Quaternary International xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

New insights into the Epipaleolithic of western Central Asia: The Tutkaulian complex

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ARTICLE INFO

Keywords:
Central Asia
Tajikistan
Epipaleolithic
Upper paleolithic
Tutkaulian
Geometric microliths

ABSTRACT

Bracketed by the Zagros, Hindukush, Altai, and Himalaya Mountains, Central Asia was a likely a migration route for early people moving into North and East Asia. Because of its central geographic setting, the area also channeled cultural and technological influences and exchange between adjoining regions in early prehistory. In this paper we analyze techno-typological characteristics of stone tool assemblages assigned to Early and Late Epipaleolithic industries from two key archaeological sites in Tajikistan – Tutkaul and Obi-Kiik. We compare –these industries with preceding Upper Paleolithic assemblages from the same region, as well as with cultural entities from the Levant and Zagros which share technological traits. Our study reveals key similarities, suggesting that the Tutkaul and Obi-Kiik techno-complexes belong to a single Epipaleolithic culture – which we refer to as the Tutkaulian – split into a three-stage developmental sequence. We argue that the Tutkaulian, defined by bladelet-based primary reduction and an abundance of geometric microliths, with a chronological progression from trapeze-rectangle to lunate forms, has its origins in the local Upper Paleolithic culture (Kulbulakian) emerging through repeated episodes of cultural exchange with earlier or synchronous Levantine and Zagros industries.

1. Introduction

With the Eurasian interior hosting three different species of early modern humans during the Paleolithic (Neanderthal, Denisovan, and *H. sapiens*), recent scholarship suggests a crucial role for Central Asia in early human dispersals, interactions, and cultural exchanges (Prufer et al., 2014). To date, however, the Paleolithic archaeological record of much of Western Central Asia has been poorly understood or inaccessible to scholars (Dennell, 2009; Sharon, 2014), with the majority of artifact collections from the Late Pleistocene and Early Holocene published during the 1970s only in Russian language. Recent publications concerning the Middle and Upper Paleolithic of this region (Kolobova, 2014; Krajcarz et al., 2016; Shalagina et al., 2015) have begun to shed light on the early material record of Central Asia, enabling comparisons with Upper and terminal Upper Paleolithic technocomplexes from the Near and Middle East (Ghasidian et al., 2017; Kolobova et al., 2016).

Nonetheless, most early studies of the technocomplexes of the Late Pleistocene – Early Holocene carried out in Central Asia during the 20th century suffer greatly from the absence of absolute dates. Late Pleistocene-Early Holocene sites in Central Asia, Siberia and Far East were first defined in an archaeological sense by A.P. Okladnikov. He followed the paradigm common in Europe at the time, wherein geometric microliths industries were described as “Mesolithic”. Most such Mesolithic sites have been found in the Caspian region and the Hissaro-Alay range, and Okladnikov associated these with geometric microliths assemblages known from Europe, Near East and Africa (Okladnikov, 1966). In this scheme, assemblages without geometric microliths from Hissaro-Alay, Tian-Shan, Pamir, Altai, Baikal region, Eastern Central Asia and Far East were described by Okladnikov using the term “Epipaleolithic” – the genesis of which he linked to the local development of Central and East Asian pebble-tool assemblages (Okladnikov, 1966).

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https://doi.org/10.1016/j.quaint.2018.10.001
Received 24 February 2018; Received in revised form 13 September 2018; Accepted 1 October 2018
1040-6182/

Most scholars, using this scheme, have since classified all the Late Pleistocene-Early Holocene sites into supposedly synchronous (11-8 kyr.) Mesolithic and Epipaleolithic assemblages (Ranov 1988; Ranov and Karimova, 2005; Filimonova, 2007). The Mesolithic assemblages (Tutkaul, Darai-Shur, Obi-Kiik, Chil-Chor-Chashma) were characterized by geometric microliths with rectangular and lunate shapes, different styles of backed points. The primary flaking technique has been described as a combination of the "pebble" technique[1] and volumetric bladelet cores. Some scholars argue that the genesis of the Mesolithic was a result of direct migration from the Levant and Zagros (Ranov and Davis, 1979).

In contrast, the Epipaleolithic (Oshhona, Obishir-5, Obishir-1, Karatumshuk, Beshkent sites) was characterized by pebble and microblade knapping, with tool sets dominated by end-scrapers, notched bladelets, drills, small bifacial points. Researchers have traditionally accentuated the absence of geometric microliths in those complexes, and considered the Epipaleolithic to be the result of autochthonous development of regional Upper Paleolithic (Korobkova, 1989; Ranov and Davis, 1979; Ranov and Karimova, 2005).

In recent years, however, it has become clear that these industries referred to as "Mesolithic" and "Epipaleolithic" were not in fact synchronous, but rather followed a developmental sequence– with Mesolithic materials dating earlier (20 ka BP – 13 ka BP) and Epipaleolithic later (13–8 ka BP) (Shnaider and thesis, 2015). New data based on absolute dates from known sites – Istyksksya cave, Obishir-5, Obishir-1 sites (Shnaider et al., 2017; Shnaider et al., 2018), and new sites with "Epipaleolithic" characteristics – Aygirzhal and Alamishik-2 (Motuzaite Matuzeviciute et al., 2017) support this hypothesis. Only in one case – the stratigraphic sequence of the Istykskaya Cave – are the "Mesolithic" and "Epipaleolithic" techno-complexes both present. The stratigraphic context clearly demonstrates that "Mesolithic" layers located under the "Epipaleolithic" indicate their succession (Ranov and Khudjageldiev, 2005).

Here, we use the umbrella term "Epipaleolithic" to describe all assemblages from western Central Asia dating between the LGM and the Neolithic. Use of a single, common term for this period helps to underline similarities in cultural developments between Central Asia and the Levant/Zagros (Kolobova et al., 2016; Ghasidian et al., 2017; Ranov and Davis, 1979); a similar approach has recently been effectively applied to the characterization of late Stone Age cultures in Caucasus (Golovanova et al., 2014).

New Upper Paleolithic archaeological data from the western ranges of the Pamir and Tien Shan Mountains are important for the regional Epipaleolithic studies. Specifically, the recently identified Kulbulakian Upper Paleolithic lithic tradition (ca. 39–23 ka cal. BP) includes assemblages from Kulbulak (layers 2.1 and 2.2), Kyzyl-Alma-2, Dodekatym-2 and Shugnou sites. The defining characteristic of the Kulbulakian is the production of bladelets from carinated cores. The tool kits are dominated by geometric (scalene triangles) and non-geometric microliths (backed bladelets and micropoints) along with different varieties of end-scrapers. The Kulbulakian progressed through several stages before giving way to a regional Epipaleolithic tradition (Kolobova et al., 2016). On the basis of the available absolute dates the age of Kulbulakian is estimated to be ca. 39-20 kyrs BP (Vandenberge at al., 2014). This necessitates reassessment of the local Late Pleistocene – Early Holocene lithic industries. Building upon a reexamination of materials from the two most important Epipaleolithic sites in the region, Tutkaul and Obi-Kiik (Fig. 1), the present paper aims to characterize typo-technological variability in the Pleistocene –Early Holocene assemblages from western Central Asia, and thus revise the end of the Paleolithic in the region. We conducted a twofold approach, incorporating 1) the lithic analysis of key Epipaleolithic complexes; 2) and the nmMDS plot statistic approach to define a stage in Tutkaulian. We explore the implications of our results in the context of the emergence of the Epipaleolithic across the broader region of western Eurasia, and develop hypotheses for the origin of key technological changes identified in our study.

2. Regional setting

2.1. Tajik depression

Situated in the heart of Central Asia, the Tajik depression is located at the intersection between the Pamir, Tien Shan, Gissar and Hindukush mountain belts. The climate is arid and continental, with cold winters and hot summers. As a high mountain region, temperature and rainfall vary according to altitude and slope exposure. Neighboring mountain areas (Gissaro-Alai in the north, Pamir in the east) receive abundant winter snowpack, which upon melting feeds two of the great rivers of Central Asia — Amu Darya in the south, and Syr Darya in the north. The gusty *Afghanets* (a strong, gusty, wind that derives from the upper Amu Darya river) is preceded and accompanied by dust storms from Afghanistan, while in the valleys the warm and dry downslope wind known as *Harmsil* prevails.

2.2. Tutkaul site setting and stratigraphy

Tutkaul is located in Dashti-Mazar, 70 km southeastwards from Dushanbe where the Vakhsh enters the Pulisangin Gorge (Fig. 2, *1*). The site was discovered by the archaeological expedition headed by A.P. Okladnikov in 1956 and excavated by a team headed by V.A. Ranov in 1963 and again in 1965–1969 (Ranov and Korobkova, 1971).

The description of the Tutkaul site stratigraphy is based on published materials of V.A. Ranov (Ranov and Korobkova, 1971) and his field diary and reports, stored in the library of A. Donish Institute of History, Archaeology and Ethnography (Dushanbe, Tajikistan). V.A. Ranov identified six stratigraphic layers (A–F) incorporating four cultural units (Fig. 2 and).

Layer A. Modern soil.

Layer B. Beige loess silt, its thickness – 0,5–4 m; in the upper part were discovered remains of a Medieval town, in the lower part – the remains of a Bronze Age habitation and the first cultural layer of the Neolithic Hissar culture (unit 1).

Layer V. Dark silt with a large amount of charcoals, its thickness is 0,4–2,5 m. Here was discovered the second Neolithic Hissar culture unit (unit 2), dated to 8020 ± 170 BP (Ranov and Karimova, 2005). Layers B and V were separated by a 0.15–2 m sterile layer.

Layer G (0,3–0,6 m). Rubbish-silt mud flow sediments; the layer contained Epipaleolithic remains (unit 2a). According to V.A. Ranov's description the separation of layers V and G was easy to recognize.

The amount of time between the deposition of layers G and V could not be established on the basis of geology alone. Based on analogies of lithic industries V.A. Ranov suggested consider unit 2a as dating to the 10th millennium before present (Ranov and Korobkova, 1971).

Layer D (0,8–1,8 m). Brown-red sand with stone debris, with several sublayers: a yellow sandy silt, a green sandy clay and finally a debris lens. No archaeological remains were found in this layer.

Layer E (0,6 m). Grey alluvial sand with several lenses of debris and red clay. Unit 3 (0,03–0,07 m) was discovered in one of the red clay lenses. The unit contained a large amount of lithic artifacts and a few bones and charcoals. Unfortunately, the bones and charcoals were lost after excavations.

Bellow layer E there was a sterile red and green clay deposit (layer F, 0,4–0,5 m), which covered an alluvial cone (Ranov and Korobkova, 1971).

In Ranov's scheme, unit 3 belonged to the Early Mesolithic. The diagnostic markers used to make this inference are trapeze-rectangles reminiscent of the Geometric Kebara artifacts, a tool type which he

[1] In Soviet literature the term "pebble knapping" was understood as the knapping of pebbles for flake production.

