Study of magnetite mineralization in korkoramine (Kurdistan) with mineralogy and geochemistry data

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ABSTRACT
Korkoramagnetite mineralization is located in the north of Kurdistan province that is part ofUremia- Dokhtar Zone. The type of ore minerals are magnetite, magnetite-martite, magnetite-pyrite that are formed over the oligomiocene metamorphic marble with or without intermediate of skarns rocks. There are outcrops of the different rock consists of Tertiary to quaternary conglomerate, sandy limestone, tuffithic, fossiliferous gray limestone and iron bearing horizon.Igneous rocks are mostly volcanic rocks including rhyolite to rhyodacitic and trachyte domes to quartz porphyry and plutonic rocks including diorite to locodiorite. The youngest rocks consist of alluvial tuff that is large expanse between magnetite debris and ore bodies. The main mineral of ore deposit is magnetite that is formed as stratiform, lens, disseminate, granoblast and layered associated with hematite, martite, limonite and goethite. Korkora mine is one of the most valuable Fe mines of the NW Iran because it is high grade ironup to 65% and Iron high reserve up to 20 thousand tons and slight of the P and S.

INTRODUCTION

The study area is located in the north east of Kurdistan, at a distance 100 km north of Bijar and east of Shahrak village at the west of the Zanjani Mountain. Zanjani Mountain is part of Soltanieh-Misho Mountains [1] that is located west of the Central Iran structure zone [2]. Based on the magnetite outcrop and geophysics data [3], ore deposit is divided to two major blocks in north and south. In addition, there are outcrop of magnetite as small mass and dispersed between mains blocks (Fig.1). Korkor block is located in north of study area as layer structure, east-west direction and approximately 15 km east. According to the mineralization map, half of Korkorabodies are exposed almost continuous or scattered and the other half, especially in the east, is covered by debris of soil or different rock.

Geology setting:

Based on the field study, there are vary types of mineralization including of magnetitic, magnetitic-martite and magnetite-pyrite that are formed over the oligomiocene carbonate formation and marble with or without intermediates skarn rocks. Rock units in the area consist of Jurassic to Eocene fossiliferous gray limestone, Eocene lithic tuff, Oligocene conglomerate and sandy limestone, and iron bearing horizon (Fig. 2). There are igneous rock including Rhyolite to rhyodacite, trachyte, quartz porphyry dome and diorite to locodiorite bodies. The youngest rock unit is alluvial that is located between two blocks of ore deposit and debris that is divide korkorablock to three bodies. Gangue of korkora mine are limestone marble, quartz porphyry, rhyolitic tuff and skarns.

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Fig. 1: Magnetic map of the iron distribution in Korkoramine [4].

Fig. 2: Outcrops of Fe- horizons contact in the upper part of the Korkora Mountain with quartz porphyry and limestone, A: View to the southwest, B: View to the north
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Fig. 3: Geological map 1/20000 simplified of the Korkora

Tectonic setting:

The faults are often normal, strike-slip and or combination of all of them that its direction is north -south, northeast – southwest, east -west, and sometimes northwest - southeast (Fig. 3). The magnetic anomalies map of Korkorashowstó important faults of the north- south and west- east forshift of the ore bodies sothat present shape of ore body is developed by shift of fault system(Fig. 4).

The ore deposit and gangue permeability to water were increased by action of the faults and jointsand cause to extreme alteration and oxidation of the superficialto deep in fault plain [4]. The mostly dip of sedimentary stratigraphy is horizontally whereas in some part, it is observed dip change of the limestone strata by faulting oreexistence of igneous intrusions (diorite and locodiorite).

Fig. 4: Interpretation map 1:500 of magnetic anomalies in study area[4].

Discussion:

Based on magnetic and geophysical data, Korkora ore deposit is recognized as two main blocks innorth and south and some disseminate iron stains.
The Korkorablock is observed with 758 m length, 64 to 349 m width, 7 to 37 m thickness and W-E direction that is extensive as layer with extent 15ha. The ore bodies exposed are continuously or scattered and in some place is covered by iron stain and debris. The boreholes data is displayed influence of the mineralization process, area tectonic setting and erosion processes in lack of Fe-mineralization as integrity and deeply continuity and high thickness of the ore body. Ferruginous horizon has 10° to 15° dip to the south that are concordant strata with limestone and marble bottom set beds. The ore deposit contact is faulted with steep slope with rhyolite units.

Korkora ore deposits was observed as stratiforme, lens, disseminated and layer. There are magnetite as main ore mineralization with low amount of hematite, martite, limonite, goethite, and pyrite. There are two type of ore bodies from the aspect of grade including:

1- high grade ore deposit:
   It is massive, compact and dense structure with scatter euhedral to hypidiomorphic crystal (5 to 500 m) at the matrix.

2- low grade ore deposit:
   It is almost layer – lattice and disseminated structure that result asmetasomatic rocks [5]. In the grab samples, magnetite crystals are perfect shape near the gangue and in the geode.

