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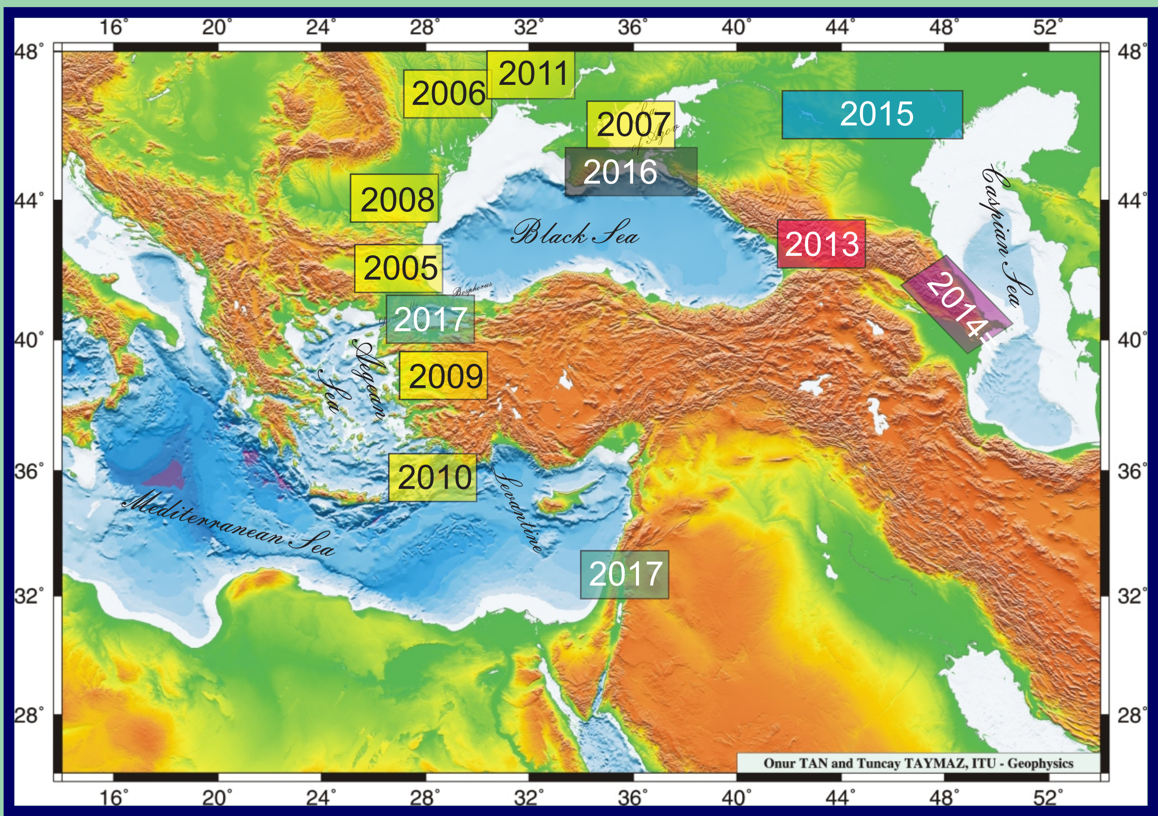

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CORRELATION OF THE PALEOGEOGRAPHIC EVENTS OF THE CASPIAN SEA AND RUSSIAN PLAIN IN THE LATE PLEISTOCENE: NEW DATA

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Introduction

The problem of correlation between transgressive-regressive oscillations in the Caspian and glacial events on the Russian Plain is of great importance and complexity in Pleistocene paleogeography. It has been thoroughly studied previously by a number of researchers. A review of the varied views on this problem has been published in a previous paper (Yanina, 2012). At the present moment, there is no unequivocal opinion on the correlation of Caspian events with glacial-interglacial changes on the Russian Plain. According to the view of the present authors, many factors (neotectonic movements, sedimentation in the basin, the restructuring of the hydrographic network, etc.) have affected the transgressive-regressive rhythm of the Caspian Sea, chief of which is the global climate rhythm. This work presents new data obtained by the authors during the last two years. They allow us to specify relationships and synchronization of events in the Caspian Sea and on the East European Plain.

Materials and methods

The authors have carried out analyses of the sections Srednyaya Akhtuba and Nizhnee Zaimische-Cherniy Yar from the Lower Volga Region and boreholes cores from the northern Caspian Sea. We studied the facies-lithologic structure of the sections and the cores, and the composition and stratigraphic distribution of mollusks in the Upper Pleistocene sediments. We determined the dating of Lower Volga deposits by the method of optically stimulated luminescence (OSL) conducted by the Northern Luminescent Laboratory of the University of Aarhus. For the upper part of the section, the dating of Lower Khvalynian and the Atelian deposits was carried out using quartz, and for the underlying loessic and soil horizons, it was done using feldspar. Paleogeographic evidence on glacial-interglacial events on the Russian Plain is based on published sources.

