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Regional Structural Controls and Emplacement of the Miduk Cu Porphyry from High-Resolution Structural Mapping and Fully Constrained 3D Implicit Geologic Modeling

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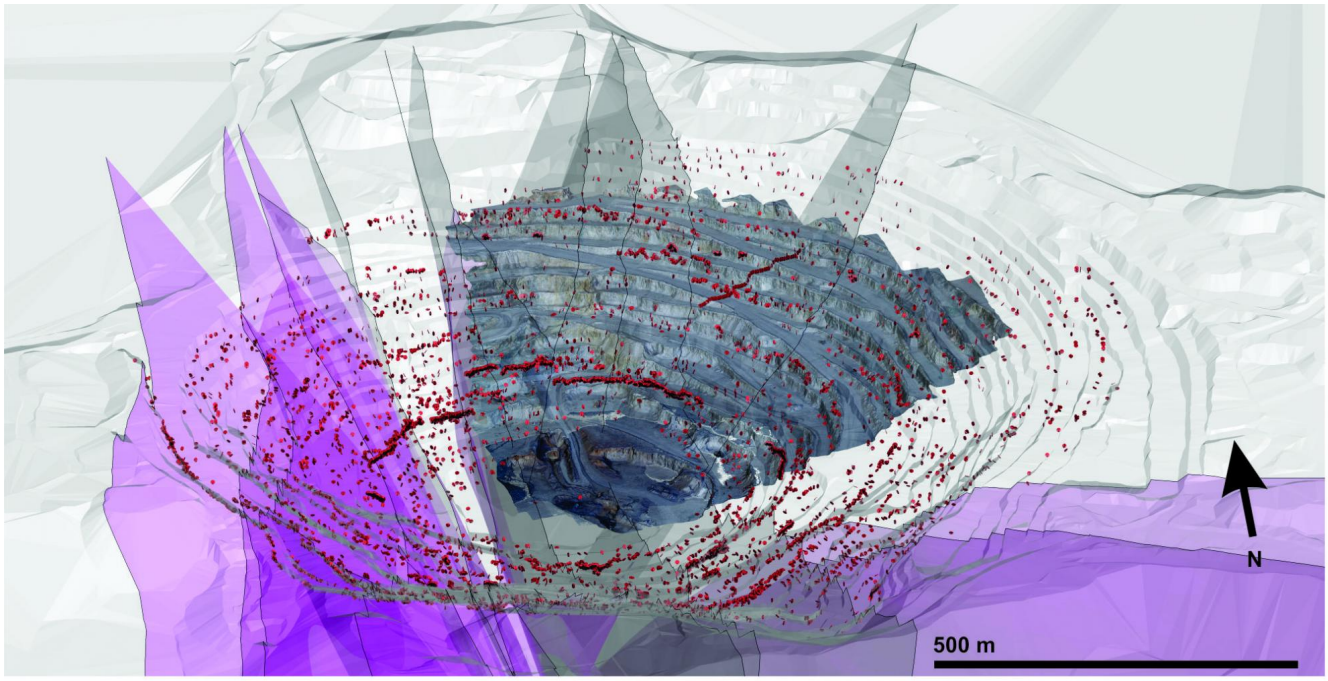
The Miduk Cu Porphyry is located 85 km along strike from the world-class Sarcheshmeh Cu porphyry and forms one of a suite of major, actively mined Cu porphyries within the Urumieh-Dokhtar Magmatic Arc (UDMA). Miduk's Cu mineralization remains significantly open at depth and opencast mining, along with future underground operations, are planned over a 20-year life-of-mine cycle. Exploration of analogous satellite Cu porphyry systems in Miduk's vicinity is also underway, adding to the resolution of regional-scale endowment of a fertile Cu-mineralized porphyry system and associated crustal- to meso-scale structural emplacement mechanisms.

Since 2017, comprehensive structural mapping and implicit 3D geologic modeling of the deposit and its country rocks was undertaken. This resulted in the integration of over 12,000 structural measurements, from exposed pit faces and excavations, UAV-based photogrammetry surveys, and regional outcrops, with drill hole data and mine-wide downhole ATV surveys and macrostructural logging, which produced the first fully constrained implicit 3D geologic model of the deposit, depicting structure, country rocks, alteration, and mineralization zones.

The structural model depicts predominantly synmineralization brittle deformation, characterized by domain-bounding, steeply dipping, N-S- to NNE-SSW-trending, sinistral strike-slip faults (D_2) that crosscut earlier, conjugate NW-SE and NE-SW strike-slip faults (D_1). Overall, the geometry and kinematics of D_2 are consistent with R', and D_1 with R and P shears as part of a right-lateral Riedel shear configuration. This reflects the progressive development of right-lateral transpressional tectonics along the UDMA and associated lateral escape structures such as the Sanandaj-Sirjan Suture Zone, from the late Miocene (<12 Ma) onwards. A conspicuous 3D radial fracture/joint pattern provides further insight into the emplacement and geometry of mineralized vein stocks above the quartz-diorite cupola and the development of the associated alteration and mineralization envelopes.

Structural features elucidate preferential reactivation of brittle R' shears and associated extensional fractures as the main driving/throttling mechanism for dilation and thereby emplacement of the Miduk Cu porphyry system. On a regional scale, this points to emplacement within right-lateral dilational jogs or strike-slip step-over zones driven by 1st-order or subordinate NW-SE-trending, terrane (UDMA)-parallel structures. These findings provide invaluable insight not only for existing Cu porphyry deposits along the UDMA, their ongoing mining, and their geotechnical design, but also for regional and mine-scale exploration strategies.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