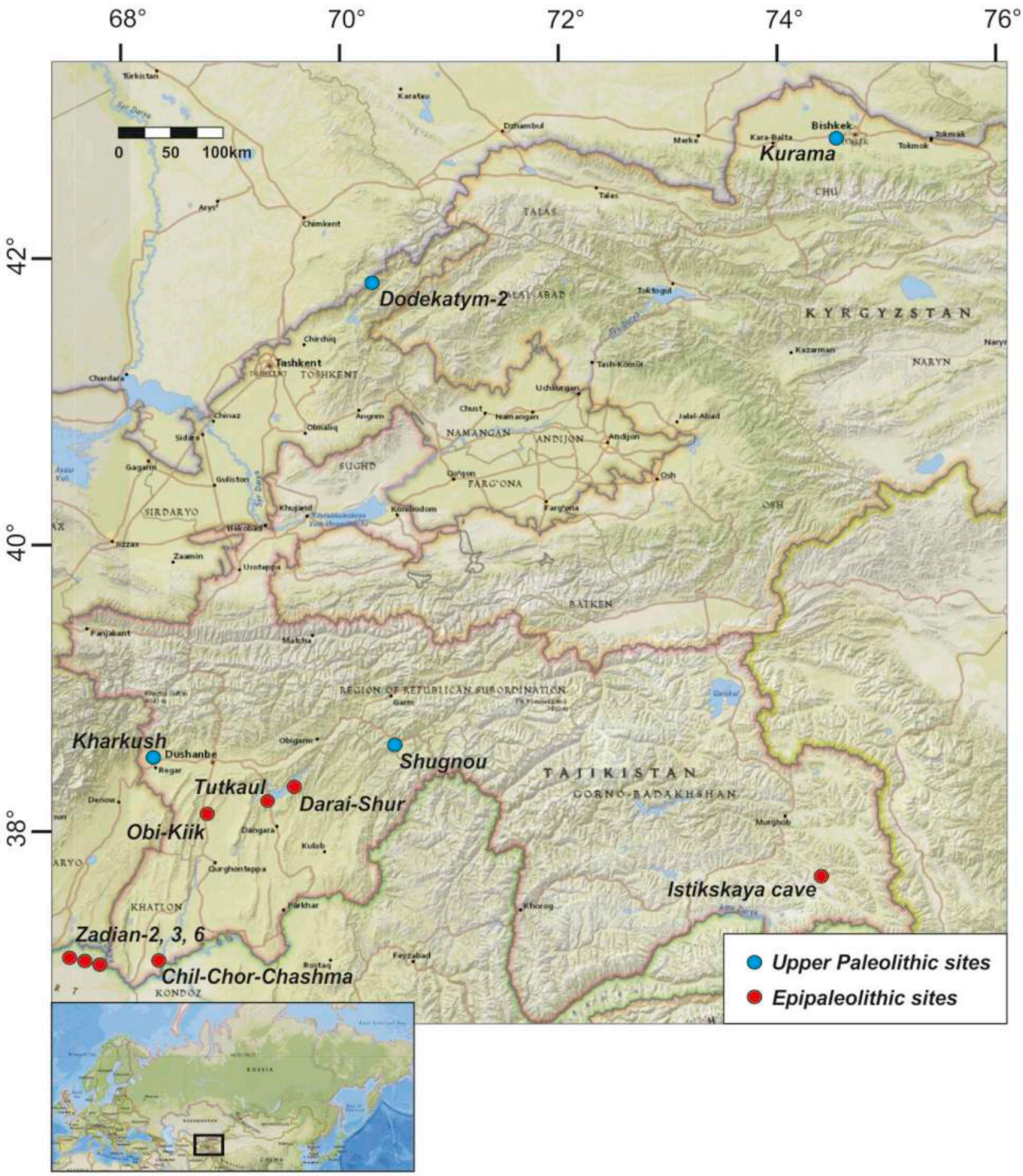

Fig. 1. The location of archaeological sites mentioned in the article. Map produced using National Geographic Basemap using ArcGIS Online.

suggested might correlate with similar assemblages from the Near East (Ranov, 1988). It was suggested that this assemblage represents cultural diffusion from Near East through eastern Iran and northern Afghanistan (Ranov, 1988; Filimonova, 2007).

2.3. Obi-Kiik site setting and stratigraphy

The site of Obi-Kiik is located in Dashti-Kiik, where the Dagan Gorge joins the Obi-Kiik Valley (Fig. 1). The site was discovered by A.P. Okladnikov in 1948 and studied by him in 1953. V.A. Ranov (1980) carried out large-scale excavations at the site in 1964. Ranov identified two strata at the site (Fig. 3).

Layer 1 (0,9 m). Grey-red loessic silt. Several archaeological artifacts were found in the upper part.

Layer 2 (1,1 m). Beige loess with no archaeological remains.

Two brown-red lenses were discovered at the interface of layers 1 and 2. These lenses were interpreted by V.A. Ranov as the remaining of a previous cultural unit. Redeposited archaeological materials were found in the upper portion of Layer 1. Because both complexes contained lunates, Ranov (1988) assessed the Obi-Kiik complex as synchronous to that of Tutkaul Layer 2a. Based on the context of artifact deposition and the position of refit artifacts during our reanalysis, the recovered archaeological materials do indeed appear to represent a single technocomplex.

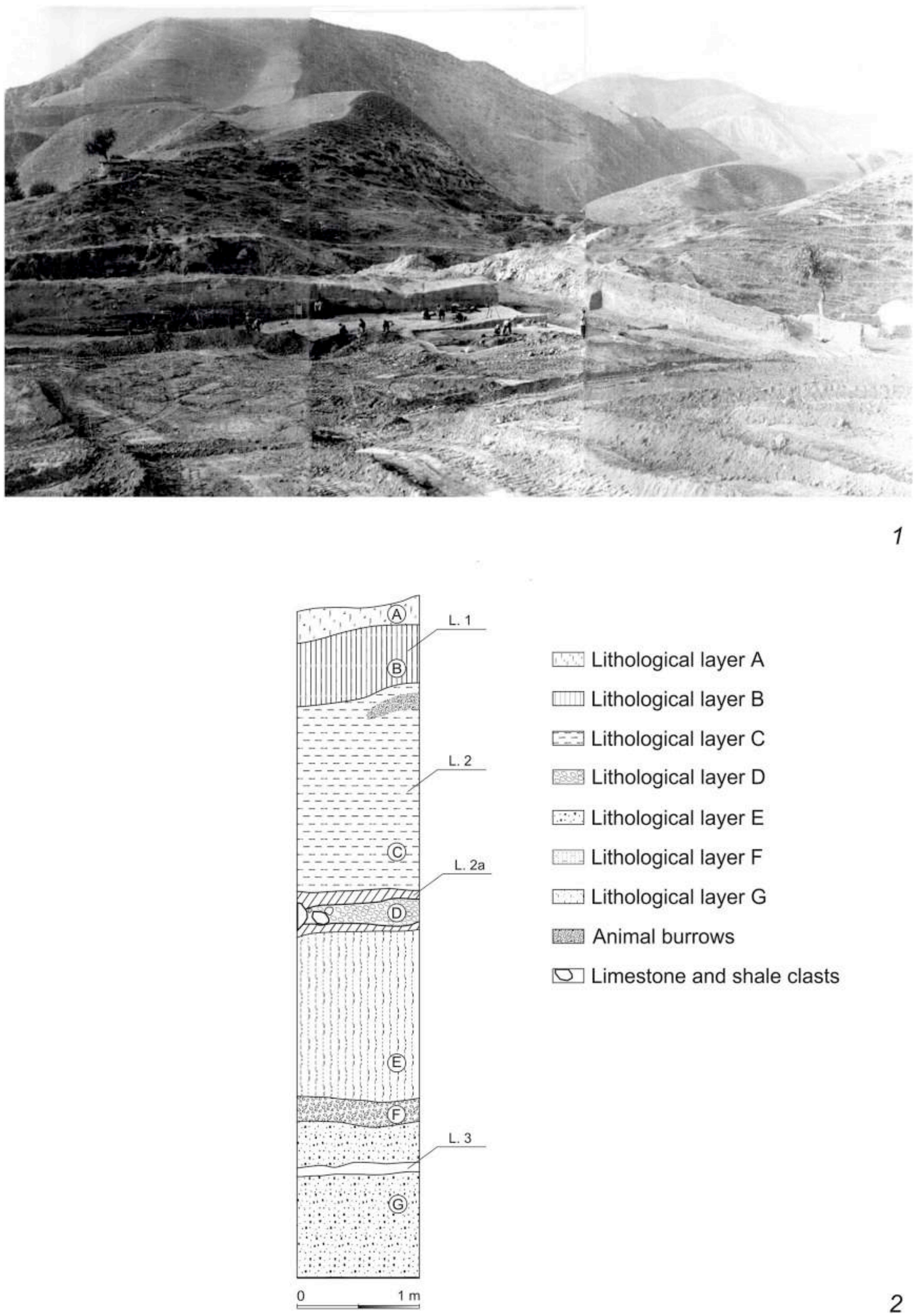

Fig. 2. Tutkaul site view and stratigraphy.

2.4. *Istykskaya cave setting and stratigraphy*

Materials from Istykskaya Cave in the eastern Pamir Mountains (Tajikistan) may help elucidate the development of lithic tool manufacturing in Western Central Asia. The site was first excavated and studied by V.A. Zhukov in 1975, who identified four intact horizons with cultural materials. Unfortunately, a full description of the stratigraphy did not survive. Zhukov's original four strata were later revised into a two unit cultural scheme, on the basis of similarities between the archaeological materials from Horizons 1 and 2, and between Horizons 3 and 4. Zhukov attributed the lower unit to the Epipaleolithic and correlated it culturally and chronologically with Tutkaul 2a, while the

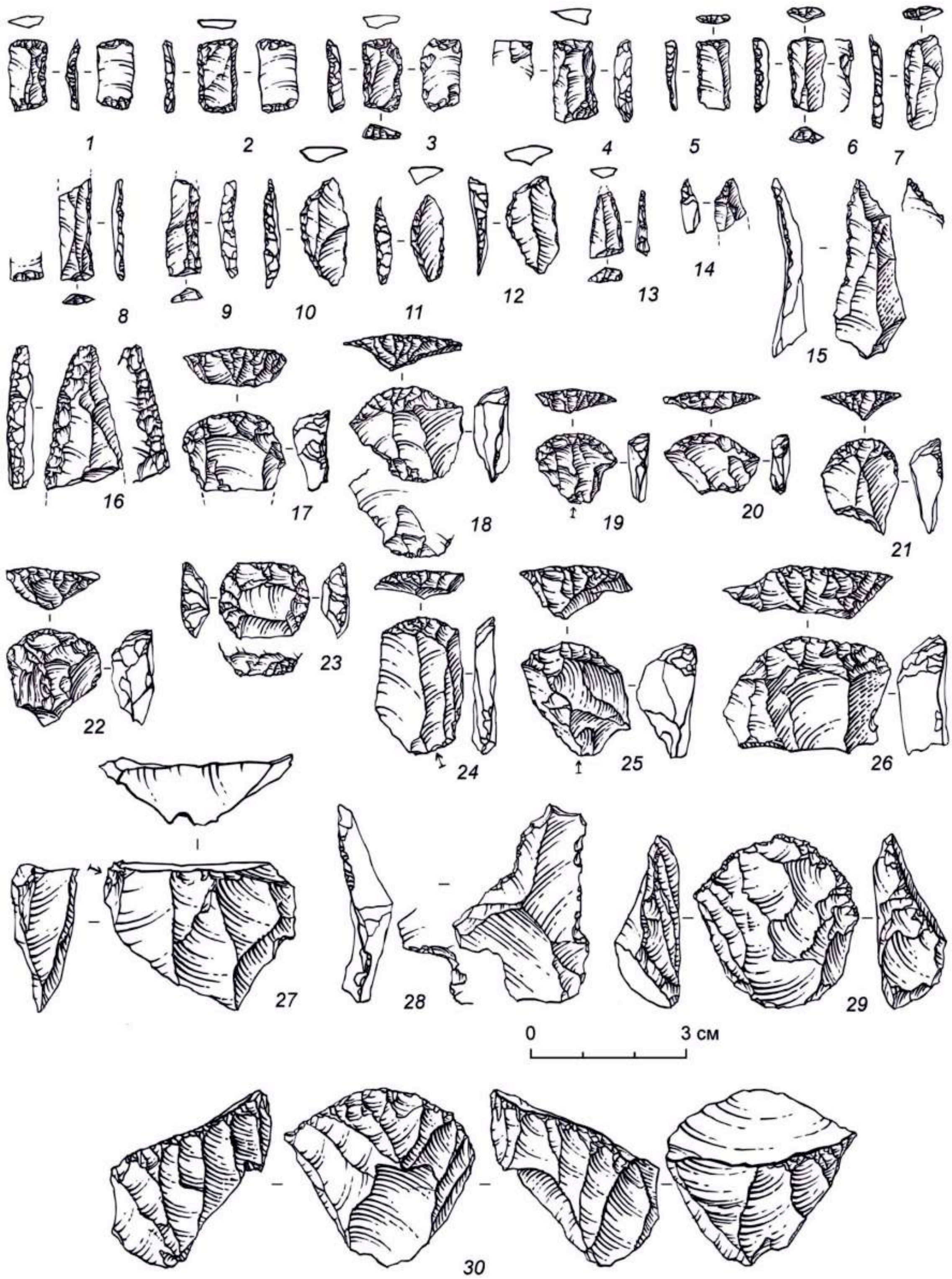

Fig. 3. Selected artifacts from Tutkaul site (layer 3).

upper unit seemed to resemble the lithic material from the Oshhona site (11–7 ka BP) (Ranov et al., 1982; Korobkova, 1989; Filimonova, 2007).

3. Materials and methods

We analyzed the archaeological collections from all three sites described above (Fig. 1). For each site, we have assembled information concerning the geological context and stratigraphy from both published articles and unpublished archive materials from V.A. Ranov's library at the Archaeological Department of Institute of History, Archaeology and Ethnography (Dushanbe, Tajikistan).

