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Hydrothermal Fluid evolution in the Dalli porphyry Cu-Au Deposit: Fluid Inclusion microthermometry studies

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Introduction

A wide variety of world-class porphyry Cu deposits occur in the Urumieh-Dohktar magmatic arc (UDMA) of Iran.The arc is composed of calc-alkaline granitoid rocks, and the ore-hosting porphyry intrusions are dominantly granodiorite to quartz-monzonite (Zarasvandi et al., 2015). It is believed that faults played an important role in the emplacement of intrusions and subsequentporphyry-copper type mineralization (Shahabpour, 1999). Three main centers host the porphyry copper mineralization in the UDMA: (1) Ardestan-SarCheshmeh-Kharestan zone, (2) Saveh-Ardestan district; in the central parts of the UDMA, hosting the Dalli porphyry Cu-Au deposit, and (3) Takab-Mianeh-Qharahdagh-Sabalan zone. Mineralized porphyry coppersystems in the UDMA are restricted to Oligocene to Mioceneintrusions and show potassic, sericitic, argillic, propylitic and locally skarn alteration (Zarasvandi et al., 2005; Zarasvandi et al., 2015). In the Dalli porphyry deposit, four hydrothermal alteration zones, includingpotassic, sericitic, propylitic, and argillic types have been described in the two discrete mineralized areas, namely, northern and southern stocks. Hypogenemineralization includes chalcopyrite, pyrite, and magnetite, with minor occurrences of bornite.Supergene activity has produced gossan, oxidized minerals and enrichment zones. The supergene enrichment zone contains chalcocite and covellite with a 10-20 m thickness. Mineralization in the northern stock is mainly composed of pyrite and chalcopyrite. The aim of this study is the investigation and classification of hydrothermal veins and the constraining of physicochemical compositions of ore-forming fluids using systematic investigation of fluid inclusions.

Materials and methods

Twenty samples were collected from drill holes. Thin and polished sections were prepared from hydrothermal veins of thepotassic, sericitic and propylitic alteration zones. Samples used for fluid inclusion measurements were collected from drill cores DH01, DH02, DH06, and DH07, and outcrop samples. Microthermometric data were obtained by freezing and heating of fluid inclusions on a Linkam THMSG600 mounted on an Olympus microscope at Lorestan University.

Results

1) Five main veintypes were identified, belonging to three stages of mineralization:type (I): barren quartz, type (II): quartz + pyrite + chalcopyrite ± bornite ± chalcocite ± covelite, type (III): quartz + magnetite ± chalcopyrite, type (IV): K-feldspar± quartz ± chalcopyrite, type (V): chlorite + biotite.

2) Seven groups of fluid inclusionswere observed: (IA) liquid-rich mono-phase, (IB) vapor-rich mono-phase, (IIA) liquid-rich two-phase (liquid + vapor), (IIB) vapor-rich two-phase (vapor + liquid), (IIIA) high salinity simple fluids (liquid + vapor + halite), (IIIB) high salinity opaque mineral-bearing fluids (liquid + vapor + halite + pyrite + chalcopyrite + hematite), (IIIAB) multi-phase fluids (liquid + vapor + halite + sylvite + hematite + magnetite + pyrite + chalcopyrite ± erythrosiderite)

3) Multiphase fluid inclusions with predominant homogenization temperatures 420 to 620°C and predominant salinities 70 to 75 wt.%NaCl, are

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thought to be the early fluids involved in mineralization.
4) The coexistence of high saline liquid and vapor rich fluid inclusions (IIIAB, IIIB, IIIA and IIA types) resulted either from fluid entrapment during the boiling process or the co-presence of two immiscible fluids generated from the magma.
5) Dalliporphyry Cu-Au deposit was formed in a magmatic-meteoric system.

Discussion

Two conventional thermometric procedures, freezing and heating, were employed for the measurement of temperature of homogenization and approximate salinity. Freezing was conducted mainly for halite-under saturated inclusions (types IIA and IIB), to measure the initial melting temperature (Te) and the last melting point (Tm_{ice}), whereas heating was carried out on the halite-bearing inclusions (types IIIA, IIIB and IIIAB). Based on the microthermometric results, the Dalli fluid inclusions can be divided into two distinct groups: (1) medium-high temperature, hypersaline (Types IIIA, IIIB and IIIAB) and (2) low-medium temperature, low salinity group (Types IIA and IIB). Type IIB inclusions, which homogenize to the vapor phase and have a relatively low cooling rate, provide a fairly good estimate of entrapment pressure (Roedder and Bodnar, 1980). Based on the pressure estimated for the Dalli deposit, mineralization likely occurred at depth of 0.6-1.1 km. The calculated depth is coincident with the estimated mineralization depths of the porphyry deposits in the world (Pirajno, 2009). Fluid inclusions with a wide range of vapor and liquid ratios are abundant in all of the Dalli samples. This represents heterogeneous trapping of liquid and vapor. The coexistence of inclusions with different volumes of vapor contents, which homogenize either to liquid (Th(L-V)) or vapor (Th(V-L)), are interpreted as an evidence for the prevailing wide range of physico-chemical conditions during the cooling history of ore-forming fluid at the Dalliporphyry Cu-Au deposit. The boiling process is documented by the abundance of heterogeneously trapped fluid inclusions with extremely variable liquid to vapor ratios (Ahmad and Rose, 1980).

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References

Ahmad, S.N. and Rose, A.W., 1980. Fluid inclusions in porphyry and skarn ore at Santa Rita, New Mexico. Economic Geology, 75(3): 229–250.

Pirajno, F., 2009. Hydrothermal processes and mineral systems. Geological Survey of Western Australia. Springer, 1250 pp.

Roedder, E. and Bodnar R.J., 1980. Geologic pressure determinations from fluid inclusion studies, Annu. Review Earth Planet, 8(6): 263–301.

Shahabpour, J., 1999. The role of deep structures in the distribution of some major ore deposits in Iran, NE of the Zagros thrust zone. Journal of Geodynamics, 28(3): 237-250.

Zarasvandi, A., Liaghat, S. and Zentilli, M., 2005. Porphyry Copper Deposits of the Urumieh-Dokhtar Magmatic Arc, Iran, Super Porphyry Copper and Gold deposits. A global perspective PGC publishing Adelaide, 2(4): 441-452.

Zarasvandi, A., Rezaei, M., Sadeghi, M., Lentz, D., Adelpour, M. and Pourkaseb, H., 2015. Rare earth element signatures of economic and sub- economic porphyry copper systems in Urumieh–Dokhtar Magmatic Arc (UDMA), Iran. Ore Geology Reviews, 70(3): 407-423.