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Study on Ore-forming Fluid of Shiyaogou Porphyry Molybdenum Deposit, Henan Province, China

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As a type of hydrothermal deposits, the porphyry deposits were distributed throughout the world and they are the important source of copper, molybdenum, gold and other metals . The deposits with different regions and different times show the similar veins and alteration types (Seedorff et al.,2005), therefore, from the perspective of ore-forming fluid to know about porphyry deposts has been the focus for scholars both at home and abroad(Rusk et al,2008). Shiyaogou molybdenum deposit is a newly discovered porphyry molybdenum deposit, although previous research focused on its geological characteristics and Re-Os age, there lack of ore-forming information. Based on the study of fluid inclusions in different ore-forming stages and the use of laser Raman technique, the author want to discover the characteristics of ore-forming fluid in this deposit.

1 Geologic Setting

The Eastern Qinling Mo-bearing metallogenic belt is located in the south margin of North China Platform and north margin of Yangtze Platform. This belt comes from Jinduicheng of Shanxi Province in the west, and reaches at Fangcheng district of Henan Province in the east(Li Nuo et al.,2007). The strata in this belt is mainly middle Proterozoic Xiong'er group intermediate-basic volcanic rocks, middle Proterozoic Guandaokou group littoral facies clastic rocks and carbonate rocks, and Archean Taihua group gneiss and migmatite, and upper Proterozoic Luanchuan group marble, dolomitic marble, quartzite and schist. Intrusive rocks in the belt are mainly Yanshannian granitie porphyry, dioritic bodies, and intermediate to acidic dikes(Fan Hongrui et al.,1999).

2 Deposit Geology

The alteration related to mineralizing in Shiyaogou molybdenum deposit is obvious. From porphyry body center to outside, the alteration zonation is early K-metasomatism zone, silicification zone, sericification zone, beresitization zone,propylitization zone, and carbonation zone. The ore minerals in the stockwork are mainly pyrite, molybdenite, and chalcopyrite, with minor magnetite, hematite. The gangue minerals are mainly quartz, potash feldspar, sericite and chlorite.Based on the structural, textural and mineralogical relationships of the ores, three kinds of veins can be distinguished from early to late stage. Their mineral assemblages are quartz-pyrite±molybdenite，quartz-molybdenite-pyrite±chalcopyrite and quartz-calcite±pyrite±fluorite, reaspectively.

3 Fluid Inclusions Studies

On the basis of phase ratios observed at room temperature, combined with fluid inclusion behavior during heating and freezing, four types of fluid inclusions were recognized in the stockwork and vein ores. They are NaCl-H_2O,pure CO_2,CO_2-H_2O and daughter mineral-bearing fluid inclusions in composition, only the NaCl-H_2O composition can be found in the late stage. The early stage is characterized by fluid inclusions at a wide range of salinities(3.55%~57.62%$NaCl_{eqv}$) and homogenization temperatures(191.7~484℃)，with the average homogenization temperature and salinity of 310℃ and17% $NaCl_{eqv}$. The middle stage reveals a medium low salinity(3.23% ~50.62% $NaCl_{eqv}$) and homogenization temperature(132.1~423℃). The late stage shows a low homogenization temperature(117.1~247.7℃)and medium-low salinity(2.74%~8.95% $NaCl_{eqv}$). On the basis of Laser Raman microspectroscopy, we found the early stage is characterized by high content of CO_2,and there is poor CO_2 in the late stage. The opaque and translucent daughter

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minerals are mainly observed in the early and middle stage, besides that high content of CH_4 can also be conformed in the middle stage.

4 Discussion and Interpretation

Based on fluid inclusions studies and Laser Raman microspectroscopy, we found that the initial ore-forming fluid abounds in CO_2,halite and hematite, but the middle stage abounds in chalcopyrite and CH_4, fluid boiling and release of CO_2 in this stage result in rapid precipitation of ore-forming materials. The late stage fluid characterized by low temperature, low salinity and poor CO_2, maybe resulted from the participation of meteoric water. So we concluded that the initial fluid is characterized by high temperature, high salinity , high oxygen fugacity,and high content of CO_2, the middle stage is characterized by reducibility for abounding in chalcopyrite, combined with the fluid boiling, the ore-forming materials become precipitate. Although the source of molybdenum is controversial in the world till now, we hold that the ore-forming materials come from lower crust for the content of Re is 8.24～30.24ppm in Shiyaogou molybdenum deposit(Gao Yalong et al.,2010), which is similar to Yuchiling and Leimengou molybdenum deposit. CO_2-H_2O fluid inclusions appear to be coexist with daughter mineral-bearing fluid inclusions in middle stage with similar homogenization temperature, this suggests fluid boiling happened, and this is consistent with the existence of breccia. Considering the fluid boiling is common in other molybdenum deposits in East Qinling Mo-bearing metallogenic belt, we concluded fluid boiling maybe the dominant factor for the formation of molybdenum deposits.

5 Conclusions

The evolution of hydrothermal ore-forming in Shiyaogou molybdenum deposit can be divided into three stages from early stage to late stage. The early stage is characterized by high content of CO_2, high temperature, high salinity and high oxygen fugacity; the middle stage is characterized by reducibility for high content of CH_4 and chalcopyrite, and the late stage is characterized by low temperature, low salinity and poor CO_2.Foluid boiling mainly occurred in the middle stage suggests it maybe the dominant factor for molybdenite precipitate.

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