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STRATIGRAPHY AND PALEOLITHIC LANDSCAPES OF THE BEGANCHIK SITE AT THE KAMA-VOLGA CONFLUENCE

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The Beganchik locality is a stratigraphic sequence of loessic deposits, pedogenic horizons and Paleolithic occupations located at the Kama-Volga confluence. The sequence is exposed on a bluff formed on the west side of an erosional remnant between the Kuybyshev Reservoir and the former channel of the Aktay River. Although the site is known for its Terminal Paleolithic-Mesolithic occupations of the Pleistocene-Holocene transition, evidence of older occupations and remains of fauna has been identified. Our research team identified evidence of human presence associated with a pedogenic horizon of MIS 3 age. Two AMS radiocarbon ages from a hearth produced ages around 47 000 years BP. Pollen and phytoliths from two soils horizons, including the one associated with the hearths indicate a steppe environment coincident with the formation of correlative soils elsewhere in the Russian Plain.

Keywords: archaeology, Paleolithic, periglacial deposits, paleosols, pollen, phytoliths.

Introduction

The Beganchik locality, situated at the Kama-Volga confluence region (fig. 1), presents many opportunities to study prehistoric occupations and megafaunal assemblages embedded in its sequence of loessic and alluvial deposits. The site is the remnant of an Upper Pleistocene terrace isolated between the Kuybyshev Reservoir and the estuary of the Aktay River (fig. 1C). Previous research at this locality, and the Komintern locality on the other side of the Aktay River, have produced evidence of Terminal Paleolithic-Mesolithic transition (Galimova 2001; Galimova et al. 2018) and scarce remains of older occupations (Galimova et al. 2021).

Since 2017 our team began mapping, describing, and sampling the locality in tandem with the pedagogic activities of the Bolgar International Archaeological school and the sponsorship of the Institute of Archaeology named after A. Kh. Khalikov. In the process of these activities we have identified new objects of archaeological, paleontological and geomorphological importance, which we describe briefly in this paper.

Because our research at the Beganchik locality is in progress, the data and interpretation presented here are preliminary. Nonetheless, they constitute the basis for further studies at the site and the broader region. Thus, our objectives of this paper are first to describe the stratigraphy of the site focusing on new findings and radiocarbon dates associated with an occupation during Marine Isotope 3 (MIS 3) and, second, to link our findings with previous archaeological research at the locality.

The locality and previous research

The Beganchik locality (N 55º 09’ 21”, E 49º 33’ 45”) is situated in the Spassk District in the Republic of Tatarstan, on the south side of the Kuybyshev Reservoir (fig. 1A). The locality forms an isolated promontory between the reservoir and the estuary of the modern channel of the Aktai River, often connected to the mainland by a sand spit (fig. 1B-C). Over time, the erosion shaped the promontory into two surfaces referred to here as the upper and lower terrace (fig. 1C). Wave erosion has constantly eroded the west side of the high terrace exposing the sequences the sediments with various natural and cultural layers.

The study area has been continuously explored since the mid-1950s. Fossil Quaternary fauna and stone artefacts on the shallows of a terrace outlier called "Izmersky Island" or "Beganchik" were first recorded by E.P. Kazakov

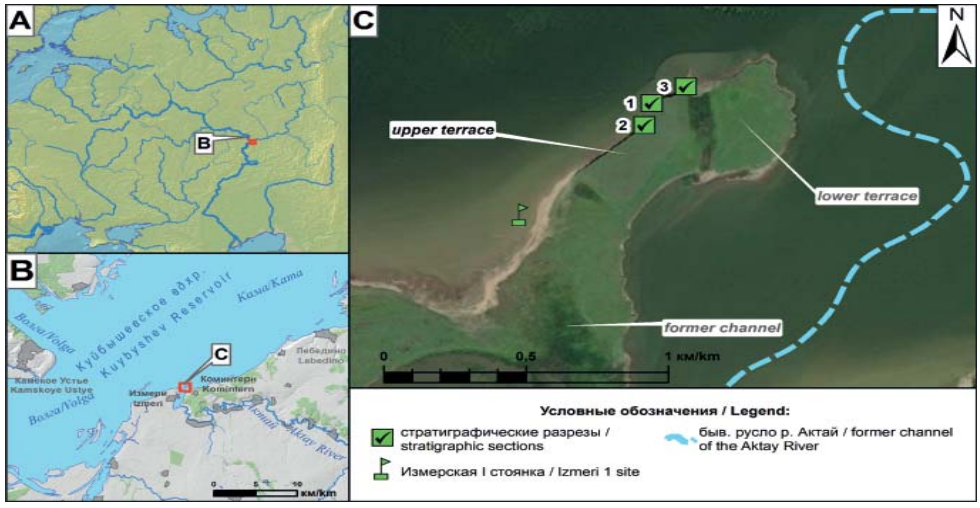

Fig. 1. A) Location of the Beganchik archaeological locality; B) terrace remnant with the location of profiles studied; C) aerial view of the northern part of the terrace remnant (Google Earth-Pro); stratigraphic sections 1, 2, and 3, correspond to Beg-1, 2, and 3 in the text

Рис. 1. A) Местоположение памятника археологии Беганчик; B) остаток террасы с расположением изученных профилей; C) вид с воздуха на северную часть остатка террасы (Google Earth-Pro); стратиграфический профиль Бег. 1, 2, и 3, соответствуют Бег-1, 2 и 3 в тексте

in 1981. The object he discovered was labelled as the Izmeri I Paleolithic site (Starostin, 1986., p. 68, # 422a), which was completely eroded by wave action from the reservoir. In 1985, about 250 m to the north-north-east from this site, another site of the Terminal Paleolithic - Early Mesolithic was discovered. The latter was named the "Beganchik" site (Galimova, 2001, p.193). This site is the object of the presented study.

Excavations of the upper part of the western and northern side of the promontory provided evidence of Terminal Paleolithic- Mesolithic occupations (Ust-Kamskaya culture) of the layers below the modern Chernozem and above the loessic yellow deposits (Galimova 2001; Galimova et al. 2018). A more recent study in 2013 aimed at investigating the possible mammoth-lithic association at the northwestern end of the terrace remnant where Paleolithic-Mesolithic tools mixed with megafaunal remains (woolly mammoths, woolly rhinoceros, and horse) dislodged from older layers (Galimova et al., 2018).

Findings of flint cores in association with mammoth remains suggested the existence of a different, probably earlier culture (Kazakov 2001). A more recent study of the Komintern locality (fig. 1B) found some evidence of earlier occupation, which included a flake and a broken fragment of a bone identified as *Coleodonta antiquitatis* (woolly rhino) (Galimova et al. 2021). Furthermore, the same study recovered a lithic fragment in the equivalent layer on the west side of Beganchik. The correlation of the layer between Komintern and Beganchik was assigned to the MIS 3 (Galimova et al., 2021). Concurrently, our study found more evidence of human occupation in the same layer, which is the topic of this paper.

