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Global distribution of ophiolite-type diamond, and its implications for mantle dynamics and recycling processes

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Ophiolite-type diamond has been reported from 25 ophiolites in different suture zones globally. These diamond–bearing ophiolites have different ages and different internal structures, including the Neotethyan ophiolites along the Yarlung Zangbo and the Bangong-Nujiang suture zones in China, the Indus Suture Zone in India, the Indo-Burma Range in Myanmar, and the Mediterranean mountain belts in Albania and Turkey. Some other, diamond–bearing examples include Mesozoic ophiolites along the Pacific Rim in Japan and the western USA and at the Caribbean plate margin in Cuba; Paleozoic ophiolites in the Uralides and the Central Asian Orogenic Belt in Russia and China, and in the Acatlán complex in southern Mexico; the Cenozoic ophiolites in Chile at the western Andean Orogenic Belt and in New Caledonian Peridotite Nappe in the southern hemisphere. The diamonds occur in the mantle sequences (peridotite and chromitites) of ophiolites and have light C isotope ($\delta^{13}C_{PDB}$ ranging from -18 to -28‰) values and similar mineral inclusions (NiMnCo alloy, Mn-rich silicate minerals, Ca-silicate perovskite). The ophiolite-hosted diamonds are different from diamonds in either kimberlites or metamorphic belts, pointing to a new occurrence of diamond on Earth. A high pressure and reduced mineral assemblage in chromitites, such as psuedomorph of stishovite, qingsongite (cBN, a cubic boron nitride mineral) and a high-pressure polymorph of rutile (TiO2 II), suggest their formation pressures of 10–15 GPa at temperatures ~1300 °C, consistent with mantle depths of >380 km, near the Mantle Transition Zone (MTZ). Why do these globally distributed ophiolite diamonds have similar characteristics? A simple deduction suggests that they must: (1) have come from the mantle same source, and (2) formed by the same mechanism(s) at great depths. We think that the MTZ represents a unified reservoir for ophiolite-type diamond in the Earth. We posit that the previously subducted, C-bearing crust might be decomposed, forming a C-rich fluid layer in the MTZ. Diamond and ultrahigh–pressure minerals crystallize when the carbon-rich fluids rise, and the P-T conditions change. Mantle plume and/or mantle convection processes bring diamonds and ultrahigh–pressure minerals to the shallow lithospheric depths beneath spreading centers during the formation of oceanic crust (i.e., ophiolites).