For each collection, we conducted lithic attribute analysis (after Monigal, 2002) with special attention to technological and typological attributes, including typology of the dorsal surface, ventral surface, proximal edge, striking platform parameters, lateral profile, cross sectional morphology, and metric characteristics. To estimate the age of undated tool assemblages, we conducted detailed typological comparisons with other, well-dated, Central Asian archaeological assemblages and produced a synthetic chronology for the late Paleolithic of the region. Finally, to evaluate the efficacy of our proposed cultural and chronological classification, we conducted non-metric multidimensional scaling (nmMDS), on the basis of 9 typological variables: the relative frequency of prismatic and carinated cores, the relative frequency of lunates, Tutkaulian points, alternately retouched blades, scalene triangles, backed bladelets and narrow points. The nmMDS is based on computing a similarity/distance and locating each item in low-dimensional space (Taguchi and Oono, 2005). To explore technological and typological connections with the region's Upper Paleolithic assemblages, we also coded and included the assemblage from the latest UP site known from western Central Asia (Dodekatym-2, layer 2) (Kolobova, 2014).

4. Results

4.1. Tutkaul site lithic assemblage (layer 3)

The lithic collection of Horizon 3 totals 874 artifacts, including 440 pieces of debris (Table 1). According to petrographic analysis, the majority of artifacts (96%) were made of rock with high silicon content – flint and chalcedony— while 2% of artifacts were made of effusive rocks and 2% of artifacts were made of sandstone (Ranov et al., 2015).

We identified two morphologically distinct core types in layer 3 (Table 2), carinated core (Fig. 4, *30*) and convergent bladelet core (Figs. 4, *29*). Core preparation blanks included core tablets, *eclats débordante*, front core trimming spalls (Figs. 4, *27*) and one carinated lateral spall (Table 3), while in the spall category we registered 121 flakes, 53 blades and 247 bladelets (Table 1).

The morphometric features of the flakes are not standard; they are characterized by angular shapes, longitudinal or transversal flaking scars on the dorsal face, polyhedral cross-sections, and planar and linear striking platforms. These features, together with the absence of flake cores, suggests that most flakes in this assemblage were not the target of lithic reduction, but instead the byproducts of core preparation.

Judging by the morphology of available cores and the composition of the artifact collection, the primary goal of the reduction sequence in this assemblage was blade production. The blanks demonstrate the following morphometric features: longitudinal flaking of the dorsal face (82%), straight (70%) or twisted and curved (30%) lateral profiles, triangular (43%) and trapezium-shaped (41%) cross-sections, and reduced linear (57%) or punctiform (28%) striking platforms.

The tool kit comprises 130 tools (Table 4). The category of geometric microliths (the most numerous category) include trapeze-rectangles (Figs. 4, *1–9*), lunates (Figs. 4, *10–12*) and a scalene triangle (Figs. 4, *13*). The tool kit also includes backed bladelets, borers (Figs. 4, *14, 15*), alternately retouched blades (Figs. 4, *16*), notched pieces (Figs. 4, *28*) and various types of end-scrapers ((Figs. 4, *24–26*) including "thumbnail" end-scrapers (Figs. 4, *17–23*).

Table 1
Artifact type list from Tutkaul (layers 3 and 2a) and Obi-Kiik.

Debitage	*Tutkaul*				*Obi-Kiik*	
	Layer 3		Layer 2a			
	N	*%*	*N*	*%*	*N*	*%*
Cores	2	0,5%	72	4,6%	14	6%
Pebbles	–	–	6	0,4%	–	–
Core trimming elements	11	3%	78	5%	6	3%
Flakes	121	28%	835	54%	145	60%
Blades	53	12%	322	21%	20	8%
Bladelets	247	57%	228	15%	65	21%
*Total, without debris**	*434*	*50%*	*1541*	*55%*	*240*	*78%*
Debris (chunks, chips, flakes less than 20 mm)**	440	50%	1266	45%	69	22%
Total	***874***	***100%***	***2807***	***100%***	***309***	***100%***

*Percentage of the total number of artifacts from layers without debris.
**Percentage of the total number of artifacts in the layer.

Table 2
Core type list from Tutkaul (layers 3 and 2a) and Obi-Kiik.

Types of cores	Tutkaul		Obi-Kiik
	Layer 3	Layer 2a	
Flat faced cores	**1**	**28**	
for flakes		***16***	
Radial		2	
Unidirectional		10	
Bidirectional		2	
Orthogonal		2	
for bladelets	***1***	***11***	
Discoidal		1	
Unidirectional		4	
Bidirectional		1	
Orthogonal		2	
Opposed		3	
Convergent	1	–	
for blades		***1***	
Unidirectional		1	
Narrow fronted cores		**11**	**2**
for bladelets		***11***	***2***
Narrow fronted unidirectional		6	2
Narrow fronted bidirectional		5	
Prismatic cores	**1**	**19**	**2**
for blade		***2***	
Semi-cylindrical		2	
for bladelets	***1***	***17***	***2***
Semi-pyramidal		10	
Cylindrical		7	
Carenated	1		2
Total	***2***	***58***	***4***

4.2. Tutkaul site lithic assemblage (layer 2a)

The artifact collection associated with layer 2a is comprised of 2807 specimens, the majority of which are debris (n = 1266; 45%) (Table 1). Petrographic analysis indicates that the artifacts were mostly made of effusive rocks (54%) and flint and chalcedony (43.9%) with minor utilization of sandstone (2%) and quartz (0.1%) (Shnaider and thesis, 2015).

A total of 64 artifacts were defined as cores (Table 2) including six exhausted cores. Flat-faced cores include the radial, discoidal, unidirectional (Fig. 5, *5, 6*), bidirectional (Figs. 5, *10*), orthogonal and opposed (Figs. 5, *7*) varieties. The collection also includes narrow-face bladelet cores with unidirectional (Figs. 5, *8*) and bidirectional (Figs. 5, *9*) flaking patterns. In terms of prismatic cores, we identified semi-cylindrical blade (Figs. 5, *11*) cores as well as semi-pyramidal (Figs. 5, *3, 4*) and cylindrical bladelet cores (Figs. 5, *1*).

Core reduction elements (Table 3) included flaking face trimming spalls (Figs. 5, *2*), *eclats débordante,* core tablets, and crested and semi-crested blades. The trimming elements of the distal part of core, lateral trimming spalls and an overshot were also noted. In the spall category, most objects were defined as flakes (n = 835), along with blades (n = 322) and bladelets (n = 228).

Debitage analysis supports the assessment that the reduction sequence, which was based on the utilization of flat-faced cores, produced non-standard flakes. The flakes in the assemblage exhibited variable forms and dimensions of both spalls and striking platforms; reduction patterns were identified on 50% of the total number of spalls. Horizon 2a blades are characterized by a longitudinal reduction pattern of the dorsal face (80%), linear (50%) and plane (25%) striking platforms,

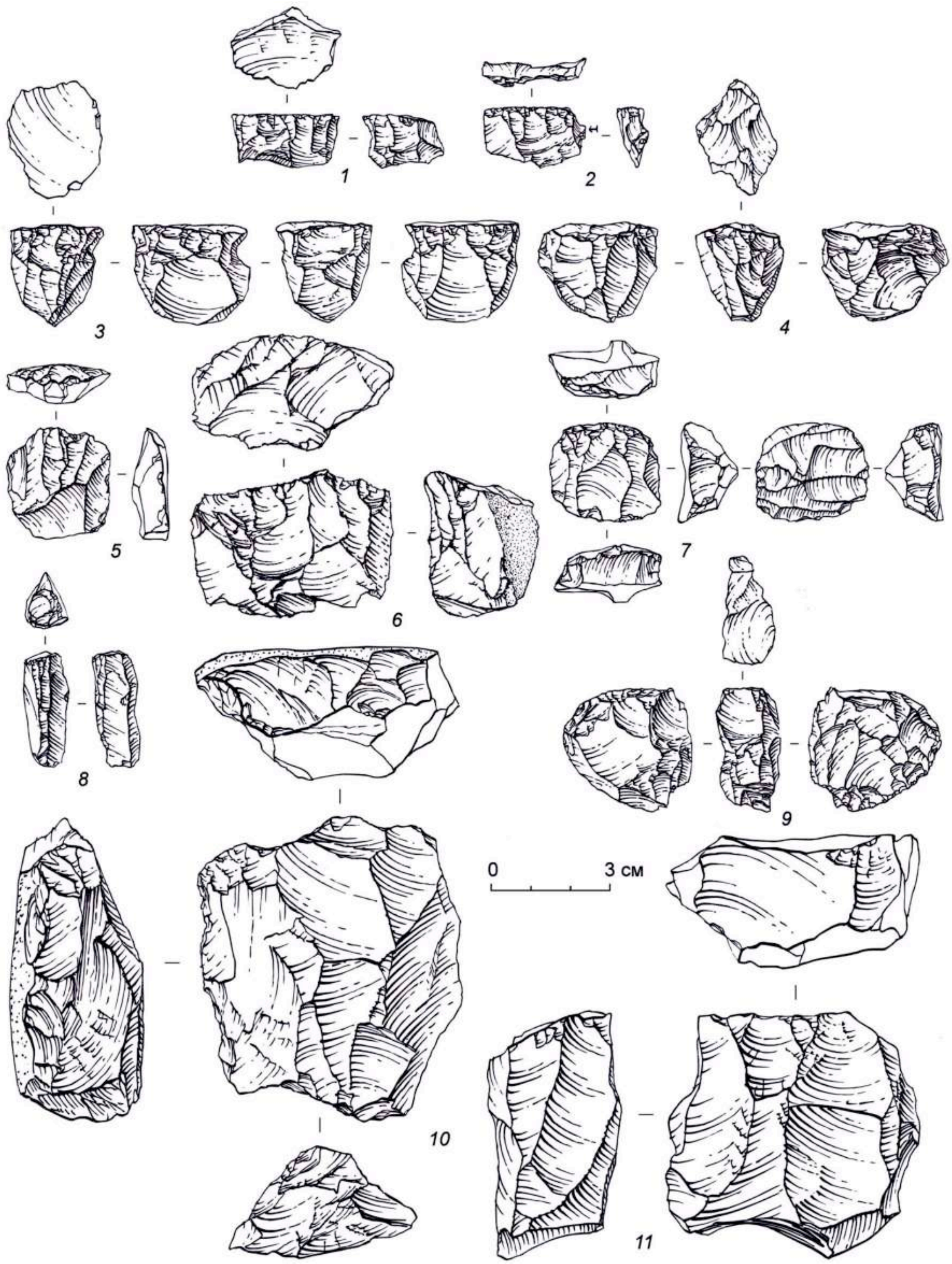

Fig. 4. Selected artifacts from Tutkaul site (layer 2a).

triangular (58%) and trapezoid (36%) cross-sections and straight lateral profile (90%).

This layer contained 264 identifiable tool specimens (Table 4). Geometric microliths were the most numerous, including both lunate (Fig. 6, *1–5*) and triangle (Fig. 6 and) shapes. The category of non-geometric microliths is represented by backed bladelets and narrow micro -points with a truncated base. The proportion of "Tutkaulian points" (Figs. 6, *7–10*) (asymmetrical points fashioned on blades through backing retouch) is considerable (18.2%). The tool assemblage also includes pointed, ordinary and double backed blades, borers (Figs. 6, *16, 17, 20*), notched pieces (Figs. 6, *18, 19, 21*), splinted pieces (Figs. 6, *22, 23*), scrapers (Figs. 6, *25*) along with end-scrapers (Figs. 6, *11–14*), thumbnail end-scrapers (Figs. 6, *15*), carinated scrapers (Figs. 6, *24*), and circular scrapers.

4.3. Obi-Kiik site lithic assemblage

The Obi-Kiik lithic collection consists of 309 artifacts including 69

Table 3
Technical spall list from Tutkaul (layers 3 and 2a) and Obi-Kiik.

Types of core trimming elements	Tutkaul		Obi-Kiik
	Layer 3	Layer 2a	
Débordantes	3	15	1
Front core trimming spalls	3	24	2
Core tablets	4	13	–
Semi-tablet	–	–	1
Crested blade	–	7	–
Semi-crested blades	–	9	–
Lateral trimming spalls	1	2	2
Rejuvenation of core's terminal part	–	7	–
Overshot	–	1	–
Total	***11***	***78***	***6***

Table 4
Tool list from Tutkaul (layers 3 and 2a) and Obi-Kiik.

