

Oxidation of FeS₂ and FeS by MnO₂ in Marine Sediments

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Dissolution of FeS₂ under anaerobic conditions in marine sediments is experimentally shown for the first time in this study. In slurry experiments with ⁵⁵FeS₂ and a MnO₂ rich marine sediment a dissolution of ⁵⁵FeS₂ was detected which decreased with depth and decreasing concentration of MnO₂ in the sediment. FeS₂ and FeS were oxidized chemically at pH 8 by MnO₂ but not by nitrate or amorphous Fe(III) oxide. Elemental sulfur and sulfate were the only products of FeS oxidation, whereas FeS₂ was oxidized to a variety of sulfur compounds, mainly sulfate plus intermediates such as thiosulfate, trithionate, tetrathionate, and pentathionate. Thiosulfate was oxidized by MnO₂ to tetrathionate while other intermediates were oxidized to sulfate. The reaction products indicate that FeS₂ was oxidized via the Thiosulfate-mechanism and FeS via the Polysulfide-mechanism (Schippers et al. 1996; Schippers and Sand, 1999). The reactions are summarized by the following equations:



For FeS₂ oxidation the reaction rates related to the mineral surface area were 1.02 and 1.12 nmol m⁻² s⁻¹ for total dissolved S and total dissolved Fe, respectively. Since these values are in the same range as previously published rates for the oxidation of FeS₂ by Fe(III), Fe(III) is assumed also to be the oxidant for FeS and FeS₂ in the presence of MnO₂. At the iron sulfide surface, Fe(III) is reduced to Fe(II) which is reoxidized to Fe(III) by MnO₂. Thus, an Fe(II)/Fe(III) shuttle should transport electrons between the surfaces of the two solid compounds.

Schippers A & Sand W, *Appl. Environ. Microbiol.*, **65**, 319-321, (1999).

Schippers A, Jozsa P-G & Sand W, *Appl. Environ. Microbiol.*, **62**, 3424-3431, (1996).