The Tongling area of Anhui Province is an important copper polymetallic ore district in the iron-copper-sulfur-gold metallogenic belt of the Middle and Lower Yangtze River in eastern China, and it is famous for the skarn deposits becoming the main contributors of ore reserves in the area. In recent years, with the further carrying out of the geological prospecting, porphyry deposits in the deep and polymetallic vein deposits in the shallow area have been successively discovered. The element associations of the porphyry deposits include Cu (Sujiadian deposit, Wang et al., 2012), Cu-Au (Dongguashan deposit, Xu et al., 2014) and Cu-Mo (Southern Hucun deposit). Those of the polymetallic vein deposits are mainly Ag-Au-Pb-Zn and Pb-Zn-Au. In this paper, three types of deposits in the Shizishan ore field of the Tongling ore district were chosen to further develop the metallogenic model.

1 Southern Hucun Porphyry Cu (Mo) Deposit

Southern Hucun Cu (Mo) deposit, discovered in the recent years, is located in the southern part of the Shizishan ore field and the NE limb of the Qingshan anticline. The strata exposed at the surface are mainly banded limestones and bedded nodular limestones of Lower Triassic Helongshan and Nanlinghu Formations. SN-, NNW- and NNE-trending faults developed in the ore district and controlled the distribution of the Hucun and Chenjiachong granodiorite apophyses which are connected under the sedimentary coverage. The orebodies buried at depth below 1000m from the surface, and occurred as lentoid in granodiorite and its corresponding contact wallrocks which are mainly cherts, siliceous shales and shales of Lower Perminian Qixia and Gufeng Formations. The ore-controlling structures consist of fissure structures and contact zone structures. Major ore minerals are molybdenite, chalcopyrite, pyrite and pyrrhotite. The ores have granular, metasomatic-interstitial, exsolution textures. The Cu-bearing ores have massive or vein structures, while the Mo-bearing ores have veinlet, stockwork, veinlet-disseminated structures. The grade of Mo in the ores is not high but homogeneous, while that of Cu in the ores is just the opposite. Alteration mineral assemblages from the center of the intrusion to the wallrocks are K-feldspar-biotite, quartz-sericite, chlorite-epidote and hornfels/seam. The geological characteristics show that the deposit is very similar to typical porphyry deposit worldwide.

2 Datuanshan Skarn Cu (Au) Deposit

The Datuanshan deposit is located in the center of the Shizishan ore field and SE limb of the Qingshan anticline. The exposed strata at the surface include limestone, dolostone, interbedded dolomitic limestone and limestone of Lower Triassic Yinkeng, Helongshan, Nanlinghu Formations and Middle Triassic Dongma’anshan Formation. The orebodies mainly output in the interstratified decollement structures between the Lower Triassic Yinkeng Formation and the Upper Perminian Dalong Formation at depth below 500m from the surface. The deepest orebodies occur in the upper Perminian Qixia Formation. The ore-controlling structures are mainly the interstratified decollement structures, locally contact zone and fracture structures. The deposit is surrounded by Datuanshan granodiorite in the western, southern and northern sides. The orebodies occur in the eastern side of the granodiorite. The ore types are mainly Cu-bearing magnetite skarn, Cu-bearing skarn and Cu-bearing massive sulfide. The ore minerals are mainly chalcopyrite, pyrrhotite, sphalerite, cubanite, pyrite, marcasite, molybdenite, bismuthinite. The ores have euhebral-granular, intersertal lamellar, metasomatic, exsolution textures and banded, disseminated, massive and veinlet

Model of the Porphyry, Skarn and Polymetallic Vein Deposits in Shizishan ore Field, Tongling, Anhui Province

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structures. The contact metamorphism formed marbles and hornfels in the ore district. And skarnification, carbonation, chloritization, silicification are the main wall-rock alteration types related to mineralization.

3 Jiguanshi Ag-polymetallic Vein Deposit

The Jiguanshi Ag-polymetallic deposit is located in the southeastern part of the Shizishan ore field and the SE limb of the Qingshan anticline. The exposed strata at the surface are dolostone, interbedded dolomitic limestone and limestone of the Middle Triassic Dongma’anshan Formation. The ore-controlling structures are mainly NW-, EW-trending faults and interlayer fractures. The intrusion associated with mineralization is the Jiguanshi quartz-monzodiorite, overlying the contact zone. The deposit can be divided into two parts, the upper and the lower. The orebodies of the upper part appear in vein and veinlet within quartz-monzobiorite, while those of the lower part in lentoid in wall-rocks. The ore minerals at the primary ore zone are mainly pyrite, colloidal pyrite, tetrahedrite, chalcopyrite, arsenopyrite, galena, sphalerite, native silver, native gold, electrum, while those at the secondary ore zone are mainly limonite, goethite, argentite, cerussite, smithsonite, bismutite, sardinianite. The major gangue minerals are quartz, sericite, calcite, chaledony, kaolinite. In the lower part of the deposit, garnet, diopside, wollastonite and scapolite are the gangue minerals. The ores have veinlet-disseminated, banded, fracture-brecciated structures and granular, metasomatic, poikilitic, exsolution, recrystallization textures. Silver and gold are mainly distributed in defects and fissures of the ore mineral crystals and occur as independent minerals such as native silver, native gold, electrum, or as solid solution in sulfides such as tetrahedrite, galena and pyrite. Parts of silver and gold are distributed in intercrystalline cracks of tetrahedrite, pyrite, sphalerite, galena and gangue minerals and occur as granular and lamellar. The wall-rock alteration is characterized by low-temperature hydrothermal alteration such as sillification, beresitization and kaolinization.

4 Conclusions

The isotopic compositions of sulfur and lead of the deposits in the Shizishan ore field imply that the source of the ore-forming metal elements come from the Mesozoic magma or magmatic rocks. And the isotopic compositions of hydrogen and oxygen indicate that the ore-forming fluids are mainly magmatic water (Xu et al., 2014). Therefore, the deposits in the Shizishan ore field, including above three deposits, have very similar geochemical characteristics, which show that they are all controlled by a unified magmatic hydrothermal system. Not only the isotopic ages of the ores formed are consistent with those of the related magmatic intrusions, but also the spatial distribution of the deposits shows an obvious regularity, that is, from the depth to the surface in the section, or from central to the outside of the ore field at the surface, porphyry→skarn→vein deposits distribute in order. We considered that the three types of the deposits belong to a unified metallogenic series and developed a synthetical model for the porphyry, skarn and polymetallic vein deposits in Shizishan ore field. The model emphasizes the significance in the metallogenic theory research and the actual prospecting exploration of the Tongling ore district.

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