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Investigation Of Effect Of Structural Pattern On Mineralization Model In The C- North Ore Deposit, Sangan, NE Iran

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Abstract: Structural systems related to iron ore mineralization in the Sangan mining region, northeastern Iran, have a direct relationship with the geometry of deformations. Fractures and faults, linear and planar structures and the influence of igneous bodies as the source of the fluids have the final effect of magmatism on mineralization. The purpose of this study was to investigate and identify the tectonic structures in C-North ore deposit, including a regional structural model with a structural model of ore deposit, and deposit formation model. Due to the location of the Sangan mining area at the end of one of the large-scale branching terminals of the Dorouneh fault, Sangan region is considered as part of the tectonic escape, and many structural functions in the area can be found in the Sangan ore deposits is due to the activity of this phenomenon. By investigating the existing faults in the area and performing a spatial density analysis for each fault series, a fault density map is generated which indicates the three fault systems in the C-North ore deposit. Based on intrusive body studies, the schematic diagram showing the probable accretion style, mechanism of outward building and exsolution of magmatic fluids during the emplacement of magma was presented along with the C-North ore deposit formation model. The results of studying of skarns and C-North ore deposits have great applied scientific significance and can be used for the study of skarn deposits.

Keywords: Structural model, Mineralization, Tectonic escape, C-North deposit, Sangan.

INTRODUCTION

Economic geologists have long recognized that hydrothermal deposits have a spatial relationship with faults and structural breaks or discontinuities [1,2]. The empirical relationships between ore deposits and major structures play an important role by providing a pathway for fluids to be focused into the upper crust due to its high permeability and low strengths.

Mineralization occurs with several natural processes related to geological events such as structures, hydrothermal fluids, magmatism, and sedimentation, which are all essential for the exchange of mineralization characteristics, especially ore grade values and geometrical shapes [3-6]. Fault and fracture patterns also provide evidence of structural growth processes [7-9]. Main faults are important for the spatial distribution of ore deposit characteristics such as ore elements and geometrical shapes [4]. Structural features, specifically main strike-slip faults are important host structures of hydrothermal ore deposits in the world. Intraplate strike-slip fault systems can accommodate tens to hundreds of kilometres of horizontal displacement between adjacent lithospheric blocks [10,11]. They typically include almost straight belts alternated with bends and offsets in individual segments, each of them consisting of complex arrays of anastomosing fault strands [12]. The total stress field results from the interplay between the stress field produced by fault motion (i.e. the kinematically-induced stress) and the regional stress field [13]. Strike-slip, transpressional and transtensional fault segments typically coexists along intraplate strike-slip fault systems [10]. This may occur at different scales and may result in the development of very complex fault patterns (in space, time and kinematics; [14]). However, mineralization does not occur uniformly along individual strike-slip faults. In view of the expansion of the mining works, a better knowledge of the deposit is required and a detailed structural work was carried out, taking advantage of artificial outcrops in the open pits. Various researchers attempt to quantify ore distribution and its relationship to lithology, structural features, alteration, metamorphism and deformation. These relationships are of great importance and essential for the mining and exploration industry.

Pull-apart basins are prominent features along continental transform margins which form in extensional to transtensional environments along fault bends or between two adjacent left- lateral faults or two right-lateral faults [15]. The geometry and the sedimentary fill of these basins are key sources of

Information concerning the tectonic history of the transform [16]. Bends or stopovers in the fault paths due to inhomogeneity and structural complexity of the continental crust become favourable locations for extensional and compressional deformation if the shear motion is oblique. In fact, pull-apart basins are depressions bounded on their sides by two or more strike-slip faults and on their ends by diagonal transfer faults. Moreover, while pull-apart is one of the most explored features in strike-slip fault regimes and its structure has been documented in many tectonic environments [10,17].

This paper focuses on the structural control processes associated with the formation of the C-North skarn system. Field observations are correlated with the regional scale tectonic settings in an effort to further investigate the link between the structural control processes, the emplacement of the magmatic rocks, determination of regional structural model with a structural model of ore deposit, and deposit formation model.

METHODS

The study area is located in the SE of the Khorasan-e-Razavi Province, approximately 280 km from the City of Mashhad, and in the end part of the Khaf-Kashmar-Bardskan Tertiary magmatic belt of Central Iran blocks along the regional E-W trending and the eastern segment of large scale old Dorouneh fault passing near the area. The Sangan Magmatic Complex (SMC) at the NE edge of the Lut block includes a thick pile of volcanic rocks intruded by younger granitoid stocks [18]. One of the most prominent areas for ore mineralization associated with the Tertiary volcanic-plutonic magmatism in NE Iran is the C-North skarn system within the Sangan ore district. Understanding the relationship between iron mineralization and the structural history of the C-North deposit is essential in the development of a formation model for the deposit. Structural study typically pertains to the observation, description and interpretation of structures that can be mapped in the field [18]. Kinematic analysis is a technique for analysing fault data (e.g. [19]), which permits to define the overall strain pattern in an area as well as testing for kinematic compatibility of faults sets. Structural data of faults in the study area are displayed as pole to fault stereogram, statistical contours, and rose diagrams. This analysis can only be performed in faults with slickenside lineation and definite shear sense; in the study area. A study of field observation from the C-North deposit was carried out to evaluate the role of effective processes in ore deposit formation.

