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The mantle source of lamproites from Torre Alfina, Italy: Evidence from melt inclusions in olivine

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The complex post-collisional subduction setting of peninsular Italy, in the central-western Mediterranean region, has given rise to an extremely diverse spectrum of potassium-rich volcanic rocks. The most primitive of these products show trace-element and radiogenic isotope signatures that point to melt derivation from upper mantle domains affected by metasomatism associated with sediment recycling. The style and extent of this metasomatism, and the metasomatic agents responsible for this modification, seem to differ significantly throughout the Italian peninsula.

The lamproites of the Tuscan magmatic province, central Italy, are a peculiar and rare example of rocks that require extensive source modification that is not yet well-understood. These rocks are ultrapotassic and mafic in composition and have high compatible trace-element contents. Although bulk-rock compositions have been used to interrogate their petrogenesis, bulk lavas do not reflect the full heterogeneity of their mantle source. Here, we study the geochemistry of melt inclusions in forsterite-rich olivine, which in contrast to their host lavas are snapshots of near-primary melts that have bypassed modification on their way to the surface.

The olivines (Fo_{88-93}) from the studied lamproites of Torre Alfina host melt inclusions with major- and trace-element compositions that define two distinct groups. The first is marked by lower SiO_2 (47–51 vs. 50–60 wt%) and higher K_2O (11–17 vs. 8–14 wt%), CaO (3.5–6 vs. 1.5–5 wt%), TiO_2 (1.8–2.4 vs. 0.3–1.8 wt%), P_2O_5 (1.0–1.7 vs. 0.1–0.9 wt%) and different trace-element contents. Group-1 melts are generally similar to other Tuscan lamproites, whereas group-2 melts are, in terms of trace elements, more akin to the Tuscan high-K calc-alkaline mafic rocks. We interpret these two melt types to originate from a sediment-metasomatised mantle source, which is characterised by distinct (vein) lithologies arising from superimposed metasomatic events.

The Sr-Nd-Pb isotope compositions of a subset of the studied inclusions, analysed by wet chemistry and TIMS techniques, will be presented to further constrain the mantle source of these unusual and hitherto unreported primitive melt compositions, and ultimately better understand lamproite petrogenesis.