Geophysical Research Abstracts, Vol. 7, 02677, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02677

Modelling of long-term changes in carbon and oxygen isotopic composition of authigenic calcite in sediments of lake Gosciaz, Poland

K. Rozanski, P. Wachniew, , R. Sikora,

AGH University of Science and Technology, Krakow, Poland

(rozanski@novell.ftj.agh.edu.pl Fax: +48126340010 / Phone: +48126172986

Carbon and oxygen isotope composition of authigenic carbonates deposited in lakes have long been recognized as important indicators of environmental changes on continents. Numerous examples of reconstructions of past climates and environments based on records of δ^{18}O and δ^{13}C of authigenic carbonates preserved in lake sediments are known for all continents and climatic zones. However, they are mostly qualitative or semi-quantitative, based on simplistic models of lake system response to external forcings.

The quantitative model of long-term evolution of δ^{18}O and δ^{13}C values in authigenic carbonates preserved in laminated sediments of lake Gosciaz, Poland, has been developed. Lake Gosciaz is a groundwater-controlled lake located in central Poland, which bottom sediments provide high-resolution record of environmental changes covering the last 13000 years (Ralska-Jasiewiczowa et al., 1998). The knowledge of the Gosciaz lake system, derived from present-day observations and modelling (Wachniew and Rozanski, 1997), was integrated into the model simulating its long-term behaviour.

The model simulates evolution of isotopic signatures of water, DIC and the deposited authigenic calcite. Basic equations of the model account for mass balance of water, DIC and their isotopic species. The DIC budget includes the following sources and sinks: surface and groundwater inflows and outflows, respiration of organic matter, exchange of CO_2 with the atmosphere, photosynthetic assimilation, calcite precipitation. Isotopic chemistry of DIC is described by equilibrium equations. An important feature of the model is its ability to simulate internal dynamics of the system. The

model simulates also the long-term evolution of δ^{18}O values in calcite in relation to changes in δ^{18}O of precipitation, relative humidity of the atmosphere, the hydrologic budget (total inflow to evaporation ratio) and the temperature of lake waters. Equilibrium fractionation factors between water and DIC and precipitated calcite were adopted for the calculations.

The modelling results are compared with the records of δ^{18}O and δ^{13}C in bulk carbonate, available for the entire sediment column of lake Gosciaz. Good correspondence between measured and modelled δ^{13}C values was obtained by fitting of several model parameters related to hydrology and photosynthesis/respiration cycle. The most significant among them are: isotopic composition of DIC in the inflow, isotopic composition of DIC released during respiration and photosynthetic assimilation rate. For δ^{18}O there is an apparent discrepancy between the measured and modelled values for sediments younger than ca. 6000 years BP. Better fit could be not obtained for realistic values of the fitting parameters (water temperature, surface air humidity, isotopic composition of inflowing waters). Possible reasons for this discrepancy are discussed in detail. The proposed model can be applied to other lacustrine systems for which appropriate sedimentary records δ^{18}O and δ^{13}C in bulk carbonate are available.

This work was partially supported by the Committee for Scientific Research (KBN).

References

Ralska-Jasiewiczowa M., Goslar T., Madeyska T. and Starkel L.(Editors) (1998). Lake Gosciaz, Central Poland – A Monographic Study. W. Szafer Institute of Botany, Polish Academy of Sciences, Krakow, 340 pp.

Wachniew P., Rozanski, K. (1997). Carbon budget of a mid-latitude, groundwater-controlled lake: Isotopic evidence for the importance of dissolved inorganic carbon recycling. *Geochim. et Cosmochim. Acta*, 61, 2453-2465.