# Tracing volatiles in Earth's mantle using He-C-N isotopes in garnet-bearing diamondites

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The origin of diamond-forming carbon in the Earth is unclear [1-3]; sources include subducted organic sediment and primordial mantle carbon. For example, some diamonds contain eclogitic silicate + sufide inclusions and have depleted $\delta^{13}C$ (-10 to -30‰), enriched $\delta^{15}N$ (+3 to +35‰) values, consistent with subducted crustal material [2-3]. However, some diamonds show mantle-like $\delta^{15}N$ (<-5‰) and depleted $\delta^{13}C$ values (-10 to -30‰ ) which have been cited as evidence of enstatite chondrite-like primordial C-N sources [1]. The helium isotope composition of mantle rocks are powerful tracers,of Earth's volatile history because primordial $^3He$ is not recycled back into the mantle. However, there are few He isotope studies of diamond fluids. The $^3He/^4He$ of garnet-bearing diamondites from the Orapa mine (Botswana) range from 0.1 to 3 $R_a$ [4-5], consistent with a recycled origin. However, our recent work has identified a suite of diamondites with $^3He/^4He$ = 0.06 to 8.2 $R_a$ which correlates negatively with $\delta^{13}C$, suggesting that the subduction-related C is associated with mantle $^3He/^4He$ ratios.

To unravel this complexity we are combining He, C and N isotope analyses in polycrystalline diamond from garnet-bearing diamondites from the Orapa mine. These data will also be used to assess the extent to which carbon and nitrogen isotopes are decoupled during diamond-formation [3].

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