

Late Quaternary chronology of paleo-climatic changes in Caspian Sea region based on Lower Volga sections

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Lower Volga is a unique region for understanding the history of the Caspian Sea in the Pleistocene, its correlation of paleogeographic events with glacial-interglacial rhythms of the East European Plain and the global and regional climate changes. The reason is representativeness of Quaternary sections, their completeness, presence of both marine and subaerial sediments, paleontological richness of the materials and available 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 summarizing the study results for the Srednyaya Akhtuba reference section.

Located near city of Volgograd, at Khvaynian plain natural outcrop of Srednyaya Akhtuba section, reveals in a series of exposures a unique to the region series of marine Caspian continental deposits with four levels of buried soil horizons and loess. The results were obtained during 2015 and 2016 complex field research with application of lithological, paleopedological, paleontological, paleocryological, OSL-dating, paleomagnetic methods, that allowed more fundamental approach to the chronological assessment of individual horizons.

The structure of the Srednyaya Akhtuba reference section reflects a number of paleogeographic stages of development of 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 its Middle Pleistocene age (MIS-6 stage), corresponding to Moscow stage of the Dnieper glaciation of the East European Plain and the final stage of 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). Epoch of soil formation, based on the results the OSL-dating, can be referred to the warm sub-stages (MIS 5c and 5a), with unstable climatically transitional phase from Mikulino (Eemian) interglacial to the Valdai glaciation. Lower soil horizon that has no dating, logically refers to the maximum warm era of Mikulino interglacial (MIS 5e). In the history of Caspian Sea this era responded to Late Khazarian transgressive-regressive stage (MIS 5): Late Khazarian minor transgression (level of about -10 m), characterized by warm-water, and the Hirkanian transgression with slightly cool environmental conditions. Both transgressive basins did not reach latitude of Srednyaya Akhtuba.

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 Atelian formation, situated between Late Khazarian and Khvalynian transgressive epochs of the basin. Different facies complex (layers 11-9) of alluvial deposits of the section reflects the stage of initial development stage of Khvalynian transgression of the Caspian Sea - the accumulation of alluvium strata in raising erosion basis conditions, responding to interstadial Inter-Valdai warming era (MIS 3).

Late Pleistocene continental development stage ends with faze of accumulation of loess sandy loam (layer 8). Obviously, it correlates with the last glacial maximum (MIS 2), dry cold era, conditions of which were not conducive to the development of the Caspian transgression - it was regressive (eltonskaya regression?) stage. Thus, the continental Atelian era of the upper (Volgograd) area of the Lower Volga region reflects three distinct paleogeographic events of the Caspian Sea history: 1. Atelian Caspian regression in conditions of Kalinin glaciation (MIS 4); 2. The initial stage of Khvalynian transgression under interstadial warming (MIS 3); 3. Regression, corresponding Ostashkovski glaciation (MIS 2). This sediments complex represents Atelian formation in Caspian region stratigraphic scheme, the amount of which is beyond the scope of the same name regression (Atelian).

"Marine" stage of area development is expressed in Khvalynian complex (layers 7-3), corresponding to Early Khvalynian transgression of the Caspian Sea. This chocolate clays are interbedded with sands containing numerous shells of mollusks: *Didacna protracta*, *D. ebersini*, *Dreissena rostriformis*, *Dr. polymorpha*. OSL dates of chocolate clays (15000 ± 1000 and 13000 ± 500 years) testify their accumulation in the era of Ostashkov glaciation degradation. These data are in good agreement with the results of radiocarbon dating of mollusk shells, lying in the sand interlayers in the thickness of chocolate clays of Lower Volga [Arslanov et al., 2016], and they are

contrary to the thermoluminescence results [Shahovets 1987]
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