Re-Os ages and formation mechanism of Shilu Fe–Co–Cu deposit, Hainan, South China

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The Shilu Fe–Co–Cu deposit located in Changjiang County, Hainan Province was once known as the largest hematite deposit in Asia. Its formation age and mechanism still remain debated. The deposit is hosted as stratoid bed in the sixth layer of Neoproterozoic Shilu group. There are 2 to 3 layers of iron ore bodies developed in the middle of the wall rocks (dolomite, limestone and diopside-tremolite rocks), with local gypsum, barite, iron jasper, etc. In the section, the iron ore body is located in the upper part and the cobalt copper ore body at the bottom. Mineralization is closely related to the diopside-tremolite rocks.

The Re-Os isochron age of Co-pyrite and hematite is 676 ± 6.6 Ma in the Beiyi mining area, which may represent the initial depositional age of Shilu group and Fe-Co-Cu ores. The Re-Os model age of the massive cobalt-bearing pyrite in the South mining area is 224 ± 2.6 Ma, which is consistent with the age of the Indosinian magmatic activities around the mine, considered as the mineralization age. The low $\delta^{30}Si$ values ranging from -0.5 ‰ ~ -0.6 ‰ and the high $\delta^{18}O$ values ranging from 15.5 ‰ ~ 18.3 ‰ of the quartz in the iron jasper are similar to those observed in BIF, indicating its submarine exhalative origin. The $\delta^{34}S$ values of barite and sulfide in the deposit are abnormally high, with mean values of 24.4 ‰ (14) and 15.9 ‰ (38), respectively, suggesting that the sulfide is formed by the reduction of marine sulfate in a closed environment. The high $\delta^{56}Fe$ values of the hematite range from 0.12 ‰ ~ 1.36 ‰, with a gradually decreasing trend from the bottom to the top.

During the submarine exhalation, the copper-rich sulfide ore body formed at first. With increasing oxygen fugacity while the mineralization proceeding, the oxidation of Fe^{2+} carried by the hydrothermal activities initiated, forming barite-bearing, silicon rich poor iron deposit. The $\delta^{56}Fe$ of the hematite decreased as the oxidation progressed until completed. The Shilu iron ore was strongly metamorphosed, reformed and reworked during the Indosinian large-scale granite intrusion. Silicon was lost and combined with the magnesium-rich carbonate, forming diopside and tremolite; while hematite remained under the alkaline and oxidative environment, leading to the formation of the hematite ore.