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Post-Subduction Porphyry and Epithermal Gold Systems and Associated Magmatism of the Miocene Anatolian Metallogenic Belt, Turkey

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Lithogeochemical and geochronological data from the Anatolian-Tauride block of central Turkey reveal that the closure of the northern and southern branches of the western Neotethys Ocean produced widespread subduction, back-arc, and postcollisional magmatism since the Late Cretaceous, which resulted in the formation of a dozen porphyry- and epithermal-style mineral deposits. The temporal, spatial, and metal distribution of these deposits and similar prospects is strongly controlled by geological and tectonic factors. Most gold resources (>20 Moz) are within Miocene magmatic rocks, mainly at the Kışladağ porphyry (891 Mt at 0.66 g/t Au), the Efemçukuru intermediate- to low-sulfidation epithermal (14.61 Mt at 6.63 g/t Au), and the Öksüt high-sulfidation epithermal deposits (35.32 Mt at 1.22 g/t Au). Although the Miocene magmatic episode extended continuously from 22 to 8 Ma, new $^{40}Ar/^{39}Ar$ and Re-Os radiometric data indicate that epithermal and porphyry mineralization events peaked several times from 18 to 8 Ma, such as at Kışladağ (14.49 ± 0.06 Ma), Afyon-Sandıklı (11.63 ± 0.05 Ma), and Inlice (8.16 ± 0.25 Ma). The spatial distribution of these gold systems defines the newly defined, prospective, E-trending, 1,500-m-long, Miocene Anatolian metallogenic belt that links the Aegean subduction zone to the Arabian collisional domain. This belt, which extends northwesterly to Greece (e.g., Skouries) and southeasterly to Iran (e.g., Sari Gunay, Takab belt), constitutes the most gold endowed segment of the Western Tethyan orogen. The fertile Miocene magmatism was produced during the closure of the southern Neotethys Ocean and emplaced as isolated volcanic complexes that were structurally controlled by graben (western domain) and transtensional basins (central and eastern domains). Field and petrographic observations show that the Miocene Au-rich, Cu-poor porphyry and epithermal systems formed during the first stages of magmatism within these volcanic complexes. Those gold systems are partially covered, mainly by the Pliocene-Quaternary (<6 Ma) alkaline volcanic flows. The geochemical signature of the Miocene magmatic suites varies along strike and through the local volcanic stratigraphy in terms of alkalinity (from medium-K calc-alkaline to shoshonitic) and trace element ratios (Sr/Y, La/Yb, Th/Ta). Those variations imply an overarching increase of the asthenospheric mantle input controlled by the complex geometry of the southern Neotethyan slab subducted beneath Anatolian-Tauride block in Miocene time. This geochemical evolution, coupled with the geochronological constraints on the Anatolian gold mineralization, indicates that the mineralized magmatism along the Miocene Anatolian metallogenic belt occurred after the southward migration of the subduction front (west) or after the rupture of the subducted slab (east). Postsubduction tectonism, which was responsible for the formation of mineralized magmatism along the Miocene Anatolian metallogenic belt, included (1) extreme extension in back-arc setting caused by the rollback of the southern Neotethys oceanic slab in the western and central domains of the Anatolian-Tauride block, (2) a slab tear that accommodated the differential rates of rollback between the western and central Anatolian domains, and (3) slab break-off prior to the incipient continental collision in the central and eastern domains.