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Structure and reactivity of biogenic iron (oxyhydr)oxides: control of arsenic mobility in anaerobic environments and in acid mine drainage

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Iron (oxyhydr)oxides widely occurs in earth surface environments, including soils, sediments and aquifers. Owing to their large specific area, these minerals can adsorb efficiently trace elements, as arsenic. Microorganisms are able to (trans)form iron minerals, directly by enzymatic oxidation or reduction and indirectly by complexation to organic compounds, and thus potentially play an important role in the cycling of trace elements. For example, bioreduction of ferric (oxyhydr)oxides is known to be responsible for the arsenic contamination of some important groundwaters resources throughout the world. In contrast, biooxidation of Fe(II) largely contributes to arsenic immobilization, especially in acidic environments.

We will present recent investigations of natural and model systems, using X-ray Absorption Spectroscopy (XAS) and electron microscopy, illustrating the relation between the crystal chemistry of arsenic and its speciation and distribution at the Earth's surface. Our findings show the importance of arsenic adsorption on, or coprecipitation with, ferric oxides in delaying the long-term impact of As on the biosphere, in both anoxic and oxic media. Evidences of bacterial oxidation and reduction of iron and arsenic in field studies reveal that arsenic mobility often depends on spatial and temporal variations of bacterial activity.