Tectonic breccia are formed often in the fault plain by ore bodies and debris. Quartz and calcite gangue are occurred often as vein, veinlet, amygdale and geode. On the base of the field studies and 85 boreholes samples, there are determined mineralization magnetite with hematite, martite, limonite and minor amounts of pyrite as aspect of the type, depth and intensity of alteration (Fig. 5). The pyriteminaerization is not more occurrence as that on the base of the mineralogy, geochemistry, Fe/FeO and S are recognized 3-type of mineralization.

Fig. 5: Location of the exploration boreholes and exposed ore bodies as 3D topography.

A) Magnetite ore zone:
   This type of ore body is allocated large volumes of ore blocks and it is observed as various sectors of the surface outcrop and deep ore blocks. Magnetite is the main mineral of the ore body, which carries traces of pyrite. There is 66% Fe grade with <15% S. The Fe/FeO ratio is less than 4.6 and was occurred to 50% oxidation and martitization of magnetite (Fig. 6).
Fig. 6: core sample with Fe different grade in magnetite zone.

B) Magnetite– Martite ore zone:

This zone is almost in the west and south quartzporphy body. The large part of this zone is oxidized to limonite and martite. The main minerals are magnetite, hematite, Martite, goethite and limonite. Drilling cores data is indicated to magnetite oxidation in deep of the some borehole so that oxidation process is to 25.5 m deep and including 58% ore bodies and Fe/FeO ratio is 5.48. In some part, oxidation process was developed to deep by high permeability zones, plain fault, joints and shear zone and are formed plenty of hematite and limonite. In addition, there are occurred martitization during the marginal and along the cleavage magnetite crystal [6]. Also there is observed cementation texture by residual magnetite grains and hematite - martite [4]. In the later stages, martitization is developed and cause to formed martite-hematite to ward center of magnetite crystals and along to the tiny fissures as that increasing oxidation is displayed as irregular patches of the hematite - martite into the primary magnetite crystals. Partly development of the oxidation and hydroxylation process cause to remain just spotty of the magnetite texture and structure. The magnetite crystals is often as euhedral to subhedral in 5 to 500 µ and vesiculation that is filled often by pyrite and pyrrhotite. There is locally up to 3% pyrite (250 µ) as euhedral to unhedral(Fig.7). Partially up to 80% of magnetite was altered to hematite at margins and fracture.

Fig. 7: A: magnetite and hematite in B zone, B: Core samples, C: Polished section samples.
c) Pyritic magnetite zone:

Pyritic magnetite zone is formed small part of the Korkoraironreserves. There is $S > 0.15$ as troublesome that result of existence of the pyrite and pyrrhotite. The pyrite crystals is observed often coarse with space filling textures or scatter in the text. In addition, there is pyrite as intersecting or parallel veins along the joints and cracks. There are Fe/FeO > 2.3 and magnetite crystals occurred as euhedral to unhedral to 40% (400 µ). Samples of C zone have fractures and vesicular as that in part of it is occupied by pyrrhotite. Also there is observed weakly alteration of the magnetite to hematite. Pyrite crystals was as formed in cavities and fractures of magnetite crystals as euhedral to unhedral (2 to 100 µ, 3-5%) and 2% chalcopyrite (2-300µ) associated with hydroxide and Fe-oxides minerals (fig. 8). Study of the Core washing is determined to existence magnetite, goethite hematite as, major minerals and calcite, quartz, chlorite, dolomite and montmorillonite as accessory minerals.

Fig. 8: Polished section of core samples C zone.

4 boreholes Cross section are displayed fault contact of the ferruginous horizon with igneous rocks that is conformity with underlying limestone layer (Fig. 9). There are some data of the boreholes (Table 1).

Fig. 9: Schematic cross section of 4 boreholes and their depth in the study area
Table 1: Data analysis from four boreholes drilled in the ferruginous horizon.

<table>
<thead>
<tr>
<th>Number of boreholes</th>
<th>From deep</th>
<th>To deep</th>
<th>distance</th>
<th>Grade Fe</th>
<th>Grade FeO</th>
<th>Grad e S</th>
<th>Fe/FeO</th>
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<td>6</td>
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Conclusions:
As a result of iron mineralization, there are occurred ore deposit including of magnetite, hematite and limonite in Oligocene carbonate formation at the Northern Province of Kurdistan. Magnetite is formed upper horizon of the Korkora Mountain. Its dip is 15° to south with average 65% grade that is one of the most valuable Fe-resource of the North West of Iran. There are limestone, marl, conglomerate and skarn as gangue. There are igneous rocks with fault contact. Cores studied indicate magnetite ore bodies as stratiform, mass, disseminate. Korkora Fe-mineralization is economic by low of sulfide minerals such as pyrite and chalcopyrite.

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REFERENCES