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Geological Characteristics and Metallogeny of Qiushuwan Porphyry Type Cu-Mo Deposit in East Qinling

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1 Introduction

Qiushuwan Cu-Mo deposit is the largest copper deposit in Henan Province even though it only has the middle-scale copper and molybdenum resources individually in Chinese standards. The deposit is located at about 35 kilometers Northwest of Nanyang which is the nearest major city in southwest Henan. Since 1970s, it has been intermittently explored and mined in the region. In the recent years, the newly molybdenum mineralization around has been discovered, resulting the enthusiasm of the exploration and development of the region.

2 Geological Setting

Geologically, the deposit is located at the north side of the east-west trending Shangnan-Zhengping regional fault zones, which is the major suture line between North China craton and Yangtze craton, dividing the Qinling orogenic belt into two parts. The strata exposed in the area are mainly the Qinling group, which is a set of early Proterozoic schist, marble and granitic gneiss distributed between the Shangnan-Zhenping regional faults and the northwest trending regional Zhuxia fault zones. The widespread granitoids include Caledonian granites and Mesozoic small porphyries. It is indicated that the Mesozoic porphyries is related to the cyptoexplosive breccia type and porphyritic (skarn) type mineralization in the region (Guo et al., 2005; Lu et al., 2002).

3 Characteristics of Mineralization

There are two main types nmineralization in the region. In the centre of the deposit, the mineralized Qiushuwan granodiorite porphyry occurs in an elliptic shape with the east-west trending approximately 300 meters and north-south trending approximately 200 meters. The Re- Qs dating of the molybdenites shows that the model age is 145.57±1.80 Ma–147.98±2.21 Ma，averaging 146.42±1.77 Ma , and the isochron age is 147±4 Ma (Guo et al., 2005). Spatially, the molybdenum mineralization is mainly distributed along the contact zones between the Qiushuwan granodiorite porphyry and the marble, mainly resulting porphyritic (-skarn) type Mo mineralization. The copper mineralization mainly occurs in the cyptoexplosive breccia pipe at Beishan (north hill). The sulphides of ore include molybdenite, chalcopyrite, pyrite, sphalerit e, galena, pyrrhotite, etc. The hydrothermal alteration is mainly silicification, potassic feldspar alteration, sericitization, skarnization etc. and roughly exhibits circular distribution.

There are 26 copper orebodies and more than 30 molybdenum orebodies discovered so far. The copper orebodies mainly occur at low part of the breccia pipe, and exhibit layered and irregular lentoid, with 300–500 m long, averaging 80 meters width and 7–8 meters thick. The molybdenum orebodies mainly occur lentoid with the northwest trending, less than 800 meters length, approximately 400 meters deepening and 1–55.72 meters thick, and dipping 40°–60°.

The hydrothermal activities and mineralization include three periods: 1) rare xenomorphic pyrrhotite, magnetite, pyrite and molybdenite were formed in the high temperature hydrothermal alteration-skarn period in early time; 2) the precipitation of the main sulfides when porphyritic Cu-Mo mineralization and quartz-sulfides were formed in the period; and 3)The calcite-barite-quartz period in late stage. The inclusions of the above-mentioned three periods suggest that they were captured from the inhomogeneous fluids, show that the fluids boiling occurred many times.

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4 Geochemistry and Metallogeny

The geochemistry characteristics of the Qiushuwan granodiorite shows it I type and calc-alkaline series. And on the other hand, the high Ba-Sr of the Qiushuwan granodiorite indicates the migmatization of the mantle and crust in the region.

The primary inclusions take the shapes of irregular, ellipse and negative crystal form, with the size of 2–26 μm. They exhibit halite-bearing multiphase, pure liquid phase, CO_2-bearing phase, gas-liquid phase and pure gas phase. It suggests that the fluids system of the deposit is relative complex, and the primary fluid (H_2O-NaCl-CO_2-rich) is related to the differentiation of the deep magma. In the middle to late stage, the exploration of rock and the participation of the other fluids bring the temperature down and result in the deposition of the copper and molybdenum.

The homogenization temperature of the quartz inclusions and equilibrium temperature interval of sulfur isotope pairs of pyrite-chalcopyrite show that the mineralization temperature is about 140–360 ℃. The δ^{18}O-δD diagram of the orebearing quartz vein show the water originated from the mixture of the meteoric water and magmatic water (Guo et al., 2005). The sulfur istope of the sulfides shows the low positive value (δ^{34}S1.44‰–3.66‰), indicates the character of deep origin.

The Re content of the molybdenites in Qiushuwan deposit is 112.7×10^{-6}–180.0×10^{-6}, averaging 151.8×10^{-6}, obviously higher than that in Luanchan molybdeum deposit ($13.1–53.7\times10^{-6}$), Jinducheng molybdeum deposit (16.13×10^{-6}) and Donggou molybdenum deposit (4.12×10^{-6}) which are located in the north part of the Qinling orogenic belt and formed in middle to late Mesozoic, and the molybenum derived from the low crust (Lu et al., 2002; Li et al., 2004). The content of Re is lower than that in the Huanglongpu deposit (averaging 428.36×10^{-6}), which formed in early Mesozoic and the molybdenum was derived from the upper mantle (Huang et al., 1994). It probably indicates that the copper and molybdenum was derived from the mixture of upper mantle and low crust.

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