Board 0338: Connecting Magma Chamber Mush Dynamics to Post Eruptive Reinflation at Cordón Caulle

Tuesday, 14 December 2021

16:00 - 18:00

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

Abstract

Volcano inflation, for durations of months to years immediately following an eruption, has been observed at a number of volcanoes, including the 2011/12 eruption of Cordón Caulle, Chile. Such reinflation is often explained by replenishment of the magma reservoir from a deeper source. Whether and why that is the case remains uncertain in most instances, but the implications for renewed eruptive potential may be profound. Here, we posit redistribution of melt within a zoned magma reservoir consisting of a crystal rich mush overlain by an eruptible layer of crystal poor rhyolite as an alternate mechanism for reinflation. Such a zoned magma body is consistent with conceptual models for how crystal poor rhyolites form and with the presence of mafic enclaves within the Cordón Caulle rhyolite. The enclaves can be interpreted as pieces of mush entrained into the overlying rhyolite during its withdrawal from the reservoir. We test the hypothesis that melt from the inter-crystalline pores of the mush can redistribute by porous flow into the overlying crystal poor rhyolite, causing inflation after an eruption. We simulate the flow of melt within the zoned reservoir during and after eruption with a numerical model. As crystal poor rhyolite is erupted, magma pressure within the rhyolite layer above the mush decreases. Consequently, interstitial melt flows upward within the mush, toward the reduced pressure at the interface of mush and crystal poor rhyolite. The mush is treated as a poroelastic material, with interstitial melt flow governed by Darcy's law. Thus, the change in pressure caused by withdrawal from the overlying rhyolite diffuses downward into the mush as the interstitial melt flows upward. The change in pore pressure results in an elastic deformation of the mush matrix. Because pore pressure diffusivity is small, melt redistribution can persist for years after eruptive activity ends, leading to slow inflation compared to fast eruptive deflation. We predict a partial recovery of volume lost from the eruption. Reinflation occurs because the expansion of decompressing melt flowing from the mush into the crystal poor rhyolite exceeds compression of the poroelastic mush. For cases where the interstitial melt is moderately compressible due to exsolved volatiles, our model reproduces the deformation observed at Cordón Caulle.

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