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Impact of extreme climatic events on the spatial and temporal distribution of major and trace elements in bed sediments of reservoirs in the Dominican Republic

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In certain world regions, extreme climatic events (ECE) as tropical cyclones, have increased in frequency and/or intensity affecting the structure and function of dam lakes, by altering the sedimentation processes, the delivery and processing of nutrients and organic matter and the water quality. The Dominican Republic has a tropical climate intensified by periods of extreme hydrometeorological events that occur almost every year. This climate, in a volcanic region with pronounced slopes and fine-grained soils, enhance the transport and deposition of the finer particles in lakes, causing high sedimentation rates and decreasing water quality. Studies carried out in two reservoirs located near the higher mountainous zone (Cordillera Central), with identical lithology in the drainage basins and distinct climatic conditions (Tavera at North with greater precipitation, Sabana Yegua (SY) at South, under drier weather), tried to evaluate the influence of the climate and ECE in their sedimentation.
Throughout the lake area, surface sediments and sediment columns were collected with a shipeck dredge and an Uwitec corer (for spatial and temporal distribution of geochemical characteristics). The sedimentary columns, approximately 1 meter length, were sectioned in 1 cm thick layers up to the first 20 cm and in 2 cm layers until the end. Major and trace elements were analyzed by ICP-OES after alkali fusion or microwave-assisted multi-acid digestion of sediments.

Although there are differences in the chemical composition of sediments between both reservoirs as a consequence of minor lithological variations of the drainage basins, sedimentation is very uniform. In each reservoir, geochemical data are homogeneous throughout the lake, including deeper, shallow areas and the entrance of the main waterways. Examples of this uniformity are evident by the medium and standard deviation values of the more immobile major and trace elements such as Al, Fe, Si, Ti, Cr or Sr (Al: 7,48 ±0,81% (SY) and 9,81±0,93% (Tavera), Fe: 5,14±0,59% (SY) and 6,72±0,40% (Tavera), Si: 22,04±2,24% (SY) and 19,84±0,95% (Tavera), Ti: 0,52±0,05% (SY) and 0,57±0,03% (Tavera), Cr (158,32±29,64 mg/kg (SY) and 272,74±62,10 mg/kg (Tavera); Sr (235,32±82,07 mg/kg (SY) and 142,33±46,87 mg/Kg (Tavera)). The distribution of trace metals show also little spatial variance (e.g. Zn in Tavera: 112,54±7,67 mg/kg, Ni in SY: 98,81±10,29 mg/Kg). As expected, a slightly less uniformity is observed in relation to mobile elements as Ca, K or Mn.
This uniformity was also observed in the distribution of concentrations in depth. The slightly variations that occur are related to the release of mobile elements from the upper layers to the water column (e.g. Ca, Na, K) and to the correlation between metal elements (Cu, Zn, Ni) and redox values, which correspond to quite stable reducing conditions.
The spatial and temporal geochemical homogeneity of the sediments of these Dominican reservoirs contrast with the heterogeneity observed in most of the world artificial lakes which show the influence of multiple factors over inorganic and organic sedimentation. These influences are superimposed by the extreme climatic conditions that are annually registered which lead to high rates of particles leaching from basins and a great hydrological and sedimentary dynamism.