

Lithospheric Controls on the Porphyry Cu-Au-Mo Mineralization Along the West-Central Neotethyan Metallogenic Belt

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The Neotethyan orogenic belt features highly clustered economic epithermal Au-Ag and porphyry Cu(-Au-Mo) ore deposits. Notwithstanding the important role played by uplift and erosion in shaping their spatial distribution, the parochialism of the host magmatic rocks reflects a differential mantle-lithosphere coupling, as well as complex accretionary histories along the southern Eurasian margin. On the other hand, the punctuated temporal distribution of ore mineralization along particular arc segments since the Late Triassic can be correlated with changes in plate kinematics, whereby transitions from rapid convergence and consequent high magma fluxes to slower rates of subduction and extension in the overriding plates facilitated shallow plutonism and porphyry formation. Given that regional porphyry-style mineralization has been increasingly recognized in atypical tectonomagmatic settings such as back arcs and collisional orogenic segments, the last 100 m.y. of west-central Neotethyan orogeny is ideal for comparing petrogenetic processes that govern the porphyry-type metallogeny during subduction of oceanic lithosphere, syn- and postcontinental collisions along a composite cratonic margin.

Although canonically associated with calc-alkaline to mildly alkaline rocks with adakitic signatures ($MgO \leq 3$ wt %; $Sr/Y \geq 40$ and/or low $Y \leq 18$ ppm) that do not appear vastly different in major element contents, whether they formed in magmatic arcs or by partial remelting of the arc lithosphere, trace element signatures (Dy/Yb ; Th/Rb) and the Nd-Sr-Hf-Pb isotopic systematics of subduction-related, collisional magmas and back-arc porphyry-hosting magmas are respectively distinct. The nature of associated porphyry-type deposits, notably their metal associations, also changes from Cu to Au and Mo-bearing systems. Moreover, broadly similar tectonic regimes operating along adjacent Neotethyan orogenic tracts (Oligo-Miocene Balkans vs. Miocene Anatolia; Miocene Kerman belt vs. Late Jurassic Lesser Caucasus; Late Cretaceous Apusenian-Banat-Timok-Srednogorie belt vs. Eocene Urumieh-Dokhtar arc) have resulted in magmatic rocks hosting deposits of vastly different metal loads.

Accepting the role of the MASH processes in petrogenesis of globally uniform arc andesites by interaction between mantle-derived hydrous basalts and the upper plate crust along the petrological Moho, the metallogenic variety observed along the Tethyan realm strongly points to the lithospheric column traversed by the upwelling melts as the locus of this diversification. While magmas and metals were ultimately sourced from the mantle, petrogenetically identifiable processes such as high-pressure fractional crystallization, assimilation-fractional crystallization, and anatexis of thickened cratonic roots or shallow basement rocks were the overarching controls on the metal endowment of shallowly emplaced magmas.

Three world-class Neotethyan porphyry deposits (Bor-Majdanpek with 1.4 Bt at 0.6 wt % Cu and 0.31 g/t Au; Sar Cheshmeh with 1.2 Bt at 0.6 wt % Cu; Kisladag with 1.27 Bt at 0.57 g/t Au) are compared to show that the host magma suites with contrasting geochemical signatures could be traced to a common source of parental melts but were differentiated by separate paths

involving partial melting, lower and upper crustal assimilation, and fractional crystallization. Variations in age and degree of melting/assimilation across the belt are in turn the basis for a geodynamic interpretation of its locally ore-mineralized segments.