Advanced Engineering Days

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Isotope geochemistry of Koçaşlı Barite mineralization

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Cite this study: Karasu, V., Yalçın, C., & Uras, Y. (2022). Isotope geochemistry of Koçaşlı Barite mineralization. 5th Advanced Engineering Days, 178-180

Keywords
Barite
Isotope
Geochemistry
Seawater
Koçaşlı

Abstract

Precambrian-Mesozoic dated rocks are seen combined along the Taurus Orogenic Belt owing to the closure of the Neotethys ocean's branches. In this area, there are significant barite deposits related to carbonate rocks. The mineralization of Koçaşlı (Gülnar, Mersin) barite may be observed in Devonian carbonates located in the Central Taurus Mountains. The slope and dip are toward 60°SW, and the ore is orientated N10°W. The ore zone has a thickness of 7 meters and an average length of 15 meters. The initial analyses of the barite in this area were done using stable oxygen, sulfur, and $^{87}Sr/^{86}Sr$ isotopes respectively. The Koçaşlı barite samples' ^{34}S values are quite high compared to the isotope composition in modern sea water, indicating that they are enriched in the heavy isotope ^{34}S. The amount of ^{18}O isotope found in barites shares similarities with the sulfates observed in seawater from the Devonian period. The $^{87}Sr/^{86}Sr$ ratios of the barite samples examined for the study are higher than the isotopic composition of modern seawater. These isotope values for the barite sample point to a considerable contribution from the continental crust and a rich source of ^{87}Rb. Results from isotope analysis demonstrate that mineralization in this area is majorly caused by sedimentary processes.

Introduction

Barite ($BaSO_4$), an intense mineral, is a crucial industrial raw material. Barite also lacks magnetic properties despite the fact that it can withstand high pressure and heat without losing its chemical properties. It is a crucial mineral in heavy concrete applications because of these qualities. Barite is still implicated in the paragenesis of Pb, Zn, Cu, and Au deposits in low, medium, and high sulfidation classes [1–2], while being mostly observed in marine environments [3-4].

The Alpine and Hercynian Orogenies contributed to the formation of Turkey's significant barite deposits [5]. Barite mineralization hence occurred in major tectonic belts. The Taurus Orogenic Belt is reported to contain important mineral deposits in carbonate rocks [6–7]. This belt is made up of units where tectonic slices are persistent and is divided into three segments by the Western, Central, and Eastern Taurus Mountains [8]. In these units, there are many barite mineralizations related to carbonate rocks.

The Koçaşlı (Gülnar, Mersin) region of the Central Taurus Mountains has tectonic slices that are a part of the Geyikdağı Unit [9]. In the Ovacık and Araca Tectonic Slices, Upper Devonian-aged limestones have been enriched with barite [10]. BaO concentrations range from 64.76 to 67.09%, while SO_3 is the only substantial oxide. In terms of SrO composition, barites with an average of 0.39% are comparable to sedimentary deposits [10]. This paper analyses the isotope geochemistry information of the barite deposit in this area.

Material and Method

Stable oxygen, sulfur, and $^{87}Sr/^{86}Sr$ isotope analyses were completed (Table 1) in order to demonstrate that barite deposits formed. Barite isotope analyses of ^{18}O and ^{34}S were carried out at Washington State University in

the United States, while $^{87}Sr/^{86}Sr$ isotope analyses of the same specimens were carried out at the Central Laboratory R&D Training and Measurement Center of the Middle East Technical University (Ankara).

Table 1. Oxygen, Sulphur, and 87Sr/86Sr isotope contents of barites

SAMPLE	MINERAL	$\delta^{18}O_{SMOW}$	$\delta^{34}S_{VCDT}$	$^{87}Sr/^{86}Sr$
KO-4	Barite	14.61	32.07	0.710618
KO-2	Barite	14.95	31.90	0.710623
AVERAGE		**14.78**	**31.99**	**0.710621**

Mineralization and Isotope Geochemistry

The Devonian-aged limestone outcropping southeast of Koçaşlı district contains barite deposits. The ore is oriented N10°W, while the slope and dip are towards 60°SW. The ore zone has an average length of 15 meters and a thickness of 7 meters. Iron is abundant in this ore zone's upper levels [10].

In comparison to the SO_4^{2-} (^{34}S =21 ‰) isotope composition in modern sea water, the Koçaşlı barite samples' ^{34}S values are quite high, indicating that they are enriched in the heavy isotope ^{34}S. In heavy sulfur-enriched diagenetic processes, some microorganisms (Bacterial Sulphate Reduction BSR) reduce SO_4^{2} to such high quantities that barite precipitates from such fluids. It can be argued that diagenetic processes and microorganisms play a significant role in the creation of regional barites in this regard. The amount of ^{18}O isotope detected in barites has characteristics similar those of the sulfates observed in Devonian seawater.