Methods

The objectives of our study include the recovery of stratigraphic, geomorphological and paleobotanical information from the sedimentary exposures of the Beganchik promontory. Stratigraphic recording consisted in dividing profiles into discrete units from

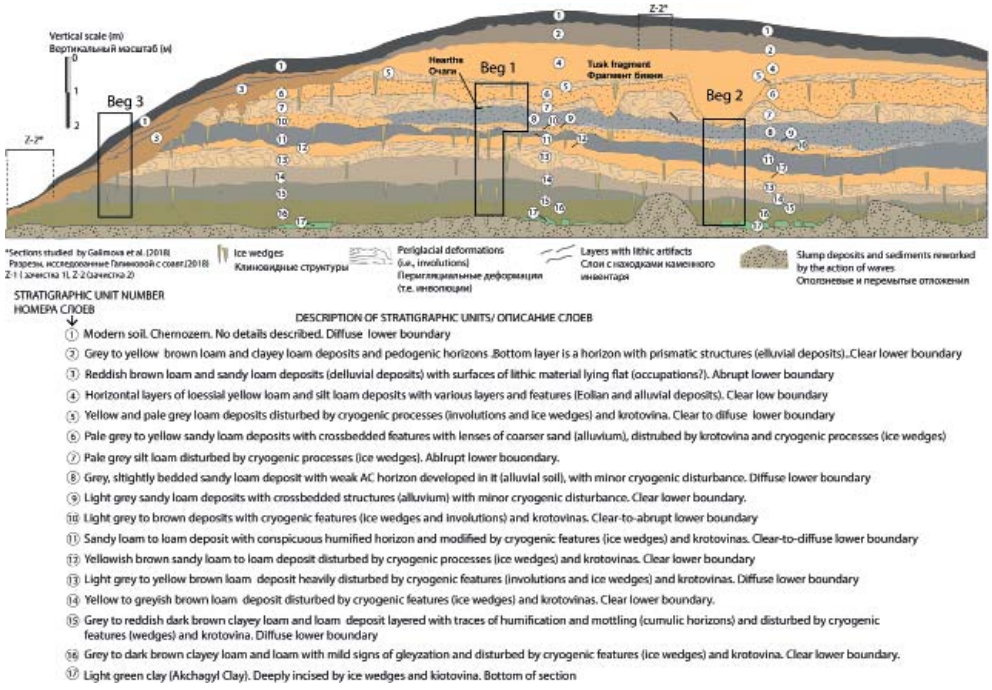

Fig. 2. General stratigraphy
Рис. 2. Общая стратиграфия

top to bottom or by presumed relative age. Each unit consists of a package of several more discrete stratigraphic zones or horizons denoting a depositional event.

A selected number of samples from two of the paleosols were processed for pollen, spores, phytoliths and charcoal density. The samples were first decalcified with HCl, removal of unwanted organics using KOH, and flotation using Sodium Polytungstate at 2.3 density. The remaining residue was mounted on microscope slides using Entellan as a medium. In addition to pollen and phytoliths, other spores, ascospores, charcoal, and sponge spicules were also counted. Additionally, soil samples were processed to obtain particle size distribution using sieves and flotation of clays. Organic carbon percent by loss on ignition provided a proxy for organic carbon in the soil, and calcium carbonate percentage was obtained by hydrochloric acid digestion.

Two samples of charcoal from a hearth were collected for radiocarbon dating. They were analyzed by the AMS method at the A.E. Lalonde AMS Laboratory of the University of Ottawa, Canada. Calibration was performed using OxCal v.4.2.4 (Ramsey, 2009), using the IntCal13 calibration curve (Reimer et al., 2013). Ages here are presented first in AMS 14C years and subsequently as calibrated years BP rounded to the nearest 1000 years.

Stratigraphy and chronology

The section exposed on the west side of the terrace consists of 17 units (fig. 2). Their definition is mainly based on details described in section Beg-1, 2, and 3. The topmost unit (1) is the modern Chernozem soil, which overlies unit 2 on most of the upper terrace and unit 3 on the northwest side of the terrace. Unit 2 consists of several layers and horizons, described at exposure Z-1 (зачистка 1) (fig. 2) by Galimova et al. (2018: 21). Unit 3 consists of a reddish brown loam

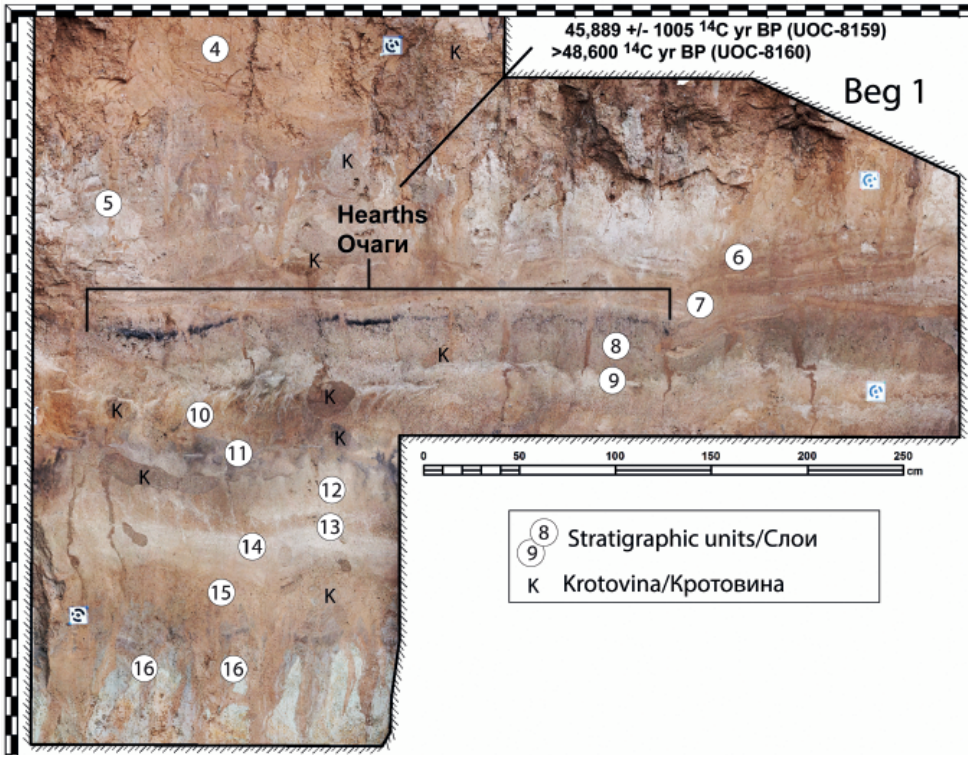

Fig. 3. Stratigraphic section Beg 1
Рис. 3. Стратиграфический профиль Бег. 1

deposit with beds dipping northwest, and with layers of lithics lying flat. The material seems to be associated with the Terminal Paleolithic-Mesolithic occupations studied at location Z-2 (зачистка 2) by Galimova et al. 2019.

