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New Dental Finds Associated with the Paleolithic Selenga Culture, Western Trans-Baikal Region

We describe human teeth discovered in 2012 during the re-examination of the lithic assemblage and paleontological complex from Ust-Kyakhta-3, in the western Trans-Baikal region, excavated by A.P. Okladnikov. This is one of the key Final Paleolithic sites in this area, having a distinct two-layer stratigraphy, a consistent series of radiocarbon dates, and the largest (and the most representative) collection of artifacts. Dental finds come from layer 1, whose dates range from 11,505 ± 100 to 12,151 ± 58 BP. The finds include fragments of a deciduous left upper second molar of a child aged 11–13, and an incompletely erupted upper permanent molar, possibly from the same child. Morphological comparison of these teeth with those from Malta in the Cis-Baikal region demonstrates considerable similarity. This finding suggests that the populations of Malta and Ust-Kyakhta-3 represent one and the same southern Siberian Upper Paleolithic dental complex.

Keywords: *Ust-Kyakhta-3, Trans-Baikal region, Final Upper Paleolithic, dental anthropology, southern Siberian Upper Paleolithic dental complex.*

Introduction

Plenty of Middle and Upper Paleolithic sites in Trans-Baikal region illustrate the earliest prehistory of this region (Konstantinov, 1994: 13–38; Lbova, 2000: 6–22; Tashak, 2004; 2005: 5–16; Moroz, 2014: 19–23; Pavlenok G.D., 2015b). Despite abundant publications on archaeological heritage, no anthropological material from the Trans-Baikal Paleolithic has been described in the literature so far. Only V.I. Tashak mentioned orally that the assemblage from the Oshurkovo site contained dental finds, which regrettably have not been published yet.

Studies of Ust-Kyakhta-3, a bilayer site of the Final Paleolithic in the southwestern Trans-Baikal region (Fig. 1), have a long history. The site was discovered in 1947 by A.P. Okladnikov, the Head of the Buryat-Mongolian Expedition (Okladnikov, 1948, 1950). Initially, only occasional finds from the surface were collected (Abramova, 1953, 1959). However, Okladnikov mentioned some artifacts in the archaeological context. For that reason, in 1976 and 1978, excavations at Ust-Kyakhta-3 were carried out, producing an exceptionally abundant archaeological collection from two culture-bearing layers: more than 40,000 lithic artifacts and numerous osteological remains.

Preliminary information on the site and its stratified complex was provided in Okladnikov's reports (1977, 1979). Then, the site was mentioned in several summarizing papers (Lbova, Khamzina, 1999: 125–127;

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Fig. 1. Map of Cis- and Trans-Baikal regions, showing location of Ust-Kyakhta-3.

Lbova, 2000: 136). The most detailed description of the site and its industries was provided by I.V. Aseev (2003: 33–40). The last large review summarized the data on the Paleolithic and Mesolithic sites in the Ust-Kyakhta archaeological area, including Ust-Kyakhta-3 (Tashak, 2005). Studies of the Ust-Kyakhta-3 assemblage were resumed (Pavlenok G.D., 2015b); and in 2012, among the materials from layer 1 (obtained after wet-sieving), two human tooth fragments were identified. This paper is devoted to description of these dental finds.

General information about the site

The site of Ust-Kyakhta-3 was located on the northern bank of the Selenga River (Fig. 2). Initially, its sediments were identified as pertaining to the second fluvial terrace (Okladnikov, 1977). However, observations made by Doctor of Geology E.I. Ravsky, obtained earlier for the whole of Inner Asia, suggest that fluvial terraces at such rivers were either absent, or were exposed only during the lowest water level (1972: 108–118). On the basis of the resumed studies of Ust-Kyakhta-3 in 1978, Okladnikov reconsidered his preliminary inferences. He came to the conclusion that the site deposits represented two morphological structures of different origin, demarcated by a clear borderline. These are the dune sands overlying the lamellar, lacustrine sediments bearing traces of cryogenic processes (Okladnikov, 1979).

