Origins of transition elements of the BIFs: Implications for the Archean seawater chemistry

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Chemical compositions of banded iron formations (BIFs), which are chemical sediments ubiquitously distributed in the Precambrian supracrustal belts, are helpful for deciphering geochemical evolution of seawater 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 bulk compositions of BIFs from ~3.8 Ga Isua supracrustal belt (ISB), southern West Greenland, and micro-scaled distributions of REE and some transition elemenents within BIFs from ~3.0 Ga Cleaverville area, Western Australia.

The BIFs in the ISB are composed of magnetite, quartz and actinolitic amphibole. Because amphibole-rich BIFs are significantly enriched in V, Ni, HREE and U contents, their bulk compositions are not suitable for estimate of seawater chemistry. Moreover, positive correlations of V, Ni and U with Zr contents in magnetite-rich BIFs suggest that the elements were derived from detrital materials so that the transition element contents such as Ni in the Archean ocean were much lower than previously estimated[1], and comparable to those in the Proterozoic ocean.

The BIFs in the Cleaverville area comprise thin hematite and chert laminations (mesobands). The hematite mesobands are further composed of thin, μm-thick, hematite-predominant bands (microbands). Elemental mappings of the hematite mesobands with LA-ICP-MS show that thin hematite bands are interlayered with layers with higher Al, Ti and HFSE contents. Moreover, coincidence of distributions of Ni, Cu and Zn with those of Al and Ti suggests that they were derived from detrital materials. On the other hands, Mo was hosted by the precursor of the hematite because Mo-rich areas are limited to the hematite layers. 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.

[1] Konhauser *et al*. (2009) *Nature* **458**.