Unit 4 corresponds to a series of yellow brown loam deposits laid on a horizontal surface and in some locations filling in some channel depressions cutting through older deposits. Units 5, 6, and 7 correspond to loam and sandy loam deposits with cryoturbation features (involutions and ice wedges).

Unit 8 is a sandy loam to loam grey deposit with sufficient signs of pedogenesis to consider it an AC horizon transitioning to a light brown sandy loam deposit (unit 9). In turn, these units overlie a loam deposit with cryoturbation features (ice wedges and involutions), and heavily bioturbated (krotovina).

Unit 11 is a dark grey loam deposit characteristic of a humic horizon with abundant root marks filled with carbonate and silt. Although this unit is conspicuous in some places, it seems that its top has been eroded. Its lower boundary is transitional to unit 12, which is a yellow brown loam deposit, overlying a series of other loam deposits (units 13 and 14) with various degrees of disturbance by cryogenic processes and bioturbation. Units 15 and 16 are loamy deposits with pedogenic development, but due to heavy cryogenic and biogenic disturbance we could not refine their interpretation until we study more sections. The lowest layer (unit 17) corresponds to a green clay deposit, identified as the lower Pleistocene Akchagyl Clay (Khisyatmedinova 2013).

Section Beg-1 is of great interest because of the finding of a hearths on top

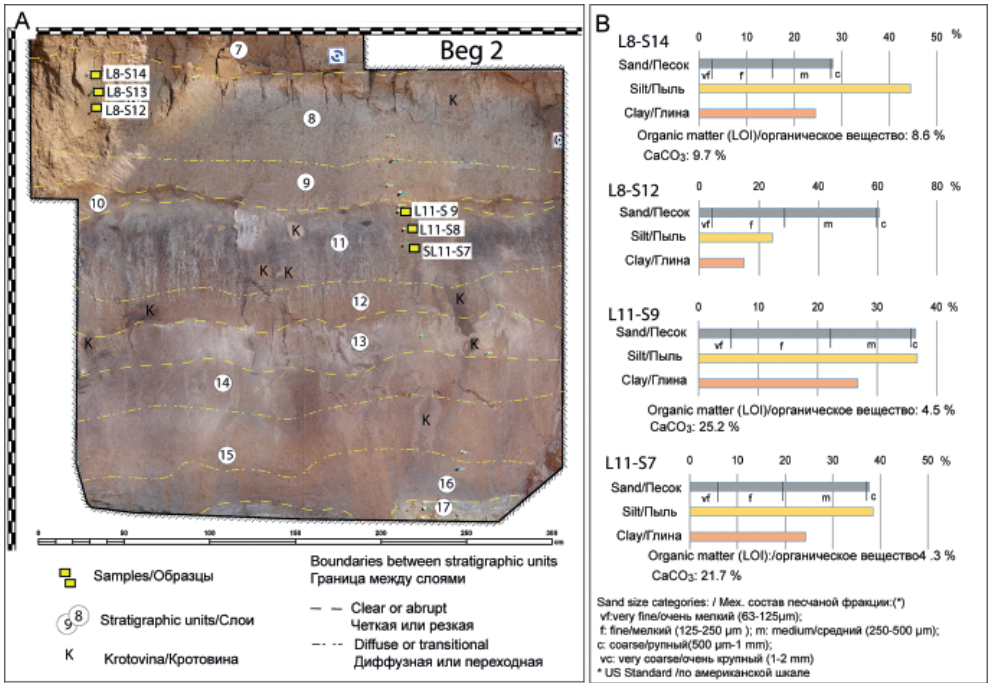

Fig. 4. Stratigraphic section Beg 2
Рис. 4. Стратиграфический профиль Бег. 2

of unit 8 (fig. 3). AMS dates for this feature are c. 47 000 yr BP or earlier, indicating relatively early human presence in the region. Unit 8 corresponds to a soil horizon (AC) developed on alluvial deposits. Although most stratigraphic units seem to appear in section Beg 1, most of them are heavily disturbed by cryogenic and biogenic processes, particularly those below unit 8.

Section Beg-2 offers a better exposure of stratigraphic units for detailed description and sampling for various sedimentological and palaeobotanical analyses (fig. 4). However, although it is less affected by krotovinas, some layers were partially removed by erosion, as is the case of unit 10. Multiple samples were taken from stratigraphic units 5 to 17, but at this moment only selected samples from units 8 and 11 have been processed and tested for pollen and phytoliths.

Section Beg 3 is located towards the north end of the bluff (fig. 5 A). Although not relevant to the archaeological finds associated with Unit 8, it is important in terms of its relation with the Terminal Paleolithic-Mesolithic finds previously studied at Beganchik (Galimova 2001; Galimova et al. 2018). The most relevant aspect to point out here is the abrupt boundary below unit 3 (fig. 5 B), which marks an erosional event forming an incision into the upper terrace.

Pollen and phytoliths

Pollen counts in each of the selected samples from units 8 and 11 at Beg 1 were very low despite the large samples processed (up to 30 grams), which is consistent with low counts in Pleistocene loess sequences, as periglacial vegetation is sparse and pollen preservation is generally poor (Zelikson, 1995). Thus, despite low counts pollen and spore spectra obtained in (Table 1) indicate the general presence and relative abundance of certain groups of taxa.

