

Geology and Genesis of the Multistage High-Sulfidation Epithermal Pascua Au-Ag-Cu Deposit, Chile and Argentina

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Abstract

The giant Pascua epithermal Au-Ag-Cu deposit is located in the El Indio belt of north-central Chile and Argentina and was the product of a high-sulfidation hydrothermal system. The host rocks consist mainly of Triassic granite and heterolithic Miocene breccia pipes. Granitic rocks host ~60 percent of the mineralization (or >80% if granitic breccia fragments are included) but were not the cause of hydrothermal activity. The economic mineralization forms a large orebody centered on Brecha Central, the largest of the breccia pipes, and several smaller satellite bodies that are separated by zones of subeconomic mineralization.

Hydrothermal activity produced two main stages of advanced argillic and vuggy silica alteration. These were separated by an intermediate stage of argillic alteration, silicification and hypogene jarosite, which occurred penecontemporaneously with the emplacement of Brecha Central. Main-stage Au-Ag-Cu mineralization occurred toward the end of the second stage of alteration and involved precipitation of native gold with pyrite and enargite and incorporation of Au in the structure of these minerals. Four types of mineralization are recognized based on the occurrence of economic concentrations of Au in rocks containing significant amounts of the following minerals: (1) alunite, pyrite, and enargite; (2) pyrite; (3) pyrite and szomolnokite; and (4) native gold. Main-stage gold mineralization was followed by a sulfate stage represented by barite and anglesite at lower elevations and barite, anglesite, plus primary szomolnokite, the first reported occurrence of this phase as a hydrothermal ore mineral, at higher elevations. Late-stage silver mineralization, characterized by the occurrence of microscopic Cl-, I-, and Hg-bearing phases in voids and fractures, enriched the upper parts of the deposit, forming an extensive subhorizontal zone that overprints previous alteration and mineralization.

Advanced argillic alteration and high-sulfidation mineralization at Pascua are interpreted to have resulted from a high-level hydrothermal system developed above a porphyry stock located in Argentina. Extensive vuggy silica and advanced argillic alteration reflect interaction of the wall rocks with acidic magmatic vapors. Gold, copper, and arsenic are interpreted to have been transported by these vapors and to have deposited as a result of their cooling and subsequent condensation. Ore-forming hydrothermal activity terminated with silver enrichment in response to the condensation of residual magmatic vapors during the waning stages of the system.

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