Mo and Zn-bearing carbonaceous layer in the oldest volcanogenic massive sulfide deposit: the oldest enzymatic action?

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The importance for the submarine hydrothermal area on the early Earth has been emphasized by many previous investigators. The oldest volcanogenic massive sulfide deposit (ca. 3.2 Ga) occurs in the Panorama district, western Australia. It has been known that some volcanogenic massive sulfides contain kerogenous and bituminous organic matter; the shape of the organic matter seems often microbial-like form. Spatial relationship between organic matter and massive sulfides and distribution pattern of the bio-essential elements are revealed in this study.

The surface rocks in the Sulfur Spring region are not suitable for the scientific analyses, because of the heavy modern weathering. Drilled core materials were used in this study.

The drilled core samples cover the following stratigraphy: lowest volcanic rocks, massive sulfide, carbonaceous layer and marker chert. The lowest volcanic rocks are footwall rocks of the massive sulfides and altered intensively by the 3.2 Ga submarine hydrothermal activities.

Concentrations of organic carbon in the carbonaceous layer is rather high, up to 10 wt %C, but essentially no organic carbon was detected within altered volcanic rocks and massive sulfides. These suggest that the microbial activity was high at the late submarine hydrothermal discharging stage. Some organic matter occur as colloform or stromatolite-like structure. These are interpreted as ancient colony of microbial life forms developed around discharging zone.

It is found that Mo and Zn are enriched in carbonaceous zones. Mo and Zn are bio-essential elements to activate many enzyme. Probably Mo and Zn were trapped in micro-organisms first from hydrothermal solution. Then concentrated in carbonaceous layers. If it was the case, this is the first report for the oldest enzymatic actions.