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Controls on recent pyrite formation in aquatic systems and its relevance for environmental processes

Stefan Peiffer

University of Bayreuth, Hydrology, 95440 Bayreuth

The formation of pyrite has been extensively studied because of its abundance in many anoxic environments such as marine and river sediments, groundwater aquifers, and peat lands, and hence its importance in both iron and sulfur cycling. It forms over a wide pH interval, ranging from acidic to alkaline. It is generally regarded that sulfide reacting with iron-containing minerals forms metastable iron sulfide minerals before eventually transforming into pyrite in the presence of different sulfur.

In this contribution, I will discuss the importance of sulfidation of ferric (oxy)hydroxides (FeOOH), i.e. the reaction between aqueous sulfide and the surface of FeOOH, to stimulate pyrite formation and compare this process with other pathways and kinetics of pyrite formation described in the literature. Sulfidation of FeOOH initially leads to formation of surface bound FeS-species and its transformation to pyrite is controlled by either the availability of FeOOH or the supply rate of sulfide. These kinetic constraints define the environments where rapid pyrite formation occurs to be suboxic, rich in FeOOH and shaped by cryptic sulfur cycling. Under these conditions, highly reactive pyrite precursor species are forming that also affect trace metal cycling.