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The search for a primitive magma at Mount Vesuvius: possible role of a MORB-derived picrite in the genesis of Vesuvian magmas.

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Abstact

Near-primary melts, preserved as microinclusions in olivine of ultramafic ejecta (dunite and pyroxenite bearing *mosaic-equigranular* or *porphyroclastic textures* typical of mantle peridotites) of Mount Vesuvius, have a trachybasaltic, basanitic, and rarely trachybasaltic and picrobasaltic compositions (Mg# up to 68-75).

Thermobarometric estimates, obtained by using a grid of selected reactions, indicate that the *hydrous picrobasaltic melt* is in equilibrium with olivine and clinopyroxene at higher pressures: i.e., at about 17-18.5 kbar and temperatures of 1240-1300 °C, whereas a *moderately hydrous basanitic melt* is in equilibrium with the above phases at lower pressures of 11-14 kbar for temperatures ranging 1230-1350 °C. Pressure estimates are consistent with the geophysical data that indicate the crust-mantle transition, below Mount Vesuvius is at about 30-36 km.

Trace element data indicate moderate to high contents in incompatible elements for the *ultramafic ejecta* (Rb/Sr range 0.19-0.24), with enrichments up to about two order of magnitude above *primordial mantle values*. In particular spider diagrams indicate strong positive anomalies for Ta and P, whereas some sample may exhibit strong negative anomalies in Hf. Moreover, these spiders diagrams show similar patterns between the ultramafic ejecta and recent Vesuvian lavas which suggest a common source. REE patterns for *dunites* are relatively regular with moderate enrichments in LREE, and HREE contents comparable or slightly above average chondrites: $(La/Yb)_N$ varies between 7 and 16. *Clinopyroxenitic nodules*, with $(La/Yb)_N$ ranging 4.8-6.4, show a slightly higher degree of enrichment in terms of LREE and a relatively "flat" pattern for these elements. HREE distributions, normalized to chondrites, decrease progressively

with increasing atomic number, and show and enrichment of 1.5 to 3 times higher then average chondrite.

Isotope data obtained on ultramafic vesuvian nodules ($^{87}Sr/^{86}Sr$ range from 0.70691 to 0.70728; whereas $^{143}Nd/^{144}Nd$ range 0.51248-0.51254) confirm a close genetic link between these materials and the lavas which have rather similar isotope ratios. Isotopic parameters, such as $\square_{Sm/Nd}$ (calculated at 2 Ga, according to De Paolo, 1988) show values of 0.42-0.59 both for the lavas and the ultramafic nodules. These values are consistent with 1-10% partial fusion of an eclogitic source. Moreover, $\square_{Sm/Nd}$ parameters (Salters and Hart, 1989; Salters, 1996) constrain the degree of partial fusion at 5-7 %.

Mass balance calculations on major elements have been cross-checked iteratively by utilizing the computer code MELTS (Ghiorso and Sack, 1995) to identify a possible primary parental mgma. Such a primitive melt is a picrite which fractionates garnet + clinopyroxene at high pressure at/or in proximity of its souce region (□28 kbar), followed by a moderate decompression coupled with fractionation mainly of olivine at moderately lower pressure (□ 18 kbar) to give a picrobasaltic melt (with a fraction of melt remaining, F~ 0.66). At lower pressures (approaching 12 kbar) the partly evolved parental will continue separating slightly variable amounts of olivine, clinopyroxene, spinel as well as fractions of apatite to generate basanite (F~0.12), tephrite (F~0.06) and phonotephrite (F~0.04). Trace element abundance of the above primary picritic magma have been retrived by “backstripping” the trace element distributions found within the lavas (following a two-step model to include P-T variations of selected partition coefficients for the mineral phases involved in the process). The calculated REE pattern of the “primary picrite” is a typical MORB approaching a “flat” pattern with a degree of enrichment of LREE and HREE above 10-20 times average NMORB.

Partial fusion models, constrained by phase relationships at high pressure (according to selected sections of the O’Hara tetrahedron) allowed identification of an original NMORB source. This inference suggests that Vesuvian magmas can be generated by small degree of partial fusion of a MORB derived eclogitic source (i.e., a garnet pyroxenite according to O’Hara’s and Yoder’s definition) which is likely represented by the remnants of the subducted oceanic crust. Therefore, it is not excluded that mantle metasomatism (occurring with a mechanism consistent with the model proposed by Peccerillo, 1999) of subducted oceanic crust is eventually followed by slab melting below Mount Vesuvius. This petrogenetic process could play a significant role in the genesis of other magmas within the Roman Comagmatic Province and within the Southern Thyrrenian region.

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