Later, a slightly different opinion on the origin of the Ust-Kyakhta-3 sediments was proposed. D.-D.B. Bazarov distinguished here two sedimentological strata: subaerial deposits, which did not contradict Okladnikov's determination (Ibid.), and floodplain and channel river alluvium (unpublished data presented in V.I. Tashak's dissertation) (1995: 105–109). Tashak studied the Ust-Kyakhta-17 site located 6 km from the site under discussion, and described the upper stratum as the aeolian and landslide deposits; the underlying stratum he described as the alluvial deposits (floodplain and channel alluvium facies) (Ibid.: 30).

During the works in 2012, the following stratigraphic situation was established (Pavlenok K.K., 2013; Pavlenok G.D., 2015b). In total, twelve lithological strata were identified (Fig. 3). The upper portion (strata 1–5) were formed through colluvial and aeolian sedimentation processes. The lower unit (strata 6–12) represented the floodplain alluvium, which agrees with the determinations made by Bazarov and Tashak.

Archaeological materials were embedded in two lithological strata. The upper cultural layer was associated with the humic, fine-grained sandy loam layer 4 to 12 cm thick, designated as stratum 9. Artifacts were recovered from a single plane, with vertical dispersal of the

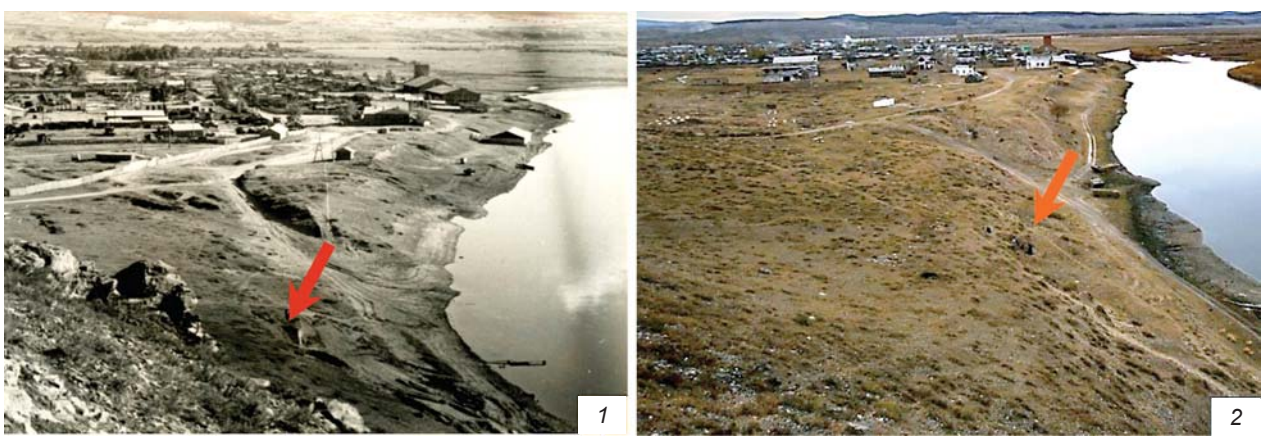

Fig. 2. View on the site.
1 – photo from 1978 (after (Okladnikov, 1978)); *2* – photo from 2012.

artifacts within 1–2 cm, suggesting the *in situ* occurrence of cultural remains. Analysis of lithic artifacts from cultural layer 1 testifies to the homogeneity of the industry, and allows us to attribute it, in terms of its technical-typological features, to the Final Paleolithic (Pavlenok G.D., 2015b).

