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PAST HUMAN ADAPTATIONS IN CENTRAL ASIA AND THE PEOPLING OF EURASIA: INSIGHTS FROM A MULTIDISCIPLINARY INVESTIGATION OF THE OBI-RAKHMAT SITE (UZBEKISTAN)

Abstract

This article presents the results of a zooarchaeological study of the faunal remains from Obi-Rakhmat (Uzbekistan), a key Palaeolithic site in Central Asia, to understanding the peopling of Eurasia by Neanderthals and Modern Humans and the origins of the Upper Palaeolithic. The site is of particular interest for its peculiar lithic material associated with a long and well-dated multi-layered stratigraphy, which includes the Middle to Upper Palaeolithic transition. Due to the sedimentological and depositional context and harsh climatic conditions, bones are usually not preserved in Palaeolithic sites of this region. Thus, the preservation of animal and human remains at the site is remarkable.

This paper focuses on a taphonomic, zooarchaeological and typo-technological study of the osseous and lithic remains from layer 16 of Obi-Rakhmat. The study allows the reconstruction of the environment and subsistence behaviour of the populations that left the remains found in this layer. Several lines of evidence support the contemporaneity of the archaeological and human remains, which comprise of a fragmented young adulescent scull cap.

The implications of the site for the global understanding of Neanderthal / Modern Human interactions in their easternmost habitats, as well as Neanderthal demise, are discussed. The apparently long and persistent presence of Neanderthals in Central Asia is considered in a broader perspective, and alternative scenarios concerning general current models on the peopling of Eurasia by Modern Humans and the origins of the Upper Palaeolithic are proposed.

Keywords

Central Asia, Obi-Rakhmat, Middle / Upper Palaeolithic, peopling

INTRODUCTION

The transition between the Middle and Upper Palaeolithic (hereafter MP/UP) takes place during the Weichselian Interpleniglacial (or MIS 3), with a generally fairly temperate and humid climate marked by three colder events known as Heinrich events. In the centre of the Eurasian continent, the MP/UP transition is characterised by the appearance of new lithic and bone industries called transitional industries (Chabai, 1998; Chabai et al., 2004; Derevianko, 2001; Derevianko et al., 2000; Marks, 1998; Zwyns and Viola, 2014) and by the presence of three human species: Neanderthals, Denisovans and the first Anatomically Modern Humans (hereafter AMH) (Krause et al., 2007; Trinkaus, 2005, 2006; Vishnyatsky, 2004). In this vast geographical area, the modalities of the arrival(s) and dispersal(s) of AMH and their associated cultural traditions are still relatively poorly known, as are their possible biological and cultural interactions with Neanderthals and / or Denisovans. Research on subsistence behaviour of the last Neanderthal societies of Eurasia has shown that some populations had a lasting stabilised relationship with their environment (i. e., persistency of territories and behaviour) (Chabai and Patou-Mathis, 2009; Patou-Mathis and Chabai, 2005; Patou-Mathis et al., 2020) while other populations underwent economic and socio-cultural changes (i. e., new *savoir faire* and

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territories) (Derevianko, 2001; Hublin et al., 2020). Based on a diachronic and synchronic study of animal resource management modalities, both for dietary and non-dietary purposes, we attempt here to characterize the subsistence behaviour of potentially the easternmost Neanderthal populations in relation to those attributed to the first AMH, as well as between different so-called transitional techno-complexes. We will focus on the study of subsistence behaviour at one site in Uzbekistan: Obi-Rakhmat. Placed in their ecological and cultural contexts, we will discuss the contribution of data obtained to current animated scientific debates on the MP/UP transition in Central Asia that is still not comprehensively investigated.

STUDY SETTING

The Obi-Rakhmat site (thereafter O-R) is located in Central Asia, on the foothills of the Western Chatkal Mountains in North-Eastern Uzbekistan (**Fig. 1: a**). Located 1,200 m above sea level, the site is a collapsed cave which is now a small rock shelter (**Fig. 1: b-c**). The entrance faces south in the direction of a canyon drained by a river. The site is watered all year long by a natural spring. Archaeological investigations were performed during the 1960s by the Uzbek Institute of Archaeology and since the late 1990s by the Institute of Archaeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences. Andrei Krivoshapkin directed the last excavation campaigns and research.

In this region the majority of Palaeolithic sites are represented by open-air sites with a single archaeological layer. Long stratigraphic sequences are very rare. In this context, O-R is an exception as here, an impressive sedimentary sequence composed of 22 archaeological layers, measuring 10 m in thickness, survived (Mallol et al., 2009) (**Fig. 1: c**; **Fig. 2: a-b**).

Different radiometric dating methods have been applied to investigate the chronology of the O-R deposits, including AMS, U-series, ESR and OSL. The chronology of the sequence is now well known (**Fig. 2: a**), with the top of the sequence (i.e., the top four layers) younger than 40,000 uncal BP, layers 5 to 14 dating between 40,000 and 50,000 uncal BP, and layers 15 to 22 older than 50,000 BP down to about 80,000 BP (Blackwell et al., 2006; Krivoshapkin et al., 2010; Skinner et al., 2007; Wrinn et al., 2004).

The lithic industry of the site is composed of a mix of Middle and Upper Palaeolithic tool types (**Fig. 2: c**), such as numerous points of different morphology (including elongated Levallois points or pointed blades), burins, and side-scrapers on blades. Core reduction demonstrates a combination of strategies characterizing the Middle and the Upper Palaeolithic, mostly aimed at blade and bladelet production (Krivoshapkin et al., 2006).

In addition, in layer 16, close to 150 human remains have been discovered together with faunal remains. The different studies performed on the specimen show that the cranial and dental remains belong to a juvenile individuum (Bailey et al., 2008; Glantz et al., 2004, 2008; Smith et al., 2011). The cranial remains present features more characteristic of Modern Humans, while the more archaic morphology of the teeth suggests the dentition is essentially Neanderthal. This mix of characters is usually found in juvenile Neanderthals, making the specimen one of the easternmost known Neanderthals.

