MORE PRECISE EQUATION OF THE JD-DI BAROMETER

Ashchepkov I.V.
Igor.Ashchepkov@uiggm.nsc.ru; phone- fax: (3832) 33-35-84

Grant RFBR 99-05-65688

Monomineral thermobarometry has an advantages comparing with the polymineral allowin the TP reconstructions and estimation of the geotherms for the kimberlite pipes with the disintegrated and serpentinized mantle inclusions. Pyroxene methods [1-4] have the higher resolutions comparing with the garnet – based [5] and do not need the complete associations as [2,5] and other Px-Gar methods. Jd-Di barometer [1] (Ashchepkov, 2001) for mantle peridotites give the estimates in a good agreement with the orthopyroxene methods [3] and experimental data for the wide rock spectrum being more for applicable for the moderately depleted craton keel peridotites. For the metasomatic assemblages with the high concentration of Na_2O, TiO_2, Al_2O_3, the barometer systematically overestimates the pressure. Here the more precise equation is represented. It essentially increase the agreement of the pressure estimates with those based on Opx methods and experimental data (more then 1300 natural and about 250 experimental associations were used for the calibration)

$P(Ash2003a)_{1st}=0.19*Kd^{3/4}*T^oK/(1+Fe)-35*\ln(1273/T^oK)*(Al+Ti+2.5Na+1.5Fe3+)$ {1} where Kd = Na/Ca *Mg/(Al+Cr)(F.u.) and more precise second polynomial approximation $P(Ash2003b)= -0.009*P_{1st2}+1.5191 *P_{1st}$ {2} (r=0.855). For the temperature estimations it is proposed also to use the polynomial approximation: $T=-0.000001*T^2_{NT}+0.9575*T_{NT} +107.01$ with the estimates based on [2] 2Px и $T=0.0000005*T^3_{NT} -0.0013*T^2_{NT} +1.851864*T_{NT}$ and on [2] Opx method.

These equations give good TP data for the pyroxenes from wide range of the basic and ultramafic essentially Mg- rich rocks (Fig.1). The universal equation has not been found yet. The KD by the order of 2/3 is better working for the low pressure compositions, and by the order of 3/4 .is working for wider compositions. The simple equation [1] is working for slightly depleted peridotites while using the additions in equation similar to published in [4] essentially rises the agreement of the diagrams (Fig.2) Comparison with the experimental data shows in general the close pressure values with the experimental ones. The disagreement is partly explained by the non equilibrium experimental products and not a good analytic data as well as some calibration error.