The lower cultural layer corresponds to stratum 11, which is 15–20 cm thick and comprises gray-brown sandy loam. The vertical dispersal of the artifacts within the layer is considerable; but the analysis of the lithic artifacts attests to the homogeneity of the industry and its attribution to the Final Paleolithic (Ibid.). Refitting of several artifacts was carried out (Pavlenok G.D., 2016), suggesting that this assemblage was formed in quite a short period. The set of available dates in the range of 13,000–15,000 cal BP (see *Table*) supports the attribution of the Ust-Kyakhta-3 deposits to the Final Pleistocene.

Analysis of lithic and bone artifacts allowed us to attribute this site to the Final Paleolithic Selenga culture (Pavlenok G.D., 2015b), the existence of which until recently, like some other Paleolithic cultures of the Trans-Baikal region, had not been supported by any anthropological materials. The term of "Selenga culture" was proposed by G.F. Debets for exposition of lithic artifacts collected near the town of Kyakhta and village of Ust-Kyakhta and attributed to the Early Neolithic (1930). Tashak provided new information concerning this culture. He defined the Selenga culture on the basis of assemblages recovered from Ust-Kyakhta-3 and -17, and attributed it to the Mesolithic, "despite the fact that it was practiced in Pleistocene times" (Tashak, 2005: 115). The most recent studies of the Ust-Kyakhta-3 materials provided significant new data about this culture of the western Trans-Baikal region, and attributed it chronologically to the Final Paleolithic (Pavlenok G.D., 2015b).

The raw materials for this lithic industry were pebbles, including siliceous aleurolite, alueropelite, and sandstone.

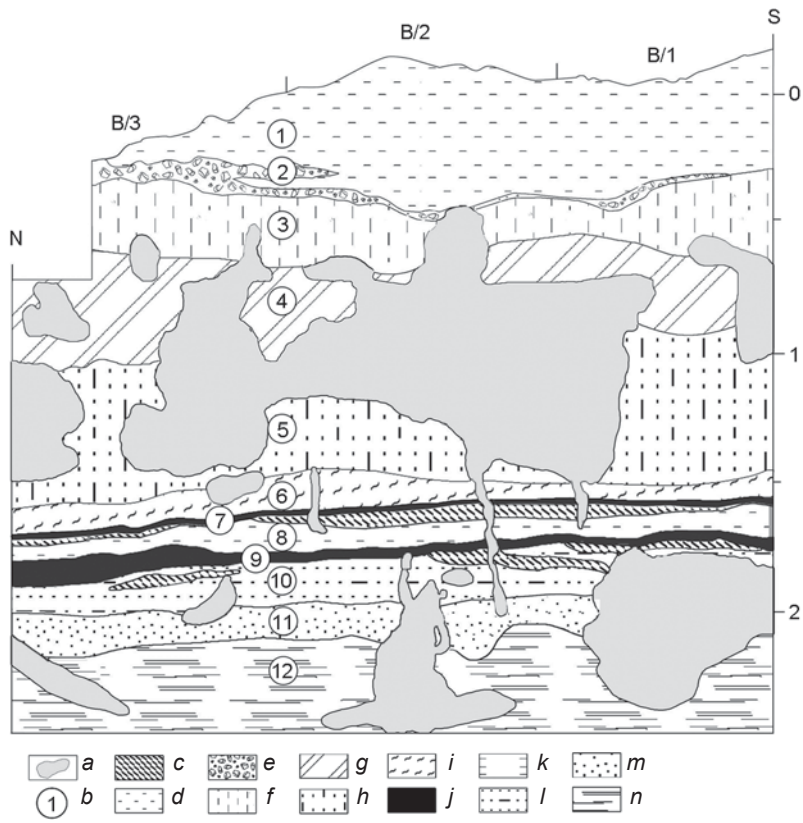

Fig. 3. Ust-Kyakhta-3 stratigraphic section.
a – rodent-burrows; *b* – lithological layer number; *c* – carbonate-formation area; *d* – modern soil (grayish-brown sandy loam); *e* – grayish-brown sandy loam intermixed with gruss and gravel; *f–m* – sandy loam: *f* – brownish-gray intermixed with sand, *g* – grayish-yellow fine-grain, *h* – brown, *i* – whitish-gray, *j* – humic blackish-brown, *k* – dark brown, *l* – light brown, *m* – grayish-brown; *n* – fine whitish-gray sand.

