DIAMONDIFEROUS GARNET MACROCRYSTS IN THE NEWLANDS KIMBERLITE, SOUTH AFRICA - ROSETTA STONES FROM THE KAAPVAAL CRATON KEEL.

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A suite of fragments of diamondiferous garnet harzburgite has recently been found in the Newlands kimberlite, South Africa, following the resumption of mining activity. Unlike their counterparts at other better-known kimberlite localities on the Kaapvaal craton, these harzburgitic diamond host assemblages have survived transport to the surface without being completely disaggregated. In this respect, they resemble diamond-peridotite xenoliths from Roberts Victor (Viljoen et al, 1991), but are much better preserved.

The Newlands kimberlite is located 60 km NW of Kimberley and consists of a series of five blows up to 40 m in diameter on a NE-SW trending fissure system. The intrusion is of Cretaceous age (114 Ma) and is a Group II kimberlite (Smith, 1983). Approximately forty 1-3 cm diameter garnet macrocrysts/xenoliths comprising purple garnet ± olivine, orthopyroxene, chromite and diamond or graphite have thus far been recovered. The diamonds are generally colourless 1-2 mm diameter octahedra with stepped edges and no significant resorption. Some of the garnets have kelyphite rims and all are fractured to varying extents. However, the interiors of fracture segments are fresh. The most spectacular specimen is a purple garnet with chromite, altered olivine and diamond visible. The largest of three protruding diamonds has garnet and chromite as inclusions. Documentation of the assemblage reported here is based on binocular microscope observations of intact samples and analysis of chips of mineral grains from an initial selection of nine diamond- and one graphite-bearing specimens.

The garnets are chrome pyropes with a range of Ca contents from strongly subcalcic (1.7% CaO; 9.8% Cr_2O_3) to calcium saturated (4.5% CaO; 4.6% Cr_2O_3; Fig. 1, Table 1). Associated chromites are of the high Cr variety (63% Cr_2O_3; Table 1) typical of the harzburgitic paragenesis of diamonds. Ti contents of both garnets and chromites are generally below EMP detection limits. Olivines and orthopyroxenes are variously altered and fresher grains from the interiors of some of the specimens have yet to be analysed.

Sr and Nd isotope signatures have been determined for three diamond- and one graphite-bearing garnet macrocrysts (labelled A,B,C and D respectively) covering the range of Ca and Cr contents in Fig. 1. Analyses were performed on fragments of garnet from which all exterior and interior fracture surfaces were removed by microsurgery under a binocular microscope. Isotope ratios have been calculated back to 90 Ma for comparison with similar subcalcic garnets from Kimberley and Finsch kimberlite heavy mineral concentrates and are plotted on a Nd-Sr isotope correlation diagram (Fig. 2). All four Newlands garnets have highly radiogenic $^{87}Sr/^{86}Sr$ ratios (0.711-0.728). Yet, as for the Finsch and Kimberley garnets, their measured Rb contents are negligible. These radiogenic Sr isotope compositions require ancient metasomatic enrichment followed by diffusive reequilibration with a host phase with high Rb/Sr ratio during subsequent mantle storage.

Garnet $^{143}Nd/^{144}Nd$ ratios are more variable. Those for garnets A and B are unradiogenic. Their combined Nd and Sr isotope signatures define a trend subparallel to those for Finsch

and Kimberley (Fig. 2). Both garnets have Sm/Nd ratios lower than the chondritic ratio, consistent with ancient LREE enrichment. Garnet B with the highest Sr and lowest Nd isotope ratios also has the most subcalcic major element composition (Fig. 1). Conversely, garnets C and D have radiogenic $^{143}Nd/^{144}Nd$ ratios correlated with Sm/Nd ratios significantly higher than the chondritic ratio, consistent with subsequent LREE depletion. These two garnets appear to have lost their subcalcic character (Fig. 1) while the assemblage has retained diamond (garnet C) or had it converted to graphite (garnet D), and apart from the apparent absence of modal clinopyroxene they begin to resemble garnets in some cold coarse garnet lherzolite xenoliths from Kimberley (Richardson et al, 1985). If the four Newlands specimens analysed to date were originally cogenetic, then a period of at least 500 Ma prior to kimberlite emplacement is required to develop the difference in Nd isotope signature for garnet D (and C) relative to garnet B (and A). Nevertheless, the major, trace and isotopic data are consistent with these diamondiferous garnet harzburgites being originally Archaean in age, like their Finsch and Kimberley counterparts (Richardson et al, 1984).

Richardson, S.H., Gurney, J.J., Erlank, A.J., Harris, J.W. 1984. Nature 310, 198-202.
Richardson, S.H., Erlank, A.J., Hart, S.R. 1985. Earth Planet. Sci. Lett. 75, 116-128.
Smith, C.B. 1983. Nature 304, 51-54.
Viljoen, K.S., Robinson, D.N., Swash, P.M. 1991. 5IKC Ext. Abstr. Vol., 440-442, CPRM, Brasilia.

