

Abrupt onset of carbonate deposition in Lake Kivu during the 1960s: response to food web alteration and hydrological change

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Abstract

This study reconstructs and interprets the recent (last ~300 yr) history of a tropical lake from the East African Rift Valley and compares the past and current gross and net sedimentation of matter and nutrients. The sediment regime of Lake Kivu was investigated using three short cores from two different basins and from a moored sediment trap array deployed over two years. Diatom assemblages are interpreted as reflecting changes in mixing depth, surface salinity and Si:P ratio, and point to lower lake level during the 1700s, consistent with Little Ice Age aridity recorded in other lakes in western East Africa. The sediment cores reveal an abrupt change ~40 years ago, when carbonate precipitation started. Since the 1960s, deep-water methane concentrations, nutrient fluxes and soil mineral inputs have considerably increased and diatom assemblages have altered. These modifications probably resulted from a combination of two factors, commonly disturbing lake systems: the introduction of a non-native fish species (*Limnothrissa miodon*, the Tanganyika sardine) and climatically-related hydrological change, inducing greater upwelling. Catchment population increase accompanied by changes in land use probably had a longer term impact, as the flux of soil minerals due to more intense erosion increased earlier in the last century and the current external nutrient inputs have only a minor contribution (~ 10%) compared to P-inputs by upwelling. The contemporary sediment trap data indicate seasonal variability, governed by phytoplankton blooms during the annual mixing in the dry season, similar to Lakes Malawi and Tanganyika. The ratio of settling fluxes to net sediment accumulation rates implies mineralization rates of 80-90% at the sediment-water interface. The rate of organic carbon mineralization may in part account for the 15% increase in deep water methane concentrations observed in Lake Kivu since the 1960s.

Keywords: East Africa, nutrients, net and gross sedimentation, carbonates, diatoms, ecological change.