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Distribution of carbonate minerals and morphological observation by SEM in Okuoku-hachikuro hot spring, Akita Prefecture

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Recent studies of biomineralization mainly treated biominerals produced by evolved organisms. There exist uncertainties if primordial microbes are precipitating biominerals. In addition, importance exists to examine interaction between primordial microbes and minerals to constrain the pre- to early- biotic mineral-organic interactions.

Okuoku-hachikuro hot spring, located in Kosaka, Akita Prefecture, Japan, is a hot springs where carbonate minerals are precipitating. In this hot spring, aragonite is dominating minerals in entire area. Color of hot spring precipitates change from red to mixture of red and green, corresponded to difference in microbial type: Fe-oxidizing bacteria to cyanobacteria. We collected sinters, soft to solidified sediments and microbial mats then constituents were observed using field emission-scanning electron microscopy (FE-SEM). Analyses of X-ray diffraction, pH, DO, dissolved amino acids and carbon isotope compositions were also performed.

Most samples contain radial aggregates of needle-shape aragonite. Such morphology was found in bubble in the first discharging fluid, which is not influenced by microbial activities. Each needle in radial aggregates seems to be bigger depending on a distance from the discharging point. Aggregates of coarser and random orientated needles of aragonite are found in lower stream zone, where evaporation and cooling of hot spring water are more visible. Because of no systematic correlation to biological activities (microbial mat, amino acid, organic carbon, etc.) to those morphological changes, all aragonites are formed inorganically. On the other hand, ferrihydrite covering sheath of Fe-oxidizing bacteria and cyanobacteria are found locally. It is noteworthy that no ferrihydrite showed perfect crystalline signature or conversion to hematite. They can possibly be influenced by microbes or organic molecules. Furthermore Si was detected in ferrihydrite. This result suggests that ferrihydrite probably adsorbs amorphous silica selectively.

Keywords: aragonite, ferrihydrite, Fe-oxidizing bacteria, cyanobacteria, biomineralization, FE-SEM