch on the ventral side (Fig. 5: *12*).

1.3. Simple trapezes, with untreated dorsal surfaces, have lateral edges or one of the bases shaped by abrupt retouch to achieve the desired form (5 specimens) (Fig. 5: *6, 11, 15*). This group, from layers 7–11, includes two trapezes (high and medium-high) created on the cross-section of double-truncated blades. The dorsal surface of the high trapeze features two notches on the lateral sides from the inverse surface, likely resulting from fragmenting the blade to produce a blank. Subsequently, the upper parts of the sides were treated with abrupt retouch to smooth out the edge, resulting in a somewhat rounded shape for the upper base (Fig. 5: *6*). The second trapeze from the same layer has sides treated with abrupt, parallel retouch. Its

upper base also features fine abrupt retouch, appearing slightly rounded. Two specimens were discovered in the layers of the late Neolithic/Eneolithic period (Fig. 5: *11, 15*), crafted on medium-high, double-sloped blanks. The lateral sides and upper bases of these specimens are treated with fine, abrupt retouch.

Type 2 – rectangles

2.1. Rectangles with thinned backs consist of 13 specimens, including one sample discovered in excavation II by T.D. Belanovskaya, found in layer 9 (Fig. 3: *23–34*). The dorsal surfaces of these rectangles are treated with transverse-parallel pressure thinning retouch.

2.2. Rectangles with thinned backs consist of 7 pieces, characterized by semi-abrupt retouch on the lateral sides and small scales/facets on the dorsal surface, created using a percussion method (Fig. 5: *8, 14, 16, 17*). The upper and lower bases remain untreated. Within the Early Neolithic layers, dating to 5720–5620 BC, one piece was crafted on the cross-section of a triple-truncated blade. The intensive treatment of another piece's dorsal surface makes it difficult to ascertain the original faceting of the blank. Notably, one of the pieces exhibits a sub-square shape (Fig. 5: *16*). The second specimen in the collection has low outlines (Fig. 5: *17*) with two notches at the corners of the upper base. These notches likely indicate that the blank was created through a fragmentation process that involved breakage along the notches. This technique used for creating the blank is unique within the site's collection of microliths. Alongside thinning retouch, the dorsal surface of this piece was retouched along the lower base, with the retouch applied from the ventral side. In the layers dated to 5670–5520 BC, two pieces were found, made from medium-high, double-ridge blanks. In the late Neolithic/Eneolithic layers, three pieces were discovered, created from fragmented double-ridge blades. Truncation on these pieces was primarily achieved through pressure flaking from the sides. Additionally, one rectangle was crafted on the proximal fragment of a blade featuring a smooth striking platform. To decrease the thickness of this piece, several flakes were removed from the ventral surface, effectively cutting off the striking bulb.

Blanks were also found at the site, consisting of sections of blades or blade flakes whose shaping was not completed (Fig. 5: *18–22*). In the Early Neolithic layers, four specimens were identified as trapezoid blanks. These had small treated areas on the edges and dorsal surfaces, as well as small areas of cortex. These pieces might have been left unfinished due to the poor quality of the raw material (Fig. 5: *19, 22*). One blank, found in the layers from the end of the Early Neolithic, shows faceting on the back suggesting it was made from a section of a blade flake and potentially intended as a trapezoid blank. This piece features fine abrupt retouch on its left side. In the layers of the Late Neolithic/Eneolithic, two trapezoid blanks were uncovered (Fig. 5: *18, 20*). These pieces were likely left unfinished due to substantial damage incurred during their shaping.

Macro-wear trace analysis

A preliminary macro-wear analysis was conducted on a series of trapezoid and rectangular geometric microliths (Fig. 6) to assess artifact surface preservation and determine the feasibility of further research.

Reconstructions of flake functionality are based on projectile percussion wear traces, as detailed and experimentally verified in previous studies [13–18]. A standard traceological method was employed [19].

A high symmetrical trapeze can be tentatively attributed to cutting oblique-edged arrowheads, or to arrowheads with an oblique-edged orientation in the frame of composite projectile tools (Fig. 6: *12*). A complex of macro-traces characteristic of the oblique-edged orientation is observed, including a distinct crumpling of one of the acute angles of the trapeze and a breakage in the opposite angle. Chains of directed facets are formed on the cutting edge.

The seven high trapezes (Fig. 6: *1–5; 7; 13*) can be tentatively classified as transverse-edged forms. Their wide lower bases exhibit distinct wear characterized by a series of flat, subrectangular facets distributed across both faces of the edge. The corners formed by the intersection of the lateral sides and the lower base

display characteristic transverse fractures.

