Mantle metasomatism in a complex subduction-collision scenario: The Late Miocene lamprophyres from the Island of Kos (SE-Aegean)

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High-K mantle-derived magmatic rocks typically form in collisional to post-collisional stages of the orogenic cycle and are of particular interest as they carry information about the chemical and mineralogical conditions of the uppermost mantle. The numerous Late Miocene lamprophyre dykes from Kos, which are distinctive by their highly variable petrographic character, comprising amphibole- and mica-rich varieties, were emplaced above the eastern end of the active South Aegean subduction zone.

The Sr, Nd and Pb isotopic compositions of the lamprophyres fall in narrow ranges ($^{143}Nd/^{144}Nd$ = 0.51253–0.51270; $^{87}Sr/^{86}Sr$ = 0.70393–0.70546, $^{206,207,208}Pb/^{204}Pb$ = 18.60–18.95, 15.62–15.66, 38.43–38.86). Sr and Nd isotope ratios correlate negatively, extending from the undepleted end of the mantle array towards crustal values. The crust-like isotopic compositions are linked to the addition of subducted South-Eastern Mediterranean sediments, which dominate the Pb budget in all lamprophyres. The mantle endmember is chemically heterogeneous, including material strongly enriched in trace elements and showing high field strength element systematics typical of carbonatite mantle metasomatism (including Nb/Ta up to 31, high Nb/Zr, low Ti/Eu).

Thus, there are two types of mantle metasomatism: (1) sediment-derived melts reacting with ambient mantle formed phlogopite-pyroxene-rich veins and (2) carbonatitic or carbonated low-SiO_2 melts reacting with ambient mantle formed clinopyroxene- and amphibole-rich domains. These non-peridotitic regions later melt to different degree and mix to variable portions to from the wide chemical range observed in the Kos lamprophyres.

Emplacement of the lamprophyres is related to sinistral transtension between the fast extending Eastern Aegean back-arc basin and Western Anatolia, which may also have formed ruptures in the down-going slab, allowing the introduction of material from the convecting mantle into the supra-subduction zone mantle.