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Highly siderophile element systematics of peridotites from NW Anatolia, Turkey: evidence for mantle metasomatism by melt percolation in a supra-subduction zone environment

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Platinum group element (PGE) studies of peridotites from the supra-subduction zone (SSZ) ophiolites of NW Anatolia provide evidence for the nature of melt extraction within the uppermost mantle and interactions between subduction-related magmas and the mantle lithosphere. The peridotite samples from the mantle section of the ophiolites are mainly spinel-harzburgites and dunites accompanied by subordinate amount of spinel-lherzolites. Whole-rock major-trace element and mineral chemical characteristics indicate that the peridotites originated as the solid residues of varying degrees of partial melting and were subsequently modified by interaction with metasomatizing melts. The samples have non-chondritic, fractionated chondrite-normalized PGE patterns. Melt depleted mantle harzburgites and dunites show moderate to strong enrichments in the Palladium-group relative to the Iridium-group PGEs (Pd_N/Ir_N = 1.81$\pm$0.23), and in most samples, pronounced Rh and Pd enhancements relative to Pt (Rh_N/Pt_N = 2.31$\pm$0.66; Pd_N/Pt_N = 1.93$\pm$0.20). These signatures cannot be reconciled with a simple in-situ melt extraction and removal of sulphide phases, but most likely reflect a multi-stage petrogenetic process which selectively enriches the local mantle environment in incompatible and less refractory siderophile elements that are mobilized during continuous melt percolation, while relatively depleting the mantle wedge in Pt which is not as effectively mobilized by silicate melts (or fluids). The results of quantitative model calculations indicate that the addition of sulphides originated from interaction between solid mantle and percolating hydrous basaltic melts may account for the strongly supra-chondritic ratios of both Pd/Ir and Ir/Os. The

peridotites show no systematic variation of Ir-group PGE (Ir, Ru, Os) abundances relative to melt depletion indices such as Mg#, Al_2O_3, CaO or spinel Cr#, despite their remarkable inter-element PGE variations. This along with the elevated values of some strongly incompatible elements (e.g. Ba, Th and LREE) in most of the reactive harzburgites and dunites suggest a post-melting metasomatism and melt impregnation in a supra-subduction zone environment. Enrichment in various incompatible elements (Hf, U, Ta, Sr) relative to the expected values for melt-depleted mantle residues and pronounced negative anomalies in fluid-insoluble high field strength elements (Ta, Nb, Zr, Hf, Ti) further suggest that both siliceous melts and slab-derived hydrous fluids were involved in the processes of mantle metasomatism.