Post-collisional shoshonites: product of dehydration melting of subduction-enriched metadiorite underplated at base of crust

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Post-collisional volcanism of the Aegean region is a Neogene analogue of middle Paleozoic volcanism of the Appalachians. The most voluminous Neogene Aegean volcanic rocks consist of trachyandesite to trachyte of shoshonitic character that outcrop principally in the islands of Limnos, Lesbos, and Samothraki, and in northwest Anatolia. The post-orogenic tectonic setting and the Cenozoic volcanicity of the Aegean region have been argued by many previous authors to be sourced in lithospheric mantle enriched by older subduction, as a result of dehydration melting by thermal anomalies from asthenosphere advection, which resulted from either delamination or slab break-off. Experimental studies show that such decompression melting of such a source mantle will produce small volumes of trachytic magmas.

New geochemical and isotopic analyses of rocks from Limnos and Lesbos, together with literature data from Samothraki and northwest Anatolia, show that the enriched lithospheric mantle source is untenable. In Limnos, where the shoshonitic rocks are most homogeneous, the most mafic rocks have >58% SiO_2, and a similar lack of mafic shoshonitic rocks characterizes other volcanic centres. The degree of REE fractionation in the rocks from Limnos would require about 10% partial melting of enriched mantle lherzolite, which is difficult to reconcile with the observed extreme enrichment in incompatible elements. A mantle source is also difficult to reconcile with strongly negative ε_{Nd} values for Limnos trachyandesite and the geochemically related voluminous Miocene granite of Samothraki. The large volumes of the shoshonitic stratovolcanoes in Limnos, Lesbos, and elsewhere (>10 km^3) are in strong contrast with very small volumes of enriched lamproite magma (<0.1 km^3) of clearly mantle origin in Lesbos and elsewhere and probable mantle-derived trachytes in Samos, Kos, and elsewhere (<1 km^3).

A source from either subducted oceanic crust or delaminated continental crust can be excluded on various geochemical grounds. Rather, the trachyandesites of the shoshonitic suite are derived from small degrees of partial dehydration melting from an enriched metadiorite source. This source is inferred to be diorite that underplated the crust during earlier subduction. Partial melting was favoured by orogenic thickening and the thermal anomaly from asthenospheric advection. Similar geological circumstances are to be expected in the post-collisional stages of other orogens.