

V23E-0237 - Simultaneous ash venting and effusive magma extrusion modulated by fracture outgassing at the 2011-2012 Cordón Caulle eruption, Chile



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Moscone South - Poster Hall

Swirl Topics

Earth Processes - SWIRL

Abstract

The processes that produce and sustain months of persistent effusive lava dome and/or flow eruptions with simultaneous ash venting are not well understood. Deciphering and quantifying these processes is crucial for improved monitoring of eruptions, interpreting historic eruptive deposits, and understanding effusive outgassing mechanisms that play a major role in controlling eruption explosivity. Recent eruptions at Chaitén (2008-2009) and Cordón Caulle (2011-2012) have provided us with the first direct observations of simultaneous ash venting and effusive extrusion of rhyolitic lava. Among historic silicic eruptions, these eruptions are uniquely similar in their fast effusive rate (40-65 m³/s), low phenocryst content (<5 volume %), and high silica content (70-76 wt.% SiO₂). We combine petrologic analyses of erupted products (lavas, tuffsite veins, melt inclusions) with video analysis of ash venting during the 2011-2012 Cordón Caulle eruption to inform a magma ascent model that accounts for permeable gas flow and fracturing. We then explore constraints on fracturing and ash venting mechanics. Preliminary video analysis finds ash venting velocities that range from 10 m/s to 30 m/s and a periodicity of ~30s in plume brightness (a proxy for ash content). Field observations and petrologic analyses are used to constrain magmatic conditions, such as viscosity, porosity, volatile exsolution during ascent, and ash generation depth. These inform the geometry, spatial and size distribution of the fractures, as well as their lifespans. We use these constraints to develop a steady 1D two phase conduit flow model with parameterizations for permeable bubble network development, fracture formation, and gas flow into/through fractures. Within this model, we explore the fracture depth, width, and spacing necessary to explain observations at Cordón Caulle, and more broadly the role that outgassing through permeable cap and walls play to hinder large explosions.

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