Ashchepkov I.V. Jd-Di barometer for mantle peridotites and eclogites

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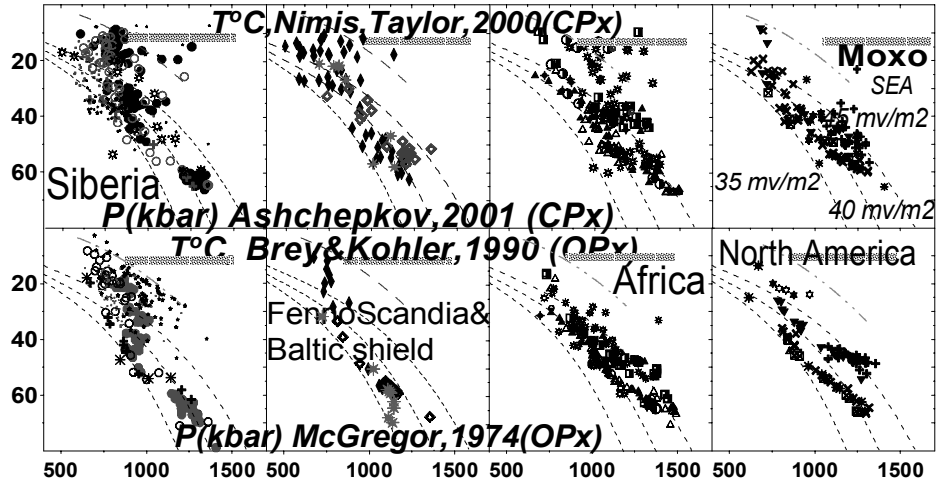
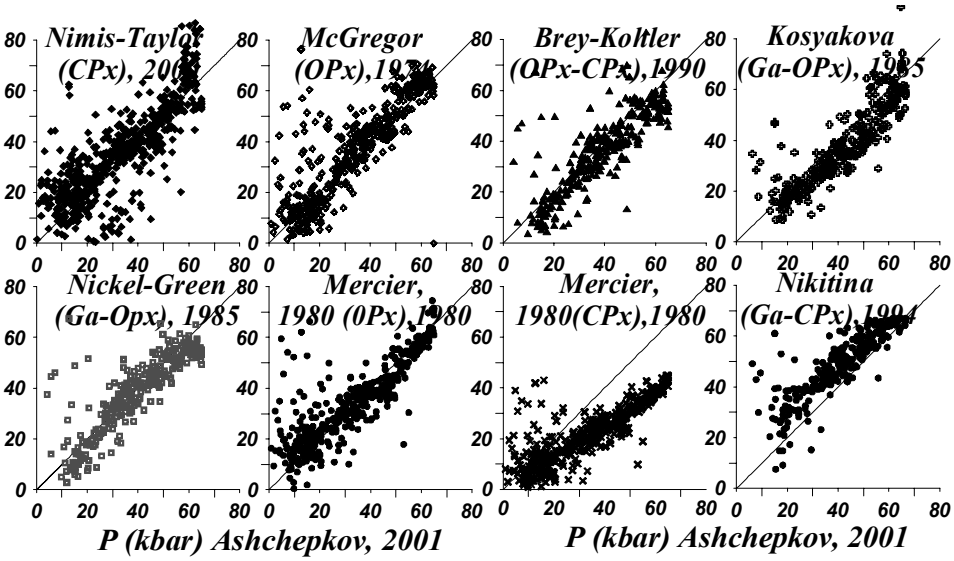
Introduction. Recent developing of single mineral thermobarometric methods (Ryan et al., 1997; Nimis, Taylor, 2000; etc.) (NT2000) give the wide opportunities for the mantle reconstruction but agreement of methods varies due to difference in experimental data sets, uncertainness in calibration, equilibration of associations, difference in rates and closure diffusion temperatures for components (Brey et al., 1991) etc. In this paper the new variant of CPx thermobarometry is presented. It was created to find the agreement between the OPx – based thermobarometry 1990(Opx) (BK90Op-McGregor, 1974(MG74)).





