

Mantle Sections Beneath Yakutian Kimberlites, Thermobarometric Study

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Thermobarometric study of mantle lithosphere Siberian kimberlites (Sobolev, 1977) is restricted by the high alteration stage of the most of mantle xenoliths except for Udachnaya, Mir, Onazhennaya and some other pipes. Mineral thermobarometry allow receiving the general regularities of the mantle sections (Ashchepkov et al., 2003; 2008).

the Fe# for coexisting olivines and other minerals calculating using regressions between xenolith's minerals with TP values (plotted in fig.1) and correlation lines between monomineral and common methods of mantle thermobarometry. Thermometer of (Krogh, 1988) with Al- barometer (McGregor, 1974) reproduce LT branch. Essentially modified (O'Neill, Wood, 1979) thermometer with the new corrections to Ca/Mg ratios reproduces the more HT path.

Regularity of mantle sections and layering in Daldyn field are recognized on the TP and P-X diagrams.

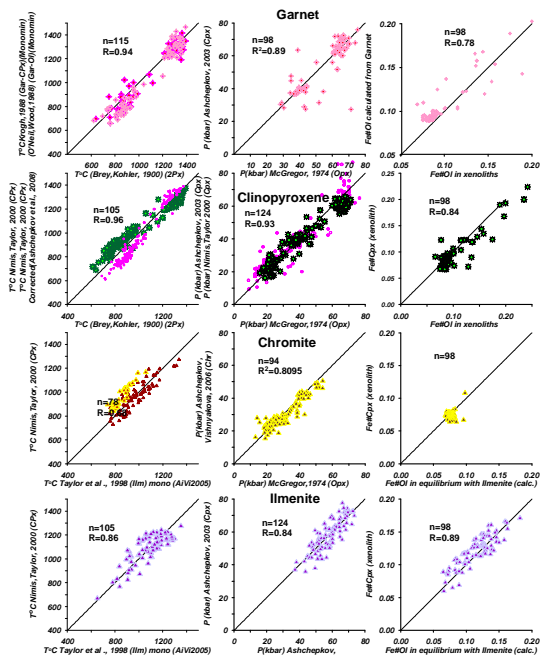


Fig1. Correlations between T°C, P(kbar) received by monomineral and common methods of mantle thermobarometry and Fe#Ol calculated vs xenoliths.

Opx thermobarometry for mantle beneath Udachnaya give not only low-temperature (LT) branch (Boyd et al., 1997) close to conductive obtained with common thermometers (Krogh, 1988; O'Neill, Wood, 1979; etc) but also two more HT- PT paths of mantle melts. Three branches are reproduced by the substitution in the thermometers Ol-Sp and Gar-Ol to Cpx different values of Fe# (0.07, 0.085 and 0.11). Modified thermobarometric equations for Garnet, Chromite and Ilmenites (Ashchepkov et al., 2008) take in to account

