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Geology and Geochemistry of Carbonate Hosted Pb-Zn Deposit on North-east Part of Kahramanmaraş (Helete) in Engizek Belt

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Abstract

The aim of this study is to reveal the geological and geochemical properties of Pb-Zn mineralizations associated with carbonate rocks along the Helete (Kahramanmaraş) district in Taurus Orogenic belt. The Paleozoic Malatya metamorphics and Eocene sedimentary rocks are present in the Helete region within the area defined as Engizek Belt (North of Kahramanmaraş) in the Eastern Taurus Orogenic belt. In the Gümüşbanı region, there are bariteed Pb-Zn mineralizations in the Paleozoic Malatya metamorphic rocks. Epigenetic mineralization observed in fractures and cracks is vein-type and disseminated. The thickness of the veins varies between 1 cm and 10 cm. The ore paragenesis contains barite, galena, sphalerite, chalcopyrite, fluorite and covellite. In geochemical analysis of samples taken from ore zone, Pb reaches maximum 50.21%, Zn maximum 51.99% and BaO 52.13%. In geochemical analysis, the ore zone has a maximum of 50.21% Pb and Zn a maximum of 51.99%. In the isotope geochemistry study, the value of $\delta^{34}S$ was determined between 10.92 and 11.24‰. As a result of the field and laboratory studies, it was determined that the mineralization was limited to the fractured lines and Paleozoic aged carbonate rocks, and S in the ore-forming solution pointed out to the continental origin.

Keywords: Taurus orogenic belt, Engizek belt, S isotope, Pb-Zn deposit, Helete

Kahramanmaraş Kuzeydoğusundaki Engizek Askuşağında (Helete) Karbonatlı Kayaçlar ile İlişkili Pb-Zn Yatağının Jeolojisi ve Jeokimyası

Öz

Bu çalışmanın amacı Toros Orojenik kuşağında yer alan Helete (Kahramanmaraş) bölgesindeki karbonatlı kayaçlar ile ilişkili Pb-Zn cevherleşmelerinin jeolojik ve jeokimyasal özelliklerini ortaya koymaktır. Doğu Toros Orojenik kuşağında Engizek Askuşağı (Kahramanmaraş kuzeyi) olarak tanımlanan alan içerisindeki Helete bölgesinde Paleozoyik yaşlı Malatya metamorfitleri ve Eosen yaşlı sedimanter kayaçlar bir arada bulunmaktadır. Gümüşbanı bölgesinde de Paleozoyik yaşlı Malatya metamorfitleri içerisindeki karbonatlı kayaçlar ile ilişkili baritli Pb-Zn cevherleşmeleri bulunmaktadır. Kırık ve çatlaklarda gözlenen epijenetik oluşumlu cevherleşme damar tipi şeklinde ve saçınımlıdır. Damar kalınlıkları 1 cm ile 10 cm arasında değişmektedir. Cevher parajenezi barit, galenit, sfalerit, kalkopirit, florit ve kovellit şeklindedir. Cevher zonundan alınan örneklerin jeokimyasal analizinde Pb maksimum

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%50,21, Zn maksimum %51,99 ve BaO ise %52,13 değerine ulaşmaktadır. İzotop jeokimyası çalışmasında $\delta^{34}S$ değerinin 10,92-11,24‰ arasında olduğu belirlenmiştir. Yapılan saha ve laboratuvar çalışmaları sonucunda cevherleşmenin kırık hatları ve Paleozoyik yaşlı karbonatlı kayaçlar ile sınırlı olduğu, cevher oluşturan çözeltideki S'nin de kıtasal kökene işaret ettiği belirlenmiştir.

Keywords: Toros orojenik kuşağı, Engizek askuşağı, S izotopu, Pb-Zn yatağı, Helete

1. INTRODUCTION

Ketin [1] classified the orogenic belts of Turkey into 4 different classes as Pontides, Anatolides, Taurides and Border folds. In the Taurides, which are one of these belts, sedimentary, ophiolitic, metamorphic massifs and lithologies of ophiolitic melange type are present in the Cambrian-Tertiary range [1]. Perinçek [2] stated that the Malatya metamorphites located in the region throughout the Eastern Taurus Orogenic Belt is the creep structure located at the top. The area has complex structural features by thrusts and faults is related to the closure of the southern branch of the Neotethys Ocean [3]. Gül [4] classified Kahramanmaraş and its vicinity as Orogenic Belt (Engizek, Binboğa, Misis-Andırın and Malatya belt), Edge Fold Belt, Fold Belt and Foreland. Yalçın [5] described Berit Metaophiolite, Kaleköy and Ziyaret Tepe tectonic slices belonging to the Malatya metamorphites on western part of Helete (Kahramanmaraş) [6]. Hanilçi et al. [7] reported that MVT and SEDEX Type Pb-Zn deposits were associated with carbonated rocks along the Taurus belt. On Eastern Taurus Orogenic belt (Figure 1a) the study area (Helete-Kahramanmaraş), where bariteed lead-zinc enrichment associated with carbonate rocks is observed in the Malatya metamorphics, is located on Engizek Belt (Figure 1b).

