Geological and geochemical studies of stromatolites and associated rocks of ca. 1.9 Ga Gunflint formation, Canada.

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Paleoproterozoic is an important age in the evolution of life, in particular for the rise of eukaryotes and the diversification of prokaryotes. Paleoproterozoic stromatolitic cherts record such microbial evolutions, while environmental factors have been poorly constrained. To approach this problem, geological surveys and geochemical studies were performed on stromatolitic cherts and associated rocks in the 1.9 Ga Gunflint Formation.
The geological survey revealed that stromatolitic chert layers, in the Mink Mountain locality, host various quartz and calcite veins. The distribution and observation of those veins indicated the shallow submarine hydrothermal activities during and after stromatolite formations. The chemistry of the hydrothermal fluids transited from CO_2-rich to SiO_2-rich, and then to H_2S-rich stages.
Examined stromatolites were highly silicified and rich in hematite. One stromatolite contained blocks of calcite aggregates along the stromatolite lamina. Pyrobitumen were recognized among these calcite blocks. This finding suggests the hydrocarbon seeping was active during stromatolite formation, most likely accompanied by shallow hydrothermal activities. This seep produced oil-bearing carbonate mounds, which collapsed and deposited onto stromatolites.
Typical hydrothermal or seep-derived elements, such as Co, Ni, Cu, Zn, Mo, and W, were detected in the stromatolite. This suggests that stromatolites were developed where the flux of hydrothermal or seep components was high. Coffinite ($(U(SiO_4)\cdot 2H_2O$) was newly discovered in pyrite crystal in a stromatolite, accompanied by pyrobitumen. This indicates that the uranium was carried by seep and fixed as coffinite via microbial activities in stromatolites. Those data imply how hydrothermal/seeping sites were the cradle for the Gunflint microbial life.

