

Geology and mineralization of the world-class Mehdiabad Pb-Zn deposit, central Iran

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Mehdiabad is the largest Zn-Pb deposit in Asia. It possess total 218 Mt ore with 7.2% Zn and 2.3% Pb, in which an oxidized ore is 45.2 Mt at 7.15% Zn and 2.47% Pb and a sulfide ore is 116.5 Mt at 7.3% Zn and 2.3% Pb. It also has economic barite of ~40 Mt. Deposit is located in the southwest Yazd block, central Iran and hosted by thick-bedded dolostone of the Lower Cretaceous Taft Formation, which stratigraphically overlies the grey- or dark-colored clastic rocks and limestone of the Sangestan Formation and underlies the Abkuh Formation limestone. These rocks are suggested to form in a back-arc basin associated with the northward subduction of Neo-Tethyan oceanic crust (Rajabi et al. 2012).

At Mehdiabad, the steeply E-dipping normal Black Hill fault is a synsedimentary fault that separates the footwall Sangestan Formation from the hangingwall Taft Formation (Ghasemi 2008). Synsedimentary breccia was formed within the hangingwall Taft Formation, characterized by subround clasts of the Taft Formation carbonate in a matrix of the fine-grained carbonate fragments. The Taft Formation carbonate in the hangingwall of the Black Hill fault has been largely dolomitized. The dolostone is usually thicker close to the Black Hill fault than that far away from the fault. However, the Taft Formation in the footwall of the Black Hill is limestone, without dolomitization.

There are three stages of barite deposition in the hangingwall rocks of the Black Hill fault. The early stage (S1) barite is finely crystallized and contains trace amount of finely crystallized chalcopyrite. The barite formed a massive and concordant body within the Abakuh Formation limestone. The second stage (S2) barite is coarsely crystallized and coexists with siderite. These minerals occur as bodies that overprint the S1 barite or as stockwork vein in the Taft Formation dolostone below the S1 barite. The third stage (S3) barite coexists with quartz and minor chalcopyrite, galena, pyrite, and sphalerite. They occur as veins in the Taft Formation dolostone below the S1 barite.

Primary sulfide ores at Mehdiabad occur in the hangingwall of the Black Hill fault and most of them are restricted to dolostone of the Taft Formation. The orebodies are tabular and concordant with the strata. The main stage of sulfide mineralization is dominated by fine-grained and brown-colored sphalerite with minor galena. The style of mineralization is characterized by replacement of S2 and S3 barite by sphalerite, which prefers to occur along the edges of S2/S3 barite veins and the boundaries of barite crystals.

Oxidized ores occur above the sulphide ores in the Taft Formation and the Abkou Formation carbonates. The minerals consist of smithsonite, cerussite, hydrozincite, and Fe and Mn oxides. The oxidized ores commonly coexist with baryte, which are termed as Fe-Mn-Ba gossan at Mehdiabad.