Geographically, Pb-Zn mineralizations associated with carbonate rocks in Central Taurus were investigated by many researchers [8-21]. These deposits are generally present in paragenesis with barite in fluorites [8]. Hanilçi et al. [7] reported that the Pb-Zn formation associated with carbonated rocks in the eastern and central Taurus orogenic belt presents similar geological features to MVT deposits.

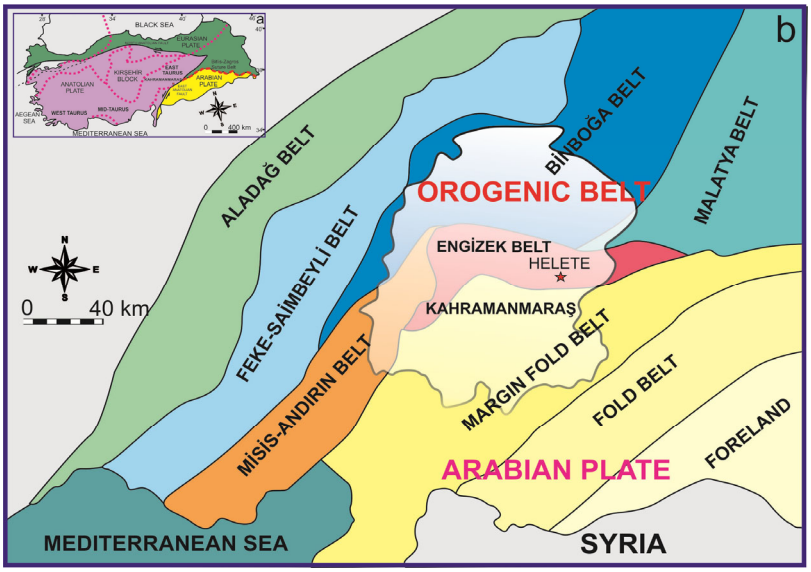

Figure 1. a. Tectonic location map of the study area (Modified from Işık [22]), b. Location of the study area in tectonic belts in and around Kahramanmaraş (Modified from Gül [4])

The geological and geochemical features of the Helete mineralization, which has a similar formation to the Pb-Zn deposits observed along the Taurus Orogenic belt, were firstly introduced in this study. The fact that both the tectonic position is close to the zone where the Anatolian-Arabian plate collided and the mineralization is related to the carbonate rocks may indicate a significant mineralization.

2. GEOLOGICAL FRAMEWORK

There are lithostratigraphic units between Paleozoic and Quaternary aged in the study area (Figure 2). Malatya Metamorphics which are the oldest units of the region are composed of schist, marble, calcschist and crystallized limestones. The Malatya metamorphics were named in various ways by many researchers [23-25]. Eocene sedimentary rocks are formed on the basic units. Eocene sedimentary rocks consist reddish gravelstone, clayeystone, mudstone, marl and limestone.

Pb-Zn mineralizations are observed in marble blocks observed in relation to Paleozoic Malatya metamorphics (Figure 3). Mineralization observed in fractures and cracks as vein type and disseminated. The thickness of the veins varies between 1 cm and 10 cm in this mineralization with epigenetic formation.

