

Nd isotope geochemistry of Archaean BIFs in the Chitradurga Schist Belt, Dharwar Craton, Southern India

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Banded Iron Formations (BIFs) are successive layers of fine grade quartz and iron minerals which consist mainly of hematite, magnetite, and siderite. They are chemically precipitated in the sea and formed mostly in the Archaean and early Paleoproterozoic, and therefore record the information of the ancient oceans. It is believed that the iron was supplied by hydrothermal vents (Bekker et al., 2010), whereas silica was either sourced from hydrothermal vents (Steinhofel et al., 2010) or continental weathering (Hamade et al., 2003). In addition to the origin of BIF, the oxidation-reduction state of the seawater can be constrained by the characteristics of trace element, rare earth element and isotope geochemistry. We have studied the geochemical characteristics, in particular the Nd isotopes of BIFs in the Chitradurga Schist Belt, western Dharwar craton, Southern India.

The Chitradurga Schist Belt belongs to the Dharwar Supergroup that overlies the basement Peninsular Gneiss (~3.0 Ga) with enclaves of Sargur 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) suggested 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 youngest depositional age of upper unit of Chitradurga group is between 2.68 Ga and 2.63 Ga. The lower Chitradurga unit is metamorphosed to the biotite-muscovite grade whereas the upper unit is chlorite-muscovite grade. Three major BIF layers occur in the Chitradurga Schist Belt, which belongs to the Bababudan Group, lower Chitradurga unit and upper Chitradurga unit. We compare the geochemical features of these three layers in this presentation.

The Chitradurga BIFs are mostly composed of quartz, magnetite and hematite and rarely contain siderite, pyrite, and carbonate minerals. Bulk rock geochemistry results revealed that the BIFs contain only very less amount of Al₂O₃ or other oxides than SiO₂ and Fe₂O₃. The majority of lower Chitradurga unit BIFs have low REE contents, LREE<HREE and positive Eu and Y anomaly. These characteristics are similar to Archaean BIFs from South Africa, North America and Greenland except that they lack positive La and Y anomalies. The large positive Eu anomalies in BIFs attribute to high temperature hydrothermal fluid fluxes (Bau and Moller., 1993). Therefore the environment of deposition of BIFs was related to hydrothermal flux, probably relating to a rift environment. Sr isotopic ratios show large variations caused by post depositional alterations and/or metamorphism, whereas Nd isotope ratios have only small variations. Nd is an immobile element that represents primary values. Most of the BIFs have epsilon Nd values (estimated at 2.8Ga) which is considered as the age of sedimentation after (Hokada et al., 2013) between -2 to +2 and TDM model ages between 3.0Ga to 3.3Ga. The sedimentation ages and model ages are not equivalent. The epsilon Nd(2.8Ga) of depleted mantle is about +4, and metabasalts associated with the BIFs range are between -4 and +4, the negative values may represent the effect of later stage alterations. Within the same stratigraphic section their epsilon Nd(2.8Ga) values show both positive and negative signatures. Although the causes are not clear yet, it might possibly due to the variations in sedimentary environment affected by hydrothermal flux. 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 in the rift environment, where they have been deposited.

References

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