Type of tool	Tutkaul		Obi-Kiik
	Layer 3	Layer 2a	
Geometric microliths:	38	46	14
rectangle	*32*	–	–
lunate	*5*	43	14
triangle	*1*	3	–
Backed bladelet	15	1	7
narrow micropoints with a truncated base	–	1	–
Tutkaulian point	–	45	–
Backed pointed blade	–	6	4
Double backed blade	–	6	–
Backed blade	–	2	1
Alternately retouched blade	5	3	
End-scraper	**21**	**30**	**3**
thumbnail end-scraper	*14*	–	–
side-scraper	*2*	–	–
end-scraper	*5*	24	3
circular end-scraper	-	2	–
carenated scraper	-	4	–
Scraper	**-**	**4**	**-**
Single side-scraper	-	3	–
Canted side-scraper	-	1	–
Borer	6	13	3
Nothed piece	1	17	12
Splinted piece	–	12	1
Burin	–	1	1
Retouched blank			
Retouched blade	11	6	3
Retouched bladelet	7	8	1
Retouched flake	4	22	11
Blank with utilization retouch			
Blade	5	–	4
Bladelet	4	3	4
Flake	4	7	–
unrecognazible fragment of tool	9	34	3
Total	**130**	**264**	**75**

pieces of shatter and debris (Table 1). Petrographic analysis indicates that all artifacts were made of flint (Shnaider and thesis, 2015). The category of cores includes prismatic and narrow-face (Fig. 7, *16*) varieties as well as carinated cores (Figs. 7, *19, 20*) and a carinated pre-core (Table 2). Core reduction elements (Table 3) include lateral trimming spalls and a semi-tablet from a carinated core (Figs. 7, *17*), along with flaking face rejuvenation spalls (Figs. 7, *18*) and *eclats débordant*. The majority of spalls are flakes (n = 145); but blades (n = 20) and bladelets (n = 55) were also identified.

The tool assemblage totals 75 specimens (Table 4), the highest proportions of which are lunates (18.6%) (Figs. 7, *1–4*). Non-geometric microliths found at Obi-Kiik include backed bladelets (Figs. 7, *8, 12*), pointed backed bladelets (Figs. 7, *5*), alternately retouched blades (Figs. 7, *13*), and one backed blade. Other tool types are end-scrapers (Figs. 7, *9*), notches (Figs. 7, *6, 7*), borers (Figs. 7, *10, 11*), a double edged splintered piece (Figs. 7, *15*) and a single-faceted angle burin (Figs. 7, *14*).

4.4. Istykskaya cave lithic assemblage (layers 3–4)

Our description of the lithic assemblage from Istykskaya cave is based on the published works of Ranov et al. (2005). Unfortunately, the complete metric data from this assemblage has not been published, and the collection is now stored in a number of different museums across Tajikistan. We therefore provide here the analysis only of a portion of the original tool and core assemblage.

We analyzed the artifacts from the Istykskaya cave lower unit (Horizons 3–4) (Ranov and Khudjageldiev, 2005). The artifact collection associated with these layers totals around 1000 artifacts. The primary reduction strategy here appears to have been based on knapping prismatic and narrow-face blade cores. The morphology of the Istykskaya narrow-face cores is similar to that noted in the core assemblage from Tutkaul 2a.

4.5. Absolute dating of Istykskaya cave

We conducted a new absolute dating of Istykskaya cave assemblage using samples obtained from two bone fragments found within archaeological collections stored at the Archaeological Department of Institute of History, Archaeology and Ethnography (Dushanbe, Tajikistan). One sample was processed and dated at the AMS laboratory of Novosibirsk Center for Cenozoic Geochronology (Russia) giving a calibrated date of 13830-13450 (NSKA 1622). Another date was obtained at the Center for Applied Isotope Studies, University of Georgia giving a calibrated date of 13750-13600 (UGa 23052). Given date ranges correspond to 1-sigma (68.2%) probability range, calibrated using IntCal13 (OXCAL version 4.3).

We assume that the newly obtained dates may be used to assess the age of Tutkaul 2a as well (Table 5).

5. Discussion

5.1. Tutkaulian in the regional scale

Attribute analysis indicates that small lamellar blanks were removed from prismatic flint cores in the lithic industries associated with Layers 3 and 2a at Tutkaul. The toolkits at Tutkaul share the common features of lunates, end-scrapers and backed bladelets. However, the lithic industry of Layer 3 contains only a few lunates, while in Layer 2a, lunates represent one of the most abundant tool types. In contrast, backed bladelets are among the most numerous tool types in the lithic industry of Layer 3, while Layer 2a contains only one backed bladelet. The stratigraphic context of the site suggests a chronological hiatus between the industries, which excludes the possibility of artifact admixture.

Obi-Kiik archaeological materials also share features noted in the lithic collections from Tutkaul, mainly those of layer 2a. These include similar types of raw material, similar blade and bladelet production techniques and significant proportions of byproducts from carinated core reduction. Both tool assemblages include lunates, backed bladelets and blades bearing signs of alternate retouch (Fig. 8).

Obi-Kiik and Tutkaul Layer 2a both exhibit a predominance of lunates and notches. The lunates from Obi-Kiik and Tutkaul 2a exhibit similar morphometric characteristics. Both technocomplexes also display bidirectional backing retouch on lunates thicker than 4 mm.

In the Obi-Kiik lithic collection, lunates represent the most numerous tool type (and other types of geometric microliths are lacking) while carinated cores are found in the primary reduction products. Formerly, it was believed that carinated reduction characterized Upper Paleolithic through Early Epipaleolithic industries (Shugnou, Kharkush, Dodekatym-2, and Tutkaul Layer 3) (Kolobova, 2014; Shnaider and

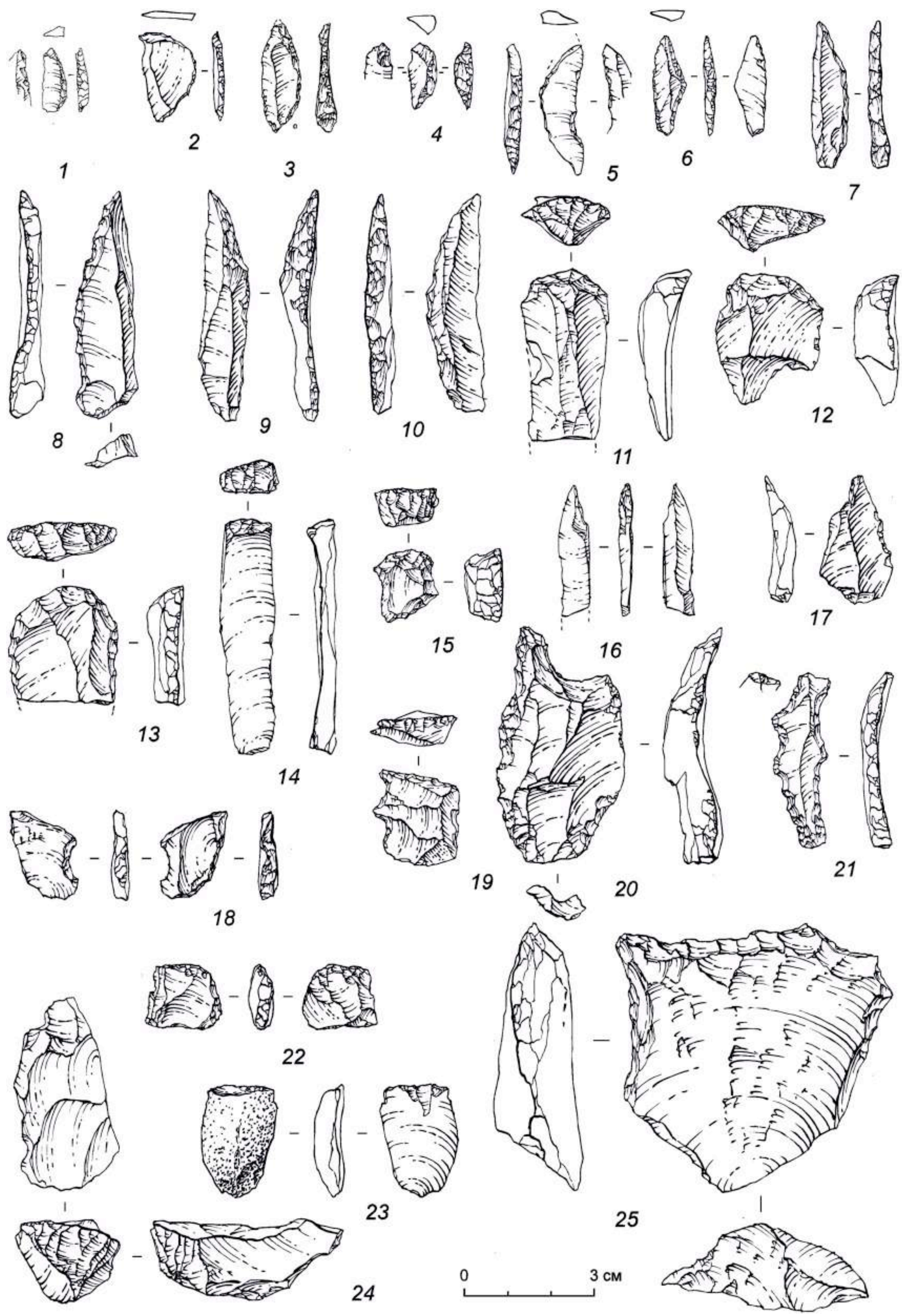

Fig. 5. Selected artifacts from Tutkaul site (layer 2a).

thesis, 2015), while lunates were considered as markers of the late stage of the local Epipaleolithic (Tutkaul Layer 2a, Darai-Shur) (Ranov, 1988; Filimonova, 2007). The identification of these two traits within a single complex (never identified together before) suggests that Obi-Kiik occupies an intermediate chronological and typological position between the industries associated with Tutkaul Layer 3 and 2a.

The tool kit from the Istykskaya Cave Horizon 3–4 also shows certain common features with that of Tutkaul 2a: lunates, "Tutkaulian" points (Fig. 9, *1–7*), end-scrapers, pointed backed blades, backed and double backed blades and backed bladelets. Thus, the lithic industries from Istykskaya Cave 3–4 and Tutkaul 2a show technological and typological similarities suggesting that they may be roughly

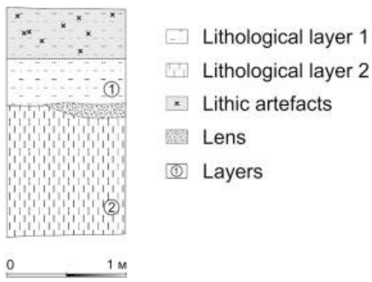

Fig. 6. Stratigraphy of Obi-Kiik site.

contemporaneous.

Unfortunately, Tutkaul and Obi-Kiik have been subsequently destroyed since their excavation, and it is not possible to obtain organic materials deriving from the sites for absolute dating. However, absolute dates are available for other sites with similar Epipaleolithic industries (i.e. Tutkaul 2a), which can be used in assessment of these assemblages (Ranov and Khudjageldiev, 2005).

Estimating the age of Tutkaul 3 through analogy is more complicated, as there are no available archaeological collections with similar technical-typological features and absolute dates. The stratigraphic position of Tutkaul layer 3 indicates an older age than that of Tutkaul 2a, which, using Istykskaya Cave as a guide would suggest a date older than ca. 13,830–13,450 cal. BP (Table 5). In terms of an upper bound for the age of Tukaul 3, dates of 23,035–22,715 cal. BP (Chargynov, 2015) for the local Upper Paleolithic can be found at Kurama in northern Kyrgyzstan. Layer 2 at Dodekatym-2 in Uzbekistan, assumed to be one of the possible sources of the Epipaleolithic, has also been dated to 23,231–22,898 cal. BP (Kolobova et al., 2018). There is thus a chronological gap of approximately 10 thousand years between the well-dated late Upper Paleolithic assemblages (Dodekatym-2, Kurama) and the late Epipaleolithic (Tutkaul 2a).

