

V23D-0252 - Post-Eruptive Re-inflation of Cordón Caulle, Chile, by Melt Extraction from a Crystalline Mush



Tuesday, 10 December 2019



13:40 - 18:00



Moscone South - Poster Hall

Abstract

Cordón Caulle, part of the voluminous Puyehue-Cordón Caulle Volcanic Complex in the Southern Andes, erupted from June 2011 to March 2012. Eruptive activity ranged from sub Plinian (VEI 4) to effusive. Magmas were crystal-poor rhyolite, inferred to have been stored at 50-100 MPa pressure under near-liquidus conditions. InSAR monitoring shows uplift immediately following the eruption, initially at high rates of approximately 45 cm/yr and diminishing exponentially to 6 cm/yr at present.

It is suggested that bodies of crystal-poor rhyolite, as erupted at Cordón Caulle, accumulate above crystalline magma mushes by residual melt extraction. The presence of crystal-rich mafic enclaves with a rhyolitic interstitial glassy matrix is consistent with the 2011/12 Cordón Caulle magma having erupted from such a crystal-poor magma layer, with enclaves entrained during eruptive magma withdrawal from an underlying crystalline magma mush. We show how the post-eruptive uplift at Cordón Caulle can be explained by replenishment of the crystal-poor magma lens due to poroelastic melt extraction from the underlying crystalline mush.

We assume that during the 2011/12 eruption magma withdrawal from the crystal-poor rhyolite resulted in a decrease in pressure of this layer and, hence, deflationary subsidence. Assuming a contiguous reservoir system comprised by the crystalline mush and overlying crystal-poor rhyolite, the reduced pressure at the boundary between mush and overlying rhyolite drives melt flow from within the mush to the rhyolite. If the mush has sufficiently high crystal content, the melt flow will be governed by Darcy's law, whereas the response of the crystalline matrix will be poroelastic. We present the conditions, defined by reservoir system geometry, as well as permeability, porosity, and Biot coefficient of the crystalline mush, for which the redistribution of melt from the mush into the overlying crystal-poor layer will occur on similar time scales as the observed post-eruptive re-inflation and with a net increase in volume of the reservoir system.

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