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Gold Metallogenesis and Detecting Areas of High Potential Gold Mineralization Using Large Spatio-Temporal Datasets, Northwest Iran, Western Sector of Tethyan Metallogenic Belt

Mana Rahimi,[1,*] Ali Reza Jafari Rad,[2] Ali Reza Almasi,[2] Bahram Samani,[3] and Farzin Talebi Rad[4]

[1]University of British Columbia, Mineral Deposit Research Unit (MDRU), Vancouver, Canada
[2]Islamic Azad University, Science and Research Branch, Department of Geology, Tehran, Iran
[3]Hamoon Institute of Science and Technology, Tehran, Iran
[4]ESPEER Mining Services Co., Tehran, Iran

*Corresponding author: e-mail, mrahimi@eos.ubc.ca

Closure of the Neo-Tethys ocean in Iran resulted in the formation of three major tectonic elements. These elements are recognized from northwestern to southwestern Iran and include the Urumieh-Dokhtar magmatic arc, the Sanandaj-Sirjan zone, and the Zagros fold-thrust belt. In northwest Iran, the Urumieh-Dokhtar magmatic arc and the Sanandaj-Sirjan zone host some major Carlin epithermal and orogenic Au deposits, namely, the Aghdarreh-Zarshuran (Takab area) and Sariguni (Qorveh area) gold deposits and Saqez-Sardasht orogenic gold belt (Qolqoleh, Kervian, and Ghabaghloujeh).

Zarshuran, the largest active deposit of the area, is a disseminated gold deposit hosted by Precambrian black shale and carbonates, which have been intruded by a weakly mineralized, highly altered granitoid. This intrusion fractured the host formation and provided a favorable site for mineralizing hydrothermal solutions. Decalcification, sericitization, and kaolinitization are the principal alterations. The jasperoids and the iron-manganese oxide horizons are enriched to economic proportions in gold with accompanying arsenic, antimony, zinc, lead, silver, and barium. In the Aaghdarreh deposit, the richest mineralization occurs in jasperoid lenses in the upper part of the limestone and in underlying horizons, conformable with the limestone bedding, rich in iron and manganese oxides. Orogenic gold occurrences are hosted by Upper Cretaceous metavolcanosedimentary rocks and are placed over ductile to brittle shear zones and located within or adjacent to the major deep Saqez-Sardasht thrust fault and other confining normal faults across this structural zone. The secondary host rock in these indications (especially in Qolqoleh) is altered mylonitic granite. Due to metamorphic genesis of Au mineralization in this region, felsic units are only important as heat sources for percolating hydrothermal fluids. Moreover, endowment of arsenic, bismuth, and mercury has been recorded in these mineralizations. The study area covers about 35,000 km^2 and is located in the western sector of Tethyan metallogenic belt, northwest of Iran.

Building regional mineral prospectivity models using all mineralization signatures detected by different exploration datasets based on metallogenic styles is an economic and effective method. Advances in collecting and interpreting different data have resulted in acquisition of various types of evidence, such as (1) alteration zones detected from aero-radiometric-magnetic data and satellite imagery, (2) geochemical anomalies delineated from correlated elements, (3) favorable structures identified using aeromagnetic data, satellite imagery, and geological maps, (4) mineral assemblages recognized via satellite imagery, and (5) desired source and host rocks outlined in geological maps.

An optimized GIS-based mineral prospectivity model combines all the crucial factors of mineralization in an unbiased manner. Converting evidence into information layers and integrating layers to produce a mineral prospectivity map (MPM) are the two major tasks that control the validity and reliability of each model. In order to have the least complexity and ambiguity in the process of producing information layers, proper fuzzy functions were employed in order to directly convert the interpretation result of each dataset into evidence layers. Moreover, to ensure an impartial integration of all the evidence, fuzzy operators and the index overlay method were employed simultaneously in the models.