

Timescales of mafic recharge events during the February-March 2021 lava fountains events of Mt. Etna South-East crater: a multi mineral approach.

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Mt. Etna is the most active volcano in Europe with four active vents in the summit area. The South-East Crater (SEC) is the most active crater of the last 20 years and is characterised by episodic eruptions, i.e. sequences of paroxysmal lava fountains with rather variable frequency and duration from a few weeks to months. Between December 2020 and February 2022, the SEC produced over 60 paroxysmal events divided into a first phase (December 2020 – April 2021) and a second phase (May 2021 - February 2022). Here we focus on a time series of six paroxysms from the first phase (February 16 to March 10, 2021). Frequency of magma recharge episodes and eruption triggering mechanisms are investigated via textural and chemical characteristics of the clinopyroxene and plagioclase population.

Clinopyroxenes show frequent sector zoning superimposed on complex concentric zoning. Plagioclases show two texturally distinct populations: Group 1 characterised by pervasive fine oscillatory banding, and Group 2 showing simpler large amplitude zoning. Two compositional domains characterise both mineral phases: 1) augitic clinopyroxene (Mg# 68-75) and labradoritic plagioclase (An₅₇₋₇₅) are the most frequent compositions; 2) diopsidic clinopyroxene (Mg# 74-80) and bytownitic plagioclase (An_{>75}) are mainly found in cores and intermediate portions and less abundant in rims. Chemical and textural characteristics indicate complex magma dynamics with mafic recharges from the intermediate to the shallow storage zone. Mineral-liquid equilibria indicate that the mafic recharge is characterised by Mg#_{cpx} > 76, Cr_{cpx} > 300 ppm and An_{plg} > 75.

Timescales of mafic recharge are calculated from diffusion modelling of Fe-Mg in clinopyroxenes and Mg in plagioclase. Clinopyroxene timescales indicate that mafic recharge started in June-July 2020 and continued until February 2021 with an increased intensity from December 2020. Similarly, Mg-in-plagioclase indicates occurrence of mafic recharge in the two months preceding the February 16 eruption. The correspondence between the timeline of mafic recharge recorded by both clinopyroxene and plagioclase suggests a causal link between magma replenishment at shallow depth and paroxysmal events enhancing our understanding of complex magma dynamics at open-conduit basaltic volcanoes.