



## Interannual variation of the isotopic composition of sedimenting organic carbon and nitrogen in Lake Lugano: A long-term sediment trap study

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**ABSTRACT:** We examined the evolution of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of sedimenting particulate organic matter (SPOM) in response to changes in primary productivity, nutrient loading, and plankton dynamics in Lake Lugano between 1985 and 1998. A decreasing  $\delta^{13}\text{C}$  reflects the decline of phosphorus loading in Lake Lugano, suggesting that the  $\delta^{13}\text{C}$  of SPOM is a good indicator of P availability in the lake, with phosphate being the major control on the  $\text{CO}_2$  draw-down in the photic zone. However, annual primary production and  $\delta^{13}\text{C}$  do not correlate. The expansion of the trophogenic layer in response to lowered plankton biomass concentrations balanced the effect of reduced phosphate concentration on total primary production (per unit area) and, thus, biased the correlation of  $\delta^{13}\text{C}$  and primary productivity. Whereas a substantial decrease of total phytoplankton biomass in the late 1980s clearly affected the  $\delta^{13}\text{C}$  of SPOM, it did not seem to affect  $\delta^{15}\text{N}$ . Marked changes in the plankton population composition did not have a major effect on  $\delta^{15}\text{N}$ . If at all, the effects of primary productivity, nitrate utilization, and changes in the intensity of denitrification are superimposed on a signal dominantly derived from changes in the amount and isotopic composition of dissolved inorganic nitrogen from external sources. A marked positive shift ( $+3\text{‰}$ ) in the  $\delta^{15}\text{N}$  observed in 1994/1995 corresponded to the introduction of a denitrification stage in wastewater treatment. This study demonstrates that the  $\delta^{13}\text{C}$  of exported organic matter is a useful indicator of the trophic state of lacustrine environments. The  $\delta^{15}\text{N}$  of sedimentary organic matter is unlikely to reflect nitrate utilization or denitrification if the input of external N sources dominates the N-isotope dynamics within the lake. However, in those systems, organic matter  $\delta^{15}\text{N}$  can provide information on the development of N pollution and subsequent effects of lake restoration measures.

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