Mineralogy of Pb-Zn Gushfil mine dolomites in Irankuh, sw Isfahan

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Abstract

Pb-Zn Gushfil mine located in SW Isfahan.Main host rock of sulfide ore zone is dolomite carbonate rock. Dolomite units of study based on Petrography contains five groups very fine to finely crystalline anhedral dolomites, finely to medium crystalline euhedral dolomites, medium crystalline subhedral dolomites, medium to coarsely crystalline anhedral dolomites (saddle) and coarsely crystalline planar-C dolomites (cement dolomite). Studding on pervasive dolomitization express that dolomite sediment has been not happened in one stage but this phenomenon has been happened in long time. Dolomites of type 1, 2 and 3 shows digenetic replacement, type 4 shows digenetic replacement and cementation and type 5 shows digenetic cementation. On the base of geochemical studies (SEM) on Gushfil dolomites, formation of these dolomites occurred in a reducing environment and increasing temperature. These observations can explain that digenesis in section of study has been act vastly.

Keywords: *dolomite , mineralology, digenesis, Gushfil, Irankuh.*

General geology

Irankuh heights are located 20 kilometers southwest of Isfahan. This region, in terms of tectonic – sedimentary considerations is in the central part of Iran (Figure 1). North Irankuh deposits consist of carbonate rock host (dolomite and limestone dolomite) . Age of the minerals belong to the lower Cretaceous which are on the organization of Jurassic shale - sandstones(Figure 2).

The deposits contain huge amounts of zinc and lead but barite values are less. Carbonate units in the area had been affected by hydrothermal fluids derived from dolomite shale.

Methods

300 samples were taken manually during field visits from the dolomite sections of Gushfil Region. Sampling was taken as systematic facies. Of these, 80 thin section were made. Petrography studies of thin sections were done by polarizing microscope equipped with a camera. Petrography studies for the classification of dolomites were used through Sibley and Greeg method (1984 and 1987), Mazzulo (1992), Friedman (1965) and Adabi (1991). These classifications are based on the size of the crystals, the shape of the crystals, the internal making of the crystals and the effective rate of the primary carbonate rocks being dolomite. To determine more precisely the petrography of carbonate rocks and identification of calcite and dolomite, they were colored by red alizarin and potassium ferricyanide (Scholle 2003). In this way without iron Calcite type become pink and the iron type of Calcite becom violet or purple red. Dolomite without iron becomes colorless and type of with iron becomes blue turquoise. In order to study the geo chemical properties of dolomite mineral accurately, 14 points from 4 dolomite unit samples were analyzed by electronic microscope.

Dolomite types existing in Gushfil Region:

According to dolomite classifications by Sibley and Greeg (1987, 1984), Mazzulo (1999) Friedman (1965) and Adabi (1991) the dolomite studied in the region can be divided into 5 types:

1 - Very fine to finely crystalline anhedral: This type of dolomite crystals are made of shapeless anhedral. Size of crystals is 25 to 60 microns. Dolomites of this group are dense and without porosity, with dark brown color which may be due to the concentration of iron oxide in these sections (Figure 3 a and b). This type of dolomite is equivalent to xenotopic A of Sibley and Greeg (1987) and non-planar tissue A of Mazzulo (1992).

2 – Finely to medium crystalline: consist of the diamond-shaped euhedral with flat crystal borders. Size of crystals is 50 to 250 microns. Due to the existence of iron oxide inclusions, zoning can be seen (Fig. 3 c) and a brown color appearance is created. This fabric may become hipidiopotic or xenotopic as the result of continued growth of dolomite crystals (Friedman 1965). These dolomites have cross cleavages, which are equivalent to type two Adabi (1991), Idiotopic fabric of Friedman (1965), idiotopic p of Greeg and Sibley (1984) and flat dolomites of Mazzulo (1992).