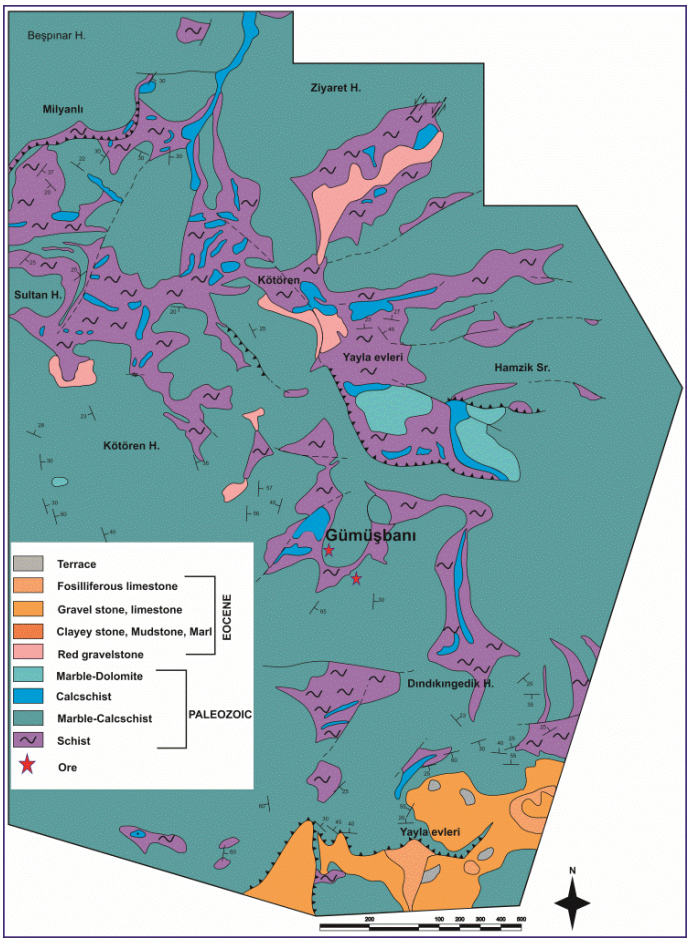

Figure 2. Geological map of the study area (Modified from Gedik [26])

3. MATERIAL AND METHODS

Geological map was prepared according to the contact relations of the ore zone and its vicinity. Samples were taken from the ore zone for petrographic and geochemical studies. Petrography and ore microscopy studies were carried out in the Petrography laboratory of the Kahramanmaraş Sütçü Imam University.

5 ore and host rock samples taken from the study area were transformed into agate mortar in the geochemistry laboratory of Kahramanmaraş Sütçü İmam University and sent to the Acme Laboratory (Vancouer, Canada). For geochemical analysis of samples, major oxide and trace elements calculated via LİBO2 FUSION and ICP/MS method.

Isotope analysis was performed in Iso-Analytical Laboratory. $\delta^{34}S$ analysis of galena samples were performed on EA-IRMS device.

