

## Fe(III) bioreduction in a mixed oxide-colloidal clay system

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*In natural environments, iron oxyhydroxides and clay minerals are often closely associated in microaggregates. Their physico-chemical interactions play a major role in stabilizing soil or sediment structure and in biogeochemical cycling of nutrients and carbon [1]. The presence of iron-rich minerals could, in one hand, increase aggregates stability and in the other hand, promote bacterial dissimilatory iron reduction and the transformation of mineral aggregates. Indeed, many bacterial species are able to generate energy for growth by coupling the oxidation of organic and inorganic compounds (carbohydrates, lactate, formate, H<sub>2</sub>) with the reduction of insoluble iron(III) [2]. As a function of the physico-chemical conditions, the soluble Fe(II) generated by such bio-reduction processes could form secondary iron-rich phases. However, the concomitant biomediated processes of reduction and precipitation of iron in a mixed mineral system “oxide-clay” are poorly known and are, thus studied herein.*

*To this purpose, several mixtures of akaganeite (b-FeOOH) and colloidal nontronite (Na<sub>x</sub>Fe<sub>2</sub>(Si,Al)<sub>4</sub>O<sub>10</sub>(OH)<sub>2</sub>) were incubated in the presence of an iron-reducing bacterium *Shewanella oneidensis* MR-1. Nontronite/Akaganeite ratios ranged from 0 to 10% (w/w) and some assays were supplemented with an efficient synthetic electron shuttle (anthraquinone-2,6-disulfonate, AQDS). Samples were periodically collected to quantify soluble, exchangeable and total Fe(II) by the ferrozine assay. The dissolution of the iron-rich smectite was monitored by measuring solubilized silicium and aluminium over the time by ICP-MS. Secondary minerals were determined by X ray diffraction. At the end of the incubation period, mineral fractions and micro-aggregates were characterized by transmission electron microscopy, transmission Mössbauer spectroscopy, X-ray diffraction and particle size analysis.*

*The results indicate that (i) low amounts of nontronite (nontronite/akaganeite = 5%) modifies the shape of minerals aggregates, the rate and the extent of akaganeite bio-reduction (ii) magnetite is the main secondary mineral formed regardless of the nontronite content (iii) the addition of nontronite seems to govern or modify the crystallinity of the magnetite.*

[1] Neumann, A. et al. Atom Exchange between Aqueous Fe(II) and Structural Fe in Clay Minerals. *Environ. Sci. Technol.* **49**, 2786–2795 (2015).

[2] Lovley, D. R. Dissimilatory Fe(III) and Mn(IV) Reduction. *MICROBIOL REV* **55**, 29 (1991).