Microbial Formation of Magnetite and Siderite by Thermophilic Bacteria from Deep Subsurface

Y. Roh[1], C. Zhang[2], and T. J. Phelps[1]
[1]Environmental Sciences Division, Oak Ridge National Laboratory
[2]Department of Geological Sciences, University of Missouri-Columbia

Understanding the biogenic formation of magnetite and siderite by thermophilic (45 - 75℃) bacteria is essential to the search for ancient biological activities in hydrothermal systems in Earth. The thermophilic iron reducing bacterial strain, TOR39, was isolated from the deep subsurface sediment in Taylorsville Triassic Basin in Virginia, USA. The TOR39 produced magnetite and siderite using amorphous iron hydroxide as an electron acceptor and glucose as an electron donor. Minerals precipitated under a nitrogen atmosphere were predominantly diamond shaped-single domain magnetite. In the presence of 20% headspace CO_2 a mixture of magnetite, and iron rich carbonate such as siderite formed. Environmental conditions, incubation time, and incubation temperature exhibited profound influences on type of minerals precipitated in anaerobic microbial cultures. Microbial Fe(III) reduction and iron mineral formation may play an important role in (a) implications for geological history and for paleomanetism in the rock records, and (b) microbial reduction and coprecipitation of heavy metals and radionuclides from subsurface sediments.