Mid- and Late Holocene hydrological and geochemical changes in Lake Chokrak (NE Crimea)

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The Crimean Peninsula has around 50 saline lakes, which formed during the Holocene marine transgression. These lakes are valuable archives of the Holocene sea-level changes in the Black Sea, but their chronologies and evolution remain largely unknown. This study presents reconstructions of evolution of the Lake Chokrak basin and its depositional environment during the last 8000 years. At present, the lake is hypersaline and separated from the Sea of Azov by a narrow sandbar. The environmental reconstructions are based on multi-proxy data including shell content, organic geochemical and x-ray fluorescence analyses and radiocarbon dating of an 11-m sediment core. The aim of the study is to provide new insights into the evolution history of the lake in the region where such data are limited. Based on the interpretation, the following succession of stages was recognized in the lake evolution. Around 8000 cal yr BP, an open relatively shallow marine embayment existed in the study area, which is evidenced by high contents of Mn, indicating well-oxygenated waters, and presence of shells of Cerastoderma edule, which is favoured by shallow calm waters. Lamination of the sediments during this stage indicates relatively stable marine conditions. A deeper transgressive stage is observed from 7000 to 6500 cal yr BP when waters became less oxygenated, the grain size decreased and laminations disappeared. Precipitation of carbonates at the end of this stage indicates seawater evaporation. A dry stage from 6500 to 6200 cal yr BP is characterized by further decrease in water level and precipitation of gypsum. Starting from 6200 cal yr BP, a renewed transgressive stage is observed with increased water oxygenation, accumulation of fine sediments and precipitation of carbonates. From 5400 to 5000 cal yr BP higher erosion is demonstrated by an increase in Zr, Ti, Rb and Si contents and occurrence of sand layers in the sediment core. After 5000 cal yr BP starts a dry stage of the basin, which is connected to the slower rate of the Holocene sea transgression. Precipitation of evaporites (carbonates, halite, gypsum) increased at this time and fine-grained clays accumulated in the basin. This stage is also characterized by virtually continuous presence of C. edule shells. Relatively high organic carbon content and C/N ratios imply increased input of terrestrial organic material throughout this stage. The infilling of the basin and formation of the sandbar started around 3000 cal yr BP when clay sediments intermixed with sand layers. A transitional stage from semi-open to closed basin lasted from 1400 to 800 cal yr BP and it is characterized by precipitation of evaporites and disappearance of shells. The current stage (from 800 cal yr BP to present) of the closed lake basin is characterized by sediment lamination, high
precipitation of gypsum and potassium salts, and complete absence of molluscs due to high salinity of the brine. The obtained results show that hydrological regime and geochemical composition of the lake were influenced by complex interaction of climatic, local tectonic and eustatic factors throughout its history.