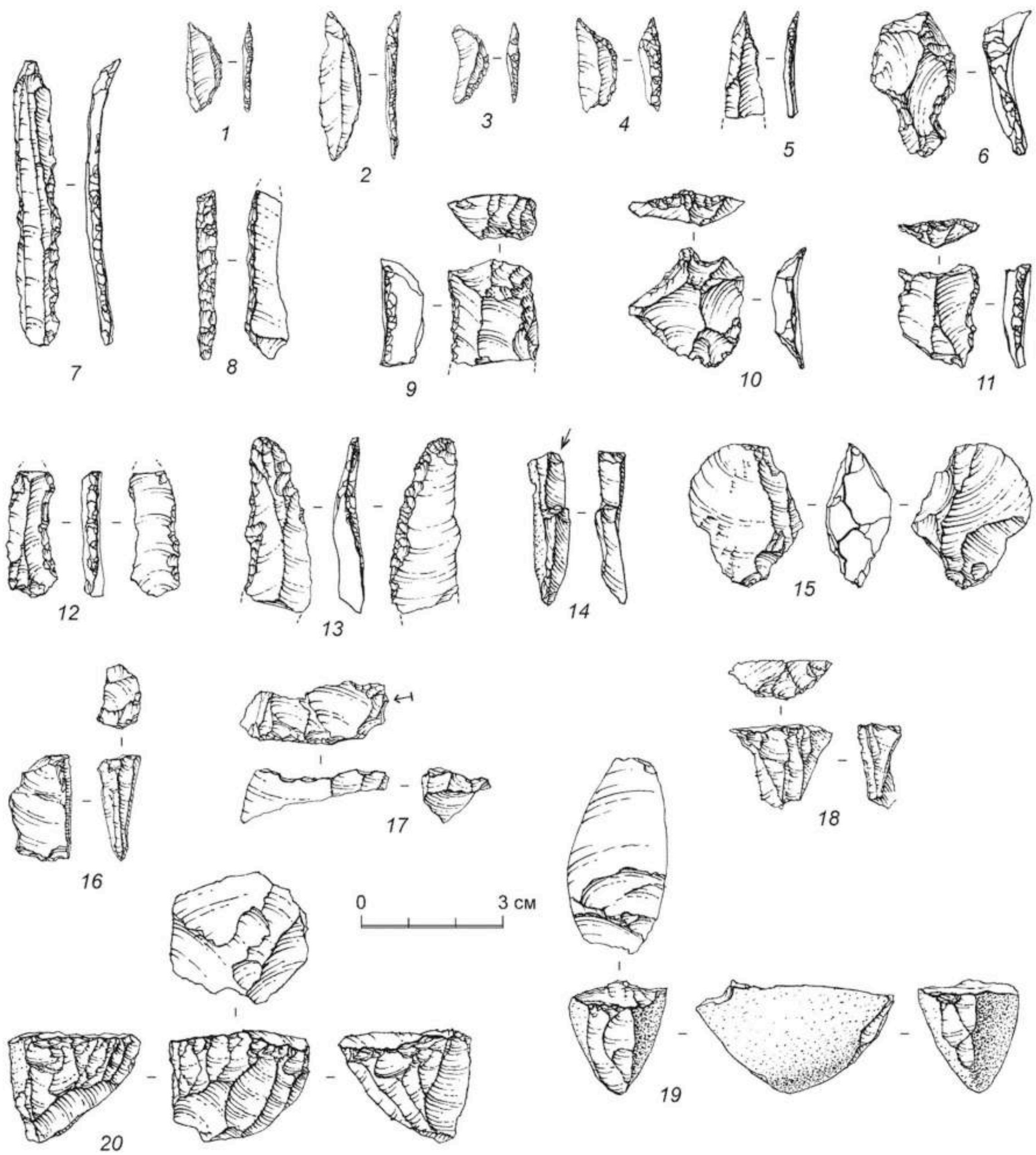

Fig. 7. Selected artifacts from Obi-Kiik site.

Table 5
Radiocarbon dates from Istykskaya Cave.

Layer	Lab-Nr	Conventional RC Age	Calibrated	Dating materials
3–4	NSKA-1320	9715 ± 121,91 BP	13,750–13,600 CalBP	Bone
3–4	NSKA-1622	11,863 ± 37 BP	13,830–13,450 CalBP	Bone

Given considerable typological distinctions between Tutkaul 3 and Dodekatym-2 layer 2 (scalene triangles and trapeze-rectangles) (Kolobova et al., 2016), we hypothesize that Tutkaul 3 falls between the interval of 17,500 to 15,000 cal. BP. This interval coincides with the Geometric Kebaran period in the Levant, where trapeze-rectangles predominate in geometric microlith assemblages (Belfer-Cohen and Goring-Morris, 2014). Based on techno-typological features, the Obi-Kiik lithic collection appears to occupy an intermediate position between the Tutkaul 3 and 2a. In our proposed scheme, the Obi-Kiik lithic collection may thus fall between ca. 16,000–14,000 cal. BP, which roughly corresponds to the early Natufian in the Levant (Vardi et al., 2015; Yegorov et al., 2015).

Several sites with features similar to those of Tutkaul and Obi-Kiik have been found in western Central Asia – open-air sites in the Afghan-Tajikistan Depression, including Chil-Chor-Chashma, and Zadian-2, 3 and 6. These sites share many core and tool types with Tutkaul 3: carinated cores, trapeze-rectangles (Figs. 9, *19, 21, 24–35*) and lunates (Figs. 9, *20*), backed bladelets, blades with alternate retouch, and thumbnail end-scrapers (Figs. 9, *22, 23*) (Okladnikov, 1958; Vinogradov, 1979). The materials from Darai-Shur (Gissaro-Alai, Tajikistan) are also typologically similar to those from Tutkaul 2a. They include similar tool types (lunates (Figs. 9, *12–18)*, Tutkaulian points (Figs. 9, *10, 11*), end-scrapers), as well as core types (bladelets unidirectional cores, semi-cylindrical (Figs. 9, *8*), semi-pyramidal (Fig. 9 and), cylindrical and narrow fronted cores) (Ranov et al., 1982; Filimonova, 2007). Our proposed chronological scheme, in conjunction with the results of the technological cluster analysis may help to understand and interpret these undated stone tool assemblages.

5.2. Statistic analysis

The resulting three dimensional nmMDS plot (Fig. 10) demonstrates a high degree of similarity between the discussed herein assemblages. They all fall within a 95% confidence ellipse. This result underscores a basic typological similarity of the Epipaleolithic western Central Asian assemblages, both in comparison to each other as well as to the late Upper Paleolithic assemblage included in the analysis. Taking in account that small inter-point distances imply typological similarities between the assemblages, our results suggest proximity between the Early Tutkaulian (Tutkaul, layer 3) and Late Kulbulakian (Dodekatym, layer 2). The intermediate position of Obi-Kiik could reflect the transitional character of this assemblage. Obvious clustering of the Late Tulkaulian assemblage also suggests a high degree of typological similarity and supports the analytical validity of this cultural unit.

Specifically, the nmMDS plot supports the analytical grouping of three separate assemblage clusters: 1. Tutkaul, layer 3; 2. Obi-Kiik; 3. Tutkaul, layer 2a, Darai-Shur and Istykskaya, layers 3–4.

In order to assess our nmMDS results, we performed a multivariate statistical PERMANOVA permutation test for centroid and dispersion equivalence (Anderson, 2001). The failure to reject the null hypothesis of equivalence using the PERMANOVA test suggests broad similarity among the three mentioned above groups of Epipaleolithic assemblages (9999 permutations, F: 8,3138, *p-value*: 0.1011), and corresponds to the similarity in nmMDS scores.

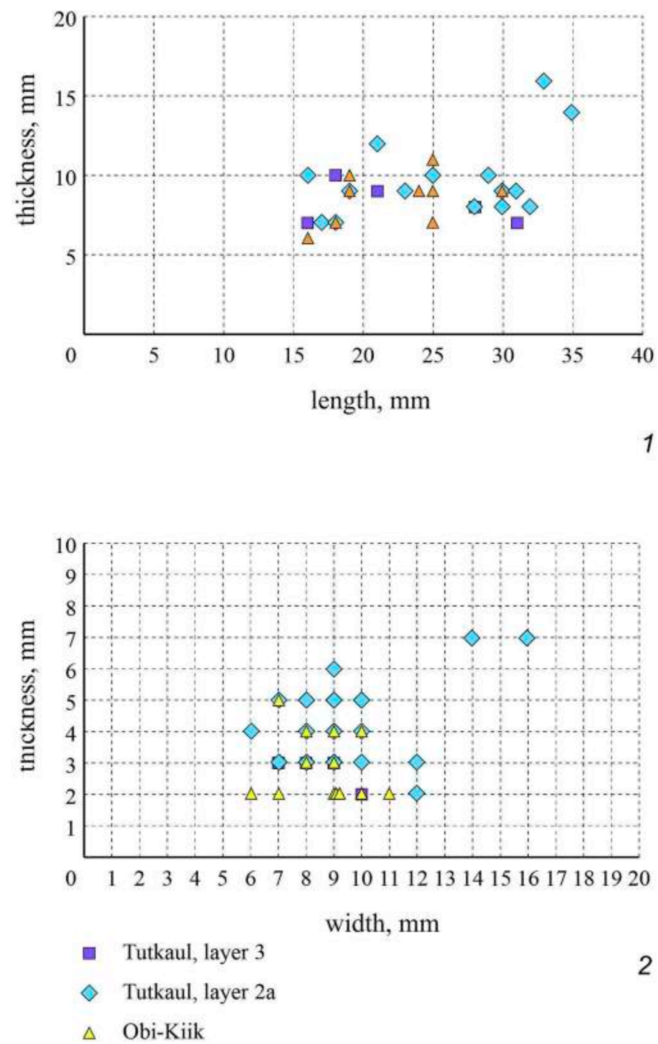

Fig. 8. Comparison of dimensions of the lunates from Tutkaul (layers 3, 2a) and Obi-Kiik site.

5.3. Implications and comparison with Near East assemblages

Most prior scholarship on the origins of the western Central Asian Epipaleolithic position considered the Levant and Zagros as the primary, if not the only, geographic sources from which the lithic Epipaleolithic traditions of the region first evolved (Davis, Ranov, 1979; Korobkova, 1989; Filimonova, 2007). In particular, comparison of the Levant and Zagros Epipaleolithic technocomplexes with cultural materials from western Central Asia have shown major similarities, and an apparently synchronous dispersal of particular types of geometric microliths over a vast region (Shnaider and thesis, 2015; Kolobova et al., 2018).

While the Late Pleistocene-Early Holocene archaeological record of these three regions demonstrate major differences, specific lithic innovations make it possible to explore the question of interconnectivity between the Levant/Zagros and western Central Asia. Since the 80's, geometric microliths have been identified at Terminal Upper Paleolithic sites across a wide geographic region – at Dodekatym-2 in western Central Asia – 23 kyrs cal. BP (Kolobova, 2014); at Ohalo-2 (Masrakan culture) in the Levant around 23 kyrs cal. BP (Nadel, 2003; Yaroshevich et al., 2013) and possibly at Warwasi in Zagros (Zarzian culture) around 22 kyrs BP (Smith, 1986). Ohalo-II (Yaroshevich et al., 2013) yielded the earliest scalene triangles among other geometric microliths in the Levant. The Ohalo-II was associated with the Masraqan (Late Ahmarian) culture that is transitional from the Upper Paleolithic to the

