Abstract

The eruptive products of continental arc volcanoes have the potential to provide wide ranging insights into the processes governing storage, differentiation, and final eruption (or emplacement) of magmas in multi-component magmatic systems. This is certainly the case in the back-arc region of the Central Andes, specifically at the monogenetic center of Quillacas on the Bolivian Altiplano where c. 1.4 Ma andesites are not only hosts to igneous and metamorphic crustal xenoliths, but also rarer cumulate hornblendite enclaves (the focus of this study).

The fractionation, and important role, of amphibole in arc magmatic systems is well documented yet it is generally absent as a prevalent phenocrystic phase in erupted, differentiated lavas. Textural study of sampled enclaves in this work classifies them as mesocumulates. MicroXRF mapping and hyperspectral imaging via SEM-EDS clearly reveals their porphyritic textures with cumulus hornblende (90-95%) and intercumulus albitic plagioclase. Compositionally all analyzed enclaves (n=7) are similar (basaltic at <45wt. % SiO₂; <4.5wt. % Na₂O+K₂O), display moderate LREE depletion (La₅/Sm₅: 0.9-1.1) and minor HREE enrichment (Dy₅/Lu₅: 1.9-2.2) with preliminary isotopic work returning non-radiogenic ⁸⁷Sr/⁸⁶Sr signatures at 0.707314 and corresponding ¹⁴₃Nd/¹⁴⁴Nd at 0.512316 (n=1). In-situ analyses of accessory apatite (n=125) record LREE enrichment (La₅/Sm₅: 1.9-4.0) and HREE depletion (Gd₅/Lu₅: 4.4-6.9) with Eu anomalies ranging from 0.51-0.85, consistent with plagioclase fractionation.

The presence of hornblendite mesocumulates at the Quillacas Bolivian monogenetic center thus validates the extensive fractionation of amphibole in arc settings that is otherwise rarely recorded by the erupted lavas. The relative absence of this phase in volcanic products can be attributed to the increased viscosity of ascending magmas provoking stagnation within the mid-crust and preventing eruption. The nature of the hornblendite, plagioclase feldspar, apatite-bearing cumulates can ultimately help us advance our understanding of the inner workings of magmatic plumbing systems and the processes driving magmatic evolution at continental arcs.

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