MATERIAL AND METHODS

Faunal remains dominate within the archaeological assemblage uncovered from the site. A large part of the faunal collection was studied and partly published by P. Wrinn in his dissertation. Wrinn studied the material

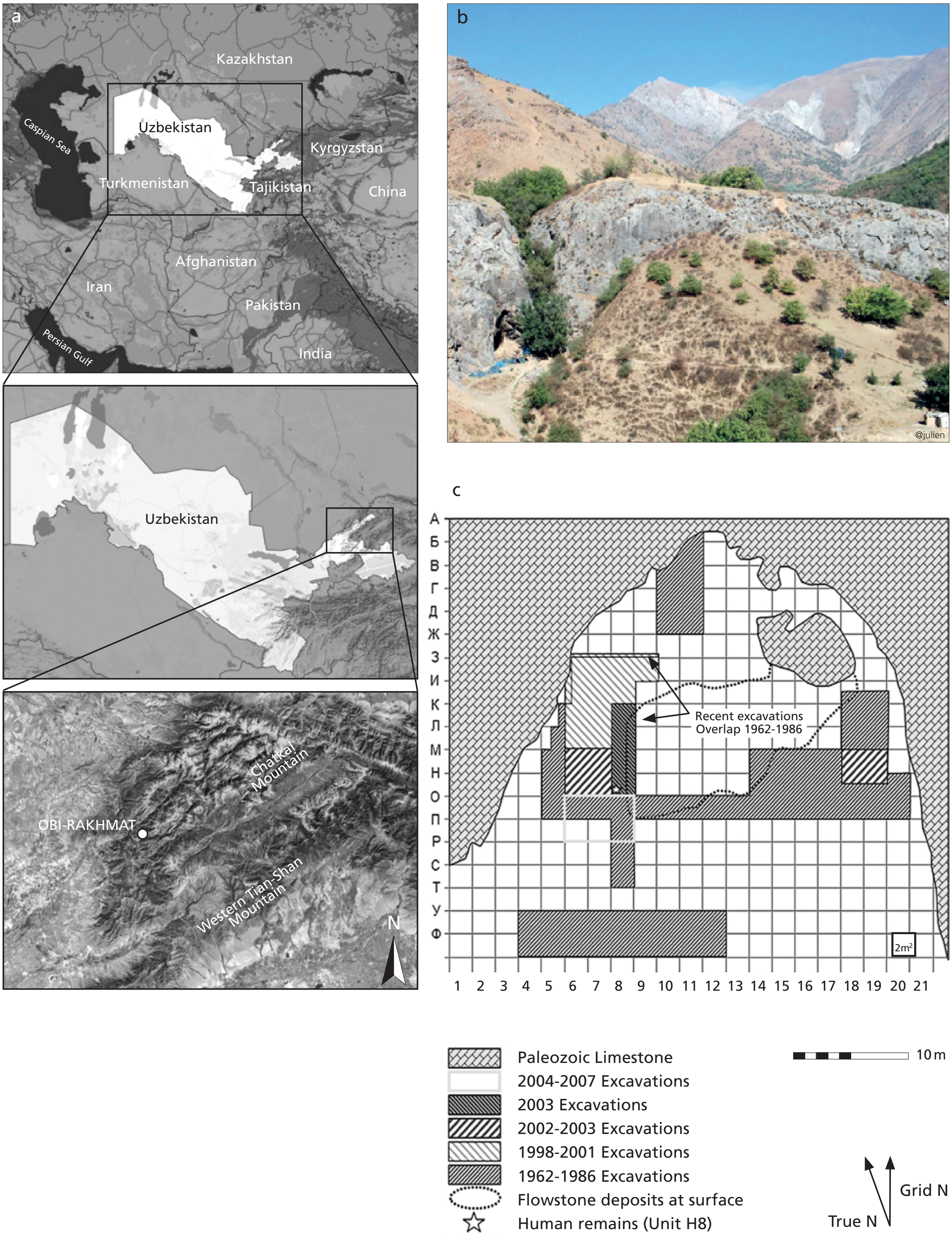

Fig. 1 Geographic location of Obi-Rakhmat rockshelter (Uzbekistan). **a** map location; **b** site view; **c** excavation plan in 2007. – (1a @wikipedia; 1b photo: M.A. Julien; 1c modified after Krivoshapkin).

