Mineralographical studies of various generations of sulfide minerals: A case study of the Gol-e-Gohar iron ore mine, Kerman, Iran

Azam Mohammadi[a], Mohammadreza Shayestehfar[b], Reza Derakhshani[c], Behzad Hajalilou[d]

[a]Department of Geology, Tabriz Payam Noor University, Tabriz, Iran (sarzamineziba@yahoo.com)

[b]Department of Mining Engineering, Shahid Bahonar University of Kerman-76175-133(shayeste@mail.uk.ac.ir)

[c]Department of Geology, Shahid Bahonar University of Kerman-76175-133(reza_1217@yahoo.com)

[d]Department of Geology, Tabriz Payam Noor University, Tabriz, Iran (hajalilou@pnu.ac.ir)

Abstract

Pyrite is one of the most associated sulfide minerals of the Gol-e-Gohar iron ore mine that has occurred differently within the ore body. In the Gol-e-Gohar iron ore mine. pyrite is observed among the bottom magnetite minerals and to some extent with the top magnetite minerals regarding Eh and pH, temperature and pressure conditions. An extensive mineralographical studies from the Gol-e-Gohar iron ore has confirmed seven generations of pyrite minerals on polished sections. The first generation of pyrite minerals is in the form of subhedral pyrite with silica inclusions. This type of pyrite is to some extent observed among the magnetite and silicate minerals. Some of the pyrite minerals contain magnetite inclusion and even vice versa. This particular texture expresses the syngenetic mineralization and the change in oxygen and sulfur fugacity at the expense of solution precipitation in sedimentary basins. At the end of diagenetic and metamorphic processes of mineral deposit, the euhedral pyrite minerals undergone recrystalization leads to the second generation of pyrite. The layered type of pyrite mineral is the third generation of pyrite which is in the form of interlayer grains among the oxide-silicate minerals. This texture shows syngenetic mineralization of sulfide with silicate and iron oxide minerals. Sometimes these pyrite grains, due to the metamorphic processes exhibit microfolding structures as fourth generation of pyrite. This particular texture states the metamorphic conditions on oxidized minerals, primitive sulfides and silicates. The fifth generation of pyrite minerals is confirmed by fault activities, tectonic and metamorphic processes. In this process, pyrite minerals exhibit breccias and cataclastic textures. These particular textures could have occurred in crushed zones. The Sixth generation of pyrite minerals has occupied the faults and joints in the form of open-space filling which has placed into the fractured and micro-cataclastic magnetites. This texture could happen following the metamorphic processes in the regions with the fault and fracture structures. Sometimes pyrite grains have undergone an extensive weathering and dissolution in the form of martite and hematite which creates the seven generation of pyrite. Chalcopyrite minerals are the other sulfide minerals as an inclusion of magnetite in the Gol-e-Gohar iron ore mine. The first generation of Chalcopyrite is recrystallized along with the hydrothermal solution. The Second generation of chalcopyrite minerals is formed at the expense of pyrite minerals. The Third generation of chalcopyrite minerals is observed in the form of open-space filling along with the fault and veins. The Third sulfide mineral is pyrhhottite which is in the form of elongated and interlayer crystals as compared to the oxide and silicate minerals. Though the abundance of these particular sulfide minerals is rare, but it has shown its unique impact on hematite and magnetite minerals in terms of supergene and oxidized processes that can be started from the margins of oxide minerals.

Keywords: *Mineralography; Iron Ore; Textures; Pyrite; Chalcopyrite; pyrhhottite.*