3 - Medium crystalline half-shaped dolomite: formed form the subhedral to anhedral crystals. Size of crystals is 75 to 300 microns, having compromised straight line boundaries and many levels of contact between adjacent crystals. Porosity between crystalline and Matrix are less seen. In this context early sedimentary dolomite posts can not be detected. In this type zoning classification is observed (Figure 3 d, e). This type of dolomite accords with hipidiopidic type of Friedman (1965), half-shaped idiotopic of Sibley and Greeg (1984) and the third type of Adabi (1991).

4 - Medium dolomite to coarsely anhedral crystalline (also horse saddle): formed from anhedral crystalline. These dolomites are dense and non-porosity formed both by substitution or cementation. Size of is crystals 125 to 500 micron. Distorted network crystalline characterize horse saddle dolomites which cause curvature of surfaces. Levels of cleavages are also curved and have undulose extinction in polarized light. Due to incorporation of residual fluid and calcite crystals in the microscopic appearance of this type, they have a cloudy appearance and are pearl-like (Figure 3 f). Dolomites of this section are equivalent to Friedman xenotopic (1965), C Sibley and Greeg xenotopic (1984), non-flat tissue, A of Mazulo (1992) and type four of Adabi (1991).

5 - Coarsely dolomite crystalline to fill the gaps (Dolomite cements): made of transparent milky color dolomite crystals (1mm to500 mm). The size of crystals depends on the size of the existing spaces. Form of crystals are euhedral and subhedral and have flat borders with cement filling cavity and small spaces and fractures (Figure 3 g). The size of crystals increases from margins to the center. This type of dolomite is equivalent to type five of Amtoor and Friedman (1991) and type five of Adabi (1991).

Dolomite mineral chemistry

Studies on thin sections indicated that the dolomite studied have two types of zoning that were precisely analyzed and geochemically evaluated by electron microscope. Geochemical data of the mineral dolomite is expressed in Table 1. The following are studied:

1 - Dark brown zoning: due to iron oxide inclusions zoning and brown color appears (Figure 3c). 2 - turquoise blue zoning: due to dolomite formation which took place in two stages. In the first stage iron free dolomites whose colors are cream, in the second stage dolomites that substitute ferruginous calcite or fluids containing iron have been created (Figure 3 d). Zoning electron microscope picture is given in sample 32 in Figure 4 a. and b.

Na2O and K2O rate changes in an area with dolomite reverse classifications indicates the upside down trend these two dioxides have from the margins to the center. Usually in the center an enriched sodium compared to potassium is visible (Fig. 5 a). Between MgO and CaO a linear reversed trend exists in dolomite (Fig. 5 b). In the minerals studied the amount of magnesium is reduced by increasing calcium, this mode indicates to dolomite formation process. Changes in the amount of CaO and MgO from margins to the center is an almost parallel process, generally center combination is rich in MgO and poor in CaO (Figure 5 c). Fluctuations between the value of the two oxides from margins to the center region indicates geochemical classifications in dolomite. Reviewing the ratio between MgO / CaO indicates chemical zoning from margins to the center with a decreasing trend (Figure 5 d).

Conclusion

1 –According to the Petrography column in the study area dolomitization process is quite visible. Based on petrography studies five dolomite categories were identified in this area: Very fine to finely anhedral crystalline dolomites, finely to medium euhedral crystalline, medium crystalline subhedral, the average medium crystalline subhedral, horse saddles and large dolomite filling cavities.

2 - dolomite types 1,2,3 show alternate diagenetic, type 4 alternative type and diagenetic cement and type 5 only diagenetic cement.

3- Diagenetic and petrography Studies showed that the dolomitization in south-west of Isfahan is a delayed kind.

4 - Major part of the large crystals have been formed of horse saddles dolomite in the study which show deep burial environment over time.

5 - Average ratio of Mg / Ca of the Gushfil dolomite indicates that these dolomites have an irregular and non-stoichiometry network due to deep burial and hydrothermal fluid presence.

6 - High Sr and Na levels in this region can be due to the formation of dolomite in the carbonate succession with the primary aragonite mineralogy.

7 - High percentage of Fe and Mg have caused from restoration conditions during alteration diagenetic dolomite formation and deep burial.

