

Brine and seawater circulation in the Fore-Carpathian Basin in Miocene times constrained by Nd isotopes

Over the past three decades, neodymium isotopes have become a powerful tool used in the oceanographic and paleoceanographic studies to define water masses and to track changes in ocean circulation. The dissolved isotopic composition of Nd in the ocean is controlled mainly by weathering of different types and ages of continental crust, and these variations are redistributed into the ocean via aeolian and riverine inputs, or remobilization of Nd from river-transported coastal and shelf sediments. While Nd isotope records from modern oceans are very numerous, studies documenting lateral variations in Nd isotope composition of seawater in ancient epicontinental seas have so far been rare. The planned project is aimed at using of Nd isotope composition of marine precipitates to reconstruct circulation of brines and seawater in the Fore-Carpathian Basin (FCB) during Miocene times. Its concept derives from pilot data collected in the northern periphery of the FCB, which revealed that some carbonate and gypsum rocks exhibit strongly radiogenic Nd isotope compositions, inconsistent with the paleoceanographic model postulated for the FCB. The pilot data indicate that seawater and brine, from which gypsum and carbonate precipitated, must have received neodymium from young, Cenozoic volcanics or subduction-related rocks. Therefore, it seems that intensive runoff from the thrusting Carpathians, constituted the major riverine input to the FCB. In addition, the pilot data appear to confirm that the evaporite basin was not influenced by any remarkable seawater inflow from the Paratethys Ocean.

The usage of the Nd method is novel to studies of seawater circulation in evaporitic basins and in semi-closed, orogenic foredeeps. The innovative aspect of the proposed project will be in analyzing of Nd isotope composition in various rocks (halite, gypsum, carbonates, clays) and skeletal carbonates. Such studies have not been conducted anywhere in the world so far. The samples will be taken from two intervals of the sedimentary infill, from the exposures and boreholes located in the Polish, Ukrainian and Czech segments of the Fore-Carpathian Basin. The project encompasses innovative and interdisciplinary investigations, combining disciplines such as geology, analytical geochemistry and oceanography. The deliverables of the project may be applied in further sedimentological and paleogeographic studies. This knowledge will be useful for general understanding of the seawater circulation and depositional patterns in orogenic foredeeps. It should also help us to understand how did the reorganization of the Paratethys affect climate and runoff processes in a tectonically active compressional orogen.