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Metallogeny of the Hod Gold Corridor, Eastern Pontides Belt, Turkey: Transitions from VMS to Porphyry-Epithermal Environments

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Porphyry and VMS deposits rarely form concurrently and in the same geological domain along convergent margin environments. Their temporal and spatial association indicates that contrasting ore-forming processes occurred in the evolving tectonic settings. The Artvin Au-Cu district is one of the major clusters of VMS bimodal-felsic, porphyry, and epithermal deposits in the Eastern Pontides Belt in northeast Turkey. Whereas ore-forming processes, timing, and tectonic setting of VMS mineralization are well defined, those for gold-rich porphyry and epithermal mineralization remain less constrained. The ~110-km-long Hod Gold Corridor in the Artvin district is defined by the northeast trend of several recent Au ± Cu mineral discoveries (~205 t Au; ~0.33 Mt Cu) including Hod Maden, Ardala-Salinbaş, and Taç-Çorak. These deposits include gold-rich porphyry, high- and intermediate-sulfidation epithermal, carbonate-replacement, and hybrid VMS-epithermal mineralization styles.

We present new U-Pb, $^{40}Ar/^{39}Ar$, and Re-Os geochronological results, interpreted with previously-compiled data, constrains Artvin district magmatic events to the Carboniferous (358-325 Ma), Jurassic (182-174 Ma), Late Cretaceous (92-78 Ma), Eocene (51-40 Ma), and Oligocene (30 Ma). Porphyry and epithermal mineralization along the Hod Gold Corridor peaked in the Early (~113 Ma; Berta prospect), Late Cretaceous (~88-82 Ma; e.g., Taç and Çorak deposits), and Eocene (~50 Ma; e.g., Ardala deposit), whereas VMS bimodal-felsic mineralization was restricted to the Late Cretaceous (~89-83 Ma). Therefore, we interpret that the Hod Gold Corridor was a long-lived, deep, crustal-scale structural feature along which the successive magmatic and mineralization events were emplaced.

The Late Cretaceous precious and base metal mineralization event is genetically associated with the emplacement of the felsic volcanic units of the Kızılkaya Formation (~89-83 Ma). Although this stratigraphic horizon is most well-known as host for VMS bimodal-felsic Cu-Zn mineralization along the Eastern Pontides Belt, we show that contemporaneous high- and intermediate-sulfidation epithermal Au ± Cu mineralization formed in it along the Hod Gold Corridor (e.g., Taç and Çorak deposits). Epithermal features and gold enrichments are increasingly pronounced and elevated eastwards across the Artvin district (Fig. 1). We interpret that the Cu-rich VMS (e.g., Cayeli and Murgul deposits) and Au-rich epithermal-style deposits represent two spatially and tectonically distinct end-members that formed during the same magmatic-hydrothermal event in the back-arc and arc settings, respectively. The eastward shallowing of the sea level and increased contributions from magmatic fluids are two possible first-order factors that could account for the contemporaneous variations of mineralization styles and metal associations.

This study examines the metallogenic responses to the spatial transition from back-arc to arc settings, contrasting geological domains, and implications for gold endowment in magmatic-hydrothermal systems in submarine environments.

Figure 1: Schematic, northwest-southeast, tectono-magmatic cross section of the Artvin district in the Late Cretaceous (~89-83 Ma) that shows the variation of mineralization style (i.e., from VMS bimodal-felsic to porphyry-epithermal) and metal association during the emplacement of the Kızılkaya Formation.