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The study of lithology and faults in the Se-Chahun mine, Bafgh, Central Iran

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Abstract

Bafgh is considered as a part of Central Iran zone, and has conserved its characteristics as a platform till Triassic period, but it has been affected by folds and thrusts since Jurassic. Evolution of East micro continent and center of Iran is explainable by Pan orogenic -African in 600 years ago. The comparison between sedimentary basin, magmatic belt and existed faults in Saudi Arabia, East micro continent and center of Iran is not possible easily, because this micro continent was located at the east part of Saudi Arabia 600 years ago. Southern XI anomaly has two main faults. F1 fault is located at the east wall of southern XI anomaly extending NE-SW in the boundary of sedimentary rocks and metasomatism. F2 fault is located at the north wall of southern XI anomaly with 80° slope to NE and its shear zone is 5m. F3 fault is extended NW-SE; it has led to creation of a boundary between metasomatisme rocks and low-grade ore. F4 fault is located at the east wall of southern XI anomaly extending NE-SW in the boundary of metasomatisme rocks and full-fledged ore. X anomaly faults include: F5 fault has 35° slope to NE, and metasomatisme rocks are beside rhyolite rocks. F6 fault is located in southern wall of mine extending NE-SW and its slope degree is about 80° to NW. Under the effect of this fault's function amphibolite rhyolite rocks are located beside ore with specified boundary.

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Introduction

Most of the world iron ore production is from banded iron formations (BIF), magnetite-apatite deposits ("Kiruna-type"). An iron oxide copper–gold (IOCG) study widely for the Bafq district deposits (Barton and Johnson, 1996; Williams *et al*., 2005; Jami *et al*., 2007; Torab and Lehmann, 2007; Daliran, 2002; Stosch *et al*., 2011).

The Bafq district of Central Iran is the most important Fe metallogenic province in the region and a significant district on a worldwide basis (Jami, 2005). The iron ore deposits of the Bafq district are associated with volcanosedimentary rocks and high-level intrusions, and have a sulfide-poor mineral assemblage of low-Ti magnetite (hematite) with varying but characteristic amounts of fluorapatite and actinolite (Torab, 2008). Volcano sedimentary Unit is one of the important components in Cambrian and consists of shale, sandstone, limestone and dolomite. Within this sequence recognized the Saghand Formation and the Rizu to Dezu Series (Samani 1993).

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The Bafq mining district is in the Early Cambrian Kashmar-Kerman volcano-plutonic arc in Central Iran and hosts important "Kiruna-type" magnetite-apatite deposits (Torab, 2008). The Bafq district of Central Iran is the most important Fe metallogenic province in the region and a significant district on a worldwide basis (Jami, 2005). The iron ore deposits of the Bafq district are associated with volcanosedimentary rocks and high-level intrusions, and have a sulfide-poor mineral assemblage of low-Ti magnetite (hematite) with varying but characteristic amounts of fluorapatite and actinolite(Torab, 2008). Volcano sedimentary Unit is one of the important components in Cambrian and consists of shale, sandstone, limestone and dolomite. Within this sequence recognized the Saghand Formation and the Rizu to Dezu Series (Samani 1993).

The Se-Chahun Iron Ore mine is containing two major groups of ore bodies called the X and XI anomalies (NISCO, 1975). Anomaly XI located 3250 m northeast of Anomaly X (Fig. 1). Anomaly XI has been explored by geophysical methods and extensive drilling. The deposit is divided into two parts (north and south orebodies) with a total reserve of about 140 Mt low-grade iron ore with an average grade of 36% Fe (Torab, 2008). Although the massive magnetite-actinolite ore in Anomaly X has a higher grade, up to 67% Fe.

The purpose of this article was study of lithology and faults in the two anomaly's of Se-Chahun mine, Bafgh, Central Iran.

