EGU21-15199
https://doi.org/10.5194/egusphere-egu21-15199
EGU General Assembly 2021

Chemical-physical constraints of the 2015 eruptive activity of Mt. Etna: new insights from thermo-barometry and geochemistry of olivine-hosted melt inclusions

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The concomitant activation off all four summit craters of Mt. Etna during the December 2015 eruptive event allow us to investigate the chemical-physical crystallization conditions and magma dynamics in the shallower portion of the open-conduit feeding system. In this study, we discuss new petrological, geochemical and thermo-barometric data as well as the composition of major element and volatile content (H_2O, CO_2, F, Cl and S) of olivine-hosted melt inclusions from the explosive and effusive products emitted during the December 2015 eruptive event.

Results and rhyolite-MELTS thermodynamic modelling of mineral phase stability highlight the relatively shallow crystal equilibrium depth prior to the eruption ranging from 400-500 MPa for Central Crater and North East Crater, up to 200 MPa below the New South East Crater. The study of high-pressure and high-temperature homogenized olivine-hosted melt inclusions allowed us to identify the composition of the almost primary alkali-basalt magma (11.8 wt% MgO) containing up to 4.9 wt% and 8151 ppm of H_2O and CO_2 respectively. The results, together with those already reported for the previous paroxystic events of the 2011-2012 (Giacomoni et al., 2018), reinforce the model of a vertically extended feeding system and highlight that the activity at the New South East Crater was fed by a magma residing at significant shallower depth with respect to Central Craters and North East Crater, although all conduits are fed by a common deep (P = 530-440 MPa) basic magmatic refilling. Plagioclase stability model and dissolution and resorption textures confirm its dependence on H_2O content, thus suggesting that further studies on the effect that flushing from fluids with different H_2O/CO_2 ratio are needed in order to understand the eruption triggering mechanisms of paroxystic fountaining.

References

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