Metal reduction and mineral formation by iron-reducing bacteria

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Microbial reduction of Fe(III) greatly influences the biogeochemical cycles of carbon and many metals. The objective of this study was to identify environmental factors that control metal reduction and mineral formation by iron-reducing bacteria. Psychrotolerant, mesophilic, and thermophilic iron-reducing bacteria were used to examine metal reduction and mineral formation. These iron-reducing bacteria were able to use glucose, pyruvate, lactate, acetate, succinate, and hydrogen as electron donors while reducing iron (III), chromium (VI), cobalt (III), and uranium (VI) at temperature ranges from 0°C to 70°C. The bacteria exhibited diverse mineral formation capabilities including the formation of magnetite, siderite, calcite, hematite, goethite, sergeevite, and uraninite. These iron-reducing bacteria have been shown to coprecipitate other metals such as Co, Cr, Ni, Pd, and U with iron oxides during microbial metal reduction. Results of this study showed that the atmosphere, chemical milieu, incubation temperature, and species of bacteria affected the mineralogy and morphology of iron oxides and iron carbonate minerals. Microbial Fe(III) and metal reduction may play an important role in the formation of Fe(II) containing minerals, decomposition of organic matter, sediment gleying, modification of Fe(III) in clays, immobilization of radionuclides and heavy metals, and carbon cycling in subsurface environments.

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