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Table1: SEM data of the mineral dolomite.

Sample	32_{P1}	32_{P2}	32_{P3}	32_{P4}	39_{P1}	39_{P2}	39_{P3}	39_{P4}	57_{P1}	57_{P2}	74_{P1}	74_{P2}	74_{P3}	74_{P4}
Na_2O	0.40	0.39	0	0.88	0	0	0	0	0	0	1.571	2.55	0.730	0.851
MgO	18.13	26.39	17.31	30.08	24.82	25.35	21.89	23.98	27.61	21.63	28.23	28.40	25.15	34.4861.96
K_2O	0.65	0.32	0.55	0.20	0	0	0	0	0	0	0.46	1.05	0.16	0.16
CaO	57.58	55.66	74.36	52.75	61.96	64.38	64.74	74.91	66.24	79.38	67.28	60.65	69.06	61.26
FeO	0	0	0	0	1.03	1.06	0.803	1.299	0.634	2.48	0	0	0	0
SiO_2	0	0	0	0	1.273	0.404	0.806	0.939	0.361	1.34	0	0	0	0
ZnO	1.63	1.48	1.75	1.04	0	0	0	0	0	0	1.31	1.10	0.87	0.90
V_2O_5	0	0	0	0	5.33	8.03	7.30	9.37	9.403	5.33	0	0	0	0

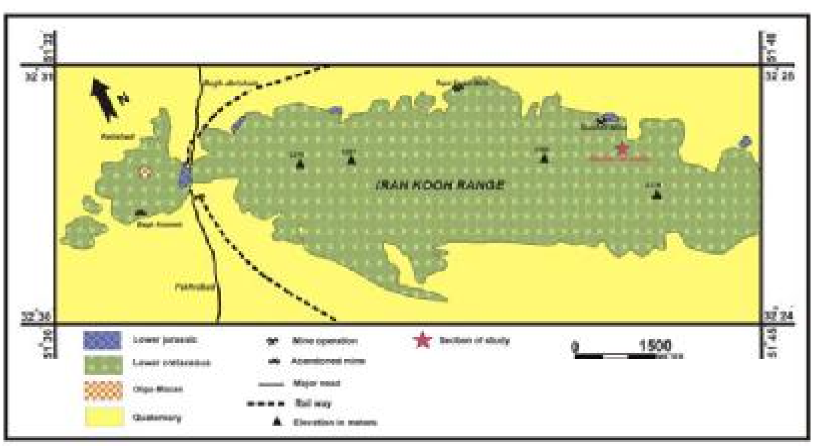

Figure 1: Geological map of section of study (extracted from Rastad, 1980).

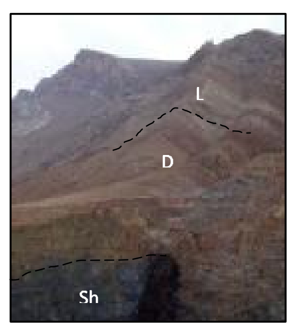

Figure 2: Dolomite (D), Limestone (L) alternation on the shale (SH) in Gushfil mine.

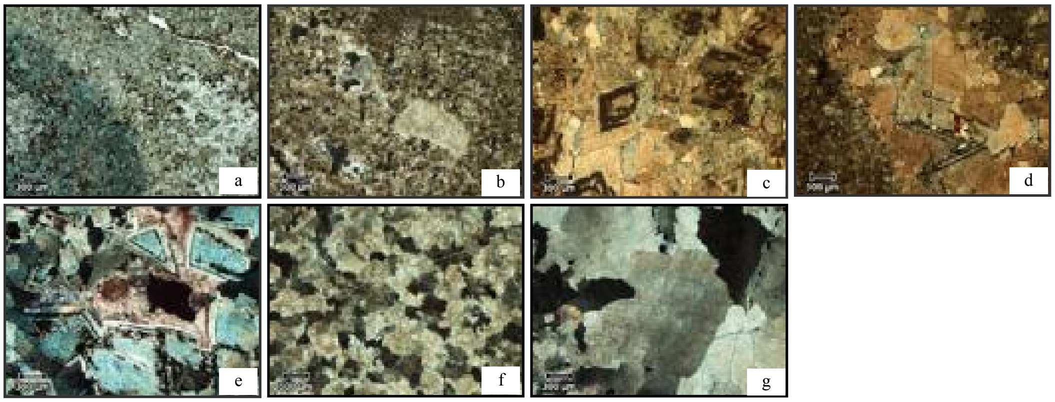

Figure 3: Types of Gushfil dolomites.