In the samples of unit 8, pollen of herbaceous taxa (Poaceae, Asteraceae,

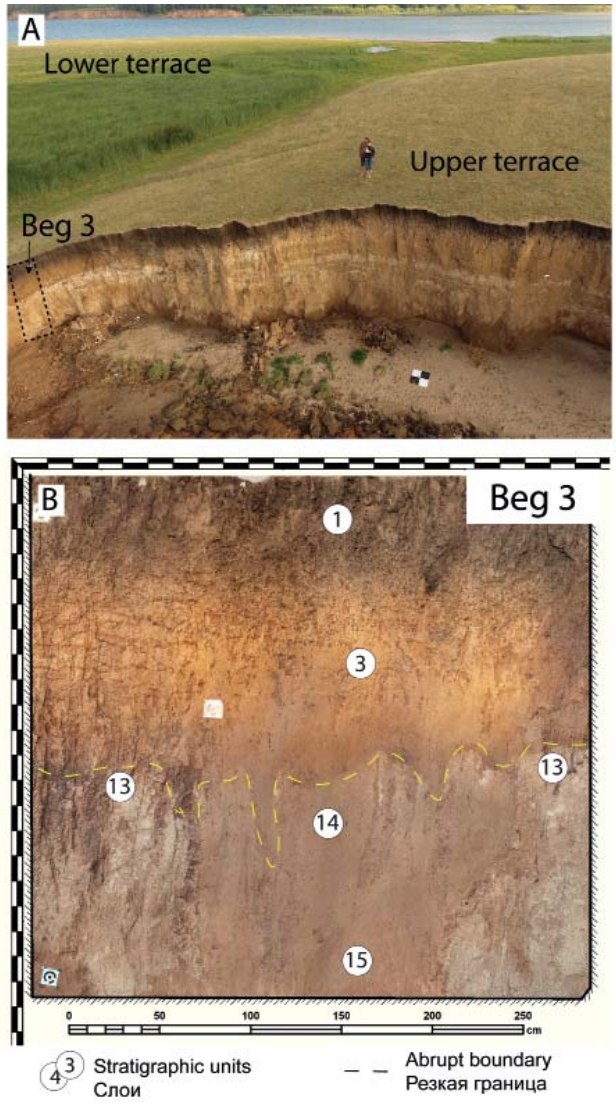

Fig. 5. Stratigraphic section Beg 3. A) Aerial view; B) Section
Рис. 5. Стратиграфический профиль Бег. 3. A) Вид с воздуха; B) Разрез

Artemisia, and Cyperaceae) dominate, pollen of few aquatics (*Potamogeton* and Nymphaceae) seem to suggest a local or nearby wetland. In the only sample of unit 11, pollen herbaceous plants seem to dominate, especially Poaceae (grasses) and Asteraceae. In all four samples, hardwood pollen is virtually absent. However, the small amount of pollen makes any reconstruction difficult, but taxa occurrence in all cases suggests a cold dry steppe.

Phytolith assemblages in all samples also suggest the dominance of graminoids (grasses and grasslike plants such as sedges) (fig. 6A). Certain phytolith morphotypes spheroids and epidermal polygonal plates in the assemblage are indicative of woody plants, though not necessarily trees.

In all the samples of Unit 8 tall conical rondels and trapezoidal bilobates (Stipa-type) dominate the assemblages (fig. 6B; fig. 7: 1, 2, 4 and 5), with a

Table 1

Pollen counts from selected samples (see provenience in fig. 4)

Samples:	L8-S14	L8-S13	L8-S12	L11-S8
POLLEN/ПЫЛЬЦА				
Picea	1	1		1
Pinus		3		1
Cuppresaceae		1		1
Betula				1
Poaceae	2	8		6
Cyperaceae		1	2	
Amaranthaceae				1
Caryophyllaceae		2		1
Ranunculaceae				1
Euphorbiaceae	1	1		
Daphne type			2	
Campanulaceae				1
Artemisia	1	3		1
Asteraceae tubuliflorae		4		3
Potamogeton	2			
Nymphaceae			1	1
Undeterminable/Неопределяемая	1	4	2	
SPORES/СПОРЫ				
Bryophytes	2	1	9	24
Monolete spores		1		1
Inaperturate spores		9		3
Cryptogramma	1			3
Other spores/Другие споры			1	3
ASCOSPORES/АСКОСПОРЫ				
Sporormiella	1			1
Sordaria				1
Other fungal spores	10	4	6	2

smaller proportion of long crenates. These grass short-cell morphotypes correspond largely to the Pooideae grass subfamily, a typical taxonomic group of C_3 grasses (Blinnikov 2006; Solomonova et al. 2019). A few saddles appear in the samples, but their round morphology (fig. 7: 3), which suggests that they are not Chloridoideae, but perhaps forms of the Pooideae or the Danthonioideae subfamilies (Cordova, 2013). The abundance of trapezoidal bilobates, rondels, and round saddles over long crenates suggests the strong presence of Stipaeae (a tribe in the Pooideae grass subfamily), but more conclusive statement should be backed up with more data. In addition to a few morphotypes of woody plants, sample L8-12 in Unit 8 has blocky pitted phytoltihs (fig. 6B; fig. 7: 9) that could represent some conifers (Carnelli et al., 2004; An, 2016). Round blocky types and Asteraceae platelets suggest the presence of herbal communities probably associated with Artemisia or other Asteraceae (Blinnikov, 2002). Finally, the abundance of sponge spicules in the samples of unit 8 suggest that the area was often flooded.

With respect to the only sample with significant numbers in Unit 9 (L11-S9) graminoid phytoltihs are dominant, with a noticeable lack of elongates and abundance of acute bulbosus (fig. 6 A). Most of the non-graminoid phytoliths in this sample are irregular types, which are not diagnostic of a particular