While the series of low trapezes and rectangles lack significant macroscopic wear, microscopic analysis may reveal polishing, small chips, and fractures. These micro-traces could indicate their use as inserts or points within slotted tools, potentially with varying cutting edge orientations. Confirmation requires a full traceological analysis using microscopy.

Residues consistent with adhesive materials were observed on the surface of some microliths. Similar residues, in terms of appearance, morphology, and location, have been documented on geometric microliths from Late Paleolithic and Mesolithic layers at sites in the Gubskoye Gorge (Northwest Caucasus, Krasnodar Territory, Mostovskoy District) [20].

Beyond functional wear traces, evidence suggests a specific hafting method for these geometric microliths. This involves a series of intentionally created notches and fractures located either directly on the cutting edge or on the opposing edge (Fig. 6: *2, 9, 11*). A similar technique of creating small notches and fractures has been observed on geometric microliths from Stone Age layers at Dvoynaya Cave [17]. Further traceological analysis will enable a complete reconstruction of how these microliths were used and how they were hafted within frames or onto shafts.

Discussion

The production technology for the selected groups of geometric microliths shares several common features, particularly regarding raw material selection (constrained by limited availability), blank production, and secondary treatment.

Raw materials. The reconstructed technological context at the site is incomplete, suggesting a lithic industry primarily focused on small-scale knapping. Blanks and processed cores appear to have been imported from distant raw material sources, potentially located near the Seversky Donets River [4, p. 21]. However, the presence of small split pebbles and a concentration of washed-in flint fragments within the cultural layers indicates some local exploitation of available flint resources. Geometric microliths were manufactured from a range of flint qualities, including high-quality (Fig. 6: *6, 8–12*), medium-quality (Fig. 6: *3–5, 7*), and low-quality (Fig. 6: *1, 2, 13*) materials. This suggests that under conditions of raw material scarcity, even flint fragments with cortex were utilized (particularly in the Early Neolithic layers).

Obtaining the blanks. Most microliths were crafted from the medial sections of blades. Only three specimens were made on lamellar flakes, and another three retained sections of cortex. This use of cortical material is atypical for microlithic assemblages at other sites. Blanks were generally produced by simple blade fracture. A single microlith from the Early Neolithic layer provides an exception, with its blank produced by fragmentation along notches (Fig. 5: *17*).

Secondary retouch techniques employed at the site include a variety of methods. Percussion retouch was used for creating microliths with thinned edges and simple trapezes. Rectangles with thinned backs exhibit pressure thinning flaking, while trapezes with thinned backs show a combination of impact retouch and pressure thinning flaking. These retouching techniques were likely executed using pressure flaking. Percussion techniques were employed for shaping the lateral edges of the tools. Specifically, abrupt or vertical retouch was used on small areas of the dorsal surface when creating trapezes with thinned edges. A semi-abrupt retouch was applied to the edges of the ventral surface of trapezes. Pressure flaking, however, was exclusively used for flattening the dorsal surfaces of both trapezes and rectangles. While all these techniques aim to flatten the dorsal surface, they achieve this through different methods. Notably, a semi-abrupt “Helwan” retouch was observed on the lateral sides of faceted trapezes.

The distribution of microlith groups differs for the chronological periods of the Rakushechny Yar settlement. In the early Neolithic layers (12-23, dating to 5720–5620 BC), geometric microliths are primarily represented by pieces with thinned edges, with a single exception identified as a rectangle with a thinned back. Several distinctive microlith production techniques are observed within these early Neolithic

layers. These include the use of Helwan retouch on the lateral sides — a relatively archaic technique for this particular site [22; 23] — and the presence of trapezoidal blanks. The later periods at the site contain all identified microlith types. Geometric backed microliths become the clearly dominant type in the late Neolithic layers. Further standardization is observed in the Neolithic/Eneolithic transition, where trapezes with thinned backs of medium-high proportions are the most prevalent (Fig. 4).

Several geometric microliths were found to contain a complex of macro-traces, presumably associated with projectile wear.

Distribution of geometric microliths in the Ponto-Caspian region. Geometric microliths with thinned edges are primarily found in the western Ponto-Caspian region (Fig. 1). Their precise chronological placement is challenging. At the Gard settlement, layers containing these microliths date to ca. the mid-6th millennium BC [24]. Based on the Rakushechny Yar settlement stratigraphy, their appearance is estimated ca. 5720–5620 BC. At the Razdorskaya 2 settlement, they were found alongside scaled trapezes in layers dating to the mid-7th millennium BC [22].

