The Carbon Source for Lithospheric Diamonds

BUREAU H. [1*], REMUSAT L. [1], ESTEVE I. [1], PINTI D.L.[2], CARTIGNY P.[3]

[1] IMPMC, UMR UPMC-CNRS 7590, Campus Jussieu, Paris, France

[2] GEOTOP, Université du Québec à Montréal, Montréal, Canada

[3] LGIS, IPGP, Université D. Diderot, UMR CNRS 7154, Paris, France

Trapping inclusions in diamonds during growth experiments is used as a diagnostic to constrain natural diamond formation conditions in the Earth's lithosphere. Isotopic signature of the new diamond grown areas close to those inclusions is also useful to identify the carbon source for the diamonds. In this study experiments were carried at conditions compatible with the Earth's geotherm between 6-7 GPa (1300-1675°C) in multi-anvil presses from a few hours to a few days. Carbon-bearing starting materials are powders of carbonates and graphite. Results show that within the timescale of the experiments diamond growth occurs on pre-existing seeds if water and alkali-bearing carbonates are present. The $\delta^{13}C$ isotopic composition of the new diamond grown areas measured close to the inclusions show a different isotopic signature than that of the starting seeds (-29.6 to -30.4±1.4‰). The new diamond carbon signatures are falling into the range of signatures of the starting carbonates used for the experiments (-4.8±0.1 to -16.2±0.1‰) but far away from the composition of the starting graphite (-26.4±0.1‰). This suggests that the carbon source for diamond growth at the conditions of the lithosphere must be the carbonates present either as CO_3^{2-} ions dissolved in the melt or as carbon dioxide in the aqueous fluid. It is concluded that diamond growth occurred from carbonate reduction rather that from graphite dissolution in the melt.