Calibration. This method uses simplified exchange Di –Jd. The Na reveal better correlation with (Al^{tot} +Cr) (Kuligin et al., 1998) then with Al^{VI} + Fe^{3+}+Cr that depends from the Si accuracy in measurements. Dependency KD = Na/Ca *Mg/(Al+Cr) from calculated pressure was calibrated using more then 1000 associations from kimberlite deep seated inclusions. The temperatures were determined by (Nimis –Taylor, 2000) (NiTa2000) with the polynomial correction to T^o values determined with the (Brey- Kohler, 1990) BK2Px. The equation Pi= 0.04*Kd *T°C/(1-2.4*Fe)-5.5 {1} gives the estimates correlating with P (MG74) as following P= -0.0068*Pi^2 +1.3538*Pi-0.35 {2} (r=0.84). Resulting P values lineally ~1 correlates (r=0.91) with those obtained with (MG74) ones. Resulting geotherms are similar to those obtained by OPx (fig.2).

Since (BK90Op) thermometer have no corrections to Fe and other components it gives overestimations 50-100° under 2Px methods such as Wells, 1977 (We77), Bertrand Mercier, 1985 (BM85); Brey- Kohler (1990)(Opx-Cpx). Nimis&Taylor, 2000 CPX thermometer give good correlation with the clinopyroxene methods (R=0.91-0.95) but essentially underestimates the temperature values to 100-150° in the low temperature association. To correct this and to reproduce BM85 values the polynomial $T = 0.000001*T^2_{(NiTa2000)} + 0.9575*T_{(NiTa2000)}$ 107.01 was used. Together with the equation 1-2 this thermobarometirc method reproduces OPX geotherms for different cratons. (Fig.1.)

Possibly the Na- bearing phases (amphiboles) may interfere in the Na behavior like the coexisting plagioclase and spinels in influence on the on the Al_2O_3 content in the Opx. But in the lack of the Na- phases the barometer is the

kind of the structural barometer where the volume of the structural cell is determined by the pressure.

Essential entrance of the Fe^{3+} in the clinopyroxene produces the overestimations of the calculated pressures for the aegerine bearing varieties. The more complex model where KD = Na/Ca Mg/(Al^{IV}+Cr+ Fe3-2*Ti) partly solve this problem. It give the following best approximation to P values after McGregor, 1974.

$P= 0.54*KD*T^{(2/3)}/(1+2.45*Fe) -5.3.$ {3}

When using it with (BK90Op) temperatures PT values practically reproduce OPx-based plots for individual pipes such as Udachnaya (Pokhilenko et al, 1993, 2000; Boyd et al., 1997) and other localities.

Correlation With Other Methods. The correlations between the methods are shown on the Fig.1 . As it evident the new barometer gives very good correlation with those based on the Opx (McGregor,1974) and Gar- Opx (Nickel, Green, 1985; Brey, Kohler, 1990) not bad with the Ga-Cpx method-(Nikitina, 1994) but less with those based on single clinopyroxene Nimis, Taylor, 2001; Mercier, 1980.

Implication To The Shallow Mantle. In the shallow mantle the resolution of the method is lower due to the interaction with the different melts more higher Fe3 contents and presence of the metasomatic minerals. The McGregor equations often overestimate the pressure in the shallow mantle for example from Vitim (Ashchepkov,1991) mantle so we used a modified version

$P=0.45*KD*(T0)^{(2./3.)}/(1+2.5*Fe(f.u.)-3$ {4}

that give more realistic pressure range. It reproduces the mantle heating under Vitim (Ashchepkov et al ., 1988), the Mantle section beneath Malaiita Nixon, Boyd, 1973 and often allow to give the pressure values for the basaltic inclusion of spinel and garnet lherzolites.

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