In this region, simple trapezes, a common type of geometric microlith during the Neolithic period, frequently appear alongside trapezes with thinned backs or precede them chronologically. They can also be found in association with segments (e.g., the Baibek and Varfolomeevskaya settlements, layer 3 [25]) and are absent in later periods.

Neolithic sites with assemblages containing pressure-retouched microliths are widespread across the Ponto-Caspian region [26; 27] (Fig. 1). Some early assemblages featuring trapezes with thinned backs include the Girzhevo site [28] in the Lower Dniester region, sites in Podontsovye [29], Mountainous Crimea (settlements of Tash-Air, Kaya Arasy, Shan Koba, etc. [30; 31]), and the South Caucasus (settlements of Goytepe, Mentesh Tepe, Hadji Elamkhanly Tepe, Akhnashen, etc. [32–34]).

Backed geometric microliths at the Rakushechny Yar are associated with the late early Neolithic and the late Neolithic/Eneolithic periods, although their latest occurrence is difficult to determine. Similar trapezes were found at Razdorskoye I in Neolithic-Eneolithic layers (layers 1-2) [35]. In the Northern and Northwestern Caspian Sea and Lower Volga regions, trapezes with thinned backs appear in developed Neolithic contexts (Kairshak I, Varfolomeevskaya layer 2B) and late Neolithic contexts (Tenteksor, Zhe-Kolgan I, Varfolomeevskaya layer 2A, Dzhangar layer 1, Ulan-Tug 2, Tu-Buzgu-Khuduk II, etc. [36]), dated to approximately 5900-5600 BC and 5500-5000 BC, respectively [37]. They are also present in the late Neolithic materials of the Mariupol burial ground and the Kalmius settlement [38; 39]. Such geometric microliths clearly mark the Late Neolithic period in the Northern Caspian and steppe Volga regions [40; 41]. They are absent from sites of the Neo-Eneolithic Caspian culture (dated 4900-4600 BC [37; 42]) or originate from mixed Late Neolithic/Eneolithic assemblages [43]. However, some argue that similar trapezes, first appearing in the Late Neolithic, are common during the transition to the Chalcolithic and are found at Eneolithic sites like Mu-Kyukn 1 [36].

Conclusion

Geometric microliths represent a widespread artifact category encompassing diverse morphological types and functional uses, including arrowheads and tool components [14; 44]. Regional assemblages exhibit distinct shapes and treatment methods. The floodplain settlements of the Don Valley (Razdorskaya 2, Razdorskoye 1, Rakushechny Yar), the Seversky Donets (Ust-Bystraya, Nizhneserebryakovskoye 1), and the Northern Azov region (Matveyev Kurgan I, II) are characterized by a microlith assemblage that differs from sites exhibiting Mesolithic industry features, which have more similarities with the North Caspian area (Kremennaya 2, 3, Rassypnaya 1, VI, Zhukovskaya 2, Platovsky Stav 1, the location near the village of Kurganny, and Kirpichnoye 2) [3].

This research has identified consistent series of geometric microliths at the Rakushechny Yar settlement and refined the chronology of various types. The earliest type identified, geometric microliths with thinned

edges, dates to 5720–5620 BC. These are part of a broader microlithic complex including geometric microliths, microdrills, and miniature slate adzes. Trapezes with thinned edges are more commonly found in the western Ponto-Caspian region.

Backed geometric microliths later became the most prevalent type. At the Rakushechny Yar settlement, their earliest appearance is dated to 5670–5520 BC and 5620–5520/5410–5310 BC, contemporaneous with similar artifacts found at sites in the steppe Volga region [1]. Determining the upper chronological boundary for backed geometric microliths is more challenging. Few dates from the late Neolithic/Neo-Eneolithic layers at Rakushechny Yar fall within the broad range of 5474–5046/5010–4549 BC. The complex formation of these layers makes dating of microlith use during later period, and their association with the Neo-Eneolithic Lower Don culture, difficult. Perhaps the upper boundary of the Neolithic should mark the end of the existence of trapezes with thinned backs, which are not recorded in the Neo-Eneolithic Caspian culture of the steppe Volga region and the Northern Caspian region, dated to the first half of the 5th millennium BC, analogies of which are found in the materials of the Lower Don culture [37].

Microliths constitute approximately 4-6% of the assemblage within various layers at Rakushechny Yar. This stable proportion within the lithic industry is also observed at other Ponto-Caspian sites, although some sites show a significantly higher prevalence of microliths. New excavations, aided by improved methodology, have substantially expanded the collection of geometric microliths. While further excavation may uncover more microliths, the suggested proportion within the overall lithic assemblage is expected to remain relatively constant.

