1 Ore Deposit Geology

1.1 Geology of ore district

The Zhaojikou lead-zinc deposit is a newly-discovered large scale ore deposit located in western of the Jiangnan transition belt of Anhui Province. The exposed strata in the ore district consist of Mesoproterozoic Xikou group of Jixian system, Neoproterozoic Likou group of Qingbaikou system and Xiuning Formation of Nanhua system, which is a set of low metamorphic clastic rocks of low greenschist facies. The original rocks of the strata are mainly polymictic conglomerate, lithic sandstone, siltstone, silty mudstone, mudstone, andesitic basalt, andesitic tuff. The ore-bearing stratigraphic unit is the Huansha Formation of Mesoproterozoic Jixian system, which consists of a set of dark gray, gray and purple, light green meta-sandstone, meta-siltstone, meta-silty mudstone, meta-muddy siltstone.

Fold and fault structures well developed in the ore district. The fold structures are mainly Zhaojikou reversal anticline with NEE ~ nearly E-W trending of axial plane and Leigongjian reversed syncline, involved in the low metamorphic clastic rocks of the Mesoproterozoic Huansha Formation and Neoproterozoic Gegongzhen Formation. The ore bodies occur in the core and southern lamb of Zhaojikou reversal anticline. Fault structures are mainly NNE-NE trending Dongzhi fault and Xucun fault. The Zhaojikou Pb-Zn deposit is located in the area between the Dongzhi fault and Xucun fault. The ore bodies occur as vein and lentoid in the subsidiary fissures of the Dongzhi fault. They only developed in the western side of the fault. Some ore bodies occur as lentoid in the breccias under fault clay of the Dongzhi fault, and they are small in scale and similar to the fault in occurrence.

Ore minerals are mainly sphalerite and galena, accompanied with a small amount of pyrite, chalcopyrite, marcasite; Gangue minerals are mainly quartz and calcite, secondly siderite, muscovite, hydromica, sericite, chlorite and barite. The ores are characterized by filling, inclusion, droplet-like texture and vein, stockwork, massive structure. Wall-rock alteration are weak and mainly silicification and carbonatization, secondly pyritization and chloritization.

According to the mineral assemblages and relations between the veins, the mineralization can be divided into three stages. Early and late stage formed the quartz vein and quartz-calcite vein respectively. These veins were not found lead-zinc mineralization. Middle stage is the main metallogenic stage and formed ore mineral sphalerite, galena, chalcopyrite and pyrite associated with quartz and calcite. The main feature of the mineralization is that the ore minerals crystallized and filled in extensional shear structural breccias.

1.2 Orebody characteristics

The major ore bodies, direction of dip NW290° ~ 320°, angle of dip 45° ~ 55°, output as vein and lentoid in the subsidiary fissures of the Dongzhi fault. They only developed in the western side of the fault. Some ore bodies occur as lentoid in the breccias under fault clay of the Dongzhi fault, and they are small in scale and similar to the fault in occurrence.

Ore minerals are mainly sphalerite and galena, accompanied with a small amount of pyrite, chalcopyrite, marcasite; Gangue minerals are mainly quartz and calcite, secondly siderite, feldspar, muscovite, hydromica, sericite, chlorite and barite. The ores are characterized by filling, inclusion, droplet-like texture and vein, stockwork, massive structure. Wall-rock alteration are weak and mainly silicification and carbonatization, secondly pyritization and chloritization.

According to the mineral assemblages and relations between the veins, the mineralization can be divided into three stages. Early and late stage formed the quartz vein and quartz-calcite vein respectively. These veins were not found lead-zinc mineralization. Middle stage is the main metallogenic stage and formed ore mineral sphalerite, galena, chalcopyrite and pyrite associated with quartz and calcite. The main feature of the mineralization is that the ore minerals crystallized and filled in extensional shear structural breccias.
2 Characteristics of the Fluid Inclusions

2.1 Petrographic characteristics

Fluid inclusions in sphalerite, quartz and calcite of the ores were chosen for micro-petrography study here. According to their size, shape and phase in room temperature, three types of fluid inclusions were identified. Type I is pure liquid phase (LH2O) inclusions, ratio of quantity 10%±, size in 1 ~ 5 μm, scattered with granular, stripe, elliptical and irregular shape, mainly found in quartz. Type II is pure gas phase inclusions, ratio of quantity < 5%, size in 2 ~ 10 μm, distributed along the growth band of sphalerite or isolated in quartz. Type III is liquid-rich gas-liquid phase (VH2O+LH2O) inclusions, ratio of quantity 90%±, size in 4 ~ 18 μm, volume ratio of gas/liquid 10% ~ 40%, isolated or in cluster with oval, round and irregular shape. The type III is the main object for temperature measuring.

2.2 Micro-thermometry

The homogenization temperatures of fluid inclusions in the major ore-forming stage range from 110°C to 275°C, concentrate on 120°C to 200°C, while those in the late ore-forming stage range from 121°C to 136°C. The freezing temperatures range from -0.3°C to -9.0°C, those in the late ore-forming stage range from -2.8°C to -3.7°C. According to the formula given by Hall et al (1988), salinity of the ore-forming fluids range 0.18% to 12.85% NaCl eqv. According to the figure of homogenization temperature vs density given by Ahmad et al (1980), density of the ore-forming fluids range from 0.87 g/cm3 to 1.03g/cm3. From this, it is estimated that the ore-forming pressures in major ore-forming stage are from 24.4MPa to 61.9 MPa, corresponding to the ore-forming depth from 0.97 km to 2.47km.

3 Discussion and Conclusion

By comparing the geological characteristics of the Pb-Zn deposits on different genetic types, the Zhaojikou Pb-Zn deposit is distinct from MVT Pb-Zn deposit and VMS Pb-Zn deposit worldwide in the ore-host rocks, ore-controlling structures and relationships to the magmatic activities. It is found that the Zhaojikou deposit has some similarities to the Chaganbulagen Pb-Zn(Au) deposit, Jiawula Pb-Zn(Ag) deposit and Yingshan Ag-Cu-Pb-Zn deposits, these deposits are considered to be epithermal or porphyry-epithermal in genesis (Qi, 2005; Mao, 2010).

Chen (2010) point out that the fluid inclusions in the epithermal deposits contain neither daughter-crystal-bearing nor CO2-rich/bearing, aqueous fluid inclusions are quite developed in the ores, which shows the ore-forming fluids of the epithermal deposits are low temperature, low-salinity and CO2-poor. The fluid inclusions in the Zhaojikou Pb-Zn deposit are just characterized by low temperature, low-medium salinity and CO2-poor. The petrographic characteristics and micro-thermometry of the fluid inclusions from the Zhaojikou Pb-Zn deposit are consistent with those of the epithermal deposit.

Acknowledgment

Financial supporting from the National Natural Science Foundation of China (No. 40972063 and No. 41172085) and the Science and Technology Foundation of Department of Land and Resources of Anhui Province (Nos. 2011-K7) is sincerely acknowledged.

References

Ahmad, S.N., Rose, A.W., 1980. Fluid inclusions in porphyry and skarn ore at Santa Rita, New Mexico. Economic Geology, 75(2): 229 ~ 250