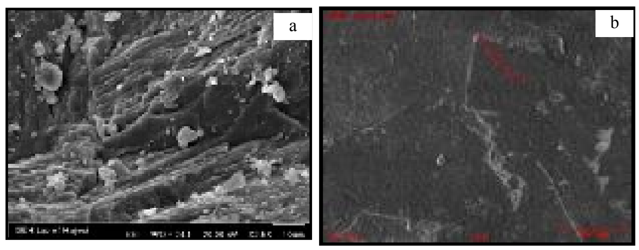

Figure 4: (a) SEM image from surface of dolomite type 2, (b) SEM image from analized points in zoning of euhedral dolomite.

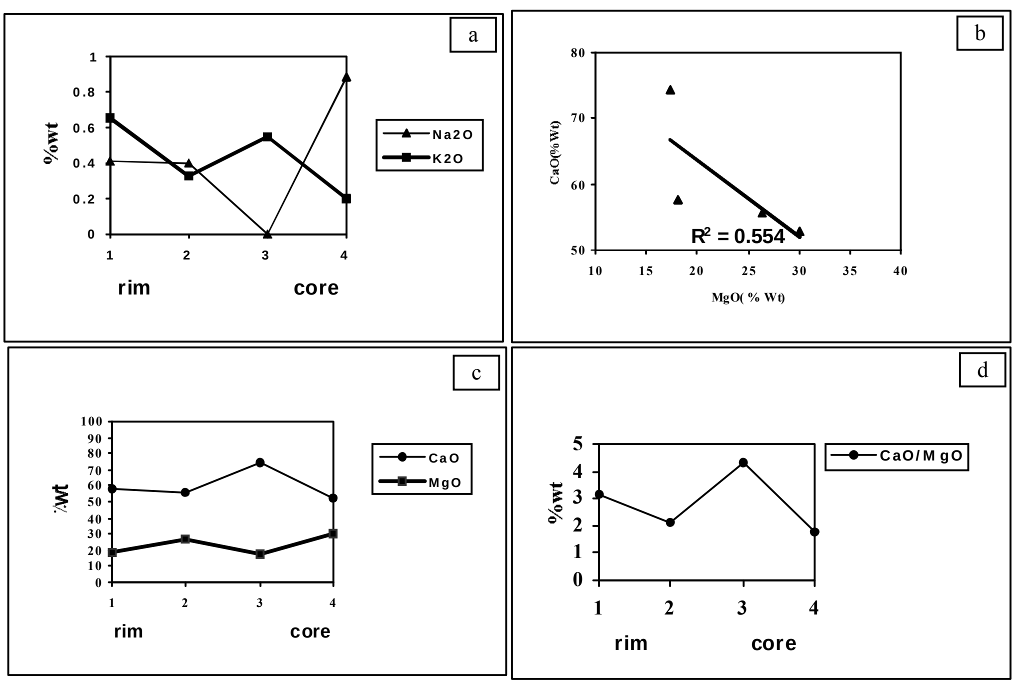

Figure 5: (a) Variation of weight percent of Na_2O and K_2O in sample 32 (points 1 and 3 between zoning, points 2 and 4 on the zoning). (b) Variation of weight percent of CaO and MgO in sample 32. (c) Variation of weight percent of Na_2O and K_2O in sample 32 (points 1 and 3 between zoning, points 2 and 4 on the zoning). (d) Variation of weight percent of CaO/MgO in sample 32.