Microbialites in chemosynthetic ecosystems

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Microbialites are macroscopically identifiable the earliest evidence of life, which are formed with association of benthic microbial communities and some environmental factors (1). Most microbialites consist of carbonate, but also consist of silica, phosphate, iron- and manganese-oxides, iron sulfides (2), and magnesium hydroxide (3). Previous investigations for microbialites in terrestrial (rivers, lakes, and hot springs) and shallow marine settings revealed that photosynthetic microbes such as cyanobacteria and algae play an important role for microbialite formation (2). However, microbialites are also occurred in some chemosynthetic ecosystems at subsurface and deep-sea settings. Due to the sample availabilities, reports and descriptions of such unusual microbialites were limited so far. Here, I summarize the studies on microbialites at the dark environments, and introduce characteristics on a microbialite that have newly found on 2013 at the Shinkai Seep Field, Southern Mariana.
Some carbonates at deep-sea methane seep sites (4, 5) and in pipeline at the landfill sites (6, 7) contained microbialite textures. Carbon isotope ratio of the carbonates and biomarkers indicated the association of methanogen and/or methane-oxidizer for making microbialite textures. Some iron sulfide deposits near deep-sea hydrothermal vents also exhibited microbialite textures, which have been interpreted as organosedimentary structures associated with various chemosynthetic microbes. A newly discovered chimney at the Shinkai Seep Field consisted of magnesium hydroxide and calcium carbonates, which were interpreted as a product of serpentinite-associated alkaline fluid. Microbialite textures were locally found in the chimney and only consisted of magnesium hydroxide. Scales of microbialites at the chemosynthetic ecosystems were ranged from several mm to cm. In addition, some of them occurred with bivalves and tubeworms. On the other hand, microbialites at the photosynthetic ecosystems occur larger scales at a maximum of several km (2). Further studies for understanding microbialites at the chemosynthetic ecosystems will provide useful information for reconstruction on early life from ancient microbialites.
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