

# Interaction between minerals and microbes in the Earth surface, and its evolution

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Interaction between minerals and microbes in the Earth surface, and evolution the Earth Surface were reviewed. Some examples of the interaction between bacteria and minerals are shown as follows. Hypothesis of Mn-nodule being deep sea stromatolite with fractal-like characteristics was demonstrated based on mineralogical descriptions by LM, SEM, HRTEM, XRD, X-ray CT imaging and mathematical simulation.

Iron Ore deposit in Gunma Iron Mine was described and clarified as Biologically Induced Iron Ore deposit. This Iron mineralization is showing contrast to mineralization in Precambrian iron formation.

Placer Gold samples from Sado Island were mineralogically examined and biological signatures were suggested. Nano size gold grains were accumulated by bacteria and diatoms in the experiments.

About As contamination of groundwater in Asia region, there were two possibilities of oxidative or reductive dissolution. The mechanism was experimentally examined from the standpoint of mineral-microbe interaction. The dissolution mechanism of As was demonstrated as reductive dissolution by accelerated reducing the environment by bacterial action.

Cs contamination in the environment by Fukushima Dai Ichi NPP Accident was examined by using bacteria obtained from litate village. Culture experiment using the bacteria, non radioactive 1% CsCl solution and culture medium showed that 38% Cs accumulation in the globule inside the bacteria. This suggests some role of bacteria in the future re-circulation of Cs in the environment.

Framboidal pyrite is common material in the muddy sediments and we found icosahedral framboid.

Formation of framboidal pyrite by adding culture medium of sulfate reducing bacteria was found.

Magnetotactic bacteria were examined mineralogically. Evolution order of magnetosome form was suggested as follows; octahedral, to hexagonal prism and finally to tear drop type. This is supported in the magnetic domain diagram (Banerjee and Butler, 1975). The formation of the magnetosome may be related to the origin of Biologically Controlled Mineralization.

Furthermore, principles of Mineral behaviour are discussed from thermodynamics and the concept of 'mineral evolution' by R. Hazen (2008) was also examined. Finally, Earth Surface evolution and the key role of minerals as 'nodal point' in the evolution are emphasized.

Keywords: mineral-microbe interaction, Earth Surface, evolution, Mn-nodule, Biologically Induced Iron Ore, magnetotactic bacteria