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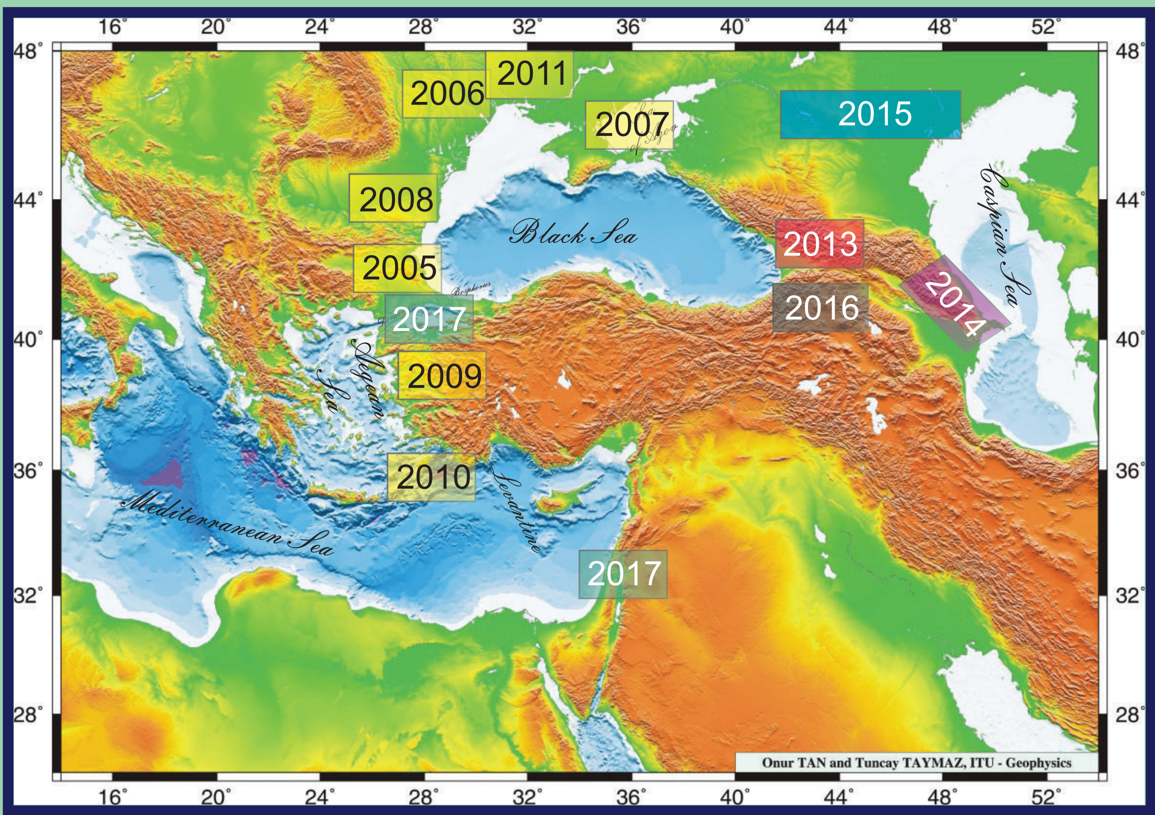

Proceedings of the Fourth Plenary Conference

IGCP 610 “From the Caspian to Mediterranean: Environmental Change and Human Response during the Quaternary” (2013 - 2017)

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IGCP 610 Fourth Plenary Conference and Field Trip, Tbilisi, Georgia, 2-9 October 2016

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NEW RESULTS ON STRUCTURE OF THE SREDNYAYA AKHTUBA REFERENCE SECTION

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Introduction

The Lower Volga is a unique region for understanding the history of the Caspian Sea in the Pleistocene as well as the correlation of its paleogeographic events with glacial-interglacial rhythms of the East European Plain and the global and regional climate changes. The reason is the representativeness of the Quaternary sections, their completeness, the presence of both marine and subaerial sediments, the paleontological richness of the materials, and their availability for study. The purpose of this work is to reconstruct the paleogeographic events in the Late Pleistocene of the Lower Volga region on the basis of a summary study of the Srednyaya Akhtuba reference section. This section was selected as a reference for research because it most fully reflects the events of the late Pleistocene.

