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Combining Airborne Geophysical Data with Available Geology and Geochemistry to Identify Prospective Areas for Pb-Zn Mineralization in Central Iran

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In 2010, Eagle Mining Exploration Company commissioned a number of extensive regional airborne magnetic and radiometric surveys in central and northwest Iran. These surveys were designed to fill in gaps in earlier geophysical campaigns completed in the late 1970s, ultimately providing continuous geophysical coverage over the country's major metallogenic provinces. Combination of these data with regional geochemistry, geology, and mineral occurrences allows for systematic targeting of different mineralisation styles. From an exploration perspective, significant Pb-Zn endowment in central Iran (as reflected by the Mehdiabad and Iran Kuh deposits) is of particular interest.

There is considerable debate about the genesis of many of the sediment-hosted Pb-Zn deposits in Iran, with deposits such as Mehdiabad, Iran Kuh, Angouran, and Tiran described as MVT, Irish-type, or SEDEX deposits. Based on field relationships observed at a number of Pb-Zn deposits and occurrences in central Iran, it is the opinion of the authors that most of them are best explained by an MVT model in an extensional continental-rift setting. Using the above data, paleoreconstructions were created, which suggest a major mineralization event associated with the opening of Mesozoic back-arc basins related to subduction of the Neo-Tethys.

A knowledge-driven targeting approach has been adopted, focusing on source rocks, fluid pathways, trap sites, and timing of mineralization. For the delineation of likely MVT deposits, available data were interrogated to isolate the following favorable geological features: (i) Jurassic sandstones as potential source rocks, (ii) Triassic-Cretaceous evaporates providing saline fluids, (iii) major basin-bounding structures and secondary transverse structures as likely pathways for mineralizing fluids, (iv) Cretaceous (and Triassic-Jurassic) carbonate rocks as suitable host rocks, (v) reef and related fossiliferous rocks as proxies of former basin margin position, and (vi), in the case of the Cretaceous deposits, the base of the first massive Cretaceous limestone unit, which is considered to be a critical stratigraphic position. Airborne magnetic data provided a means of mapping basin-controlling structures under cover, thereby providing significantly better insight into the controlling hydrothermal systems for several of the known occurrences and deposits.

Given the relatively small number of known deposits available for training cells, target layers were combined using simple Boolean overlay and compared with anomalous geochemistry and known Pb-Zn and Ba deposits and occurrences to validate results. Based on this study, a number of prospective areas for MVT Pb-Zn mineralization have been identified. Field site visits to prospective areas provided further encouragement, highlighting the potential for significant unexplored base metal sulfide mineralization.