Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

BPT23-12 Room:104 Time:May 25 12:00-12:15

ICA of the ~3.8Ga Isua supracrustal belt BIFs: Implications for the Eoarchean hydrothermal chemistry and processes

AOKI, Shogo[1*] ; KATO, Yasuhiro[2] ; HIRATA, Takafumi[3] ; KOMIYA, Tsuyoshi[1]

[1]Department of General System Studies, Graduate School of Arts and Science, The University of Tokyo, [2]Frontier Research Center for Energy and Resources, School of Engineering, The University of Tokyo, [3]Division of Earth and Planetary Sciences, Graduate School of Science, Kyoto University

Banded Iron Formations (BIFs) are the chemical sediments, which are ubiquitously distributed in the supracrustal belts of the Precambrian era except for Middle Proterozoic Era. Therefore, they are helpful for deciphering the surface environmental evolutions throughout the earth history. Especially, the geochemical studies of the BIFs in the Eoarchean (≥ 3600Ma) supracrustal belts can present a key to the understanding of oceanic chemistry on the early Earth, where the early life had emerged.

However, the chemical compositions of the BIFs depend on not only composition of seawater but also their mineralogy. They inherently have inhomogeneous mineral mode by the point that they have chemical bands composed of Fe-oxide and chert with the addition of carbonate minerals and clastic materials; that is to say their bulk-chemical compositions controlled firstly by their primary mineral mode. As above, before discussing the oceanic chemistry or processes from their bulk-chemical analyses, they are needed to be resolved into their constituent minerals' chemistry and discuss their origins.

In this study, we firstly analyzed the bulk chemical compositions of 80 BIFs and chert in the ~3810Ma Isua supracrustal belt, Southwest Greenland, by XRF and ICP-MS. Then we estimated the primary minerals of BIFs and their origins by the Independent Component Analysis (ICA) from their bulk chemical compositions, and finally discussed the chemical variations free of mineral modal variations.

The result shows that their bulk-chemical variations are explainable by the following three independent components; (1) Fe-hydroxide + Chert, (2) Dolomite (3) Ankerite, and no clastic material component. Moreover carbonate mineral components (2), (3) show the same or higher Eu anomalies than that of component (1), suggesting that carbonate minerals were deposited in relatively stronger hydrothermal environments. This characters are also shown in the BIFs of ≥ 3960Ma Nulliak supracrustals. This implies that, in the Eoarchean ocean, carbonate minerals could be precipitated in the hydrothermal environments, where the fluids could be supersaturated in them.

Moreover, samples with strong independent component (1) and weak component (2), (3) show the negative correlations between Eu anomaly and REE/Fe, La/Yb ratio as shown in modern metalliferous sediments around mid-oceanic ridge. These correlations, in modern sediments, can be caused by variations of burial rates accompanied with the variable strength of hydrothermal activities, which have an influence on REE adsorption on Fe-hydroxide. Given the same processes in the Eoarchean ocean as modern hydrothermal environments, the variations of chemical compositions of the ~3810Ma Isua BIFs, free of the modal variations, are explainable by the relative strength of the hydrothermal activities.

Keywords: the Eoarchean era, the Isua supracrustal belt, Banded Iron Formations, Independent Component Analysis (ICA)