Paper Number: 2179

Physico-chemical controls on ore deposition in the the La'erma and Qiongmo Au–Se deposits in the western Qinling Mountains, China

Liu, J.J.[1,2], Zhai, D.G.[1,2], Wang, J.P.[1,2], Wang, Y.H.[1,2] and Liu, Z.J.[1,2]

[1]State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Beijing 100083, People's Republic of China, liujiajun@cugb.edu.cn

[2]School of Earth Sciences, China University of Geosciences (Beijing), Beijing 100083, People's Republic of China

---

The micro-disseminated gold deposits at La'erma and Qiongmo are located at the plunging end in the west part of the Baiyigou Anticline in the western Qinling area. They are hosted in the Cambrian Taiyangding Formation, which is composed of a series of carbonaceous cherts and slates. More than 100 gold ore bodies have been delineated. Gold mineralization is strictly controlled by strata, lithology and interformational fractures [1]. The deposits are quite complex in mineralogy. Up to now more than 80 minerals have been identified, including sulfides of Cu, Pb, Zn, As, Mo, Ni and Sb, U-bearing minerals and a variety of oxides. It is interesting to note that a variety of selenides and Se-bearing minerals, such as tiemannite, clausthalite, antimonselite, kullerudite, and an unnamed mineral containing Ni–As–S–Se have been identified. Based on the crosscutting relationships of ore veins, ore compositions and mineral associations, two stages of mineralization can be recognized in the La'erma and Qiongmo deposits: (1) the early stage represented by the association of pyrite–marcasite–chalcopyrite–bornite–native gold–quartz, and (2) the main stage represented by the association of stibnite–selenides–native gold–quartz–barite.

Both in the host rocks and the gold ores selenium is present in high abundance, either as selenide minerals or isomorphous admixtures in sulfides, with independent selenium orebodies that can be delineated in some localities. Intergrowth of selenides and native gold is commonly observed. Selenium is also noticed in considerably high content in fluid inclusions in quartz and barite, which are closely related to gold mineralization [2].

The high enrichment of selenium, with abundant independent selenides and Se-bearing minerals, in the deposits reflect a specific condition of their formation. Our studies show that the La'erma and Qiongmo deposits are formed at intermediate to low temperatures (142–269°C) and low pressures (9–30 MPa) and gold is transported as Au–S–Se complex. In the early stage of mineralization, fO_2 and fSe_2 are relatively low while fS_2 is relatively high, with $fS_2/fSe_2>1$. In this circumstance, sulfur would be precipitated as sulfides and selenium would tend to be trapped in the sulfides as an isomorphous admixture. Therefore, the minerals are characterized by the association of pyrite–marcasite–

chalcopyrite–bornite–native gold–quartz. In the main stage of mineralization, fSe_2/fS_2 and fO_2 would increase with the precipitation of sulfides. The high fO_2 would favor the formation of selenides, especially when SO_4^{2-} is prevailing, thus leading to the separation of selenium from sulfur, thus forming the association of stibnite–selenides–native gold–quartz–barite. The control of the oxidizing environment on the separation of S and Se, on the transport of Se and deposition of selenides minerals from hydrothermal fluids was discussed in detail by Tischendorf (1969) [3] in terms of Eh, and by Simon and Essene (1996) [4] and Simon et al.(1997) [5] in terms of $fO_{2(g)}$ and $fS_{2(g)}$. These publications are important to understanding the aqueous geochemistry of Se and to discuss the mechanism of Au–Se association in the La'erma and Qiongmo gold deposits.

It can be generalized that the critical conditions for the simultaneous precipitation of gold and selenium as seen in deposits at La'erma and Qiongmo are: (1) abundant source of gold and selenium in chert; and (2) an oxidizing environment.

Acknowledgements: Funding for this project was jointly granted by the National Natural Science Foundation of China [41573036 and 41030423], by the Specialized Research Fund for the Doctoral Program of Higher Education [20130022110001] and by the 111 Project [B07011].

References:

[1] Liu J J et al.(2000) Ore Geology Reviews 17: 91–111

[2] Liu J J et al.(2000) International Geology Review 42: 1037–1045

[3] Tischendorf G (1969) International Geology Review 11: 1298–1301

[4] Simon G and Essene E J (1996) Economic Geology 91: 1183–1208

[5] Simon G et al (1997) Economic Geology 92: 468-484