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Ophiolite-hosted Type Ib microdiamonds: spectroscopic evidence for their natural origin

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Ophiolites in Tibet and Russia are known to contain abundant microdiamonds [1,2]. Due to their unusual setting in the oceanic lithosphere rather than the cratonic lithosphere, as well as their small size and unaggregated nitrogen (C centres), many researchers have dismissed these microdiamonds as lab-grown HPHT contaminants. We undertook a spectroscopic study of 33 microdiamonds (about 200 µm diameter) from two ophiolitic localities: microdiamonds in peridotite and chromitite from the Luobusa ophiolite (Tibet) and microdiamonds in chromitite from the Ray-Iz ophiolite (Polar Urals, Russia). Our main goal was to distinguish these diamonds from lab-grown HPHT diamonds and confidently establish that they occur naturally within these ophiolites.

The diamonds are mostly broken fragments that are translucent and yellow to yellowish-green in color. These ophiolitic diamonds have many characteristics **similar to lab-grown HPHT diamonds**: 1) well-formed cubo-octahedral faces; 2) majority of nitrogen (>60 %) incorporated as C centres (Type Ib); 3) nickel-related defects, visible as the 882 – 884 nm doublet in their photoluminescence (PL) spectra; and 4) presence of the H2 (NVN^-) defect in their PL spectra. **In contrast to lab-grown HPHT diamonds**, these ophiolitic diamonds contain abundant fluid and mineral micro-inclusions (e.g., water, carbonates, chromite, magnesiochromite, magnetite, hematite, and moissanite). Additionally, step-like resorption features on some diamond faces indicate a natural origin. Our spectroscopic evidence, together with stable isotope and trace element data for microdiamonds from Luobusa [3], indicate that microdiamonds are naturally present within the Luobusa and Ray-Iz ophiolites and should not be considered as contamination.

Any geological model for the occurrence of diamonds within these ophiolites should account for their unaggregated nitrogen, the association with high-Cr minerals and crystallisation from water-rich fluids.

Temperature constraints for Type Ib diamonds require that they did not experience temperatures over 850 °C for any extended period [4]. C centres in ophiolitic diamonds could be preserved though rapid tectonic exhumation shortly after their formation, as shown for Type Ib diamonds from West Africa [5]. A possible scenario is that these diamonds formed in association with the subduction of oceanic crust to ultra-high pressures that was uplifted during continental collision, similar to Type Ib metamorphic microdiamonds [6]. However, since these ophiolites have no record of subduction-related metamorphism (as seen in the Kockchetav UHP metamorphic rocks [7]), the geodynamic setting for the origin of these ophiolitic Type Ib diamonds needs to be further explored.

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