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The Mirdita Eastern Ophiolite, Albania: Non-metasomatized Spinel-harzburgites whithin the Suprasubduction Ophiolite of Tropoje

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The Mirdita ophiolites in northern Albania are divided into the Western Mirdita Ophiolite (WMO), with MORB geochemical affinities, and the Eastern Mirdita Ophiolite (EMO), for which suprasubduction geochemical affinities have been reported (Beccaluva et al., 2005). Ultramafic massifs in the WMO are often plagioclase bearing lherzolites/harzburgites whereas those in the EMO are strongly depleted spinel harzburgites.The Tropoje ultramafic-mafic complex, which forms the northernmost part of the EMO, consists of spinel harzburgites, dunites, wherlites, orthopyroxenites and gabbros (Fig. 1).

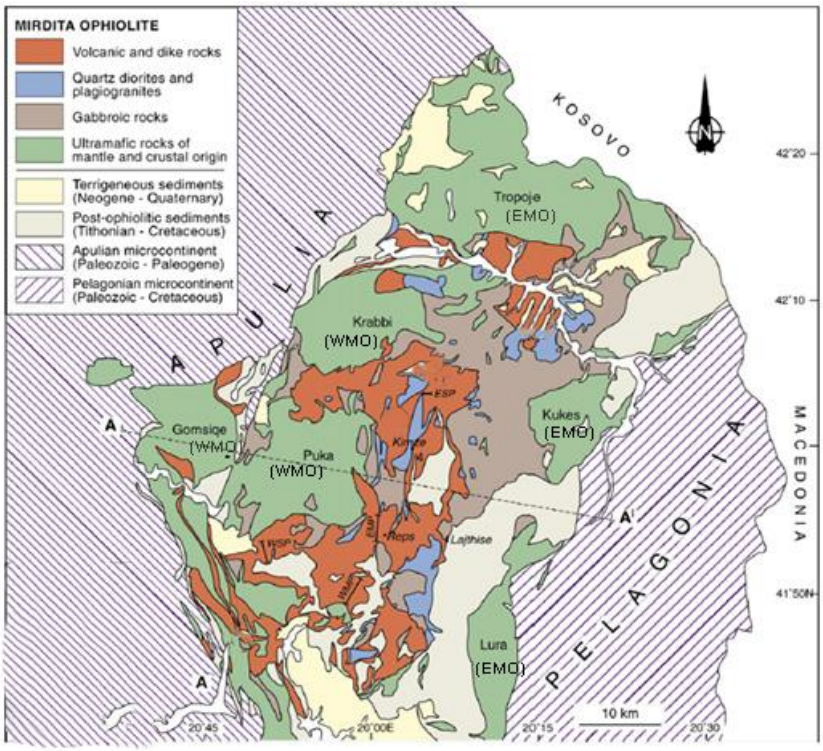

Figure 1. Geological map of northern Albania modified after Dilek et al., 2007. WMO: Western Mirdita Ophiolite, EMO: Eastern Mirdita Ophiolite.

The spinel harzburgites, which experienced variable degrees of serpentinization, are coarse- to medium-grained. One of the most striking features of the Tropoje ultramafic rocks is an outcrop of exceptionally fresh coarse- to medium-grained spinel harzburgites. While occasionally the peridotites exhibit a weak foliation, the prevalent texture is protogranular. Olivine is mainly coarse-grained (up to 6 mm size), typically showing kink-bands that frequently contain submicron-sized spinel exsolution lamellae. Both orthopyroxene and clinopyroxene, with grain size up to 3 mm and 1.5 mm, respectively, carry very thin exsolution lamellae of the other pyroxene. The olivine inclusions in coarse-grained orthopyroxene show evidence for reaction of a percolating melt with dunites (Fig. 2). Spinel, up to 1 mm in size, is interstitial between boundaries of the associated silicates and its composition indicates that the Tropoje peridotites are strongly depleted in basaltic components.

The rock-forming minerals (olivine, orthopyroxene and clinopyroxene) are all highly magnesian and chemically homogenous. The magnesium numbers (Mg#=100xMg/[Mg+Fe]) for olivine and orthopyroxene are fairly homogeneous and vary within the narrow range of 90.9-91.6 and 91.5-91.7, respectively. The clinopyroxene is exceptionally highly magnesian, with Mg# ranging between 93.6 and 95.4. In both orthopyroxene and clinopyroxene, the Al_2O_3 contents range from 0.95 to 1.75 and from 0.62 to 2.27 wt%, respectively. Spinel shows a considerable variation in $Al_2O3$and Cr_2O3. The range in Cr# (Cr#=100xCr/[Cr+Al]) is 51.7-69.2, but no compositional variations have been observed between core and rim.

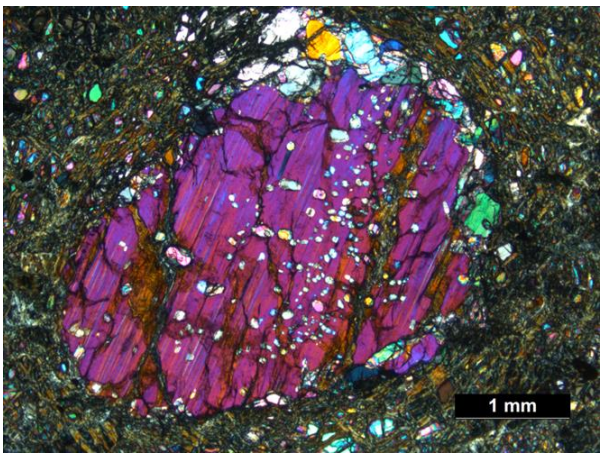

Figure 2. Coarse-grained opx with olivine inclusions: evidence for rock-melt interaction

The silicate minerals are strongly depleted in trace elements. LA-ICP-MS analyses of clinopyroxenes show that the LREE are below detection limit whereas the ratio of (Tb/Yb)N range from 0.10 to 0.15 and Lu is around 0.5xPM.Equilibrium temperatures calculated at a pressure of 1.5 GPa are relatively low, ranging between 620 and 830◦C.The lowest temperature corresponds to the most residual peridotite, in which the clinopyroxene has the highest Mg# (95.4) and the spinel the highest Cr# (69.2).The spinel-harzburgites from these exceptional fresh outcrop have experienced high degrees of partial melting. Applying the method of Hellebrand (2001) to samples containing spinel with Cr# < 60 yields around 20% partial melting. The overall strong depletion in trace elements and prominent depletion of the LREE in clinopyroxenes as well as the absence of hydrous phases is not consistent with a suprasubduction origin as it has been suggested for the Tropoje ultramafic massif.

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