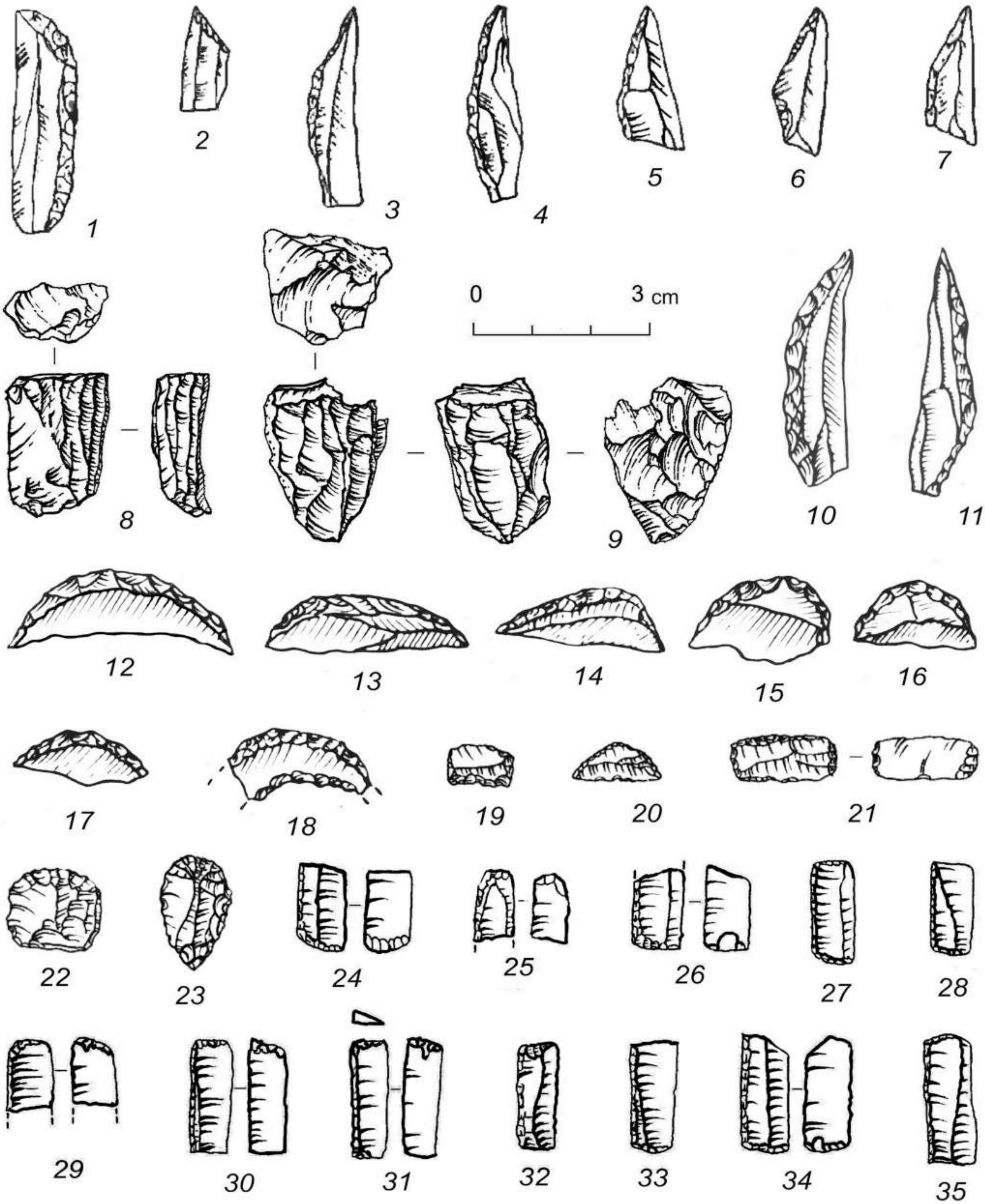

Fig. 9. Selected artifacts from Istikskaya cave, Darai-Shur, Chil-Chor-Chashma and Zadian 3.

Epipaleolithic. The Masraqan technocomplexes show many traits characteristic of both the Upper Paleolithic and Epipaleolithic (Goring-Morris, 1995; Nadel, 2003; Yaroshevich et al., 2013; Richter et al., 2011). The site has been dated to the chronological range of 22.5–23.5 cal. kyr BP (Nadel, 2003; Nadel et al., 2006). It is likely that D. Nadel designated geometric microliths as proto-triangles in his earliest publications (Nadel, 2003), while in his later articles, they are referred to as scalene triangles only (Yaroshevich et al., 2013). It is necessary to mention as well of later Nizzanan entire (20000-18700 cal BP) dominated by triangle geometric microliths in different technological context - made using microburin technique. Nizzanan also characterized by arched backed bladelet and microgravettes (al-Nahar,

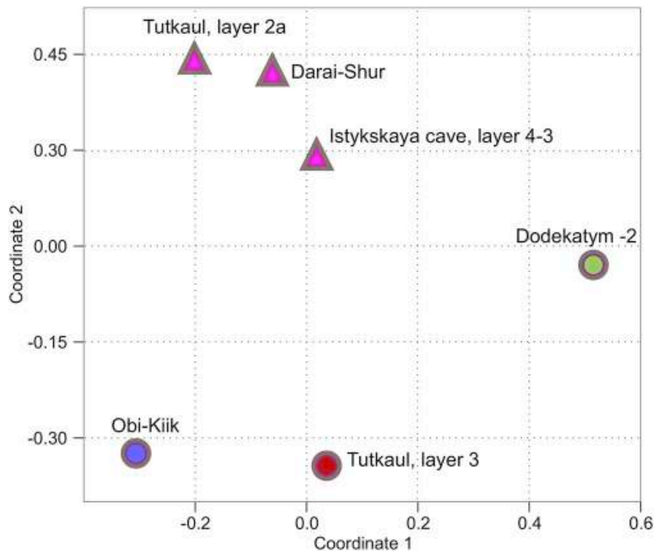

Fig. 10. Three dimensional nmMDS plot of western Central Asian Epipaleolithic sites.

Olszewski and al-Nahar, 2016).

The Middle Epipaleolithic (17,5–14,6 kaBP) in the Levant is notably characterized by the genesis of the Geometric Kebaran culture (Wadi-Sayakh, Jabrud-3, Netzer Sereni, Neve David, e.g.: Bar-Yosef, 1987) from the earlier Kebaran culture, characterized by its carinated technology. The Geometric Kebaran tool kit shows a predominance of trapeze-rectangles, and the presence of thumbnail scrapers and variants of backed bladelets (Bar-Yosef, 1987). Trapeze-rectangles were shaped by double truncation of backed bladelets, use wear analysis identified diagnostic impact fractures on the trapeze-rectangles attesting that they were mostly hafted as lateral blades (Yaroshevich et al., 2010).

Simultaneously, other Levantine Middle Epipaleolithic cultures adopted different lithic tools and technological approaches. In the Mushabian culture (Mushabi-5, 14, Shunera-2, 4, 21) La-Mouillah points, scalene and isosceles triangles produced with the microburin technique predominate in archaeological assemblages (Pirie, 2001; McDonald, 2013). The Ramonian techno-complex (Nahal Neqarot) (Belfer-Cohen et al., 1991) is characterized by the dominance of the standardized Ramon point, a usually concave backed and obliquely truncated bladelet produced using the microburin technique. Lunates are characteristic of the late stage of the Ramonian, which marks the transition from Middle to Late Epipaleolithic (Vardi and Yegorov, 2013; McDonald, 2013).

The Levantine Late Epipaleolithic (14,6–11,5 kal. BP) is marked by the development of the Natufian culture (El-Wad, Nahal-Oren, Beidha), with lunates becoming a major element/component of the lithic industry. Changes in the design of projectiles may explain the adoption of lunates, as these were mostly used as single transversal points (Yaroshevich et al., 2010). An evolution in how lunates were produced can also be observed between Early Natufian complexes (where they were produced using Helwan retouch) and Late Natufian complexes (where lunates are characterized by smaller dimensions and were made using the microburin technique and backed retouch) (Bar-Yosef, 1998). In the arid zone of the Levant the lithic industry of the Harifan culture (Abu Salem, Ramat Harif, Maaleh Ramon West) shares many similarities with the Natufian, including the use of microburin technique for the production of lunates, but the toolkit differs by the addition of Shunera and Harif points (Marks and Scott, 1976; Goring-Morris, 1991).

In the Zagros region, the Zarzian culture (Warwasi, Pelegavra, Shanidar) expresses some strong common features with the Levantine complexes (Smith, 1986; Bar-Yosef and Belfer-Cohen, 1989). Four chronological stages of the Zarzian have been identified based on the stratigraphic sequence of the Warwasi site (Olszewski, 2012). The industries of the lower layers, characterized by non-geometric microliths (known as Dufour bladelets) are linked to the early Upper Paleolithic, and are not strictly relevant for the question of Epipaleothic cultural interactions. The middle part of the stratigraphic sequence yielded scalene triangles, associated with Dufour bladelets and backed bladelets. In the upper layers of Warwasi site, the tool kit consists of trapeze-rectangles, truncated bladelets and backed bladelets with convex lateral retouch. The small numbers of microburins were divided for Zarzian, the lowest for earlier stage. The latest stage of the Zarzian culture, exhibited by the Shanidar B1 and Zavi Shemi Shanidar sites, contains many small lunates (Olszewski, 2012). A limited amount of absolute dates are available for the Zarzian complex. The Zarzian techno-complex with scalene triangles from Haji Bahrami cave (TB 75) has been dated to 18,000–17,500 cal. years BP (Tsuneki, 2013). The Middle Zarzian period seems to date from 14,350 to 10,590 years uncal. BP, based on the dates obtained on Palegawra and Shanidar B2 (Olszewski, 1993; Wahida, 1999). A new series of dates in the range of 12,500 to 10,200 years uncal BP has been generated for Palegawra (Olszewski, 2012), narrowing the timeframe of the occupation.

For these Levantine and Zagros Epipaleolithic cultures, there is a general pattern of the replacement of non-geometric microliths by geometric. The earliest form of geometric microliths for both regions were scalene triangles, followed by trapeze-rectangles, and then lunate shapes (Burdukiewicz, 2005; Olszewski, 1993, 2012; Yaroshevich et al., 2013).

Our results demonstrate that the same general tendency also characterizes the Epipaleolthic of western Central Asia (Fig. 11). Recent investigations explored the diffusion of the scalene triangles across the Near, Middle East and Western Central Asia (Kolobova et al., 2018). Zarzian and Early Levantine Epipaleolithic (Masraqan) artifacts have similar morphometric characteristics, but are based on different blank-producing technologies. This scenario points to a shared idea through replication of shape and size of tools, likely to produce specific functional features and outcomes related to hafting and production of composite projectiles.

Our analysis demonstrates that the same trend is observed for the Middle Epipaleolithic Tutkaulian complex from Central Asia (Tutkaul 3), the Levantine complexes (Geometric Kebaran), and the Late Zarzian from the Zagros. These three regions share an extensive production of geometric microliths, trapeze-rectangles (Bar-Yosef, 1970; Belfer-Cohen and Goring-Morris, 2002; McDonald, 2013; Olszewski, 2012; Yaroshevich, 2006). In the Late Epipaleolithic, a high proportion of geometric microliths, particularly lunates (Yaroshevich et al., 2010) is a common characteristic shared by the technocomplexes from the Levant (Natufian), the Zagros (latest Zarzian), and the two Central Asian assemblages presented in this study: Obi-Kiik and Tutkaul 2a.

Together, comparison of these Epipaleolithic assemblages from Levant and Zagros with sites from Western Central Asia (Tutkaul 2a and 3 and Obi-Kiik) points to a roughly synchronous distribution of similar types of geometric microliths at a large macro-regional scale.

Our technological attribute studies, the comparison of undated and dated assemblages, and cluster analysis, suggest that the lithic traditions underlying the assemblages at Tutkaul 2a and 3 and Obi-Kiik developed along a similar cultural trajectory to that of the Epipaleolithic complexes of the Levant and Zagros. This argument is supported by the widespread emergence of a common sequence of different geometric microliths across Western Central Asia, the Zagros and Levant, beginning with scalene triangles and progressing to trapeze-rectangular and lunate forms.

This pattern suggests a great antiquity of cultural contacts (i.e. exchange of goods, ideas, or lithic technologies) between populations of these regions, an inference supported by the recent discovery of shells from the eastern Mediterranean coast in the Zagros region (Olszewski, 2012; Richter, 2009). Bearing in mind the great distances involved, as