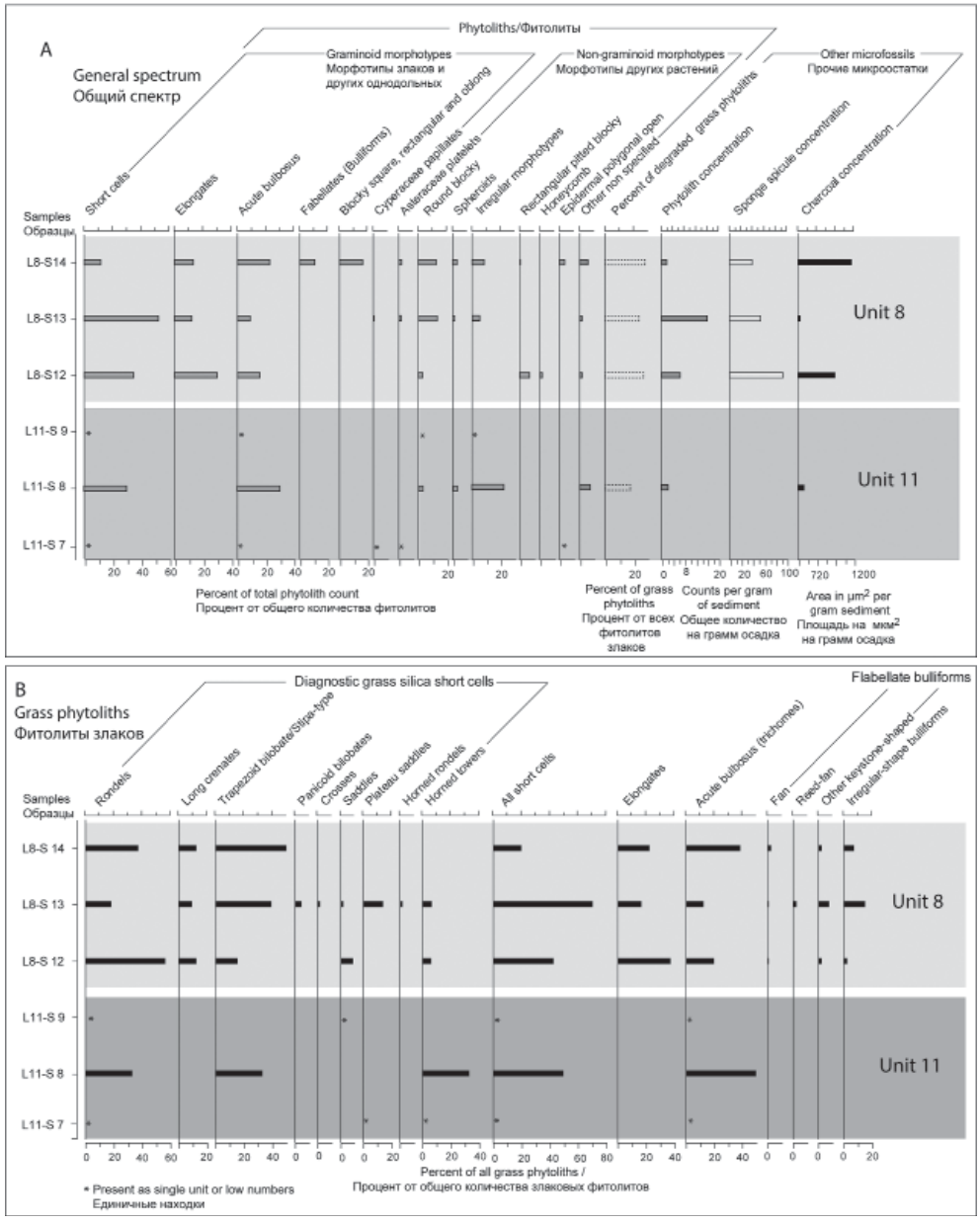

Fig. 6. A) Overview with Summary percentages of phytolith morphotypes and other microfossils; B) Percentages of grass morphotypes. All samples are from section Beg 2

Рис. 6. А) Общая характеристика со сводным процентным содержанием морфотипов фитолитов и других микроостатков; В) Процентное соотношение морфотипов трав. Все образцы из профиля Бег. 2

group. However, a small amount of spheroids suggests the presence of a few woody shrubs in the vegetation around the locality at the time. Domination of conical rondels and trapezoidal bilobates, with almost total absence of long crenates, suggest strong presence of Stipeae grasses. The environment of this soil seems to be terrestrial and dry, as sponge spicules are practically absent.

In summary, pollen and phytoliths from the pedogenic horizons of Units

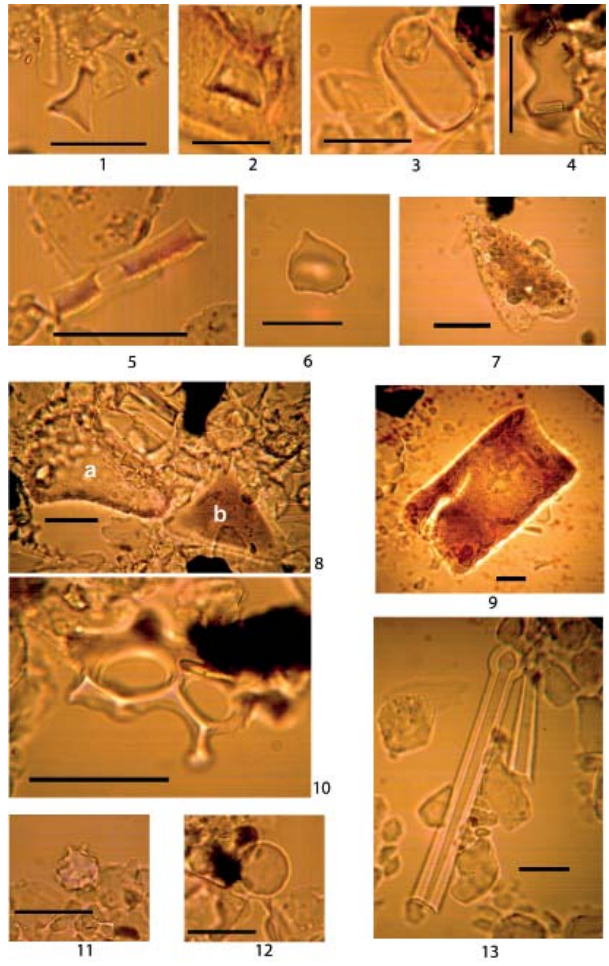

Fig. 7. Images of phytoliths and sponge spicules. Grass short cells: 1–2 – rondels; 3 – saddle; 4–5 – trapezoid bilobate, polar and distal view, respectively; 6 – Cyperaceae undecorated papillate; 7 – acute bulbosus (trichome) with long base and short awn, 8: a – flabellate bulliform (fan-shaped), b – triangular acute bulbosus; 9 – rectangular pitted blocky; 10 – epidermal polygonal open; 11 – spheroid ornate; 12 – spheroid psilate; 13 – sponge spicules. All images are from sample L8-S14 except 2 and 5, which are from sample L11-S9.

Рис. 7. Фотографии фитолитов и спикул губок. Короткие клетки злаков: 1–2 – усеченно-конические (рондели); 3 – седловидные; 4–5 – трапециевидные двулопастные, вид с торца и сверху, соответственно; 6 – фитолиты папилл осок; 7 – трихома с длинным основанием и короткой остью; 8: а – веерообразная пузыревидная клетка, б – треугольная трихома; 9 – параллелепипедная блочная клетка с ямками; 10 – эпидермальная многоугольная клетка; 11 – сфероид с орнаментом; 12 – сфероид гладкий; 13 – спикулы губок. Все фотографии из образца L8-S14, кроме 2 и 5, которые из образца L11-S9.

8 and 11 suggest steppe environments dominated by C_3 grasses (cold-adapted), with Cyperaceae, Artemisia, and a few shrubs. Conifers may be present in some areas, but not abundant. Nonetheless, in both cases the reconstructed environment points to steppe with sparse shrubs.

