Subduction-related mantle heterogeneity recorded by Sr-Nd-Pb isotopes in melt inclusions from central Italy

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Subduction of Earth's surface material at convergent plate boundaries exerts fundamental control on global element fluxes that shape long-term planet evolution. However, the extent and mechanisms of subduction recycling remain ambiguous, especially in continental subduction zones where sediment input is highest. To resolve this issue, we examine the complex subduction setting of peninsular Italy, whose diverse post-collisional magmatic products reflect substantial temporal and spatial variations in subducted material in the mantle source.

Primary melt systematics are potentially masked in bulk lavas by magma mixing and assimilation in the crust. Hence analyses are conducted on olivine-hosted melt inclusions (MIs), which more fully record the geochemical heterogeneity of the mantle source. Recent advances in TIMS technology, i.e. the use of 10^{13} Ω amplifiers [1], now allow isotope analysis of MIs with exceedingly low abundances of Sr (2 ng), Nd (30 pg) and Pb (100 pg).

Coupled Sr-Nd-Pb isotope, major and trace element data are presented on ~20 homogenized, high-potassium (HKS) to melilitite melt inclusions hosted by primitive ($Fo_{92–90}$) olivines from three key Quaternary volcanic centers (Vulsini, Sabatini and Alban Hills) in the Roman Magmatic Province, central Italy. Systematic covariations are recorded in the MIs between proxies for sediment metasomatism such as K_2O, U/Th, U/Nb, Cs/Rb, Be and $^{87}Sr/^{86}Sr$. Furthermore, the MIs exhibit striking unradiogenic Pb isotope compositions, which have not been reported for volcanic rocks from this area before.

These primitive melt compositions indicate the involvement of isotopically distinct and trace element–enriched mantle domains below central Italy. We infer that the covariations reflect melt extraction from a small-scale heterogeneous mantle source that was modified by sediment melts derived from the subducted Adriatic slab. As such, these findings will help to better constrain mantle modification and recycling fluxes in subduction zones.

[1] Koornneef *et al.* (2015) *Chem Geol* **397**, 14-23.