

Peculiarities of pyroxenite paragenesis garnets distribution in Yakutian kimberlites and some aspects of the Siberian craton lithospheric mantle evolution.

Pokhilenko, N.P.¹, Sobolev, N.V.¹, Kuligin, S.S.¹, and Shimizu, N.².

1. Institute of Mineralogy and Petrography, Novosibirsk, 630090, Russia

2. Department of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA.

Three intense cycles of kimberlite magmatism activity are known on the Siberian Platform: Upper Devonian-Lower Carboniferous (370-345 Ma), Triassic (240-220 Ma), and Upper Jurassic (150-135 Ma) (Davis et al., 1980; Brachfogel, 1995). Another paramount event of the Phanerozoic stage of the Siberian Platform evolution was a huge but relatively short-term cycle of trap magmatism at the Permian-Triassic border, with its maximum intensity expressed 235-230 Ma ago (Zolotukhin, Almukhamedov, 1988; Baksi, 1990).

Thus, two cycles of kimberlite magmatism, Upper Devonian-Lower Carboniferous and Upper Jurassic, and the peak of intensity of the Jurassic trap magmatism were separated by considerable gaps of 110 Ma and 70 Ma, respectively. The kimberlite fields formed during the Upper Devonian-Lower Carboniferous are known both for central and northeastern regions of the Yakutian Kimberlite Province, while the Upper Jurassic kimberlites have been established only in the north and northeast.

Comparative analysis of the distribution of compositions of representative samples of pyropes (>100 grains from each body) from the concentrates of several tens of heterochronous pipes in the central and northern fields of the province as well as pyropes from the Lower Carboniferous conglomerates developed within the Kyutyungda graben on the northeastern margin of the Siberian Platform (Sobolev et al., 1981) showed that:

1. Pyropes from the Middle Paleozoic kimberlites from the central and northern regions are very close in CaO and Cr₂O₃ variations for compositions corresponding to lherzolite and harzburgite-dunite parageneses; a distinguishing feature of the Middle Paleozoic kimberlites from the northern regions is the nearly complete absence of Ca-rich Cr-pyropes of wehrlite paragenesis which are rather common in the kimberlites from the central regions (Sobolev et al., 1973).
2. A typical feature of the garnet complex from the Upper Jurassic kimberlites is a many-fold increased share of pyropes of pyroxenite parageneses in them as compared with the garnets from the Paleozoic kimberlites; this is expressed in significantly increased of FeO average and decreased Cr₂O₃ contents (see Table 1).
3. In the kimberlites of Upper Jurassic age the role of pyropes with a high (>7 wt.%) admixture of Cr₂O₃ drastically drops: for example, the amount of these pyropes for 32 pipes of Middle Paleozoic age from the Daldyn and Alakit fields averages 15.2%, and for 26 pipes of Upper Jurassic age from the Lower Olenek region it averages 2.1% (see Table 1).

Detailed study of the complex of mantle rock xenoliths from the heterochronous kimberlites of the Siberian Platform has shown that the thickness of the lithosphere of the central regions in the Paleozoic time was no less than 250 km at heat flows in the range from 36 to 39 mWm⁻² (Pokhilenko et al., 1991; 1993; Griffin et al., 1995; Boyd et al., 1997). The complex of mantle-derived xenogenous material from the Upper Jurassic kimberlites in the northeastern part of the Siberian Platform characterizes the considerably less thickness of the lithosphere (no more than 150 km) with heat flows being no less than 40 mWm⁻² at that time. On the other hand, Ni-Cr thermobarometry of the pyropes from the Middle Paleozoic kimberlites on the same territory gives the lithosphere

thicknesses and heat flows comparable with those for the Middle Paleozoic kimberlites from the central parts of the platform (see Fig. 1).

A considerably increased role of pyroxenites in the lithosphere mantle of the Siberian Platform, joint with a significant increase in the total thickness of the lithosphere, may be due to the processes of erosion (thinning) of the lithosphere mantle as a result of the active interaction of the lithosphere roots with melts of asthenosphere origin during an intense cycle of trap magmatism, covering a territory of about 1.5 mln km² (Pokhilenko, Sobolev, 1995).

The transformation of the harzburgite-dunites from the lithosphere roots into lherzolites and wehrlites as a result of the interaction with mantle-derived melts is documented at different stages of its evolution by rare findings of these rocks in the xenolith complex (Shimizu et al., 1994; 1997). We have found and explored a unique xenolith of peridotite with unambiguous signs of its primary paragenesis of harzburgite-dunite type and its successive transformation into wehrlite and then into lherzolite; the amount of clinopyroxene completely missing from the primary rock reached 30-35 vol.% in the end product. The presence of the rocks of this composition in the mantle corroborates our scheme suggesting significant transformation of the lower levels of the lithosphere mantle when trap magmatism intensely developed within the Siberian Platform.

Table 1. The compositional peculiarities of the garnets of ultrabasic paragenesis from the Yakutian kimberlites (Pokhilenko et al., 1988).

Kimberlite regions	$\frac{N}{n}$	FeO x/S	Cr ₂ O ₃ x/S	n ₁ , %	n ₂ , %	n ₃ , %
Daldyn-Alakit	$\frac{32}{6726}$	$\frac{8.06}{1.07}$	$\frac{4.20}{2.34}$	35.8	15.2	3.2
Lower Olenek	$\frac{26}{3834}$	$\frac{9.44}{1.62}$	$\frac{2.75}{1.26}$	4.8	2.1	0.0

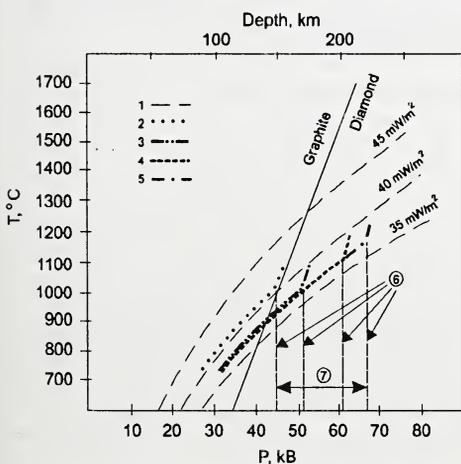
N - amount of researched pipes; n - amount of analyzed garnet grains.

n₁ - amount of pyropes with Cr₂O₃ > 5 wt. %

n₂ - amount of pyropes with Cr₂O₃ > 7 wt. %

n₃ - amount of pyropes with Cr₂O₃ > 10 wt. %

Fig. 1. The estimations of lithosphere thickness and geotherm character for the North-Eastern marginal zone of the Siberian Platform at Middle Paleozoic and Upper Jurassic time.



1. The geotherms calculated for the heat flows of various intensity.
2. The geotherm for Lower Olenek region (Upper Jurassic time).
3. The geotherm for the lithosphere under Ivushka pipe (Middle Paleozoic time).
4. The geotherm of the South-Western board of Kyutyungda graben (Middle Paleozoic time).
5. The geotherm for the North-Eastern board of Kyutyungda graben (Middle Paleozoic time).
6. The estimations of maximal pressures and depths of the root parts of lithosphere for the areas 2-5 at various time.
7. The maximal interval of lithosphere erosion of the region during the period between Lower Carboniferous and Upper Yurassic time.

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