

Amphibole Chemistry and Titanite Petrochronology of Ore-related Porphyries and Barren Intrusions in Sonora, Mexico

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This study investigates ore-related porphyry stocks and barren intrusions in the porphyry copper belt of Sonora, northwestern Mexico. Particularly, we focused on the Cuitaca, Cerro Verde, Lucy, Luz del Cobre, and Suaqui Verde districts. A set of 6 representative samples of porphyries and barren intrusions was selected to evaluate the timing of formation, pressure–temperature conditions of emplacement, and geochemical signatures.

Mineral compositions include amphibole (tremolite, hornblende, and tschermakite), andesine to oligoclase plagioclase, Mg-rich biotite commonly intergrowing with amphibole. Titanite and magnetite occur as accessory phases.

Preliminary amphibole thermobarometry indicates pressures of ~0.1–0.3 GPa, corresponding to emplacement depths of ~3–7 km within the upper crust and temperatures of ~600–750 °C. These pressure-temperature estimates are consistent with shallow emplacement levels typical of porphyry-related magmatic systems. Amphibole compositions record magmatic H₂O contents of ~4–7 wt% and redox conditions (ΔNNO) from 0.2 to 1.5, consistent with oxidized and hydrous arc magmas capable of transporting metals.

Our preliminary U–Pb titanite petrochronology indicates a bimodal distribution: a set of samples yield ages ranging from c. 62–74 Ma, whereas another set yields older ages of c. 96–107 Ma. These ages will be further linked to specific magmatic geochemical characteristics using trace-element signatures recorded in titanite.

This study provides new constraints on the timing and thermobarometric conditions of barren and ore-related intrusions in porphyry copper localities of Sonora. Our results contribute to enhancing our understanding of magma evolution and fertility in subduction-related arcs and highlight the potential of accessory minerals, particularly titanite and magnetite as proxies of ore-forming magmas.