Eruption run-up at Mt. Etna volcano fixed with volatile diffusion in olivine-hosted melt tubes

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Diffusion chronometry of volatile species along olivine-hosted embayments revealed to be a good method to fix magma ascent rates at various volcanic systems worldwide. The measured compositional gradients of volatile elements are produced by diffusion processes developing from the inner part of the embayment toward the outer melt as a response of degassing-induced decompression. However, an essential condition for the application of diffusion modelling is the quantification of volatile species dissolved in olivine-hosted melt inclusions, which provide the original magma volatile contents and the initial pressure before decompression.

In this contribution we present preliminary results on olivine-hosted melt inclusions and embayments found in tephra erupted during three variably energetic eruptive episodes selected from the post-2011 activity at Mt. Etna volcano, namely: 1) February 19, 2013; 2) December 3, 2015; 3) December 24, 2018. FT-IR and micro-Raman spectroscopy have been used for the quantification of H_2O and CO_2 contents, whereas major elements, S, Cl and F contents in melt inclusions have been determined through electron microprobe. Our data highlight lower volatile budgets for the post-2011 activity with respect to the H_2O-CO_2-rich magmas emitted during the 2001 and 2002-2003 eruptions at Mt. Etna. Water contents across the olivine-hosted melt embayments are, on average, higher in the inner parts of the olivine embayments for the February 19, 2013 and December 3, 2015 samples whereas, the December 24, 2018 products exhibit more water-depleted concentrations. In any case, water concentrations produce gradients from the inner to the outer portions of the tubes in all the three samples. Integration of the whole dataset obtained on olivine-hosted melt inclusions and tubes furnish paramount indications on the decompression-driven timescales of degassing, which are strongly related to differences observed in eruptive dynamics at Mt. Etna volcano for the three variably explosive events considered.