# CORRELATION OF THE PONTO-CASPIAN BASINS DURING THE MIS 2 BASED ON STABLE OXYGEN ISOTOPE ANALYSIS

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## Introduction

Global climate changes were fundamental for both the transgressive-regressive state of the Ponto-Caspian basins, as well as for glacier formation and retreat on the East European Plain. Isotopic composition changes reveal the influx of fresh water in the basins as well as it reflects global climatic changes. Thereby we show the correlation between transgressive-regressive events among Ponto-Caspian basins and glacial-interglacial epochs at the East European Plain during the MIS 2.

## Material and methods

Over the past years our group of researchers from Lomonosov Moscow State University and OAO «MorInzhGeologia» studied Late Pleistocene sedimentary evolution of the North Caspian basin and the Lower Volga reference sections (Bezrodnykh et al., 2015, 2016, 2017; Bolikhovskaya et al., 2017; Sorokin et al., 2018; Yanina et al., 2018; Van de Velde et al., 2019) and in the Black sea (Sorokin et al.,2018; Zenina et al., 2018; Krijgsman et al., 2019). Here we report on stable oxygen isotope analyses of cores KOP-4 and IGS-1 from the Caspian North-Western area, ВС-2Б from the Western Black sea area and RBH-16 from the Eastern Black sea area and complex study of the Srednyaya Akhtuba, Chernyj Yar, Kopanovka sections. The studies are based on drilling material from the edge of the shelf and outcrops. Oxygen isotope analysis was carried out on ostracod shells.

## Results

Combining the obtained oxygen isotope and microfaunistic results with published materials we created the Ponto-Caspian paleoreconstruction for the MIS 2 highlighting 4 main stages:

1. *Second half of MIS3 – beginning of MIS2.* Caspian transgressive stage at the beginning of the Late Valdai glaciation, when against the background of a general climate cooling, there was an increase in the water balance positive components, a decrease in evaporation and an increase in the relative humidity and the continental river flow.

2. *Beginning of MIS2 – Last Glacial Maximum (LGM).* The regressive stage of the Caspian and Black seas as a result of climate severity. Significant sea level fall, desalination and isolation of both seas (lake type functioning).

3. *Deglaciation and postglacial time.* After a deep regression during the Last Glacial Maximum both Caspian and Black Seas evolution began according to a single scenario. Moreover both basins were substantially desalinated. Glacial melt waters flow intensification and permafrost melting together with increasing temperatures in the northern hemisphere led to Caspian level increase. Due to the sea level rise along the ingressive bays chocolate clays probably accumulated. As a result of ice sheet degradation and occasional large melt water influx the transgressive stage of the Caspian and Pont with complex internal dynamics began.

However after the maximum levels culmination during the postglacial time the same global climate events began to reflect differently in Khvalynian and Neoeuxinian basins despite the existing connection between the seas. While Caspian Sea level was rising, Black Sea level reaction to the same climatic events turned out to be the opposite. These differences manifest themselves most clearly during the interstadials Bølling and Allerød. The most important role was played by the water discharge from the Khvalynian into the Neoeuxinian basin through the Manych corridor, which made it possible to maintain a higher level of the Black Sea during the Oldest Dryas, thereby shifting the transgressive-regressive rhythm by a step relative to the Caspian.

Even during the transgressive phase Black Sea level did not reach high positive absolute marks and was about -25 m due to the low level of the Bosphorus threshold (bedrock here lies at a depth of -100 m, modern position is -35 m). At the same time, the Khvalynian Sea level was much higher due to the Manych threshold position probably more than 26 m, so the influence of melt water could be much more noticeable, and increasing evaporation less affected the changes in Caspian water balance.

Interruptions in the chocolate clays accumulation in the Caspian region occurred during the cold phases, which is probably an indirect sign of sea level fall. At the same time the water discharge along Manych allowed the transgressive phase in the Black Sea to continue. The level of the Bosphorus was reached only at the warm phases, when the Caspian Sea level was higher again due to the increased meltwater flow. So the changes in the Black Sea level seemed to be late in relation to the Caspian.

Thereby we assume the following basins dynamics during the postglacial time:

Oldest Dryas – Caspian Sea level fall as a result of a meltwater flow reduction and maintaining or raising of the Black Sea level due to Caspian water discharge during the maximum Khvalynian trangressive stage.

Bølling – Caspian Sea level rise, increasing runoff and the chocolate clays accumulation. Black Sea level fall due to the water discharge through the Bosphorus and evaporation increase.

Older Dryas – Caspian Sea level fall as a result of a meltwater flow decrease and Black Sea level rise due to Caspian water discharge during the Khvalynian trangressive stage at the level of 20-22 m.

Allerød – overall recurrence of Bølling events with Caspian Sea level rise, increasing runoff and the next phase of chocolate clays accumulation. As well as Black Sea level fall due to the water discharge through the Bosphorus and probably evaporation increase.

Younger Dryas – regression of both basins against the background of the harsh cold climate condition confirmed by various analyzes and noticeably heavier oxygen isotopic composition.

4. *Holocene beginning (MIS1).* The both seas level rise with a sharp warming; continuation of the Black Sea transgressive phase as a result of the two-way communication establishment with the Atlantic, and therefore Black Sea water salinization; the regressive Mangyshlak phase in the Caspian basin as a result of evaporation increasing and runoff decreasing. As the fifth stage Holocene transgressions of both seas, when basins developed independently, can be called.

As a result, the history of Black Sea level fluctuations during the postglacial time was smoother, without the high-amplitude pulsations characteristic of the Caspian.

**Conclusions**

We established the paleogeographic stages in the history of the Ponto-Caspian during the MIS 2. Oscillations of the oxygen isotope curves for the Caspian and Black Seas correlate with the main climatic episodes recognized throughout the northern hemisphere. There is an inextricable link between glacial-glacial rhythm and transgressive-regressive events in the Ponto-Caspian basin.

The climatic factor played a major role in Ponto-Caspian sea level changing during MIS 2. The connection of the Caspian and Black Seas with global climatic events in the northern hemisphere at the postglacial time is multidirectional.

Moreover calculation of the basins paleohydrological parameters using the unified formulas for oxygen isotope data in the Ponto-Caspian region is impossible. They require the introduction of adjustments based on special studies.

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