Stratigraphy and sedimentary process in a closed-basin lake in Central Italy during the Anthropocene

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Shallow and closed lakes are affected by meteorological and climate variations and are especially sensitive to the change in their hydrological balance. In central Italy, there is the fourth-largest lake of the country, the Trasimeno Lake, whose water level has undergone various fluctuations over the centuries with alternation of flood and drought periods because of its shallow depth and the absence of natural outflows [1].

Sediment archives are used as information records to study chemical, physical, and biological environmental variations and changes in the hydrological budget driven by climatic fluctuations, but this is particularly complicated in shallow lakes due to the multiple perturbative phenomena. A robust study depends on the ability to obtain valid high-resolution geochemical data from lake sediments.

We conducted high-resolution geochemical analysis on three sediment cores about 1 meter long each, collected in Lake Trasimeno. We sectioned at 1 or 2 cm interval, which provided a detailed characterization of the significant changes in lacustrine processes that occurred in the basin during the Anthropocene (~last 150 years) [2], combining quantitative chemical (ICP-OES) and semi-quantitative (XRD and SEM) investigations. Geochemical variables are used as paleolimnological proxies to reconstruct past lake events that occurred within the water column. In particular, we report the study of the endogenic precipitates characteristic of the Trasimeno sediments, whose precipitation processes have been influenced by water fluctuations and anthropogenic impacts.

Given the strong presence of water fluctuations, the investigation period was divided into three distinct phases related to the lake's hydrometric state and characterized by sedimentary compounds of different nature. The endogenic carbonate compounds of calcite (commonly present in the Trasimeno sediments) contain a different Mg percentage during the different hydrometric phases. The lake sediments are particularly rich in Mg-calcite due to both water level changes and biological effects. Moreover, co-precipitation of non-crystalline Ca-P compounds (e.g., apatite type) has been detected during a hydrometric phase characterized by high microorganisms activity. Precipitation processes were triggered in Trasimeno by the growth of nutrient discharge into the lake (since the 1970s) and are currently studied for their importance in controlling eutrophication phenomena.
In conclusion, our findings show that rapid lake responses to water fluctuations and climate variations were transcribed within the sedimentary stratigraphic archives, which underlines their value and high quality in paleoenvironmental and paleohydrological reconstruction.

References:
