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Mantle Peridotites from the Mersin Ophiolite (S-Turkey): implications for effects of melting and subsequent melt interaction on whole-rock and mineral compositions

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Mersin ophiolite, from the middle Tauride, southern Turkey, is represented by mantle unit and overlying crustal sections composed of ultramafic to mafic cumulates and basalts. Mantle peridotites are composed mainly of harzburgite and dunite. They are variously depleted, compared to the primitive mantle, and are characterized by very low TiO_2 (<0.03 wt%), Al_2O_3 (0.27–0.86 wt%) and CaO (0.10–0.80 wt%) contents. Forsterite values of olivine range between 89.2 and 93.6, and Cr# values of coexisting spinels range from 48 to 73, although most of the samples are characterized with spinel Cr# between 60 and 70, indicating moderate to high degree melt depletion for their origin. Composition of olivine and spinel in some samples are distributed within the olivine-spinel mantle array, although these phases from most of the samples plot out of the mantle array due to the lower Fo value of olivine in these samples. Spinel grains generally contain low TiO_2 (<0.1% wt%) content; however spinels in some samples are represented by up to 0.30 wt% TiO_2 that is not consistent with their depleted nature. Primitive mantle-normalized whole rock Lanthanum Group Elements (LGE) patterns show depletion towards heavy LGE to medium LGE. However, all peridotite samples show marked enrichment of light REE and Large Ion Lithophile Elements (LILE) compared to medium LGE. Whole-rock heavy LGE patterns of some peridotite samples follow the melting residue lines, and are modeled ∼22–27 fractional melting in spinel stability field. However, depletion of medium LGE compared to heavy LGE is stronger in some samples and the heavy LGE to medium LGE patterns do not follow the melting lines produced by various degree of fractional melting in spinel stability field. These samples can be modeled by 5 to 10% fractional melting started in garnet stability field and followed in spinel stability field with additional 28 to 23% melting. Enrichment of TiO_2 in high Cr# spinel from some samples as well as enrichment of light LGE compared to the medium LGE in whole-rock samples cannot be explained by simple melting events, and requires multistage melting and enrichment processes. Interaction of light LGE and Ti-rich melts/fluids percolating through the overlying mantle in supra-subduction zone environment may explain the compositional variation of mineral and whole-rock geochemistry of the Mersin peridotites.