Environmental quality assessment of sediments settled in an artificial lake, the case of Ridracoli Lake

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Introduction: Ridracoli lake is a reservoir for water supply located in the Foreste Casentinesi-Monte Falterona-Campiglia National Park, between Romagna and Tuscany in Italy. The lake, formed by the construction of a dam, operates since 1982 for drinking water storage and hydropower generation. In reservoirs, the sediment settles along the bottom where it becomes trapped and, without sustainable management, it might reduce the volume for water storage influencing water quality. Sediments accumulation, dynamics and quality are often of concern in an artificial lake management, but assessment tools as geochemistry and modelling can help. The aims of this work are to quantify the amount of sediment that has been settle since the construction of the dam and to characterize the quality of the sediment following the Italian regulatory framework and in particular the *sediment quality guidelines*.

Methods: The amount of sediment deposited was estimated using bathymetric data collected in 2015 and hystorical maps (raster) elaborated in Q-GIS to assess the bottom sediment morphology and its evolution. Sediment samples were taken from 6 stations within the area of the lake during a sampling campaign undertaken in June 2018 (Figure 1). Total composition was determined by X-ray fluorescence spectrometry (XRF) and pseudo-total composition using aqua regia digestion and ICP-MS [1]. The organic carbon and nitrogen contents were evaluated using an elemental analyzer (CHN-S). In addition, we performed geostatistical analysis.

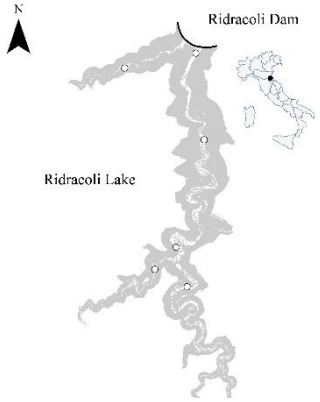

Fig. 1: Ridracoli Lake shape and sampling stations.

Results: Data obtained from model and analysis allowed to quantify and have a quality assessment of the sediment inside the Ridracoli reservoir.
Existing data show a minimum reduction of the reservoir volume with a siltation rate of 0.08%, although European reservoirs with a similar size showed a depletion rate averaging 0.51% per annum [2]. The chemical composition of the sediment, rich in clay minerals and carbonates, is directly related to the geology of the area which were subjected to massive turbiditic events [3]. Thanks to geostatistical analysis coupled with the chemical characterization we noted a direct correlation between elements and Al (clay minerals). Furthermore, iron and manganese oxides occur in the bottom sediment, in which elements, (e.g., Cu, Cr, Ni, V) are probably absorbed according to the correlation matrix analysis.

Discussion: After the characterization of sediment and the comparison with guidance limits [4], we found no alarming concentrations for selected metals, so the function of the potable water of the reservoir is likely not affected. It is also possible to envisage a ground basis for a more effective management in a hypothetical scenario where the sediment can be reworked for afteruse.

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