Results of radiocarbon dating of the materials from Ust-Kyakhta-3

Archaeological layer	Radiocarbon date, BP	Calibrated value*, BP	Material	Method	Lab code	Source
1	11,505 ± 100	13,399 ± 140	Charcoal	^{14}C	SO AN–1552	(Orlova, 1995)
1	12,136 ± 54	14,165 ± 236	Bone	AMS	AA-12176; NSKA–00830	(Pavlenok G.D., 2015b)
1	12,151 ± 58	14,183 ± 234	″	″	AA-12185; NSKA–00831	(Ibid.)
2	12,595 ± 150	14,930 ± 367	Charcoal	^{14}C	SO AN–1553	(Orlova, 1995)
2	11,851 ± 53	13,758 ± 138	″	AMS	AA-11936; NSKA–00828	(Pavlenok G.D., 2015b)
2	12,250 ± 60	14,326 ± 266	Bone	″	AA-12292; NSKA–00829	(Ibid.)

*Calibration was carried out using http://www.calpal-online.de/

Stone-knapping was aimed at producing blades by plane or prismatic reduction, and micro-blades by detachment of wedge-shaped cores or flakes from small, often non-standard cores (Fig. 4, *A*, *B*). The specific feature of this culture is that after flattening of the core face, some flat cores (along with pebbles and thick flakes) were used as blanks for wedge-shaped cores (Fig. 4, *C*). This modification was carried out through two different strategies (techniques) (Tashak, 2000; Pavlenok G.D., 2015a).

Each of the reconstructed strategies consisted of a specific chain of operations executed with particular tools at various stages of core reduction. The initial stages of shaping of large flat-faced and prismatic cores

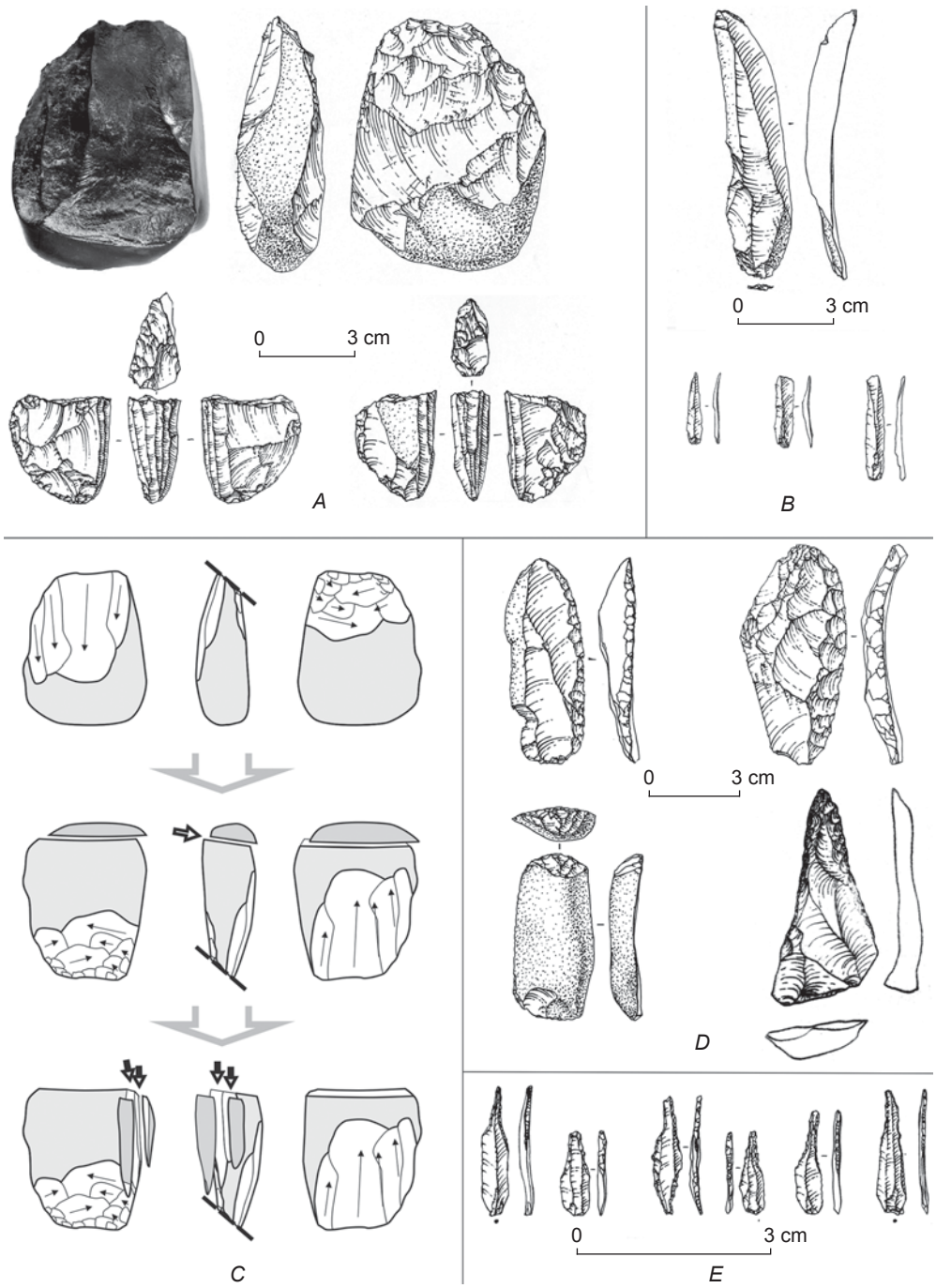

Fig. 4. Lithic industry.
A – cores; *B* – blanks without traces of secondary treatment; *C* – modification of flat cores, and utilization as blanks for wedge-shaped cores; *D*, *E* – tool kit.

were carried out by direct percussion with a hard hammer. Blanks with the proportions of blades were produced through direct or indirect blows with a soft hammer. Similar traces of percussion were noted on flakes that were used for core rejuvenation at the stage of serial production of blanks. Microblades were removed from wedge-shaped cores through pressure flaking technique. Examination of the scars from removals suggested that these could have been obtained by three techniques: use of hand crutch; hand crutch and core clump; shoulder crutch and core clump. The cores were, in addition, shaped with the aid of a soft hammer.

The established technological features of the lithic assemblage are well supplemented by the typological parameters. For example, primary reduction was targeted at blade and micro-blade production, this strategy being supported by the selection of blanks for secondary treatment. The toolkit is dominated by knives, and side- and end-scrapers; more rarely, specific Ust-Kyakhta points (Tashak, 2012) and burins, fashioned mostly on blades (Fig. 4, *D*), occur. A set of borers on microblades is noteworthy (Fig. 4, *E*) (Pavlenok G.D., 2015b: 14, 20). The tools were mostly shaped through dorsal retouching (Tashak, 2005: 41–66; Pavlenok G.D., 2015b: 20).

In addition to lithic artifacts, archaeological collections of the Selenga culture include comparatively few, but representative, bone tools, which are conventionally classified into three groups: pointed tools (including needles), shafts of single- or double-edged insertion tools, and fishing-hooks (Tashak, 2005: 57–60; 120–121; Pavlenok G.D., 2014). Other important features of the Selenga assemblages are pieces of art (Zotkina, Pavlenok G.D., Tashak, 2018) and traces of the arrangement of living-space (Tashak, 2005: 28–38).

