

Ophiolite-hosted diamond: The key to understanding the evolution of oceanic mantle

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Diamonds have now been confirmed in the peridotites and chromitites of 10 ophiolites, widely separated in age and geographic position. These bodies have also yielded very similar collections of UHP, highly reduced and crustal-type minerals. The diamonds are small (100-300 μm), with octahedral and cubo-octahedral morphologies, and have similar ranges of inclusions and light carbon isotopes ($\delta^{13}\text{C} = -18$ to -27). They occur in both high-Al and high-Cr chromitites, with textures ranging from massive to disseminated. The most common inclusions are alloys (Ni-Mn-Co, Ni-Mn-Fe, Fe-Ni-Al), coesite and Mn-rich phases including Mn, MnO, tephroite (MnSiO_4), spessartine ($\text{Mn}_3\text{Al}_2\text{Si}_3\text{O}_{12}$ and galaxite (MnAl_2O_4). The diamonds are accompanied by many grains of moissanite, metal alloys, native elements, and crustal minerals. The widespread occurrence and age range of the diamond-bearing ophiolites point to a common process of formation unconstrained by space or time. We propose that subduction of oceanic lithosphere carries organic C, Mn, Si, and Al to the transition zone where the material is mixed with highly reduced material, perhaps derived from greater depths. Crystallization of diamond from a C-rich fluid with light C isotopes encapsulates Mn-rich phases and silicate inclusions. Diamonds may be widely dispersed in the oceanic mantle and carried to shallower levels by convection above mid-ocean ridges where they are preserved in chromitites and peridotites of ophiolites.