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# Rheological control on the dynamics of explosive activity in the 2000 summit eruption of Mt. Etna

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In the period from January to June 2000 Mt Etna exhibited an exceptional explosive activity characterized by a succession of 64 Strombolian and fire-fountaining episodes from the summit South-East crater. Textural analysis of the eruptive products reveals that the magma associated with the Strombolian phases had a much larger crystal content > 55 vol% with respect to the magma discharged during the fire-fountain phases ($\sim$35 vol%). Rheological modelling shows that the crystal-rich magma falls in a region beyond a critical crystal content where small addition of solid particles causes an exponential increase of the effective magma viscosity. When implemented into the modelling of steady magma ascent dynamics, the large crystal content of the Strombolian eruption phases results in a one order of magnitude decrease of mass flow-rate, and in the onset of conditions where small heterogeneities in the solid fraction carried by the magma translate into highly unsteady eruption dynamics. We argue therefore that crystallization on top of the magmatic column during the intermediate phases when magma was not discharged caused the conditions to shift from fire-fountain to Strombolian activity. The numerical simulations also provide a consistent interpretation of the association between fire-fountain activity and emergence of lava flows from the crater flanks.