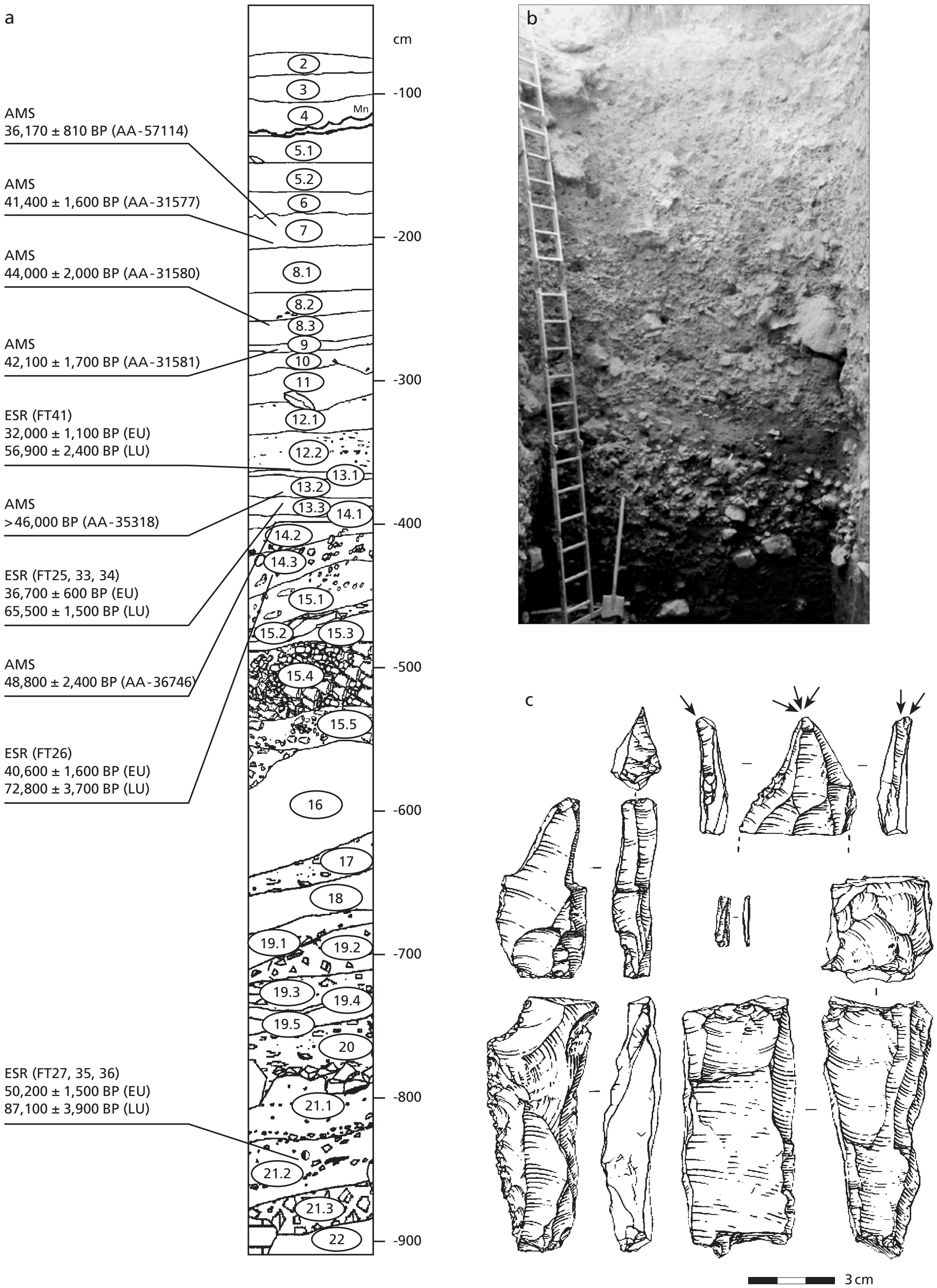

Fig. 2 Obi-Rakhmat. **a** synthetic chronostratigraphic sequence; **b** stratigraphy view; **c** examples of lithic artefacts. – (Modified after Krivoshapkin et al., 2006, 2010; Skinner et al., 2007).

from the first part of the excavation campaign (Wrinn, 2004). We analysed the material from the excavation performed by A. Krivoshapkin between 1998 and 2012 and our study can be considered to represent the first complete study of the faunal material from O-R.

In this paper we focus on the bone remains from layer 16, in which the human remains attributed to Neanderthals were found. Discovered in the summer 2003, these hominin remains represent the first additions to the human fossil record from Uzbekistan in over 65 years. We studied all faunal remains excavated in 1999 (Derevianko's excavations) and in 2000-2006 (Krivoshapkin's excavation campaigns).

No direct dating was performed on layer 16; however, dates from layer 14 gave an upper age limit of 48.8 ka uncal AMS ^{14}C, and a lower limit for layer 19 of between 50 and 80 ka by ESR (Blackwell et al., 2006; Skinner et al., 2007; Wrinn et al., 2004) (**Fig. 2: a**).

Taphonomic, paleoecological and archaeozoological approaches were applied to the study of the faunal material. Bones are described following standard parameters as the total Number of Remains (NR), the total Number of Identified Specimens (NISP) and the combined Minimal Number of Individuals (cMNI) (Brugal et al., 1984; Binford, 1981; Bunn, 1983; Lyman, 1994). Taphonomic analyses are based on the reading of alteration marks from climate-edaphic or biological (including anthropogenic) modifications. We used several archaeological, experimental and actualistic references to identify each kind of trace (Andrews and Cook, 1985; Behrensmeyer, 1978; Gifford, 1978; Lyman, 1994; Patou-Mathis, 1997; Shipman and Rose, 1988; Villa and Mahieu, 1991). Material was also determined by referencing the comparative faunal collection from the Institute of Archaeology of Novosibirsk.

RESULTS

Faunal spectrum

The faunal bone collection from the site is particularly rich, with almost 100,000 recorded remains (**Fig. 3**). Faunal remains are present in all layers, but 80 % of the material comes from the lower layers 12 to 21.

Very few species are present, with no major changes throughout the sequence (**Fig. 3**). Two species are omnipresent in all layers: *Capra sibirica*, the large Siberian ibex, and *Cervus* cf. *elaphus*, the Red deer. Siberian ibex and deer are always the most abundant species, both in NISP and cMNI (**Fig. 3**).

Other ungulates include roe deer and wild boar, present mostly in the lower part of the sequence, but only represented by a few remains. In addition, marmot and hare were also documented in the lower part of the sequence. Carnivore remains are very rare, the most common being the golden jackal and fox. Cave lion was only documented in layers 9 and 20; hyena, only in layer 21. A few bear remains were found in layers 19 and 21 (**Fig. 3**).

Layer 16 is relatively poor in bones: a total of 2,552 remains were unearthed from an excavated area of about 25 m². 2,363 bones (92,6 %) could not be attributed to species. Among the 189 bones determined to species (NISP), ibexes predominate (34,4 %) (**Tab. 1**). Red deer, roe deer, wild boar, golden jackal and hare were also identified, as well as four small bird bone fragments (**Tab. 1**). Forest taxa (red deer, roe deer and wild boar) were well represented.

Layer	NRT	NISP	cMNI
2	1,132	18	3
3	1,425	32	2
4	4,818	114	7
5	7,345	88	6
6	13	4	1
7	226	205	6
8	642	97	8
9	151	148	8
10	585	77	4
11	3,097	248	11
12	8,151	356	10
13	8,186	524	12
14	1,587	626	15
15	22,368	612	18
16	2,552	189	11
17	44	7	2
18	932	128	11
19	1,831	79	6
20	5,996	113	9
21	24,451	979	15
total	**95,532**	**4,644**	**165**

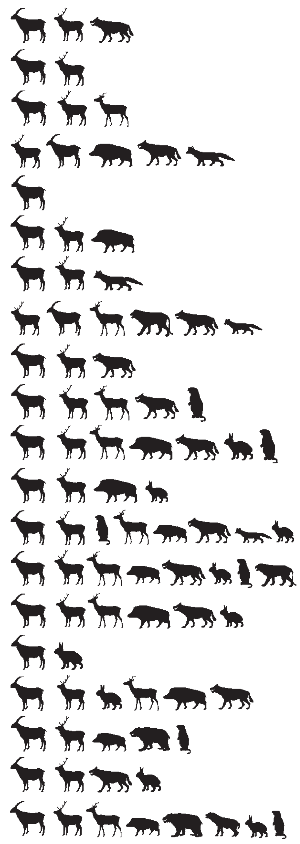

Fig. 3 Obi-Rakhmat. Stratigraphic quantification of the faunal spectrum. Total Number of Remains (NRT), Number of Identified Specimens (NISP) and combined Minimal Number of Individuals (cMNI). For each layer species are ordered from the most to the less frequent remains.