Introduction

Mining area of Gol- e- Gohar is located at 55 Km southwest of Sirjan (Kerman province) and is also located at marginal east of Sanandaj- Sirjan zone [1] and has the height of beyond 1700 m with respect to the sea level. The study area is located in the geographical longitude of 55º 10 00 to 55º 24 00 and latitude of 29º 03 00 to 29º 07 00. The connection ways are the Sirjan - Niriz - Shiraz asphaltic road and the rail way of Bafq- Bandar-e-Abbas. The climate of the area is dry and wilderness with the less rainfall. Therefore the chemical weathering had less effect on geomorphology of the area. The study of the stratigraphical age shows approximately post protrozoic- pre Paleozoic age for the Gol-e- Gohar ore deposit. Gole-e-Gohar iron ore contain 6 ore bodies and the sequence of the beds in the pit of the mine includes quartzite, top magnetite, middle magnetite and bottom magnetite. The Gol-e-Gohar iron ore mine is one of the most important economic sources of Iran with the proved ore of nearly $900_{mil/ton}$ iron ore with the assay value of 57.2% **Fe**, 0.16% $\mathbf{P_2O_5}$ and 1.85% **S**. [2]

Discussion

Pyrite as a most important sulfide mineral in the Gol-e- Gohar ore body, contain the numerous primary and secondary shapes. This factor is also due to the vast versatility of the processes that has given to the pyrite mineralization in the ore deposit and has provided different generation of sulfides .The sub-hedral pyrites are of the first generation include mostly of the silica inclusion.(figure1,2) are primary.[3] The pyrite minerals that contain layered structures (figure3,4) are also primary and sometimes are in the form of spongy state (figure5) and seems to be the pyrite intergrowth with fine silicates.[4] The pyrite which found with the magnetite-bearing grains is also of the a state of primary texture of pyrite mineral.[5] Sometimes in some pyrite grains, the recrystalizing (figure 6,7) or folding (figure 8,9) can be visible. In fact these shapes and structures are given due to the effect of metamorphic phenomena in the ore deposits. In areas that the breccias fault are so active, the pyrite minerals exhibit the cataclastic texture (figure10,11) that provides shattered and broken outlook and this is a state of secondary texture of pyrite mineral. The pyrite minerals that precipitate in the form of open-space filling (figure 12) and vein (figure 13) or convert to the hematite and martite (figure 14) due to the weathering effects are also secondary textures of pyrite in the Gol-e-Gohar ore deposit. Chalcopyrite can be named as other sulfide minerals of Gol-e-Gohar iron ore which is in the form of primary and secondary shapes, structures and generation. The calcopyrite minerals which are in the form of chalcopyrite-bearing inclusion inside the magnetite minerals as first generation sulfides (figure 15,16) and the chalcopyrite which are in the form of chalcopyrite converted pyrite,(figure 17) or vein- type chalcopyrite (figure 18) are of the secondary state of sulfides.

Conclusion

The pyrite is the most important and versatile sulfide minerals that are included in the Gol-e-Gohar iron ore mine. These sulfide minerals can be formed mostly in the bottom magnetite as compare to the top magnetite zone of the Gol-e- Gohar iron ore deposite. In this work a careful study on pyrite mineral has categorized seven different generations of this particular sulfide minerals. Sub-hedral pyrite mineral is the first generation of pyrite with the silica inclusion. Recrystalized pyrite is the second generation of pyrite. Laminated and layered

pyrite is the third generation of pyrite. Folded pyrite is the fourth generation of pyrite. Cataclastic pyrite is the fifth generation of pyrite. Vein and fractured-filling pyrite is the sixth generation of pyrite and weathered pyrite is the seven generation of pyrite. Chalcopyrite and pyrhhottite minerals are named as the other sulfide minerals of the Gol-e-Gohar iron ore mine.

