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Mt. Etna primary melts from 600 ka to the present day characterized by geochemistry of melt inclusions

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The geochemical and isotopic variability of tholeiitic/calc-alkaline volcanic products in the southern region of Italy suggest the involvement of an HFSE-enriched, OIB-type mantle component. The Sicily province includes recent to active volcanoes in eastern Sicily (Etna, Iblei), Sicily Channel, Ustica and Prometeo, which are host from tholeiitic to Na-alkaline lavas. The origin of Sicily magma's diversity is debated, but the prevailing hypothesis is that it results from melting a heterogeneous mantle influenced by subducting Ionian lithosphere and interaction with an ascending plume.

To address the genesis of the Sicilian magmatism as a function of time, we study olivine-hosted melt inclusions (MIs) from Etna. Etna's magmatic evolution consists of six volcanic stages, started 600 ka ago with submarine tholeiitic lavas and continued until present days eruptions of Na-alkaline products. Here we present the geochemistry of MIs from Tholeiitic (542 & 332 ka), Timpe (154 – 126 ka), AAV (102 ka) and Mongibello (1669 AC) stages.

Homogenized MIs are hosted by high-Fo olivine for Tholeiitic stage (Fo 90.5-87) and Timpe stage (Fo 90.5–74), and moderate Fo for AAV and Mongibello stages (Fo 81-72). Spinel from the Tholeiitic and Timpe stages show lower Cr# (~0.5) compare to the alkaline ones (~0.8).

Studied MIs demonstrate a wide compositional diversity reflecting the variation of parental melt groups for the separate Etna magmatic stages. Tholeiitic melts differ from all other stages (alkaline melts) by low K_2O, P_2O_5, depleted trace elements and high SiO_2, with more refractory spinel suggesting a primitive mantle source for this first Etna magmatic stage. Alkaline MIs from 102 ka – 1669 have similar major and trace element compositions to recent alkaline lavas and published MIs. In contrast, the alkaline MIs from the Timpe stage (K_2O 1-3 wt.%) differ from alkaline lavas and MIs from all other stages by higher TiO_2, Al_2O_3, CaO, P_2O_5, SO_3 and low SiO_2.

Our results indicate that the mantle under Etna is very heterogeneous and requires the involvement of at least two different lherzolite mantle sources for magmas of Tholeiitic and Timpe stages, and a contribution of subduction-derived components for magmas for the more recent stages.