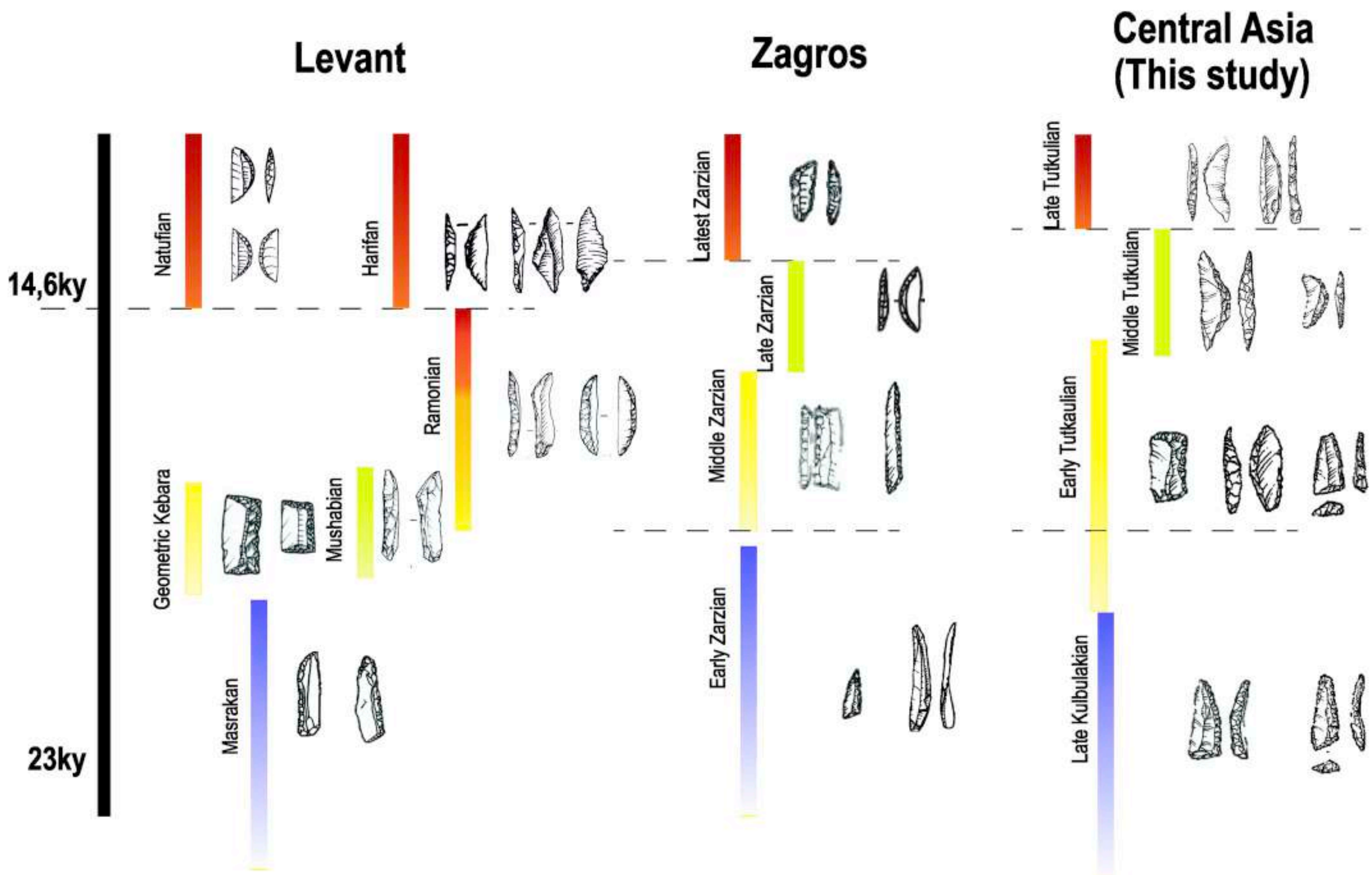

Fig. 11. Cultural scheme of Epipaleolithic complexes of Near, Middle East and Western Central Asia.

well as the different technological approaches used for the preparation of geometric microliths in Levant/Zagros and Central Asia regions, the present data suggest that the dispersal of trapeze-rectangles and lunates took place primarily through the sharing of ideas – specifically, the replication of the shape and size of composite projectiles. Given the magnitude of this shift and the importance of projectiles in human subsistence strategies, this technological progression may reflect important changes in hunting strategies related to the changing environment, and changing fauna of the Pleistocene in western Eurasia.

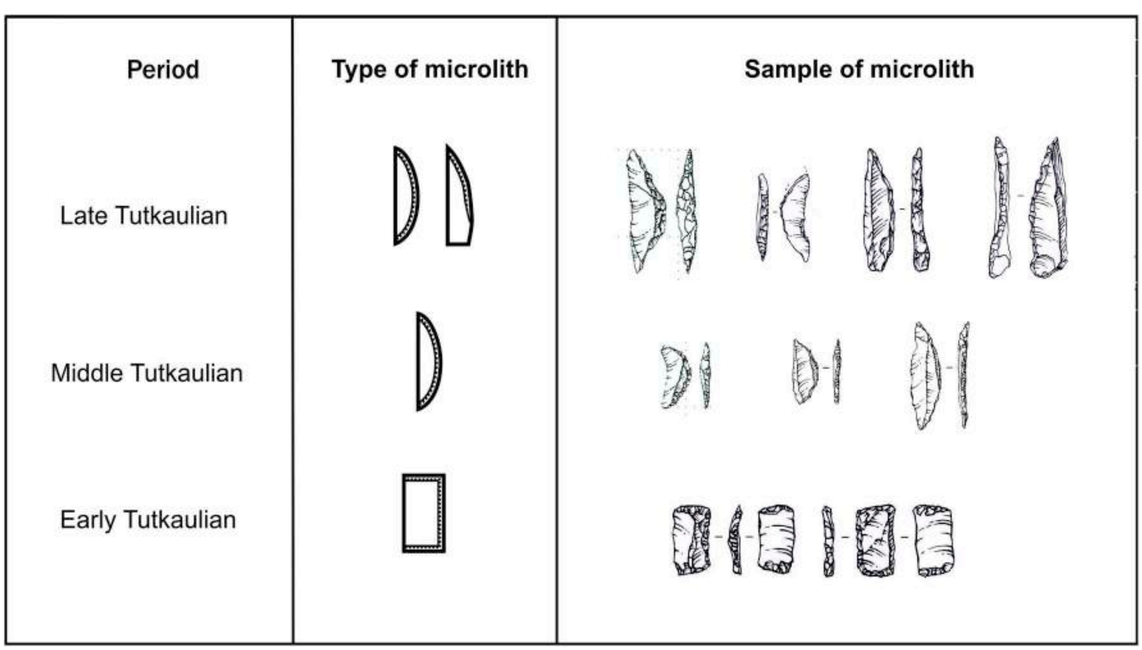

Fig. 12. Comparison of the Early, Middle and Late Tutkaulian assemblages.

6. Conclusions

Based on technological attributes and hierarchical cluster analysis, we define the Tutkaulian culture (20–9 kyrs BP) as an important stage in the cultural sequence of western Central Asia. The characteristic features of the culture are: bladelet-based primary reduction, an abundance of geometric microliths, and a chronological shift from trapeze-rectangle to lunate forms (Fig. 12). Unfortunately, until now no evidence of symbolic activity has been discovered in Tutkaulian culture. Three subsequent stages can be established in the Tutkaulian transformation: the early stage (Tutkaul 3), middle (Obi-Kiik) and late (Tutkaul 2a, Istykskaya Cave layers 3–4, and Darai-Shur). Our technological attribute studies, the comparison with dated assemblages, and cluster analysis, suggest that the lithic traditions underlying the Tutkaulian assemblages developed along a similar cultural trajectory to that of the Epipaleolithic complexes of the Levant and Zagros.

The Early Tutkaulian follows the Late Kulbulakian (28-22 cal BP) recently interpreted as transitional from Upper to Epipaleolithic in western Central Asia (Kolobova et al., 2016). During the Early Tutkaulian, flint was the most commonly utilized raw material, and the predominant primary reduction strategy was aimed at small blade production. Bladelets with curved and twisted profiles were detached from carinated cores, while bladelets with straight profiles represent longitudinal reduction. The tool kits from this period contain mostly geometric microliths with trapeze-rectangular forms predominating, and triangles and lunates occurring in low quantities. Microliths exhibited metric standardization, and other tool categories include bladelets and blades with alternate retouch.

During the Middle Tutkaulian, flint remained the predominant raw material and similar primary reduction strategies were used. Significant changes are visible the tool kit, with lunates becoming the most numerous. However, lunate metric standardization is low. In terms of secondary retouch, artifacts thicker than 4 mm are fashioned through bidirectional backing retouch. The tool kit also includes pointed backed bladelets, blades with alternate retouch and notched tools.

Late Tutkaulian assemblages exhibit a considerable variability of raw materials. Flat-face and semi-cylindrical cores were prepared on effusive rocks, and large spalls (including flakes and blades) were removed from these core types. Bladelets were removed from multidirectional and narrow-face flint cores, and no longer produced through carinated core flaking. Tutkaulian points become the most numerous in the tools kit. Lunates remain abundant, sharing similar features with the previous development stage. Completing the late Tutkalian toolkit are pointed backed blades, various end-scrapers, notches, and spurs.

This hypothesized sequence of regional Epipaleolithic industries is supported by analogical comparisons with dated assemblages as well as hierarchical cluster analysis. The Tutkaulian appears to be the result of the evolutionary transformation of the local Upper Paleolithic industries (Kulbulakian) with repeated cultural impacts from earlier and roughly synchronous Levantine and Zagrosian industries.

Acknowledgements

We thank the organizers of the session and APA Congress 2016, in particular Dr. Masami Izuho (Tokyo Metropolitan University) for the invitation to participate in this special issue of *Quaternary International*. We are indebted to Vsevolod Panov and Vasilii Zenin (Institute of Archaeology and Ethnography, SB RAS, Novosibirsk, Russia) for radiocarbon analyses. We also acknowledge the incredible contributions of Natalia Vavilina (Institute of Archaeology and Ethnography, SB RAS, Novosibirsk, Russia) and Sergei Kogai (Irkutsk State University, Irkutsk, Russia) in producing illustrations for this article. We wish to convey special thanks to our colleagues in the Institute of History, Archaeology and Ethnography of the Tajikistan Academy of Sciences – Dr. Saifullaev N., and Hojageldiev T. – for their assistance, collegiality and friendship over many years. Finally, we are obliged to Dr. K. Pavlenok and Dr. G. Pavlenok for their participation and to all the people who took part in this research. We are grateful to Dr. Anna Belfer-Cohen and Dr. W. Rendu for careful reading of the draft of this paper and professional corrections. We also thank our anonymous reviewers for their comments and suggestions.

References

Anderson, M.J., 2001. A new method for non-parametric multivariate analysis of variance. Austral Ecol. 26, 32–46.
Bar-Yosef, O., 1970. The Epipaleolithic Cultures of Palestine. The Hebrew University, Jerusalem, Israel Ph.D. thesis.
Bar-Yosef, O., 1987. Pleistocene connections between Africa and southwest Asia: an archaeological perspective. Afr. Archaeol. Rev. 5, 29–38.
Bar-Yosef, O., 1998. The Natufian culture in the Levant: threshold to the origins of agriculture. Evol. Anthropol. 6, 159–177.
Bar-Yosef, O., Belfer-Cohen, A., 1989. The origins of sedentism and farming communities in the levant. J. World PreHistory 3, 447–498.
Belfer-Cohen, A., Goring-Morris, N., 2002. Why microliths? Microlithization in the levant. In: In: Elston, R.G., Kuhn, S.L. (Eds.), Thinking Small: Global Perspectives on Microlithic Technologies, vol. 12. VA American Anthropological Association, Arlington, pp. 57–69.
Belfer-Cohen, A., Goring-Morris, N., 2014. The upper paleolithic and earlier epipaleolithic of western Asia. In: In: Renfrew, A.C., Bahn, P.G. (Eds.), The Cambridge World Prehistory, vol. 3. Cambridge University Press, Cambridge, pp. 1381–1407.
Belfer-Cohen, A., et al., 1991. An epipalaeolithic rockshelter at nahal Neqarot in the central negev. Mitekufat Haeven - Journal of the Israel Prehistoric Society 24, 164–168.
Burdukiewicz, J.M., 2005. Microlithic technology in the stone age. Journal of the Israel Prehistoric Society 35, 337–351.
Chargynov, T.T., 2015. Arkheologicheskie raskopki stratifitsirovannogo pamyatnika Kurama v 2014 g. (Archaeological excavation of multilayered site of Kurama in 2014). In: The Materials of Science-practical Conference «VII Orazbaev Reading». Almaty. Kazak University, pp. 83–87 (In Russian).
Dennell, R., 2009. The Palaeolithic Settlement of Asia. Cambridge University Press, Cambridge.
Filimonova, T.G., 2007. Verkhni Paleolit I Mesolit Afgano-tadjikskoi Depressii (Upper Paleolithic and Mesolithic of the Afghan-tajik Depression). Ph.D. thesis, Institute of Archaeology, Ethnography and Anthropology TAS, Dushanbe, Tajikistan (In Russian).
Ghasidian, E., Bretzke, K., Conard, N., 2017. Excavations at Ghar-e Boof in the Fars Province of Iran and its bearing on models for the evolution of the Upper Palaeolithic in the Zagros Mountains. J. Anthropol. Archaeol. 47, 33–49.
Golovanova, L.V., Doronichev, V.B., Cleghorn, N.E., Koulkova, M.A., Sapelko, T.V., Shackley, M.S., Spasovskiy, YuN., 2014. The epipaleolithic of the Caucasus after the last glacial maximum. Quat. Int. 337, 189–224.
Goring-Morris, N., 1991. The harifian of southern levant. In: In: Bar-Yosef, O., Valla, F.R. (Eds.), International Monographs in Prehistory, vol. l. Archaeological Series, pp. 173–234.
Goring-Morris, A.N., 1995. Complex hunter-gatherers at the end of the Paleolithic (20,000–10,000 BP). Archaeol. Soc. Holy Land 141–168.
Kolobova, K.A., 2014. Verkhnii Paleolit Zapadnogo Pamiro-tyan'-shanya (Upper Paleolithic of Western Pamir-tien Shan). Ph.D. Thesis. Institute of Archaeology and Ethnography SB RAS, Novosibirsk, Russia (in Russian).
Kolobova, K.A., Shnaider, S.V., Krivoshapkin, A.I., 2016. Preemstvennost razvitia verkhnepaleolithicheskikh I mezoliticheskikh industry v zapadnoi chasti Tsentralnoi Azii (Continuous transformation of the Upper Paleolithic and Mesolithic industries in western Central Asia). Stratum Plus 1, 51–63 (In Russian with English abstract).
Kolobova, K.A., Krivoshapkin, A.I., Shnaider, S.V., 2018. Early geometric microlith technology in Central Asia. Archaeological and Anthropological Sciences. https://doi.org/10.1007/s12520-018-0613.
Korobkova, G.F., 1989. Mezolit srednei Azii i Kazakhstana (mesolithic of central Asia and Kazakhstan). In: Rybakov, B.A., Munchaev, R.M., Bashilov, V.A., Gaidukov, P.G. (Eds.), The Mesolithic of USSR. Nauka Press, Moscow, pp. 149–173 (in Russian).
Krajcarz, M., Kot, M., Pavlenok, K., Fedorowicz, S., Krajcarz, M., Lazarev, S., Mroczek, P., Radzhabov, A., Shnaider, S., Szymanek, M., Szymczak, K., 2016. Middle Paleolithic sites of Katta Sai in western Tian Shan piedmont, Central Asiatic loess zone: geoarchaeological investigation of the site formation and the integrity of the lithic assemblages. Quat. Int. 399, 136–150.
Marks, A.E., Scott, T.R., 1976. Abu Salem: type site of the harifian industry in southern levant. J. Field Archaeol. 3 (1), 43–60.
McDonald, D.A., 2013. Interpreting variability through multiple methodologies: the interplay of form and function. Ph.D. thesis In: Epipalaeolithic Microliths. University of Toronto, Canada, Toronto.
Monigal, K., 2002. The Levantine Leptolithic: Blade Technology from the Lower Paleolithic to the Dawn of the Upper Paleolithic Unpublished Ph.D. Dissertation. Southern Methodist University, USA.
Motuzaite Matuzeviciute, G., Preece, R.C., Wang, S., Colominas, L., Ohnuma, K., Kume, S., Abdykanova, A., Jones, M.K., 2017. Ecology and subsistence at the mesolithic and Bronze age site of Aigyrzhal-2, naryn valley, Kyrgyzstan. Quat. Int. 437/B, 35–49. https://doi.org/10.1016/j.quaint.2015.06.065.
Nadel, D., Grinberg, U., Boaretto, E., Werker, E., 2006. Wooden objects from Ohalo II (23,000 cal BP), Jordan Valley, Israel. J. Hum. Evol. 50, 644–662.
Nadel, D., 2003. The Ohalo II flint assemblage and the beginning of the epipalaeolithic in

