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Characterization of fluid inclusions and sulfur isotopes in the Iju porphyry copper deposit, North West of Shahr-e-Babak

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Introduction

The Iju porphyry copper deposit is located in the southern part of the Urumieh-Dokhtar magmatic arc (Dehaj-Sarduieh belt) within the Kerman copper belt (Dimitrijevic, 1973). The Porphyry Copper mineralization in the Iranian plate occurs dominantly along the Urumieh-Dokhtar arc, which has resulted from the subduction of the Arabian plate beneath the central Iran and the closure of the Neo-Tethys Ocean during the Alpine orogeny (Hassanzadeh, 1993). The Iju porphyry copper deposit with 25 million tons of ore reserves is one of the main copper deposits within the Kerman copper belt. The mining area is composed of upper Miocene volcanic and subvolcanic rocks (mineralized and barren subvolcanic rocks) and quaternary deposits. Two hydrothermal alteration zones of quartz-sericite-pyrite and propylitic zones can be identified in the Iju area. The copper mineralization in the Iju deposit occurs as disseminated, stockwork and hydrothermal breccia. In the hypogene zone, the mineral paragenesis include chalcopyrite, pyrite, with minor occurrences of bornite and magnetite. This paper reports geological, mineralogical, fluid inclusion and S isotope data from the Iju deposit in order to investigate ore-bearing fluids' characteristics and the mechanisms of ore deposition.

Materials and methods

Fifteen samples of syngenetic quartz+pyrite bearing veinlets within the quartz-sericite-pyrite zone were selected from different depths across the seven boreholes. Quartz was used for double-polished thin sections and pyrite was used for sulfur isotope analysis. Fluid inclusion studies were performed using the Linkam cooling and heating stage, the THMSG 600 model. The syngenetic pyrite with thermometry quartz sample was used for the sulfur isotope experiments. Stable isotope analysis was performed at the Hatch Stable Isotope Laboratory in the University of Ottawa, Canada.

Results

The fluid inclusions of the Iju deposit represent a wide range in the homogenization temperatures between 140 to 480°C and salinity between 0.18 to >52.99 wt.% NaCl equiv., which are most similar to the results of the other Iranian porphyry copper deposits. Being located in the quartz-sericite-pyrite alteration zone, the results of thermometry indicates that ore deposition in the Iju deposit has occurred via mixing of magmatic and surface fluids. Variations in salinity and paragenesis of the saline multiphase fluid inclusions and two-phase gas-rich fluid inclusions indicate the occurrence of boiling phenomenon in some samples of the Iju deposit. The amount of $\delta^{34}S$ for pyrite has a limited range close to zero (average, 0.229‰) that shows a magmatic origin for sulfur. Considering the presence of subvolcanic rocks, the type and extension of alteration zones, the structure and texture of ore bodies, thermometry results of fluid inclusions and sulfur isotope values, the Iju deposit is similar to porphyry copper deposits.

Discussion

In the quartz-sericite-pyrite zone, three main groups of veinlets have been identified. The

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quartz+pyrite veinlets are more abundant than the other types and they were selected for fluid inclusions and stable isotope studies. Petrographic studies of fluid inclusions identifies two groups of fluids including: 1- fluid inclusions without the halite phase, including the types L+V, L+V+S1 and (L+V+S1+S2, that is secondary), 2- fluid inclusions with halite phase, including the types L+V+H, L+V+H+S1, L+V+H+S1+S2 and L+V+H+S1+An. Homogenization temperature and salinity for the fluid inclusions without halite phase are as follows: 140 to 380°C and 0.18 to 24 wt.% NaCl (Fig. 8A and C) and for the fluid inclusions with halite phase they range from 230 to 480°C and 30 to 52 wt.% NaCl (Fig. 9A, B and D), In addition, the pressure and depth for the fluid inclusions containing halite phase are 750 bar and 3500 m on the average. Fluid inclusions available at the quartz veinlets of porphyry copper deposits can be formed in a wide range of chemical composition and under different temperature and pressure conditions (Rusk and Reed, 2008). The wide range in fluid inclusions data of the Iju deposit can be justified by physicochemical changes in the fluid as it is boiling and mixing with the surface fluids. Cooling, fluids mixing, boiling and fluid-rock reaction play important roles in the settling of chalcopyrite from the hydrothermal fluid and the dilution of saline ore-bearing fluids can cause the formation of copper ores from the ore-bearing fluid (Ulrich et al., 2002). Pyrite $\delta^{34}S$ value ranges from -0.86 to +1.27‰ (average, +0.22‰) and the $\delta^{34}S_{H2S}$ value of the syngenetic fluid with pyrite ranges from -0.23 to -2.36‰ (average, -1.17‰). The limited and near zero range that is observed about $\delta^{34}S$ value of the sulfur minerals indicates the controlling role of magmatic processes in the mineralization events (Chen et al., 2009).

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References

Chen, Y.J., Piranjno, F., Li, N., Guo, D.Sh. and Lai, Y., 2009. Isotope systematica and fluid inclusion studies of the Qiyugou breccia pipe-hosted gold deposit, Qinling Orogen, Henan province, China: Implication for ore genesis. Ore Geology Reviews, 35(2): 245-261.

Dimitrijevic, M.D., 1973. Geology of Kerman region. Geological Survey of Iran, Tehran, Report No. Yu/52, 334 pp.

Hassanzadeh, J., 1993. Metallogenic and tectonomagmatic events in the SE sector of the Cenozoic active continental margin of central Iran (Shahr e Babak area, Keman Province). Ph.D. thesis, University of California, Los Angeles, America, 204 pp.

Rusk, B.G. and Reed, M.H., 2008. Fluid inclusion evidence for magmatic-hydrothermal fluid evolution in the porphyry copper-molybdenum deposit at Butte, Montana. Economic Geology, 103(2): 307-334.

Ulrich, T., Gunther, D. and Heinrich, C.A., 2002. The evolution of a porphyry Cu-Au deposit, based on LA-ICP-MS analysis of fluid inclusions: Bajo de la Alumbrera, Argentina. Economic Geology, 97(8): 1889-1920.