Xenoliths and Cumulates: Insights into the Petrological, Geochemical, and Geochronological Stratigraphy of the Central Andean Arc Crust

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To advance our understanding of the architecture of continental arc magmatic plumbing systems, constraints on the nature of these systems' components are needed. The Andes of South America represent the type-example of a modern-day continental arc system, characterized by several volcanically active zones. Of particular note are the Central Andes where the second-highest plateau on Earth can be found, the Bolivian Altiplano, which sits atop c. 80 km of continental crust. Pampa Aullagas and Quillacas, the focus of this study, exist as part of a series of Pleistocene-aged monogenetic centers found scattered across the Altiplano. Here, the nature of the sub-arc crust is revealed through a suite of petrologically diverse crustal xenoliths and rarer hornblendite cumulates (unique to Quillacas) hosted in andesitic-dacitic lava.

In this study, we present new bulk geochemical data (majors, traces, Sr-Nd-Pb isotopes) and in-situ analyses of mineral phases for both the xenolith (apatite, zircon) and hornblendite (amphibole, apatite) suites. Two igneous xenoliths were selected for initial study. Apatites are LREE enriched and HREE depleted but distinct between samples (La_N/Sm_N at 0.36-2.6 vs. 1.77-2.71, Gd_N/Lu_N 3.95-16.18 vs. 2.78-9.57) with Eu anomalies of 0.23-0.39 and 0.57-0.77, respectively. In-situ zircon U-Pb dating reveals Neogene ages, significantly younger than previously dated Devonian-Paleoproterozoic metamorphic xenoliths from the same suite (McLeod et al., 2013, GSAB). Future work includes U-Pb-Hf zircon analyses via split-stream LA-MC-ICP-MS.

The hornblendites are compositionally homogeneous (basaltic at <45wt. % SiO_2 ; <4.5wt. % Na_2O+K_2O) with SEM-EDS imaging revealing oxy-exsolution of ilmenite from titanomagnetite. In-situ apatite analyses display LREE enrichment (La_N/Sm_N : 3.4-6.4) and HREE depletion (Gd_N/Lu_N : 40.1-55.8) with Eu anomalies of 0.51-0.85. Amphiboles exhibit usual MREE enrichment with La_N/Sm_N <1 and Eu anomalies of 0.75-0.90. Bulk isotopic work for the hornblendites returns non-radiogenic $^{87}Sr/^{86}Sr$ signatures at 0.707291-0.707314 and corresponding $^{143}Nd/^{144}Nd$ at 0.512271-0.512316. Collectively, the hornblendites and xenoliths yield new insights into the nature of magmatic systems within the continental basement of the modern-day Central Andean Cordillera.

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