Ashchepkov I.V.[1], Pokhilenko N.V.[1], Vladykin N.V.[2], Kuligin S.S.[1], Malygina E.V.[1], Pokhilenko L.N.[1], Ovchinnikov Y.I.[1] Using of Jd-Di clinopyroxene thermobarometry for the mantle reconstruction.

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keywords: [mantle, mineral thermobarometry, layering, peridotite, pyroxenites, density, heating, subduction, plum]

Abstracts. New Cpx barometer (Ashchepkov, 2001) used for reconstructions of mantle sections have no essential restrictions for mineral associations and allow to determine TP conditions for spinel and garnet bearing peridotites coinciding with OPx thermobarometry and adding the new information. Sections in the central parts of cratons are composed from the consequently depleted slices of mantle peridotites what probably reflect the evolution in time of subducting slabs coupling with lithospheric layers. Marginal parts of cratons are either more depleted (Zimny Bereg, Aldan-Chompolo) or contain numerous pyroxenites (Obnazhennaya pipe). Mantle sequences subjected to plums are anomalously heated in 30-12 kbar interval responsible for basalt generation and at the basement of lithosphere. Heated associations are more ferriferous. Pyroxenites are common at the depth ~ 40 kbar what is regulated by viscosity and density properties of silica saturated melts. Density inversion of ultramafic melts near 65 kbar determines the common thickness of lithospheric keel of cratons.

Introduction . Common methods of thermobarometry often produce smooth geotherms for continental lithospheric keels [1] while detail investigation reveals mantle layering beneath large pipes in Africa, America and Siberia [2, 3] supported by dating [2]. Orthopyroxene barometry [4-5] giving the best TP results do not work for OPx-free association. CPx-based methods [6-7] have relatively low resolutions and restrictions. New Jd-Di barometry [8] produces more regular geotherms close to OPx-based and with higher resolution then garnet-based [9].

Structure of mantle beneath Siberian platform .

Udachnaya pipe [10-13] reveal the following mantle structure (Fig.1). HT layer (I) (70-60 kbar) of sheared lherzolites and hot pyroxenites giving two PT trends producing the inflection of geotherm to 40-42 mW/m^2. Layer (II) (60-50 kbar) – cold giant-grained (diamondiferous) garnet dunite - harzburgites [10] close to conductive 35 mW/m^2 geotherm and more hot websterites (to 40 mW/m^2). It is overlain by horizon (III) (45 to 37 kbar) of two layers – lower essentially lherzolitic placing on Graphite-Diamond transition line and upper harzburgitic deviated to 38-40 mW/m^2. GROUP (IV) (35-27 kbar) - Ga-lherzolites are dispersed from 35 to 50 (average 45 mW/m^2). GROUP (V) – Hot Ga Lherzolites (27-20 kbar) is above conductive geotherm 50mW/m^2 as well as Ga-Sp lherzolites group (VI) (23-20kbar) Group (VII) Sp-lherzolites on Cpx- based plot is grouping near 800^{o}C. Resulting close to adiabatic geotherm seems to be produced by coupling with the bands which were originally either subduction- related mantle wedges or the plum – related mantle diapirs. First is realistic for the horizons deeper 30 kbars. Degree of depletion growth with depth and refer to the evolution of the thermal regime of the subducting slabs, lithosphere and asthenosphere. The amount of points for pyroxenites essentially exceeds natural proportions.

