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High Grade Cu-Au-Ag Overprint at the Filo del Sol Porphyry Deposit, Argentina-Chile

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The Filo del Sol porphyry deposit is associated with Miocene porphyritic diorite dikes along the Argentina-Chile border. The deposit contains high copper and gold grades due to early porphyry-style mineralization overprinted by high sulfidation-state minerals. This overprint bringing high gold and silver extends to depths greater than 1000 m. The early event formed mushketovite and biotite plus pyrite with subsequent anhydrite intergrown with chalcopyrite and bornite. Co-existing pairs of anhydrite and chalcopyrite yield sulfur isotope equilibrium temperatures between 550° and 450°C at sulfide-dominant conditions. Oxygen isotope compositions of anhydrite support a high-temperature magmatic-hydrothermal origin of the early mineralization. Later hydrothermal activity caused a deep overprint of residual quartz and quartz-alunite on the early mineralization. This later stage of hydrothermal activity was relatively oxidized and cool. It produced an assemblage of enargite, digenite, covellite, chalcocite, and pyrite. The sulfide minerals are accompanied by native gold grains, and silver sulphosalts and selenides. The cool temperature of the late mineralization is confirmed by intergrown K-rich alunite and enargite, which yield sulfur isotope equilibrium temperatures of ~260°±30ºC. Pyrite is common and crystallized throughout hydrothermal activity, with diverse crystal habits and textures and variable sulfur isotope compositions.

High-grade Cu-Au porphyry deposits with high sulfidation-state mineral assemblages occur around the world. This study shows that detailed petrographic and mineralogic studies combined with stable isotope analyses are effective in unraveling the evolution of the mineralization stages of magmatic hydrothermal activity.