

Speciation of P in iron rich solid phases of a high mountain lake, a study at the micron scale on the LUCIA beamline

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Abstract:

We are studying the origin of the eutrophication of a high mountain lake (Joeri Lake XIII, Silvretta mountain range, Switzerland) that, although pristine, has evolved from an originally oligotrophic glacial melt lake into a mesotrophic lake with an elevated concentration in phosphate [1]. In the catchment area of the lake, reddish and blackish mineral coatings are observed on blocks and pebbles. These crusts are characterized by a strong enrichment in P, and Fe and Mn oxide mineralization [2]. Mineral forms as well as their physical and structural parameters must be affected by microbial activity, free phosphate, and competing ions.

To achieve this objective, we are working on the LUCIA beamline (SLS - synchrotron SOLEIL). It is a "tender" (0.8-8keV) X-ray microprobe with capabilities for elemental mapping by μ XRF and for chemical speciation by μ XAS. It allows measuring heterogeneous samples at a micron size combining these two element-specific and non-destructive techniques [3].

We have conducted first investigations on mineral crusts taken from the lake influent and the effluent. Mapping of the elements shows a heterogeneous, patchy or lamellar distribution of Fe- and Mn- enriched zones. P, Al and Si are also detected. Phosphorous exhibits a distribution correlation with iron. To characterise the phases, μ XAS experiments were performed at P, Fe, Mn, Si and Al K-edges. These first investigations suggest that the association between P and Fe cannot simply be described by adsorption whereas crystalline phosphate phases are not detected either. Experiments and data analysis are still in progress.

References:

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