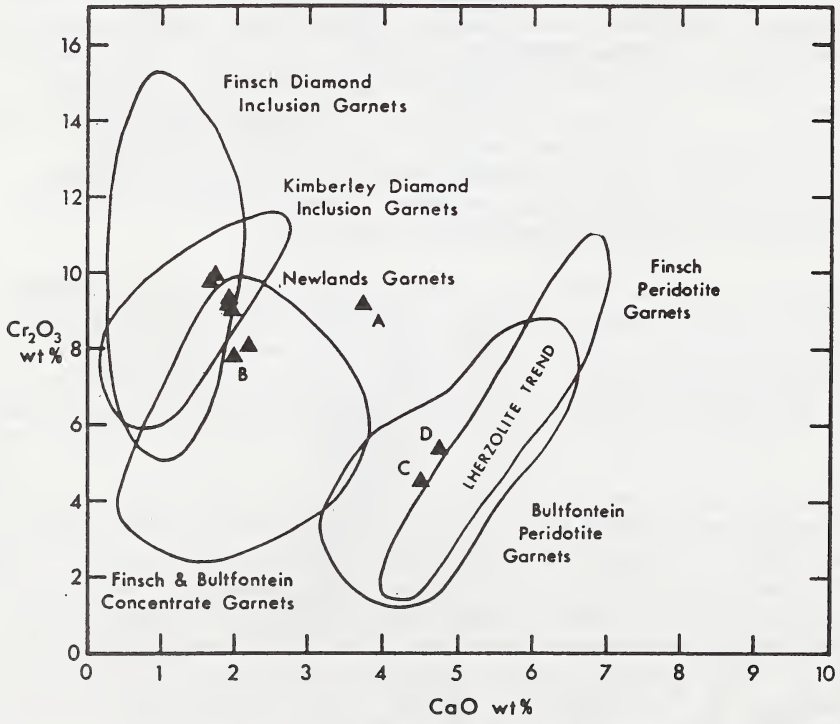

Fig.1 Distribution of CaO and Cr_2O_3 in diamondiferous garnet macrocrysts from the Newlands kimberlite relative to fields for subcalcic garnets in diamonds and heavy mineral concentrates, as well as calcium saturated garnets in peridotite xenoliths, from the Kimberley and Finsch kimberlites (Richardson et al, 1984, and references therein).

Table 1. Garnet and chromite analyses of diamondiferous harzburgites from Newlands kimberlite

Sample	SIO2	TIO2	AL2O3	CR2O3	FEO	MNO	MGO	CAO	TOTAL
Garnets									
A	41.42	0.08	17.26	9.18	5.82	0.32	22.03	3.73	99.80
B	41.94	n.d.	18.54	7.81	5.85	0.31	23.37	1.96	99.78
C	41.84	n.d.	20.94	4.58	6.70	0.36	21.15	4.50	100.05
D	41.74	n.d.	20.17	5.35	6.84	0.41	20.71	4.72	99.94
AHM D1	41.73	n.d.	17.76	9.08	5.83	0.32	23.16	1.94	99.80
AHM D2	41.66	n.d.	17.10	9.78	5.96	0.33	23.22	1.66	99.71
AHM D3	41.65	n.d.	17.58	9.13	5.87	0.30	23.09	1.90	99.50
AHM D4	41.77	n.d.	18.40	8.07	6.07	0.28	23.04	2.16	99.79
AHM D5	41.67	n.d.	17.32	9.32	5.85	0.28	23.12	1.90	99.45
AHM 4	41.43	n.d.	16.92	9.97	6.08	0.36	23.18	1.68	99.61
Chromites									
AHM D1	n.d.	n.d.	7.64	63.53	13.92	0.27	14.28	n.d.	99.64
AHM D2	n.d.	n.d.	7.81	62.91	14.44	0.24	14.03	n.d.	99.43
AHM D4	n.d.	0.11	7.57	63.43	14.72	0.22	13.93	n.d.	99.98

Notes: 1. n.d. = not detected 2. FeO calculated as total FeO

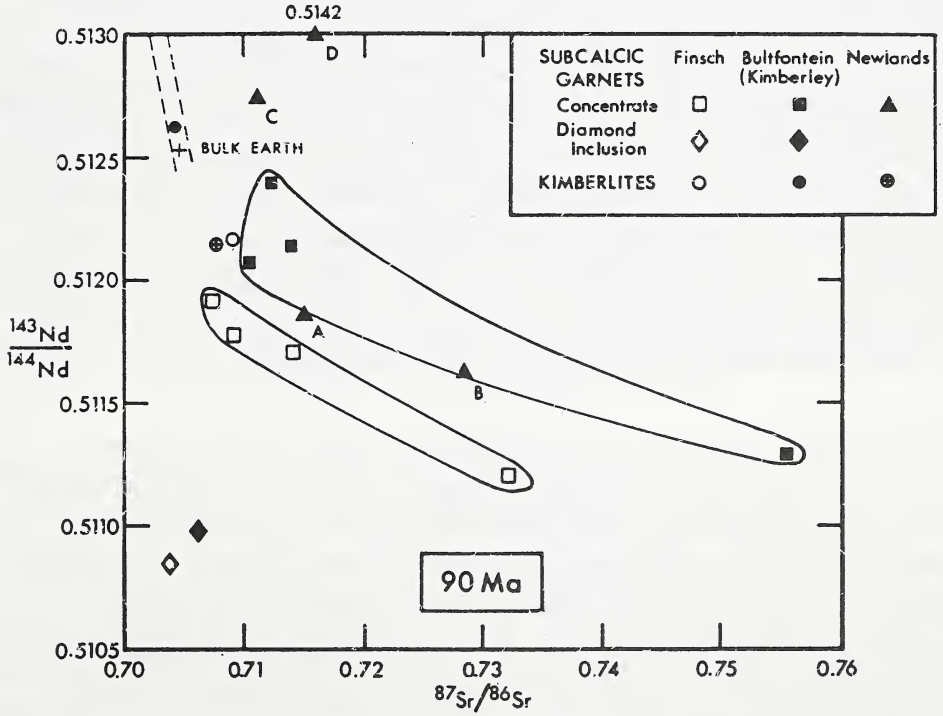

Fig.2 Nd-Sr isotope correlation diagram (constructed at 90 Ma) for macrocryst garnets from the Newlands kimberlite relative to inclusion and concentrate garnets from the Kimberley and Finsch kimberlites (Richardson et al, 1984, and references therein).