Rare earth element and Nd isotope geochemistry of Archaean banded iron formations in the Chitradurga Schist Belt, Dharwar Craton, Southern India

KOINUMA Kentaro[1,*], M. SATISH-KUMAR[1], MISHIMA Kaoru[2], UENO Yuichiro[2] and HOKADA Tomokazu[3]

[1] Department of Geology, Faculty of Science, Niigata University, Niigata, Japan

[2] Department of Earth and Planetary Sciences, Tokyo Institute of Technology, Tokyo, Japan.

[3] National Institute of Polar Research, Tachikawa, Tokyo, Japan

*f14e048a@mail.cc.niigata-u.ac.jp

Banded Iron Formations (BIFs) are chemically precipitated marine sedimentary rocks. They are formed mostly in the Archaean and early Paleoproterozoic and preserve the record about ancient seawater. BIF is composed of alternate SiO2 and iron-rich layers which consists mainly of hematite, magnetite, and siderite. It is believed that the source for iron and silica are hydrothermal vents (Bekker et al., 2010) or continental weathering (Hamade et al., 2003). The origin of BIF and oxidation-reduction state of the seawater can be constrained from the characteristics of trace element, rare earth element and isotope geochemistry. We have studied the geochemical characteristics of BIFs in the Archaean Chitradurga schist belt, Dharwar craton, Southern India.

The stratigraphic succession of the Chitradurga Schist Belt comprises of a volcano-sendimentary sequence of Dharwar Supergroup that overlies the basement Peninsular Gneiss (~3.0 Ga) which contain enclaves of the Surgur group (3.3~3.1 Ga). The Dharwar Supergroup is subdivided into two groups, the Bababudan Group and the Chitradurga group. Hokada et al., (2013) suggests that the oldest depositional age of Bababudan Group and lower unit of Chitradurga group is around 3.14 Ga and 3.22–2.92 Ga and the depositional youngest age of upper unit of Chitradurga group is between 2.68 Ga and 2.63 Ga. Three map scale BIF layers exist in the Dharwar Supergroup and we compare them using their geochemistry.

The Chitradurga BIFs are mostly composed of quartz, magnetite and hematite and rarely contain siderite, pyrite, and carbonate minerals. They contain very low content of Al2O3 (<1wt.%) indicating less detrital components. The PAAS-normalized REY (REE+Y) patterns of the majority Chitradurga BIFs show low REE contents, LREE (light rare earth element) < HREE (heavy rare earth element) and positive Eu anomaly. These characteristic are similar to Archaean BIFs from South Africa, America and

Greenland except lack of positive La and Y anomaly. The large positive Eu anomalies in BIFs attribute to high temperature hydrothermal fluid fluxes (>250℃) (Bau and Moller, 1993). In addition, some BIFs negative Ce anomaly that reflects oxidizing condition. Therefore the environment of BIFs was at times strongly oxygenated and related to hydrothermal flux. Initial Sr isotopic ratios of BIFs have variations, which suggest post depositional alterations, whereas Nd isotope compositions have less variations than Sr and Nd is immobile element so Nd show probably primary values. It is typical that the positive εNd(t) is related to the depleted mantle, whereas the negative εNd(t) is caused by continental crustal sources. Most of the BIFs show ε Nd(2.8Ga) in the range between -2 to +2 and TDM model age are 3.0Ga to 3.3Ga which is not equivalent to inferred sedimentation age. The ε $Nd_{(2.8Ga)}$ of depleted mantle is about +4, and metabasalts of around BIFs in the range between -4 to +4. Our isotopic data is inconsistent to each other because in spite of BIFs being sampled from same stratigraphic section their $\varepsilon Nd_{(2.8Ga)}$ shows both positive and negative signatures.

The geochemical data of BIFs suggest that they were not affected by continental source and REY pattern probably show effect of high-T hydrothermal fluid fluxes. Moreover Nd isotopic data show the possibility of depleted mantle source.

References

Bau, M., Moller, P., 1993, Rare earth element systematics of the chemically precipitated component in Early Precambrian iron formations and the evolution of the terrestrial atmosphere-hydrosphere-lithosphere system. *Geochimica et Cosmochimica Acta* **57**, 2239–2249

Bekker, A.,Slack, J.F., Planavsky, N., Krapeˇz, B., Hofmann, A., Konhauser, K.O., Rouxel, O.J., 2010, Iron formation: the sedimentary product of a complex interplay among mantle, tectonic, oceanic, and biospheric processes. *Economic Geology* **105**, 467–508.

Hamade, T., Konhauser, K.O., Raiswell, R., Goldsmith, S., Morris, R.C., 2003. Using Ge/Si ratios to decouple iron and silica fluxes in Precambrian banded iron formations. *Geology* **31**, 35–38

Hokada, T., Horiea, K., Satish-Kumar, M., Ueno, Y., Nasheethe, A., Mishimad, K., Mishima, K., Shiraishi, K.,2013, An appraisal of Archaean supracrustal sequences in Chitradurga Schist Belt, Western Dharwar Craton, Southern India. *Precambrian Research* **227**, 99-119