Results

The section at Srednyaya Akhtuba includes the reference horizon of chocolate clays of the Khvalynian transgression, the polyfacies thickness of the Atelian continental deposits, and the three pronounced ancient soils. These thicknesses reflect different paleogeographic stages in the development of the region. All of them are dated (see the paper in this book).

The lower part of the section contains three soil horizons. The lowest soil horizon has no date, but on the sandy loams overlying it, an OSL date of 112,630±5400 years was obtained. The second soil horizon was dated to 102,500±5160 years, and the upper soil was dated to 68,280±4170 years. The loess-like sandy loams lying between them (the 2nd and 3rd soil horizons) were dated to 87,620±4100 years. Judging by the resulting dates, the soil horizons were formed during warm intervals of MIS 5 (5e, 5c, and 5a, respectively). In the history of the Caspian Sea, this period (MIS 5) was followed by the Late Khazarian-Girkanian transgressive-regressive stage (Yanina et al., 2014).

The upper horizon of the soil is broken by frost cracks and wedges that are filled with the Atelian sediments lying above it. According to our representations, they were formed during the Late Valdai (Kalinin, MIS 4) glacial period of Eastern Europe. In the Caspian Sea, the Atelian regression developed. The dating obtained by us for the top part of this layer (48,680±3100 years) testifies to the complete formation of these deposits in the first half of MIS 3. In the structure of the cores of marine boreholes, we also established the Atelian regressive horizon (Bezrodnykh et al., 2015b); the radiocarbon dates determined for it lie in the range of 45-40 ky, which will be coordinated with the data obtained using the OSL method.

This thickness is capped by alluvial deposits, on which OSL dates of 36,780±3000, 35,500±2800, and 27,000±1580 years were obtained. The formation of alluvial sediments happened due to an increase in erosion, which the Caspian Sea underwent. We conclude that it was the period of an early stage of the Khvalynian transgression of the Caspian Sea (MIS 3) (Bezrodnykh et al., 2015a,b). Their radiocarbon dates of 31.5-28.5 ky are comparable with the OSL dates. It was the epoch of interstadial Valdai warming. Alluvial sediments are overlain by a layer of subaeral loessic deposits, apparently a result of a regressive phase in the development of the Khvalynian basin and the LGM (MIS 2). In the boreholes, an accumulation of sandy and dusty sediments was noted as corresponding to this time. The age (^{14}C) interval of this event was 22-19 ky (Bezrodnykh et al., 2015a).

The thickness of the Caspian Lower Khvalynian deposits is represented by chocolate clay with the sand pro-layer containing numerous *Didacna protracta*, *D. ebersini*, *Dreissena rostriformis*, and *Dr. polymorpha*. For chocolate clays overlying the pro-layer of sand, an OSL date of 13,000±500 years was obtained; the lower pro-layer of chocolate clays was dated to 15,000±1000 years. In the paleogeographic relationship, the period of accumulation of chocolate clays corresponds to the time of degradation of the Late Valdai (Ostashkovo, MIS 2) glaciations of Eastern Europe. These data are in a good agreement with the results of radiocarbon dating of malacofauna from sandy pro-layers in the thickness of chocolate clays from the Nizhnee Zaimische-Cherniy Yar sections (13,450±130 to 14,940±380 years) and other sites of the Lower Volga area (Svitoch and Yanina, 1997; Arslanov et al., 2016; Makshaev and Svitoch, 2016). In the boreholes, clay sediments of brown coloring are noted. According to ^{14}C dating, their age interval is 17.6-16.1 ky (Bezrodnykh et al., 2015a).

Conclusions

New data allow us to propose some correlations between the transgressive-regressive oscillations in the Caspian Sea and glacial events on the Russian Plain. (1) Contrary to previous representations, it appears that each peak of warming of MIS 5 in the Lower Volga area led to an interval of soil formation. (2) OSL and ^{14}C dating confirm the development of the Atelian regression of the Caspian Sea during the epoch of Kalinin (MIS 4) glaciations of Eastern Europe, and they fix its end during an epoch of interstadial warming (MIS 3). (3) The first stage of the Khvalynian transgression took place during the second half of the interstadial warming of MIS 3. (4) The LGM in Eastern Europe was reflected in the development of a falling sea level in the Caspian Sea. (5) The epoch of degradation of the Late Valdai (Ostashkovo) glacial stage (MIS 2) corresponded to the time of sea-level rise in the Caspian Sea and the accumulation of the full thickness of the Khvalynian chocolate clays.

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