The Nazca-Ocoña Metallogenetic Belt, Arequipa, Peru: Geological Characteristics of Quartz-calcite-sulfide Veins

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The Nazca-Ocoña metallogenic belt in southern Perú is host to more than 70 recognized Au-Ag and base metal deposits. These deposits are spatially associated with Cretaceous intrusive rocks of the coastal Batholith in a zone that extends more than 350 km along the Central to Southern part of Perú. In order to establish a revised genetic model for precious metal bearing veins in the Nazca-Ocoña belt, we conducted detailed studies at two representative deposits in this metallogenic belt: Mollehuaca and San Juan de Chorunga. At both sites, small-scale mining has focused on quartz-calcite-sulfide veins hosted in granodiorite. Here we present the results from geological field mapping, field-emission scanning electron microscopy, electron microprobe analysis, nano-scale secondary ion mass spectrometry, laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) on pyrite, and fluid inclusion petrography of quartz to elucidate the ore forming processes.

Ore mineralogy is characterized by pyrite, chalcopyrite, arsenopyrite, galena, sphalerite, native gold, Au-tellurides, and electrum. Native gold occurs disseminated throughout the veins as micro to sub-micron inclusions in pyrite, and electrum occurs in pyrite as cavity and fracture fill. The LA-ICP-MS analyses show that pyrite has complex internal zonation and are host to precious metals (Au, Ag), base metals (Co, Ni, Cu), and metalloids (As, Sb) as lattice-bound impurities and sub-micron inclusions. San Juan de Chorunga pyrite has $\delta^{34}S$ values ranging from 0.4 to 1.4 ‰, and Mollehuaca pyrite $\delta^{34}S$ values range from 5.8 to 7.4 ‰, representing a magmatic-hydrothermal sulfur. Fluid inclusion petrography of these veins show recrystallized quartz with implosion and explosion fluid inclusion textures, indicative of pressure variations during quartz vein formation. Our observations suggest that the majority of the gold in these veins formed in association with a shallower hydrothermal event, potentially in association with the emplacement of shallow intrusions in the Late Cretaceous.