Extreme heterogeneity prior to extensive mixing: Sr-Nd-Pb isotope analysis of individual melt inclusions from the Italian Peninsula

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Extreme isotope variability observed in primitive melt inclusions compared to host lavas suggests that lavas represent accumulated mixtures of melts. Studying the compositions of melt inclusions offers the potential to constrain the different mantle source components that contribute to the magmatism. Isotopic analyses of melt inclusions are, however, challenging because of their limited size. To date, Sr and Pb isotope data have only been obtained for oceanic islands by application of in situ analysis techniques, either by SIMS or LA-(MC)-ICPMS.

Here, we report coupled Sr-Nd-Pb isotope data on individual melt inclusions from K-rich lavas from mainland Italy, obtained using combined wet chemistry techniques and TIMS analysis. We use newly developed 10^{13} Ω resistors mounted in the feedback loop of Faraday cup amplifiers. Compared to default 10^{11} Ω, use of 10^{13} Ω resistors results in a 10-fold improvement of the signal-to-noise ratio and more precise data for small ion beams (< 20 mV).

Twenty-one olivine hosted (85 – 92 mol % Fo) melt inclusions from nine volcanic centres along the Italian peninsula were analysed for Sr and Nd isotope composition. $^{87}Sr/^{86}Sr$ ratios in the melt inclusions range from 0.70508 to 0.71543; $^{143}Nd/^{144}Nd$ ratios from 0.51175 to 0.51268. Complimentary Pb isotope data will be presented at the conference. Significant differences in $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ between melt inclusions and host lavas are interpreted to be the result of (1) mixing of melts derived from a heterogeneous mantle modified by subduction-related metasomatism, (2) mingling of distinct batches of olivine-bearing magma within the plumbing system, and (3) local assimilation of crustal material.

These preliminary data suggest that analysis of individual melt inclusions for Sr-Nd-Pb isotope ratios is a promising tool for identifying distinct components in magma source regions. Expanded data sets of combined major and trace element, and isotope data per volcano are required to model melt mixing mechanisms in individual plumbing systems.