Taphonomy

The osseous material from Layer 16 is very fragmented: more than 88 % of the bones have a length of ≤ 2 cm. This fragmentation relates to weathering damage, mostly producing elongated bone fragments. Preservation of the bone surfaces is relatively good. Although climato-edaphic signals are scarce (0.7 % of the NR), they essentially occur due to percolation (mainly in the form of manganese deposition). We can therefore propose that climate was relatively temperate and humid after deposition. Moderate weathering indicates a regular and relatively quick sedimentation.

The action of plant roots is negligible, and traces of rodents and carnivores are absent. This may indicate that this level was not occupied by denning carnivores, and that they were probably not present at all. The relatively high percentage of bones with anthropogenic marks (10.01 % of the NR) results from the numerous presence of burned bone(s) (242 remains, i.e., 94.5 %, distributed in all excavated squares). Six bone flakes and six bones with green bone fractures in form of percussion marks attest to the recovery of long bone marrow from ibex. Only two bones bear marks of butchery: an undetermined long bone diaphysis and a radius attributed to ibex. Corresponding to defleshing, they both come from square П7.

Skeletal representation

Ibex

Ibex is represented by 66 remains belonging to at least 5 individuals: 2 young, 1 sub-adult, 1 young adult and 1 elderly adult. The mortality pattern observed does not correspond to a natural profile. As carnivores did not play a role in the origin and taphonomic history of the bone assemblage from layer 16, the observed mortality could correspond to an anthropogenic hunting profile.

The majority of the bones belong to the cranial skeleton (NISP = 34) and to the autopodium (NISP = 28) (**Fig. 4**). The upper part of anterior limbs is represented by only four remains. The postcranial skeleton enables the calculation of an MNI of two: a young individual and an adult *sensu lato*.

A radius (**Fig. 5**) and a metapodial diaphysis, as well as two proximal phalanges show anthropic breakage. This suggests that the meat and marrow of long bones of at least two ibexes was consumed. Ibex remains were present in all squares excavated, without any clear spatial concentration.

Roe deer

Roe deer is represented by 15 bones, attributed to at least one adult individual *sensu lato*. Cranial remains are absent. The postcranial skeleton is represented by an element of the spine (head of the rib), a diaphysis of a humerus and 13 fragments of a total of eight bones of the autopodium. A distal end of a proximal phalanx is burned.

It is probable that this individual was brought into the cave as a complete carcass and subsequently consumed by humans. The roe deer bones mainly concentrated in squares H/M-6/7.

Medium size ungulates

According to their dimensions, 92 faunal remains that could not be attributed to species probably originate from ibex and/or roe deer. These bones mostly represent the axial skeleton (mainly fragments of ribs,

Layer 16	NISP	MNE	cMNI
Capra sibirica	66	38	5
Capreolus capreolus	15	10	1
Cervus elaphus	10	7	1
Medium-size ungulate	91	6	1
Sus scrofa	1	1	1
Canis cf. *aureus*	1	1	1
Lepus sp.	1	1	1
Small bird(s)	4	3	1
total	**189**	**67**	**12**

Tab. 1 Obi-Rakhmat. Faunal spectrum of layer 16 in Number of Identified Specimens (NISP), Minimal Number of Elements (MNE) and combined Minimal Number of Individuals (cMNI).

vertebrae and pelvis) and the autopodium. This relativizes the absence or the scarcity of these body parts observed for these two taxa.
Among the material, we identified a newborn from a germ of a decidual tooth and two long bone fragments. For this individual, death can be stipulated to the beginning of summer.

Other mammals
Among the remaining material, ten faunal remains correspond to at least one sub-adult deer: two teeth and eight bone fragments (corresponding to 5 bones) of the autopodium. A lower right incisor attests the presence of a wild boar, probably a female. A canid, tentatively attributed to the golden jackal, is represented by a first upper left premolar from an adult individual. Finally, a hare was identified by a cuboid fragment.

Human remains

Human remains from Layer 16 of Obi Rakhmat have been studied by different scholars (see Bailey et al., 2008; Glantz et al., 2008; Smith et al., 2011). They consist of six isolated (5 left and 1 right) permanent maxillary teeth (incisor, canine, two premolars and two molars) and over 121 cranial fragments (parietal, frontal, temporal, petrous, vault). All remains were recovered from layer 16 and they were found adjacent to the southern wall of the central 10 m deep trench (Bailey et al., 2008; Glantz et al., 2008; Smith et al., 2011) (**Fig. 1: c**). Their recovery, partially *in situ* and partially from the screening of the sediment, supports a strong spatial association of the remains in a single square meter (H8) (**Fig. 6**).
Anthropological analysis concluded that the most parsimonious interpretation of the O-R material is that it represents a single individual of roughly 9-12 years old (OR-1; Bailey et al., 2008). The highly fragmented

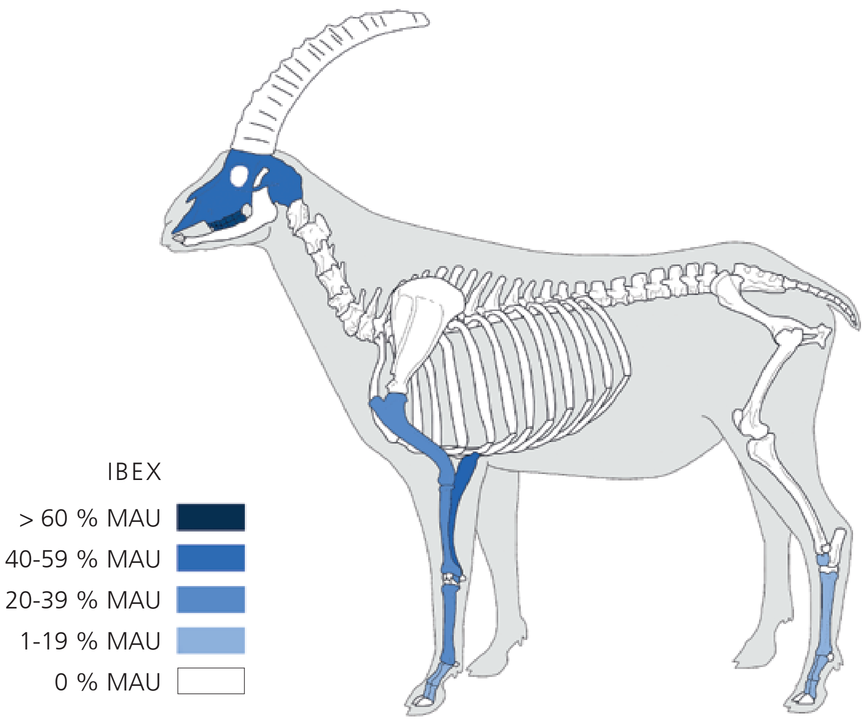

Fig. 4 Obi-Rakhmat. Skeletal representation of Siberian Ibex from layer 16 (in percentage of Minimal Animal Unit: MAU).

