[JJ] Evening Poster | B (Biogeosciences) | B-BG Biogeosciences & Geosphere-Biosphere Interactions

[B-BG02]Interrelation between Life, Water, Mineral, and Atmosphere

convener:Ken Takai(Extremobiosphere Research Center, Japan Agency for Marine-Earth Science &Technology), Kentaro Nakamura(Department of Systems Innovation, School of Engineering, University of Tokyo), Yuichiro Ueno(東京工業大学大学院地球惑星科学専攻, 共同), Yohey Suzuki(Graduate School of Science, The University of Tokyo)

Mon. May 21, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)

Life on Earth is based on a diversity of physical and chemical dynamics and processes throughout the history. Interaction between life, water, mineral (rock) and atmosphere is a key to understand co-evolution of Life and Earth. It is a brief since the pioneers proposed this session almost 20 years ago. Current JpGU meeting is filled with international- and interdisciplinary-joint sessions with similar aims to this session in responding to surrounding situations of JpGU and earth science field in Japan. Conveners believe that this session has provided an excellent opportunity to discuss such interdisciplinary research results and directions for about 20 years but are also afraid if this session may complete the initial goal. It is a matter for JpGU members to decide. This is a final call whether this session will continue in future. If you need this session, you will submit abstract of your research to this session for oral presentation with your intension. If we have less than 12 abstracts for oral presentation, we will cease this session in 2018. Join to this session!

[BBG02-P04]Geochemical study on the sulfide and organic matter at the Potterdoal deposit in Abitibi Greenstone Belt in Canada

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Keywords:Archean, Hydrothermal activity, Volcanogenic Massive Sulfide (VMS) deposit, Methanotroph

The early Archean seafloor hydrothermal vents are often considered as a cradle of early life [1]. The seafloor hydrothermal activities, in particular, became intensive at ca. 2.7 Ga and they formed volcanogenic massive sulfide (VMS) deposits, possibly containing organic matter [2]. However, it is poorly constrained that what was the original source of hydrothermal sulfur to form VMSs in ca. 2.7 Ga and whether the organic matter was originated by chemoautotrophs around hydrothermal vents or by the other possibility. Although the high activity of methane-oxidizing bacteria has been proposed in ca. 2.7 Ga oceans [3], ambiguity still have existed for production of methane in the ocean at that time. To reveal the biosphere and hydrosphere associated with the hydrothermal activity at that time, geological survey was conducted on the Munro township area located in the 2.7 Ga Abitibi Greenstone Belt in Canada. It hosts Potter and Potterdoal VMS deposits. The purposes of the present study are (1) to reconstruct ore forming processes and the source of sulfur at the Potterdoal deposit; (2) to constrain the microbial activity in relation to the ambient ocean water and hydrothermal activities at the Potterdoal deposit; (3) to propose the generalized microbial activities in the entire area of 2.7 Ga Munro oceans in comparison to our previous geochemical data from the Potter deposit.

At the Potterdoal VMS deposit, massive sulfides were dominantly composed of $CuFeS_2$, ZnS and FeS_2. Massive sulfides showed layered structures suggesting that sulfide precipitation on the ocean floor. Chemical compositions of ZnS suggest that all sulfides were precipitated at constant f_{S2} conditions (around 10^{-10}) under thermodynamically equilibrium conditions. Chert and sandstone appeared in the distal area from VMSs and those sedimentary rocks were often brecciated by veining by of the

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hydrothermal fluids following VMS. The sulfur isotope composition ($d^{34}S$) values of the bulk VMSs ranged from -0.1 to +2.0 ‰ (CDT) and those values of pyrite in chert and sandstone were from +5.0 to +6.9 ‰ (CDT). So total variation of $d^{34}S$ values was 7 ‰ and this range suggests the sulfur source of VMSs was seawater sulfate. Since $d^{34}S$ values of sulfate cannot be lower than those of pyrite, they were at least larger than +6.9‰ (CDT) at that time.

The organic carbon concentration of examined bulk samples were 0.0 to 0.5 wt. %C for VMSs, and 0.2 to 1.0 wt. %C for sedimentary rocks, respectively. Raman spectroscopic analyses on isolated kerogen from VMSs and sedimentary rocks showed constant metamorphic grades of all samples and the thermal alteration temperature was estimated as 291 ± 30 °C based on the full widths of half maximum of the D1 band in the Raman spectra of kerogen from VMSs, which indicates less altered features for the Archean rocks.

The carbon isotope composition of organic matter ($d^{13}C_{org.}$) values of all Potterdoal samples ranged from -43.1 to -31.8 ‰ (PDB). Those values suggest the presence of methanotrophs in the ambient ocean water. $d^{13}C_{org.}$ values of Potter samples ranged from -48.6 to -39.6 ‰ (PDB), which are lower and relatively constant than those of Potterdoal samples.

The estimated total mass of VMS at the Potter deposit is about three times as large as the Potterdoal deposit [4]. This probably suggests that a larger hydrothermal system existed at the Potter site. Such difference may have affected thermal degradation of organic matter at both sites. The organic matter at the Potter site suffered additional degradation by thermal decomposition of it, producing more methane to the ocean than the Potterdoal site. Such process may have promoted activities of methanotrophs resulting more ^{12}C-rich feature of organic matter at Potter samples.

References

[1]Baross and Hoffman, 1985, *Origins of Life and Evolution of the Biosphere*, [2]Bekker et al., 2010, *Economic Geology*, [3]Hayes et al., 1994, *Early Life on Earth*, [4]Epp, 1997, *unpublished MSc thesis, McMaster University*.

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