



Organic-looking' carbon and nitrogen isotope compositions in mantle derived diamondites: Mantle fractionation vs. re-worked crustal organics?

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Diamondites are fragments of polycrystalline diamond and intergrowths of silicates (mostly garnet \pm cpx; however they do not contain olivine). Open cavities lined with euhedral diamonds imply the presence of fluids during crystallisation. It can be demonstrated that silicates and diamonds very likely grew synchronously from the same fluid (1, 2). It has been suggested that these "polycrystalline diamonds" should be regarded as rocks, termed diamondites (1, 2); this nomenclature has been followed herein.

'Organic-like' carbon and nitrogen isotope compositions, in this study, corresponds to carbon isotope compositions of $< -10\text{‰}$ and nitrogen isotope compositions of $> +3\text{‰}$. Several studies have used isotopic compositions of both diamond and silicates in polycrystalline diamonds to unravel the clues as to their petrogenesis. Noble gas analyses of framesite have yielded low $3\text{He}/4\text{He}$ ratios, indicating little contribution from primordial mantle-derived 3He (3), they have shown 'crustal-like' nucleogenic Ne (high $^{21}\text{Ne}/^{22}\text{Ne}$) (4), isotopically light carbon ($\sim -20\text{‰}$) (5), isotopically heavy nitrogen (positive values) (6, 7) and unradiogenic Nd coupled with heavy oxygen isotope compositions in eclogitic garnets ($> +5\text{‰}$) (8). On the basis of this evidence one could postulate a crustal origin for the carbon and nitrogen; either remobilisation of the lower cratonic lithosphere shortly before kimberlite eruption (8, 9) or subducted crust containing crustal/organic carbon and nitrogen (3, 4). When focusing on their coexisting garnet trace element geochemistry (1, 2, 10) and the trace element composition in the diamond itself (11) it has been argued that there is no crustal component involved in their petrogenesis (using the same sample set as this study).

Here we present a study of coupled carbon and nitrogen isotope compositions and nitrogen contents of diamondites that have previously been studied in detail for their garnet geochemistry (10) and carbon isotope composition (5).

There are two ways in which these diamondites could have been formed based on their carbon and nitrogen isotope compositions: (1) Reworking (either recycling via remobilisation of the lower lithosphere or subduction) could have provided the carbon and nitrogen which have preserved their 'organic-like' signatures; or (2) the loss of ^{13}C rich oxidised carbon from the system by carbonisation of olivine (explaining the lack of olivine inclusions in diamondites) during diamondite crystallisation would result in increasing of the N/C ratio (\approx N ppm) and a drives the carbon isotopic value lighter. The small increase in nitrogen isotopes to more heavy values (at this early stage) is thought to be a function of a small loss of nitrogen from the substrate. This is followed by continuous diamond formation where oxidised carbon is lost via silicate carbonisation and the formation of carbonates (^{13}C enrichment in the source) and nitrogen is removed from the source by being partitioned into the crystallising diamonds (^{15}N enrichment in the source). During such progressive crystallisation of diamondites the carbon and nitrogen isotope compositions can be fractionated to extremely 'organic-like' values. We find that both models warrant sufficient discussion for this data set.

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