SEG-MJD 2016 Conference

Spatial and Temporal Alteration Model of Afyon-Sandikli (As) Alkaline Porphyry Cu-Au Deposit

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Turkey, located in the western Tethyan metallogenic belt (TMB), hosts many different types of magmatic-hydrothermal deposits, including porphyry Cu, epithermal Au, base metal skarn, and volcanogenic massive sulfide. These are the result of voluminous magmatism starting in the Late Cretaceous and continuing to the late Miocene. Porphyry Cu deposits are an important class of deposits in western Anatolia. They have been formed by the emplacement of several phases of calc-alkaline to alkaline magmatic intrusions into the crystalline basements or younger sedimentary and volcanosedimentary basins formed by ongoing Aegean subduction. Halilaga (Çanakkale), Kışladağ (Uşak), Muratdere (Bursa), Tüfekçikonak (?), Gelemiç-Sarıçayır, Demirtepe (Bursa), and Afyon-Sandıklı (AS-Afyon) are examples of the growing number of porphyry Cu deposits/prospects in western Anatolia.

The alteration pattern, spatial and temporal association between the timing and emplacement of precursor intrusions, and alteration-mineralization are well documented at Kışladağ (ca. 14 Ma), whereas the AS deposit (ca. 12 Ma) is less studied. Both deposits are associated with the younger alkaline intrusive-volcanic activity in western Anatolia. Although the AS deposit shares similarities with Kışladağ, data are still lacking on the alteration and mineralization style, temporal associations between alteration-mineralization, and precursor alkaline intrusions. We have mapped and sampled the main volcanic and intrusive phases together with advanced argillic, potassic, phyllic, and propylitic alteration types covering approximately 5 km^2. The studies have shown that volcanic rocks consist of trachyte, latite, and latite porphyry, and are pervasively altered to form potassic and argillic alteration. These alterations are so intense that the original textural and compositional features are generally obliterated. Occasionally, the original textural and compositional features are partly preserved in latite porphyry, where they are altered to sericite. These rocks have a remnant porphyritic texture and contain sanidine and plagioclase in phenocrystal to megacrystic assemblage.

For identification of alteration zones, 299 core and rock samples have been collected from the surface exposures and drill cores for TerraSpec analyses. TerraSpec analyses resulted in identification of advanced argillic alteration and showed that the predominant mineral assemblages in these are alunite, kaolinite, and dickite. Besides, pyrophyllite has also been defined in the levels above the potassic alteration that also host the main mineralization. The potassic alteration consists primarily of hydrothermal biotite. No hydrothermal K-feldspar was detected in this alteration. The potassic alteration was partly overprinted by sericitic alteration. Chlorite and epidote were identified by petrographic analyses, and this forms the dominant alteration mapped at the northern and southern part of the deposit. Additionally, tourmaline that forms discrete fine-grained crystals, veins, and breccia cement was identified at the western part of the orebody. This is considered to be part of phyllic alteration, and it is hosted by latite porphyry.

Chalcocite, chalcopyrite, and tetrahedrite are common copper minerals in the potassic alteration. These minerals are also accompanied by pyrite. Molybdenite is another mineral that doesn't reach ore grade in the potassic alteration and is replaced by pyrite.