Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 549

Remobilization of Ancient Material Within the Subcratonic Lithosphere

Dorrit Jacob[1], **Fanus Viljoen** (fviljoen@mhs7.tns.co.za)[2], **Nathalie Grassineau** (nathalie@gl.rhbnc.ac.uk)[3] & **Emil Jagoutz** (jagoutz@mpch-mainz.mpg.de)[4]

[1] Mineral.-Petrol. Institut, Universität Göttingen, Goldschmidtstr. 1, D-37077 Göttingen, Germany
[2] DeBeers Geoscience Center, PO Box 82232, Southdale 2135, South Africa
[3] Dept. of Geology, Royal Holloway University of London, Egham, Surrey TW20 0EX, UK,
[4] Max-Planck Institut für Chemie, Dept. Cosmochemistry, Saarstr. 23, 55022 Mainz, Germany

For the first time, it can be shown directly that remobilisation processes occur within the subcratonic lithosphere. These are documented by eclogitic garnets included in polycrystalline diamond aggregates (framesites) from the Venetia kimberlite in South Africa whose isotopic and trace element characteristics evidence remobilisation of older silicate and carbon components to form the framesites possibly shortly before the eruption of the kimberlite 533 million years ago.

Framesites (Gurney and Boyd, 1982) are recovered from kimberlites together with monocrystalline diamond. The diamond crystallites in these aggregates are typically in the micro- to millimetre range and can host interstitial inclusions of silicates and/or sulphides. The silicate inclusions compositionally cover the same range of harzburgite, lherzolite and wehrlite as do inclusions in monocrystalline diamonds, although harzburgitic compositions seem to be underrepresented (Smelova, 1995; Kirkley et al., 1995). $\delta^{13}C$ values are mostly very negative, which has led some authors to propose an origin from subduction of carbon-bearing sediments for these rocks (Kirkley et al., 1995).

We are currently studying a suite of Framesites from the Venetia kimberlite, situated within the Limpopo Belt off the northern edge of the Kaapvaal craton. The four specimens presented here bear eclogitic garnet with Mg-numbers between 57 and 70 ±sulphide inclusions. Measured $\delta^{13}C$ values are between -15.6 and -22.9 permil which is within, but at the lower end of the variation found in Framesites from Orapa and Jwaneng (McCandless et al., 1989; Kirkley et al., 1995) and overlaps with the distribution found in eclogitic monocrystalline diamonds.

All four garnets have negative initial ε_{Nd} values between -15.86 and -21.67 and low $^{87}Sr/^{86}Sr$ ratios (0.70319-0.70359). They are widely separated from the fields for Group I and Group II kimberlites, but within the large variation observed for diamond-bearing eclogites and eclogitic diamond inclusions. In a Sm-Nd isochron plot the samples form a straight line yielding an apparent age of 125 Ma. This is younger than the age of the Venetia kimberlite (533 Ma) and therefore clearly represents a mixing relationship of components with different Sm/Nd- and $^{143}Nd/^{144}Nd$-ratios. Further support for mixing derives from correlations between initial Nd isotopic and most other chemical parameters of the framesites, such as Mg-numbers, $\delta^{18}O$-values as well as with ratios of trace elements in the garnets . Also, carbon isotopic composition of the diamond crystallites correlates with Mg-number and $\delta^{18}O$ of the garnets.

One of the inferred end-members of this mixing array is characterized by high Mg-number (>81) and TiO_2-contents, low $\delta^{18}O$ (<6.5 permil) and $d^{13}C$ values (< -23 permil), and, most prominently, very nonradiogenic Nd and Sr isotopic compositions. The unradiogenic Nd-isotopes clearly require an old, long term LREE-enriched but unusually Rb-depleted, carbon-bearing end-member. We propose this end-member to be an ancient carbonate vein system in the lithosphere which was remobilised to form a carbonatitic melt containing evolved carbon and Nd isotopic values. This melt reacted with components of carbon-bearing eclogite (second end-member) to form framesite.

Sm and Nd concentrations measured both by isotope dilution and Laser Ablation ICP-MS are identical within error for all but one sample, which was found to be inhomogeneous. This sample contains parts enriched in LILE, but most prominently in Sr which is up to 20 times higher than in the homogeneous main part of the same grain. The Sr-enrichment coincides with an enrichment in Nb, but not Ta, and a depletion in Zr, but not Hf, compared to the homogeneous parts. These trace element zonations may be interpreted as growth zonations and argue for framesite formation very shortly before kimberlite eruption. REE patterns are typical for garnet with depleted LREE and enriched HREE to about 50 times chondrite.

The geochemical composition of cratons appears to be repeatedly influenced by remobilisation of small isolated reservoirs which may be of extreme isotopic compositions, leading to changes in the "original" craton composition and this should caution scientists not to take isotopic ages at face value alone.

Gurney JJ & Boyd FR, *Carnegie Inst. Ybook*, 262-273, (1982).
Kirkley M., Gurney JJ & Rickard RS, *Diamonds: Characterization, genesis and exploration. CPRM Spec. Publ. 1/95*, 127-135, (1995).
McCandless TE, Kirkley MB, Robinson DN, Gurney JJ, Griffin WL, Cousens DR & Boyd FR, *Ext. Abstr. 28th Intern. Geological Congress*, 47-51, (1989).
Smelova GB, *Ext. Abstr. 6th Intern. Kimberlite Conf*, 538-540, (1995).