SEG-MJD 2016 Conference

Hydrothermal Evolution of the Çöpler Porphyry-Epithermal Au Deposit, Erzincan Province, Central Eastern Turkey

Ali Imer,* Jeremy Peter Richards, and Karlis Muehlenbachs

Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta T6G 2E3, Canada

*Corresponding author: e-mail, imer@ualberta.ca

The Çöpler Au deposit is centered around shallow-level dioritic to granodioritic intrusive rocks of the middle Eocene Çöpler-Kabataş magmatic complex, which have been emplaced into a succession of regionally metamorphosed late Paleozoic-Mesozoic sedimentary and carbonate rocks.

The deposit comprises a centrally located subeconomic porphyry Cu-Au system characterized by a potassically altered core overprinted by a more extensive phyllic alteration zone. The potassic alteration zone is associated with early M-type hairline magnetite and crosscutting B-type quartz ± magnetite ± sulfide veinlets, whereas the enveloping phyllic-altered rocks contain abundant D-type quartz-pyrite and lesser polymetallic quartz-sulfide veinlets. Overprinting intermediate-sulfidation epithermal Au mineralization occurred in two stages. Main-stage epithermal mineralization is characterized by carbonate-sulfide veinlets consisting of manganocalcite, arsenical pyrite, arsenopyrite, marcasite, chalcopyrite, tennantite/tetrahedrite, galena, and sphalerite. Late-stage sooty pyrite veinlets contain realgar and orpiment and are associated with zones of carbonate alteration. In the carbonate-sulfide veinlets, invisible gold is primarily hosted within arsenical pyrite and, to a lesser extent, by arsenopyrite, tetrahedrite, and tennantite. In sooty pyrite veinlets, invisible gold is associated with fine-grained arsenical pyrite. Gold-bearing manto-type carbonate-replacement zones, occurring distally to the porphyry system, display a mineral paragenesis similar to the epithermal carbonate-sulfide veinlets in that they contain abundant arsenical pyrite together with lesser chalcopyrite, arsenopyrite, and marcasite, and sparse sphalerite, galena, tennantite, and tetrahedrite. Invisible gold in these ores is mainly contained within pyrite and chalcopyrite. Polyphase brine inclusions (~47–62 wt % NaCl equiv) in early B-type quartz ± magnetite ± sulfide veinlets were trapped together with low-salinity (~3–5.5 wt % NaCl equiv), vapor-rich inclusions at temperatures ~390°C and at a depth of ~1.5 km under lithostatic conditions. Fluids associated with the overprinting phyllic alteration were slightly cooler (~370°C) and less saline (37–42 wt % NaCl equiv). Fluid inclusions in manganocalcite and sphalerite from epithermal carbonate-sulfide veinlets trapped moderate-salinity (4–15 wt % NaCl equiv) fluids at ~290°C, whereas fluid inclusions hosted in barite and realgar from sooty pyrite veinlets were formed from low-temperature (~100°C) and low- to moderate-salinity (1–14 wt % NaCl equiv) fluids. These data indicate that the Au-mineralizing system at Çöpler progressed from a high-temperature porphyry system to a relatively low temperature, intermediate-sulfidation epithermal system. Deposition of gold in the early stages of epithermal mineralization resulted from cooling, sulfidation, and neutralization of predominantly magmatic sourced hydrothermal fluids, whereas a meteoric water component is evident in the latest stage of mineralization. Deposit-scale geological observations combined with fluid inclusion and stable isotope evidence suggest that mineralization at Çöpler records activity of a relatively deep epithermal system and that its formation was structurally and lithologically controlled. Specifically, the thick

premineralization carbonate sequence once overlying the deposit acted as a pressure seal and also as a neutralizing agent during the buildup of the magmatic-hydrothermal system. The weakening of this carbonate cover by igneous intrusion and subsequent hydrothermal activity may have contributed to later selective erosion of the alteration zone, thereby telescoping the intermediate-sulfidation epithermal system onto the earlier porphyry system and creating the Çöpler window.