Iron Reduction by Extremophiles

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Dissimilatory metal reduction influences the biogeochemical cycles of carbon and metals and plays an important role in the bioremediation of metals, radionuclides and organic contaminants. To further investigate their diversity, metal-reducing bacteria were isolated from a variety of extreme environments such as deep terrestrial subsurface, Siberia and Alaska permafrost soils, deep marine sediments and Hawaii deep-sea water. Thermophilic isolates from terrestrial subsurface formations that had been geologically and hydrologically isolated for about 200 million years were able to use glucose, pyruvate, lactate, acetate and hydrogen as electron donors, and were able to reduce iron, manganese, chromium and uranium, as well as produce magnetite at 50-95°C. Those bacteria exhibited diverse mineral precipitation capabilities including the formation of magnetite, siderite, and uraninite. The partial pressure of carbon dioxide and ionic species composition exhibited profound influences on the type of minerals in these anaerobic cultures. The psychrotrophic isolates were able to use iron, manganese, and cobalt as electron acceptors, and were able to produce magnetite at 0°C. A few isolates were able to reduce cobalt at - 4°C. Phylogenetic analyses indicated that the thermophilic iron-reducing bacteria were closely related to *Thermoanaerobacter ethanolicus* whereas the pychrotrophic iron-reducing bacteria were related to the members of the *Shewanella* genus. The partial microarray containing about 1000 genes from *Shewanella oneidensis* MR-1 were constructed and used to monitor gene expression patterns under anaerobic conditions and compare genomic diversity among the psychrophilic iron-reducing bacteria. Substantial differences in gene expression patterns were observed under aerobic and anaerobic conditions. It appears that the genes involved in iron reduction were reasonably conserved among these bacteria.

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