

Insights Into the Petrogenesis of the Taca Taca Bajo Cu-Mo Porphyry Deposit (Argentina) and Its Significance Within the Andean Retro-Arc

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The magmatic processes that lead to porphyry Cu deposit formation in continental retro-arc settings remain poorly understood, creating uncertainty in exploration within these regions. New case studies are therefore essential for improving targeting success, particularly as copper is considered a critical resource. The Taca Taca Bajo Cu-Mo-Au deposit (11.7 Mt contained Cu), located in the retro-arc of the Central Andes, offers valuable insights as a well-mineralized retro-arc expression of the middle Eocene to early Oligocene metallogenic belt.

Mineralization is spatially and temporally correlated with a series of north to northwest-trending rhyodacitic porphyry dikes, from which six characteristic samples were analyzed for whole-rock geochemistry and zircon petrochronology (U-Pb, O, and Lu-Hf isotopes as well as trace elements). The crystallization ages of these Oligocene rhyodacitic porphyry intrusions range from 30.3 ± 0.5 Ma to 29.1 ± 0.3 Ma (zircon U-Pb SHRIMP). Based on zircon isotopic signatures, the source of the rhyodacitic porphyry dikes is interpreted to be a mantle-derived arc magma ($\epsilon_{\text{Hf}} = +5.3 \pm 2.4$ to $+7.6 \pm 0.7$; $\delta^{18}\text{O} = 5.6 \pm 0.5$ to $5.8 \pm 0.2\text{‰}$ [2 SD]), which interacted with older, predominantly Permian crustal material (270-250 Ma, i.e., Choiyoi arc magmatism) in the lower- to mid-crust.

Zircon trace element geochemistry data indicates that the Oligocene Taca Taca intrusions are moderately hydrous (mean $\text{Eu}/\text{Eu}^* = 0.25$ to 0.34) and oxidized (mean $\Delta\text{FMQ} = +0.2$ to $+1.0$), but less than other Cu porphyry deposits within the same middle Eocene to early Oligocene metallogenic belt (e.g., Escondida, Chuquicamata, El Salvador). It is suggested that the Taca Taca Bajo deposit may have failed to reach the supergiant-scale (>24 Mt) potentially due to the isolated, relatively small volume of magma and shorter duration of magmatism (1–1.5 Myr). This is attributed to its position in the retro-arc with thinner crust and less intense compression.