



## Stratigraphic position, origin and characteristics of manganese mineralization horizons in the Late Cretaceous volcano-sedimentary sequence, south-southwest of Sabzevar

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### Introduction

The Mn mineralization occurs in the northeastern segment of the Sabzevar zone (SZ), north of the Central Iranian Microcontinent (CIM). This Zone (SZ) is located between the CIM fragmentation in the south and the Kopeh dagh sedimentary sequence in the north. The ore deposits of the northeastern segment of the Sabzevar zone can be divided into three groups, each with different metal association and spatial distribution and each related to a major geodynamic event. The first mineralization with associated Ordovician host rock is characterized by Taknar polymetallic (Fe-rich) massive sulfide deposit. The Cretaceous mineralization consists of Cr deposits associated with serpentinized peridotites, Cyprus type VMS, Mn deposit in pillow lava, volcano-sedimentary hosted Besshi type VMS and Mn deposit. Paleogene mineralization in eastern segment of the Sabzevar zone began with porphyry deposits, Cu Red Bed mineralization occurs in the Paleogene sandy red marl.

### Materials and methods

A field study and sampling was performed during the autumn of 2012. To assess the geochemical characteristics of 48 systematic samples (least fractured and altered) of ore-bearing layers and host rocks were collected from the deposit for polished thin section examination. In order to correctly characterize their chemical compositions, 15 least-altered and fractured samples were chosen for major elements analysis.

### Results

The Late Cretaceous volcano-sedimentary sequence in south-southwest of Sabzevar hosts numerous manganese mineralization. The sequence based on the stratigraphic position, age and composition of the rocks, can be divided into two lower and upper parts. The lower part or K2<sup>IV</sup> unit mainly formed from marine sediments interbedded with volcanic rocks. The sedimentary rocks of this part include silicified tuff, chert, shale and sandstone, and the volcanic rocks involve pyroclastic rocks of various composition, rhyolite, dacite and andesitic lava. The upper part or LMV unit comprised of limestone, marl and volcanic rocks, overlies concordantly on the lower part (K2<sup>IV</sup>). The manganese mineralization within the host volcano-sedimentary sequence, based on stratigraphic position, relative age and type of host rocks involved the two horizons: the first horizon (Mn Ia, Ib) consisting of Benesbound (Masoudi, 2008), Nudeh (Nasrolahi et al., 2012), Homaie (Nasiri et al., 2010), Goft and Manganese Gostar Khavar Zamin deposits, occurred in the lower part of the sequence (K2<sup>IV</sup> unit) and is hosted by red tuffs. The second horizon (Mn II) comprising of Zakeri (Taghizadeh et al., 2012), Cheshmeh Safeid, Mohammad Abad Oryan and Chah Setareh deposits, is hosted by marly-carbonate tuffs and locates within the upper part of the sequence (LMV unit) (Maghfouri, 2012). Geometry and shape of the ore bodies in various deposits are as stratiform, layered, parallel and concordant with layering of the host rocks.

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Textures of the ores include massive, lenticular, banded, laminated and disseminated. Mineralogy of the ores in the two ore horizons is simple and similar and is dominated by pyrolusite, psilomelane and braunite. Gangue minerals are predominantly the host rock-forming minerals including quartz, chlorite and feldspar.

### Discussion

Geochemical data, structures and textures, stratigraphic position and lithologic characteristics of the host rocks represent that manganese reserves in south-southwest Sabzevar were formed as sedimentary-exhalative.

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