FIRST RESULTS OF STABLE OXYGEN ISOTOPE ANALYSIS OF UPPER PLEISTOCENE SEDIMENTS IN THE NORTH CASPIAN BASIN

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Late Pleistocene sedimentary evolution of the North Caspian basin (Bezrodnykh et al., 2015, 2017; Bezrodnykh and Sorokin, 2016; Bolikhovskaya et al., 2017; Sorokin et al., 2018; Yanina et al., 2018). These studies are based on high and low frequency seismic-acoustic profiles and on deposits sampled by drilling on the shelf during the course of prospecting research. The obtained core was analyzed using lithological, faunistic, palynological, and geochronological (radiocarbon) methods.

Here, we report on stable oxygen isotope analyses from core KOP-4, which was bored to a depth of about 60 m on a structure Shirotnaya in the northwestern Caspian area, where the bottom lies at 11 m below the Caspian Sea surface. Isotope analyses were carried out on ostracods, and species identifications were made by Prof. M. Stoica (Bucharest University). Measurements of $\delta^{18}O$ content were made in the Geosciences Laboratory of Utrecht University under the guidance of Prof. L. Lourens. In total, 133 samples were analyzed, and for each sample, we used three ostracod specimens (Fig. 1).

The lower part of the core covers lower Khazarian sediments (late Middle Pleistocene) and contains both regressive and transgressive sediments. The $\delta^{18}O$ ratios for regressive (-1.22‰) and transgressive (-7.46‰) sediments are very different. The Upper Khazarian sediments that form the base of the Late Pleistocene sedimentary unit contain a basal regressive interval. Throughout the upper Khazarian, isotope ratios are higher during lowstands/regressions (-0.58‰) and lower during transgressions (-7.04‰). Hyrcanian transgressive sediments overlay Upper Khazarian intervals: they are separated by an erosion surface. The Hyrcanian interval is characterized by high amplitude changes in $\delta^{18}O$ ratios: records vary from -3.37‰ in lower part (near the erosion boundary, reflecting low Caspian Sea levels) to -10.62‰ in the middle part (maximum transgression) and again up to -3.65‰ in the upper part of the layer, showing a regression that marks the onset of the Atelian regressive stage. The $\delta^{18}O$ ratios of upper Khazarian-Hyrcanian sediments show a similar pattern as those of the lower Khazarian intervals: lowstands correspond to high ratios and highstands to low ratios.

The very low $\delta^{18}O$ ratios (-10.55‰) found at the bottom of the interval overlying the base of the Atelian interval is remarkable. Such values indicate near freshwater conditions at the time.

The regressive Atelian sediments lie in paleodepressions, filled with freshwater river sediments (Bezrodnykh et al., 2015, 2017).