Fig. 5 Obi-Rakhmat. Fragment of a radius diaphysis (layer 16, square П7) of Siberian Ibex showing two cut-marks identified by the black arrows, and anthropic fracture. – (Photo: L. Crépin).

cranial pieces offer no clear indication for duplicate bones, in that they are distinct from the six isolated permanent maxillary teeth in terms of morphometrics or ontogenesis (Bailey et al., 2008; Glantz et al., 2008; Smith et al., 2011). Age estimates derived from an examination of relative root development and the degree of dental wear.

A mosaic of morphological patterns expresses a mix of archaic and modern features and the absence of key anatomical areas, like the mental symphysis, did not allow taxonomic identification. In summary, it is not clear whether OR-1 is a Modern Human (in the sense of Qafzeh and Skhul) or a Neanderthal (Bailey et al., 2008; Glantz et al., 2008; Smith et al., 2011).

Remarks on human remains taphonomy

The preservation of hominin cranial fragments is quite heterogeneous. Some fragments exhibit dark grey or black stains (possibly manganese deposits), but most bones are white or close to yellow (Glantz et al., 2009). The bone surface is relatively well preserved while in some cases the external surface is altered, as observed on the faunal remains. Most of the fracture angles resulted from post-depositional processes on dry bones, although few remains show curved bone edges. Some fragments display edge rounding (**Fig. 6**). Taphonomic variables observed on the human remains show the same characteristics as those found on the faunal remains. Thus, the taphonomic histories of both human and animal remains do not appear to have differed. The cranial remains display, however, slightly heterogeneous preservation. Several fragments showing very different preservation were refitted, with no evidence for duplicates. In this context, the absence of the

Fig. 6 Obi-Rakhmat. Parietal reconstruction of OR-1 composed of 27 cranial fragments. – (Modified after Glantz et al., 2008 and Krivoshapkin, pers. comm.).

mandible (as well as inferior teeth) is striking. This seems to indicate that the fragmentation of the cranium occurred shortly after deposition, and that some fragments were exposed to different sub-surface post-depositional influences despite their spatial proximity to one another. The absence of other human remains among the bones from layer 16 seems surprising, especially since a large area was opened up in the immediate vicinity of these remains during several excavation campaigns.

The human remains could derive from a secondary deposit of a young adolescent skull cap in a specific sector (square H8), that was subsequently affected by low fragmentation and limited alteration. This parsimonious hypothesis cannot be substantiated without a more complete excavation of Layer 16.

DISCUSSION AND CONCLUSION

The Obi-Rakhmat deposit is an exceptional archive of recurrent human occupations over several tens of thousands of years in a mid-mountain context. The quality, diversity and preservation of the remains make it an important site to understand how different waves of human populations developed and adapted in Central Asia.

Excavations at O-R have uncovered 22 archaeological layers. The upper part of the filling was dated between 36 ka and 41.4 ka uncal BP (layer 7) and 48.8 ka uncal BP (l.14) and the lower layers (layers 15 to 22) from > 50 ka BP up to about 80 ka BP (Blackwell et al., 2006; Krivoshapkin et al., 2010; Skinner et al., 2007; Wrinn et al., 2004).

The lithic assemblages of all layers of O-R show striking similarities with the so-called Early Middle Palaeolithic blade industries from the Near East (especially Hayonim cave – unit F, and Mysliya cave; Zaidner and Weinstein-Evron, 2020), from Tajikistan (Honako 3 site – PK2) and Uzbekistan (Pavlenok et al., 2016; Kolobova et al., 2018), which date back to more than 200 ka, while late Middle Palaeolithic / Transitional blade industries of the Altai Mountains in Siberia, date back to ~ 60 ka. This may reflect the long-lasting and gradual transition from the Middle to the Late Palaeolithic in the western part of Central Asia (Derevianko, 2001;

Krivoshapkin et al., 2010) or provide evidence of retention of the blade-based Early Middle Palaeolithic in Central Asia (Vishnyatsky, 2004).

The occurrence of forested species in the lower part of the O-R sequence documents forested biotopes in the vicinity of the site. Their absence in the middle and upper part of the sequence seems to result from a succeeding extension of steppe vegetation. The site of O-R records different depositional environments between the top and the bottom of the sequence, with colder and more arid conditions prevailing in the upper levels and more temperate climatic conditions in the lower layers. These levels are characterized by the development of soil horizons as reported by sedimentological and palynological studies (Mallol et al., 2009).

In the mountain areas of Central Asia, as well as for the O-R sequence, we do not observe any noticeable change in subsistence behaviour. Over several thousand years, an impressive resilience in subsistence is evident with only few and minor differences. Minor differences most likely reflect global climatic and environmental changes (which contributed to shorter occupations) rather than clear or abrupt cultural or traditional changes. In all likelihood, this shelter, at an altitude of 1,250 m, whose occupations appear to be mainly of short duration, has been used on numerous occasions as a hunting camp in the mountainous environment.

The assemblage from layer 16 is not rich in faunal remains, but the assemblage attests to a classical subsistence behavior in that it reflects few activities mainly focusing on butchery during a short summer hunting camp targeting mid-size ungulates (mainly ibex and red deer).

A singularity of layer 16 is the presence of human remains showing a mixture of Neanderthal and modern traits, characteristic of juveniles (Bailey et al., 2008; Glantz et al., 2008; Smith et al., 2011). Moreover, a detailed understanding of the origin and history of that bone accumulation supports the hypothesis that the depositional association of human remains and archaeological remains seems not random and likely corresponds to the deposition of a human calvaria (without the mandible) in the living area.

