Study of vein-type Cu±Au mineralization in Sangan mineral occurrence (southeastern Torbat-e-Heydarieh), Based on mineralogy, geochemistry and fluid inclusion

H. Gholami¹, A. Malekzadeh Shafaroudi¹,², M. H. Karimpour¹,²

¹-Department of Geology, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran
²-Department of Geology, Research Center for Ore Deposit of Eastern Iran, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran

(Received: 21/1/2020, in revised form: 27/5/2020)

Abstract: Sangan prospect area is located northeast of Torbat-e-Heydarieh in Khorasan Razavi Province and in relation to regional geology, it is situated in eastern section of Khaf-Kashmar-Bardaskan magmatic belt. Metamorphosed sediments of the Shemshak Formation (slate, schist, quartzite) is the oldest unit, which is intruded by Kafardoogh granitic intrusion. The dikes of quartz monzosyenitic and dioritic composition in the last magmatism stage have intruded into the fore mentioned units. Structurally-controlled mineralization has formed along subsidiary faults, branching from the Doruneh major fault, with general trends of NNW-SSΕ to WNW-ΕSE (dipping 60-90 degrees southerly and westerly) and NE-SE (dipping 50-70 degrees easterly). The major parts of mineral deposit has occurred in fault zones of metamorphosed Shemshak Formation due to deposition of mineralizing hydrothermal fluid in open spaces of faults as cement of fault breccia fragments. The hypogene mineralization is characterized by chalcopyrite as the main ore mineral and minor amount of pyrite together with quartz and barite as gangue minerals. Malachite, chrysocolla, chalcocite, neotocite and secondary iron oxides constitute the mineralization of oxidation and supergene zone. The occurrence of structures and textures as vein-breccia, open space filling, veinlets and secondary replacement are characteristics of mineralized veins in this area. Silicification is the principal alteration associated with mineralization. The geochemical survey of veins indicates not only high content of Cu (more than 5 percent), but also considerable anomaly of Au up to 0.4 ppm while other significant metallic elements are not anomalous. Cu, Pb, Zn, Ag and Mo have good positive geochemical correlation but Au does not show correlation with other elements (except Ag). Studying two phase liquid-rich primary fluid inclusions of quartz and barite along with mineralographic studies demonstrate two phase of hypogene mineralization. Accordingly, the main phase of primary mineralization has formed from a hypogene hydrothermal fluid at temperature of 274°C to 318°C and salinity of 7.3 to 12 wt% NaCl equivalent. The late phase, which is related to barite mineralization, has been derived from a fluid at temperatures between 200°C to 259°C and salinity of 10.2 to 11.4 wt% NaCl equivalent. The temperature and salinity data represents the role of fluid mixing and dilution by cool-dilute meteoric fluids as ore-forming processes. Based on mineralogy, structure, texture, alteration, vein geochemistry and fluid inclusion studies, the Sangan mineral occurrence most resembles vein-hydrothermal deposits of epithermal Cu±Au type.

Keywords: Mineralogy; geochemistry; fluid inclusion; Sangan mineral occurrence; epithermal Cu±Au; Khaf-Kashmar-Bardaskan belt.

*Corresponding author; Phone: 05138805488, Email: shafaroudi@um.ac.ir