Noble gases in diamond hosted fluid inclusions: sorting the deep from the dregs

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Fluid inclusions trapped during diamond formation provide pristine information into the nature of mantle volatile sources. The majority of diamonds are formed at the base of the lithosphere, which due to its non-convective nature is able to retain geochemical heterogeneities introduced through interactions with the upper and lower mantle, crustal, and subduction related sources. In order to evaluate the origin of diamond forming fluids in the lithosphere, we present noble gas isotopic data from a suite of cubic, coated and cloudy diamond from the Nyurbinskaya Kimberlite, Siberia.

Noble gas signatures extracted from fluid inclusions by crushing show two distinct volatile components present within the Siberian lithosphere. Cubic diamonds have average $^{3}He/^{4}He$ of 10 R_A, whilst the $^{3}He/^{4}He$ of the coated and cloudy diamonds is the 6 R_A. The Ne isotopic data is also different between the diamonds with $^{20}Ne/^{22}Ne$ in the cubic diamonds (10.7) consistently higher that the coated and cloudy diamonds, which are dominated by an atmospheric component.

The $^{3}He/^{4}He$ in fluids trapped in the coated and cloudy diamonds are typical of samples from the lithospheric mantle. Fluids trapped in the cubic diamonds have higher $^{3}He/^{4}He$ than lithospheric and MORB mantle sources, but are similar to values reported from the Siberian Flood Basalts (SFB), which are derived from a lower mantle source. Ne isotopic data from the cubic diamond also suggests these diamonds contain a lower mantle volatile component.

Noble gases in diamond hosted fluid inclusions have shown the Siberian lithosphere contains both lihtospheric and lower mantle volatile compponents. The coexistence of lithospheric and lower mantle volatiles within diamonds originating from the same kimberlite indicates the Siberian lithosphere must have had at least two periods of diamond growth from two distinct diamond forming fluids.