Study region and methodology

Located near the city of Volgograd, at the Khvalynian plain 1 km above the bridge across the Akhtuba River (48.7005277 N, 44.89330709 E, altitude 16 m), the natural outcrop reveals a series of exposures unique to the region: a series of marine Caspian continental deposits with four levels of buried soil horizons and loess. The results were obtained during 2015 and 2016 by a complex field research program by a group of specialists from MSU, Saint-Petersburg University, and the Institute of Geography in the Lower Volga. Application of lithological, paleopedological, paleontological, paleocryological, OSL-dating, and paleomagnetic methods allowed a more fundamental approach to the chronological assessment of individual horizons.

Results

The Srednyaya Akhtuba section (Fig. 1, left chart) in its upper part is represented by modern soil, developed on subaerial post-Khvalynian (Holocene) sediments of sandy loam (layers 1-2), which received the "control" dating age of 720 ± 70 years.

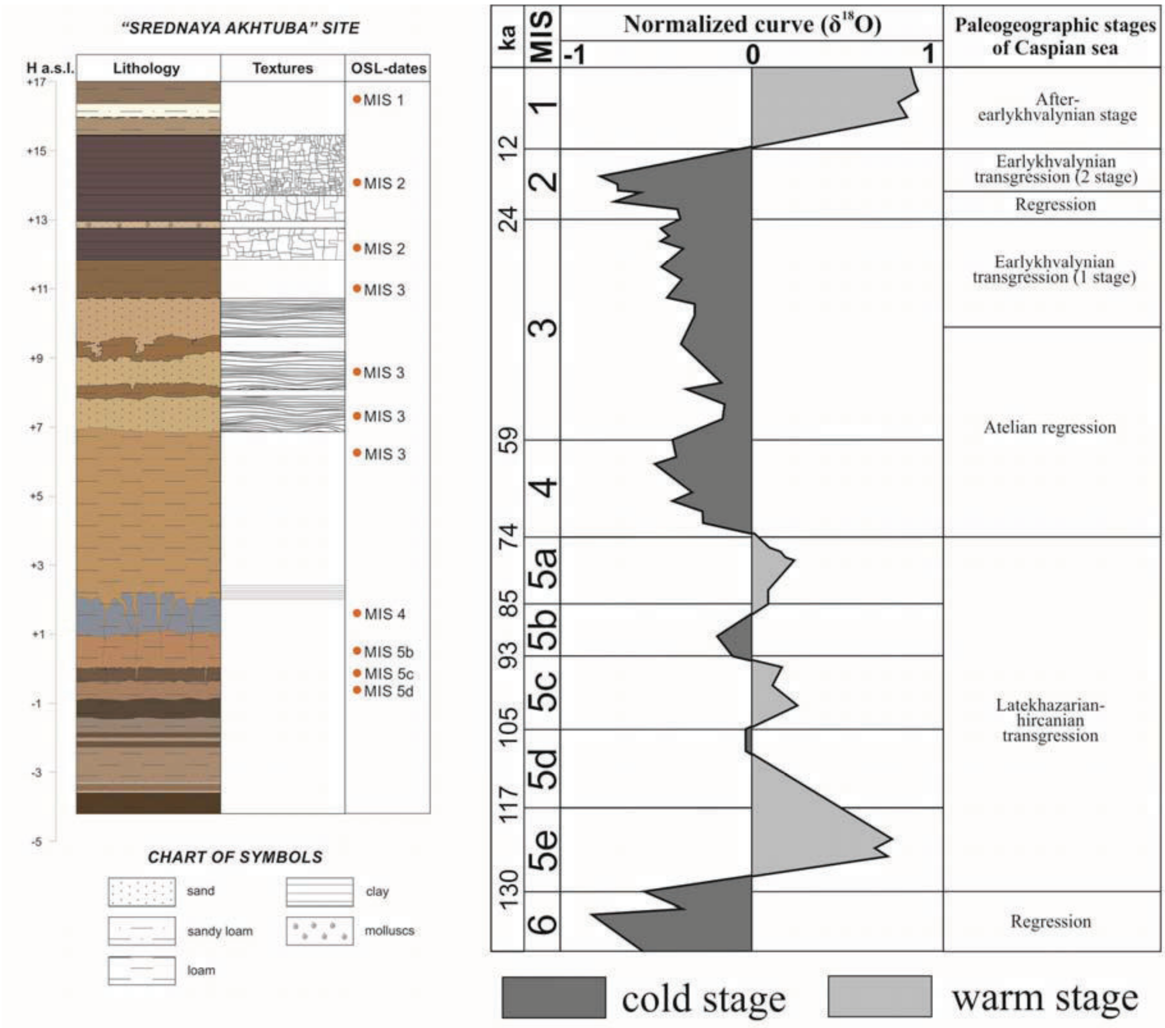

Figure 1. Srednyaya Akhtuba section and correlation of OSL-ages with MIS-stages.

Beneath them lies a thick deposit (layers 3-7) of Caspian Lower Khvalynian sediments: a layer of sandy loam, dark beige, horizontal stratification, with a smooth lithologically clear lower boundary (layer 3); two layers of chocolate clays horizontally layered on the top of each other: layer 4 of 0.75 m with small prismatic structure, thin layers (0.5 to 3 cm) of a beige-gray sand, and layer 5 of 0.95 m consisting of a solid structure in the bottom with a large prismatic texture (dating yielded 13,000 ± 500 years). Under the chocolate clays lies a layer of sand, 0.45 m in thickness, which includes numerous mollusk shells of Early Khvalynian *Didacna protracta*, *D. ebersini*, *Dreissena rostriformis*, and *Dr. polymorpha* (layer 6). The sands are underlain by another layer of chocolate clays, 0.9 m (layer 7) dated at 15,000 ± 1000 years.