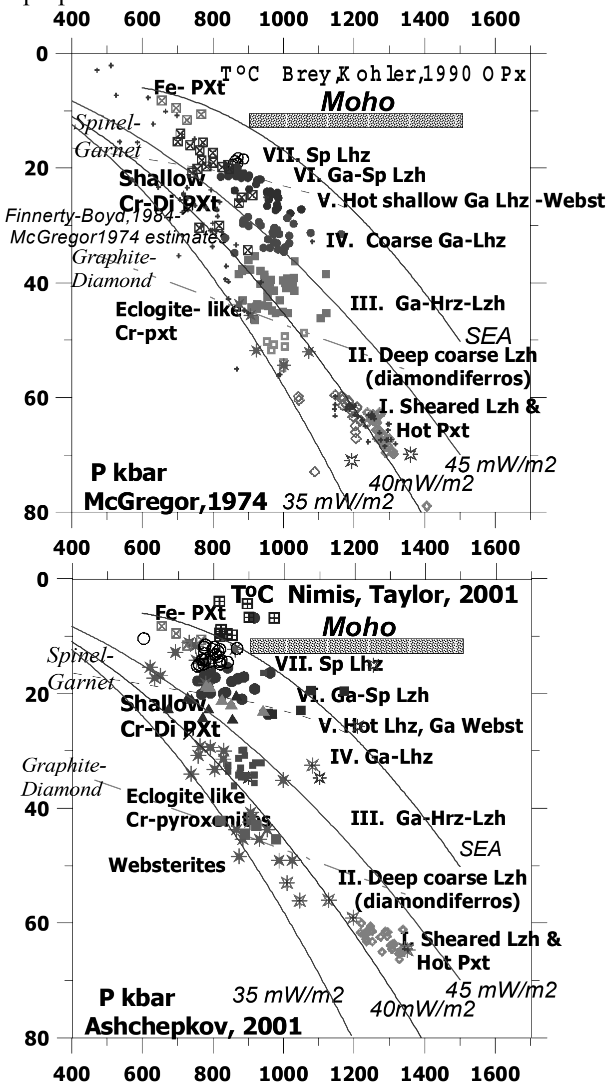

Fig.1. TP reconstructions for Udachnaya pipe. Data used: [1, 10-12]

For Mesozoic Obnazhennaya pipe [13] the layering is not contrast (Fig.2). Sp-lherzolites enriched in CPx compile 10-15 kbar interval being substituted lower by Ga-Sp lherzolites which extends to 30 kbars. Widely distributed Ga websterites are more frequent in lower horizons. Starting from 30 kbars eclogite like rocks prevail in the mantle sequence. OPx-based geothermal gradient determined for this pipe is close to adiabatic also while CPx-based one is much more smoothed showing the variations from 35 to 55 mV/m^2 in at least two-three lenses (Fig.2).

ALDAN SHIELD mantle sequence consists from at least four horizons (Fig.3). The lower and upper parts are essentially heated showing enrichment in Fe in Cpx upper then 40 kbar and an opposite tendency bellow. Opx TP estimates for hot harzburgites are placing close to SEA rift geotherm. Close high irregular heating was determined for xenoliths from Prianabarie is typical for continental rifts [13-15]. Anomalous heating for Siberia is probably caused by Permo-Triassic plum produces the depletion to Fe-dunites (sometimes with glimmerite lenses) in Prianabarie and to Fe- harzburgites in periphery of the Aldan shield. Heating is common for the mantle sections beneath the Mesozoic kimberlite pipes [2,17,18]. In mantle reconstructions the middle horizons ~40 kbars are often enriched in pyroxenites producing the crossing with lherzolitic trends in Cr_2O_3-CaO diagrams for the garnets [18-20].

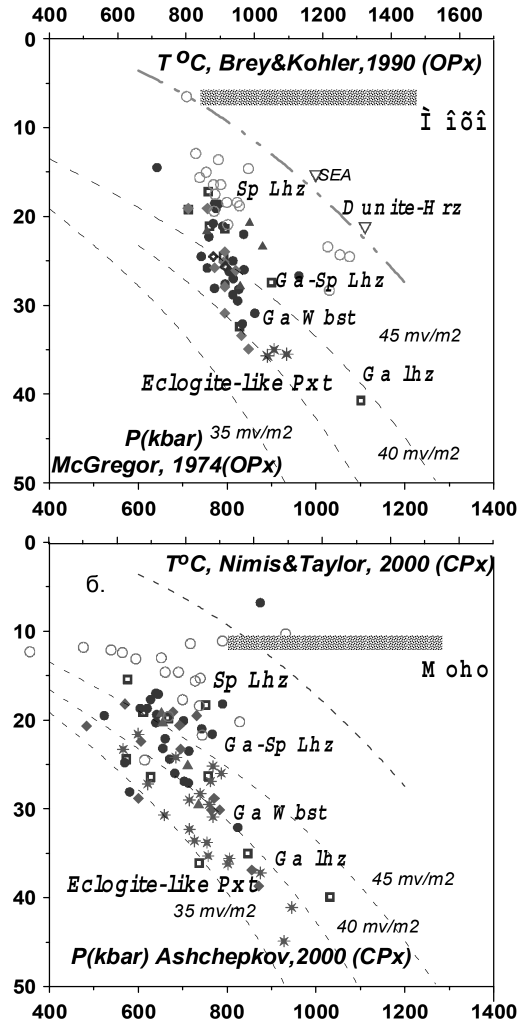

Fig.2. TP reconstructions for Obnazhennaya pipe. Data used: [13]

Summary for the kimberlitic mantle sections. Mantle sequences in the central parts of cratons reveal contrast layering more smoothed in periphery. Pyroxenites lenses trace phase transition boundaries reflecting the leap of melt/solid density ratios. Pyroxenites and metasomatics in upper mantle sections decrease mg' upward from common mantle ~0.9 due to differentiation of rising melts and are often heated. Common thickness of the of the lithospheric keel results from density ol-melt inversion [20].