FINDINGS AND ARGUMENT

The most important segments hosting iron deposits in the Sangan mining region are pull-apart basins, splay structures, releasing bends, and fault intersections. Localization of fluid flow within these segments is a fundamental aspect of the crustal-scale hydrothermal system that produced the Fe deposits in the study area. The C-North ore deposit is structurally controlled, few structural data have been reported apart from the attitude of the main ore deposits and some major faults. Based on field observations and regional geological evidences, the tectonic escape mechanism has considered in the study area. These tectonic features are the result of the clockwise and the counter clockwise rotations of the Dorouneh fault in the study area. A structural-tectonic model was developed to assess the occurrence of C-North ore deposit (Figure 1). The close relationship between macro- and meso-scale structural features implies a strong structural control on the ore deposit and suggests that these structures played a significant role in the (re) mobilization and subsequent concentration of the metals. The C-North iron ore deposit is characterized by three groups of faults (often normal and strike- slip faults). These tectonic settings are represented by E-W, NW-SE, and NE- SW trending faults. Based on the analysis of the structural geological characteristics, geology setting of the typical iron ore-deposit and ore-controlling factors in the area, we argue that the distribution of the deposits that occur in the strike-slip faults is controlled by two ore-controlling factors, i.e., carbonate strarta, and interstratified fault zone, whereas the Fe deposits that occur around the Sangan granite were restricted by the thick bedded skarn (Figure 2).

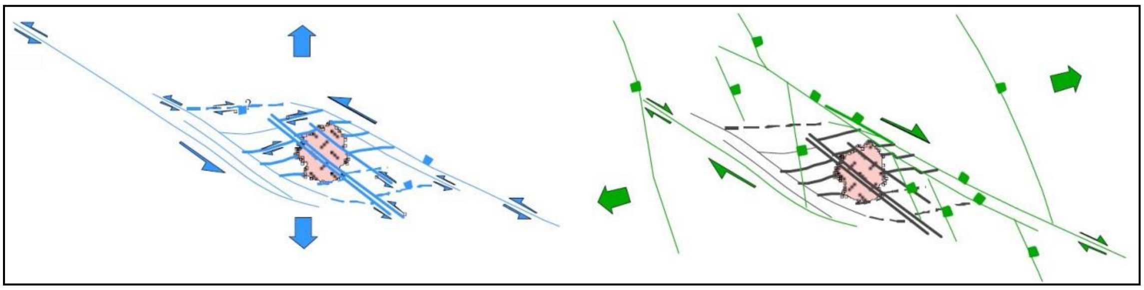

Figure 1. The map shows the control of structural style of the distribution of C-North iron ore deposit; Syn-mineralization (right side) and post-mineralization (left side)

CONCLUSIONS

Different ore types are associated with tectonic settings and structures, especially faults. The subvolcanic activity, hydrothermal alteration development, ore mineralization, and post- mineralization processes associated with the Sangan skarn system appear to be strongly controlled by the intersection of district and regional tectonic structures. Detailed structural data combined with field observations and structural analysis were used to define the main fault systems in the area, the relative age of faulting, as well as the role of the geological structures in the origin and the later evolution of the ore deposits. Based on comparisons with adjacent areas, a model for the tectonic evolution in the area was proposed. The proposed tectonic escape model could be useful in mining exploration in the region. It commenced as a pull-apart basin and developed as a natural response to tectonic escape-related strike-slip faulting subsequent to post-collisional intracontinental compressional tectonics during which sediments were intensely deformed. The tectonic regime in the Sangan region has changed from extension to shortening. Three phases of faulting were recognized and its relative ages defined based on crosscutting relationships, rock ages, field observations, and structural analyses. Faults of the first phase strike E-W, and host the main ore deposits in the area. This phase must have occurred prior to the age of the hydrothermal event. The inception of this phase as well as its regional tectonic significance remains to be precisely defined. The second extensional phase produced faults with NE-SW strikes, reactivating the F1 faults. We associate this phase with the formation of the Basin. The third phase produces faults with NW-SE strike. Geochemical features showed that the formation

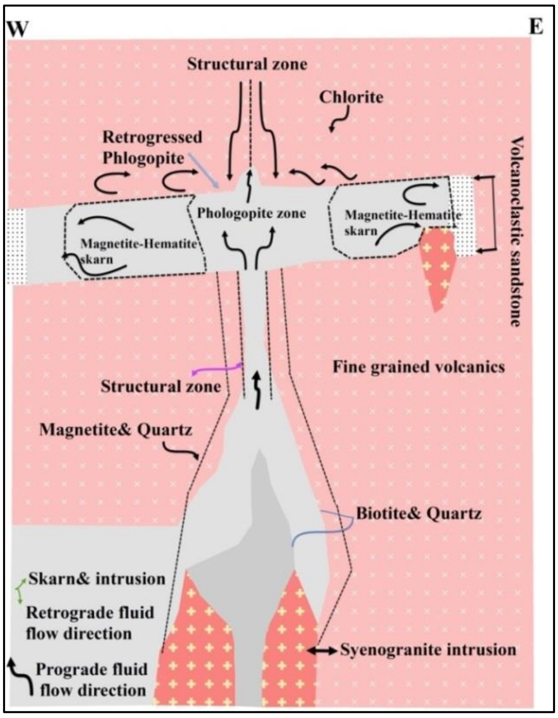

Figure 2. The ore-formation model and ore-controlling features of the C-North iron ore deposit

of most ore deposits in this district be associated with the faults and the formation process of these faults. These results contribute to further understanding of processes controlling the mineral deposit formation and investigate structural controls on ore deposition.

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