**HIGH-RESOLUTION COMPOSITIONAL MAPPING REVEALS DEGASSING DYNAMICS DURING MAJOR EXPLOSIONS AT STROMBOLI**

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Major explosions at Stromboli volcano encompass a wide range of medium to high intensity eruptions. Since the paroxysmal explosions in the summer 2019, these events have occurred with a frequency of about six per year, therefore posing significant hazard on the island, in particular on the upper flanks of the volcano. Nevertheless, their intermediate nature between ordinary and paroxysmal activities make them more elusive to pinpoint in terms of eruptive dynamics and associated precursors.

To better understand the mechanisms that trigger and accompany the evolution of the major explosions at Stromboli, we have linked texture and composition of erupted products to numerical modeling of gas-magma transfer in the upper part of the plumbing system.

High-resolution compositional mappings of residual melts were performed, by means of FEG-EMPA, on Stromboli lapilli and ash emitted during different explosive events, ranging from ordinary activity (11 April and 29 June 2022) to major explosion (13 May 2022) to paroxysms (3 July and 28 August 2019). Areas selected for FEG-EMPA mapping were preventively identified on BSE-SEM images, and in particular we focused our attention on the glasses close to vesicles. Basing on textural evidences, we mapped the zones were a clear compositional contrast was present, highlighted by different gray tones in BSE-SEM images. The occurrence of mingling textures between the two magmas emitted at Stromboli, LP (low-porphyritic) and HP (high porphyritic) respectively, were present only in the products from paroxysms. The lapilli from the major explosion contains many white filaments, 1-10 microns-thick, close to bubbles, showing irregular and fluidal shapes; ash and lapilli from ordinary activity have a quite homogeneous groundmass glass. Preliminary results suggest complex bubble-melt interaction dynamics during major explosions, evidenced by major elements patterns dictated by well-preserved trails of Cl and K in the elemental maps along the white filaments, that aren't found in products from ordinary and paroxysmal activities. These textures have been interpreted as bubble-driven mingling between LP/evolved LP and HP melts induced by partial gas-melt decoupling. Bubble rise enhances mingling between melts of different composition, and later the resulting filaments are stretched and deformed during fluid motion.

In order to better understand the measured and observational data, we used bubble growth and dynamics models to identify the decoupling time scales and physical parameter (viscosity, volatile contents) ranges leading to the observed distributions characterizing intermediate-intensity eruptions. The diffusion timescale can be estimated as the ratio between the square of the filament thickness (L) and the diffusion coeﬀicient (D). Basing on chlorine signature, and assuming a temperature range: 1200 °C ≤ T ≤ 1500 °C, a dissolved water content up to 3 wt.%, and a diffusion coefficient of Cl of 10-11 ≤ D ≤ 10-10 (Alletti et al., 2007), for a filament with L=10 µm, the diffusion timescale is 1 s ≤τ ≤ 10 s. Considering a reasonable bubble ascent rate in the shallow plumbing system of 1-10 m/s, the resulting depth where the filament was formed is ≤ 1 km. Thus, the filaments were generated at shallow depth by gas-melt decoupling. This is also consistent with the depletion in Cl (solubility of Cl rapidly decreases at low pressure). Normal activity is characterized by slower timescales; thus these textures are mostly obliterated by diffusion. The fast ascent of LP magma during paroxysms doesn’t allow widespread gas-melt decoupling.

The above described textures have been identified also in products of other volcanoes with similar composition, such as in lava fountains from Etna (personal communication) and in the recent Cumbre Vieja 2021 eruption, La Palma (Gonzalez-Garcia et al., 2023). Similarly to what proposed by Gonzalez-Garcia et al., (2023), we conclude that the very short lifetime of these filaments, together with their abundance, suggests a possible trigger mechanism for the major explosions at Stromboli, related to the arrival of many, isolated, small batches of gas-rich magma from depth and degassing at shallow level, inducing a pressurization of the shallow reservoir.