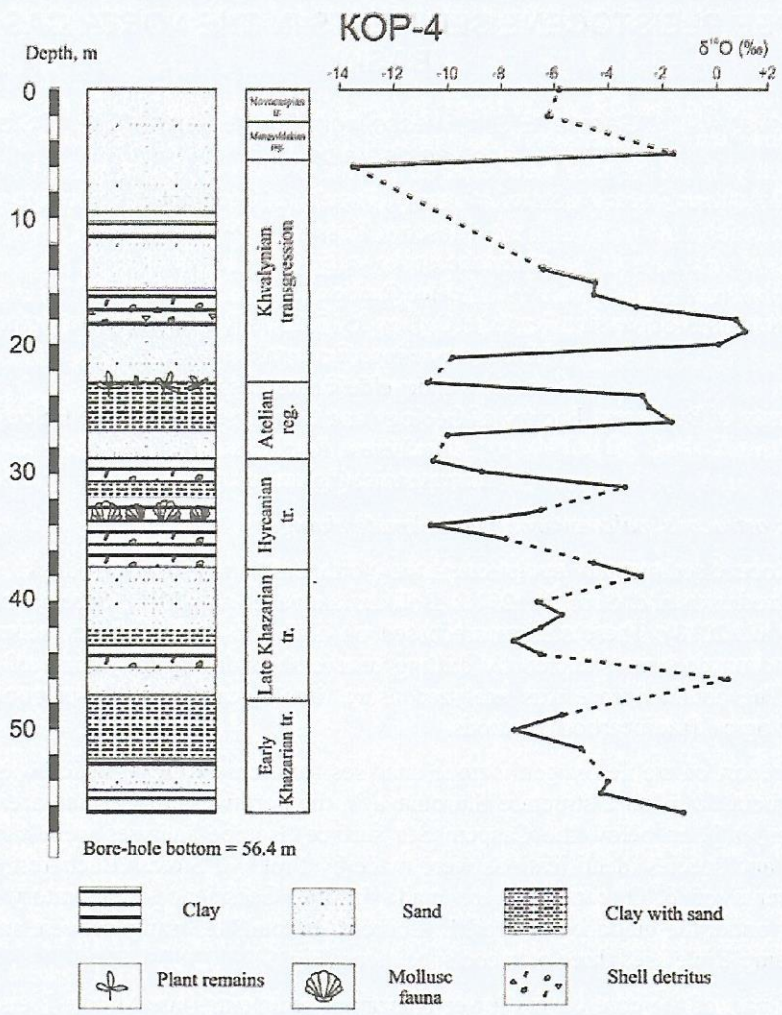

Figure 1. Isotope curve of KOP-4 core from the North Caspian basin.

The $\delta^{18}O$ ratios in the Khvalynian interval range from -13.46‰ to 1.16‰. The isotopic curve reflects a number of states of the Khvalynian basin level. The initial stage of the Khvalynian basin is characterized by low $\delta^{18}O$ ratios, indicating the contribution of atmospheric water/runoff in the North Caspian basin. Clay layers contain relatively deep-sea mollusk fauna (Yanina et al., 2018) and show the high water levels of the Khvalynian transgression that are also characterized by the $\delta^{18}O$ ratio peak (1.16‰). We explain this high ratio by active water exchange with the Middle Caspian basin that must have driven the influx of more saline waters. Unfortunately, a major part of the Khvalynian sediments in this core could not be characterized by isotope data. In the upper part, we observed minimum $\delta^{18}O$ ratios of -13.46‰, which indicates a significant freshwater influx. It is the final evolutionary stage of the Khvalynian transgression, caused by increasing runoff from the Volga drainage basin (Yanina et al., 2018).

Only one $\delta^{18}O$ value of -1.62‰ was recorded for the Mangyshlakian layer; $\delta^{18}O$ values in the Novocaspian layer are -6.24 and -5.86‰. The last value corresponds with the isotopic composition of the North Caspian water today. The $\delta^{18}O$ value of -6.24‰ represents the atmospheric component in the water balance of the North Caspian basin during the maximum of Novocaspian transgression.

Our first isotopic results show climate factors driving Caspian Sea level fluctuation during the Late Pleistocene. Insignificant peaks of lighter $\delta^{18}O$ ratios (meaning an increase in the meteorological component affecting the water balance) characterize small-scale warm transgressions: Late Khazarian and Novocaspian, which took place during the interglacials. High Caspian Sea levels during the Late Khazarian basin are also well reflected in the isotope ratios.

The maximum influence of freshwater inflow into the North Caspian basin was during the Khvalynian. Obviously, both a decrease in evaporation and an increase in runoff took place due to glacier and permafrost melting in the Volga drainage basin. With significant transgressive rise of the Caspian Sea level, a salt water influx from the Middle Caspian basin occurred that is recorded in high $\delta^{18}O$ ratios in the North Caspian basin.

Further study of Caspian sea sediments by isotope methods will permit further interesting results and settle some debated issues in the paleogeography of the Caspian region.

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