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Late Pleistocene climatic events reflected in the Caspian Sea geological history (based on drilling data)

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ABSTRACT

The analysis of seismic-acoustic profiles and drilling data from the Northern Caspian showed the climatic events are quite distinguishable in the Upper Pleistocene sedimentary sequence. The climatic events of the first half of Late Pleistocene (MIS 5) resulted in the onset of two warm-water transgressive basins – Late Khazarian and Hyrcanian ones. Though cooler than at the late Khazarian transgression, the climate during the Hyrcanian time was attributable to interglacial one. As the glacial stage MIS 4 approached its maximum under conditions of a dry and cold climate the Hyrcanian sea basin regressed. The Atelian regression of the Caspian Sea corresponded to MIS 4 stage and to the initial phases of the MIS 3 interstadial warming. The development of the global interstadial warming led to a considerable increase in the surface runoff from the catchment and resulted in the rising of the Atelian lake level and the onset of the first phase of the Khvalynian transgression. The sea level rising was interrupted at the time of maximum cooling and aridization at MIS 2 and resumed when the ice sheet was decaying. The conspicuous climatic events known as warm phases of Bølling and Allerød promoted the ice sheet melting along with thawing of permafrost, the latter having been widespread in the Volga drainage basin. All the above contributed to the Khvalynian transgression. The 'chocolate' clays were accumulated in the Volga estuary, as well as in depressions of the Pre-Khvalynian topography. Phases of a noticeable cooling known as the Oldest, Older and Younger Dryas marked by a decrease in the runoff volume from the Caspian drainage basin are correlated with regressive stages in the Khvalynian basin history. The Khvalynian came to its end at the time of the first sharp warming that resulted in the rise of the Caspian level and is generally taken as marking the Pleistocene/Holocene boundary. The Mangyshlakian regression is dated to the Holocene and was essentially a response of the Caspian Sea to the increase in the climate continentality during the Boreal period.

1. Introduction

The Caspian Sea is the largest isolated basin in the world, located in the depths of the Eurasian continent (Fig. 1) with an area of 380,000 km^2, a water body of 78,000 km^3 and a level of 27 m. The Sea is made of three major parts: the Northern Caspian, the Middle Caspian and the Southern Caspian that are divided by Mangyshlak and Apsheron thresholds. Although 95,000 km^2 in area, the Northern Caspian holds only 1% of the water reserve and most frequent depths are 5 m. The Middle Caspian has an area of about 140,000 km^2 and water volume of about 26 km^3; maximum depth is 788 m. The Southern Caspian (almost one third of the total Sea area) contains the bulk of Caspian water (two thirds). This is a 1025 m-deep depression. The basin receives water from river systems of the Russian Plain, the Caucasus, and Elburs, with a collection area of 3.6 million km^2. The main river is the Volga. The northern part of the sea receives 88% of the total freshwater inflow (Agapova, Kulakova, 1973; Zonn, 2004).

The Caspian water balance depends on the river drainage, atmospheric precipitation (the incoming fraction), evaporation, and outflow into the Kara-Bogaz-Gol Bay (the outgoing fraction). Within the incoming fraction, the main role is that of river drainage, 80% of which is contributed by the Volga River. The water balance directly affects the sea-level fluctuations.

The basin's physiographical conditions are varied due to large area, great meridian length, surrounding relief and climatic

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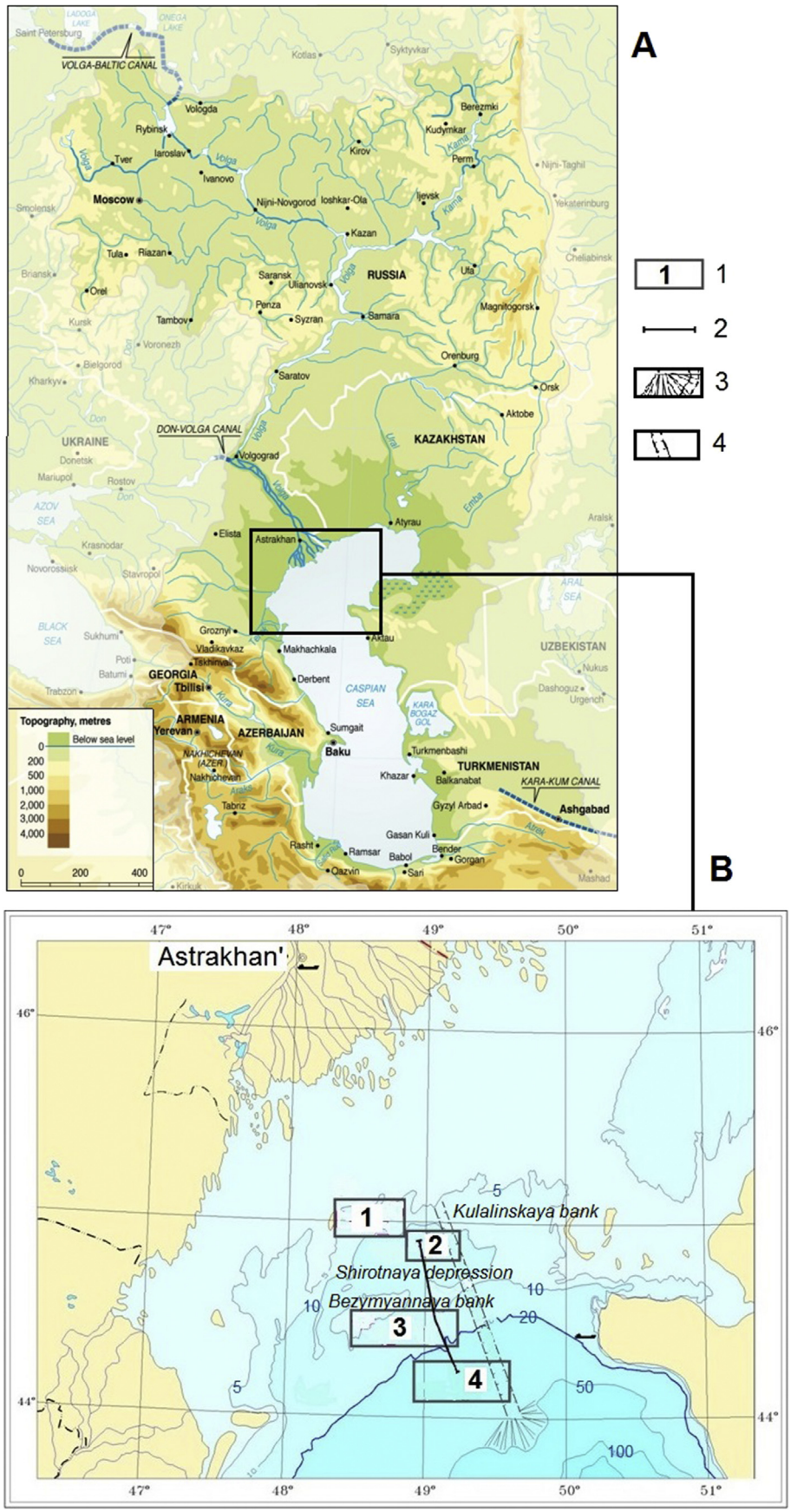

Fig. 1. Caspian Sea. Area of research. A – Caspian Sea and Caspian Sea catchment area; B – Northern Caspian Sea, research area: 1 – numbers of the studied areas; 2 –profile for correlation; 3 – paleodelta of Volga river; 4 – paleochannel of Volga river.

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