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Eocene Subduction to Oligo-Miocene Postcollisional Tectonic and Metallogenic Evolution of the Southernmost Lesser Caucasus, Armenia: Paleostress Field Reconstruction and Structural Controls of Major Porphyry and Epithermal Deposits

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The Lesser Caucasus belongs to the Central segment of the Tethyan metallogenic belt and is a key area for understanding the tectonic and metallogenic evolution of this segment, which links the European segments with the Iranian and other Asian belts. The studied region is the Meghri-Ordubad pluton in the southernmost Lesser Caucasus and belongs to the South Armenian block. It was emplaced during the convergence and final collision of Gondwana-derived terranes and the Arabian plate with Eurasia. The Meghri-Ordubad pluton was formed by repeated intrusive activity from the Eocene to the Miocene, with pulsed ore formation, including porphyry Cu-Mo and epithermal deposits and prospects. Two major pulses of ore formation and magmatism are recognized: during Eocene subduction-related evolution, and during Oligocene to Miocene collision to postcollision evolution. This study presents the paleostress and kinematic environment of the major ore-controlling faults during the subduction to postcollisional tectonic and metallogenic evolution of the pluton, and a comparison with the plate tectonic evolution of the Lesser Caucasus-Zagros belt.

Three major, deep-rooted tectonic zones have controlled magma and ore deposit emplacement in the Meghri-Ordubad pluton. They include the N-S– to NW-oriented Khustup-Giratakh and Salvard-Ordubad zones and the N-S–oriented Central zone. The major porphyry Cu-Mo deposits (Dastakert, Kadjaran, Lichk, Aygedzor, and Agarak) and epithermal deposits (Tey-Lichkvaz and Terterasar) are associated with the Central zone. The latter is located in the axial part of the Meghri-Ordubad pluton, and it is the product of a long-lasting and multistage evolution.

Detailed structural field mapping of the ore districts and the analyses of stereonets compiling ore-bearing fracture and vein orientations allowed us to constrain the internal structure of the Central zone and the main ore-controlling faults of the deposits. The Central zone consists of a network of parallel N-S–, E-W–, and NE-oriented faults, including the regional N-S–oriented Tashtun fault, which hosts the Kadjaran, Agarak, and Lichk deposits. These N-S–oriented faults, in particular at their intersection with E-W– and NE-oriented faults, played an important ore-controlling role during the formation of porphyry Cu-Mo and epithermal Au-polymetallic deposits of the region.

During the Eocene, the main paleostress axes orientations indicate that compression was NE oriented. This is compatible with the subduction geometry of the Neotethys along Eurasia. This tectonic setting during the Eocene resulted in dextral displacements along the N-S–oriented ore-controlling strike-slip faults, and was favorable for the opening of NE-oriented fracture zones. It was the major control for the emplacement of porphyry Cu-Mo deposits (Aygedzor and Agarak) and epithermal deposits (Tey-Lichkvaz and Terterasar) during the Eocene.

During the early Oligocene to Miocene, N-S–oriented compression and E-W–oriented extension predominated, which is consistent with the collisional and postcollisional geodynamic evolution of the motion of the Arabian plate. This geodynamic setting was favorable for renewed dextral displacement along the N-S–oriented ore-controlling faults and sinistral displacement along the E-W–oriented faults. This kinematic setting created the favorable geometry for the opening of N-S–, E-W–, and NE-oriented fractures and the conditions for the emplacement of vein- and stockwork-type porphyry Cu-Mo deposits, including the giant Kadjaran deposit.