Fungi-mineral interface : hotspot of weathering in soils

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Throughout geological times, tectonic forces have continuously exposed rocks to the slow but inexorable actions of weathering at the Earth's surface. This geological process forms soils upon which the entire terrestrial biosphere depends. Weathering of primary rocks also has a key-role in the carbon cycle as the alteration of Mg- and Ca- silicates coupled to the deposition in sediments of Mg- and Ca-carbonates results in a net flux of CO_2 from the atmosphere to the lithosphere. Over geological timescales, this transfer controls atmospheric CO_2 levels and hence the climate. Initially conceptualized in terms of abiotic dissolution reactions alone, there is now growing evidence that plants and their root-symbiotic partners, mycorrhiza, are key to the weathering because of their impressive capacity to interact physically and chemically with minerals.

In soils, mycorrhiza grow preferentially around, and on the surface of nutrient-rich minerals, making such contact zones potential hot-spot of mineral alteration. Here, we present a compilation of results and observations from alteration experiments in which ectomycorrhiza (*Paxillus involutus*) were grown symbiotically with a pine tree (*Pinus sylvestris*) in presence of freshly-cleaved biotite under humid, yet undersaturated, conditions typical of soils. Using FIB (Focussed Ion Beam), cross-sections of fungi-biotite interfaces were sampled along single, surface-bound hypha and analysed for (i) their contents in Si, O, Fe, Al, Mg and K at a nanometer-resolution (by STEM-EDS) and for (ii) the speciation of redox-sensitive elements (by STXM) [1]. In parallel to the biotite characterization, the chemical conditions in the near-environments of hypha and their biochemical composition were analyzed by molecular probes coupled to confocal microscopy and synchrotron-based μ-FTIR. This dataset shed light into mechanisms and also allowed for a first estimation of chemical alteration rates at the interface between fungi and rock-forming minerals [2].

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XAS and isotopic approaches to identify Zn and Cu sources in the Seine River watershed

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In order to preserve the global freshwater resource, new directives on water policy have been established imposing a good ecosystem status for 2015. For the Seine-Normandie basin, it includes the metals sources determination in order to identify the metal amount resulting from the geochemical background, and the metal amount arising from industrialisation. The combination of isotopic and XAS approaches should allow to identify the different sources, and to understand the different processes controlling the Zn and Cu cycling. Variations on the $\delta^{66}Zn$ and $\delta^{65}Cu$ can provide information relative to the main sources of metals. XAS spectra study (through the knowledge of Zn and Cu speciation) is needed to understand the processes acting on the rivers (isotopic fractionation induced by biogeochemical processes [1,2,3] versus water mixing) and determine the bioavailability of Zn and Cu. As a potential Zn source, the sediment dynamics in the river have been investigated. To do so, sediment traps representative of river bottom sediments have been analysed using XAS at the Zn K-edge. In these samples, poorly crystallized Zn sulfides constitute the Zn major species, and could explain the presence of ZnS in suspended particulate material in the river water column. In addition, two "geographic" sampling campaigns have been performed to estimate the impacts of the different environmental conditions on the Zn/Cu signal, and to help locating the potential metal sources in the system. These two campaigns highlight a general seasonal effect linked to the discharge, in addition to punctual concentration anomalies.

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