Interaction of organic matter and submarine hydrothermal fluids on the early Earth: its importance for origin of proto-enzyme and early microbial activities

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Prebiotic or biotic organic matter on the early Earth were most likely interacted with submarine hydrothermal fluids intensively. Such interaction may have produced unique chemical species, which could promote chemical evolution and activity of early life, although no data are available. In order to approach such problems, organic matter associated with Archean submarine hydrothermal deposits were studied in the present study.

It is found that sulfide ores at the 2.7 Ga Potterdoal and Schreiber deposits contain various forms of pyrobitumen. Hydrothermally altered basalts also contain various forms of oil-bearing materials. The fluid inclusions in hydrothermal quartz contain methane. Those discovery suggest that submarine hydrothermal activities on the early Earth behaved as geo-reactors to convert and recycle organic matter into various forms. Carbon isotope data of organic matter in sulfide ores suggest that productivities of hydrothermal microbial communities were controlled by products from the geo-reactors.

Such geo-reactors could produce abundant methanethiol, which might be the key molecule for prebiotic enzyme formation. Nano-scale C-S-metal compounds were found in organic matter deposited around Potterdoal and Schreiber deposits. Such metal compounds were similar to enzyme in chemistry and scale. They were most likely produced by using hydrothermal methanethiol. Such discovery from nature leads to propose the new pathway to form proto-enzyme using geo-reactors.

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