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The influence of hydrological processes and climatic changes on carbon and nitrogen cycles in lacustrine environments

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Lake sediments are considered among the most valuable archives of climatic and environmental changes on continents. Studies aimed at reconstruction of continental climates based on lake sediments are usually of interdisciplinary character, comprising physicochemical, biological and isotopic tools. To utilize fully the potential of lacustrine sediments as environmental archives, a deeper understanding of hydrology as well as carbon and nitrogen cycling in lakes under contrasting climatic conditions is required.

Lake Gosciaz is situated in central Poland (52˚35'N, 19˚21'E, 64.3 m a.s.l.) in the Vistula river valley. It is the largest in a group of four lakes which were formed during the final stages of the Last Glaciation, on the outskirts of retreating Fennoscandian ice sheet. Laminated sediments of Lake Gosciaz have been a subject of extensive interdisciplinary investigations aimed at reconstructing environmental and climatic changes in central Europe during late Glacial and Holocene. Also process studies aimed at better understanding of carbon cycling in the present-day lake have been carried out.

In recent study on that object δ^{13}C, δ^{15}N and C/N ratio in organic matter, as well as δ^{13}C of calcite, were measured in its absolutely dated sediments.

δ^{13}C of both fractions generally evolved from low values in Younger Dryas, around -6‰ and -32.5‰ up to 0‰ and -31.5‰ for calcite and organic matter respectively.

Isotopic composition of organic nitrogen also shows low values, from 1‰ to -3‰ pointing significant role of atmospheric nitrogen assimilation in its cycle. Additionally C/N ratio points at aquatic origin of analyzed organic matter, frequently dominated by macrophytes.

The carbon isotope composition of carbonates and aquatic plants material is mainly controlled by processes influencing DIC availability in lake water and its isotopic composition. These processes are related to biological productivity and respiration, soil condition in the catchment, and thereby indirectly related to climate. However, hydrological condition of lake itself, seems to strongly affect δ^{13}C of calcite and organic matter. This kind of relation has been derived by the mathematical model of the very system for other independent data.

Cycle of nitrogen consists of a complex set of biochemical reactions and environmental forces. δ^{15}N is not sensitive to hydrological conditions at all. Only one considerable alteration of δ^{15}N is linked to abrupt climatic transformations at the edge of Younger Dryas and Holocene that probably effected ecological state of the system.