Deeply subducted carbon and nitrogen within the Earth's mantle: A view from SIMS analysis of super deep diamonds from Monastery and Jagersfontein (RSA)

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Understanding mantle-crust interactions are critical to constraining the carbon and nitrogen composition of the mantle. Little is known about Earth's deep mantle (>250 km) but rare super deep diamonds provide a unique probe into the these regions, as they originated within the asthenosphere and transition zone (250-670 km) plus the lower mantle (>670 km). We present a coupled cathodoluminescence and C- and N-isotope micro-analytical study by SIMS of super deep diamonds from the Monastery and Jagersfontein mines, South Africa.

$\delta^{13}C$- $\delta^{15}N$-[N] covariations along detailed traverses across individual diamonds illustrate (1) that surficial volatiles such as carbon and nitrogen are efficiently recycled in subduction zones down to the asthenosphere/transition zone and the lower mantle. (2) that super deep diamonds formed by metasomatic processes involving C-H-O-N fluids both oxidised (carbonate or carbonatite-bearing) and reduced (CH_4-bearing) and (3) that the diamond-forming fluids are comparable to other super-deep diamonds from others localities (Brazil, Guinea), but also similar to fluids percolating at shallower depths within the lithosphere, suggesting a common mechanism of diamond genesis, with fluid speciation being similar throughout the region sampled.

These results have fundamental implications for the genesis of diamonds, the geodynamic and the compositionnal evolution of the Earth mantle.