Investigation of cu vein of the Shurk and associated gossan zone (North West of Birjand) based on alteration, mineralization, geochemistry and fluid inclusion

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1-Introduction

Recent studies concerning fluid evolution in magmatic-hydrothermal systems have mainly concentrated on porphyry copper and epithermal high-sulfidation Au-(Ag) deposits (Bethke et al., 2005; Einaudi et al., 2003; Fifarek and Rye, 2005; Heinrich, 2005). In contrast, less attention has been paid to associated epithermal base metal deposits which occur in the upper parts of the same environment and form later in the evolution of the system than the precious metal deposits (Baumgartner and Fontboté, 2008).
The Shurk area is in the west of the Lut Block volcanic–plutonic belt, in eastern Iran, about 125 Km northwest of Birjand city. Great Tertiary, The Shurk area, is located in the west of the Lut Block volcanic–plutonic belt, in eastern Iran, about 125 Km northwest of Birjand city. The Tertiary magmatic activity in the Lut Block is spatially and temporally associated with several types of mineralization events (Karimpour et al., 2012). The prospecting area covers a significant part of the Lut Block that includes numerous cases of Cu±Pb±Zn vein-type mineralization, such as Shikasteh Sabz, Mir-e-Khash, Rashidi, Ghar-e-Kaftar, Howz-e-Dagh (Lotfi, 1982), as well as kaolin deposit (Cheshmeh Khuri area) in the neighboring area. Mineralization in the Shurk district generally described by Lotfi (1982) and Tarkian et al. (1983). Any author has published no minutiae study regarding fluid evolution and ore genesis at the Shurk district. We present and discuss geology, alteration, ore petrography, geochemistry, and fluid inclusion microthermometry, which help clarify the ore genesis of the Shurk area.

2-Material and methods

Propylithic alterations, argillic alterations, and iron oxides were investigated during preliminary prospecting in the area using ASTER in the method of spectral angle mapper. The present study involved detailed fieldwork and study of thin sections and polished slabs from the igneous rocks and ore samples under the optical microscope. Metal concentrations were analyzed at IMPRC laboratory of Iran using ICP-OES techniques on 17 samples. Three samples were analyzed for Fire Assay analysis and seven samples for XRD analysis at IMPRC laboratory of Iran. Thirty-three spot analyses (microanalyses) were performed on an X-ray Analytical Microscope at IMPRC laboratory.
Doubly polished wafers (150 μm thick) were prepared from five samples taken from surface and trenches. Microthermometric measurements were carried out using a Linkam THM 600 heating-freezing stage mounted on an Olympus TH4–200 microscope stage at the Ferdowsi University of Mashhad, Iran.

3-Results and discussion

The Shurk vein occurs as an ore vein situated along a fault zone, once developed within the Middle Eocene andesitic tuff. Hydrothermal alteration displays a zoning pattern from argillic, silicified-argillic, silicified-carbonate, carbonate and propylitic. Argillic is characterized by kaolinite and illite within wall

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rocks near the vein mineralization. Silicified-argillic and silicified-carbonate occur in wall rock as a matrix with lesser amounts of kaolinite and calcite, and the accompanied vein mineralization occurs as quartz–ore veins (generally with open space filling texture). Carbonatization is the last stage of alteration, occurring mainly in wall rocks as disseminated and calcite veins. With the distance of vein, propylitic alteration is widespread rather than other alterations.

Main mineralization was formed in two stages. The zones of silicified-argillic alteration characterize Stage-1 by quartz-pyrite-chalcocite-chalcopyrite-bornite-fahlore-sphalerite vein. Stage-2 quartz-chalcocite-sphalerite vein all occur in the zones of silicified-carbonate alteration.

Due to the significant influence of weathering processes on the primary ore, secondary sulphide and oxide mineralization (malachite, azurite, chalcocite, covellite, goethite and hematite) spread widely and finally created oxidizing sulphide orebody, as the mineral assemblage has already been changed from the hypogene condition, are discussed. Zone 1: Surficial – leached capping zone (gossan), 2: Major leaching – remnant sulphides, and 3: Supergene zone. Gossan has occurred as oxidized surface expressions of underlying ore zones. Minerals include goethite, hematite, limonite, manganese oxides (XRD was pertained in determining minerals). Significant leaching – remnant sulphides begin to become visible at lower depths. This zone has occurred as metallic ferrous secondary minerals (malachite, azurite, hematite, and goethite). The supergene zone has occurred, where supergene covellite-digenite-chalcocite-valleriite -malachite-azurite and atacamite replaces a wide range of primary sulfides.

Cu, Zn, Ag, and Pb contents reached up to 5%, 333ppm, 21.3ppm, and 47ppm, respectively. Primary fluid inclusions of quartz in paragenesis with mineralization in the silicified-argillic zone and silicified-carbonate zone have an average of homogenization temperatures 267°C and 215°C respectively. Based on freezing studies, the average calculated the temperature of the last melting point of these equals to 19.4 and 11.1 wt. % NaCl, respectively. Homogenization temperature and salinity of the fluids showed a shifting trend from relatively high in silicified-argillic zone to relatively low homogenization temperature in the silicified-carbonate zone, which can be due to physicochemical changes in the fluid such as cooling and mixing with meteoric water (Shepherd et al., 1985). According to the textual evidence, boiling has also been active during the evolution of the fluid.

4-Conclusion

Mineralized veins are clearly epigenetic and fill part of the NW–SE striking and almost have a vertical fault/fracture system. Wall rock alteration occurs as narrowly-developed zones around mineralized veins and is composed of clay minerals, quartz, calcite, chlorite, and epidote exhibiting silicified, argillic, carbonate and propylitic. The vein mineralization was formed in two stages, including 1) quartz-pyrite-chalcocite-chalcopyrite-bornite-fahlore-sphalerite that are associated with argillic-silicified alteration and 2) quartz-chalcocite-sphalerite accompanied with the silicified-carbonate alteration.

Copper deposition in the Shurk vein is believed to have mainly been caused by mixing, although boiling may also have occurred. The Shurk vein is classified as epithermal-related vein deposit. The Shurk vein is an example of volcanic-hosted base metal mineralization along the Lut Block, formed by relatively low to medium temperature and by medium salinity fluids at the shallow epithermal environment. Numerous small Cu±Pb±Zn veins are present in the neighboring area (Shikasteh Sabz, Mir-e-Khash, Rashidi, Ghar-e-Kaftar, and Howz-e-Dagh veins). The similarities in ore mineralogy and geochemistry may point out that all these veins are part of a regional ore system and may, therefore, bear significant economic potential.

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