Fe(III) mineral formation by Fe(II)-oxidizing bacteria – consequences for removal of nitrate

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Microaerophilic, nitrate-reducing and phototrophic Fe(II)-oxidizing bacteria can oxidize dissolved Fe^{2+} and Fe(II) minerals producing poorly soluble Fe(III) (oxyhydr)oxide minerals (1, 2). In this contribution we will first present new data on the isolation of autotrophic nitrate-reducing Fe(II)-oxidizers (NRFeOx) from an oligotrophic, carbon-poor pyrite-containing groundwater aquifer (and other freshwater environments) and show how these microorganisms can contribute via Fe(II) oxidation to nitrate removal. We will discuss their physiology, the identity of Fe(III) minerals produced (X-ray diffraction, Mössbauer spectroscopy) and show their cell-mineral interactions using cryo-focused-ion-beam scanning electron microscopy (cryo-FIB-SEM) and nanoscale secondary ion mass spectrometry imaging (nanoSIMS). The oxidation mechanism of these autotrophic NRFeOx will be compared to the mechanisms of non-autotrophic NRFeOx that depend on an external source of carbon, leading to heterotrophic nitrite formation and abiotic chemodenitrification. The close phylogenetic relationship of the isolated autotrophic NRFeOx bacteria to microaerophilic Fe(II)-oxidizers (*Gallionellaceae*) opens questions regarding their ecological role and metabolic versatility. We will present current attempts to identify the oxidation mechanism(s) in these organisms and how their metabolism also influences other microorganisms, for example phototrophic Fe(II)-oxidizers.

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(2) Maisch, M., Lueder, U., Laufer, K., Scholze, C., Kappler, A., Schmidt, C. (2019) Contribution of microaerophilic iron(II)-oxidizers to iron(III) mineral formation. Environmental Science and Technology 53, 8197-8204.