Board 0134: Crystal Mush Storage Constraints for the Puyehue-Cordon Caulle Volcanic Complex

Wednesday, 15 December 2021

16:00 - 18:00

Convention Center - Poster Hall, D-F (First)

Abstract

Puyehue-Cordon Caulle (PCC) is an active volcanic complex located in the SVZ of the Andes that has had three major historic rhyodacitic eruptions with the most recent event in 2011-12. We provide petrologic and geochemical evidence that PCC is underlain by a crystal mush using recently identified basaltic mafic enclaves that highlights the involvement of distinct mafic magma components during the 2011-12 eruption. We suggest the mafic enclaves represent remnants of the crystal-rich mush that get entrained during eruption of the crystal-poor rhyodacite melt lens cap. This architecture requires the basaltic mush to produce rhyodacite through efficient fractionation. The dominant population of enclaves are equigranular, crystal-rich (45-55%), vesiculated (10-20%), and display interlocking grains between phases. Vesicles have complex shapes filling the irregular interlocking textures, while phenocrysts show stepwise normal zoning (uniform plagioclase cores, ~An90, overgrown with weakly zoned rims, ~An60). A second porphyritic population may represent mafic recharge into the system that bypasses the mush unperturbed. The porphyritic enclaves have spherical vesicles and tightly bound primitive mineral compositions (Fo80-86 vs Fo70-86 in the equigranular enclaves).

Published geothermobarometry from the 2011-12 rhyodacite suggests shallow magma storage (5-7 km, 100-140 MPa, 895°C), which we compare against newly determined mineral-mineral trace-element partitioning based thermometry. Our thermometry indicates the equigranular enclaves were stored at ~900-1000°C at the time of eruption suggesting both a compositionally and thermally zoned magma system. We combine this temperature information with trace element data and mass balance calculations from various minerals phases and melt to substantiate our previous hypothesis that the basaltic enclaves can produce rhyodacite given their crystallinity. These estimates may support a spatially connected basaltic crystal-mush underlying a rhyodacite melt lens cap further proving highly efficient rhyolite formation at PCC. PCC's enclaves present one of the largest compositional gaps on record globally. We compare them to other enclave-bearing systems and how PCC is an important end-member to understand enclaves as well as rhyolite formation.

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