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Fig. 1. Neolithic/Neo-Eneolithic sites with geometric microliths with thinned backs, with thinned edges, simple trapezes in the regarded complexes at the sites mentioned in the text

Рис. 1. Карта неолитических/нео-энеолитических памятников с геометрическими микролитами со струганной спинкой, с подтеской, простых трапеций в представленных комплексах на памятниках, упоминаемых в тексте.

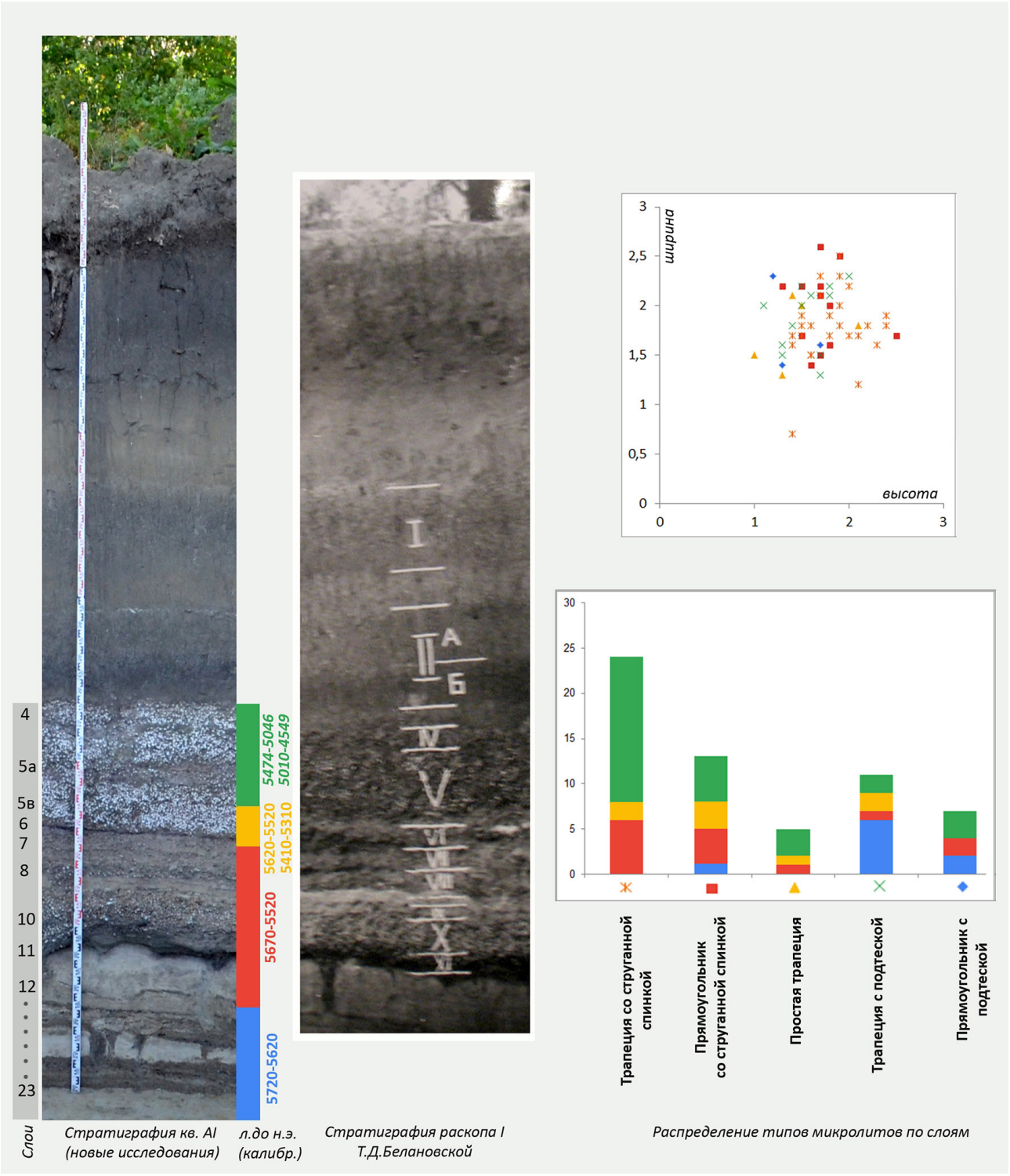

Fig. 2. Stratigraphy of the Rakushechny Yar settlement (new excavations and trench I by T.D. Belanovskaya) with indication of layers and chronological periods, distribution of geometric microlith types within chronological complexes and the ratio of metric characteristics.