Objects of archaeological significance and radiocarbon dates

In addition to the conspicuous Terminal Paleolithic-Mesolithic occupations in units 2 and 3, the findings of unit 8 are worth mentioning. They include remains of hearths (fig. 3), a

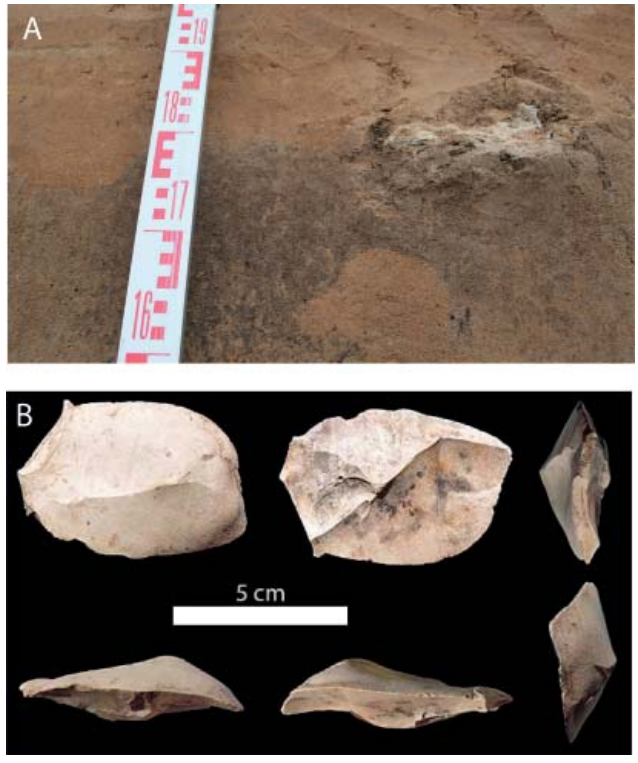

Fig. 8. A) Fragment of a tusk partially embedded on the top of Unit 8 at a locality north of Beg-2 (see fig. 2). B) Silicifi ed limestone chip collected from unit 8 south of Beg-2

Рис. 8. А) Фрагмент бивня, частично врезанный в верхнюю часть блока 8 на участке к северу от Бег-2 (см. рис. 2). В) Крошка силикатированного известняка, собранная на блоке 8 к югу от Бег-2

tusk fragment (fig. 8A) found during our 2017 season, and a lithic artifact (fig. 8B) found during our 2018 field season. Unfortunately, the exact location of the artifact could not be placed on the diagram (fig. 2) because it was off the area covered by it further south.

The hearths comprise an accumulation of charcoal concentrated into two areas (fig. 3). The horizontal extension is approximately 70 to 80 cm and no more than 10 cm thick. One of the AMS dates from charcoal yielded an age of 45 889 AMS ^{14}C years BP, and a second an age larger than 48 600 AMS ^{14}C years BP. The calibration obtained using the OxCal v.4.2.4 curve (Ramsey, 2009) provided a date of 45 528 cal BC (95%), which corresponds to 47 478 cal years BP.

At 10 meters north of Beg-2 a fragment of a tusk was found partially immersed on top of Unit 8 (fig. 8A). Although it has not been possible to recover the tusk fragment due to its fragility and subsequent collapse of the section, it indicates the presence of mammoths at the time of the time of the alluvial deposit stratigraphically correlative with the hearths.

The lithic artifact found at the same level is a chip of silicified limestone (fig. 8 B). Although it lacks definite features proving that it is an artifact (although a platform seems to be present, systematic negative scars are absent and the ventral face has a ridge rather than being smooth), no natural occurrences of this raw material or its natural fragments have been found

over 35 years of research at the site. Furthermore, artifacts previously found at the site are made with the same raw material. In addition, there are signs of what seems to be use-related damage on both edges of the chip (Madina Sh. Galimova, personal communication).

Discussion

Stratigraphy and correlation

Given the radiocarbon age produced from charcoal in the hearths, the soil horizon of unit 8 falls within the early MIS 3, which is consistent with the assignation to the MIS 3 IIIe soil by Galimova et al. (2021). In the regional stratigraphic framework of the Russian Plain, the MIS 3 encompasses several loess units and the Bryansk Paleosol (Bolikhovskaya, Molodkov 2006; Velichko et al., 2006; Panin et al. 2021). The Bryansk Paleosol seems to be absent in our sections of the Beganchik locality, although Galimova et al. (2021) assign it to a layer equivalent to our nits 5 and 6 (see fig. 2), which sandy loam and loam deposits heavily disturbed by cryogenic processes.

The radiocarbon dates of the soil horizon in unit 8 seem to correlate with contemporaneous paleosols in some localities in the Russian Plain. The Ag soil horizon in the Volga River Delta (Akhtuba locality) bracketed with OSL (optically stimulated luminescence) dates between ca. 51 000 and 42 000 years BP (Taratunina et al., 2021). Likewise, at the Alexandrovsky Quarry in the Central Russian Plain, the Alexandrov Paleosol is bracketed by OSL dates between 53 000 and 43 000 years BP (Sycheva et al., 2020). In some localities in the upper Volga region unnamed soil horizons have also been bracketed to times between the Mezin Pedocomplex and the Bryansk Paleosol (Sedov et al., 2016). The absolute and relative dates of these horizons correlate with the Krasnogorsk Interstadial, a relatively warmer stage in the Russian Plain coincident with the Moershoofd interstadial of Western Europe (see Vishnyatsky, Nehoroshev 2004). The interstadial corresponds only to the Greenland Interstadial 13 (G13) (Van Meerbeek et al., 2011). However, the age range of paleosols of the Krasnogorsk interstadial (roughly 53 000-42 000 years BP) encompass three closely occurring Greenland interstadial G14 (Svensson et al., 2008). Pollen spectra of deposits coincident with the Krasnogorsk Interstadial in various parts of the middle Russian Plain suggest steppes and woodland steppes (Bolikhovskaya, Molodkov 2006). Concurrently, despite being a small sample, pollen and phytoliths from Unit 8 support the presence of a steppe environment.

As for the conspicuous A horizon in unit 11, we first considered the Salyn/Mikulino paleosol. Galimova et al. (2021) assign it to the Mezin Pedocomplex, although it is not clear in their stratigraphic sequence in what part of the pedocomplex the soil is, the Krutitsa Paleosol (MIS 5a) or the Salyn/Mikulino paleosol (MIS 5e). Our data from Beg 2 suggests that the paelosol has relatively poor development (Cambisol or Inceptisol) with relatively low content of organic matter, and a poorly developed B horizon. In contrast, descriptions of the Salyn-Mikulino (MIS 5e) paleosols in the Russian Plain have high content of organics in their A horizon, well-developed B and E (albic) horizons (see examples in Yakimenko, 1995; Sedov et al,. 2016; Panin et al., 2021). Furthermore, pollen and phytoliths, as well as the traces of a root system show that it is probably a steppe or woodland steppe soil. Therefore, our proposal is that the paleosol in Unit 8 should correspond more to the conditions of the formation of the Krutitsa Paleosol, which is developed under steppe or open woodland vegetation (Bolikhovskaya, Molodkov 2006). The possibility that the Krutitsa and Salyn paleosols are welded together in the Beganchik section, should

not be discarded, but it requires careful stratigraphic research.