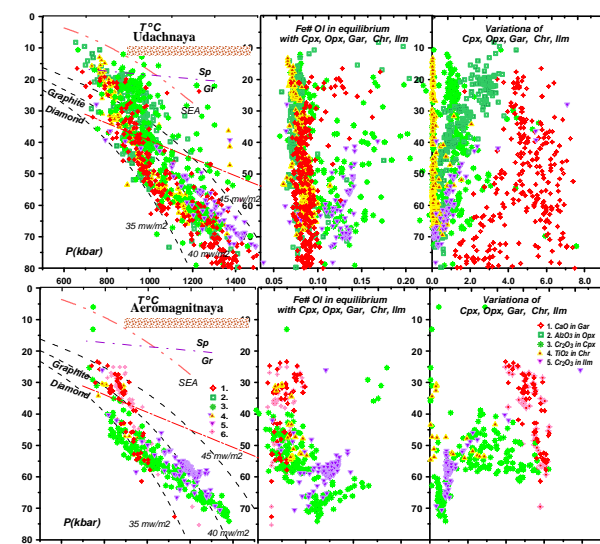


Fig.2. TP estimates for mantle sections beneath Daldyn kimberlite pipes. 1. Gar-monomineral thermobarometry: T°C (Krogh, 1988, monomineral) - P kbar (Ashchepkov, 2006); 2. the same T°C (O'Neill, Wood, 1979 monomineral); 3. Opx: T°C (Brey & Kohler, 1990) - P(kbar) (McGregor, 1974); 4.Cpx T°C (Nimis & Taylor, 2000) - P(kbar) (Ashchepkov, 2003) for peridotites; 5. Chr: T°C (Taylor et al., 1998) - P(kbar) (Ashchepkov & Vishnyakova, 2006) 6. Ilm: T°C (Taylor et al., 1998) - P(kbar) (Ashchepkov & Vishnyakova, 2006)

Thermal conditions of the lower part of mantle sections were heated by the protokimberlite melts created the megacrystalline associations. TP values of subcalcic garnets are correlating with those of picroilmenites. Large pipes like Udachnaya reveal complex layering consisting from 12-13 units correlating with the peaks of Re/Os ages (Spetsius et al., 2007) and plume events. Large amounts of pyroxenites and 'hot' eclogites (Pokhilenko et al., 2000) are found in ~55-65, ~40 and 50 kbar. For smaller pipes the layering in mantle is less visible but fertilizations with Cr-low pyroxenes also associates with the protokimberlite influence. Mantle sections of *Alakite field* are subjected to pervasive metasomatism in several stages, the latest create the Fe-enriched Cr-diopsides and some low-Ca garnets probably near the melt feeders. For mantle columns beneath the Aykhal pipe ilmenite TP trends were formed at least in the 3 stages, the major magmatic source at 60-70 kbar was accompanied by the HT metasomatites. Rising protokimberlites to 50 kbar was accompanied by Cr- enrichment according to AFC (DePaolo, 1981). Mantle layering is emphasized by the stepped Fe#-rise of garnets found in 10 intervals. In mantle lithosphere beneath Komsomolskaya the layering is visible in 6 sharp intervals. Ilmenites forming magmatic systems were found in two intervals 70-58 and 54-43 kbar, rise of CaO for garnets in these intervals or Ca-decrease is correlating with Cr- rise of clinopyroxenes.

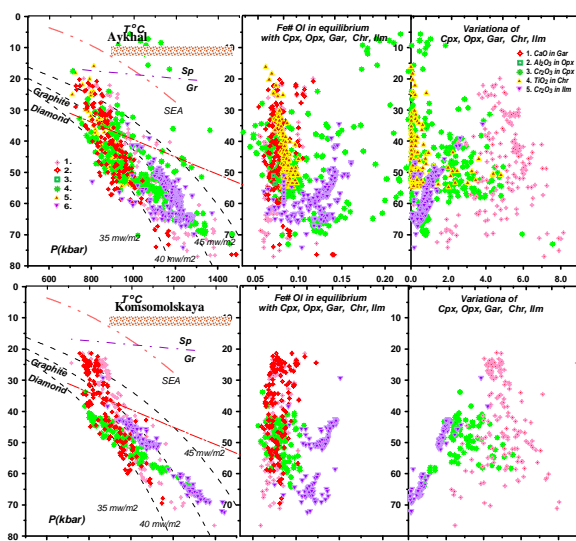


Fig.3. TP estimates for mantle beneath Alakite pipes.

In *Malo-Botuobinsky field* mantle section beneath Mir pipe is subjectet to heating from base to 45 kbar due to protokimberlites created Cr- less picroilmenites. Cr-ilmenites appear in metasomatites upper. Low- Ca garnets in this interval corresponds to several (7) layers probably reflecting primary subduction horizons. Depletion formed low- Ca (Ti-bearing) - garnets partly refer to the last plume event. Thick dunite-harzburgerite lens is detected by chromites ~50-60 kbar. Layered lherzolite sequence with abundant pyroxenites and metasomatites constitutes 4 units upper (45- 30 kbar). Heating detected by garnets TP values refers to those

found for ilmenites. Layering in mantle beneath International'naya is overprinted by metasomatism from the base to 50 kbar where HT pyroxenites and picroilmenites occur.

