Fe isotope and trace element variations in Shilu Fe-ore deposit, Hainan province, China

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The Shilu Fe ore deposit in Hainan province, China is known as the richest Fe-ore deposit in Asia. It is dominated by high-grade hematite-type Fe ores, associated with sulfide ores enriched of Cu, Co, Ni, Pb-Zn, and Ag. The ores are hosted in dolomite marble of Neoproterozoic Shilu Group. The genesis of the deposit is still unclear due to its complicated geological characteristics. Several models have been proposed: 1) skarn type deposit; 2) magmatic-volcanic origin (erupted volcano); 3) exhalative sedimentary origin. To better understand the genesis of the deposit, Fe isotopes and trace elements for iron ores and jasper from the main orebody (Beiyi Orebody) of Shilu deposit were systematically investigated, based on carefully petrographic studies.

It is observed under the microscope that fine-grained jasper is widely distributed in the Fe ores. The Fe isotopes and PAAS-normalized REE patterns vary regularly for iron ores from different layers. There are three layers of iron ores in Beiyi Orebody. The iron ores from the lower layer have δ^{56}Fe values of ca. -0.2‰ ~ 0.2‰ , whereas those from the middle layer have slightly positive δ^{56}Fe values of ca. 0.2‰ ~ 0.4‰. They both show PAAS-normalized REE patterns similar to seawater in certain degree, with LREE depleted and HREE enriched, no or negligible Eu positive anomalies, and slightly positive Y anomalies. On the other hand, iron ores from the upper layer have highly positive δ^{56}Fe values of ca. 1‰ ~ 1.5‰. Their PAAS-normalized REE patterns show remarkably positive Eu anomalies and negligible Y anomalies, similar to those for high-temperature hydrothermal fluids.

The positive and variable Fe isotope compositions, and characters of REE patterns, as well as the fact that jasper is widely distributed in the iron ores, are lines of solid evidence demonstrating that the Shilu Fe deposit is of exhalative-sedimentary origin. The variation of REE patterns among different layers of ore deposit indicates that the degree of mixing of high temperature hydrothermal fluids is not constant during Fe precipitation. The correlation between Fe isotopes and REE patterns indicate that the Fe isotope variation may be affected by changes of physico-chemical conditions (such as pH, Eh and T) during Fe-oxide precipitation. It is also suggested that Fe isotope geochemistry may be a powerful tool for tracing the genesis of Fe ore deposit.