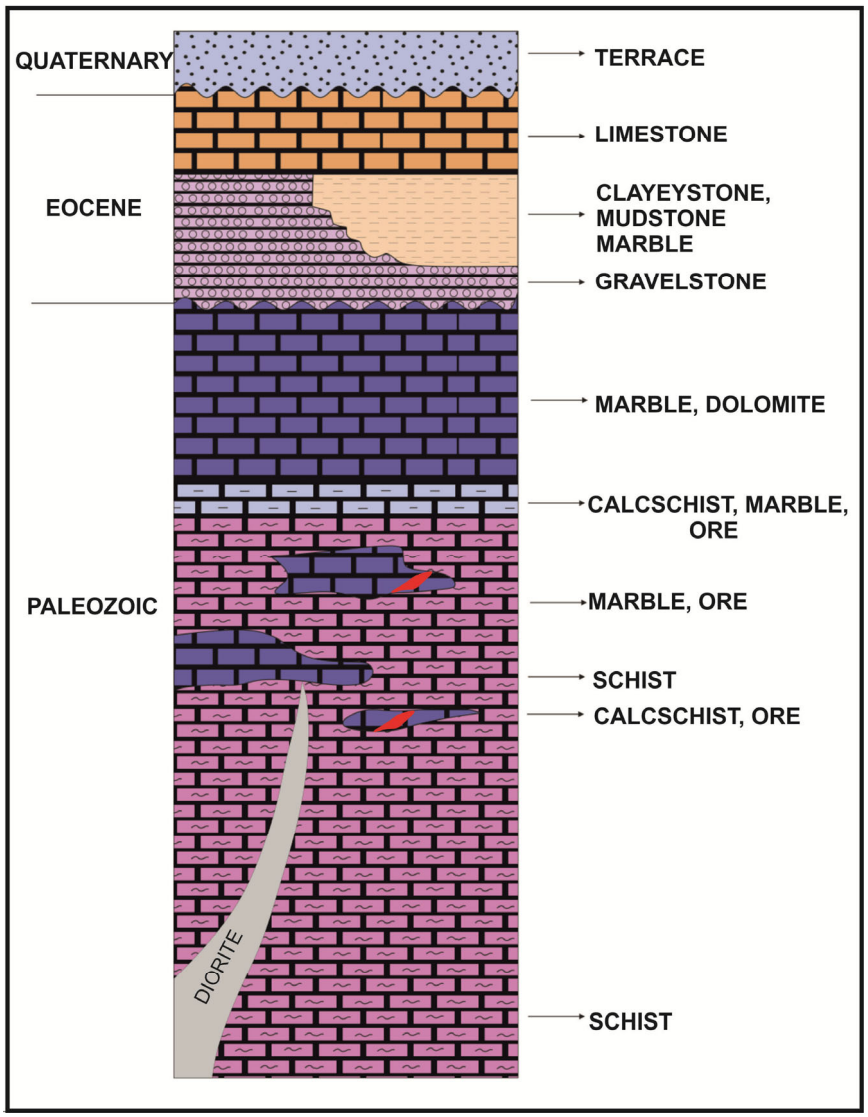

Figure 3. Geological cross section of the study area (Modified from Gedik [26]).

4. MINERALOGY

The thin sections of the samples collected from the ore zone are accompanied by calcite, dolomite and barite. Secondary quartz minerals are commonly observed in broken lines. Calcite and dolomite dominate in fractures and cracks (Figure 4).

In the ore microscoby; galenite, sphalerite, chalcopyrite, pyrite, covellite and barite minerals were determined. Brecciated ore minerals in the region due to the effect of fault zones are closely related to the silicic veins that develop secondary (Figure 5 a). Silicification was developed by hydrothermal alteration. Galenite replaces chalcopyrite in some parts and dolomite replaces galena (Figure 5b). Galenite and sphalerite minerals formed later in the system after pyrite and chalcopyrite formation (Figure 5 c-d).

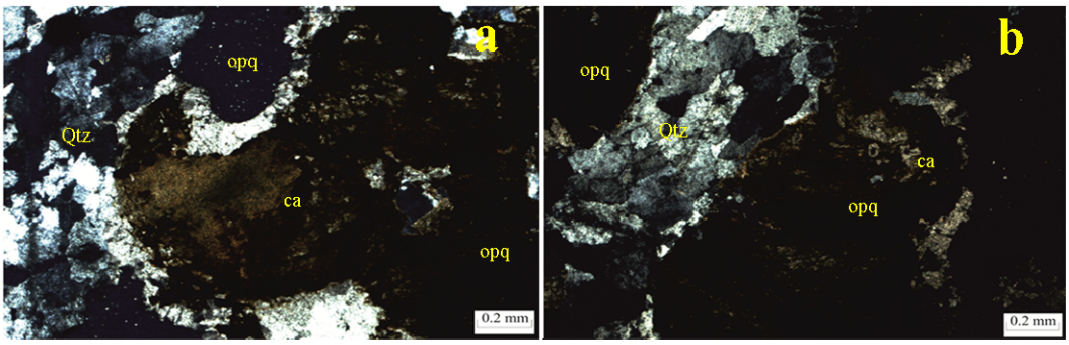

Figure 4. Polarizan microscoby of the host rock (Qtz: kuvars, opq: opaque mineral, ca: calcite)

