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GEOLOGY, MINERALIZATION AND FLUID INCLUSION MICROTHERMOMETRY OF THE NAJNEH GOLD DEPOSIT, WEST OF SAQQEZ, NW IRAN

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Abstract. The Najneh gold deposit in NW Iran is one of the orogenic gold deposits within the Sanandaj–Sirjan metamorphic belt, hosted by green-schist facies rocks of Precambrian age, occurring as gold-bearing quartz-sulfide veins. Microthermometry on 2-phase aqueous fluid inclusion reveals salinity range of 3–18 wt% $NaCl_{eq.}$ and T_H range of 120–340°C. Moreover, dilution and mixing by surface fluids and boiling is also conceivable from these data. The latter is also evident from coexistence of abundant vapor inclusions. Most of the analyzed fluid inclusions show metamorphic source, though some plot in the meteoric field, indicating the mixing of these two types of fluids.

Key words: Orogenic gold, Najneh, Sanandaj–Sirjan, Fluid inclusion.

The Najneh gold deposit is located 55 km west of the Saqqez town in northwest Iran. This area is situated on the northwestern margin of the Sanandaj–Sirjan metamorphic belt of Iran, which experienced various events of regional metamorphism, as well as opening and closure of Neo-Tethys Ocean during late Paleozoic to Paleogene. All these led to the formation of shear zones and regional uplift [1] and a favorable environment for occurrence of orogenic gold mineralization.

The area is mainly covered by metamorphic rocks attributed to Precambrian, chiefly including mica-schist, phyllite and slate illustrating green schist facies, along with lesser metarhyolite, metamorphosed acidic tuff and ignimbrite and gneiss. The green-schist facies covers the large part of the area, with a NW–SE trend parallel to the main thrust fault of the area. Magmatic activities evident in the area include several small granitic intrusive bodies, emplaced within the Precambrian metamorphic rocks, which are attributed to Jurassic period. Another small granitic–granodioritic intrusion has affected the Lower Cretaceous flysch-type rocks. However, the oldest intrusive body is the Doran granite of Infracambrian age, which intruded the Precambrian metamorphic units.

According to field investigations, the gold-bearing quartz–sulfide veins–veinlets are hosted by green-schist facies rocks, which is typical characteristic of orogenic gold deposits [2, 3]. Hydrothermal alteration is evident around the quartz veins, characterized by silicic, argillic, chloritic and carbonate alteration zones. Based on geochemical analysis results of 160 samples from these veins, the gold grade ranges from 30 to 200 ppb with a mean of 70 ppb.

In order to determine the physic–chemical characteristics and the evolutional trend of ore-bearing fluid, 4 doubly polished sections were prepared from gold-bearing quartz–sulfide veins and subjected to petrographic and microthermometric studies. Fluid inclusions within these quartz veins range in size from 2 to 20 μm and show various shapes, though the round, irregular, negative crystal and elongated shapes are more common, in order of abundance. Based on phase content at room temperatures, 3 types of fluid inclusions were recognized: liquid-rich 2-phase, vapor-rich 2-phase and monophase vapor. Microthermometry analysis was performed on large primary 2-phase fluid inclusions. During the freezing run, the last melting point for ice was

between –16 and 0°C and the calculated salinity ranges from 3 to 18 wt% NaCl eq., mainly clustering between 9 and 15 wt% $NaCl_{eq.}$. Meanwhile, the overall homogenization temperature (T_H) is about 120–340°C (Fig. 1).

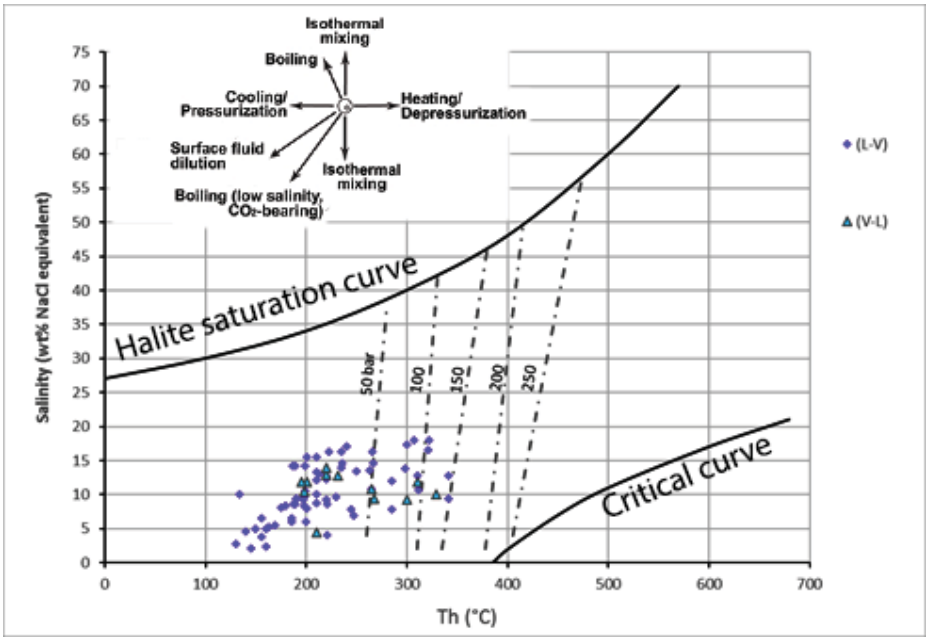

Figure 1– T_H vs. salinity diagram and the plotted data points of the Najneh gold-bearing quartz veins.

Based on T_H vs. salinity diagram, all the data points plot below the halite saturation curve, indicating entrapment from a NaCl-undersaturated fluid (Fig. 1). The minimum vapor pressure at the time of entrapment for most of the fluid inclusions is below 50 bars, though some others show values up to 150 bars. Data points trend indicates dilution and mixing with low-salinity and low-temperature surface fluids, and boiling of a low-salinity, CO_2-bearing fluid [4] (Fig.1). In this regard, most of the data points of fluid inclusions show metamorphic origin, though some plot in the meteoric field, confirming the mixing of these two types of fluids. Occurrence of boiling is also conceivable from coexistence of L-rich and V-rich 2-phase inclusions (with low to moderate salinities), which homogenize in similar range [4, 5], as well as the presence of abundant monophase vapor inclusions. Presence of cross-cutting veins and veinlets in the study area also confirms the occurrence of boiling.

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