

Scoping Cu-Au Fertility in the Volcanic Rocks: A Case Study for Castrovirreyna Mining District in Central Peru

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The Castrovirreyna Mining District (CMD) is in the south-central Andes of Peru, within the Peruvian flat-slab segment. It hosts numerous ore deposits, predominantly epithermal systems.

A total of 41 volcanic rock samples of coherent lithofacies, compiled from publicly available datasets, were reviewed. These samples represent stratigraphically constrained volcanic sequences grouped into formations. The rocks are predominantly calc-alkaline, ranging in composition from basaltic andesite to rhyolite.

The studied units include the Tantara, Sacsaquero, Castrovirreyna, and Caudalosa Formations, as well as the Huachocolpa Group (Apacheta and Astobamba Formations), listed from oldest to youngest. The younger units (Castrovirreyna, Caudalosa, Apacheta, and Astobamba), dated from the Early Miocene to the Pliocene—a period associated with cessation of arc volcanism due to flat-slab subduction—host the majority of known mineral deposits. In contrast, the older units (Tantara and Sacsaquero), of Eocene to Oligocene age, do not contain significant mineral deposits directly related to these formations, except for superimposed mineralization.

Trace element spider diagrams and REE patterns display a strong subduction-related signature, characterized by enrichment in fluid-mobile elements (Cs, Rb, Ba, Th, U) and negative Nb–Ta anomalies. REE patterns indicate amphibole-dominated fractionation with a local transition to garnet stability, as suggested by HREE depletion, and plagioclase fractionation reflected by negative Eu anomalies in selected samples.

Magmatic fertility proxies (Sr/Y, La/Yb, and V/Sc), commonly used in porphyry exploration, were applied to evaluate Cu–Au fertility in cogenetic volcanic rocks (e.g., Bensen, 2021). The results indicate weak and spatially restricted fertility signals in the Caudalosa and Castrovirreyna Formations, as well as in the Huachocolpa Group (Apacheta and Astobamba). In contrast, samples from the Tantara and Sacsaquero Formations show no evidence of fertile signatures based on these ratios, consistent with the limited occurrence of mineral deposits known within these units.