南インドダールワールクラトン、チトラドゥルガ片岩帯中の縞状鉄鉱層の堆積環境に関する研究
Depositional environment of Archaean BIFs in the Chitradurga Schist Belt, Dharwar Craton, Southern India

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Banded Iron Formations (BIFs) are chemically precipitated from the ocean and formed mostly in the Archaean and early Paleoproterozoic, and therefore record the information of the ancient oceanic environment. In this study we present the geochemical characteristics, in particular the REY (rare earth elements plus yttrium) and Nd isotopic composition of BIFs in the Chitradurga Schist Belt, western Dharwar craton, Southern India. The Chitradurga Schist Belt is a typical Archean greenstone belt that preserves strata roughly between 3.3 Ga and 2.5 Ga and three BIF distinct layers of different sedimentary age occur in this region. Correlating each BIFs located on different region is very difficult because Chitradurga Schist Belt is deformed highly with very complex geological structures. Therefore, we compared their geochemistry to reveal the formation history and discuss their sedimentary environment.
Chitradurga BIFs are mostly comprised of quartz and iron oxide such as hematite and magnetite, similar to many other Archean BIFs. Bulk rock geochemistry results revealed that the BIFs contain only very less amount of continental components, such as Al_2O_3 (<1wt.%) and TiO_2 (<0.05wt.%). Chitradurga BIFs are classified into four groups by REY pattern normalized with PAAS (Post-Archean Average Shale). Type-1 has positive Eu anomaly and Y anomaly. Type-2 has no positive Eu anomaly, large Y anomaly and some of them have negative Ce anomaly. Type-3 has extremely high positive Eu anomaly, whereas Y anomaly is absent. Type-4 has positive Eu anomaly and no Y anomaly. Most of the Chitradurga BIFs have positive Eu anomaly, which is related to hydrothermal flux, however the epsilon Nd(*T*) values of all types fluctuate from negative to positive values. The majority of epsilon Nd(*T*) values for Type-3 BIFs show only small variation between -1 and +2. Moreover, on a meso-band scale the REY patterns are similar, but epsilon Nd(*T*) values of neighboring layers have negative and positive values, suggesting a short lived fluctuations Nd source. However, the epsilon Nd(*T*) values of Type-1, 2 and 4 BIFs show a broad range between -8 and +18, deviating from the normal mantle-continent range, possibly due to secondary alteration effects.
To understand the environment of deposition, we focused on Type-3 BIFs, interbedded with pillow metabasalts and meta-pyroclastic rocks. Deposition of Type-3 BIFs is perhaps influenced of two different volcanic activities: one is enriched and the other is depleted in Nd contents. The Nd isotopic ratio of Archaean seawater was dominated by positive Nd input through active hydrothermal flux related to volcanic activity from a depleted mantle source (Alexander et al., 2009). This suggests that the depositional environment of Type-3 BIFs can be modelled by a mixing between seawater with positive epsilon Nd values and hydrothermal flux derived from enriched mantle with negative epsilon Nd values, and the variations we observe depends on the hydrothermal flux from enriched mantle. This result is consistent with the REY characteristics, large positive Eu anomaly and low Y/Ho value, and suggest a deep sea hydrothermally controlled depositional environment for

the Type-3 BIFs. Type-1 BIFs are associated with dolomite, have high Y/Ho ratio, positive Eu anomaly and broad range of Nd isotope ratio, which suggests that they were deposited in a shallow sea environment. The depositional site of Type-2 and 4 BIFs could not be constrained well due to lack of unaltered samples, but it is assumed that Type-2 and 4 BIFs were affected by less hydrothermal input, when compared with Type-3 BIFs. In summary, our results indicate that negative epsilon Nd(*T*) values does not necessarily need a source from continental crust, but can result from the mixing of Nd from an enriched mantle with Nd reservoir in the seawater.

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