Recycling oceanic crust in mantle revealed by diamond within chromitite from the Mirdita ophiolite (Albania)

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Geophysical investigations and laboratory experiments show evidence for possible subduction of ancient oceanic crust. Geological and mineralogical observations suggest that subducted oceanic crust is recycled into the upper mantle. The subduction is supported by the recovery of super-deep diamonds from kimberlites and the presence of crustal materials in ophiolitic chromitites and their host peridotites. What is the mechanism? Here we report the new discovery of ophiolite-hosted diamonds in the podiform chromitites within the Skenderbeu massif from the Mirdita ophiolite in the western part of Neo-Tethys. The diamonds are characterized by exceedingly light C isotopes ($\delta^{13}C_{PDB} \sim -25‰$), which can be interpreted as evidence for subduction of organic carbon from Earth's surface. The diamonds are also characterized by an exceptionally large range in $\delta^{15}N_{air}$ (-12.9‰ to +25.5‰), accompanied by a low N aggregation state. On the other hand, materials sparsely included in diamonds include amorphous material, Ni-Mn-Co alloy, nanocrystals (20 x 20 nm) of calcium silicate with an orthorhombic perovskite structure (Ca-Pv), and fluids. We consider that the Skenderbeu diamonds nucleated and grew from a C-saturated, NiMnCo-rich melt derived from a subducted slab of ocean crust and lithosphere in the deep mantle environment. The environment is in the diamond stability field or near the top of the mantle transition zone. The new discovery of diamonds from the Mirdita ophiolite provides a valuable opportunity to understand deep cycling of subducted oceanic crust and mantle (i.e., composition and process).