Рис. 2. Стратиграфия поселения Ракушечный Яр (новых раскопов и раскопа I Т.Д. Белановской) с указанием слоев и хронологических периодов, с распределением типов геометрических микролитов по хронологическим комплексам и соотношением метрических характеристик.

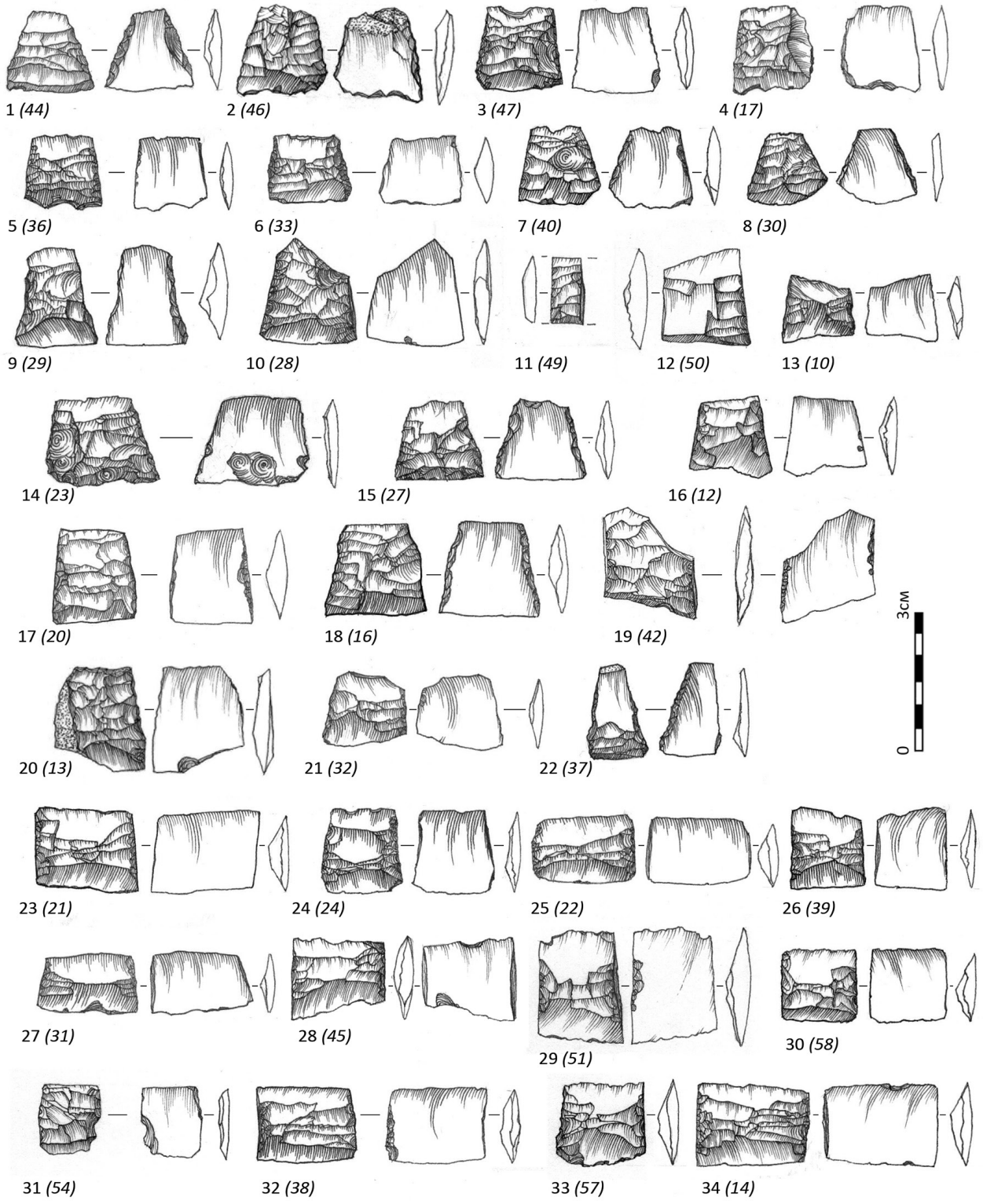

Fig. 3. Trapezes (1-22) and rectangles (23-34) with thinned backs (in brackets – the number of a microlith indicated in Fig. 4; new research – 1-4, 11, 12, 16, 18, 20, 21, 28-31, 33-34; excavation I of T.D. Belanovskaya – 5-10, 13-15, 17, 19, 22-27, 32). Chronological complexes: 5474-5046/5010-4549 BC (1-13, 21, 22, 24, 26, 27, 29, 31, 32); 5620-5520/5410-5310 BC (14-15, 25, 28); 5670-5520 BC (12-20, 23, 30, 33, 34)

