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δ^{18}O of cellulose organic fraction combined with δ^{18}O of calcite and δ^{18}O of diatoms in lake sediments: a new tool for palaeoclimate reconstructions on continents?

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Lake sediments are among the most valuable climatic archives on continents. Studies aimed at reconstructions of continental climates based on lake sediments are usually of interdisciplinary character, comprising physico-chemical, biological and isotopic tools. Isotope methods are considered as particularly useful (Leng et al., 2006). ^{18}O isotope composition of bulk carbonate fraction of lake sediments was often used to infer relative changes of lake water temperature in the past, while δ^{18}O of cellulose organic fraction served as proxy of δ^{18}O of lake water. δ^{18}O of diatoms was tested as proxy for temperature or isotopic composition of lake water (Leng and Barker, 2006).

Laminated sediments of lake Gosciaż located in central Poland have been a subject of extensive interdisciplinary investigations aimed at reconstruction environmental and climatic changes in central Europe during late Glacial and Holocene (Ralska-Jasiewiczowa et al., 1998). A recent study carried out on these sediments was aimed at systematic comparison of functioning of carbonate and diatom isotope thermometer in lake environment. Five absolutely dated sections of Gosciaz lake sediment column comprising 100-150 years each and ranging from late Glacial to late Holocene, were selected for this study. Each section was split into 10-yr samples. The following isotope parameters were analysed in each sample: δ^{13}C and δ^{15}N of bulk organic fraction, δ^{18}O of cellulose organic fraction, δ^{18}O and δ^{13}C of bulk organic fraction, δ^{18}O of cellulose organic fraction.

δ^{18}O of cellulose organic fraction gave an insight into changes of δ^{18}O of lake water in the past. The inferred δ^{18}O of lake water varied from ca. -13.5‰ during Younger

Dryas (ca. 12100 cal. years BP), to ca. -6.5%o in early Holocene (ca. 9000 cal. years BP) and -9.2%o during late Holocene (ca. 3800 cal. years BP). These large apparent changes of δ^{18}O of lake water were most probably caused by two factors: (i) a stepwise change of δ^{18}O of local precipitation at the transition from Younger Dryas to Holocene (approximately 2.5-3%o) and (ii) changes in ^{18}O evaporative enrichment of the lake water induced by changes of its hydrological balance.

These inferred changes of δ^{18}O of lake water were used to assess effective epilimnion temperatures of the lake derived from measured δ^{18}O of calcite and δ^{18}O of diatoms, assuming thermodynamic equilibrium during calcite precipitation and formation of diatom silica. The epilimnion temperatures derived from δ^{18}O of calcite vary in a large range: from ca. 5^{o}C during Younger Dryas to ca. 25^{o}C in early Holocene, whereas the epilimnion temperatures derived from δ^{18}O of diatoms are systematically lower and less variable.

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