
Formation of Banded Iron-Manganese Structures by Natural Microbial Communities

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Abstract: Microbial structures in the form of banded zebra patterns have been found as periodic iron-manganese layers in living biomats on the coast of Satsuma-Iwo Jima, a small volcanic island near southern Kyushu, Japan. Electron microscopic observation shows that coccus, fibrous, and bacillus-type bacterial communities construct zebra architecture Fe-Mn layers through biomineralization on and within cells. A living microbial fumarolic ferro-manganese precipitation growing in seawater around an active volcanic island explains one mechanism of banded formation. Biological processes form the elemental zebra pattern, with periodic distribution of bacterial cells with Fe-Mn in each layer of the architecture. Fibrous bacteria are sometimes mineralized with goethite, ferrihydrite, and buserite microcrystals, coated with granular mucoid substances. The biomineralization may then mature to form a recent stratified banded-iron formation. The Satsuma-Iwo Jima zebra architecture is unusual in that it forms under aerobic conditions in a warm shallow-water environment, in contrast to the intermittent oxidizing and reducing conditions in which deep-sea analogues develop.

Key Words: Bacteria • Banded Fe-Mn Structure • Biomats • Biomineralization • Zebra Architecture

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