

Formation Age, Geochemical Signatures and Geological Significance of the Hejiao Iron Deposit, Inner Mongolia



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Abstract: The Hejiao BIF-type iron deposit occurs in the Guyang greenstone belt, which is located in the Yinshan Block on the northern margin of Western Block of the North China Craton. The ore bodies are hosted in the amphibolites from Dongwufenzi Formation of Seertengshan Group of Neoproterozoic Erathem (Ma et al., 2014).

LA-ICP-MS U-Pb dating of zircons from the amphibolites interlayer shows that cores of the zircons characterized by core-rim texture and with a Th/U ratio of higher than 0.1 (0.27–1.00) have an upper intercept age of 2549 ± 29 Ma (MSWD=0.51), which is approximately the depositional age of the Hejiao BIF-type iron deposit, during which widespread tectonic-tectonothermal event and most BIFs occurring took place at the Early Cambrian of North China Craton.

The amphibolites are characterized by low SiO₂ (48.04%), TiO₂ (0.67%), K₂O (0.50%) content, FeO^T/MgO ratio of 1.44–1.73, alkalinity = 1.06–2.18, showing that it has the characteristics of sub-alkaline basalts ($\delta < 3.3$) and island-arc tholeiite (Gill, 2010). In the diagram of TiO₂-SiO₂ and c-n-f, amphibole falls into the igneous area, indicating that amphibolite belongs to orthometamorphic rock. In the diagram of $\lg(Nb/Y) - \lg(Zr/TiO_2)$, all samples fall into the sub-alkaline basalts zone. It is believed that the original rock of amphibolite may be basalt.

The characteristics of the major elements of amphibolite are similar to the MORB, and the chondrite-normalized REE pattern of amphibolites is flat [$(La/Yb)_N = 1.48$], similar to E-MORB and BABB curves (Sun and McDonough, 1989). The spidergrams of the amphibolite is similar to the BABB curve, with the characteristics of distinctively enriched in LILEs (Rb, Ba, K, Sr), and depleted in HFSE (Nb, Ta, U, Th). In combination with TiO₂-MnO-P₂O₅, Ti-Zr-Sr, Nb-Zr-Y and Y-La-Nb discrimination diagrams, it is speculated that the amphibolites were formed in a tectonic setting of back-arc basin. Combined with the island arc superimposed mantle plume tectonic model proposed by predecessors (Chen, 2007; Liu et al., 2012), it is believed that the original rocks of Hejiao amphibolite were formed in the tectonic environment of the back-arc basin with the superposition of mantle plume, which represents the tectonic environment during the deposition of Hejiao BIF.

The characteristics of the iron ores include the depletion of LREE, enrichment of HREE [$(La/Yb)_{PAAS} = 0.29-0.50$, slightly positive La anomaly ($La/La^* = 1.00-1.13$), strongly positive Eu anomaly ($Eu/Eu^* = 1.54-2.27$), positive Y anomaly ($Y/Y^* = 1.07-$

1.42), and no distinct Ce anomalies ($Ce/Ce^* = 0.90-0.95$). Based on the similar signatures to the komatiite at bottom of the Guyang greenstone belt and the mixture of high-temperature hydrothermal fluid and seawater (Chen, 2007; Dymek and Klein, 1988), it is inferred that Fe of the Hejiao BIF-type iron deposit were supplied through the high-temperature hydrothermal leaching of komatiites.

Keywords: BIF-type iron deposit, U-Pb dating of zircons, Geochemistry, North China Craton, Hejiao

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