The Final Paleolithic Selenga culture is an autochthonous culture based on the older Ust-Menza variant of the Late Upper Paleolithic (~18–13 ka BP) (Moroz, 2014: 98–102), which in turn originated from even older archaeological complexes of the region (Pavlenok G.D., 2015b, 23).

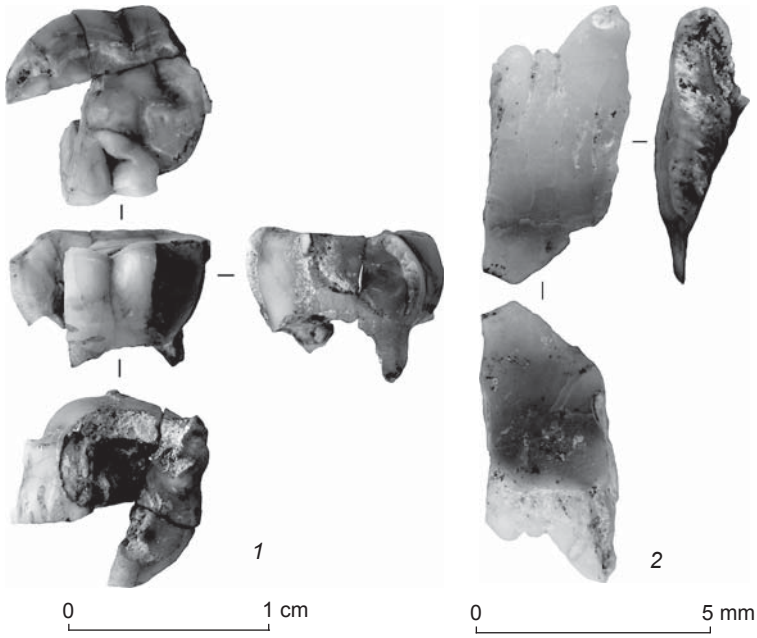

Fig. 5. Dental finds.
1 – deciduous left upper second molar; *2* – a fragment of the enamel of mesial edge of the upper permanent molar.

Materials and methods

Odonthological finds from layer 1 at Ust-Kyakhta-3 (Fig. 5) are represented by four fragments (from 6.2 × 3.1 mm to 6.5 × 9.0 mm) of a molar crown. Three of these belong to one tooth—a deciduous left upper second molar. The first one is a fragment of the vestibular segment of the crown, the other two are from the lingual segment with an adjacent part of the mesial interproximal surface bearing a fragment of a contact facet. The fact that it was a deciduous tooth is evident from the shape of the crown's cavity, its sharp narrowing at the neck, the small thickness of the enamel and dentine, small diameter and a significant curvature of the remaining part of the root, and a small height of the fragments. It can be identified as an upper tooth by the wide shape of the crown with rounded corners, distal shift of the fissure separating the cusps of the lingual side, and significantly less wear on the vestibular cusps as compared to the lingual ones. The last feature is due to the fact that in deciduous occlusion they overlap lower teeth, and are less engaged in the process of mastication. The side of the tooth is evident from the position of fissure IV separating the hypocone and the protocone. Almost complete resorption of the root system and wear on most of the crown enamel suggest that the tooth belonged to an individual aged 11–13 years.

The fourth fragment belongs to another tooth. It is a fragment (6.2 × 3.1 mm) of the enamel of the mesial edge of a upper permanent molar belonging to a child. The roughness of the enamel's surface and preservation of odontoglyphic elements of the third order suggest that the tooth had not completely erupted. Unfortunately, the fragment is too small to be subjected to morphological analysis.

The deciduous tooth was described according to the ASUDAS protocols and the conventional set of traits used in Russian dental anthropology (Zubov, 2006,

Edgar, 2017). Pathological changes (caries, enamel and dentine hypoplasia, dental calculus) and trauma were also registered to study the dietary pattern of the individual from Ust-Kyakhta-3.

