Origin of chromitites with UHP minerals in the Aladag ophiolite, Turkey: Two-way recycling in oceanic lithosphere generation

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The Aladag ophiolite (AO) in the Tauride belt (Turkey) represents 92 Ma Neotethyan oceanic lithosphere. Its upper mantle section consist of spinel-harzburgites, dunites and chromitites. Harzburgites display depleted mineral and whole-rock geochemistry and spoon-shaped REE patterns, indicating high degrees of partial melting and subduction metasomatism. AO chromitites display geochemical compositions typical of high-Cr chromitites and contain diamond, moissanite (SiC), zircon, rutile and unidentified octahedral silicate phases. Total $\delta^{13}C_{PDB}$ of Aladag microdiamonds ranges between −18.8 ‰ and −28.4 ‰, with a principal $\delta^{13}C$ mode at −25 ‰. Nitrogen contents of these microdiamonds range from 7 to 541 µg/g with a mean value of 171 µg/g, and their $\delta^{15}N_{Air}$ values range from −19.1 ‰ to 16.6 ‰, with a $\delta^{15}N$ mode at −9 ‰. Transmission Electron Microscopy (TEM) studies have revealed the existence of nano-sized inclusions of $(Ca_{0.81}Mn_{0.19})SiO_3$, NiMnCo-alloy and quenched fluid phases. We infer that the ^{13}C-depleted carbon signature of AO microdiamonds are derived from previously subducted Tethyan oceanic crust. Zircons separated from AO chromitites have $\delta^{18}O_{VSMOW}$ values of 4.9 to 8.6 ‰ and negative εHf(t) values of -0.5 to -15.9, suggesting their derivation from subducted crustal materials during intra-oceanic subduction. Our discovery of diamond, moissanite and other silicate minerals in AO chromitites further shows the common occurrence of these unusual mineral assemblages in ophiolitic mantle units, which might have had their origins near the MTZ and which may have experienced multiple partial melting episodes at various mantle depths beanth a SSZ spreading center.