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Fe Isotope Geochemistry of Hydrothermal Fe Exhalites

SUN Jian*, ZHU Xiangkun and LI Zhihong

MLR Key Laboratory of Isotope Geology, Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, China

1 Abstract

The sediments atop the sequence of ophiolite usually contain Fe(-Mn-Si) exhalites, chemical sediments that are mainly composed of amorphous Fe-Mn oxy-hydroxides and chert/jasper. They were precipitated from hydrothermal fluids produced by deep leaching of basalt particularly during volcano activity or seafloor spreading. These hydrothermal Fe exhalites provide a good record for the depositional environment and the ocean environment as well.

A well-preserved Phanerozoic Fe deposit, Motuosala Fe-Mn deposit, resulted from hydrothermal exhalation, was investigated for its trace element and Fe isotope geochemistry. The deposit is located in Xinjiang province, China and is hosted in a suit of Carboniferous volcano-sedimentary clastic rocks. The Fe deposit is mainly composed of massive hematite Fe oreand banded hematite-jasper ore. The hematite ore/band and jasper band were subjected to be analyzed. They are both composed mainly of Fe_2O_3 and SiO_2, with very low contents of Al_2O_3 and TiO_2 (<1%), indicating they were chemical precipitates with little detrital contamination. They both show slightly LREE depleted or near flat PAAS-normalised REE patterns, with positive Eu anomalies and Y anomolies, indicating that they were sourced from a mixture of high-temperature fluids and seawater. Compared to the hematite Fe ore/band, the jasper band shows higher Eu_{SN}/Eu_{SN}* but lower Y/Ho values. δ^{56}Fe values for the hematite Fe ores are clustered around -0.3‰, similar to those for high-temperature fluids. The jasper samples show heavier Fe isotope compositions varying from -0.1‰ to 0.5‰, indicating that they were resulted from partial Fe precipitation. For all samples, δ^{56}Fe values are related to Y/Ho and Eu_{SN}/Eu_{SN}* values.

The results indicate that the hematite Fe ore and jasper were deposited in different environments. The jasper was deposited in a more anoxic condition with higher hydrothermal fluids/seawater ratio, probably when the hydrothermal activity was more intense; while the hematite Fe ore was deposited in a more oxic condition with lower hydrothermal fluids/seawater ratio, probably when the hydrothermal activity was weaker.

* Corresponding author. E-mail: sunjiantc@163.com