Below a sharp boundary lies the formation of different facies (fluvial and subaerial genesis): sands and loams (layers 8-13) representing the Atelian stage in the stratigraphic scheme of the Caspian region (Fig. 1, right chart). Sediments of this formation represent a continental stage of development of the territory. The upper part is represented by a layer (0.5 m) of dense non-layered loam, uniformly lightly beige colored, forming a vertical wall (layer 8). Then, there is a sand layer, fine-grained, well-sorted, uniform beige color, with no clear stratification due to coarser sand layers, with calcareous inclusions and manganese smears (traces of soil formation process) showing a total thickness of 1.40 m (layer 9). Deposits of the top of the layer were dated to 27,000 ± 1580 years. Beneath this is a sand layer (0.40 m) with yellow-brown fine-grained streaks and lenses of light gray, with single manganese smears and a clear undulating lower boundary (layer 10). The sand is dated to 35,500 ± 2,800 years. Below that is a dense sand, small- and medium-grained, yellow-beige colored, with a total thickness of 1.45 m (layer 11) and dated to 36,780 ± 3000 years. The lower boundary is lithologically sharp. The stratum of sands is underlain by two layers of loess-like loam with columnar structure, forming vertical walls in the section. The top layer (12), 0.20 m, abounds in manganese smears and Calcium sulfate inclusions, dated 48,680 ± 3100 years. It passes into a thick (3.5 m) layer of sandy loam of uniform light brown color, with a few smears of manganese and gypsum inclusions (layer 13). The lower limit is irregular, with sediment penetrating into the underlying layers through deep wedges, cracks, and streaks.

Below, the section is represented by three clearly defined paleosols (see Makeev et al. in this volume). The upper soil horizon (layer 14) is represented by a dense loam gray-bluish in color, with nutty and fine comminuted structure, cryogenic cracks and wedges filled with syngenetic Atelian sandy loam (layer 13). The total thickness is from 0.7 to 1.0 m. The boundary limit is irregular with deep streaks in the underlying layer. The layers are dated to 68,280 ± 4170 years. The first paleosol is separated from the second one by a sandy loam loess layer (layer 15) with a thickness of about 0.7 m, mottled gray-brown color, with rusty spots and streaks, and dated to 87,620 ± 4100 years. The second soil horizon (layer 16) is characterized by a date of 102,500 ± 5160 years in age.