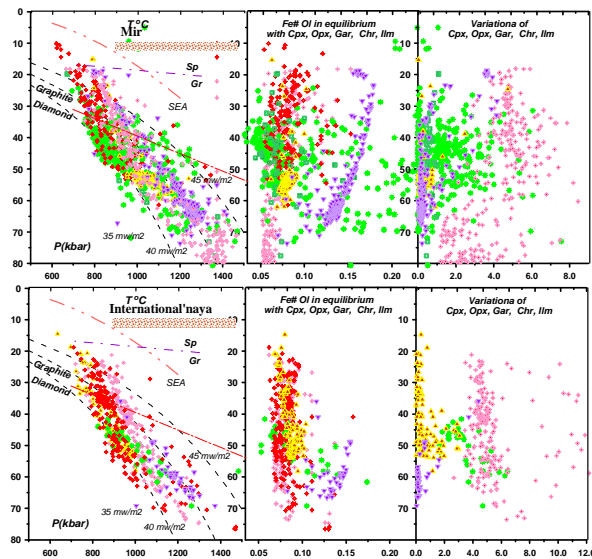


Fig.4. TP estimates for mantle lithosphere beneath Malo- Botuobinskoe kimberlite pipes

In *Upper- Muna field* mantle sequence between the Deimos pipe is close in structure to Alakite pipes. Fe-enriched clinopyroxene - bearing rocks are distributed within the pressure gap (60-55kbars) in location of ilmenite- forming systems (70-60 and 55-40 kbar), the Ilm- metasomatic veins are situated upper. Rocks with sub-Ca garnets starts from 40 kbar typically for Upper Muna field. Mantle beneath Novinka is enriched in Cpx- rocks lower 45 kbar, garnet ilmenites are scarce and substituted by Fe-chromites common for other pipes, sub -Ca garnets are abundant from 55 kbars.

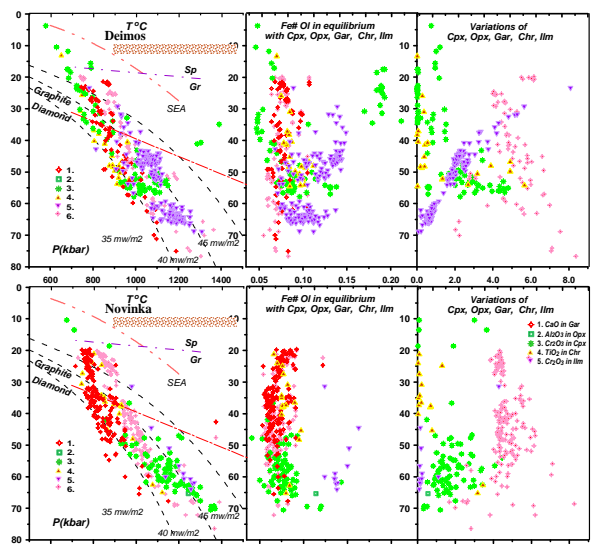


Fig.5. TP estimates for mantle sections beneath Upper-Muna kimberlite pipes.

In *Nakyn field* rhythmic layering found for peridotites for lower part (P>40kbar), fertilization by Fe-Cpx (40-50 kbar) followed the Ilm- forming system ~55-60kbar

correlating with depleted (low-Ca) peridotites occurrence beneath Nurbinskaya. The mantle sequence for Botuobinskaya is similar but peridotite depletion is higher and fertilization starts lower 50 kbar.