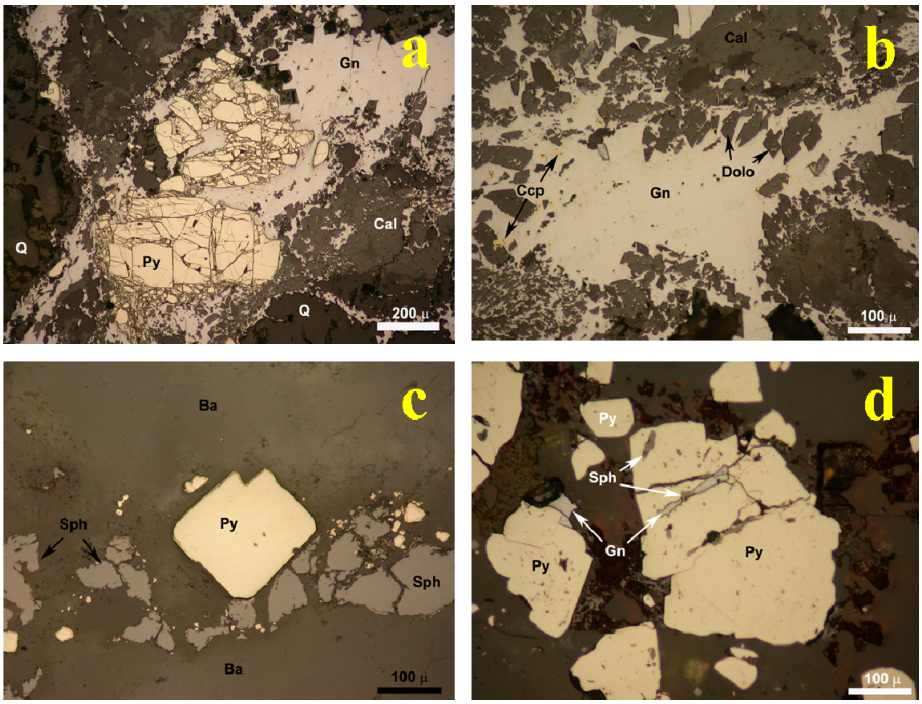

Figure 5. Ore microscoby (Gn; galenite, Sph; sphalerite, Ccp; chalcopyrite, Py; pyrite, Ba; barite, cal; calcite, Dolo; dolomite, Q; quartz)

For succession, 2 separate phases have been identified. These are the pre-stage and ore formation phase (hydrothermal phase).

Galenite and sphalerite form the major ore minerals (Figure 6). Firstly pyrite and chalcopyrite minerals were formed and in the late phase galenite and sphalerite were accompanied by mineralization. In the mineralization associated with the barite, fluorite was formed by the cooling of the fluid. Quartz, dolomite and calcite are found as gangue minerals. Limonitization is common in the supergenic alteration zone.

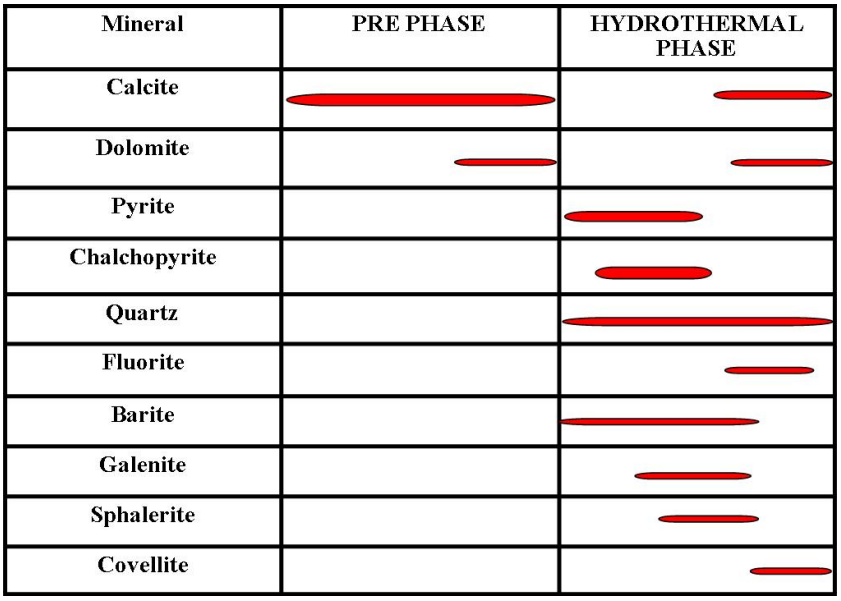

Figure 6. Paragenesis and succession of the mineralization

5. GEOCHEMISTRY

In geochemical analysis of samples taken from ore zone, Pb reaches maximum 50.21%, Zn maximum 51.99% and BaO 52.13%. (Table 1). According to the results of the analysis; the major oxide contents (SiO_2, Al_2O_5, Fe_2O_5, Na_2O, TiO_2) offer values of 16.49% or less. The trace element content is approximately 3.47%. There are trace amounts of Cu and Ag. High Hg, As and Sr values are observed in ore samples. A positive anomaly of As and Hg shows that the temperature in the solution is gradually decreasing.