Рис. 3. Трапеции (1–22) и прямоугольники (23–34) со струганной спинкой (в скобках порядковый номер микролита, указанный на рис. 4; материалы новых исследований – 1–4, 11, 12, 16, 18, 20, 21, 28-31, 33-34; материалы раскопа I Т.Д. Белановской – 5–10, 13–15, 17, 19, 22–27, 32). Хронологические комплексы: 5474–5046/5010–4549 л. до н.э (1–13, 21, 22, 24, 26, 27, 29, 31, 32); 5620–5520/5410–5310 л. до н.э. (14–15, 25, 28); 5670–5520 л. до н.э. (12–20, 23, 30, 33, 34)

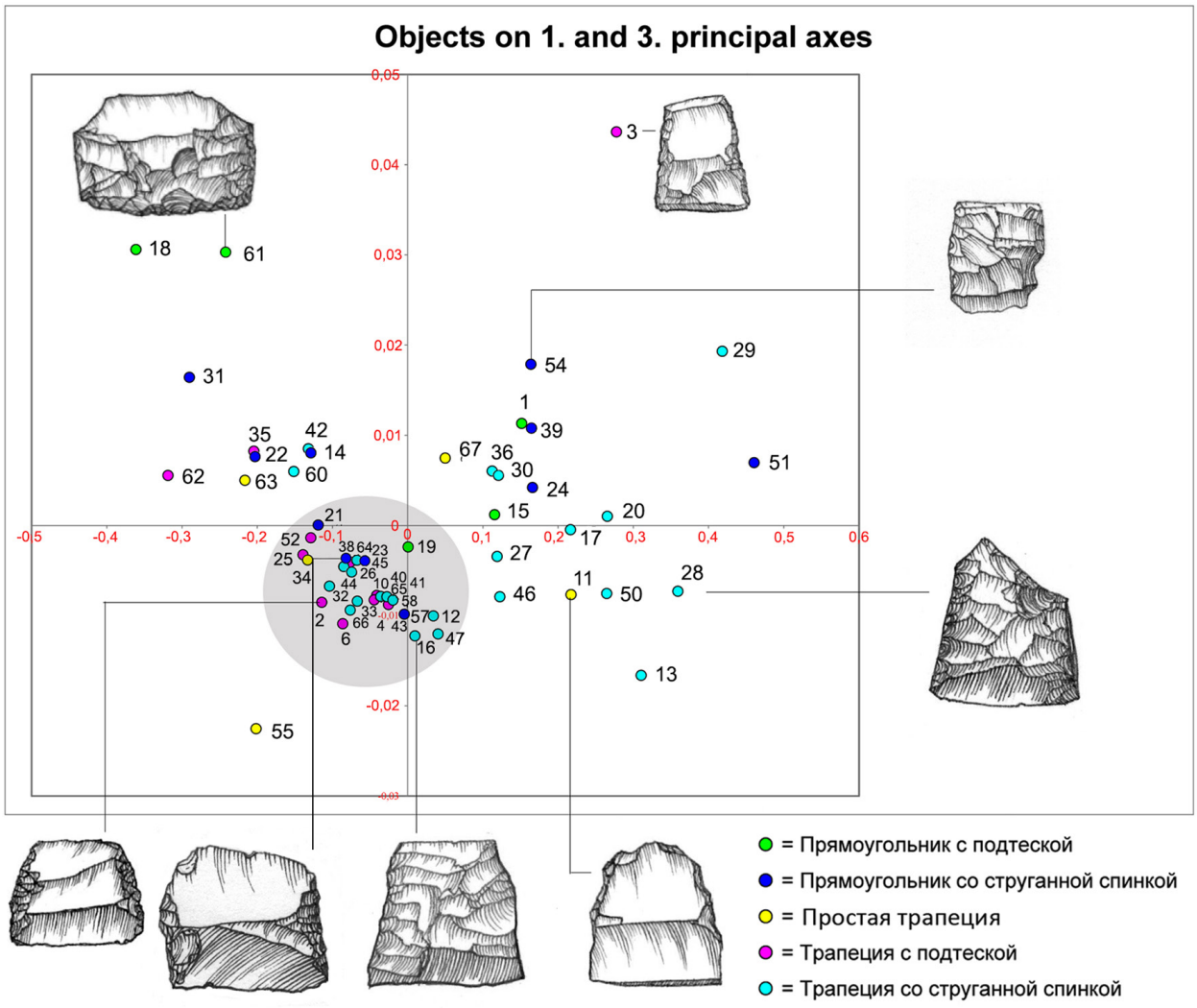

Fig. 4. Correspondence analysis of metric characteristics and proportions of geometric microliths of the Rakushechny Yar settlement

