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MINERALOGICAL AND GEOCHEMICAL CHARACTERIZATION OF COATED AND POLYCRYSTALLINE DIAMONDS FROM THE DIAVIK MINE, NWT, CANADA

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The Diavik diamond mine on the Slave craton (Canada) is one of the most prolific producers of gem quality diamonds worldwide. Here, we focus on the less coveted fibrous and coated diamonds from Diavik, because they are enriched in fluid inclusions that record diamond growth conditions and interactions between the mantle and crustal reservoirs within the Canadian shield. A total of 13 samples were studied: four polycrystalline and nine fibrous diamonds, which are those generally containing the largest volume of fluid inclusions. The diamonds displayed low degrees of nitrogen aggregation, identifying them as Type IaA (median N of 1099 ppm and average N aggregation of 11%B). Nitrogen contents and aggregation states of the diamonds indicate normal mantle residence temperatures, mostly below 1125 °C. SEM-EDX, micro-FTIR and Raman spectroscopy identified, liquid H_2O, OH, and solid inclusions of micro-inclusions of carbonate and mantle-derived pyroxenes, olivines, garnets, quartz, chromites, hercynites, iron oxides and Fe-Ni alloys. This assemblage of solid and fluid inclusions established a dominant peridotitic association, captured in lherzolitic lithospheric mantle substrates, and a Ca-rich silico-carbonatitic high-density fluid (HDF) signature. Our results allow to propose a model for the growth for these diamonds: first, influx of reduced fluids formed diamond and trapped silicate inclusions. Subsequently, numerous carbonate inclusions were trapped, which together with the complex growth of the coated diamonds, suggests a transition to broadly carbonatitic melt as the diamond-forming medium. Iron-oxide inclusions in the outer rims of the diamonds document the late arrival of an oxidized fluid in the lithospheric mantle, preceded by a possible diamond resorption event. Finally, a third metal-rich fluid event occurred, epigenetically filling fractures in the in fibrous and polycrystalline diamonds with native iron and Fe-Ni alloy, without further diamond crystallization.