Occupations in early MIS 3

The discovery of human presence as early as 47 000 BP in Beganchik and their correlative layers at the Komintern appears as a rare occurrence, but it correlates with other finds in the broader realm of the Russian Plain (Vyshyatsky, Nehoroshev 2004; Otcherednoy et al., 2019). Evidence of human presence, deemed to be the transition from Middle to Early Upper Paleolithic, appears in other parts of the Russian Plain, though no higher than the latitude 52º N (Vishnyatsky, Nehoroshev 2004). Beganchik is barely above 55 º N, which makes this finding an extreme one for the period in question without diagnostic lithic material.

Although the lithic artifact and the bone could be judged to be rolled into this locality by fluvial action, the particle size dominated by clay, silt, and fine sand in unit 8 indicate a low energy environment unable to carry a rock the size of the chip (fig. 8 B). Even if that was possible, there seems to be no exposure of silicified limestone anywhere in the vicinity (Madina Sh. Galimova, personal communication).

Conclusion

The stratigraphic analysis of the sediment exposure at Beganchik supports the conclusions of previous research at the Beganchik and Komintern localities in that the artifacts from unit 8 are dated to the early MIS 3. Although very sparse, the presence of a dated hearths (c. 47 000 years BP), faunal remains, and lithics on an alluvial soil horizon suggests that populations of humans were present in the lower Kama and Middle Volga Region during the Kransogorsk Interstadial. The fragments of bone, tusk and lithics, which are lying on top of the pedogenic horizon of unit 8, could not have been transported by the low energy; they were most likely brought in by humans. The paleosol of Unit 11 in the possible age of the Mezin Pedocomplex (MIS 5), though lack of absolute dates do not permit to assert the exact paleosol (Krutitsa or Salyn). Finally, our study confirms that the colluvial deposit of unit 3 at the time it was mixed with lithics of the Ust-Kamskaya culture (Terminal Paleolithic-Mesolithic) eroded from older layers bearing bones of megafauna that had already disappeared from the area, and that deposition of units 2 and 3 may be synchronous.

REFERENCES

1. An, X.H. 2016. Morphological characteristics of phytoliths from representative conifers in China. In *Palaeoworld* 25, 116–127.
2. Blinnikov, M., Busacca, A. and Whitlock, C. 2002. Reconstruction of the late Pleistocene grassland of the Columbia basin, Washington, USA, based on phytolith records in loess. In *Palaeogeography, Palaeoclimatology, Palaeoecology* 177 (1–2), 77–101.
3. Bolikhovskaya, N.S. Molodkov, A.N. 2006. East European loess–palaeosol sequences: Palynology, stratigraphy and correlation. In *Quaternary International* 149(1), 24–36.
4. Carnelli, A.L., Theurillat, J.P., Madella, M. 2004. Phytolith types and type-frequencies in subalpine–alpine plant species of the European Alps. *Review of Palaeobotany and Palynology* 129 (1-2), 39-65.
5. Cordova, C.E. 2013. C_3 Poaceae and Restionaceae phytoliths as potential proxies for reconstructing winter rainfall in South Africa. In *Quaternary International* 287, 121–140.
6. Galimova, M.Sh., Berezina, N.S., Berezin, A. Yu. 2018. Terminal Paleolithic Beganchik site at the mouth of the Kama. (Research results of 2013). In *Povozhskaya Arkheologiya* 3 (25), 8–29 (in Russian).
7. Galimova M.Sh., Berezin A.Yu., Berezina N.S., Mikhailov E.P. 2021. Stone Age and paleontological site near the village of Komintern: Researsch results of 2020. In *Arkheologiya Evraziyskikh stepey* 1, 262–279 (in Russian).
8. Kazakov, E. P. 2011. *Sites of the Stone Age in the Trans-Kama Area*. Series: Arkheologiia Povolzhia i Urala. Materialy i issledovaniia (Volga and the Urals Archaeology. Materials and Studies) 1. Kazan: "Foliant" Publ. (in Russian).

9. Khisyametdinova, A.A. 2013. Preliminary analysis of the geological and geomorphological structure of the sites Beganchik and Izmeri I (Palaeolithic). Appendix No 2. In Lyganov, A. V. Report on archaeological exploration in Alekseevsky, Spassky, Menzelinsky and Rybno-Slobodsky disrtricts of Tatarstan Republic in 2012. Kazan, 2013. Archive of Institute of Archaeology Russian Academy of Sciences (in Russian).

10. Otcherednoy, A.K., Voskresenskaya, E.V., Stepanova, K.N., Vishnyatsky, L.B., Nehoroshev, P.E., Kolesnik, A.V., Zaretskaya, N.E., Larionova, A.V., Blochin, E.K. 2019. Etudes géoarchéologiques pluridisciplinaires des sites du Paléolithique moyen de la Plaine Russe. In *L'Anthropologie* 123(2), 310–318 (in French).

11. Panin, P.G., Filippova, K.G., Bukhonov, A.V., Karpukhina, N.V., Kalinin, P.I., Ruchkin, M.V., 2021. High-resolution analysis of the Likhvin loess-paleosol sequence (the central part of the East European Plain, Russia). In *Catena* 205. DOI: https://doi.org/10.1016/j.catena.2021.105445

12. Ramsey, C.B. 2009. Bayesian analysis of radiocarbon dates. In *Radiocarbon* 51(1), 337–360.

13. Reimer, P.J., Bard, E., Bayliss, A., Beck, J.W., Blackwell, P.G., Ramsey, C.B., Buck, C.E., Cheng, H., Edwards, R.L., Friedrich, M. Grootes, P.M. 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. In *Radiocarbon* 55(4), 1869–1887.

14. Sedov, S., Rusakov, A., Sheinkman, V., Korkka, M., 2016. MIS3 paleosols in the center-north of Eastern Europe and Western Siberia: Reductomorphic pedogenesis conditioned by permafrost? In *Catena*, *146*, 38–47. DOI: https://doi.org/10.1016/j.catena.2016.03.022

15. Sidorchuk, A., Borisova, O. and Panin, A., 2001. Fluvial response to the Late Valdai/Holocene environmental change on the East European Plain. In *Global and Planetary Change* 28 (1–4), 303–318.

16. Solomonova, M.Y., Blinnikov, M.S., Silantyeva, M.M., Speranskaja, N.Y. 2019. Influence of moisture and temperature regimes on the phytolith assemblage composition of mountain ecosystems of the mid latitudes: a case study from the Altay Mountains. In *Frontiers in Ecology and Evolution* 7. DOI: https://doi.org/10.3389/fevo.2019.00002

17. Starostin P.N. (ed.) 1986. *Archaeological map of the Tatar ASSR. The Western Trans-Kama region*. Part 1. Kazan: IYaLI KFAN SSSR (in Russian)

18. Svensson, A., Andersen, K.K., Bigler, M., Clausen, H.B., Dahl-Jensen, D., Davies, S.M., Johnsen, S.J., Muscheler, R., Parrenin, F., Rasmussen, S.O., Roethlisberger, R. 2008. A 60 000 year Greenland stratigraphic ice core chronology. In *Climate of the Past* 4(1), 47-57.