From the Precambrian to the present, there have been significant variations in the marine sulfate's $\delta^{34}S$ and $\delta^{18}O$ compositions. Figure 1 displays the results of this investigation in terms of these values.

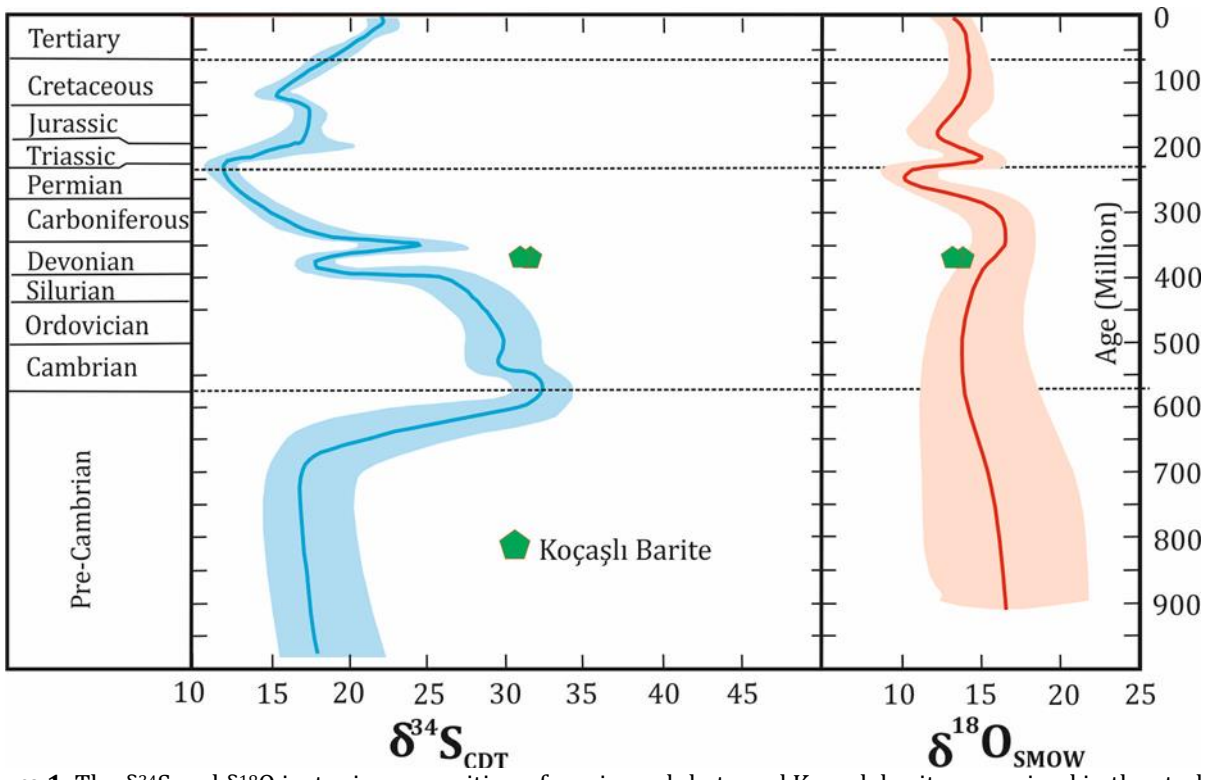

Figure 1. The $\delta^{34}S$ and $\delta^{18}O$ isotopic composition of marine sulphate and Koçaşlı barites examined in the study in different geological periods from the Precambrian to the present [11]

The barite samples analyzed as part of the study have higher $^{87}Sr/^{86}Sr$ ratios than the isotopic composition of modern seawater. These barite sample isotope values indicate a rich source of ^{87}Rb, implying a significant contribution from the continental crust.

Figure 2 compares the isotope values of barite samples to values from hydrothermal, diagenetic, and terrigenous (terrigen) sources. The graphic shows that Koçaşlı barites have characteristics in common with diagenetic and cold seep barites. Additionally, it is evident that the mineralization is overly influenced by the terrigenous material.