On a large regional scale, around the site of O-R, different sub-contemporaneous human species have been recognized: Neanderthals at Teshik-Tash (Glantz et al., 2009), O-R and Aman-Kutan (presence of one human distal femur dated at about 50 ka) in Uzbekistan, Denisova, Okladnikov and Chagyrskaya in the Altai (associated with the Sibiryachikhian culture), and perhaps at Khudji (with a child incisor dated at 37-38 ka uncal BP) in Tadjikistan (Okladnikov, 1940; Ranov and Schafer, 2000; Trinkaus et al., 2000, Vishnyatsky, 1999). In addition, a few AMH remains were discovered at Anghilak in Uzbekistan (Glantz et al., 2003), and Denisovans at Denisova cave in the Altai (Buzhilova et al., 2017; Douka et al., 2017; Krause et al., 2010; Reich et al., 2010).

The mitochondrial DNA sequences of Teshik-Tash are similar to those of European Neanderthals, and seem to be more closely related to those of Scladina (Belgium) than to those of Okladnikov (Altai), which is geographically much closer. "Eastern" Neanderthals and European Neanderthals are thus said to have separated relatively late (Glantz et al., 2009). This observation could explain the late arrival of Neanderthals in Central Asia and Siberia, probably as late as in the Last Interglacial (Krause et al., 2007; Peyregne et al., 2019; Prüfer et al., 2013).

If, despite some Neanderthal characteristics, the fifth right metatarsal discovered in 2002 in the Anghilak cave in southern Uzbekistan does belong to a modern human, AMH were already present in this region between 43,000 and 39,000 years ago. This bone was associated with a 'Mousterian' lithic industry.

The mixed composition of the lithic industry at O-R points to a complex genesis of the Obirakhmatian, perhaps resulting from cultural interaction between different human populations. The absence of visible changes in behavioural patterns throughout the sequence, as indicated by the relative continuity in both the faunal and the lithic records, makes O-R of particular interest for our understanding of the MP-UP transition – or more accurately the absence of a clear transition – in Central Asia. It might however be possible that techno-economic characteristics relate to the specialized function of the site (hunting camp).

Various researchers have proposed that at least two major waves of AMH migration into Eurasia took place: a first wave of migration to the East about 70-80,000 years ago, with a probable cohabitation of different types of humans in Central Asia; and a second wave to the West that started some ~45,000 years ago, of populations possibly carrying Neanderthal genes, and indicative of a territorial cohabitation of Neanderthals and Denisovans (Buzhilova et al., 2017; Zwyns et al., 2019).
Recently a much earlier (>200 ka) dispersal of Modern Humans out of Africa was proposed, at least, within the territory of Southwest Asia (Hershkovitz et al., 2018). Moreover, this earlier migration wave was archaeologically associated with a lithic industry characterized by 'Levallois' blades (Zaidner and Weinstein-Evron, 2020) very similar, even though much earlier, to the industry of the O-R rock-shelter (Krivoshapkin et al., 2006, 2010). In some areas, the cultural traditions seem to have evolved independently of the different waves of migration, which could be due to the function of the sites in the specific habitat of the Tian-Chan mountain slope.
In any case, this part of Central Asia must be understood within the framework of a specific regional model of evolution and cannot directly be compared to other regions of Europe or the Middle East in terms of cultural traditions or peopling by different human species.
More work will be necessary to fully understand the human occupation at O-R and its significance in this key region for the peopling of Eurasia by Modern Humans and the emergence(s) of the Upper Palaeolithic. These questions remain open and our initial research shows the need to pursue studies in the region where several human species succeeded one another and probably coexisted at certain times and in certain habitats where they may have influenced each other.

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REFERENCES

Andrews, P., Cook, J., 1985. Natural modifications to bones in a temperate setting. *Man* 20, 675-691.

Bailey, S., Glantz, M., Weaver, T.D., Viola, B., 2008. The affinity of the dental remains from Obi-Rakhmat Grotto, Uzbekistan. *Journal of Human Evolution* 55, 238-248.

Behrensmeyer, A.K., 1978. Taphonomic and ecologic information from bone weathering. *Paleobiology* 4, 150-162.

Binford, L.R., 1981. *Bones: Ancient Men and Modern Myths*. Academic Press, New York.

Blackwell, B., Mian, A., Baboumian, S., Blickstein, J., Skinner, A., Wrinn, P., Krivoshapkin, A., Derevianko, A., Wagner, J., Patchett, P., 2006. *Settling the age dispute for the Late Middle Paleolithic at the Obi-Rakhmat hominid site, Uzbekistan*. Presentation at the Paleoanthropology Society Meeting in San Juan, Puerto Rico.

Brugal, J.-P., David, F., Farizy, C., 1994. Quantification d'un assemblage osseux: Paramètres et tableaux. In: Patou-Mathis, M. (Ed.), *Acte de la 6e table ronde Taphonomie/Bone modification*. CEDARC, Treignes, pp. 143-153.

Bunn, H.T., 1983. Comparative analysis of modern bone assemblages from a san hunter-gatherer camp in the Kalahari desert, Botswana, and a spotted hyena den near Nairobi, Kenya. In: Clutton-Brock, J. (Ed.), *Animals and Archaeology: Hunters and Their Prey*. BAR International Series 16. Oxford, pp. 143-148.

Buzhilova, A., Derevianko, A., Shunkov M., 2017. The Northern Dispersal Route: Bioarchaeological Data from the Late Pleistocene of Altai, Siberia. *Current Anthropology* 58, 491-503.

Chabaï, V., 1998. The Middle Paleolithic to Aurignacian transition in the Crimea. In: Otte, M. (Ed.), *Préhistoire d' Anatolie: Genèse de Deux Mondes.* ERAUL 85. Université de Liège, Liège, pp. 339-352.

Chabaï, V., Monigal, C., Marks, A. (Eds.), 2004. *The Middle Paleolithic and Early Upper Paleolithic of Eastern Crimea*. ERAUL1 04. Liège.

Chabaï, V., Patou-Mathis, M., 2009. Kabazi V, late Middle Palaeolithic camp sites: raw material & fauna exploitation. In: Chabaï, V. (Ed.), The top issues of the Eastern European prehistoric archaeology. Actes du Colloque "Conference dedicated to the 100. anniversary of Sergei Nikolaevich Bibikov", Alushta (Crimée, Ukraine), 1-3 octobre 2008. *Archaeological Almanac* 20, 59-76.

Derevianko, A.P., 2001. The Middle to Upper Paleolithic transition in the Altai (Mongolia and Siberia). *Archaeology, Ethnology & Anthropology of Eurasia* 3, 70-103.

