

Antiquity of harzburgitic diamonds from the Venetia kimberlite, Limpopo Belt, Kaapvaal craton

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The Sm-Nd and Rb-Sr isotope systematics of harzburgitic garnet macrocrysts and inclusions in diamonds from the Venetia kimberlite have been investigated to determine their age and origin. The 520 Ma Venetia kimberlite is located in the central zone of the Limpopo Belt, considered to have been amalgamated with the Kaapvaal-Zimbabwe craton by subduction-accretion processes some 2.7 – 2.5 Ga ago [1,2].

The inclusion garnets have low Ca and high Cr contents spanning the entire G10 field of cpx-free harzburgitic garnet compositions. The macrocryst garnets have less extreme Ca and Cr contents and represent the disaggregated mantle host rocks of the diamonds. Eight macrocrysts were prepared as interior splits of single grains (1-5mg) whereas 140 inclusions (av wt 40µg) were combined into four Ca-Cr groups to obtain enough Nd, Sm and Sr for total spike ID-TIMS analysis with sample/blank ratios $\geq 10^3$. All the garnets have negligible Rb.

The inclusion garnets have high Sr and Nd concentrations and low Sm/Nd inversely correlated with Ca. Three out of the four samples give an isochron age of 2.30 ± 0.04 Ga and a well-defined unradiogenic initial ($\epsilon_{Nd} = -8$). However, caution is required since initial $^{87}Sr/^{86}Sr$ is variable and inversely correlated with reciprocal Sr, suggesting mixing between a low Ca, low Sm/Nd, radiogenic Sr (≤ 0.707) endmember and a higher Ca, higher Sm/Nd, less radiogenic Sr (< 0.705) endmember. Even so, the initial Nd composition requires a > 3 Ga precursor, as observed for lherzolitic diamonds elsewhere.

The macrocryst garnets also show low Sm/Nd but much more radiogenic Sr (≤ 0.720). Again, their least radiogenic Nd requires an Archean precursor while their most radiogenic Sr points to isolation of the inclusions by diamond in high Rb/Sr host rocks during mantle storage on a billion year timescale.

Hence, our preferred interpretation is that the Venetia harzburgitic diamonds crystallized or recrystallized at ca. 2.3 Ga in modified Archean lithosphere following stabilization of the Limpopo Belt within the Kaapvaal-Zimbabwe craton. The Venetia macrocryst/inclusion garnets are strikingly similar to counterparts from the 370 Ma Udachnaya kimberlite, Siberian craton, where both Archean and Proterozoic generations of harzburgitic to lherzolitic diamonds have been identified.

References

- [1] Phillips D. et al. (1999) *Proc 71KC* **2**, 677-688.
[2] Eglinton B.M., Armstrong R.A. (2004) *SAJG* **107**, 13-32