These soils are underlain by sediments (layer 17) of a shallow basin with calm (perhaps stagnant) sedimentation conditions (0.75 m); the result of dating yielded 112,630 ± 5400 years. Here lies another distinct paleosol horizon with a total thickness of 0.4 m (layer 18), represented by a dense loam with lumpy structure, dark gray and reddish-brown in color, with small calcareous concretions. The lower boundary is lithologically accurate, irregular. The underlying layer (0.3 m) is represented by a sandy loess-like loam of gray-brown color (layer 19). The lower boundary is slightly undulating and quite clear. At the base of the section, we identify estuary basin type deposits (layers 20-22) with an unstable level.

Conclusions

The structure of the Srednyaya Akhtuba reference section reflects a number of paleogeographic stages of development within the study area. The oldest phase (layers 22-19) is not characterized by OSL dating or faunal material. Based on the sequence of dated layers, we assume it is Middle Pleistocene in age (MIS 6 stage), corresponding to the Moscow stage of the Dnieper glaciation of the East European Plain and the final stage of the Early Khazarian transgressive era of Caspian Sea.

The next stage (layers 18-14), represented by three horizons of paleosols, refers to the first half of the Late Pleistocene (MIS 5). An epoch of soil formation, based on the results the OSL-dating, can be referred to the warm sub-stages (MIS 5c and 5a), and the climatically unstable transitional phase from the Mikulino (Eemian) interglacial to the the Valdai glaciation. The lower soil horizon that has no dating, logically refers to the maximum warm era of the Mikulino interglacial (MIS 5e). In the history of Caspian Sea, this era corresponded to the Late Khazarian transgressive-regressive stage (MIS 5): the Late Khazarian minor transgression (level of about -10 m), characterized by warm water (Yanina, 2014), and the Hirkanian transgression with slightly cool environmental conditions (Yanina et al., 2014). Both transgressive basins did not reach the latitude of Srednyaya Akhtuba.

The continuous stage of continental development of the territory, reflected in the structure of the section (layers 13-8), in the stratigraphic scheme of the Caspian region refers to the Atelian formation, situated between the Late Khazarian and Khvalynian transgressive epochs of the basin. Different facies complexes (layers 11-9) of alluvial deposits of the section reflect the stage of initial development of the Khvalynian transgression of the Caspian Sea—the accumulation of alluvial strata in raising erosion basis conditions. Climatically, it corresponds to the interstadial Inter-Valdai warming era (MIS 3).

The Late Pleistocene continental development stage ends with a phase of accumulation of loess sandy loam (layer 8). Obviously, it correlates with the last glacial maximum (MIS 2), a dry cold era, conditions of which were not conducive to the development of the Caspian transgression—it was a regressive (Eltonskaya regression?) stage (Yanina, 2014).

Thus, the continental Atelian era of the upper (Volgograd) area of the Lower Volga region reflects three distinct paleogeographic events in Caspian Sea history: (1) the Atelian Caspian regression under conditions of the Kalinin glaciation (MIS 4); (2) the initial stage of the Khvalynian transgression under conditions of interstadial warming (MIS 3); and (3) a regression corresponding to the Ostashkovski glaciation (MIS 2). This sedimentary complex represents the Atelian formation in the stratigraphic scheme of the Caspian region, the amount of which is beyond the scope of the same name Atelian regression (Yanina, 2012).

The "marine" stage of the area's development is expressed in the Khvalynian complex (layers 7-3), corresponding to the Early Khvalynian transgression of the Caspian Sea. The chocolate clays are interbedded with sands containing numerous shells of mollusks: *Didacna protracta*, *D. ebersini*, *Dreissena rostriformis*, and *Dr. polymorpha*. OSL dates on the chocolate clays (15,000 ± 1000 and 13,000 ± 500 years) testify to their accumulation during the era of the degradation of the Ostashkov glaciation (Chepalyga, 2009). These data are in good agreement with the results of radiocarbon dating of mollusk shells, lying in the sand interlayers within the thickness of the chocolate clays of the Lower Volga (Arslanov et al., 2016), and they are contrary to the thermoluminescence results (Shkatova, 2010).

Acknowledgments

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