



Ferric deposit at riverbank surface: redox filter between wetland and river

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Riverbank is the exchange zone between the soil and the river alongside the bed of a river between which the flow is confined. The redox conditions roughly change at this interface due to the seasonal changes and the strong presence of O₂ in surface. Riverbank thus plays the role of the redox barrier/filter between soil and river, controlling the chemical speciation, bioavailability, toxicity and mobility of major and trace elements (nutrients, metals and metalloids) as well as organic compounds. Iron speciation between solid and aqueous phases is largely controlled by redox conditions, which govern the Fe oxidation states and the thermodynamic stability of solid phases. At such redox interface, soluble Fe(II) precipitates as solid Fe(III) at the surface due to oxidation process driven by O₂ entering anoxic systems.

The present study aims at determining the Fe speciation in riverbank containing ferric deposits at the redox surface between wetland and river and the environmental impact on the ability of iron oxide to trap chemical elements. Riverbanks samples were collected from the Mercy riparian wetland of Kervidy-Naizin located in Brittany (France). Their chemical and mineralogical compositions have been determined. XANES analyses have been performed at LUCIA beamline in SOLEIL to determine Fe speciation.

XANES results on total bulk fraction (<2mm) show that Fe is mainly hosted by goethite (23-36%) and muscovite (up to 35%) at the riverbank subsurface, when Fe is progressively hosted by ferrihydrite, goethite and Fe-clusters bound to organic matter (OM) at the riverbank surface (16-31%, 23-36% and 29-41%, respectively). XANES analysis on clay fraction (<4 μ m) has additionally permitted to detect the presence of Fe hosted by lepidocrocite (up to 34%). Modification of Fe speciation is accompanied by change of Fe and trace metals concentrations. Iron concentration gradient is observed between the subsurface (from 2.9 to 4.3 wt%) and surface (up to 11.1 wt%). Trace metals concentrations demonstrated that As, Co, Cu, Mn, Ni, Pb, Sb, Zn and REE (especially Ce, La and Nd) are also systematically enriched in riverbank surface. In contrast, Cr contents do not show any difference between surface and subsurface.

Enrichment of some trace metals are correlated with the increase of Fe hosted by ferrihydrite and Fe-OM and the Corg content. Goethite, lepidocrocite and clay mineral do not appear as reactive phases to act on the chemical element mobility. Therefore, the formation of amorphous structures (ferrihydrite and Fe clusters bound to OM) on riverbank surface and their strong surface-sorption capacity appear to control chemical elements speciation (As, Co, Cu, Mn, Ni, Pb, Sb, Zn and REE) and their transport/mobility at this redox interface between wetland and river.