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Mantle sources and magma genesis in the peri-Mediterranean Triassic-Jurassic Tethyan ophiolites

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The peri-Mediterranean Tethyan ophiolites can basically be subdivided into two major types: (1) the “eastern” ophiolites cropping out in the Dinaride-Hellenide belt, Turkey and Cyprus and (2) the “western” ophiolites cropping out in the Alps-Apennine-Corsica orogenic system.
Volcanic rocks from the “eastern” ophiolites consist of a variety of different rock types, that is: rocks generated at mid-ocean ridge (MORB), including both normal (N-) and enriched (E-) types, rocks generated at supra-subduction zone (SSZ), including island arc tholeiites (IAT), boninites, and rocks with geochemical features intermediate between MORB and IAT (MORB/IAT), as well as alkaline within-plate basalts (OIB) and rare calc-alkaline rocks.
By contrast, the “western” ophiolites are exclusively characterized by volcanic rocks with MORB affinity, represented by both N-MORB and transitional MORB (T-MORB) types. Most of these rocks have a more or less pronounced garnet signature typified by heavy rare earth element (REE) fractionation with respect to medium REE (SmN/YbN generally >1.5).
The different volcanic rocks from the various ophiolitic complexes reflect different compositions of their mantle sources. REE modelling of mantle sources, primary melt generation, and mantle residua carried out for the various ophiolitic varieties cropping out in the peri-Mediterranean ophiolites can be summarized as follows.
Primary N-MORBs from the “eastern” ophiolites may have derived from 10 - 20% partial melting of an undepleted lherzolitic source in the spinel stability field. The primary E-MORBs from the “eastern” ophiolites may have derived from ca. 10% partial melting of an undepleted lherzolitic source in the spinel stability field variably enriched in light REE by OIB-type components. The calculated residua for both N- and E-MORBs correspond to depleted, cpx-poor lherzolites cropping out in northern Greece. The primary MORB/IAT basalts may have generated by ca. 10% of H2O-assisted partial melting of the cpx-poor lherzolites that have previously experienced MORB extraction. The primary IAT magmas and boninites may have derived from 10 – 20 % and ca. 30% partial melting of the same source of MORB/IAT basalts, but variably enriched by subduction-derived fluids and related incompatible elements. The calculated residua correspond to the depleted harzburgites found in the Hellenide ophiolites.
N-MORB volcanic rocks from the “western” ophiolites showing somewhat garnet signature may have derived from small-degree (< 10%) partial melting of a spinel peridotite source bearing small volumes of garnet-pyroxenite relics from the subcontinental lithospheric mantle, while minor N-MORBs without any garnet signature may have derived from 5-10% partial melting of spinel peridotite source. By contrast T-MORBs from the “western” ophiolites may have been derived from less than 5% partial melting of a lithospheric mantle source bearing garnet-pyroxenite relics.