Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.10562

Magma-mush dynamics control paroxysmal eruptions at basaltic volcanoes: the summer 2019 eruptions at Stromboli volcano (Italy).

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During the summer 2019 one major explosion and two paroxysmal eruptions, at an unexpected short time interval of 64 days, interrupted the normal Strombolian activity at Stromboli volcano (Southern Italy). Two types of tephra were erupted during the paroxysms: 1) a degassed highly porphyritic (*hp*) magma, typically erupted during the normal Strombolian activity and the major explosions; 2) a more mafic, hotter, volatile-rich magma with low phenocryst content (*lp*) erupted only during the paroxysm.

We decode the complex zoning patterns of clinopyroxene and integrate the results with thermobarometric and elemental diffusion modelling to shed light on the roles of magma recharge and mush evolution and their effects on the eruption pattern at Stromboli, a prime example of persistently active, open-conduit basaltic volcano. Our data indicates a significant role played by the deeper magmatic system as triggering mechanism of both 2019 paroxysmal events, with at least two distinct batches of the deeper undegassed *lp*-magma recharge arriving in the shallow *hp*-reservoir until a few days before the onset of the two paroxysmal events. A more direct and efficient link between the two reservoirs, which also favors a convective regime, is established as consequence of a rejuvenated Stromboli plumbing system where the pre-existing well-developed crystal mush has been efficiently destroyed in just over ~15 years. We suggest that the progressive erosion of the crystal-rich horizon produced mush-free magma pathways responsible for the current increased frequency of the explosive activity, as confirmed by the remarkable agreement between our calculated timescales of mafic recharge events and monitoring signals. The presence of mush-free magma pathways facilitates an interrupted and faster ascent of the deeper undegassed *lp*-magma into the shallow *hp*-reservoir, by triggering an almost immediate response (i.e., eruption) to mafic recharge.

Our approach provides vital insights into magma dynamics and their effects on monitoring signals, and demonstrates the key role of magma-mush dynamics in controlling eruption style and magnitude at persistently active basaltic volcanoes. Information gathered from high frequency petrological monitoring tools can help discriminating a gas-driven from a magma-driven eruption trigger.