Resolving Reductive Biomineralization Pathways of Ferric Hydroxides. (S11-fendorf194823-Oral)

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Abstract:

Iron minerals often control the cycling of trace metals, thus having a profound impact on their migration and bioavailability. The cycling of iron in surface and subsurface environments is largely controlled by microbial processes (both direct and indirect). Here we explore biotic, using the bacterium Shewanella putrefaciens, and abiotic transformations of ferric hydroxides to determine biomineralization pathways. Solids were characterized using a host of spectroscopic and microscopic techniques to quantitatively determine the mineral components and to identify microbial-mineral interactions and spatial relationships. Within both abiotic and biotic systems, ferrihydrite converts to goethite and magnetite, with the resulting phase governed, in large part, by Fe (II) concentration. At higher Fe(II) concentrations, magnetite is the dominant secondary phase and goethite at lower Fe(II) concentrations. As a consequence, electron donor availability and consequent microbial activity dictate Fe(II) concentrations and resulting biomineralization pathways. Limited electron donor results in reaction fronts and the conversion of ferrihydrite to goethite at the expense of magnetite.

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