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Ore horizons, ore facies, mineralogy and geochemistry of volconogenic massive sulfide (VMS) deposits of the Varandan Ba-Pb-Cu deposit, southwest of Qamsar - Iran

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Introduction

The Varandan Ba-Pb-Cu deposits are located15 km southwest of the town of Qamsar and approximately 7 km south west of the Qazaan village, in the Urumieh- Dokhtar magmatic arc. The Kashan region that is situated in west-central Iran hosts several barite-base metal deposits and occurrences, the biggest ones are the Varandan Ba-Pb-Cu (case considered in this study) and the Tapeh-Sorkh (Khalajmaasomi et al., 2010) and Dorreh Ba (Nazari, 1994) deposits. Previous researchers (Izadi, 1996; Farokhpey et al., 2010) have proposed an epithermal model for formation of the Varandan deposit. However, based on some feature of the deposit, it seems that this genetic model may not be correct. Therefore, it is necessary to do more precise research studies on the deposit. The main purpose of this paper is to discuss the genesis of the Varandan deposit based on geological, ore facies, mineralogy, wall rock alterations, and geochemical studies.

Materials and methods

A field study and sampling was performed during the summer of 2013. To assess the geochemical characteristics of the deposit, about 17 systematic samples from different ore facies of the first, second and third sub-horizon were collected for petrography and mineralogy, and for inductively coupled plasma-atomic emission spectroscopy(ICP-AES), X-ray diffraction (XRD) and X-ray fluorescence (XRF) geochemical analysis methods. The microscopic studies were done in the optics laboratory of the Shahrood University, and the geochemical analyzes were conducted in laboratories of the Center of Research and Mineral Processing Ore Minerals of Iran, Karaj, Iran.

Results

The host sequence in the Varandan deposit involves three units, from bottom to top: Unit1: grey, green siliceous tuff, brecciated tuff, crystal tuff and andesite; Unit2: white grey nummulitic limestone, limy tuff and marl: and Unit3: tuff breccia and crystal lithic tuff. Mineralization in the Varandan deposit has occurred as four ore sub-horizons in Unit1, as lenticular to tabular ore bodies concordant to layering of the host rocks. Based on textural, structural and mineralogical studies, the Varandan deposit consists of five ore facieses including: 1) veins-veinlets (stringer zone) that involves cross-cuting barite, quartz and sulfide veins-veinlets, 2) brecciated barite and massive pyrite (vent complex zone) involving replacement texture, 3) massive barite and sulfide (massive zone), 4) alternations of barite- and galena- rich bands (Bedded-banded zone) and; 5) iron-manganese-bearing hydrothermal-exhalative sediments. Primary ore minerals are barite,

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galena, chalcopyrite, pyrite, sphalerite, tetrahedrite, magnetite, oligiste, braunite, pyrolusite and bornite, accompanied with secondary minerals such as native copper, cuprite, digenite, covellite, chalcosite, goethite, hematite and malachite. Gangue minerals consist of chlorite, sericite, quartz and calcite. Major wall rock alterations in the deposit are chloritic and quartz- sericitic. For determining the type of ore of the Varandan deposit, the Cu/Zn ratio for the barite and sulfide ore of the first, second and third sub-horizon are 1.08, 0.12 and 11.08, respectively. This lies in the yellow ore for the first and third sub-horizon, and it falls in the black ore for the second sub-.

Discussion

According to the basic characteristics of mineralization such as geometry of ore bodies, textures and structures, ore facies, wall rock alterations, mineralogy, fluid inclusions data, metal zonation and geochemical features, the Varandan deposit could be classified as a bimodal-felsic or Kuroko-type voclanogenic massive sulfide (VMS) deposit, similar to those of the Hokuroko basin in Japan (Ohmoto and Skinner, 1983; Hoy, 1995, Huston et al., 2011). The Varandan deposit has been formed in an intra-arc setting due to subduction of the Neo-Tethyan oceanic crust beneath the Iranian plate during the Middle Eocene.

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