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Magnetite geochemistry of Beshhi-type Cu-Zn mineralizations in Central Pontides (Kargı-Çorum)

Cihan Yalçın*[1], Nurullah Hanilçi [2], Mustafa Kumral [3], Mustafa Kaya [3]

[1]Ministry of Industry and Technology, General Directorate of Industrial Zones, Ankara, Türkiye, cihan.yalcin@sanayi.gov.tr
[2]İstanbul University-Cerrahpaşa, Geological Engineering, İstanbul, Türkiye, nhanilci@gmail.com
[3]İstanbul Technical University, Geological Engineering, İstanbul, Türkiye, kumral@itu.edu.tr; kayamusta@itu.edu.tr

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Abstract

Gökçedoğan Cu-Zn massive sulfide deposit (VMS) in the Central Pontides is a syngenetic stratiform deposit observed in metamorphic rocks. The ore paragenesis contains pyrite, chalcopyrite, sphalerite, magnetite, hematite, covellite, malachite, and goethite respectively. Because of its physicochemical properties, in-situ laser-ablation inductively coupled plasma mass-spectrometry (LA-ICP-MS) analysis of magnetite in the ore zone was performed and a new perspective was promoted to the deposit. Analyzes were checked out in both Cu/(Si+Ca)-Al(Zn+Ca) and Cu/Ca-Al(Si+Zn+Ca) diagrams and it was decided that they exhibit similar distributions to VMS deposits in the world. In the spider diagram drew up, it has been showed that Gökçedoğan VMS deposit is close to Besshi Type Windy Craggy deposit with its high Si values.

Introduction

Due to its crystallographic structure, magnetite has an inverted spinel structure where a number of trace elements can replace Fe^{2+} or Fe^{3+} [1]. It also hides important clues as it preserves the magnetite composition, which has a stable structure due to its physicochemical properties [2]. This mineral, which is observed in igneous, sedimentary and metamorphic rocks, is found in paragenesis in many mineral deposits [3-4]. The geochemical content of magnetite [5], which is generally observed in VMS-type deposits, is used both in the classification and exploration of mineral deposits by in-situ laser-ablation inductively coupled plasma mass-spectrometry (LA-ICP-MS) method [6]. Volcanogenic massive sulfide (VMS) deposits are separated into 3 major types as Kuroko, Besshi and Cyprus Type [7]. It is recognized that there are areas similar to the Besshi type deposit, the typical example of which is in Japan, in various districts around the world. The world's largest Besshi type deposit is the Windy Craggy in northwestern of British Columbia [8].

Significant Volcanogenic Massive Sulfide deposits (VMS) are formed along the Pontide orogenic belt, which is one of the main tectonic belts in Turkey. Kuroko or Black Sea type deposits were classified in the Eastern Pontides [9-11] and Cyprus [12] and Besshi type deposits [13-14] in the Central Pontides. There are rock groups consisting of specific tectonic slices [15] in the Gökçedoğan (Kargı-Çorum) district (Central Pontide). In this district, which is in the subduction-accretionary complex as a tectonic location, units existing to the Kunduz metamorphics mostly crop out [15]. In these metamorphics, Besshi Type Cu-Zn mineralization is observed in parallel with the schistosity within the metabasite and quartzschist alternations [13]. Mainly chalcopyrite, sphalerite, pyrite, magnetite, hematite, covellite, malachite and goethite minerals are observed in ore paragenesis. In this paper, we mention new data gathered from trace element geochemistry of magnetite using LA-ICP-MS.

Material and Method

Electron probe microanalysis studies (EPMA) of magnetite detected in ore paragenesis were carried out in CAMECA SX100 device at ITU ATUM Research and Application Center. Diagrams were set up with the gained data.

Petrography

Gökçedoğan Cu-Zn mineralization was formed in metabasites belonging to Kunduz metamorphics. Mainly actinolite, chlorite, epidote and quartz minerals are observed in the rock with nematoblastic texture. In the ore petrography, it was seen that sphalerites replaced chalcopyrite and pyrite, and pseudocubic magnetites were transformed into hematite. For mineral chemistry, magnetites, which were arranged parallel to the foliation and underwent deformation, were used (Figure 1).