Derevianko, A.P., Petrin, V.T., Rybin, E.P., 2000. The Kara-Bom site and the characteristics of the Middle-Upper Paleolithic transition in the Altai. *Archaeology, Ethnology & Anthropology of Eurasia 2*, 33-52.

Derevianko, A.P., Shunkov, M.V., 2002. Middle Paleolithic industries with foliate bifaces in Gorny Altai. *Archaelogy, Ethnology & Anthropology of Eurasia* 1, 16-42.

Douka, K., Slon, V., Stringer, C., Potts, R., Hubner, A., Meyer, M., Spoor, F., Pääbo, S., Higham, T., 2017. Direct radiocarbon dating and DNA analysis of the Darra-i-Kur (Afghanistan) human temporal bone. *Journal of Human Evolution* 107, 86-93.

Gifford, D., 1978. Ethnoarchaeological Observations of Natural Processes Affecting Cultural Materials. In: Gould, R. (Ed.), *Explorations in Ethnoarchaeology*. University of New Mexico Press, Albuquerque, pp. 77-101.

Glantz, M., Athreya, S., Ritzman, T., 2009. Is Central Asia the eastern outpost of the Neandertal range? A reassessment of the Teshik-Tash Child. *American Journal of Physical Anthropology* 138, 45-61.

Glantz, M.M., Suleimanov, R., Hughes, P., Schauber, A., 2003. Anghilak cave, Uzbekistan: documenting Neandertal occupation at the periphery. *Antiquity* 77, 295.

Glantz, M.M., Viola, B., Chikisheva, T., 2004. New hominid remains from Obi-Rakhmat Grotto. In: Derevianko, A.P. (Ed.), *Grot Obi-Rakhmat.* Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Novosibirsk, pp. 77-93.

Glantz, M., Viola, B., Wrinn P., Chikisheva, T., Derevianko, A.P., Krivoshapkin, A., Islamov, U., Suleimanov, R., Ritzman, T., 2008. New hominin remains from Uzbekistan. *Journal of Human Evolution* 55, 223-237.

Hershkovitz, I., Weber, G.W., Quam, R., Duval, M., Grün, R., Kinsley, L., Ayalon, A., Bar-Matthews, M., Valladas, H., Mercier, N., Arsuaga, J.L., Martinón-Torres, M., Bermúdez de Castro, J.M., Fornai, C., Martín-Francés, L., Sarig, R., May, H., Krenn, V.A., Slon, V., Rodríguez, L., García, R., Lorenzo, C., Carretero, J.M., Frumkin, A., Shahack-Gross, R., Bar-Yosef Mayer, D.E., Cui, Y., Wu, X., Peled, N., Groman-Yaroslavski, I. Weissbrod, L., Yeshurun, R., Tsatskin, A., Zaidner, Y., Weinstein-Evron, M., 2018. The earliest modern humans outside Africa. *Science,* 359(6374), 456-459.

Hublin, J.-J., Sirakov, N., Aldeias, V., Bailey, S., Bard, E., Delvigne, V., Endarova, E., Fagault, Y., Fewlass, H., Hajdinjak, M., Kromer, B., Krumov, I., Marreiros, J., Martisius, N.L., Paskulin, L., Sinet-Mathiot, V., Meyer, M., Pääbo, S., Popov, V., Rezek, Z., Sirakova, S., Skinner, M.M., Smith, G.M., Spasov, R., Talamo, S., Tuna, T., Wacker, L., Welker, F., Wilcke, S., Zahariev, N., McPherron, S.P., Tsanova, T., 2020. Initial Upper Palaeolithic *Homo sapiens* from Bacho Kiro Cave, Bulgaria. *Nature* 581, 299-302.

Kolobova K.A., Flas, D., Krivoshapkin, A.I., Pavlenok, K.K., Vandenberge, D., De Dapper, M., 2018. Reassessment of the Lower Paleolithic (Acheulean) presence in the western Tien Shan. *Archaeological and Anthropological Sciences* 10, 615-630.

Krause, J., Fu, Q., Good, J.M., Violoa, B., Shunkov, M.V., Derevianko, A.P., Pääbo, S., 2010. The complete mitochondrial DNA genome of an unknown hominin from southern Siberia. *Nature* 464, 894-897.

Krause, J., Orlando, L., Serre, D., Viola, B., Prüfer, K., Richards, M.P., Hublin, J.-J., Hänni, C., Derevianki, A.P., Pääbo, S., 2007. Neanderthals in Central Asia and Siberia. *Nature* 449, 902-904.

Krivoshapkin, A.I., Anoikin, A.A., Brantingham, P.J., 2006. The lithic industry of Obi-Rakhmat Grotto, Uzbekistan. *Bulletin of the Indo-Pacific Prehistory Association* 26, 5-19.

Krivoshapkin, A.I., Kuzmin, Y.V., Jull, A.J.T., 2010. Chronology of the Obi-Rakhmat grotto (Uzbekistan): first results on the dating and problems of the paleolithic key site in Central Asia. In: Jull, A.J.T. (Ed.), Proceedings of the 20th International Radiocarbon Conference. *Radiocarbon* 52, 549-554.

Lyman, R.L., 1994. *Vertebrate Taphonomy.* Cambridge University Press, Cambridge.

Mallol, C., Mentzer, S.M., Wrinn, P.J., 2009. A micromorphological and mineralogical study of site formation processes at the Late Pleistocene site of Obi-Rakhmat, Uzbekistan. *Geoarchaeology* 24, 548-575.

Marks, A.E., 1998. A new Middle to Upper Paleolithic "transitional" assemblage from Buran-Kaya III, Level C, eastern Crimea: a preliminary report. In: Otte, M. (Ed.), *Préhistoire d'Anatolie, Genèse de deux mondes*. ERAUL 85. Université de Liège, Liège, pp. 353-66.

Okladnikov, A.P., 1940. Neanderthal man and his culture in Central Asia. *Asia* 40, 357-361.

Patou-Mathis, M., 1997. Les marques de boucherie au Paléolithique. *Revue Médicale et Vétérinaire* 148, 959-968.

Patou-Mathis, M., Chabaï, V., 2005. Un site récurrent d'abattage et de boucherie du Paléolithique moyen: Kabazi II (Crimée, Ukraine*).* In: Molines, N., Moncel, M.H., Monnier, J.-L. (Eds.), *Les premiers peuplements en Europe*. BAR International Series 1364. Oxford, pp. 307-328.

