Abstract: 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 (Fig. 1). The diamonds are characterized by exceedingly light C isotopes ($\delta^{13}$C_PDB $\approx -25\%$), 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 (Fig. 2). On the other hand, materials sparsely included in diamonds include amorphous material, Ni-Mn-Co alloy, nanocrystals (20 nm $\times$ 20 nm) of calcium silicate with an orthorhombic perovskite structure (Ca-Pv), and fluids (Fig. 3). 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).

Key words: Mirdita ophiolite, diamond, NiMnCo alloy, calcium silicate perovskite, carbon and nitrogen isotopes, subduction, West Albania

Fig. 1. (a) Distribution of major Tethyan ophiolites and suture zones in the Mediterranean region (modified from Dilek and Flower, 2003). DSF: Dead Sea Fault; EAF: East Anatolian Fault; NAF: North Anatolian Fault; BZCZ: Bitlis Zagros Collision Zone. (b) Simplified geological map of the Internal Albanides, showing the Mirdita zone ophiolites and major peridotite massifs, the conjugate passive margins of Apulia and Pelagonia-Korabi, and the Cenozoic sedimentary basins (modified from Dilek et al., 2005).
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References

Fig. 2. (a) $\delta^{15}$N$_{AIR}$ vs $\delta^{13}$C$_{PDB}$ plot of isotopic compositions of the Skenderbeu diamonds compared to other global sources of mantle diamond. Skenderbeu data from this study are shown as filled squares and the data from Howell et al. (2015) are shown as filled circles. The compositional separation shows that ophiolite-hosted diamonds and other Earth diamonds are unrelated. The comparative fields for peridotitic (olivine, clinopyroxene, and orthopyroxene), eclogitic (garnet and clinopyroxene), transitional types and fibrous diamonds are from a global database sourced from Haggerty (2017) and references therein. Data for the mantle mean are from Cartigny (2005). OCT: octahedral growth sector of the diamonds. CUB: cubic growth sector of the diamonds. (b) $\delta^{15}$N$_{AIR}$ vs N concentrations of the Skenderbeu diamonds. The data from both sectors of the ophiolite-hosted diamonds show a negative relationship, with increasing $\delta^{15}$N$_{AIR}$ as nitrogen concentrations decrease.

Fig. 3. TEM images of diamond foil E180-5#5010 with details.
(a) HAADF image of the entire foil showing the location of inclusion 3. (b) HAADF image of inclusion 3, which is composed of perovskite, NiMnCo alloy, and fluid. Dark areas represent pores that may have formed during preparation of the foil. (c) Dislocations in Skenderbeu diamond E180-5.

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