

Environmental conditions of the heavy-metal deposition mediated by microorganisms under the seafloor

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In relation to the formation of manganese nodules and crusts on the ocean floor, many investigators have proposed that microorganisms play an important role in the deposition of manganese-oxide from seawater. On the other hand, it is well known that the manganese deposits contain many kinds of heavy metals other than manganese, such as nickel and cobalt. However, we do not know well the effect of microbial mediation on the heavy metal deposition at the ocean floor. In this study, we investigated through biological experiments the possibility and environmental conditions of heavy-metal deposition mediated by microorganisms.

The bacterial slime used in the experiments was collected at the pilot shaft of the Seikan Undersea Tunnel under the Tsugaru Straits of Japan. The bacterial slime is mainly composed of a sheath-bacterium similar to *Gallionella*, which shows strong manganese-oxidation effect (Mizukami et.al., 1999)*. An aliquot (100ml) of artificial seawater containing heavy metals (Mn, Ni, Co, Cr etc.) and a small amount (0.2g) of the bacterial slime were incubated at 25°C, and the changes of metal concentrations with time were analyzed. The results of the experiments showed that Mn in seawater began to decrease rapidly by addition of the bacterial slime and then disappeared completely after four days. The heavy metals other than Mn in seawater were also decreased with time, but the manners of the reduction differ in each metal. For example, Cr decreased soon after the addition of the bacterial slime, Ni decreased gradually, while Co decreased very slowly.

These results indicate that some kinds of marine bacteria not only catalyze manganese-oxidation but also accelerate precipitation of heavy metals other than manganese. Although the mechanism of the metal deposition observed in this study is not clear, manganese-oxidation must play an important role on the propagation of the bacteria. The manganese oxide produced by the bacterial mat shows buserite structure (10-angstrom manganite) which is commonly observed in the metal-rich manganese nodules, suggesting that microorganism may play an important role in the deposition of heavy metals on the seafloor.

Many kinds of manganese-oxidizing bacteria are considered to be autotrophic microorganisms. The bacteria used in this study also lose manganese-oxidizing activity in the solutions containing nutrients in quantity. The environmental conditions at the deep sea may agree with biochemical activity of the bacteria.

*M.Mizukami, N.Mita, A.Usui and S.Ohmori (1999) Microbially-Mediated Precipitation of Manganese Oxide at the Seikan Undersea Tunnel, Japan., Resource Geology Special Issue, No.20, 65-74.