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Constraining Contrasting Styles of Magmatism and Metal Endowment Along the Maronia Magmatic Corridor, NE Greece

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Porphyry-epithermal systems host 75% of the world's known Cu reserves, along with considerable volumes of precious metal mineralization. Consequently, a key question that has puzzled the field for many years is what controls this mineralization: why, along the same magmatic lineament, are some plutons metal rich while others are metal poor? The key to unpicking this lies in examining the differing magmatic evolution of fertile and barren plutons. A considerable body of work has studied this in volcanic arc settings, where subduction-related processes generate hydrous, highly fractionated calc-alkaline magmas favorable for mineralization. However, porphyry-epithermal systems are not restricted to this geodynamic regime, and mineralization in postsubduction settings is becoming increasingly important. Furthermore, these systems exhibit significant by-product metal endowments, including PGEs, Re, and semimetals such as Te, which are in growing demand for a whole range of modern technology and green energy applications.

A key example of this deposit style can be found in the Oligocene Serbomacedonian-Rhodopean metallogenic province in southern Europe, which is associated with postsubduction collapse following the collision of Africa and Eurasia. Within this metallogenic province, straddling the border between northeast Greece and Bulgaria, lies the Maronia magmatic corridor, an NE-trending belt of calc-alkaline to shoshonitic plutons, some of which host porphyry-epithermal mineralization. Here, the Sappes, Pagoni Rachi, and Maronia Cu-Au-Mo deposits contain by-product metal enrichment, in particular significant endowments of Re and Te. The occurrence of this unusual metal endowment in a magmatic belt that also hosts unmineralized plutons, coupled with an apparent NE-trending structural control on magmatic emplacement, makes this an ideal area to study the influence of postcollisional geodynamics on magma metal fertility.

The northeast trend and degree of mineralization along the Maronia magmatic corridor is possibly controlled at depth by the basal detachment to the Rhodope metamorphic core complex. Mineralized plutons lie to the south of this structure, intruded into local Jurassic basement and Paleogene sediments. By contrast, in the north, the barren plutons are intruded into gneisses of the core complex. Here, we present the findings of an integrated geochronological and geochemical study of host pluton evolution and mineralization across this tectonic divide. High-precision U-Pb zircon ages and major element geochemistry point to two distinct pulses of magmatism. An early calc-alkaline generation of magmatism was intruded from 33 to 32 Ma, outcropping either side of the tectonic divide and associated with both barren and mineralized systems. A later, shoshonitic event has been dated to 29.5 to 30 Ma and is solely associated with the Maronia Cu-Au-Mo porphyry system.