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Lower Volga loess-paleosol sequences

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Paleogeographic development of the Caspian Sea in the Late Pleisocene is characterized by alternation of transgressive and regressive stages. Unlike transgressive periods, the paleogeographical environment during regressive periods is less understood. The main reason is the lack of paleontological and paleobotanical remains (fauna and pollen) in continental deposits of various genesis. The longest period of a Caspian Sea low level stand in the Late Pleistocene is the Atelian regression. During this period a thick sequence of continental deposits was formed. This formation is widespread within the Northern Caspian Depression and represented by subaqueous and subaerial deposits, including alluvial and aeolian. In the southern part of Lower Volga most of this strata is eroded by more active abrasion during Caspian Sea minor transgressions of Hyrkanian time and the first part of Khvalynian period. But in the north, in the series of sections around the Volgograd city, Atelian strata reach up to 10-12 m in thickness. In this area continental sedimentation was longer, the abrasion during the high-stand of Early Khvalynian transgression was relatively small (~1-3 m, depending on the

geomorphological position) due to very rapid sea-level rise in a short time (Kurbanov et al., 2018). Four sections reveal the structure of Atelian formation: Srednyaya Akhtuba, Leninsk and Batayevka on the left side of the Volga valley and Raygorod on the right side. The general stratigraphy of Atelian formation in these four outcrops differs. The existing stratigraphical framework is based on new series of luminescence dating results (Kurbanov et al., 2021; Yanina et al., 2017). Srednyaya Akhtuba is characterized by three MIS-5 paleosols and thick horizon of MIS-4 loess. The uppermost soil (MIS-5a) is disturbed by distinct deep wedges, cracks and streaks with sediment penetrating from the covering loess. These cryogenic features clearly illustrate cooling climate conditions of the MIS-4 at Lower Volga and can be easily identified at most of the sections. The upper part of the sequence is represented by alternation of alluvial sand and weakly developed loess horizons with clear traces of pedogenesis in MIS-3, that are also influenced by cryoturbations (Koltringer et al, 2020). Leninsk, located more to the South is characterized by two well-developed paleosols of MIS-5, again with clear frost wedges from the upper thick loess horizon and one level of pedogenesis at the top of MIS-3 stage (the upper part of the soil is eroded). The MIS-5a soil is disturbed by deep cracks filled by loess. At Raygorod section the Atelian strata is based on thick horizon of alluvial sediments (floodplain facies). In these alluvial clays and silts we identified two levels of pedogenesis, represented by highly hydromorphic soils. This stage remains undated, the only idea about the age of the well-developped soil at the base of the section can be obtained from the published results of pollen analysis – that indicates the Likhvin stage (MIS-9) of the Russian plain (Grichuk, 1954). On the top of this layer floodplain facies change to channel facies – clean well-sorted sands, on top of which weakly developed paleosol can be identified. This soil is disturbed by minor wedges – not very clear due to similarity of the lithology with the overlaying sands. The clean loess of MIS-4 stage with 2 layers of slightest evidence of pedogenesis passes to MIS-3 stage loess with pedocomplex containing two paleosols on the top of the sequence. This pedocomplex was partly eroded during Khvalynian transgression. Most developed sequence of Atelian time can be found at the Batayevka location, 100 km to the SE from Leninsk. Batayevka section is located on the left side of the Lower Volga valley opposite to the reference section of Chernyy Yar on the right valley side. In this outcrop we were able to identify three levels of pedogenesis of MIS-3 (in alluvial sands of the upper part of the section), well-developed pedocomplex of MIS-5, containing three combined paleosols, the top one

with permafrost features – cracks and wedges. Important difference of this section is that it contains another three older levels of pedogenesis – of unknown age (probably MIS-7 and MIS-9). The Atelian formation here developed on the alternating lagoon and lacustrine sands and silts. Described stratigraphy and chronology of the loess-paleosol sequence of the Atelian formation allows us to better understand the main stages of environmental evolution of the Lower Volga region and the whole Northern Caspian lowland during the Late Quaternary. Research was supported by the Russian Science Foundation, project 19-77-10077.

Key words: Lower Volga loess, stratigraphy, Atelian regression of the Caspian sea, Late Quaternary.

References

Kurbanov, R., Murray, A., Thompson, W., Svistunov, M., Taratunina, N., Yanina, T. 2021. First reliable chronology for the Early Khvalynian Caspian sea transgression in the Lower Volga River valley. *Boreas 50*, 1, 134–146

Yanina, T. A., Svitoch, A. A., Kurbanov, R. N., Murray, A. S., Tkach, N. T. & Sychev, N. V. 2017: Experience of dating of Pleistocene deposits of the Lower Volga area by method of optically stimulated luminescence. Vestnik Moskovskogo Universiteta, seria Geografiya 1, 21–29 (in Russian).

Koltringer, C., Stevens, T., Brad_ak, B., Almqvist, B., Kurbanov, R., Snowball, I., Yarovaya, S., 2020. Enviromagnetic study of Late Quaternary environmental evolution in Lower Volga loess sequences, Russia. Quat. Res. 1-25. https://doi.org/10.1017/qua.2020.73.