Geochronology, Geochemistry, Alteration and Mineralization of Intrusive Rocks from the Roshtkhar Fe-Cu-Au Deposit, northeastern Iran: evidence for a Cenozoic tectono-magmatic event and associated IOCG systems in the Khaf-Kashmar-Bardaskan belt

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Abstract:

The Roshtkhar Fe-Cu±Au (IOCG) prospecting area is located in the northeastern part of Lut Block, and 12 km north of Shahrak village and about 75 km northwest Sangan iron mine. This area belongs to the Khaf-Kashmar-Bardaskan volcano-plutonic belt (KKB-VPMB) of northeastern Iran along the E-W trending regional Dorouneh Fault. The mineralization is related to intrusive rocks with an area of approximately 65 km^2 that intruded into Early Eocene volcanic rocks (andesite, andesite-basalt, trachy-andesite, and pyroclastic rocks), and is also cut by diabase dikes. Petrographic studies indicate that intrusive rocks consists mainly of syenite to monzonite with minor amount of syenite porphyry, monzonite porphyry, and diorite porphyry with granular and porphyritic texture, respectively. U-Pb dating of zircons from a syenite using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) yields an ages of ca. 38 Ma. They have features typical of high-K to shoshonitic magnesian rocks, and are metaluminous, calcalkaline granitoid series, I- type in composition formed in a volcanic arc setting. Mantle-normalized, trace-element spider diagrams display enriched in LILE (Cs, Rb, Ba K, Th, and U), LREE (La and Ce) and depleted in HFSE (Nb, Ta, Ti, P, and Y) and HREE (Yb and Lu), with moderately to slightly strong LREE enrichment $(La/Yb)_N$ = 14.37-17.18) and no significant Eu anomalies. The geochemical signatures suggest that the Roshtkhar intrusive rocks cannot be related directly to subduction, and are likely resulted from a mixed origin with a range of contributions of both the mantle and crust, most probably by the interaction between mantle-derived magmas and lower crust, in an extensional setting where the heat flow provided from deeper levels. Processes responsible for partial melting of metasomatized lithospheric mantle wedge source enriched by Neotethyan subducting slab in mid-Tertiary and post-collision magmatism in NE Iran was triggered by heating due to asthenospheric upwelling in an extensional setting. Overall, the Roshtkhar intrusive rocks were generated in a post-collisional extensional environment in a continental margin arc setting with partial melting of the mantle-lower crust within the Khaf-Kashmar-Bardaskan belt. Iron mineralization occured in fault zones and fractures as vein and veinlet in the host syenite to monzonite and diorite porphyry. The orebodies are vein, veinlet, massive, breccia and stockwork. Magnetite and specularite with variations in their relative amounts form a major portion of mineralized zones; however, pyrite, chalcopyrite, goethite, limonite, malachite, and azurite, with quartz and calcite as the main gangue phases, has been observed. Hydrothermal alteration in the area includes propylitic, sericitic-propylitic, carbonate, argillic, and silicification. Low concentrations of P (<0.01-0.07 wt% P_2O_5), Ti (0.01-0.05 wt% TiO_2), Cr (<0.01 wt% Cr_2O_3) and V (7-55 ppm) in the ore samples, reject a magmatic hypothesis for this deposit. According to the ratios of LREE/HREE, Co/Ni, and positive Eu and Ce anomalies in the ores, in accompany with geothermometry (160-430ºC) and textural data, reveal hydrothermal iron deposits characteristics of the IOCG subgroup of deposits. Deep plutonic rocks in the area have acted as the source of iron and heat in the hydrothermal system. Magmatic fluids with high amounts of Fe, after mixing with meteoric waters, are responsible for ore formation. Field observations, hydrothermal alteration halos, style of mineralization, and the geochemical characteristics of the Roshtkhar iron-copper deposit and host rock indicating a large scale transfer of iron bearing fluids during Middle Eocene magmatic activitiy similar to Cenozoic IOCG-type deposits at the Khaf-Kashmar-Bardaskan belt.

Key words: Roshtkhar, geochronology, geochemistry, alteration, mineralization, IOCG deposit, tectonic setting, Khaf-Kashmar-Bardaskan belt, Iran