Journal of Economic Geology
Vol. 12, No. 1 (2020)
ISSN 2008-7306

زمین‌شناسی اقتصادی
جلد ۱۲، شماره ۱ (سال ۱۳۹۹)
صفحات ۱ و ۲

Study of the Origin and Evolution of Mineralizing Fluid using Geochemical Analysis of Rare Earth Elements and Sulfur Stable Isotopes in Mazraeh Cu-Fe-Au Skarn Deposit, North of Ahar

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Submitted: June 02, 2018
Accepted: Jan. 19, 2019

Keywords: *Mineralizing fluid, Rare Earth Elements, Sulfur isotope, Mazraeh Skarn, Ahar–Arasbaran metallogenic belt*

Introduction

The Western Alborz - Lesser Caucasus metallogenic belt includes important Cu and Cu-Au skarn, porphyry and epithermal deposits of Tertiary age in Iran, Turkey and Armenia (Karimzadeh Somarin and Moayyed, 2002; Karimzadeh Somarin, 2004). Important deposits such as Sungun and Masjed Daghi have been situated in this zone in Iran (Ghorbani, 2011). Some researchers have called this zone in the north-western part of the Iranian Copper belt Arasbaran Copper belt (Hassanpour et al., 2010). The Mazraeh deposit is located 20 km north of Ahar city between geographical longitudes '47 ° 00 and 47 ° 08', and latitudes 38 ° 40 '. In addition, 38 ° 36' is a part of Arasbaran Copper Belt in the Kaleyber's 1:100000 geological map. In recent years, it has become possible to study subsurface samples in this deposit to a depth of 300 meters and provide the opportunity for extensive study of mineralogy and geochemistry of this deposit by conducting systematic exploratory drillings by the National Copper Corporation. Considering the relatively high amounts of gold in cores obtained from drill holes, the study of relationship between gold mineralization and other metals in this deposit has become important for assessing the mineral potential of this deposit. Better understanding of the mechanisms of mineralization in this deposit is useful for its comparison with other similar deposits and better exploratory design for exploration of similar undiscovered deposits in this region. Nowadays, the origin of mineralizing fluids can be discussed with higher certainty with advances in experimental methods including isotopic analysis, fluid inclusion and REE studies (Bowman, 1998). We can obtain valuable information about the origin of fluids causing skarn ore deposits by studying the REE ratios in rock samples. The study of stable isotopes also provides valuable information on temperature of mineralization and physicochemical conditions of mineralizing fluids. Contrary to old beliefs that mineralizing fluids originated from magma in all deposits, the study of stable isotopes has shown that water from other sources can also play an important role in the formation of many deposits (Meinert, 1995). Previous studies have proved that both magmatic and meteoric water have been important in the formation and genesis of many skarn deposits (Taylor and Oneil, 1977). In this paper, we tried to use data from sulfur isotopic studies and the geochemistry of trace and rare earth elements to determine the source and type of fluids affecting mineralization in the Mazraeh skarn deposit.

Materials and methods

In order to investigate and identify the fluids effective in the process of skarn mineralization, 22

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samples (20 samples from the mineralized zone and 2 samples from the intrusive body) were sent to the Binaloud laboratory for ICP-MS analysis. The results were used in geochemical diagrams. For isotopic studies, samples were taken from different parts of the mineralized skarn. 10 samples of sulfides (pyrite and chalcopyrite) were selected to study sulfur stable isotopes. After crushing the samples, the sulfides were separated under a binocular microscope from waste gangue and they were powdered in agate pounder to obtain a concentrate of mineral sulfide. Purity of the sulfides as higher than 95% and weight of the samples was 100 to 150 mg. Isotopic measurements were performed by a mass spectrometer at Ottawa University, Canada. The type of sulfides and their isotope values based on isotopic standard of the CDT are reported in Table 2.

Results

The results of geochemical studies of rare earth elements indicate the combined effects of magmatic and meteoric water in mineralized fluids in the Mazraeh deposit. Accordingly, magmatic fluids have influenced the mineralizing fluids in the early stages of mineralization. However, the effect of meteoric water on mineralizing fluid in the process of fluid dilution and precipitation of sulfide minerals during the retrograde alteration stage has been more effective in the main and final stages of mineralization. The results of sulfur isotope analysis indicated that sulfur in mineralized fluids has originated from magmatic sources. Also, isotopic thermometry shows temperature of 369 ° C for sulfide mineralization. This temperature indicates the beginning stage of sulfide mineralization in progressive alteration stage.

Acknowledgement

The financial support for this research, which is part of the Ph.D. thesis of the first author, has been conducted by the research and development affairs of the National Iranian Copper Industry Company (Sarcheshmeh). We thank the management of research and development affairs and the staff of the National Copper Company in Ahar and Varzeqan for their cooperation in sampling.

References

Bowman, J.R., 1998. Basic aspects and applications of phase equilibria in the analysis of metasomatic Ca-Mg-Al-Fe-Si skarns. In: D.R. Lentz (Editor), Mineralized Intrusion-Related Skarn Systems. Mineralogical Association of Canada Short Course, Ottawa, pp. 1–49.

Ghorbani, M., 2011. Magmatism and Alteration in Ahar-Jolfa axis (Arasbaran), and their association with mineralization. Journal of Sciences, Islamin Republic of Iran, 81(21): 23–38. (in Persian)

Hassanpour, Sh., Rasa, I., Heidari, M., Matkan, A.A. and Moayyed, M., 2010. Geology, Alteration and Mineralization of Haftcheshmeh Cu-Mo Ore deposit. Iranian Journal of Geology, 15(4): 15–28. (in Persian)

Karimzadeh Somarin, A., 2004. Garnet composition as an indicator of Cu mineralization: evidence from skarn deposits of NW Iran. Journal of Geochemical Exploration, 81(1):47–57.

Karimzadeh Somarin, A. and Moayyed, M., 2002. Granite- and gabbro diorite- associated skarn deposits of NW Iran. Ore Geology Reviews, 20:127–138.

Meinert, L.D., 1995. Compositional variation of igneous rocks associated with skarn deposits, Chemical evidence for genetic connection between petrogenesis and mineralization. In: J.F.H. Thompson (Editor), Magmas, fluids, and ore deposits. Mineralogical Association of Canada Short Course, Ottawa, pp. 1–49.

Taylor, B.E. and O,Neil, J.R., 1977. Stable isotope studies of metasomatic Ca-Fe-Al-Si skarns and associated metamorphic and igneous rocks, Osgood Mountains, Nevada. Contributions to Mineralogy and Petrology, 63(1): 1–49.