Iron speciation and aging in organic-rich aquatic systems

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Iron is ubiquitous in natural environments and used widely in engineered treatment systems as a coagulant or adsorbent. These systems typically contain dissolved organic matter which may influence both speciation and time- dependent transformation of iron species present. In an attempt to understand the speciation and transformation of iron in organic-rich systems, a ferric salt was added in a controlled way to supernatant from a bench-scale membrane bioreactor high in soluble microbial products (SMP) and the system allowed to age and the reductive reactivity of Fe examined. In particular, for each aging time, ascorbate was added to these samples in varying concentrations. The formation of Fe(II) upon reduction of Fe(III) species by ascorbate was measured using ferrozine colorimetry [1].

Following Wang and Waite [2], we assumed the Fe(III) to be present as either weakly bound Fe(III)SMP, strongly bound Fe(III)SMP and AFO. The relative distribution of iron into these forms and their rate constant for ascorbate reduction are shown in Figure 1. It was observed that despite AFO being the most stable form, dissolved Fe(III) mainly exists as strongly bound SMP complexes with weakly bound Fe(III)SMP turning negligible after extended aging.

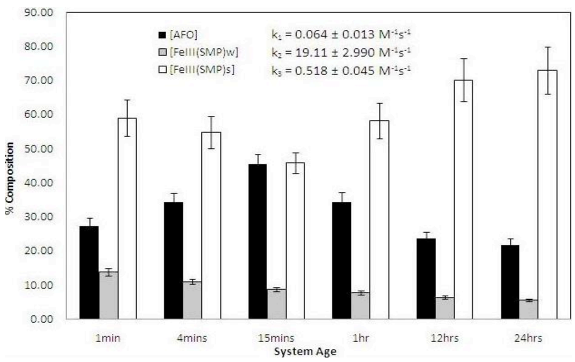

Figure 1: Relative composition of Fe(III) species and their corresponding ascorbate reduction rate constants.

[1] Viollier *et al*. (2000) *Appl. Geochem*. **15**, 785-790. [2] Wang & Waite (2010) *Water Research* **44**, 3511-3521.

Microbial communities colonising bedrock outcrops in a Swedish forest

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We are using mor-layer covered bedrock outcrops as a model system to study patterns of microbial colonisation of rocks and biogeochemical processes that lead to mobilisation of mineral nutrients essential for plant growth and ecosystem function. The nutrients released from the bedrock are utilised by the microbial community, taken up directly by roots or transported to roots via mycelia of ectomycorrhizal fungi that form symbiotic associations with tree roots. We are testing the following hypotheses: (1) Microbial communities that have the ability to weather minerals or capture mobilised nutrients will increase in relative abundance or activity on the rocks compared to the overlying organic mor-layer. (2) Ectomycorrhizal fungal communities make a major contribution to the biological weathering of minerals/bedrocks in forest ecosystems. Bedrock outcrops colonised by ectomycorrhizal fungal mycelia/tree roots should therefore have a relatively higher concentration of organic acids than the rocks colonised by mosses or apparently bare rocks. (3) Since the organic sources of C tend to have a very low $\delta^{13}C$, we expect that the rock surfaces that exhibit varying degrees of biological weathering would also reflect differences in their $\delta^{13}C$ signatures depending on the level of biological activity (deposition of C in the form of organic acids/microbial biomass, root exudates and solubilised organic matter etc). To test hypothesis 1, we are analysing fungal and bacterial communities colonising rocks using 454- pyrosequencing. To test hypothesis 2, the rock surface minerals are being used for analysis of organic acids using LC-MS/MS. To test hypothesis 3, the rock surface minerals are being used for analysis of $\delta^{13}C$ using IRMS.

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