Рис. 4. Корреспондентный анализ метрических характеристик
и пропорций геометрических микролитов поселения Ракушечный Яр

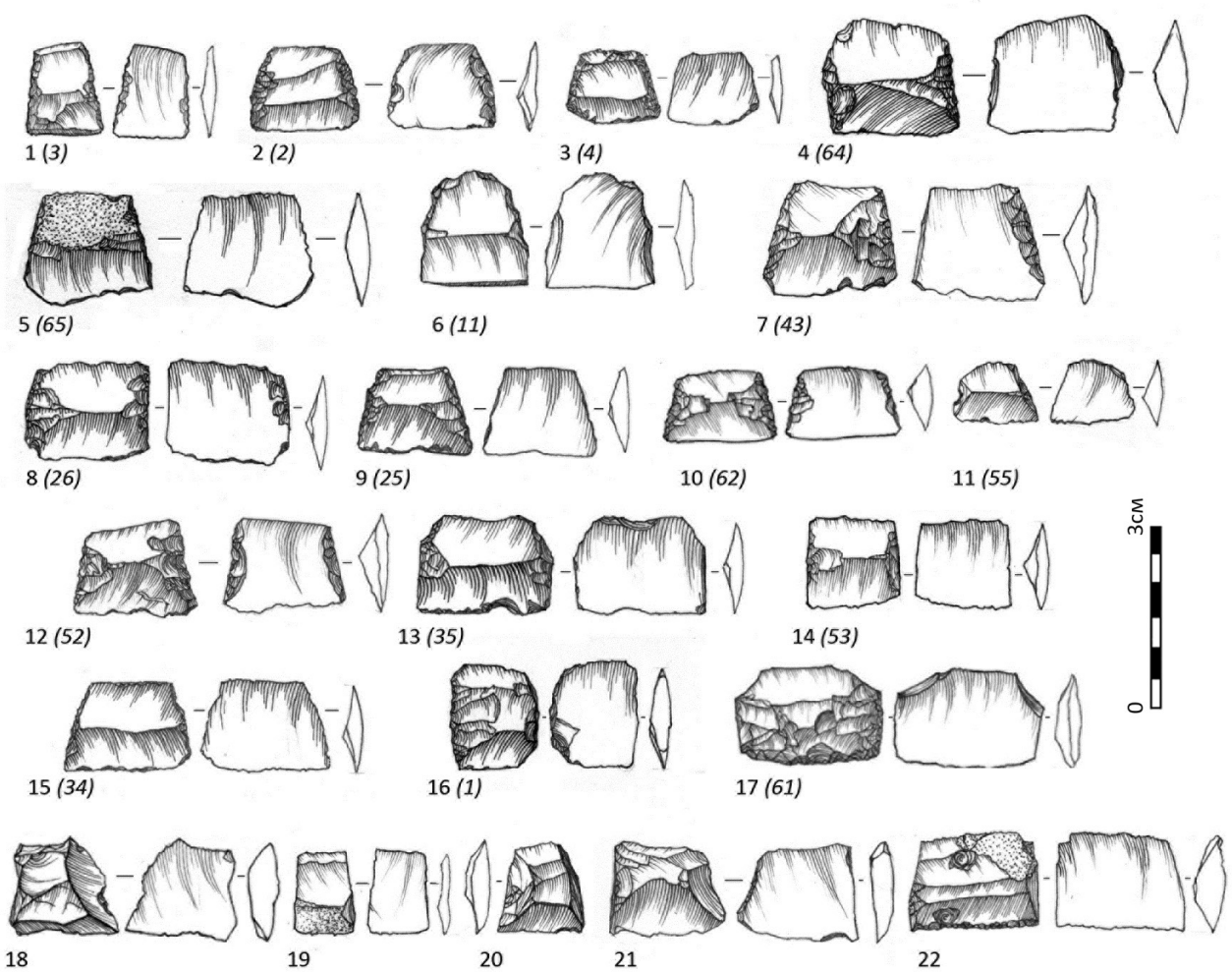

Fig. 5. Simple trapezes (6, 11, 15), trapezes (1-5, 7, 9, 10, 12, 13) and rectangles (8, 14, 16, 17) with thinned edges, blanks (18-22) (new research – 1-7, 10-12, 14, 16-22; excavation I of T.D. Belanovskaya – 8, 9, 13, 15). Chronological complexes: 5720-5620 BC (1-5, 16-17); 5670-5520 BC (6, 10, 14); 5620-5520/5410-5310 BC (7, 9); 5474-5046/5010-4549 BC (8, 11-13, 15))

