Spatial and Genetic Relationship Between Epithermal Sediment-Hosted Au and Porphyry Cu-Au-(Mo) Deposits: La Arena – La Libertad, Peru

Enrique Garay,[1,†] Jesus Valdivia,[2] Juan Rivera,[2] Greg Corbett,[3] and Israel Sangay[4]

[1]*Rio Alto Mining Limited*
[2]*La Arena S.A.*
[3]*Corbett Geological Services*
[4]*Anglo Peruana Terra*

[†]Corresponding author: e-mail, enrique.garay@rioaltomining.com

The La Arena (Au, and Cu-Au) project is located in central-north Peru, 170 km inland from Trujillo, within a prolific metallogenic province that contains many precious and polymetallic projects: Lagunas Norte (Au-Ag), Santa Rosa (Au), La Virgen (Au), Quiruvilca (Ag-base metals), Tres Cruces (Au), Shahuindo (Au-Ag), and Igor (Au-Cu).

The oldest rocks in the area constitute the Upper Jurassic and Lower to middle Cretaceous age sedimentary sequence, which is folded and faulted in the Upper Cretaceous Andean uplift. The later Calipuy volcanic group (lavas and pyroclastics) was deposited since the lower Tertiary. Subsequent to this, during the Miocene (middle to upper Tertiary), stocks and domes that are responsible for the mineralization in the region were emplaced.

The La Arena project contains two styles of mineralization that are spatially and probably genetically related. Partly supergene oxidized epithermal high sulfidation Au mineralization is hosted in locally brecciated sandstone (Chimu Formation), whereas the porphyry Cu-Au-(Mo) mineralization occurs within a multistage porphyry intrusion.

The La Arena porphyry Cu-Au-(Mo) complex was emplaced along the axes of an overturned anticline. Three stages of dacitic intrusions are distinguished by textural differences and contact breccias between individual intrusions. U/Pb (zircon) isotope studies for age determination were performed on 10 samples, with dates ranging from 24.51 ± 0.43 Ma to 25.23 ± 0.39 Ma. The uppermost portion of the intrusion displays variably intense and pervasive sericitic alteration (muscovite-quartz-pyrite), whereas relict potassic alteration (secondary biotite-magnetite-chlorite-orthoclase) is preserved below a depth of 700 m, where it is not overprinted by the sericitic alteration. Propylitic alteration occurs only in the barren andesitic dikes.

Supergene processes have resulted in the formation of a leached zone extending to a depth of about 50 m from surface, underlain by less than 40 to 50 m of secondary Cu enrichment (chalcocite + covellite ± copper oxides) and a 10- to 40-m mixed zone (chalcocite + chalcopyrite ± covellite). Primary Cu-Au-Mo mineralization (chalcopyrite ± bornite ± molybdenum, and gold), which predominates at La Arena, is normally located more than 100 m below the natural surface. The mineralization occurs in a stockwork of quartz veinlets, consisting of A, B, and D type veins. Microscopic native gold in the 50- to 70-µm range has been observed within B type quartz veinlets. Work to date indicates that the mineralized porphyry body is 2,000 m long, 1,000 m wide, and over 1,000 m deep.

The Calaorco and Ethel zones host disseminated high sulfidation-style epithermal Au mineralization, derived from a deeper-level intrusion source. The mineralization displays strong lithological and structural controls. The Au mineralization is hosted in the matrix of the oxidized,

brecciated, and commonly silicified sandstone, along the contact between the intrusive dikes, and in hydrothermal breccias controlled by NE-trending structures. The hydrothermal alteration is zoned outward from residual quartz and quartz-alunite in the core, to quartz-dickite in the outer zone, and argillic alteration on the periphery; pyrophyllite-diaspore occurs at depth. The hydrothermal alteration zonation and mineralogy are typical of high sulfidation epithermal Au deposits formed at a shallow depth, as evidenced by enargite-luzonite, as well as locally outcropping steam-heated alteration. Fine-grained free Au with a particle size from 20 to 30 μm is present in the oxidized ores to a depth of about 250 m and also in the underlying primary sulfide ores, which comprise enargite, luzonite, digenite, and pyrite. The footprint of the gold mineralization covers an area of 1,250 × 500 m and extends to 300 m depth.