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Uncommon La Virgen High-Sulfidation Epithermal Deposit, Northern Peru

Raul Montesinos¹, Zhaoshan Chang¹, Juan Carlos Castelli²

1. Colorado School of Mines, Golden, CO, USA, 2. Mochica Resources Inc, Lima, Peru

Almost twenty percent of world gold production comes from epithermal deposits. The central Andes, especially northern Peru, host world-class high-sulfidation epithermal (HS) deposits such as Yanacocha, Lagunas Norte (LN), and Pierina. The giant Yanacocha and Pierina HS deposits are hosted in pyroclastic units, but the rare Lagunas Norte with above 14 million ounces of gold is hosted mainly in siliciclastic rocks of the lower cretaceous Chimu Formation. The key factors controlling the advanced argillic alteration (AA) and HS mineralization in siliciclastic environments have yet to be well-defined. Our study was carried out on the La Virgen HS deposit mainly hosted in quartz sandstone of the Chimu Formation, 17 km East of Lagunas Norte. The outcomes fill a knowledge gap, enrich our understanding of HS ore-forming processes in siliciclastic environments, and guide exploration in siliciclastic terranes in northern Peru and worldwide.

La Virgen is structurally and lithology-controlled with textural, alteration, and mineralogical similarities to LN. The cracked and brecciated sandstone of the Chimu Formation is affected by highly acidic fluid, which produced AA. The alunite fills the interstices of resistant quartz grains of the sandstones and also microfractures. The minor K-feldspar grains in the sandstone are also altered to alunite and other clays. The alteration is cryptic, with the altered sandstone appearing fresh. The gold mineralization occurs in enargite-pyrite-luzonite—dominant sulfide zones, with intense silicification, partly as black silica with fine-grained pyrite and partly as creamy silica with high rutile content. The silicification also fills interstitial open spaces between grains of the sandstone, fractures, and occurs as cement of breccias. The lesson is that SWIR (short-wavelength infrared) analysis should be widely applied in siliciclastic terrains to identify cryptic clay minerals in reconnaissance exploration, even if the rocks look fresh.