1 Introduction

The Maoping large-sized Pb-Zn (-Ag-Ge) deposit is one of the most representative carbonate-hosted Pb-Zn deposits in northeast Yunnan province. Over the last few decades, some geological studies have been carried out on this deposit (Liu et al., 1999; Han et al., 2007a), and it has been widely accepted that the migration of large scale Pb-Zn bearing fluids resulted in the formation of these deposits in northeastern Yunnan (Han et al., 2007b). However, the sources of the ore-forming materials and fluids have long been controversial. This paper represents the geological and Pb, S, C, H, O, He-Ar isotopic composition features of the Maoping deposit, and then discusses the sources of the metals and ore-forming fluids.

2 Geological Features

The Maoping deposit is located at the intersection of the NW-trending Yadu-Ziyun fault and SN-trending Xiaojiang fault. NE- SN- and NNW-striking faults are well developed. Devonian, Carboniferous and Permian strata form the SN-trending Maomaoshan overturned anticline. Both of them control the occurrence of the Pb-Zn deposit. The deposit consists of three discrete ore body groups, which occur in the intra-formational fault zones of the medium- coarse crystalline dolostone of the Upper Devonian Zaige Formation (D3z), fine-medium crystalline dolostone of the Low Carboniferous Baizuo Formation (C1b), and the inter-bedded fine crystalline dolostone and limestone of Middle Carboniferous Weinning Formation (C2w), respectively. The Upper Permian Emeishan basalts are widely distributed in the outer surrounds of the district.

The mineralization -alteration can be divided into 4 stages (Fig. 1). The mineralization of Pb and Zn is mainly occurred at the sulfide- carbonate stage.

3 Geochemical Features

The \(^{206}\text{Pb}/^{204}\text{Pb}, \(^{207}\text{Pb}/^{204}\text{Pb}\) and \(^{208}\text{Pb}/^{204}\text{Pb}\) values for the ores range from 18.340 ~ 18.914, 15.510 ~ 15.796 and 38.845 ~ 39.573, respectively, which are similar to those of the host carbonate rocks and the Emeishan basalts. The pyrites disseminated in the wall rocks have indistinguishable Pb isotope compositions with the ores, indicating that these rocks may have provided metals to the ore fluid.

The \(\delta^{34}\text{S}\) values of the ores in Maoping Pb-Zn deposit show a total range from 7.96‰ to 24.10‰, most of them are between 10‰ and 16‰ (Fig. 2), which are similar to those of the Huize, and Daliangzi Pb-Zn deposits in the Sichuan-Yunnan-Guizhou Pb-Zn metallogenic province (SYG), and within the scope of typical MVT Pb-Zn deposits. The \(\delta^{34}\text{S}\) values of Pb-Zn deposits in SYG are much higher than that of the Emeishan basalts (0.9‰ ~ 2.5‰). By comparison, sulfur of the Pb-Zn deposits in SYG is mainly derived from the sedimentary strata.

The \(\delta^{13}\text{C}_{\text{PDB}}\) values of the gangue minerals range from 5.6‰ to -1.1‰, and the associated \(\delta^{18}\text{O}_{\text{SMOW}}\) values range from 14.1‰ to 25.2‰, the \(\delta^{13}\text{C}_{\text{PDB}}\) values of the calcites
in ores are lower than that of the surrounding carbonate rocks, indicating that the carbons of the ore-forming fluids are derived from the mixture of the crust-source in the strata and deep-source carbon. The $\delta^{18}O_{SMOW}$ values of the ores are distinct different from the Emeishan basalts, indicating that Pb-Zn mineralization is not related to the eruption of Emeishan basalts.

The fluid inclusions $\delta D$ values of the sphalerite, pyrite and calcite range from -37‰ ~ -49‰, -42‰ ~ -61‰, and -45‰ ~ -64‰, the corresponding $\delta^{18}O_{SMOW}$ values range from -9.0‰ ~ 3.4‰, -6.8‰ ~ -12.7‰ and 14.9‰ ~ 18.8‰ (Han et al., 2007a), the calculated $\delta^{18}O_{H2O}$ values of calcite range from 5.2‰ to 9.7‰, if the formation temperature is 200℃.

Fig. 3 shows the He isotope composition of the Maoping Pb-Zn deposit. The $^3\text{He}^4\text{He}$ values of the pyrites and sphalerites range from 1.21~ 2.14 Ra ($10^{-8}$), four samples are all located near the crustal helium range in Fig. 3, which indicates the He of the ore-forming fluids should be mainly derived from the sedimentary strata.

4 Sources of the Ore-forming Fluids

Geological and geochemical features indicate that the Maoping Pb-Zn deposit is an epigenic hydrothermal deposit, which is controlled by the litho-structure, as well as other carbonate-hosted Pb-Zn deposits in SYG. The ore-forming fluids are likely mixed water of strata and basement; the original fluids are mainly derived from deep metamorphic water, they have water-rock interaction and isotope exchange with the underlain ore-bearing strata during the ascending process by tectonic activities from the depth.

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References