References

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Fig .1- Subhedral Py

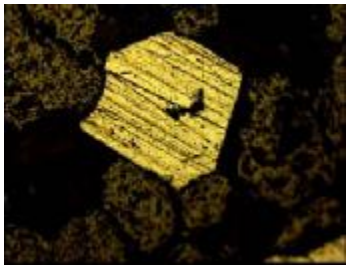

Fig . 2- Subhedral Py

Fig. 3- Layered Py

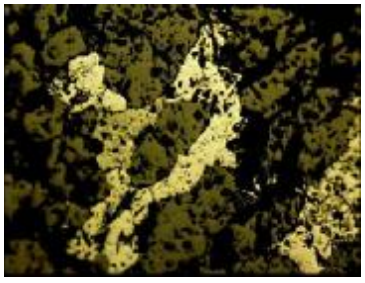

Fig . 4- Layered Py

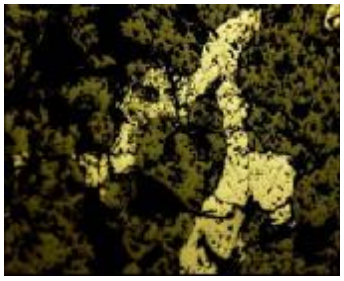

Fig . 5- Spongy Py

Fig . 6- Recrystalize Py

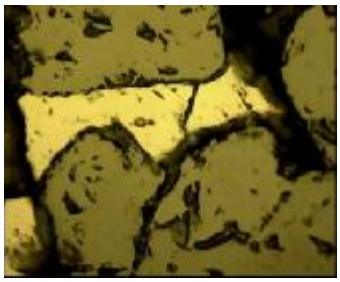

Fig. 7- Recrystalize Py

Fig . 8- Folding Py

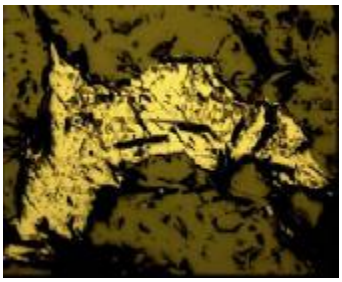

Fig . 9- Folding Py

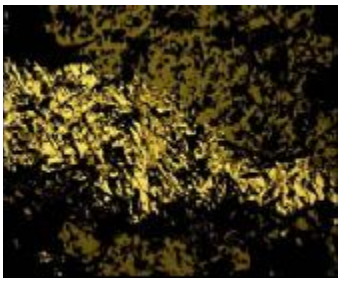

Fig. 10- Cataclastic Py

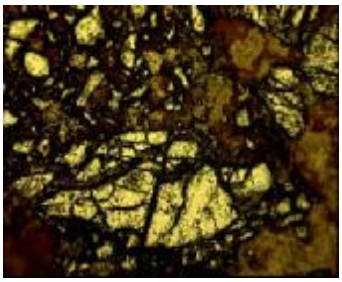

Fig.11-Cataclastic Py

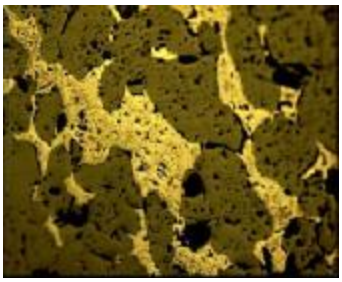

Fig. 12- Open-space filling Py

Fig. 13- Vein of Py

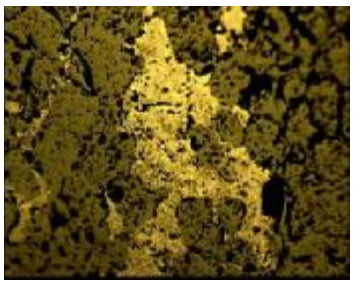

Fig. 14-Weathering Py

Fig.15- Inclusion of Cpy Inside magnetite

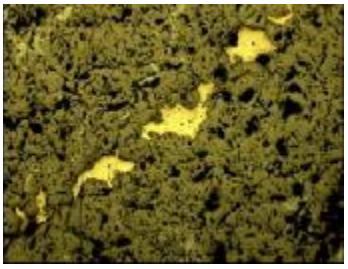

Fig.16- Inclusion of Cpy Inside magnetite

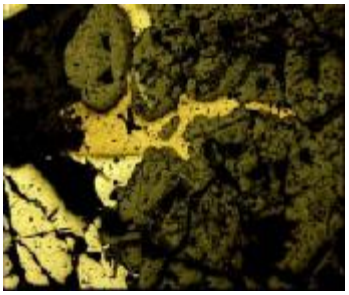

Fig..17- Cpy converted from py

Fig.18- Open-space filling Cpy