Micron-scale $\delta^{13}C$ determination by NanoSIMS in a Juina diamond with a carbonate inclusion

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Diamonds are metasomatic minerals formed through processes of either reduction or oxidation of C-bearing fluids and melts that occur over a large range of depths in the mantle and extends through time. Zoning is common in diamonds, which may reflect these processes during their growth. For this reason, carbon isotopes require to be studied at micron- or even nanoscale to unravel the complexity of diamond formation and understand the origin and fate of carbon in the mantle. Carbon isotopes can be measured using SIMS with a spatial resolution of 15–30 μm and a precision of 0.1. NanoSIMS measurements are still lacking of precision and results could be strongly affected by matrix effects on the chosen standards.

Here, we present results of $\delta^{13}C$ raster measurements (1x1μm) carried out in EM mode on three FIB foils of an alluvial diamond containing a carbonate inclusion from the Juina field, Brazil. Previous studies suggested that this diamond contains recycled carbon and that carbonate might derive from subducted material [1]. Carbon isotopic analyses on 14 areas were corrected for detector dead time, Quasi Simultaneous Arrival (QSA) effect and instrumental mass fractionation (IMF). Three standards were used: carbonado GM02, a natural Ia and one synthetic IIa diamond both used for diamond anvil cell experiments. Isotopic analyses of carbon by mass spectrometry at IPGP on Ia and IIa stds were consistent with NanoSIMS results within uncertainties. Average $\delta^{13}C$ of -5±2.3‰ is typical of diamonds of peridotitic paragenesis [2] and in the range of "mantle" carbon. Measured $\delta^{13}C$ values are also consistent with a few carbon isotopic data obtained in Juina diamonds containing carbonate inclusions [e.g., 3].

[1] Wirth *et al*. (2009) *Earth Planet. Sci. Lett*. **286**, 292-303. [2] Cartigny et al. (2014) *Annu. Rev. Earth Sci*. **42**, 699-732.
[3] Bulanova *et al*. (2010) *Contrib. Mineral. Petrol*. **160**, 489-510.