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A multi-isotope (H, C, N, O, S), trace element, and phase analytical study of environmental change from tropical Lago Enriquillo (Dominican Republic)

MICHAEL ERNST BÖTTCHER[1,2,3], CHRISTOPHER BERNDT[4], TORSTEN HABERZETTL[4], EDWIN GARCIA COCCO[5], BERENICE MATIAS MARTE DE REYES[5], IRIS SCHMIEDINGER[1], OLAF DELLWIG[6], MATTHIAS MOROS[6], PATRICIA ROESER[7] AND CLAUDIA WROZYNA[4]

[1]Leibniz Institute for Baltic Sea Research, Geochemistry & Isotope Biogeochemistry
[2]Marine Geochemistry, University of Greifswald
[3]University of Rostock
[4]University of Greifswald
[5]Servicio Geológico Nacional, Santo Domingo
[6]Leibniz Institute for Baltic Sea Research
[7]University of Bonn, Institute for Geosciences, Environmental Geology Group, Bonn, Germany

Tropical Lago Enriquillo in the Dominican Republic is the largest lake in the Caribbean. This hypersaline and endorheic lake is of marine origin and located within the main development region of tropical cyclones. It has been showing substantial water level changes in the past and modern times. Within the HURRICANE project, a multi-isotope (H, C, N, O, S) approach was applied on the lake water column and sedimentary solid phases for a reconstruction of past and on-going changes in hydrology and impacted biogeochemical processes. Measurements include the isotopic characterization of water, dissolved C and S species, as well as the stable isotope composition (C, N) of organic matter, and S in total sulfur, pyrite, and kerogen. Results are complemented by mineral phase analysis and trace element profiling as indicators for changes in environmental redox conditions and potential anthropogenic contamination. Water samples along vertical profiles through the lake were taken during two seasons in 2022 and compared to lake tributaries. Hydrochemical data were further evaluated using the speciation model PHREEQC.

Substantial changes in the lake water composition were observed between the two campaigns, including the seasonal development of deep water anoxia. Together with the element stoichiometries, the water isotopes allow for an evaluation of changes in the hydrological balance. C isotopes reflect the role of microbial activity and solution-atmosphere exchange on the modulation of the dissolved carbon system, in contact with biogenic carbonates, like ostracod shells. The contents of N, Zn, Cu, Pb, and Hg in the top parts of the sediments indicate a sudden increase after the onset of substantial anthropogenic impact on the ecosystem also impacting the sedimentary record. The C isotope composition of organic matter shifted from an apparently marine dominated origin at depth towards more substantial terrestrial contributions in younger sediments. The S speciation and stable isotope signatures indicate iron sulfidization and organic matter sulfurization associated with benthic anaerobic microbial activity, as well as carbonate mineral authigenesis.

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