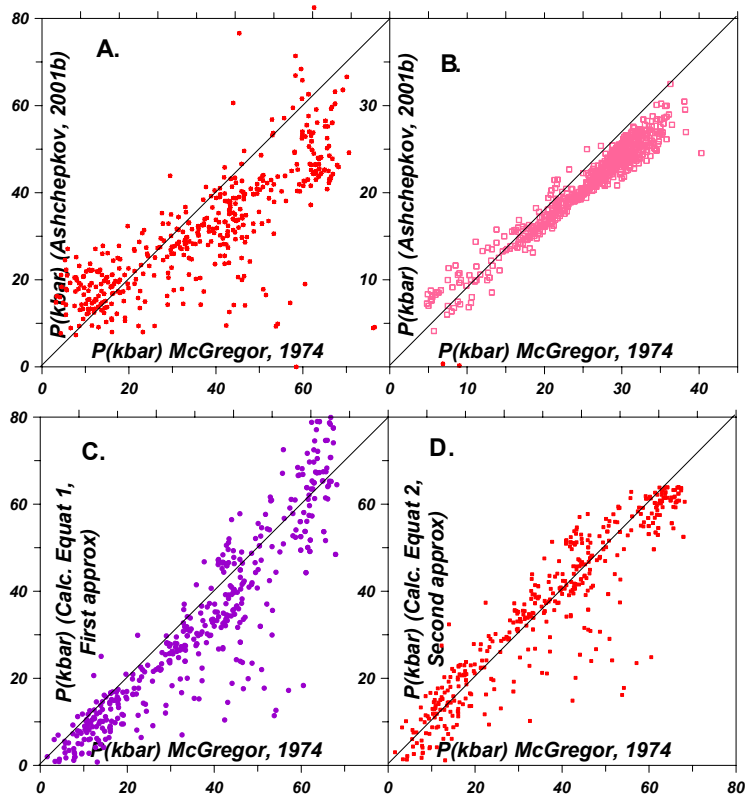
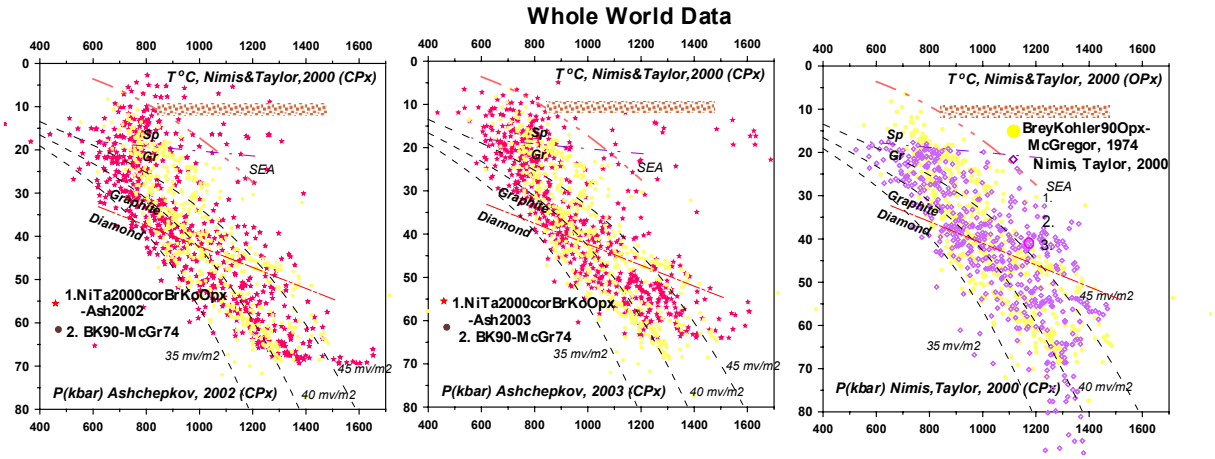


Fig.1. A. –correlation of [3]- [1] (b) estimates for kimberlite associations; B - correlation of [3]- [1] (b) estimates forVitim mantle xenoliths; C - correlation of [3]- equation 1 (this study), estimates for kimberlite associations [1]; C - correlation of [3]- equation 2 (this study), estimates for kimberlite associations [1].

For the eclogites the experimental data are restricted. Barometer is working good for Mg- rich and essentially overestimates the pressure for Fe – rich eclogites. For the Omph eclogites it is better to use the garnet - clinopyroxene thermobarometry. The estimates for diamond bearing eclogites are all plotting within the diamond stability field. It possible to use them also for the megacrystalls and peridotites from shallow mantle facies.



A. B. C

Fig.2. Comparative diagram for the kimberlite xenoliths data (1300 ассоциаций) using two versions of the Jd-Di barometer with [3] (A, B) and [4] (C). A – [1] (equ a), B – this study Note – temperatures are corrected to [2] OP – (see text).

