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Magmatic Processes and Gold Fertility in the El Indio Belt, Central Andes

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High-sulfidation deposits are major global sources of gold (Au), typically linked to porphyry intrusions that supply metals to shallow epithermal systems. The El Indio Belt (EIB) in the Chilean Andes contains several important districts and is associated with Miocene magmatism, though the processes that generated metal-rich (fertile) magmas are not fully understood.

This study integrates whole-rock geochemistry and zircon petrochronology to reconstruct the magmatic evolution of the region and assess its potential for mineralization. The results identify multiple stages of magmatic activity, each characterized by distinct chemical signatures, oxidation states, and thermal conditions. Earlier stages reflect relatively oxidized magmas with higher fertility indicators, while intermediate phases show less favorable characteristics. A later stage includes both pre-mineralization magmatism and a subsequent phase closely associated with ore formation, distinguished by more oxidized conditions and geochemical features linked to metal enrichment.

The findings suggest that the magmatic evolution of the El Indio Belt was strongly influenced by regional tectonic processes, particularly subduction dynamics and a flat-slab regime. These conditions likely facilitated interaction between mantle sources and evolving magmas, promoting the formation of gold-rich systems. Overall, the study highlights the importance of geodynamic controls on magmatic fertility and provides a framework for mineral gold exploration in the Andes.