

Genesis of Mn-nodules as deep sea floor bacterial stromatolite

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Since the first finding in 1876 Mn nodules had been problematic in its genesis; Why the shape is nodular? Why not buried: sedimentation rates of the surrounding are much faster than the slow growth rate. Where do the metals of Mn, Fe, Co, Ni etc. come from? Reason of thin rhythmic banding? Biogenic or abiogenic? Akai et al. (2013) has answered these questions; that is, Mn nodule is stromatolite with fractal like signature. Co-rich Mn crusts were also found to have fundamentally the same characters (Akai et al., 2014).

In this report, the author summarizes these results and compares other biogenetic precipitation of Mn oxides.

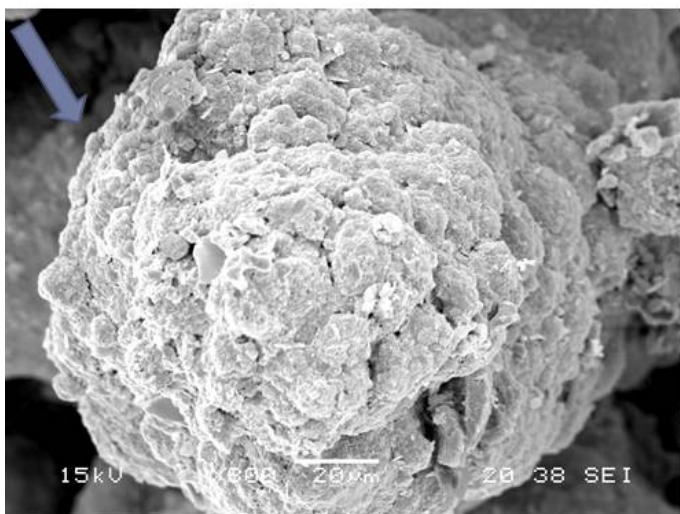
Samples of Mn nodules and Co-rich Mn crust in Pacific ocean were used for mineralogical examinations: Morphology, OM, XRD, TEM, SEM, EDS, HRTEM, X-ray CT, mathematical simulation by assuming fractal morphology.

The results (Figs.) showed the followings: morphology is fractal-like nature; the fourth order corresponds to top dome shapes of the columnar stromatolite structure, which will be mentioned later.

Bacterial signature (fossil) was widely found on the surface and inner structure. Manganese and Iron metabolic bacteria may be symbiotically cooperating to form Mn nodules. Mineralogy of the Mn oxide is characterized by 2.5 Å manganate and/or 10 Å phyllomanganate. Thin rhythmic banding is always found as growth layer, essentially similar dome-like stromatolite and sometimes it is interrupted by some event layer. There is a discussion for this thin layer as Milankovitch cycle (Han et al., 2003). Textural similarity to the present hot spring stromatolite (Akai et al., 1995, 1997) containing Mn-stromatolite is very strong. We have found stromatolite structure also at Onneto-Yunotaki Mn deposit (Kanai and Akai, 2008). Mn-nodule aggregate is apparently a kind of relic of Precambrian stromatolite bio-community.

Keywords: Mn-nodules, stromatolite, biogenic genesis, fractal-like morphology, bacterial biomineralization, Co-rich Mn crust

Typical OM/SEM/TEM images : SEM/TEM indicate bacteria (arrow) ; Mn-oxidizing & Fe-oxidizing bacteria



0.1mm

Mn oxide : Fe oxyhydroxide
Bacterial biomineralization