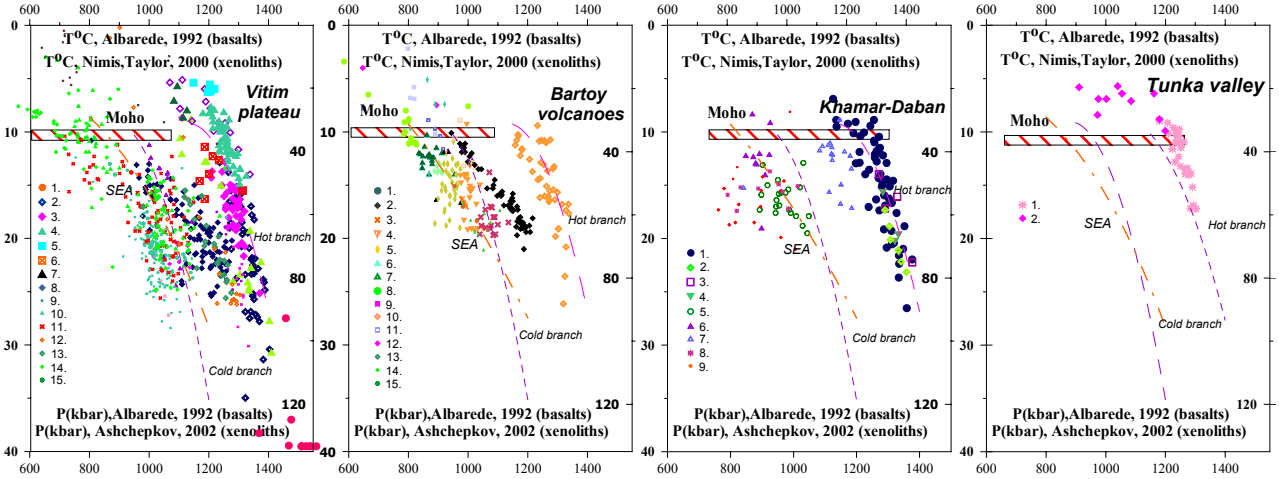


Fig.3. Comparison pf the data obtained using Jd-Di barometer for the deep seated xenoliths and megacrysts from the alkaline basalts from Baikal Rift in comparison with the TP estimates for the Basalts from the same volcanic regions (Albarede, 1992)

References:

1. *Ashchepkov I.V.* Clinopyroxene Jd Barometer For mantle peridotites and eclogites and thermal conditions of the lithospheric keels of cratons and their surroundings. Geo-odyssey. GSA Annual meeting. November 1-10, Boston. ID 11658.
2. *Brey, G.P., Kohler, T.* 1990 Geo-thermo-barometry in four phase lherzolites II: New thermo-barometers and practical assessment of using thermo-barometers. J. Petrol., 31. PP.1353-1378.
3. *McGregor, I.D.* 1974. The system MgO–Al2O3–SiO2: solubility of Al2O3 in enstatite for spinel and garnet–spinel compositions. Am. Mineral. V.59: 110–19.
4. *Nimis P., Taylor W.* 2000. Single clinopyroxene thermobarometry for garnet peridotites. Part I. Calibration and testing of a Cr-in-Cpx barometer and an enstatite-in-Cpx thermometer. // Contrib. Mineral. Petrol. V.139. N5. P.541-554.

5. *Ryan C.G., Griffin W.L. & Pearson N.J.* 1996. Garnet geotherms: Pressure-temperature data from Cr-pyrope garnet xenocrysts in volcanic rocks. J. Geophys. Res. 101. PP.5611-5625.
6. *Nickel, K.G., Green, D.H.* 1985. Empirical geo-thermo-barometry for garnet peridotites and implications for the nature of the lithosphere, kimberlites and diamonds. Earth Planet. Sci. Lett. V.73. PP.158–170. Canada. P.1-16.
7. *Albarede F.* 1992. How deep do common basaltic magmas from and differentiate. Journal of Geophysic Research. V.97. PP.10997-11009.

Electronic Scientific Information Journal "Herald of the Department of Earth Sciences RAS" № 1(21)'2003
Informational Bulletin of the Annual Seminar of Experimental Mineralogy, Petrology and Geochemistry – 2003
URL: http://www.scgis.ru/russian/cp1251/h_dgggms/1-2003/informbul-1_2003/term-7e.pdf
Published on July 15, 2003