

EGU23-6218, updated on 13 Mar 2023

<https://doi.org/10.5194/egusphere-egu23-6218>

EGU General Assembly 2023

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Evolution of Stromboli basaltic plumbing system via magma recharges and mush rejuvenation.

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Basaltic volcanoes can remain active for tens to thousands of years with the continual presence of magma, requiring storage and transport conditions that can sustain persistently eruptible melt. Magma storage conditions beneath these volcanoes may significantly change with time, leading to sudden and dramatic changes in explosivity. Determining the rates and causes of these changes and how they modulate eruptive style over societally relevant timescales is of paramount importance for evaluating potential hazards. In June-August 2019, one major explosion and two paroxysms occurred at Stromboli volcano (Southern Italy) within only 64 days offering a unique opportunity to study the short-term variations in a basaltic plumbing system that can lead to paroxysmal events.

Stromboli is an active open conduit basaltic volcano well-known for its persistent mild (normal) Strombolian activity occasionally interrupted by sudden, short-lived events ranging in size and intensity from major (violent Strombolian) to paroxysmal explosions. Strombolian activity, effusive eruptions and major explosions, all involve a degassed, highly porphyritic (*hp*) magma from a shallow reservoir. Deep-seated more mafic and, volatile-rich low-porphyritic (*lp*) magma is erupted, alongside *hp*-magma, during paroxysms, and in smaller quantities during some of the major explosions. Both *lp*- and *hp*-magmas were erupted during the 3 July and 28 August 2019 paroxysms, whereas only *hp*-magma was erupted during the major explosion on 25 June 2019.

Via a multifaceted approach using clinopyroxene from the summer 2019 paroxysms, we reveal a key role for batches of volatile-rich *lp*-magma recharge arriving in the shallow reservoir up to a few

days before these events. Our data indicate a rejuvenated Stromboli plumbing system where the extant crystal mush is efficiently permeated by recharge *lp*-magma with minimum remobilisation promoting a direct linkage between the deeper (*lp*) and shallow (*hp*) reservoirs. This sustains the current variability of eruptive styles with near immediate eruptive response to mafic magma recharge. The remarkable agreement between our calculated recharge timescales and the observed variation in time of various monitoring signals strongly supports such a model.

Our approach provides vital insights into magma dynamics and their effects on monitoring signals demonstrating that detailed petrological studies integrated with volcano monitoring signals are fundamental for a fast response during a volcanic unrest phase or crisis.

This work has been published in *Nature Communication*: Petrone, C.M., Mollo, S., Gertisser, R. *et al.* Magma recharge and mush rejuvenation drive paroxysmal activity at Stromboli volcano. *Nat Commun* **13**, 7717 (2022). <https://doi.org/10.1038/s41467-022-35405-z>.