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Oxygen, Sulfur and Lead Isotopic Compositions and Sources of the Ore Metals of Dapai Iron Polymetallic Deposit in Southwestern Fujian Province

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1 Introduction

The Dapai iron polymetallic deposit is found in Southwestern Fujian. Geotectonically, it is located along the southern margin of the polymetallogenic of Southwestern Fujian Depression belt. This area is one of the important ore concentrated areas in southeastern China. It hosts many iron polymetallic deposits, including the Makeng iron mine, Pantian iron mine, Luoyang iron mine, Yangshan iron mine, Zhongjia iron mine, etc and it has high potential for further mineralization. Domestic and foreign scholars have done a lot of research work on Makeng iron ore and proposed various models about the genesis of Makeng iron deposit. Several perspectives can be summarized as follows: marine volcano sedimentary-hydrothermal reformation deposit, skarn deposit of strata bound calcium type, volcanic hydrothermal-sedimentary deposit etc. The Dapai iron polymetallic deposit, which is an important component of the newly found "Makeng type" iron ore, has been poorly researched. The application of the current state-of-art techniques such as isotopic geochemistry to decipher the genesis of the deposit has not been realized on Dapai. It is still not clear whether the ore-forming materials came mainly from the Late Mesozoic acidic intrusive rocks or other sources. Based on the established geological characteristics of Dapai iron polymetallic deposit, major minerals of the deposits; magnetite, garnet, pyrite, sphalerite and galena has been selected to test for oxygen, sulfur and lead isotopic compositions in order to trace the sources of the ore-forming materials of the Dapai iron polymetallic deposit and to further investigate the geological significance of "Makeng type" iron polymetallic deposits in southwestern Fujian.

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2 Geological Features of Ore Deposit

The Dapai iron polymetallic deposit is located in the core of Longyan-Yongding multiple syncline of Late Paleozoic depression in southwestern Fujian. The deposit is mainly hosted in the Upper Carboniferous-Lower Permian carbonate formation. The intrusive rocks in the mine area are mainly the acid-intermediate acidity rocks and the fine-grained porphyritic granite, which has close relationship with mineralization. Besides the NE fold, thrust and detachment structure developed along the bedding planes in the mine. The main ore body is hosted in between the series of thrust, detachment fault and fault belt. The metallic element of the deposit depicts an obvious vertical zonation by which the lead-zinc ore-body mineralized in the upper part and numerous magnetite ore-body are enriched in the lower part of the orebody. The ore body is mostly distributed in layers, homo-layered and lenticular structures. The main metallic minerals of deposit are magnetite, sphalerite, galena, minor molybdenite, chalcopyrite, bornite and pyrite etc. The gangue minerals of deposit are andradite, diopside, quartz, calcite, epidote, tremolite and chlorite etc. The main structures of lead-zinc ore in the upper part are; crumb structure, fissure filling structures, secondary subhedral granular structure, and fragmentation structure. The structures of lower magnetite ore mostly are lumps structure, disseminated structure, a small amount of fragmentation structure and wrapped structure. The textures of ore are mainly disseminated texture, massive texture and strips striated texture etc. The skarnization, silicification, marblezation are the main alteration style which has close relationship with ore-body. The deposit has features of a typical strata bound skarn deposits and the mineralization is mainly divided into skarn stage, magnetite stage, quartz-sulfide stage, late carbonation stage.

3 O, S and Pb Isotopic Characteristics and its Significance

The testing results of deposit shows that the $\delta^{18}O$ values from magnetite and garnet vary 2.2‰ –6‰ indicating the possibility that the oxygen isotopic compositions of magnetite and garnet skarn inherited those of the concealed granite body. The $\Delta^{34}S$ from ore sulfides has a small range of variation -2.6‰–1.5‰, the distribution of values is around the zero, (0±3‰) a characteristic that implies magmatic sulfur. The $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ ratios of sulfide ores range within 18.486–18.537, 15.665–15.712 and 38.823–38.979 respectively. The lead isotopic ratios vary in a small range. According to isotopic plotting of each sample (Fig. 1), a comprehensive analysis of the lead isotopic data indicates that the metallogenic materials of the deposit are closely related to magmatism, mainly derived from the lower crust but also display crust-mantle mixing.

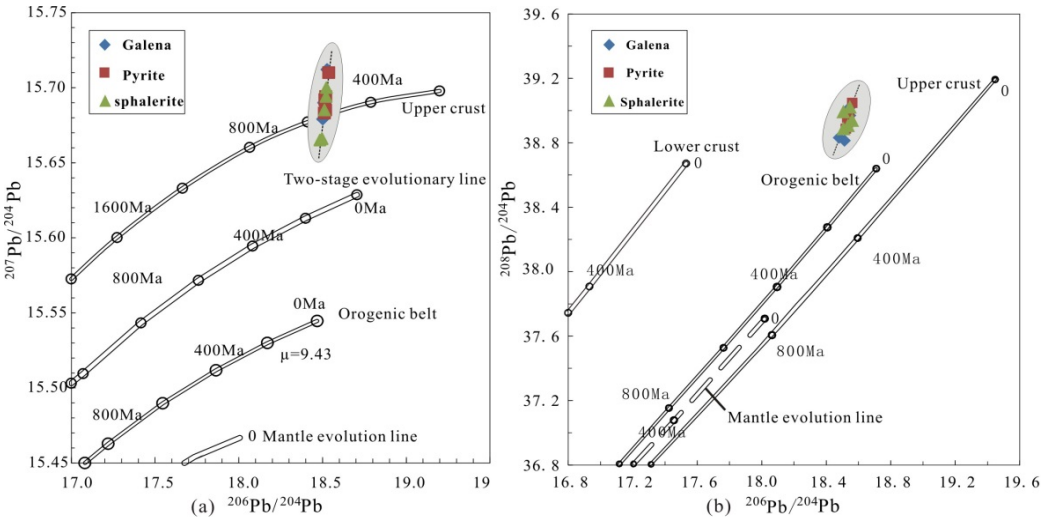

Fig. 1. Diagram showing evolutionary tectonic settings of lead isotopes in ore sulfides from Dapai ore field.

The Makeng iron deposit, which is the most representative large iron ore deposits in Southwestern Fujian and other regional iron ore deposits such as; the Luoyang, Pantian and Yangshan deposits, are located in an area connected with the Late Mesozoic granites where deep crustal melting emplacing took place. The late Mesozoic magmatism provides the major provenance for the formation of "Makeng type" iron deposit. Zhang et al. (2012), Wang et al. (2010) and Mao et al. (2006) measured the age of Juzhou-Dayang granites and Makeng molybdenite near 130±. The geochemical and isotopic compositions indicate that the Dayang-Juzhou granites belong to highly fractionated crust type granite with an added small amount of mantle components. The provenance characteristics is similar to lead isotopic characteristics of Dapai deposit further indicates the consistency that regional magmatic activity provides provenance of the deposit in the area. The age of granite and molybdenite from Luoyang iron deposit and Dapai deposit we have measured are 130± too. The petrogenesis and mineralization of "Makeng type" iron deposits are concentrated in the Early Cretaceous. In this paper, oxygen, sulfur and lead isotopic results reveal that the formation of Dapai deposit is closely related to a deep magmatic event. The discussion of "Makeng type" iron ore age of mineralization in Southwestern Fujian shows that the Early Cretaceous granite magmatism relates to large-scale iron polymetallic mineralization. In summary, exploring for the Early Cretaceous (130Ma ±) granitic magma intrusions can be used as an important direction to further explore for "Makeng type" iron ore near the region and have huge significance to expand the ore prospecting of southwestern Fujian.

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