Possible reasons of layering

Uppermost mantle 20-30 kbars probably produced in nucleation stage is often fertilized and heated by later plum melt intrusion.

Creation of the *middle (~40kbar) pyroxenite* layers may result from: 1) density jump for Mg-pyroxenite melts [20, 21]; 2) betray from coupling of mantle diapirs in nucleation stage of craton; 3) influence of Graphite-Diamond transition on volatile content and probably melt viscosities; 4) crystallization of silica-rich subducted related melts on thermal boundary; 5) concentration in lherzolites that hardly transfer the melts comparing with dunite-harzburgites in lower mantle sections. *Lower zones* of the sheared or porphyric peridotites are formed by intrusion of deep (plum) melt. Heating causing phlogopite breakout at ~1350°C brings to K_2O, H_2O melts saturation and possibly depletion of upper washed peridotites, appearance of lamproites and micaceous kimberlites. Rhythmic layering probably reflect zonation in subduction wedges evolved in time becoming more depleted with rising of oxygen content in lithosphere and amount of water passed through the mantle columns. Lithospheric keels of cratons are asymmetric due to influence of the Earth rotation when western subduction zones moving faster and sinking steeper are often either subducting or obducting while the eastern ones may couple with the continents what is reconstructed in mantle profiles obtained by thermobarometric [2,22] or by seismic methods.

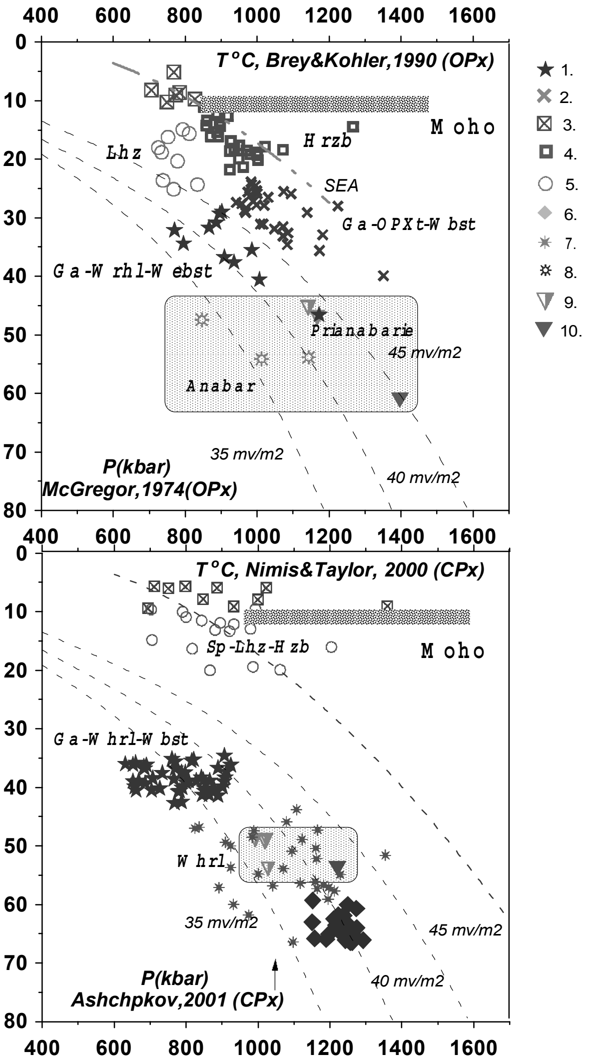

Fig.3. TP reconstructions for Aldan and Prianabarie. Data used: [17 and unpublished]

Conclusions. Single pyroxene thermobarometry reconstruct sharp layering in the lithospheric structure that differ from those obtained by garnet thermobarometric methods [9]. CPx- and OPx- based methods sometimes reconstruct different sections due to difference in mantle lithology.

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