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The search for environmental changes in the tropical Lago Enriquillo (Dominican Republic) using multi-isotope (H, C, N, O, S) partitioning

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Tropical Lake Enriquillo in the Dominican Republic is the largest lake in the Caribbean. The hypersaline and endorheic lake is of marine origin and is located within the main development region of tropical cyclones. It showed substantial water level changes in the past and modern times. Within our research project that focuses on a geochemical approach for the identification of hurricane impacts, a multi-isotope (H, C, N, O, S) approach is 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, and 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 using sedimentary Hg as a potential anthropogenic contaminant. Water samples along vertical profiles through the lake were taken during dry (March) and rainy (September) season 2022 and compared to lake tributaries. Hydrochemical data are further evaluated using the speciation model PHREEQC.
Substantial changes in the lake water composition were observed between the two campaigns. Together with an evaluation of 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 and Hg in surface sediments indicate a sudden increase after the onset of substantial anthropogenic impact on the ecosystem with ecosystem fluctuations impacting the sedimentary record. The C isotope composition of organic matter shifted from marine dominated origin at depth towards substantial terrestrial contributions during the Anthropocene. The S speciation and isotope investigations indicate iron sulfidization and organic matter sulfurization due to microbial activity, as well as evaporative sulfate mineral formation.

Session: *DEUQUA Session: Anthropogenic impact on the development of landscapes*
Keywords: *Holocene, Tropics, lake, multi-isotopes approach*