Material and methods

Sampling method

At the first stage of study, main faults of the region were sampled during a field study. It was tried to study faults' characteristics that are identifiable in rock stairs of the mine. Fortunately, alluvial walls of the mine have not been faulted, and it means that understudied region in current era has not received any extreme stress that makes fault. Other steps include applying characteristic of existed faults on the map, tracking faults all over the region and mixing samples with each other. It is obvious that each of the faults may have been extended across the region and therefore they had been sampled in the other side of the mine again. So to avoid repetition, following faults' direction and matching their characteristics to notes and pictures are necessary. Faults were analyzed after several considerations and then faults

map of the mine was prepared. Eventually, by the help of achieved information during field study, 20 faults were determined in understudied region. Faults' naming was local and mine-specified.

Results and discussion

On the basis of structural classifications that had been offered by Aghanabati (2005), understudied region is located in sedimentary structural zone of central Iran micro continent. Structural sedimentary anisotropies cause to be able to divide micro continent of central Iran to following zones:

1)Loot block, 2) Tabas block, 3) Kalmard block, 4) Posht-Badam block, and 5) Yazd block (Fig. 1).Each of the aforementioned blocks have been separated from each other in block faulting region by main faults of the region (such as Nahbandan, Naiband, Kalmard). (1) Movement of these faults has been caused fault phenomenon. On the basis of this phenomenon, surrounded blocks between main faults have been formed embayment or bump and caused current side effects.

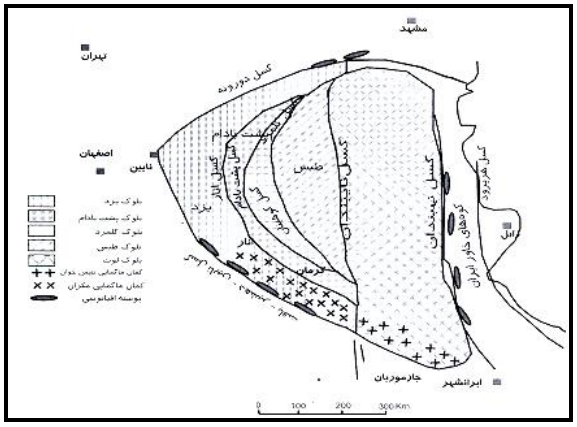

Fig. 1. Micro continent of central Iran and its sub zones (Aghanabati, 2005).

(2) According to suggested classification, understudied region is located at Posht- Badam block zone. Kohbanan fault in east and Posht- Badam fault in the west have surrounded this block. (3) Kohbanan fault with general NW-SE extension is probably southern length of Kalmard fault. Movement of this fault is clear in Cambrian, first period, Triassic and Plio-Pleistocene. The movement type of this fault is the mixture of right-handed and drifts form. It seems that it is an inverted steep fault and Posht-Badam fault, which forms left part of Posht-Badam block, is one of the ancient, deep and curved faults of central Iran that has plaid role in creation of extraterrestrials and grabens and separation of Posht- badam's outcrops. No reason can be offered for its horizontal motion, but its right- handed motion is probable.

Tectonic of Se-Chahun region

Se- Chahun deposit is located along with Se-Chahun-Mishdovan fracture extending E-W. The main tectonic feature of Se-Chahun is its block structure. It means that this deposit has been formed by down and up blocks (horst and graben structure). This block structure is shown clearly in the anomaly map of region's magnetic field.

Anomaly X

The structure of this anomaly is wrinkling and has anticline form. Volcanic-sedimentary units of ore's host have made a big anticline that had been relocated by faulting, and it has been changed to block form. Central nuclear of this anticline is located in eastern part of X anomaly. The northern edge of wrinkle has 20° slope toward NW. The western edge of this anticline has been relocated by faulting as well. Tectonic relocations has led to formation of 3 tectonic blocks in this region includes NW, middle and SW tectonic blocks.

Anomaly XI

The deposit of this anomaly is a coherent layer that has been transformed to current form by tectonic relocations after mineralization (Jafarzadeh *et al.*, 1996).

