



Tracking magma dynamics by laser ablation MC-ICPMS: $\delta^{11}\text{B}$ of ash from 1995 Mt. Etna eruption

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Mt. Etna volcano, one of the most active in the world, is characterised by an unusual geodynamic setting due its location on the suture between the converging African and European plates, adjacent to the subduction-related Aeolian island arc. In spite of the huge literature and ongoing studies, several crucial points still need to be adequately addressed, such as: i) the changes in geochemical characteristics of Mt. Etna magmas through time; ii) the sources and compositional evolution of Mt. Etna magmas; iii) the Etnean plumbing system and the processes occurring therein (Corsaro and Pompilio, 2004). While studies of olivine-hosted melt inclusions (Schiano et al., 2001) may provide insights on primitive melts and their sources, studies of juvenile glass fractions (ash) provide additional and important information on the intermediate and shallow zones of the plumbing system, where most of magmatic processes occur, and might thus be very suitable for forecasting paroxysmal events and monitoring volcanic activity (Taddeucci et al., 2002).

We have investigated a series of fragments of juvenile fractions of ash erupted in three different episodes during the 1995 (May to December) activity of Mt. Etna (Corsaro and Pompilio, 2004). Ash fragments (glassy clear and crystal-free fragments) have been mounted in epoxy resin and analysed for trace elements by laser ablation ICPMS. Mean absolute concentrations of incompatible trace elements (REE, HFSE, Actinides, LILE, LLE) are almost constant between May and October. After this date they significantly decrease, coupled with a concomitant increase in Sr concentration;

a geochemical feature that is consistent with the arrival of a new, less differentiated and gas-rich magma batch in the shallow plumbing system. Conversely, the regular decrease of some geochemically relevant ratios with time (e.g., Nb/Rb, Zr/Nb and Nb/B) indicate more complex processes (e.g., selective contamination) superimposed on processes of crystal fractionation and refilling of feeder conduit.

The high B concentrations (15 - 21 ppm) of ash allowed in-situ determination of B isotopes by laser ablation multicollector (LA-MC)-ICPMS (spot size of 60 μm). Details on the instrumental setup (consisting of a Finnigan NEPTUNE, equipped with both multiple ion counters and Faraday cups, coupled with a commercial NewWave UP213 laser probe) and adopted analytical strategies and methodologies are reported in a companion abstract (Bouman et al., 2005, VPG20 session).

The B isotope compositions of the ash overlap at 2σ level and no statistical differences have been observed among the different ash emissions. $\delta^{11}\text{B}$ values range between -4.8 and -10.7 ‰, with a weighted average of -8.0 ± 1.9 ‰ (2σ). The mean $\delta^{11}\text{B}$ signature of ash erupted during 1995, as well as the Nb/B ratio (=4.8; Schiavi et al., 2004), are significantly lower than those determined on massive volcanic products from the same eruption using bulk techniques (Tonarini et al., 2001). However, similar negative $\delta^{11}\text{B}$ values were observed for Mt. Maletto and other recent lavas (1949, 1989). Such negative $\delta^{11}\text{B}$ values were interpreted as the result of shallow level assimilation of crustal material from the sedimentary pile beneath the volcano (Tonarini et al., 2001). The difference between the $\delta^{11}\text{B}$ signature of ash and volcanic products is intriguing and many hypotheses on its origin can be formulated, including very shallow level contamination related to the hydrothermal system close to the crater vent or B isotope fractionation as a consequence of degassing.

References

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