Fluorite is one of the most important gangue minerals in the Lala IOCG deposit, which is intergrown with chalcopyrite and molybdenite, and recorded important information about the source and evolution of the ore-forming fluid. REE geochemistry of fluorite and its implications for source of ore-forming fluid are discussed in this paper.

1 Geology of the Lala IOCG Deposit

The Lala Fe-Cu-REE deposit, which is reported as a typical IOCG deposit in the Kangdian region, western margin of Yangtze Block, (Li et al., 2002, Chen and Zhou, 2011). The Kangdian region is a continental rift during early Proterozoic and Mesoproterozoic. The host rock of this deposit is Hekou Group (Pt1hk), which is composed of garnet-biotite schist and albite-granulite. The deposit contains more than 200Mt of ores, including 0.9% Cu, 0.026% Mo, 0.02% Co, 0.25% RE2O3, 0.49ug/g Au, 1.89ug/g Ag. The main ore minerals include magnetite, chalcopyrite, pyrite, molybdenite, REE, native gold and silver. Gangue minerals include albite, K-feldspar, quartz, fluorite, biotite and calcite. Orebodies are lensoid and roughly strata-bound, controlled by lithological contacts, faults or shear zones. Fe-Cu ores are generally massive, banded and disseminated, with minor veins and stockworks. Wall rock alteration include albition, fluoritization, cabonatation and biotitization.

The Lala IOCG deposit experienced 3 stages of mineralization. Stage I: marine volcanic eruption-sediment stage at 1712-1680Ma (Wang et al. 2012); Stage II: metamorphic metallization events, at about 1000Ma (Li et al.2003; Chen and Zhou, 2012), which has been divided into earlier stage (II1) and later stage (II2) (Wang et al. 2012); Stage III: hydrothermal mineralization at about 850Ma, which is related to gabbro intrusion (Zhou et al., 2009).

Two stages of fluorite with three generations are identified in the Lala IOCG deposit. Fluorite(I) and fluorite(II) belongs to stage II1 and stage II2 respectively. Fluorite(I) is intergrown with streaky chalcopyrite (stage II1), and are isolated cube shaped, with a particle size range from 1~8mm, purple; and the chalcopyrite (stage II1) has an Re-Os isotope age of 1290±38Ma (Zhu and Sun, 2013). Fluorite(II) intergrown with veinlet chalcopyrite and flaky molybdenite (stage II2) in the vein or massive-disseminated ores, light purple, with a particle size range from 0.4~5mm, and the molybdenite (stage II2) has an Re-Os isotope age of 1086±8Ma (Chen and Zhou, 2012). Fluorite(III) belongs to stage III: purple fluorite intergrown with calcite veins, which cut the ores with Fluorite( I) and Fluorite(II), with a cubic habit and particle size range from 1~5mm, and minor or no chalcopyrite in the vein.

2 REE Geochemistry of Fluorite and Its Geological Implications

2.1 ΣREE

The ΣREE of fluorite of each stage is very high, especially the fluorite(I) and fluorite(II), which is one of the main carriers of REE in the Lala IOCG deposit; and from early stage to late stage, the ΣREE of fluorite decreases gradually. The ΣREE of fluorite(III) is much lower than the formers. The ΣREE of fluorite may be controlled by the concentration of REE in the ore-forming fluid (Peng et al.2002), which is suggested that the ore-forming fluid has a high content of REE and the metamorphic stage ore-foaming fluid has a higher ΣREE than the hydrothermal one.

2.2 Implications of Y/Ho vs. La/Ho

In the diagram of Y/Ho vs. La/Ho (Fig.1) (Bau and
Fluorite( I ) and fluorite( II ) are homogenous products at different stages, but the fluorite( I ) have both positive and negative Eu anomaly, and fluorite( II ) are all have negative Eu anomaly; both of them have a weak negative Ce anomaly; There must not have a huge difference of oxygen fugacity in the same fluid, the reason for the anomalies may be the original ore-forming fluid was under a high temperature (>250°C), has a negative Ce anomalies and contain both Eu^{2+} and Eu^{3+} (Bau and Dulski, 1995; Sverjensky, 1984). The REE distribution patterns and anomaly features of fluorite are consistent with the albite-granulite, which suggested that the ore-forming fluid of fluorite( I ) and fluorite( II ) was originated from the metavolcanite, and inherited its Ce and Eu anomalies. The Fluorite(III) has a feature of remarkable positive Eu and negative Ce anomaly, which suggested that the ore-forming fluid of Fluorite(III) was characterized by low temperature and high oxygen fugacity.

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References

