Sr-Nd isotopes in the garnet-pyroxenite xenoliths from Siberian kimberlites: a new insight into lithospheric mantle.

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Garnet pyroxenite is a rare kind of mantle xenoliths in kimberlites and they have not been well characterized geochemically in comparison with peridotite and eclogite suites. A set of seven garnet pyroxenite xenoliths from the Udachnaia (6) and Mir(1) kimberlite pipes have been studied on the major element and Sr-Nd isotope composition of their minerals. Five of them are garnet websterites and the next two are garnet-clinopyroxenites.

Our garnet-websterites contain 18-40 modal% of Opx and are composed by garnet of 35- 50% and two pyroxenes in variable amounts. On the basis of chemical composition of minerals this websterite suite can be divided into two groups. The first group include 3 samples which have magnesian garnets (16.8-21.24Wt% MgO) and high MgO/Na2O ratios comparable to eclogites grA of Taylor and Neal (1989) classification. The next 2 samples have a high FeO content in Gar (19.26-23.11Wt%) and Cpx composition that plot in the field of grB eclogites. Further on the text the names a grA and grB websterites will be used. The garnet-clinopyroxenites are composed of purple garnet and emerald green Cr-diopside in proportion of 30%/70% for both. Sample yv/m89 modally metasomatised contain about 2% of phlogopite. They have a minerals signatures in color and chemistry that rather similar to peridotite than the eclogite suite. Their garnets contain Cr_2O_3 as much as 2.9-3.7 Wt%. The P-T equilibrium condition are 19-23Kbar, 790-830C^o for the grB websterites and 25-46Kbar, 760-1060 for grA respectively. For the clinopyroxenites only temperature was estimated (910-1002 C^o) at assumed pressure of 25Kbar.

The concentration of Sm and Nd in the websterite clinopyroxenes of 1.23-11.15ppm and 16.7-77ppm respectively, significantly exceed that of mantle eclogites (Snyder et al, 1997) as well as peridotites (Pearson et al,1995), but comparable to grA eclogites from Bellsbank (Neal et al., 1990) and gr2 eclogites from the Orapa kimberlite (Viljoen at al., 1996). Measured Nd isotope ratio range between 0.51518-0.51697 for garnet and 0.51097-0.51221 for Cpx respectively. The Sr isotope ratios of minerals are different among the groups being slightly radiogenic for grB 0.70485-0.70591, depleted for grA and clinopyroxenites 0.70272-0.70338 at the time of kimberlite emplacement (367Ma, Kinny et al., 1997). The Sm-Nd isotope system in the all xenoliths give a two point (Gar-Cpx) apparent isochron ages considerably older than emplacement of the host kimberlite (Tab.1). Two compositionally similar and low pressure grB xenolith show a Middle Proterozoic age 1465-1550 Ma. The xenolith from the Mir pipe give a 1227 Ma

age and two samples give a Later proterozoic age 641-616Ma. The phlogopite bearing garnet clinopyroxenite sample give an youngest age, 582Ma.

Table 1. Apparent isochron age and $^{143}Nd/^{144}Nd$ initial ratios of garnet pyroxenites.

Sample	Isochron age Ma	Initial ratio
yv21/91 G.Webster.	1550	0.510191
yv403 -	1465	0.51014
m 153/72 -	1223	0.510623
yv 22/91-	642	0.511924
yv 143/86	616	0.512123
yv/m89 G.Clinopyr.	582	0.510958

Gunter and Jagoutz (1997) demonstrated the correlation between total concentration Sm and Nd in Gar and Cpx and apparent Gar-Cpx isoxron age in the low-temperature garnet peridotites. In our case it tend to be correlated but not clear. On the other side the higher temperature samples show a lower apparent ages therefore we agree with the Gunter and Jagoutz (1997) proposal that the closure temperature of Cpx of around 860C^{o} is reasonable. Also exist a strong correlation between Al_2O_3 content in Opx with isochron age.

The Nd isotope system in garnet pyroxenites recorded a complicated history of Siberian cratonic mantle. On the diagram of initial ratio versus age (fig.1), the Middle Proterozoic websterite xenolith plot below the primitive mantle and fall to evolution line of Daldin series granulites from the Anabar shield (Spiridonov et al, 1994). On the base of isotope composition of this xenolith (εNd, -10 at 1.5Ga) we propose their origin from the enriched source and their protolith can be a recycled continental crust material. Their 1.5Ga isochron age probably reflects phase transformation and reequilibrium of this material under the mantle condition. Two Later Proterozoic Age xenolith plot between CHUR and depleted mantle evolution lines. It seems more likely that they originated as a cumulates from a melt with the depleted isotope signatures and low Sm/Nd ratio that comparable to kimberlite gr1. Phlogopite bearing clinopyroxenite show a evidence of ancient LREE enrichment and have the CHUR Nd model age of Cpx is 1.853Ga. The Sr-Nd composition of Cpx from other clinopyroxenite suggest derivation from a depleted part of lithospheric mantle, εNd= +5 at the time of kimberlite emplacement.

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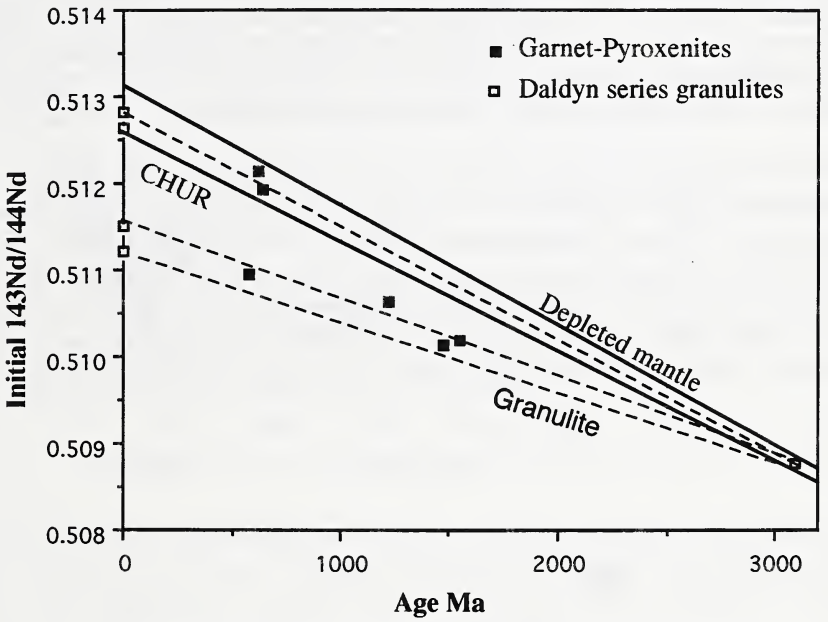

Fig 1. Initial 143Nd/144Nd ratio vs isochron age diagram for garnet pyroxenite xenoliths from Siberian kimberlites. Evolution of Daldyn series granulites shown as dashed lines.