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Structural Controls on the Kiziltepe Au-Ag Low-Sulfidation Epithermal Vein System, Western Turkey

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Kiziltepe is a multivein, stockwork- and breccia-hosted, low-sulfidation epithermal gold-silver deposit of early Miocene age, located within the Western Anatolian volcanic and extensional province. The deposit is situated at the northwestern end of a major ca. 100-km-long dextral normal fault defining the Simav half-graben (the Simav fault). This fault, having been active during the Miocene, is considered the key regional-scale structural control on the mineralization encountered at Kiziltepe; the deposit being located within subsidiary structures of the terminal splay. Another significant feature of the Kiziltepe deposit is its localization at the southwestern end of a 30-km-long and 5-km-wide, ENE-trending corridor of epithermal mineralization, referred to as the Sindirgi Gold Corridor, expressing a possible basement structure.

At the deposit scale, precious-metal mineralization is located primarily within a series of structures containing low-sulfidation veins and stockwork zones that typically trend WNW, NW, NNW, and N, and that largely demonstrate dextral transtension. These structures are hosted by a welded crystal dacitic ignimbrite which formed as part of a subaerial, caldera-facies volcanic succession of early Miocene age, which includes dacitic to rhyolitic pyroclastic rocks intruded by subvolcanic rhyolite domes. The mineralization and associated hydrothermally altered volcanic rocks of the Sindirgi Gold Corridor lie unconformably over a basement of variably deformed Mesozoic ophiolitic and sedimentary rocks and Paleozoic schists.

The Kiziltepe system formed within a large (3.8 km × 4.8 km) extensional array located in a rotated fault block (Kiziltepe fault block). Mineralization is typically located in brittle deformation zones, corresponding to Riedel (WNW-NW trending) and antithetic Riedel shears (NNW-N trending). Higher-grade precious-metal mineralization appears within tension gashes formed within a major dilational jog, occuring along the Arzu vein trend. Dilational zones typically plunge at 30°E, which corresponds to dextral normal kinetics across the fault system. Structural and geochronological data demonstrate that the mineralization is related to syn- to immediately postvolcanic faulting within the ca. 19–20 Ma volcanic rocks associated with displacement along the Simav fault at 18.3 ± 0.1 Ma.

Economic mineralization due to be mined at Kiziltepe encompasses several dominant veins, namely, Arzu South, Arzu North, Derya, and Banu. The veins display a variety of typical low-sulfidation textures including crustiform-colloform (with ginguro) and lattice blading in quartz with minor adularia. Such textures and associations suggest that the veins formed near the boiling level, from near-neutral pH hydrothermal fluids. However, as a dynamic system, fluid mixing also appears to contribute to the localization of higher-grade mineralization, where surficial waters were brought into instantaneous contact with deeper metal-bearing fluids as a result of fault rupture.

Exploration studies with the objective of identifying further economic mineralization were undertaken in recent years. Structural mapping coupled with recent drilling and geochemical data

indicates the potential for (1) plunging shoots located along structural offsets and dilational zones, (2) alternate depths of bonanza-type mineralization due to the variable architecture of the paleowater table, and (3) vein extensions beneath a rhyolitic ignimbrite cap-rock sequence. Significant potential exists to discover other mineralized dilational structures within the Kiziltepe fault block, particularly under cover and at depth.