Рис. 5. Простые трапеции (6, 11, 15), трапеции (1–5, 7, 9, 10, 12, 13) и прямоугольники (8, 14, 16, 17) с подтеской, заготовки (18–22) (в скобках порядковый номер микролита, указанный на рис. 4; материалы новых исследований – 1–7, 10–12, 14, 16–22; материалы раскопа I Т.Д. Белановской – 8, 9, 13, 15). Хронологические комплексы: 5720–5620 л. до н.э. (1–5, 16–17); 5670–5520 л. до н.э. (6, 10, 14); 5620–5520/5410–5310 л. до н.э. (7, 9); 5474–5046/5010–4549 л. до н. (8, 11–13, 15)

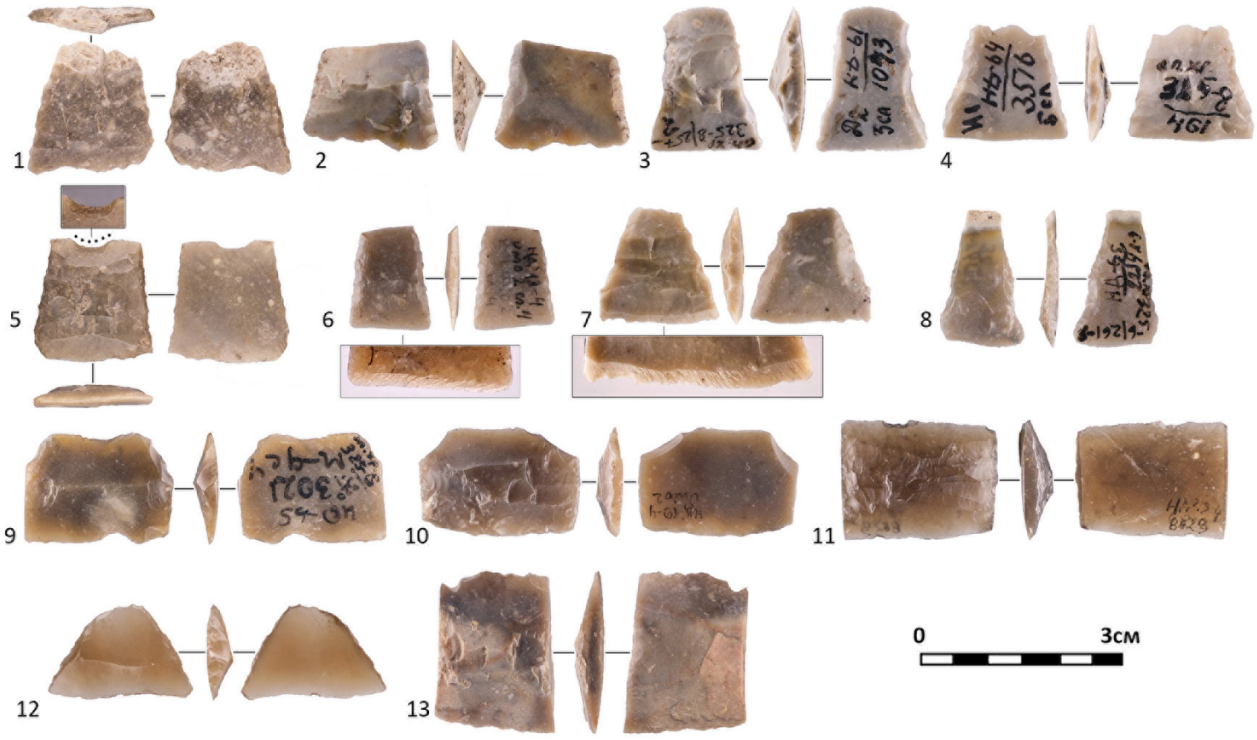

Fig. 6. Geometric microliths with use-wear traces (6 and 7) and a retouched notch (5)

Рис. 6. Геометрические микролиты с указанием следов утилизации (6 и 7) и выемки, оформленной ретушью (5)

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