Morphological description of the deciduous molar

Most details of the crown's morphology cannot be examined properly owing to severe attrition, but it supposedly had a large metacone (grade 1 according to the Zubov's scale) and a moderately reduced hypocone (grade 4 according to the Dahlberg's scale). Fissure I, separating the metacone and paracone, can be identified at the vestibular side of the tooth; and fissure IV, separating hypocone and protocone, can be identified at the lingual side. Their position implies that the contact zone between the metacone and the protocone was rather long. This suggests that a well-developed plagiocrista (crista oblique) was present in the crown's morphology, although it is not possible to estimate the degree of its continuity. The metacone bears a fragment of a tubercular groove, supposedly 1′me, which falls into fissure I. The presence of this groove reveals an originally highly differentiated odontoglyphic pattern, which is further supported by the significant depth of the fragments of intertubercular grooves. An ante-mortem enamel chip 2.5 mm in diameter impedes observation of the initial development of phenes of the Carabelli' system, but the absence of a well-developed Carabelli cusp is evident. A parastyle is absent.

Metric traits of the crown were measured with an error, as the fragments were subject to paleogenetic analysis and could not be glued together; but this error does not exceed the mean statistical error. The mesio-distal diameter of the crown could not be measured because of the post-mortem damage to the mesial segment; the buccolingual diameter is approximately 9.5 mm. The minimal mesio-distal diameter of the neck is 7.7 mm, the minimal buccolingual diameter 7 mm.

No serious pathological changes were observed on the fragments of the tooth. Enamel hypoplasia, caries, and dental calculus are absent, although some parts of the crown bear minor yellowish spots. Together with the ante-mortem enamel chip at the mesio-vestibular corner of the crown, this indicates low a carbohydrate ratio in the individual's diet, rough food processing, and probably occasional cracking of small animal bones.

Results of comparative analysis

We have limited possibilities for a comparative analysis of the Ust-Kyakhta-3 find, because deciduous left upper second molars in Northern Eurasia have so far only been found at the site in Malta, located in the adjacent region of Cis-Baikal. These belonged to two individuals (Malta 1 and Malta 2), with markedly different dental morphologies (Zubov, Gokhman, 2003; Zubova et al., 2018: Fig. 4; Shpakova, 2001). Malta 1 (the younger child) is characterized by a marked archaic morphology of the deciduous dentition, and its small size. The teeth of the Malta 2 child are notably larger and have less archaic features; in general, they are morphologically close to Caucasoid odonthological complexes. The upper second molars of this individual are not reduced, a large hypocone is present at the disto-lingual corner of the crown, the Carabelli cusp is moderately developed. The corresponding teeth of the Malta 1 child have a moderately reduced hypocone and the Carabelli cusp is absent (as far as can be judged by the incompletely formed crown).

The Ust-Kyakhta-3 molar is morphologically closer to the dentition of the Malta 1 individual than to that of Malta 2. They are similar in the peculiar shape of the crown, marked reduction of the hypocone, absence of the Carabelli cusp, and their overall small size. The buccolingual diameter of the tooth from Ust-Kyakhta-3 (9.5 mm) is notably smaller than its mean values in modern populations (10.1 mm (Zubov, Khaldeeva, 1993: Suppl., tab. 4)), but it is even smaller in the specimen from Malta 1 (9.2 mm).

Notably, the dietary patterns of the elder child from Malta (the incomplete dental formation of the younger one does not allow for examination of his diet) and the Ust-Kyakhta-3 individual could have been similar. The upper molars from Malta lack carious lesions, and dental plaque is present only in the form of yellowish spots. A paleopathological comparison can be made between the Ust-Kyakhta-3 specimen and a mandible belonging to a girl aged 14–15 found in 2014 at the Afontova Gora II site (Derevianko et al., 2014). Unlike the children from Ust-Kyakhta-3 and Malta, she had rather extensive deposits of dental calculus, although her permanent teeth had erupted not long before. This can be partially explained by metabolic disorders (Chikisheva, Zubova, 2016), but may also indicate different dietary patterns for the individuals from Afontova Gora II, Malta, and Ust-Kyakhta-3.

