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Geology and Origin of the Dohneh Copper Mineralization, Northeast of Zanjan

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Introduction

The Dohneh copper deposit is located northeast of Zanjan within the Tarom subzone and the western Alborz-Azarbayjan magmatic belt. There are several reports of copper mineralization in the Tarom region such as the Aliabad Mousavi-Khanchay Cu deposit (Saeedi, 2015),the Lolan Cu-Au deposit (Zamanian et al., 2016), the Mari Cu deposit (Hosseinzadeh et al., 2016) and the Gheshlagh Cu deposit (Abbaspour, 2017) which make this subzone an important metallogenic zone in Iran. Prior to the present research, there was no detailed study done on the Dohneh Cu deposit. Thus, the aim of this research is to present detailed characteristics of geology, mineralogy and geochemistry of the host rock as well as the origin of Cu mineralization in the Dohneh area. The results of this study can be considered as an exploratory pattern in the Tarom-Hashtjin metallogenic belt in terms of time and space.

Materials and methods

Petrographic and mineralogical features of the Dohneh Cu mineralization and host volcanic rocks were determined by studying 52 thin and thin-polished sections. Major and trace element compositions of six volcanic samples (the host of mineralization) were determined by the Iran Mineral Processing Research Center and Zarazma Company using XRF and ICP-MS methods, respectively. Furthermore, four samples were selected for electron microprobe and scanning electron microscope (SEM) analysis in the Iran Mineral Processing Research Center, Karaj.

Results and Discussion

The main rock units in the Dohneh area include Eocene tuffs and basalts which are related to the Kordkand member of the Karaj Formation. The tuff unit displays basic composition and is comprised of plagioclase, pyroxene, minor olivine and opaque minerals. There are also some basaltic fragments within the tuff unit. The Dohneh volcanic lavas can be divided into two lava flows varying in texture and mineralogy. The amygdaloidal basalt shows porphyritic and amygdaloidal textures and contains plagioclase, clinopyroxene, orthopyroxene, olivine and opaque minerals. The secondary minerals are carbonate, serpentine, epidote, chlorite, zeolite (filling the cavities), sericite and iron oxide. The second lava flow in the Dohneh area is the porphyritic basalt which shows specified porphyry texture which consists of pyroxene phenocrysts enveloped within the fine-grained matrix including plagioclase, olivine and pyroxene. The geochemical features of the Dohneh basaltic lavas show calc-alkaline nature with enrichment in LILE and LREE and depletion in HFSE and HREE. The Dohneh samples show negative anomaly of Nb, Ta and Ti in primitive mantle normalized spider diagrams. This geochemical evidence together with trace element data suggest that the Dohneh lavas have formed through partial melting of metasomatized lithospheric mantle. The status of the Dohneh samples in the tectonic

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discrimination diagrams shows subduction related magmatism analogous to those reported from the Tarom and Qazvin areas (Nabatian et al. 2014; Asiabanha and Foden, 2012).

The Cu mineralization occurred in both amygdaloidal and porphyritic basalt lavas. According to e mineralography studies, the Dohneh deposit includes native copper, native silver, cuprite, malachite and azurite minerals. The minerals occur in the forms of vein-veinlet, open space filling, replacement and residual. The major alteration minerals in the Dohneh deposit include carbonate, chlorite, zeolite, and serpentinite and minor epidote, which have formed as replacement, vein-veinlet and open space filling in the host rocks.

The field and microscopic observations, whole rock chemistry and mineral chemistry data from the Dohneh deposit suggest that the mineralization fluids and hot saline aqueous fluids have been generated during the late diagenesis and burial metamorphism in the volcanic sequence. During the ascending of fluids through the fractures and faults, the copper metal leached out of silicate minerals and turned into an elemental Cu^{2+} which is soluble in the fluid. Then, through the injection of mineralized fluids into the fractures and empty spaces of host rocks which was associated with decreasing pressure, copper and native silver minerals associated with zeolite formed at the end of the diagenetic stage, and in particular in the burial metamorphic phase. Moreover, during the circulation of fluids in the host rock, secondary minerals have formed. Consequently, mineralization of zeolite and part of copper mineralization occurred during burial metamorphism. In the final stages of mineralization and during the supergene and meteoric waters affected the minerals and caused formation of secondary minerals. In the final stages of mineralization and during the supergene and weathering activities secondary minerals have been generated. According to this study and comparing the characteristics of the Dohneh deposit to Michigan copper type deposits, it can be stated that the characteristics of the Dohneh copper deposit is the most similar to those of the Michigan copper deposits.

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