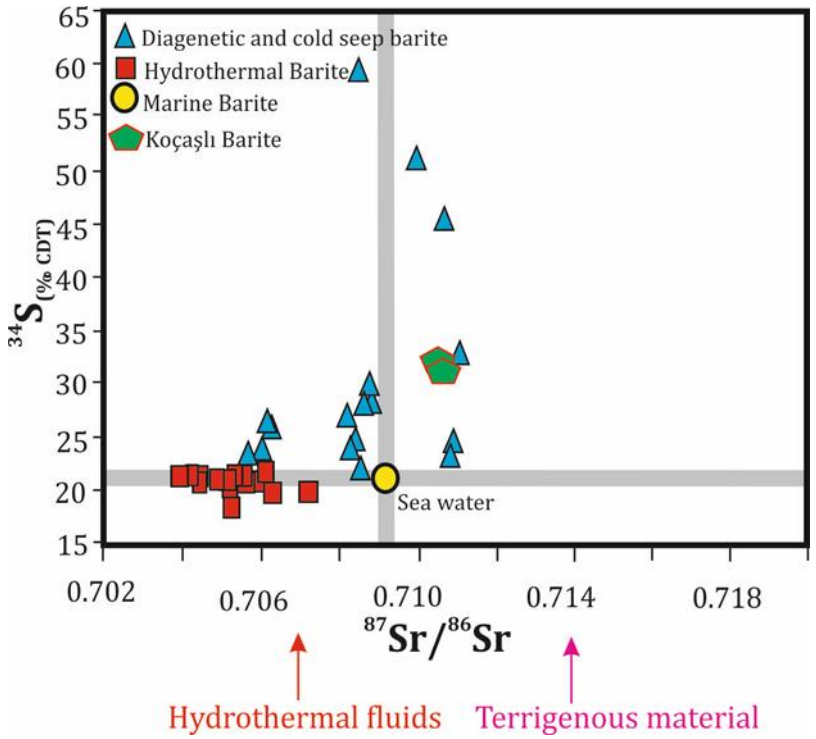

Figure 2. $^{87}Sr/^{86}Sr$ and $\delta^{34}S$ isotopic composition of barites formed in different processes [12]

Conclusion

The isotope analyses revealed that Koçaşlı barite mineralization was mostly formed by sedimentary processes. The oxygen isotopes of the barites, which are extremely sulfur-rich, have been found to represent the seawater sulfates from the Devonian period.

References

1. White, N. C., & Hedenquist, J. W. (1995). Epithermal gold deposits: styles, characteristics and exploration. *SEG Discovery*, (23), 1-13.
2. Wang, L., Qin, K. Z., Song, G. X., & Li, G. M. (2019). A review of intermediate sulfidation epithermal deposits and subclassification. *Ore Geology Reviews*, *107*, 434-456.
3. Goldberg, E. D., & Arrhenius, G. O. S. (1958). Chemistry of Pacific pelagic sediments. *Geochimica et cosmochimica acta*, *13*(2-3), 153-212.
4. Griffith, E. M., & Paytan, A. (2012). Barite in the ocean–occurrence, geochemistry and palaeoceanographic applications. *Sedimentology*, *59*(6), 1817-1835.
5. Okay, A. I. (2008). Geology of Turkey: a synopsis. *Anschnitt*, *21*, 19-42.
6. Yigit, O. (2009). Mineral deposits of Turkey in relation to Tethyan metallogeny: implications for future mineral exploration. *Economic Geology*, *104*(1), 19-51.
7. Hanilçi, N., Öztürk, H., & Kasapçı, C. (2019). Carbonate-Hosted Pb-Zn Deposits of Turkey. In *Mineral Resources of Turkey* (pp. 497-533). Springer, Cham.
8. Özgül, N. (1976). Some geological aspects of the Taurus orogenic belt (Turkey), Bull Geol Soc Turk, 19, 65–78,
9. Özalp, S., & Demirkol, C. (2003). Orta Toroslar'da Büyükeceli (Gülnar)-Yeşilovacık (Silifke) dolayının tektono-stratigrafi birimleri. *Geosound*, (42), 73-96.
10. Yalçın, C., Karasu, V., & Uras, Y. (2022). Paleozoyik Yaşlı Kayaçlar ile İlişkili Koçaşlı (Gülnar, Mersin) Baritlerinin Jeolojik Özellikleri ve Akkuyu Nükleer Santrali ile İlişkisi, 1st International Conference on Engineering and Applied Natural Sciences (ICEANS, 2022), 922-926, May 10-13, 2022, Konya, Turkey.
11. Claypool, G. E., Holser, W. T., Kaplan, I. R., Sakai, H., & Zak, I. (1980). The age curves of sulfur and oxygen isotopes in marine sulfate and their mutual interpretation. *Chemical geology*, *28*, 199-260.
12. Paytan, A., Mearon, S., Cobb, K., & Kastner, M. (2002). Origin of marine barite deposits: Sr and S isotope characterization. *Geology*, *30*(8), 747-750.