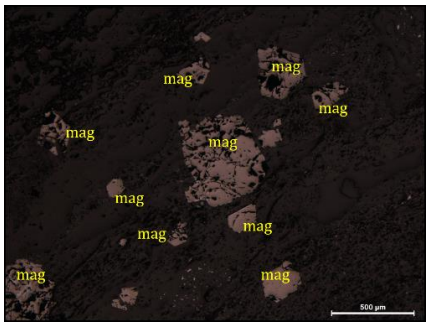

Figure 1. Deformed magnetite minerals

Results

LA-ICP-MS analysis results of magnetite mineral are given in Table 1. Most trace element abundances in magnetites are less than 0.1 ppm (Table 1). In the samples whose trace element compositions are exceedingly variable, Fe is between 72.06-73.39 and O is between 20.78-21.15 respectively. V is approximately higher than the other elements. Gökçedoğan mineralization shows a similar distribution with VMS type deposits on both Al/(Zn+Ca) vs. Cu/(Si+Ca) and Al/(Si+Ca+Zn) vs. Cu/Ca diagrams (Figure 2 a, b). In the spider diagram, Gökçedoğan mineralization has high Si, identical to the character of the VMS type deposits, and exhibits a distribution similar to the Windy Craggy deposit, which is the largest Besshi Type Deposit (Figure 2c).

Table 1. LA-ICPMS results for trace elements (%) in magnetite from the Gökçedoğan Cu-Zn deposit

%wt	KGD-317	KGD-317	KGD-317	KGD-317	KGD-317
Mg	0,01	0,01	0,01	0,01	0,01
Al	0,02	0,02	0,08	0,01	0,02
Ti	0,02	0,01	0,01	0,01	0,01
V	0,11	0,12	0,06	0,07	0,11
Mn	0,03	0,08	0,02	0,03	0,05
Ni	0,01	0,01	0,03	0,01	0,01
Zn	0,06	0,11	0,28	0,35	0,05
Sn	0,02	0,01	0,02	0,02	0,02
Cr	0,01	0,1	0,1	0,01	0,04
Fe	72,69	73,39	72,07	72,06	72,66
O	20,93	21,15	20,86	20,78	20,92
Cu	0,032	0,045	0,025	0,03	0,03
K	0,002	0,001	0,001	0,002	0,001
Ca	0,055	0,003	0,042	0,031	0,01
Si	0,008	0,6	0,05	0,055	0,013
Total	94,007	95,659	93,658	93,478	93,954

Conclusion

Trace element analysis of magnetite in the paragenesis of Gökçedoğan VMS deposit observed in the Central Pontides was carried out. As a result of this study, it was decided that Gökçedoğan Cu-Zn deposit exhibits similar geochemical characteristics with Windy Craggy Besshi Type deposit.

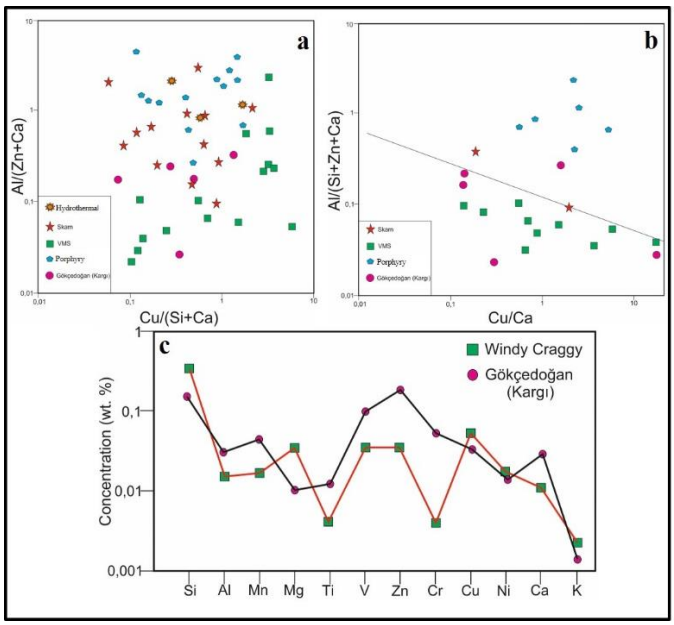

Figure 2. a) Al/(Zn+Ca) vs. Cu/(Si+Ca) diagram, b) Al/(Si+Ca+Zn) vs. Cu/Ca diagram, c) Spider diagram for Besshi Type deposits.

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