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Micro-XRD analysis and FIB-SEM Characterization of Cell Mineral Aggregates Formed During Anaerobic Oxidation of Ferrous Iron

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Ferrous iron can be oxidized anaerobically by microorganisms at neutral pH either phototrophically or coupled to the reduction of nitrate. In both cases the microorganisms face the problem of low solubility of the product of their metabolism, i.e. Fe(III). Anaerobic Fe(II)-oxidation represents an important link in iron cycling and iron mineral transformation and precipitation are known to play an important role in trace element cycling and for the fate of organic and inorganic pollutants. Therefore understanding the mechanisms of anaerobic Fe(II) oxidation and the factors controlling the identity of the mineral products is important.

We present high resolution analysis of cell-mineral aggregates of anaerobic Fe(II)-oxidizing bacteria and their produced iron(III) minerals. X-ray diffraction coupled to light microscopy (micro-XRD) reveals the identity of the iron minerals produced by different strains of nitrate-dependent and phototrophic Fe(II)-oxidizers under different conditions. Sectioning samples with a focused ion beam in a scanning electron microscope (FIB-SEM) shows the association of the iron minerals with the cell surface. FIB-SEM allows in particular to look at the 3dimensional structure of the aggregates consisting of Fe(II)-oxidizing cells and Fe(III)-minerals and shows differences in cell encrustation for different microbial strains under different conditions.