SEG-MJD 2016 Conference

Structural and Hydrothermal Fluid Evolution of the Efemçukuru LS- to IS-Epithermal Au Deposit, Western Turkey

Kaleb Boucher,[1,*] Aleksandar Miškovic,[1] Matías Sánchez,[2] Tim Baker,[3] Craig J.R. Hart,[1] Çağlar Acımaz,[4] Nadir Arslan,[4] Ömer Ilgın,[4] Mustafa Özkayhan,[4] Orbay Yavuz,[4] and Özgür Akyürek[4]

[1]University of British Columbia, Mineral Deposit Research Unit, Vancouver, BC, Canada
[2]Fault Rocks Inc., Vancouver, BC, Canada
[3]Eldorado Gold Corp., Vancouver, BC, Canada
[4]Tüprag Metal Madencilik Sanayi ve Ticaret A. Ş. Efemçukuru Gold Mine, Izmir, Turkey

*Corresponding author: e-mail, kboucher@eos.ubc.ca

The Western Tethyan metallogenic belt in Turkey hosts a number of porphyry and epithermal deposits (Ovacık, 0.63 Moz Au at 4.34 g/t and 0.40 Moz Ag at 2.79 g/t Ag; Kışladağ, 10.4 Moz Au at 0.62 g/t). The Efemçukuru epithermal gold deposit, located southwest of Izmir, contains a resource of 1.69 Moz Au (at a grade of 8.39 g/t) and comprises two mineralized NW- to NNW-trending quartz-rhodochrosite veins (Kestanebeleni and Kokarpınar). These structures are hosted in carbonate-rich phyllites of the Bornova Flysch, an Upper Cretaceous ophiolitic mélange sequence. The veins are predated by an array of similarly striking rhyolite dikes, as well as a 200- to 500-m-wide halo of silicification and chloritization.

The Efemçukuru vein mineralogy and textures have been subdivided into six paragenetic stages. Early veins of quartz, chlorite, and calc-silicates (stage I) are cut by two stages of brecciated and banded veins of quartz, rhodochrosite, rhodonite, and pyrite (stages II, III). Later veins with quartz, rhodochrosite, and disseminated (stage IV) to massive base-metal sulfides (stage V) cut previous stages. All veins are crosscut by late quartz-carbonate veinlets (stage VI). Gold mineralization occurs as both electrum and in pyrite inclusions in stage III and with pyrite and galena in stages IV and V. Quartz and carbonate-rich veins of stages II and III are thickest and most abundant in the southern Kestanebeleni vein. Contrarily, the base metal-rich stages dominate the central and northern segments of Kestanebeleni, as well as at depth.

Kestanebeleni and Kokarpınar veins are controlled by moderately to steeply dipping NW- to NNW-trending faults. An analysis of the fault patterns and vein and dike orientations, combined with rock and soil geochemistry, indicates that the highest and most prolific gold grades are associated with the steeply dipping, NNW-trending structures. These vein segments are dominated by the paragenetic defined vein stages of IV and V and are interpreted to represent "fault-linkage zones" where hydrothermal fluids were focused.

Carbon and oxygen isotope analysis of the vein carbonates indicates a mixed meteoric and magmatic source for the Efemçukuru hydrothermal fluids. Variations in $\delta^{13}C$ and $\delta^{18}O$ values reveal two trends—one corresponding to interaction of meteoric fluids with the host rocks (trend 1), and the second interpreted to reflect up to 45% degassing (i.e., boiling) of magmatic fluids (trend 2). Samples in the fluid-rock interaction trend occur in both Kestanebeleni and Kokarpınar, while samples representing the degassing trend occur as localized segments in the Kestanebeleni vein. The latter also correspond to the thickest and highest gold grade regions of the Kestanebeleni vein, suggesting that degassing was the key process for high-grade gold deposition. The fault linkage zones provided structural permeability that facilitated rapid degassing of auriferous fluids from stages IV and V. The combined structural and fluid evolution of the Efemçukuru system

emphasizes the vital roles of both structure and dynamic hydrothermal processes required to make a high-grade epithermal gold deposit.