Whole-rock abundances and spatial distributions of transition elements in the Early and Middle Archean BIFs: The mechanism of their involvement in the BIFs and reconstruction of the chemical evolution of seawater in the Precambrian.

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Banded Iron Formations (BIFs) are chemical sediments, ubiquitously distributed in the Precambrian supracrustal belts. Therefore, their trace element compositions are helpful for deciphering geochemical evolution on the earth through the time. However, it is necessary to elucidate factors controlling the bulk compositions because their compositions are highly variable. We estimated chemical evolution of seawater based on the bulk compositions of BIFs from *ca.* 3.8 Ga Isua supracrustal belt, southern West Greenland, and spatial distribution of the trace element contents within the BIFs from *ca.* 3.0 Ga Cleaverville area, Western Australia.

The BIFs in the Isua supracrustal belt are composed of magnetite, quartz and actinolitic amphibole. Because the amphibole-rich BIFs are significantly enriched in Co, Ni, Cu, Zn, HREE and U contents, their bulk compositions are not suitable for estimate of seawater composition. Moreover, the magnetite-rich and amphibole-poor samples show positive correlations of Ni, V and U contents with Zr contents, suggesting that the elements were not derived from the seawater but from detrital materials. The good correlation of the trace element contents with Zr contents or with mineralogy indicates the transition element contents such as Ni in the Archean ocean were much lower than previously estimated, and comparable to those in the Proterozoic ocean.

The BIFs in the Cleaverville Formation show laminated structures from millimeter to centimeter thick, composed of hematite and chert bands. The hematite bands are further composed of micrometer-thick, thin hematite layers. Elemental mappings of the hematite bands with LA-ICP-MS show that some layers or patches with higher Al, Ti and HFSE contents exist between the thin hematite layers. Moreover, spatial distribution that Ni, Cu and Zn contents are correlated with Al and Ti contents suggests that their elements in the BIFs were derived from detrital materials. On the other hands, because Mo-rich areas are limited to the hematite layers, Mo in the BIFs was hosted by the precursor of the hematite, providing a potential to estimate the seawater composition. The contrasting occurrence of Mo against Ni, Cu and Zn, which are redox-sensitive elements, imply that the Mid-Archean oceans were slightly oxidative because of presence of Mo (VI) in seawater.

Keywords: Banded Iron Formations, the Archean, the spatial distributions of the trace elements

