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Genetic Relationship Between the Shapinggou Porphyry Molybdenum and the Polymetallic Vein Deposits, Jinzhai County, Anhui Province

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1 Introduction

The Shapinggou porphyry Mo deposit is the largest molybdenum deposit in Qinling-Dabie orogenic belt which is the largest molybdenum ore belt in the world (Li et al., 2012). Around it, there are several small to middle scale Pb-Zn vein deposits, such as Yinshan, Gaijing, Cangfang, Yinchong, Hongjiashan, and a fluorite deposit (Zhang et al., 2010; Zhang et al., 2012). However, it is not paid more attention to the genetic relationship between the Shapinggou porphyry Mo deposit and the Pb-Zn and fluorite vein deposits. In this paper, we try to study and discuss relationship between them based on investigation of the geological characteristics of the orebodies distribution, ore mineral assemblages and alteration zoning as well as fluid inclusion petrography characteristics of the deposits.

2 Geological Characteristics of the Deposits

2.1 Geological characteristics of orebodies

The Shapinggou porphyry Mo deposit is located in the central of the Shapinggou ore district. There is only one main orebody, hidden in 200 ~ 800m under the surface as a huge spheroid. The molybdenite mineralization was found in the top of the granite-porphyry body and its wall-rocks, quartz syenite and granite (Zhang et al., 2010). Molybdenite is the primary commodity, in the Shapinggou porphyry Mo deposit, with small amounts of pyrite and very small amounts of galena, sphalerite and chalcopyrite. The principal gangue minerals are quartz, K-feldspar, muscovite and small amounts of gypsum and fluorite. The structures of the ores are mainly veinlet, veinlet-disseminated.

The mineralization of the Pb-Zn vein deposits developed surrounding the porphyry Mo deposit. Their

orebodies mainly are occurred as vein and veinlet in a variety of intrusive bodies. The intrusions are mainly granodiorite, granite, quartz-syenite, syenite porphyry and cryptoexplosive breccias in lithology. The ore veins are strictly controlled by fractures and fissures. Quartz, galena and sphalerite are main minerals and grown in banded along the wall of the fractures and fissures and sometimes formed comb structure. Occasionally galena and sphalerite scattered as euhedral or subhedral granular in the wall-rocks. The orebodies of the fluorite deposit are occurred as vein.

2.2 Alteration types and zoning

The alteration types and zones of the Shapinggou Mo deposit are very similar to the typical porphyry deposits. In the surface of and the section cutting through the main orebody, potassic (K-feldspar and biotite) and sodic (albite) alteration, beresitization (pyrite-sericite-quartz) alteration, and propylitic (epidote and chlortite) alteration are very well developed from the mineralization central to the wall-rocks. It is found that the pyrite-sericite-quartz alteration overprinted the potassic-sodic alteration and porphyritic alteration and is more closed to the mineralization in the porphyry Mo ore district. The alteration of the Pb-Zn vein deposits and the fluorite deposit is relatively weak and their alteration mineral assemblages are simple. Siliceous (quartz) alteration and pyrite alteration are often found in the orebodies and they are closed wall-rocks in the Pb-Zn vein deposits. Quartz-calcite veins are also found in the Pb-Zn vein deposits and they cut the quartz-sphalerite-galena veins usually. The quartz-calcite and fluorite-calcite veins are found in the fluorite deposit too.

3 Fluid inclusions Petrography

Quartz-sulfide veins extensively developed in the

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Shapinggou porphyry Mo deposit and the Pb-Zn vein deposits, and small amounts of quartz-calcite, calcite veins and fluorite veins in the vein Pb-Zn deposits and fluorite deposit. Five types at room temperature are identified based on petrography observation of the fluid inclusions in the deposits. They are designated as I type (gas-liquid two-phase) inclusion, II type (CO_2 -rich three-phase) inclusion, III type (daughter mineral-bearing multiphase) inclusion, IV type (liquid phase) inclusion and V-type (gas phase) inclusion.

3.1 Porphyry Mo deposit

The petrography characteristics of the fluid inclusions in the different alteration zone of the Shapinggou porphyry Mo deposit are quite different.

The quartz veins in the potassic and sodic alteration zone and pyrite-sericite-quartz alteration zone contain II type fluid inclusions and small amounts of I type and III type fluid inclusions mainly and very small amounts of V type fluid inclusions. They are generally 15 to 50 μm in diameter, and rounded, elliptic, irregular and negative crystal in shape. The II type fluid inclusions present in the two alteration zones mean that the ore-forming fluids are rich in CO_2 and high temperature.

The fluid inclusions in the quartz veins are almost I type in the propylitic (chlorite) alteration zone (Yu et al., 2012). The fluid inclusions are generally 3 to 16 μm in diameter, and have elliptic and negative crystal shapes. The vapor phases occupy 20 to 50% of total volume at room temperature. It shows that the ore-forming fluid is poor CO_2 in this stage.

3.2 Vein Pb-Zn deposits

There are two styles of quartz vein in the Pb-Zn vein deposits in the region. The one is quartz vein with comb structure and the other without. The fluid inclusions in the former are almost IV type, and those in the latter are mainly I and IV type. The petrography characteristics of the fluid inclusions show that the ore-forming fluids are mainly liquid and vapor phase H_2O and poor in vapor CO_2 in the Pb-Zn vein deposits. The ratio of the vapor phase is small, implying that the ore-forming temperature is relatively lower which is consistent with the ore mineral assemblages of the deposits.

3.3 Fluorite deposit

The fluid inclusions from the fluorite deposit are similar

to those in Pb-Zn vein deposits. The fluid inclusions are mainly I type and IV type in fluorite.

4 Conclusions

Given all that, the orebodies of the porphyry Mo deposit and Pb-Zn vein deposits occur in the quartz-syenite, syenite porphyry and cryptoexplosive breccias which are proved to be formed in the late stage in this region (Li et al., 2012). And both the porphyry Mo deposit and the Pb-Zn and fluorite vein deposits, the most closed alteration to mineralization is beresitization or quartz and pyrite alteration. Petrography features of the fluid inclusions show that the ore-forming fluids are higher in temperature and rich in CO_2 at the earlier stage of the porphyry Mo deposit. The characteristics of lower in temperature and rich in H_2O are found in ore-forming fluids of the Pb-Zn and fluorite vein deposits as well as the later stage of the porphyry Mo deposit. The characteristics of the orebodies, ore minerals, alteration zones and petrography characteristics of fluid inclusion of the deposits show that the Mo, Pb-Zn and fluorite mineralization belong to the same metallogenetic series and they share close genetic relationship.

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