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Magnetite-apatite mineralization in Khanlogh iron deposit, northwest of Neyshaboor, NE Iran

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Khanlogh iron deposit lies on Sabzehvar-Ghoochan Cenozoic magmatic belt in northwest of Neyshaboor, NE Iran. The lithologic units in this area include a series of sub-volcanic intrusive rocks like diorite porphyry, quartz-diorite porphyry, and micro-granodiorite of Oligocene age. Mineralization in this area occurred as veins, dissemination, and open space filling in brecciated zones within the host sub-volcanic intrusive bodies. Three distinct types of mineral associations can be distinguished, (1) diopside-magnetite, (2) magnetite-apatite, and (3) apatite-calcite. Microscopic examinations along with SEM and EPMA studies demonstrated that magnetite is the most common ore mineral occurring as solitary crystals. The euhedral magnetite crystals are accompanied by lamellar destabilized ilmenite and granular fluorapatite in magnetite-apatite ores. The results of EPMA revealed that the lamellar ilmenite, relative to host magnetite crystal, is notably enriched in MgO and MnO (average of 3.3 and 2.6 wt%, respectively; n=5), whereas magnetite is slighter enriched in Ti (TiO_2 around 1.8 wt%) being average of MgO, MnO and $V2O_3$ of 0.6wt%, 0.2wt%, and 0.6 wt% (respectively; n=20). Minerals such as chlorapatite, calcite, and chalcedony are also present in the magnetite-apatite ores. The samples from apatite-calcite ores contain coarse crystals of apatite and rhomboedral calcite.
The plot of the EPMA data of Khanlogh iron ore samples on diagram of TiO_2-V2O5 (Hou et al, 2011) illustrated that the data points lies between the well-known Kiruna and El Laco (Chile) iron deposits. The magnetite crystals in the sub-volcanic host rocks were possibly formed by immiscible iron oxide fluids during magmatic stage. However, the magnetite and apatite existing in the veins and breccia zones may have developed by high temperature hydrothermal fluids. Studies done by Purtov and Kotelnikova (1993) proved that the proportion of Ti in magnetite is related to fluoride complex in the hydrothermal fluids. The high fluorine content of the apatite at Khanlogh may testify to the presence of Ti-fluoride complex in the fluids. Formation of apatite crystals was concurrent with development of titanium lamellae in magnetite. The apatite possesses high REE content which is possibly associated with monazite inclusions. The SEM studies better show these inclusions are occasionally present at the margin of apatite crystals and veins. Based upon field relations, microscopic examinations, and the results of XRD analyses, sodic (albite), propylitic (epidote, chlorite, calcite), and argillic (montmorillonite) alterations are developed in the study area. The principal minerals in these alteration zones are albite, epidote, sericite, chlorite, quartz, calcite, and montmorllonite. Mineralogy, alteration, geochemistry, structure, and texture of the ores at Khanlogh indicate that the magnetite and apatite were chiefly formed by hydrothermal solutions which were enriched in iron mainly transported by F- and Cl- rich fluids.

Reference

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