Bacterial formation of Fe-phosphates in the water column of meromictic ferruginous Lake Pavin (Massif Central, France)

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Lac Pavin (Massif Central, France) is a deep (~92 m) stratified crater lake with anoxic and ferruginous conditions developing in the water column below ~60 m depth. Previous geochemical studies have shown that dissolved Fe(II) and phosphate (PO_4) are present at high concentrations in the anoxic monimolimnion (resp. ~1200 µM and 300 µM) and predicted the formation of vivianite ($Fe(II)_3(PO_4)_2 \bullet 8(H_2O)$) in this layer [1,2]. We performed a detailed characterization of the mineralogy of the settling particles in the water column, and determined the potential role of anaerobic bacterial communities in Fe and P cycling in the lake. Bulk x-ray diffraction and x-ray absorption spectroscopy analyses were used to characterize the mineralogical composition and Fe redox state of Fe-bearing particles collected at different depths in the water column and sediments deposited at the bottom of the lake. In the oxygenated layer of the lake, Fe is hosted by phyllosilicates and Fe-(oxyhydr)oxides (FeOOH). Amorphous Fe-phosphates form close to the redoxcline, whereas vivianite becomes dominant in the monimolimnion. FeOOH are preserved throughout the water column and undergo reductive dissolution at the surface of the sediments, where vivianite becomes the main Fe-bearing phase. These results were confirmed by electron and scanning transmission x-ray microscopies, which showed heterogeneities in the composition and Fe redox state of the particles at the submicrometer-scale. Fe-phosphates were moreover observed to encrust microbial bodies. Based on comparisons with laboratory experiments [3], we propose that the precipitation of Fe-phosphates results from the activity of Fe-oxidizing bacteria. Polyphosphate-accumulating microorganisms could also participate in the formation of Fe-phosphates by concentrating PO_4 in the monimolimnion.

[1] Michard *et al.* (1994), *Chem. Geol.* 115, 103-115. [2] Viollier *et al.* (1997), *Chem. Geol.* 142, 225–241. [3] Miot *et al.* (2009), *Geochim. Cosmochim. Acta* 73, 696-711.

Mass specific magnetic susceptibility as a proxy to differentiate soils within the humid subtropical region

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Magnetism (χ_{LF}) In Soils

Mass specific magnetic susceptibility (χ_{LF}) data were used to differentiate soils within the humid subtropical region of Brazil. Soils with different degree of weathering and formed under different edaphoclimatic conditions had very different magnetic behabior.

Data collected in the fine earth and clay size fraction of soils from a 200.000 Km^2 area of Paraná State-Brazil shows χ_{LF} values ranging from zero to more than 10.000 10^{-8} m^3 kg^{-1}. Coarse grained multidomain magnetites were present in the sand and silt fractions of the soils while maghemite was detected in the clay size fraction. Higher magnetite contents were found in soils developed from basalts in Latosols/Oxisols. The χ_{LF} values observed for the the soils with poor drainage conditions were low ($< 100 \times 10^{-8}$ m^3 kg^{-1}) but not all magnetite from the coarser fractions were reduced and dissolved. In the clay size fraction quantification of the iron oxides [1] shows that maghemite is the iron oxide responsible for the χ_{LF} values and detailed X-rays diffraction data that soil maghemites have extended degree of Fe for Al isomorphous substitution that decreases with increasing soil pH and less intense weathering conditiions (lower average rainfall and temperature) [2]. Important bioavailable metals such as Cu, Mn, Zn and Co presented strong correlation with the χ_{LF} values specially with the magnetite content..

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