The Yushui deposit located in Meizhou, Guangdong Province, is a middle-scale copper deposit associated with Ag, Pb, and Zn, and was discovered in the late 1980s. This deposit has got geologists' attention because of its high grade of copper in a small area, with contents averaging 3.25% and a maximum of 50-60%, and being associated with a medium-sized reserve of silver. Researchers had begun to study this deposit in the early 1990s (He, 1990; Chen et al., 1992; Cai et al., 1996; Liu, 1997; Wang et al., 1999; Gu et al., 2003), but its ore-forming fluids need further study. This paper is aimed to research He-Ar isotopic compositions of the fluid inclusions in sulfides from the Yushui deposit. We expect to use the He-Ar isotopic evidence to discuss the ore-forming fluids source for the Yushui Cu-polymetallic deposit, and to provide the evidence for further work.

1 Deposit Geology Characteristics

The Yushui deposit located in Meizhou, Guangdong Province, is a middle-scale copper deposit associated with Ag, Pb, and Zn, and was discovered in the late 1980s. This deposit has got geologists’ attention because of its high grade of copper in a small area, with contents averaging 3.25% and a maximum of 50-60%, and being associated with a medium-sized reserve of silver. Researchers had begun to study this deposit in the early 1990s (He, 1990; Chen et al., 1992; Cai et al., 1996; Liu, 1997; Wang et al., 1999; Gu et al., 2003), but its ore-forming fluids need further study. This paper is aimed to research He-Ar isotopic compositions of the fluid inclusions in sulfides from the Yushui deposit. We expect to use the He-Ar isotopic evidence to discuss the ore-forming fluids source for the Yushui Cu-polymetallic deposit, and to provide the evidence for further work.

2 He-Ar Isotopic Results and Discussion

The sulfides from the Yushui deposit were analyzed He-Ar isotopic compositions of their fluid inclusions. The results are as follow: (1) \( {\text{He}} = (2.27 \sim 22.41) \times 10^{-5} \text{cm}^3 (\text{STP} \cdot \text{g}^{-1}) \), \( {\text{He}} = (0.53 \sim 4.06) \times 10^{-12} \text{cm}^3 (\text{STP} g^{-1}) \), \( {\text{Ar}} = (0.63 \sim 3.78) \times 10^6 \text{cm}^3 (\text{STP} g^{-1}) \), \( {\text{Ar}} = (1.25 \sim 10.40) \times 10^9 \text{cm}^3 (\text{STP} g^{-1}) \). (2) \( {\text{He}}/\text{He} \) value of the fluid inclusions are 0.006-0.056 \( R_a \) (\( R_a \) is the \( {\text{He}}/\text{He} \) value of atmosphere, conventionally is 1.39\( \times 10^6 \)), with the average of 0.026 \( R_a \). (3) \( {\text{Ar}}/\text{Ar} \) value of 333.76 \sim 501.68 with average of 398.71, is slightly higher than the atmosphere (295.5).

On the \( {\text{Ar}}/\text{Ar} \) vs. \( R_a/R_a \) diagram (not shown), the sulfides from the Yushui deposit plot in the field of crustal fluids. It indicates that there is no mantle helium in the ore-forming fluids and the ore-forming fluids come from the crust. The \( {\text{He}}/\text{He} \) values and \( {\text{Ar}}/\text{Ar} \) values of samples are 0.006 \sim 0.056\( R_a \) and 0.0011 \sim 0.0155 respectively while the lithospheric mantle fluids are \( \sim 8\( R_a \) and 0.5 and the crustal fluid are \( \sim 0.1 R_a \) and 0.2 (Stuart et al., 1995). On the \( {\text{Ar}}/\text{Ar} \) vs. \( R_a/R_a \) diagram (Fig.1), the samples fall in the field of crustal fluids. The
$^{40}\text{Ar}^{*}/^{4}\text{He}$ values of two samples are far lower than the others. It can also be identified in the $^{40}\text{Ar}/^{36}\text{Ar}$ vs. $R/R_a$ diagram that the two samples plot slightly under the field of crustal fluids. As a consequence, it is necessary to analyze the two samples.

By the analysis of trace element and rare earth elements, we find that the contents of U and REE in the two samples are much higher than the others, and the total rare earth elements contents are more than 1300ppm. Furthermore, more evidences are found that the REE minerals distribute spatially along veins and replacement the later stage vein of galena, based on the observations of microscope and scanning electron microscope. These evidences show that the primary He-Ar isotopic compositions of the two samples were changed by the influence of later stage hydrothermal alteration. However, the influences of hydrothermal alteration on the other four samples are week. He-Ar isotopic compositions of the four samples can represent the primary He-Ar isotopic compositions of ore-forming fluids. In a word, the ore-forming fluids of the Yushui deposit are crust-derived.

3 Conclusion

(1) The $^{3}\text{He}/^{4}\text{He}$ values and $^{40}\text{Ar}^{*}/^{4}\text{He}$ values of the fluid inclusions in sulfides from the Yushui copper-polymetallic deposit are 0.006 ~ 0.056$R_a$ and 333.76 ~ 501.68, respectively, belong to the range of crustal fluids. It is indicated that the ore-forming fluids of the Yushui deposit may be the crustal fluids without mixing with mantle fluids.

(2) The $^{3}\text{He}/^{4}\text{He}$ values and $^{40}\text{Ar}^{*}/^{4}\text{He}$ values of some samples in the Yushui deposit are significantly lower than the characteristic value of crustal fluids. Combined with microscopic observation and analysis of trace element and rare earth element, indicated that part of the Yushui ore body are influenced by later stage hydrothermal alteration.

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Reference