Table 1. Major oxide and trace element results of the samples collected in ore zone

Formula	H-1	H-2	H-3	H-4	H-5
SiO_2	%0.93	%0.49	%16.49	%14.84	%11.65
Al_2O_3	%0.05	%0.014	%0.23	%10.70	%0.71
Fe_2O_3	%0.15	%0.67	%1.05	%0.43	%3.14
CaO	%1.27	%0.06	%0.05	%11.36	%3.78
Na_2O	%0.21	%0.18	%0.16	%0.29	%0.38
TiO_2	%0.07	%0.05	%0.09	%0.06	%0.12
MnO	%0.02	%0.06	%0.03	%0.55	%0.84
BaO	%31.61	%21.11	%49.20	%40.23	%52.13
SO_3	%22.99	%21.91	%25.36	%22.84	%21.98

Pb	%40.82	%50.21	%0.13	%0.78	%8.38
Zn	%0.97	%3.69	%3.47	%51.99	%0.19
Trace El. (ppm) Cl	277	379	624	802	445
Th	23	81	325	429	396
Ni	59	58	1242	8483	6256
As	502	946	1254	2492	2124
Ag	452	293	472	170	298
Ga	620	1000	589	627	800
Cu	419	309	122	235	228
Hg	313	404	1274	2124	1487
Sr	4880	4604	6883	45	6577
LOI	0.1	0.001	2.86	5	1.97

On the other hand the $\delta^{34}S$ isotope analysis of the galena in the study area is between 10,92 and 11,24‰. The results of the analysis were evaluated by Hoefs [27] δ^{34S} (‰) diagram (Figure 7). According to the isotope values observed in a narrow range, S in the ore-forming solution pointed out to the continental origin.

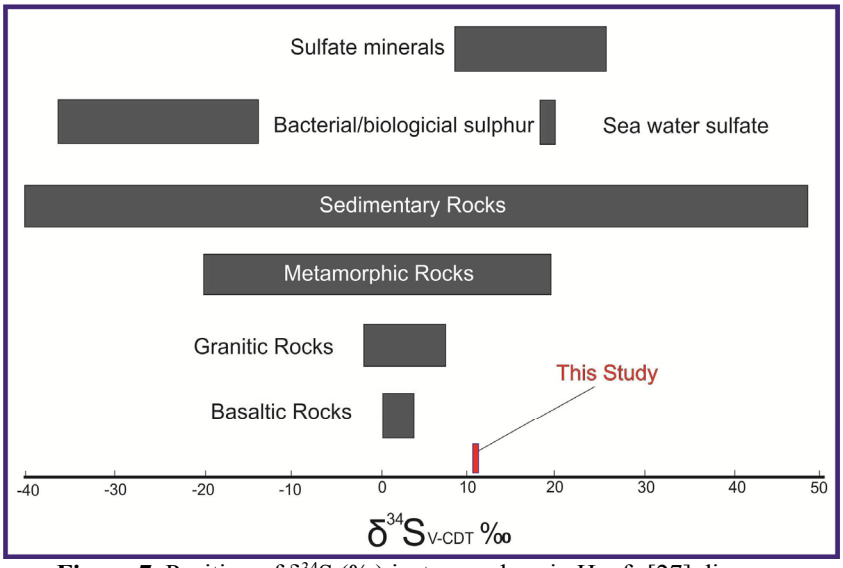

Figure 7. Position of $\delta^{34}S$ (‰) isotope values in Hoefs [27] diagram

6. DISCUSSION

Helete Pb-Zn mineralization is vein type and disseminated. This mineralization with epigenetic character is similar to the mineralization of Bolkardağı, Göktepe, Aladağ and Çayarası [8-12, 17,21]. In the previous studies, $\delta^{34}S$ values are reduced to a narrow area according to the S isotope results obtained in the Central Taurides [13,18]. The isotope results of the Helete Pb-Zn deposit are similarly reduced to a narrow area. Kuşçu [8] stated that in some areas in the Pb-Zn mineralization around Göktepe, not only barite, but also fluorite is located in paragenesis in some areas. In the vicinity of the Helete, both barite and fluoride are observed in paragenesis.

Zhou et al. [28] reported that Pb-Zn deposits developed as vein type and epigenetic character in Paleozoic carbonate in the compressive regime due

to the closure of Paleotethys in southeastern of China. The disseminated ore paragenesis consists of galenite, sphalerite, barite and fluorite [28-30]. Helete deposit offers similar features in this regard.

7. CONCLUSIONS

As a result; in this zone, where vein type mineralization is seen on Eastern Taurus Orogenic Belt (Engizek Belt), galena and sphalerite represents high temperature phase of ore formation phase, barite and fluorite represents the relatively low temperature phase. Pb-Zn mineralizations associated with metamorphosed carbonate rocks in Malatya metamorphites as well as the other mineralizations on Taurus Belt. The mineralization was limited to the fractured lines and Paleozoic aged carbonate rocks, and S in the ore-forming solution pointed out to the continental origin via isotope results.

8. ACKNOWLEDGEMENT

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