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Geologic, Geochemical, and Geophysical Characteristics of the Dalli Porphyry Copper-Gold Deposit in Central Iran and Implications for Exploration

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The recently discovered Dalli porphyry copper-gold deposit (17 Mt at 0.5% Cu and 0.65 g/t Au) is located in the central segment of the Urumieh-Dokhtar Magmatic Arc (UDMA) in Iran. The UDMA hosts several major porphyry Cu (Mo-Au) systems and is part of the Tethyan metallogenic belt. This research aims to characterize the deposit in order to guide further drill targets and define exploration criteria for similar mineralization along the UDMA. Dalli was initially identified by Rio Tinto, then an Iranian junior company discovered two major mineralized porphyry centers by drilling. The mineralization is hosted by several NE-trending quartz-diorite porphyry stocks intruded into a wall-rock andesite porphyry. The mineralized porphyries show surface expressions of 190 x 225 m in a conical hill, and 250 x 400 m in a twin hill (Fig. 1).

Lithogeochemical analyses of the least altered Dalli intrusions and volcanic rocks indicate high Sr/Y (49-61) and Eu/Eu* (0.89-0.92), features typical of Cu porphyries. LA-ICP-MS U-Pb dating of zircons of the mineralized quartz diorites and andesite porphyry yielded magmatic crystallization ages of 16.0-15.4 Ma. The zircon trace element concentrations of Dalli are characterized by high Eu/Eu* (0.3-0.8), (Ce/Nd)/Y (0.01-0.3) and 10,000*(Eu/Eu*)/Y (2-15) ratios (Fig. 1), similar to fertile porphyry suites such as the giant Sar-Cheshmeh and Qulong porphyry Cu deposits along the Tethyan metallogenic belt. This suggests that the Dalli intrusions are fertile and require extensive deep drillings to define their real potential.

Disseminated and stockwork Cu-Au mineralization at Dalli is mostly related to potassic alteration, comprising magnetite and well-developed late K-feldspar and biotite, and quartz-sericite-specularite overprint, surrounded by extensive barren argillic and propylitic alterations. In the peripheries of the porphyry centers, there are some N-trending vuggy quartz veins, which host epithermal Au-Ag-As-Sb-Bi-Pb-Zn-Cu mineralization. Geochemical analyses of drill core samples showed that the core of the porphyry stocks is low grade, whereas the high-grade disseminated and stockwork mineralization (~1% Cu and ~1.2 g/t Au) occurred within 40 m on both sides of the contact between the porphyry stocks and wall-rock andesite porphyry. These contact zones are favorable drill targets for high-grade copper and gold mineralization.

There is a strong correlation between Cu and Au, and both show a second-order correlation with Fe, As, Pb, and Zn at the Dalli deposit. A ground magnetic survey revealed two significant magnetic anomalies, which are associated with intensive mineralized potassic alterations in quartz-diorite intrusions and their contacts with andesite porphyries. A relatively weaker E-trending magnetic anomaly, showing no surface porphyry expressions, was identified in the reduced-to-the-pole magnetic map of the area. This magnetic anomaly is associated with a lithocap, consisting of argillic alteration and surface expressions of epithermal mineralization, and is indicative of a possible hidden porphyry center. The discovery and characteristics of the Dalli deposit highlight the importance of the UDMA as a potentially significant, economically important, but relatively underexplored porphyry province.

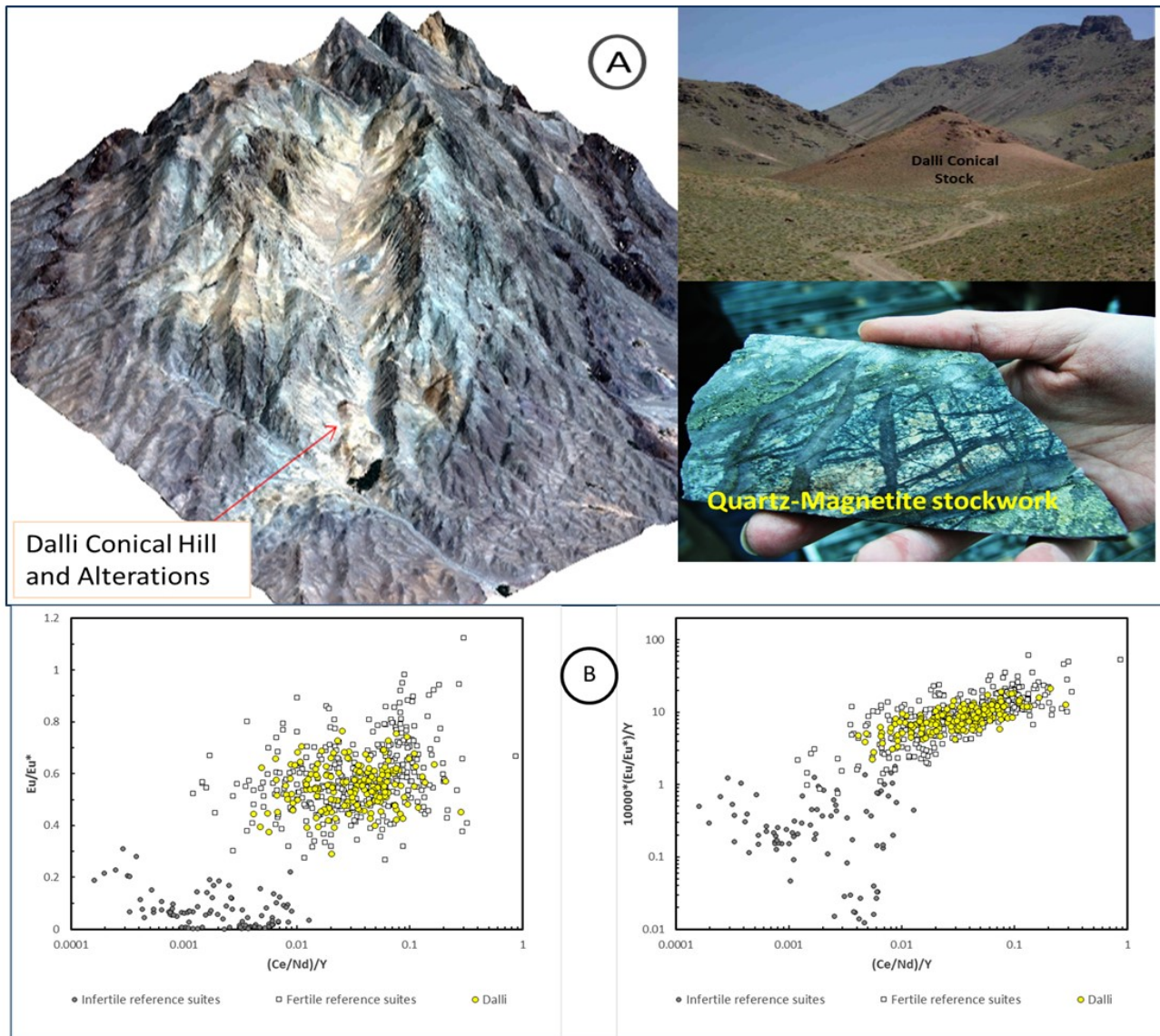


Fig. 1 A-Satellite Image and field overviews of the Dalli deposit, B- Zircon trace element composition of the Dalli porphyries in comparison with the infertile and giant fertile reference porphyry suites.