It should be noted that the classic complex of Malta is significantly more ancient (approximately 20–23 ka BP) (Sitlivy, Medvedev, Lipnina, 1997: 31) than those of Ust-Kyakhta-3 and Afontova Gora II. Therefore, a direct comparison of these sites is not possible; we can only assess their positions generally in the regional cultural-chronological pattern of the Paleolithic.

The origins of the Selenga culture assemblages is seen as a result of the autochthonous development of the earlier lithic industries of the region (Tashak, 2000: 69; Pavlenok G.D., 2015b). The Ust-Menza technology of preparation and use of wedge-shaped cores, observed

in the finds from the Late Upper Paleolithic sites of the western Trans-Baikal region (~18–13 ka BP), is seen as a direct predecessor of the Selenga lithic tradition, including one of its main elements—the shaping of wedge-shaped cores on spalls and pebbles (Moroz, 2014: 99–102). Thus, the oldest dates in the chronological range of the Malta complex come close to the latest ones for the Ust-Menza culture.

There are also earlier origins of the tradition of forming wedge-shaped cores on the exhausted flat cores observed in the region (Tashak, 2000: 69). Tashak has discovered this strategy in the assemblages of the initial Upper Paleolithic in the Podzvonkaya (more than 35 ka BP) (Tashak, 2016: 18–19) and Tolbaga (42–26 cal ka BP) (Izuho et al., 2019) archaeological sites. Notably, the samples from these sites exhibit all the elements of the material culture associated with the Selenga cultural complex. Outstanding examples of bone industry (Vasiliev, 2005; Tashak, 2007) and evidence of non-utilitarian human activity (Tashak, 2002; Konstantinov et al., 1983) are present here. Planigraphic study of the Podzvonkaya and Tolbaga sites reveals residential and economic complexes (Kostantinov, 1994: 50–51; Tashak, 2014; 2016: 42–70). The Malta site is also known to exhibit all of these elements (Gerasimov, 1931, 1935, 1958, 1961; Medvedev, 1983; Lipnina, 2002; Kimura, 2003).

We thus support the hypothesis that links the complexes of Podzvonkaya, Tolbaga, Malta, the Ust-Menza variant of the Late Upper Paleolithic, and the Selenga culture into a single evolutionary sequence of material culture. Although the available anthropological and archaeological data are fragmentary, this model seems to be the least contradictory.

Conclusions

The analysis of the dental finds from layer 1 at Ust-Kyakhta-3 allows a conclusion to be drawn that these are fragments of the deciduous left upper second molar of a child aged 11–13, and an incompletely erupted upper permanent molar, possibly from the same child. Both metric and non-metric traits of the deciduous tooth make it similar to the analogous teeth from Malta 1, which may suggest the attribution of anthropological finds from Ust-Kyakhta-3 to one and the same southern Siberian Upper Paleolithic dental complex (Zubova, Chikisheva, 2015). However, on the basis of the available data, this is as yet a premature conclusion.

Paleopathological features point to a good state of health for the Ust-Kyakhta-3 individual, to the dominance of meat in his diet, and probably to differences in diet patterns between him and Malta children on the one hand and the Afontova Gora II girl on the other hand.

The return of research interest in the old collections ensures the obtaining of important new data. The analysis of the Ust-Kyakhta-3 collection included the use of advanced method involving wet-sieving. It was this method that allowed the smallest fragments of anthropological material to be preserved, which proved to be a first in the history of studying the Stone Age in the Trans-Baikal region. Future prospects are associated with paleogenetic studies conducted in the Max Planck Institute for Evolutionary Anthropology, which hopefully will soon provide new information about the population of the Trans-Baikal region at the turn of geological times.

Acknowledgements

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