In this region, various faults separated this deposit from its surrounding rocks along with the rock units belonging to Rizu middle series, and they themselves made an independent tectonic block that it is separated from each other by big faulting zone extending E-W (mostly regular typed faults) and are

divided to two north and south blocks. Aforementioned fault has 70° slop toward north that is reduced in depth, and is reached to 25-40°. Northern block is divided to several smaller blocks by various faults and one of them has iron ore. Southern block is again divided into some tectonic blocks by next faults, and 5 blocks have iron rock. Part of this tectonic relocation is appeared as fault mirror after extraction and stripping at mine's workbench.

In the excavation core, fault zone with crunch rocks and mylonitic zones are observable and sometimes they appear without these parts at the middle of cores along with sudden rocks' lithological changes.

Main faults in area

Southern XI anomaly has two main faults in the region.

F_1 fault

This fault is located at the east wall of southern anomaly XI extending NE-SW in the boundary of sedimentary rocks and metasomatism. Fig. (2) shows fault mirror in Work bench of Se-Chahun mine.

Fig. 2. Fault mirror of F_1in workbench of Se-Chahun mine, southern anomaly XI, the view is toward SW.

F_2 fault

This fault is located at the north wall of southern anomaly XI with 80° slope to NE and its shear zone is 5m. This fault has about 2 km outcrop around the mine and is placed in the boundary of sediments and metasomatisme rocks (Fig. 3).

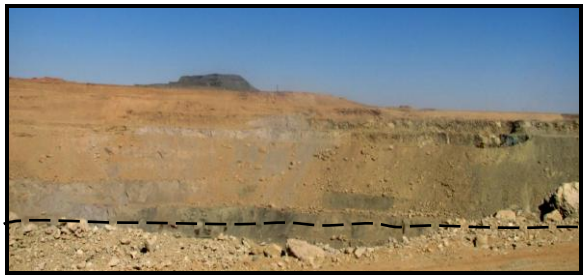

Fig. 3. F_2 fault in northern wall of southern anomaly XI, the view is toward SW.

F_3 fault

This fault is located in eastern wall of mine on its stairs with 1590 m height extending NW-SE and its slope degree is about 90° to SW, it has led to creation of a boundary between metasomatisme rocks and low-grade ore (Fig. 4).

Fig. 4. F_3 fault plate in eastern wall of the mine.

F_4 fault

This fault is located at the east wall of southern anomaly XI extending NE-SW in the boundary of metasomatisme rocks and high ore rocks. Picture shows fault mirror of F_4 (Fig. 5).

Fig. 5. F_4 fault's plate.

Anomalies X faults are listed as below:

F_5 fault

This fault is located at the western wall of the mine with 35° slope to NE (Fig. 25-2). Metasomatisme rocks are beside rhyolite rocks (Fig. 6).

Fig. 6. F_5 fault in western wall of anomaly X, the view is toward west.

F_6 fault

This fault is located in southern wall of mine extending NE-SW and its slope degree is about 80° to NW. Under the effect of this fault's function amphibolite rhyolite rocks are located beside ore with specified boundary. The signs of iron oxide are observable on the surface of this fault (Fig. 7).

Fig. 7. F_6 fault's plate.

Conclusion

Southern anomaly XI has two main faults. F_1 fault is located at the east wall of southern anomaly XI extending NE-SW in the boundary of sedimentary rocks and metasomatism. F_2 fault is located at the north wall of southern anomaly XI with 80° slope to NE and its shear zone is 5m. F_3 fault is extended NW-SE; it has led to creation of a boundary between metasomatisme rocks and low-grade ore. F_4 fault is located at the east wall of southern anomaly XI extending NE-SW in the boundary of metasomatisme rocks and high ore rocks. Anomaly X faults include: F_5 fault has 35° slope to NE, and metasomatisme rocks are beside rhyolite rocks. F_6 fault is located in southern wall of mine extending NE-SW and its slope degree is about 80° to NW. Under the effect of this fault's function amphibolite rhyolite rocks are located beside ore with specified boundary.

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