the Jordan valley. In: Belfer-Cohen, A., Gorring-Morris, N. (Eds.), More than Meets the Eye: Studies on Upper Paleolithic Diversity in the Near East. The Short Run Press, Oxford, pp. 216–230.

Okladnikov, A.P., 1958. Issledovaniya Pamyatnikov Kamennogo Veka Tadzhikistana. Predvaritel'noe Soobshchenie O Rabotakh 1948, 1952–1954 Gg. (The investigations of stone age sites in Tajikistan. Preliminary results of work 1948, 1952–1954). Materials and investigations about USSR archaeology 66, 12–71 (In Russian).

Okladnikov, A.P., 1966. Paleolit i mezolit srednei Azii (the paleolithic and mesolithic of middle Asia). In: Middle Asia in Stone and Bronze Age. Leningrag, Moscow, pp. 11–75 (in Russian).

Olszewski, D., 1993. The Zarzian occupation at Warwasi rockshelter, Iran. In: The Paleolithic Prehistory of the Zagros-taurus. The University Museum, University of Pennsylvania, Philadelphia, pp. 207–336.

Olszewski, D., 2012. The Zarzian in the context of the epipaleolithic Middle East. International Journal of Humanities 19 (3), 1–20.

Olszewski, D.I., al-Nahar, M., 2016. Persistent and ephemeral places in the early epipaleolithic in the Wadi al-hasa region of the western highlands of Jordan. Quat. Int. 396, 2–30.

Pirie, A., 2001. Chipped Stone Variability and Approaches to Cultural Classification in the Epipaleolithic of the South Levantine Arid Zone. Thesis submitted for the degree «doctor of philosophy», Durham 369 p.

Prüfer, K., Racimo, F., Patterson, N., Jay, F., Sankararaman, S., Sawyer, S., Heinze, A., Renaud, G., Sudmant, P.H., de Filippo, C., Li, H., Mallick, S., Dannemann, M., Fu, Q., Kircher, M., Kuhlwilm, M., Lachmann, M., Meyer, M., Ongyerth, M., Siebauer, M., Theunert, C., Tandon, A., Moorjani, P., Pickrell, J., Mullikin, J.C., Vohr, S.H., Green, R.E., Hellmann, I., Johnson, P.L.F., Blanche, H., Cann, H., Kitzman, J.O., Shendure, J., Eichler, E.E., Lein, E.S., Bakken, T.E., Golovanova, L.V., Doronichev, V.B., Shunkov, M.V., Derevianko, A.P., Viola, B., Slatkin, M., Reich, D., Kelso, J., Pääbo, S., 2014. The complete genome sequence of a Neanderthal from the Altai Mountains. Nature 505, 43–49. https://doi.org/10.1038/nature12886.

Ranov, V.A., Khudjageldiev, T.U., Schafer, J.D., 2005. Khargushon–A new area of the distribution of Mousterian industries in Tajjikistan. J. Asian Civiliz. 28, 1–28.

Ranov, V.A., 1980. Stoyanka Obi-Kiik i nekotorye voprosy izucheniya mezolita yuga Srednei Azii (Obi-Kiik site in the context of Mesolithic studies of south Central Asia). In: Prehistory Archaeology. Searching and Findings. Kiev, pp. 82–90 (in Russian).

Ranov, V.A., 1988. Kamennyi Vek Yuzhnogo Tadzhikistana I Pamira (Stone Age of Southern Tajikistan and Pamir). Ph.D. Thesis Novosibirsk, Institute of History, Philology and Philosophy, SB AS USSR USSR (in Russian).

Ranov, V.A., Davis, R., 1979. Toward a new outline of Soviet central Asian paleolithic. Current Archeology 20, 249–262.

Ranov, V.A., Karimova, G.R., 2005. Kamennyi Vek Afgano-tadzhikskoi Depressii (Stone Age of the Afghan-tajik Depression). Devashtish Press, Dushanbe (in Russian).

Ranov, V.A., Khudjageldiev, T.U., 2005. Kamenii vek (stone age). In: Bubnova, M.A. (Ed.), History of Gorno-badakhshan Autonomous Region, Vol. 1: from Antiquity to Modern Period. Paivand Press, Dushanbe, pp. 51–107 (In Russian).

Ranov, V.A., Korobkova, G.F., 1971. Tutkaul – mnogosloinoe poselenie gissarskoi kultury v yuzhnom Tadjikistane (Tutkaul – multilayered settlement site of the Gissar culture in southern Tajikistan). Soviet Archaeology 2, 133–147 (in Russian).

Ranov, V.A., Yusupov, A.Kh, Filimonova, T.G., 1982. Kamenii inventar' stoyanki Darai-Shur I ego kul'turnie svyazi (Lithic industry of Darai-Shur site and cultural links). In: Negmatov, N.N., Ranov, V.A. (Eds.), Culture of Prehistoric in Tajikistan. Donish Press, Dushanbe, pp. 5–21 (In Russian).

Ranov, V.A., Shnaider, S.V., Pavlenok, G.D., 2015. Mezoliticheskie kompleksi pamyatnika Tutkaul (Tadjikistan) (Tutkaul mesolithitic complexes (Tajikistan)). Russian Archaeology 2, 30–45 (In Russian with English abstract).

Richter, T., Garrard, A.N., Allock, S., Maher, L.A., 2011. Interaction before agriculture: exchanging material and sharing knowledge in the Final Pleistocene Levant. Camb. Archaeol. J. 21, 95–114.

Richter, T., 2009. Marginal Landscapes? the Azraq Oasis and the Cultural Landscapes of the Final Pleistocene Southern Levant. University College, London, pp. 1–384.

Shalagina, A.V., Krivoshapkin, A.I., Kolobova, K.A., 2015. Truncated-faceted pieces in the paleolithic of northern Asia. Archaeol. Ethnol. Anthropol. Eurasia 4 (43), 33–45.

Sharon, G., 2014. The Early Prehistory of Western and Central Asia. University of Cambridge, Cambridge, pp. 1357–1378.

Shnaider, S.V., Krajcarz, M.T., Bence Viola, T., Abdykanova, A., Kolobova, K.A., Fedorchenko, A.Y., Alisher-kyzy, S., Krivoshapkin, A.I., 2017. New investigations of the Epipalaeolithic in western Central Asia: Obishir-5. Antiquity 91.

Shnaider, S., Taylor, W.T., Abdykanova, A., Kolobova, K., 2018. Evidence for early human occupation at high altitudes in western Central Asia: the Alay site. Antiquity 92.

Shnaider, S.V., 2015. Tutkaul'skaya Liniya Razvitiya V Mezolite Zapadnoi Chasti Tsentral'noi Asii (Tutkaulian Culture in the Mesolithic of Western Central Asia). Ph.D. thesis. Institute of Archaeology and Ethnography SB RAS, Russia, Novosibirsk (In Russian).

Smith, P., 1986. Paleolithic Archaeology in Iran. – Philadelphia: American Institute of Iranian Studies. 70 p.

Taguchi, Y.-H., Oono, Y., 2005. Relational patterns of gene expression via non-metric multidimensional scaling analysis. Bioinformatics 21, 730–740.

Tsuneki, A., 2013. Proto-Neolithic caves and neolitization in southern Zagros. In: Matthews, R., Nashli, H.F. (Eds.), The Neolithisation of Iran. Short run press, Oxford, pp. 84–96.

Vandenberghe, D.A.G., Flas, D., De Dapper, M., Van Nieuland, J., Kolobova, K., Pavlenok, K., Islamov, U., De Pelsmaeker, E., Debeer, A.-E., Buylaert, J.-P., 2014. Revisiting the Palaeolithic site of Kulbulak (Uzbekistan): first results from luminescence dating. Quat. Int. 324, 180–189.

Vardi, Y., Yegorov, D., 2013. Har-harif. Antiquity 125, 12–18.

Vardi, J., Yegorov, D., Crouvi, O., Birkenfeld, M., 2015. Renewed excavations at site K7: a final report of the 2012 salvage excavation at har Harif plateau. Journal of the Israel Prehistoric Society 45, 55–76.

Vinogradov, A.V., 1979. Issledovaniya pamyatnikov kamennogo veka v severnom Afganistane (The investigations of Stone Age sites in Northern Afganistan). Ancient Bactria 7–62 (In Russian).

Wahida, G., 1999. The Zarzian industry of the Zagros mountains//Dorothy garrod and the progress of the paleolithic. In: Studies of Prehistoric Archeology of the Near East of Europe. William Davies, Ruth Charles. Oxbow Books, Oxford, pp. 181–208.

Yaroshevich, A., 2006. Techno-morphological aspects of microlithic projectile implements: examples from the levantine geometric Kebaran and the east european epigravettian. Archaeol. Ethnol. Anthropol. Eurasia 4 (28), 8–30.

Yaroshevich, A., Kaufman, D., Nuzhnyy, D., Bar-Yosef, O., Weinsteiner-Evron, M., 2010. Design and performance of microlith implemented projectiles during the Middle and the Late Epipaleolithic of the Levant: experimental and archaeological evidence. J. Archaeol. Sci. 37, 368–388.

Yaroshevich, A., Nadel, D., Tsatskin, A., 2013. Composite projectiles and hafting technologies at Ohalo II (23 ka, Israel): analyses of impact fractures, morphometric characteristics and adhesive remains on microlithic tools. J. Archaeol. Sci. 40/11, 4009–4023.

Yegorov, D., Yaroshevich, A., Vardi, J., Birkenfeld, M., 2015. Sha'on hol, site 14 (HG14): a new late epipalaeolithic site in the central negev highlands. Journal of the Israel Prehistoric Society 45, 77–96.