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## New Constraints on Petrogenesis of the Bajo de la Alumbrera Cu-Au Porphyry System and Other Porphyries of the Farallon Negro Volcanic District (NW Argentina)

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The Farallon Negro Volcanic District is a well-endowed area in the Sierras Pampeanas of Argentina. It includes key Cu-Au porphyry and low-sulfidation epithermal deposits including Bajo de la Alumbrera, Agua Rica, and Farallon Negro. This study investigates the petrogenesis of the Bajo de la Alumbrera porphyry Cu-Au deposit as well as mineralised and unmineralised satellite porphyry stocks including El Durazno, San Lucas, and Las Pampitas. The aim is to understand the petrogenesis of the porphyry systems of the Farallon Negro Volcanic District, using whole-rock geochemistry (TE, REE) and zircon isotope analyses (U-Pb, $\delta^{18}O$, Lu-Hf, TE). Ten least altered porphyry samples were analysed: four from Bajo de la Alumbrera, three from Las Pampitas, two from San Lucas, and one from El Durazno.

The samples were dated by SHIRMP U-Pb analysis. The El Durazno porphyry was emplaced at 8.0 ± 0.3 Ma, making it the oldest intrusion. The Las Pampitas intrusions were emplaced between 7.3 ± 0.1 and 7.03 ± 0.2 Ma, and the San Lucas porphyries are a similar age at 7.3 ± 0.2 and 7.2 ± 0.2 Ma. The Bajo de la Alumbrera porphyries are the youngest, forming from 6.9 ± 0.2 to 6.7 ± 0.2 Ma. All intrusions show a similar whole-rock TE and REE pattern, with an enrichment in LILEs relative to HFSEs. There is overall enrichment in REEs, a flattening of the slope in LREEs, and a trough in MREEs, suggesting amphibole fractionation. The Eu/Eu° ratio is between 0.80 and 0.92, indicating no plagioclase fractionation in the source melt. The El Durazno zircons exhibit a mantle-like $\delta^{18}O$ and Lu-Hf signature ($\delta^{18}O$ = 5.7±0.1‰; εHf = -0.5 ± 0.4), whereas Bajo de la Alumbrera, Las Pampitas, and San Lucas have a supracrustal signature ($\delta^{18}O$ >6.5‰, εHf <-2), suggesting assimilation of crustal material. Because of cohesive isotopic values and lack of inheritance and zircon cores, it is likely that assimilation of crustal material did not occur during emplacement or magma fractionation and instead was incorporated into the source melt. It can be inferred that the Bajo de la Alumbrera, Las Pampitas, and San Lucas intrusions are cogenetic. Zircon Ce/Ce* ratios reveal an oxidised source; however, there is no difference in zircon trace element signatures between fertile and infertile intrusions with respect to Cu-Au fertility.

Based on these data and other studies, a petrogenetic model has been proposed for the formation of the porphyry stocks in the Farallon Negro Volcanic District. From 9.5 to 8.0 Ma there is mantle-derived, extrusive magmatism and the emplacement of the El Durazno porphyry. From 7.5 to 6.0 Ma a magma chamber develops, and magmatism is intrusive. This period encompasses the emplacement of the Las Pampitas, Bajo de la Alumbrera, and San Lucas porphyries, as well as Cu-Au mineralisation of the Bajo de la Alumbrera porphyry. The magma source also changes from mantle-derived to a mix of mantle-derived and crustal. Understanding the petrogenesis and changing source compositions of these porphyry stocks is key to unravelling the components necessary for Cu-Au mineralisation in porphyry deposits.