Patou-Mathis, M., Crépin, L., Julien, M.A., Péan, S., 2020. Comportements de subsistance à la transition Paléolithique moyen/Paléolithique supérieur: exemples d'Europe orientale et d'Asie centrale. *Les Nouvelles de l'Archéologie* 161, 27-31.

Pavlenok, K.K., Krivoshapkin, A.I., Shalagina, A.V., 2016. Technological Variability of the Obi-Rakhmatian: the Industry of Khudji site, Western Pamir-Tien-Shan. *Stratum Plus* 1, 85-101. (in Russian).

Peyregne, S., Slon, V., Mafessoni, F., de Filippo, C., Hajdinjak, M., Nagel, S., Nickel, B., Essel, E., Le Cabec, A., Wehrberger, K., Conard, N.J., Kind, C.J., Posth, C., Krause, J., Abrams, G., Bonjean, D., Di Modica, K., Toussaint, M., Kelso, J., Meyer, M., Paabo, S., Prüfer, K., 2019. Nuclear DNA from two early Neandertals reveals 80,000 years of genetic continuity in Europe. *Science Advances* 5, eaaw5873.

Prüfer, K., Racimo, F., Patterson, N., Jay, F., Sankararaman, S., Sawyer, S., Heinze, A., Renaud, G., Sudmant, P., Filippo, C., Li, H., Mallick, S., Dannemann, M., Fu, Q., Kircher, M., Kuhlwilm, M., Lachmann, M., Meyer, M., Ongyerth, M., Pääbo, S., 2013. The complete genome sequence of a Neanderthal from the Altai Mountains. *Nature* 505, 43-49; https://doi.org/10.1038/nature12886.

Ranov, V., Schafer, J., 2000. The Palaeolithic of the late Middle Pleistocene in Central Asia, 400-100 Ka ago. In: Ronen, A., Weinstein-Evron, M. (Eds.), *Toward Modern Humans: Yabrudian and Micoquian, 400-50 k-years ago.* BAR International Series 850. Oxford, pp. 77-94.

Reich, D., Green, R., Kircher, M., Krause, J., Patterson, N., Durand, E.Y., Viola, B., Briggs, A.W., Stenzel, U., Johnson, P.L.F., Maricic, T., Good, J.M., Marques-Bonet, T., Alkan, C., Fu, Q., Mallick, S., Li, H., Meyer, M., Eichler, E.E., Stoneking, M., Richards, M., Talamo, S., Shunkov, M.V., Derevianko, A.P., Hublin, J.-J., Kelso, J., Slatkin, M., Pääbo, S., 2010. Genetic history of an archaic hominin group from Denisova Cave in Siberia. *Nature* 468, 1053-1060.

Shipman, P., Rose, J., 1988. Bone tools: an experimental approach. In: Olsen, S. (Ed.), *Scanning Electron Microscopy in Archaeology*. BAR International Series 452. Oxford, pp. 303-335.

Skinner, A.R., Blackwell, B.A.B., Mian, A., Baboumian, S.M., Blickstein, J.I.B., Wrinn, P.J., Krivoshapkin, A.I., Derevianko, A.P., Lundburg, J.A., 2007. ESR analyses on tooth enamel from the Paleolithic layers at the Obi-Rakhmat hominid site, Uzbekistan: Tackling a dating controversy. *Radiation Measurements* 42, 1237-1242.

Smith, T.M., Reid, D.J., Olejniczak, A.J., Bailey, S., Glantz, M., Viola, B., Hublin, J.J., 2011. Dental Development and Age at Death of a Middle Paleolithic Juvenile Hominin from Obi-Rakhmat Grotto, Uzbekistan. In: Condemi, S., Weniger, G.-C. (Eds.), *Continuity and Discontinuity in the Peopling of Europe: One Hundred Fifty Years of Neanderthal Study.* Springer, Dordrecht, pp. 55-163.

Trinkaus, E., 2005. Early modern humans. *Annual Review of Anthropology* 34, 207-230.

Trinkaus, E., 2006. Modern human vs Neandertal evolutionary distinctiveness. *Current Anthropology* 47, 597-620.

Trinkaus, E., Ranov, V.A., Laukhin, S., 2000. Middle Paleolithic human deciduous incisor from Khudji, Tajikistan. *Journal of Human Evolution* 38, 575-583.

Villa, P., Mahieu, E., 1991. Breakage patterns of human long bones. *Journal of Human Evolution* 21, 27-48.

Vishnyatsky, L., 1999. The Paleolithic of Central Asia. *Journal of World Prehistory* 13, 69-122.

Vishnyatsky, L.B., 2004. Evolutionary ranking of the late Middle and early Upper Paleolithic industries: a trial. *Archaeology, Anthropology & Ethnology of Eurasia* 3, 41-50.

Wrinn, P.J., 2004. The faunal remains from Obi-Rakhmat (1998-2002 seasons). In: Derevianko, A.P. (Ed.), *Grot Obi-Rakhmat*. Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Novosibirsk, pp. 159-181.

Wrinn, P.J., Wagner, J.D.M., Patchett, P.J., Slavinskii, V.S., 2004. Radiocarbon and uranium-series dating of Obi-Rakhmat Grotto. In: Derevianko, A.P. (Ed.), *Grot Obi-Rakhmat.* Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences, Novosibirsk, pp. 190-198.

Zaidner, Y., Weinstein-Evron, M., 2020. The emergence of the Levallois technology in the Levant: A view from the Early Middle Paleolithic site of Misliya Cave, Israel. *Journal of Human Evolution* 144, 102785.

Zwyns, N., Paine, C.H., Tsedendorj, B., Talamo, S., Fitzsimmons, K.E., Gantumur, A., Guunii, L., Davakhuu, O., Flas, D., Dogandžić, T., Doerschner, N., Welker, F., Gillam, J.C., Noyer, J.B., Bakhtiary, R.S., Allshouse, A.F., Smith, K.N., Khatsenovich, A.M., Rybin, E.P., Byambaa, G., Hublin, J.-J., 2019. The Northern Route for Human dispersal in Central and Northeast Asia: New evidence from the site of Tolbor-16, Mongolia. *Scientific Reports* 9, 11759.

Zwyns, N., Viola, B., 2014. L'Asie centrale et la Siberie durant le Pleistocene superieur. In: Otte, M. (Ed.), *Néandertal/Cro Magnon. La Rencontre*. Editions Errance, Arles, pp. 267-294.

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