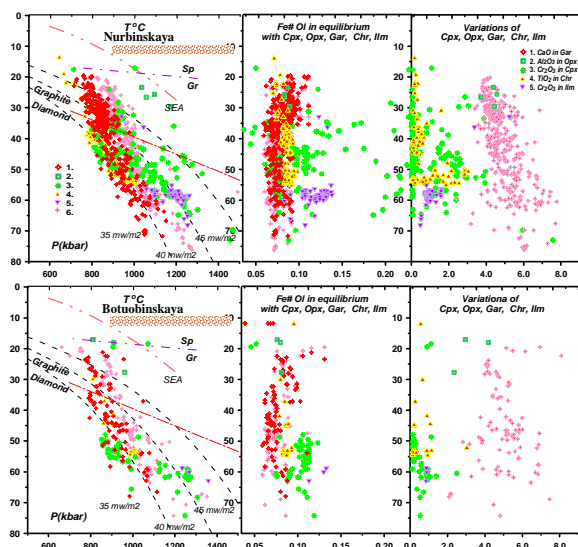


Fig.6. TP estimates for mantle in Anabar field.

In *Anabar fields* highly depleted mantle is subjected to Fe- metasomatites followed ilmenite growth $P > 40$ kbars and abundant Gar-CPx rocks are typical upper. Mantle beneath Trudvaya includes the relics of low- T^0 peridotites and pervasive protokimberlite feeders to 40 kbars. Essential fertilization take place in upper section. Cr-low ilmenites from lower part of mantle lithosphere prevail in this region. Mesozoic pipes from Kuoyka (Olenek region) and Chompolo field (Aldan) reveal highly Fe-metasomatized mantle series below 40 kbar and more strong in the level of upper asthenospheric lens. The relics of Mg-peridotites from LT branch and Cr-bearing HT metasomatites occur in lower mantle part.

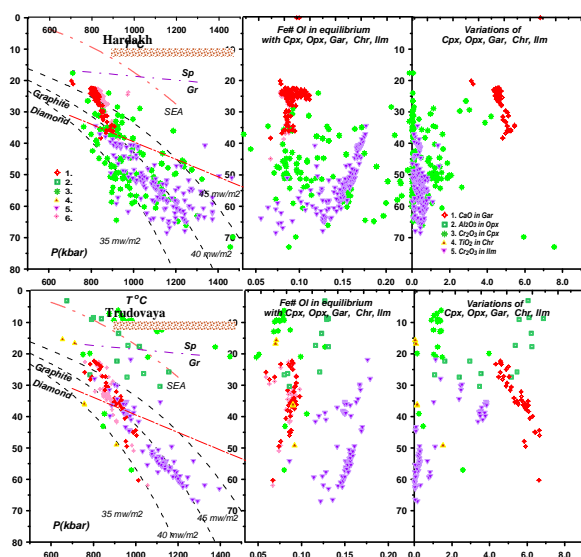


Fig.5. TP estimates for mantle sections beneath Anabar kimberlite pipes.

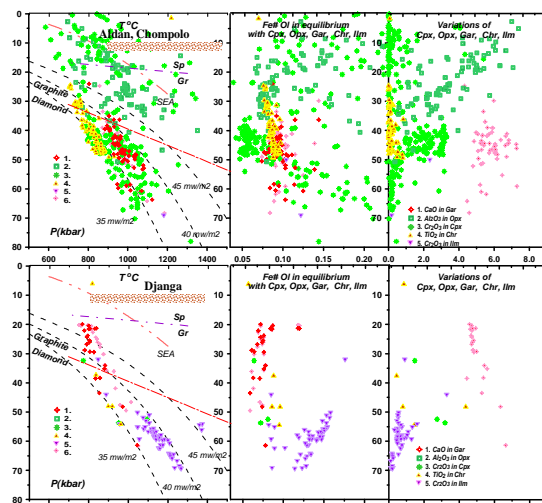


Fig.7. TP estimates for mantle in mesozoic Aldan and Olenek kimberlite fields.

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