19. Sycheva, S., Frechen, M., Terhorst, B., Sedov, S., Khokhlova, O. 2020. Pedostratigraphy and chronology of the Late Pleistocene for the extra glacial area in the Central Russian Upland (reference section Aleksandrov quarry). In *Catena*, 194. DOI: https://doi.org/10.1016/j.catena.2020.104689

20. Taratunina, N., Rogov, V., Streletskaya, I., Thompson, W., Kurchatova, A., Yanina, T. Kurbanov, R. 2021. Late Pleistocene cryogenesis features of a loess-paleosol sequence in the Srednyaya Akhtuba reference section, Lower Volga river Valley, Russia. In *Quaternary International* 590, 56–72.

21. Van Meerbeeck, C.J., Renssen, H., Roche, D.M., Wohlfarth, B., Bohncke, S.J.P., Bos, J.A.A., Engels, S., Helmens, K.F., Sánchez-Goñi, M.F., Svensson, A. and Vandenberghe, J., 2011. The nature of MIS 3 stadial–interstadial transitions in Europe: new insights from model–data comparisons. In *Quaternary Science Reviews* 30 (25-26), 3618-3637.

22. Velichko, A.A., Morozova, T.D., Nechaev, V.P., Rutter, N.W., Dlusskii, K.G., Little, E.C., Catto, N.R., Semenov, V.V., Evans, M.E., 2006. Loess/paleosol/cryogenic formation and structure near the northern limit of loess deposition, East European Plain, Russia. In *Quaternary International* 152, 14–30.

23. Vishnyatsky, L.B., Nehoroshev, P.E., 2004. The Beginning of the Upper Paleolithic on the Russian Plain. In Bratntingham, P.J., Kuhn, S.L., Kerry, K.W (eds.), *The Early Upper Paleolithic Beyond Western Europe*. Berkeley, University of California Press, 80-96.

24. Yakimenko, E.Y. 1995. Pleistocene paleosols in the loess and loess-like sediments of the central part of the Russian Plain. In *Quaternary Science Reviews* 14(7-8), 747–753.

25. Zelikson, E.M. 1995. Methodology of loess palynology. In *GeoJournal 36*(2-3), 223–228.

About the Authors:

Cordova Carlos E. PhD, Department of Geography, Oklahoma State University. Stillwater, OK 74078, USA. carlos.cordova@okstate.edu

Vyazov Leonid A. Candidate of Historical Sciences. Kazan (Volga Region) Federal University. Kremlyovskaya str., 18, Kazan, 420000, the Republic of Tatarstan, Russian Federation; l.a.vyazov@gmail.com

Blinnikov Mikhail S. PhD, professor. St. Cloud State University. 720 4th Ave S, St Cloud, MN 56301, USA; msblinnikov@stcloudstate.edu

Ponomarenko Elena V. Candidate of Biological Sciences. Adjunct Professor, Geography Faculty, Ottawa University. Simard Hall, 60 University, Ottawa ON Canada K1N 6N5; ecosystemarchaeology@gmail.com

Ponomarenko Dmitry S. Paleontological Institute, Russian Academy of Science (Moscow, Russian Federation); zemleroi@gmail.com

Sitdikov Airat G. TAS Corresponding Member. Doctor of Historical Sciences. Institute of Archaeology named after A. Kh. Khalikov, Tatarstan Academy of Sciences. Butlerov Str., 30, Kazan, 420012, the Republic of Tatarstan, Russian Federation; Professor. Kazan (Volga Region) Federal University. Kremlyovskaya St., 18, Kazan, 420000, the Republic of Tatarstan, Russian Federation; sitdikov_a@mail.ru

Salova Yulia A. Kazan (Volga Region) Federal University. Kremlyovskaya str., 18, Kazan, 420000, the Republic of Tatarstan, Russian Federation; yadviga13@yandex.ru

СТРАТИГРАФИЯ И ПАЛЕОЛИТИЧЕСКИЕ ЛАНДШАФТЫ СТОЯНКИ БЕГАНЧИК У СЛИЯНИЯ РЕК КАМЫ И ВОЛГИ

К.Э. Кордова, Л.А. Вязов, Е.В. Пономаренко, М.С. Блинников, Д.С. Пономаренко, А.Г. Ситдиков, Ю.А. Салова

Местонахождение Беганчик представляет собой стратиграфическую последовательность лессовых отложений, горизонтов почвообразования и слоев обитания эпохи палеолита, расположенных в месте впадения Камы в Волгу. Толща отложений обнажена на обрыве, образованном на западной стороне эрозионного останца между Куйбышевским водохранилищем и бывшим руслом реки Актай. Несмотря на то, что это место известно в первую очередь стоянками финального палеолита-мезолита, в ходе исследований были обнаружены также свидетельства более древнего заселения и остатки фауны. Исследовательская группа авторов выявила свидетельства присутствия человека, связанные с почвенным горизонтом возраста MIS 3. Две радиоуглеродных датировки методом AMS из очага дали возраст около 47 000 лет назад. Пыльца и фитолиты из двух горизонтов почв, включая связанный с очагами, указывают на степной ландшафт, что совпадает с формированием соответствующих почв в других местах Русской равнины.

Ключевые слова: археология, палеолит, перигляциальные отложения, палеопочвы, пыльца, фитолиты.

Информация об авторах:

Карлос Э. Кордова, доктор философии, профессор. Кафедра географии, Оклахомский государственный университет (г. Стиллуотер, Оклахома, США); carlos.cordova@okstate.edu

Вязов Леонид Александрович, кандидат исторических наук, доцент, Казанский (Приволжский) федеральный университет (г. Казань, Россия); l.a.vyazov@gmail.com

Блинников Михаил Сергеевич, PhD, профессор. Государственный университет Сент-Клауда (г. Сент-Клауд, США); msblinnikov@stcloudstate.edu

Пономаренко Елена Викторовна, кандидат биологических наук, адъюнкт-профессор, факультет географии, Оттавский университет (г. Оттава, Канада); ecosystemarchaeology@gmail.com

Пономаренко Дмитрий Сергеевич, младший научный сотрудник, Палеонтологический институт им. А.А. Борисяка РАН (г. Москва, Россия); zemleroi@gmail.com

Ситдиков Айрат Габитович, чл.-корр. АН РТ, доктор исторических наук, директор, Институт археологии им. А.Х. Халикова АН РТ; зав. кафедрой, профессор, декан Высшей школы исторических наук и Всемирного культурного наследия, Казанский (Приволжский) федеральный университет (г. Казань, Россия); sitdikov_a@mail.ru

Салова Юлия Анатольевна, Казанский (Приволжский) федеральный университет (г. Казань, Россия); yadviga13@yandex.ru

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