EXPERIMENTAL TEST OF THE MONOMINERAL STATISTICAL THERMOBAROMETERS FOR MANTLE PERIDOTITES

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Original monomineral thermobarometers for mantle peridotites for clinopyroxene, garnet, chromite and ilmenites for the mantle peridotites were statistically calibrated on the TP estimates for mantle peridotites [1] were tested using the mineral phases obtained in high pressure experiments with the natural peridotites (380 runs) and eclogites (240 runs).

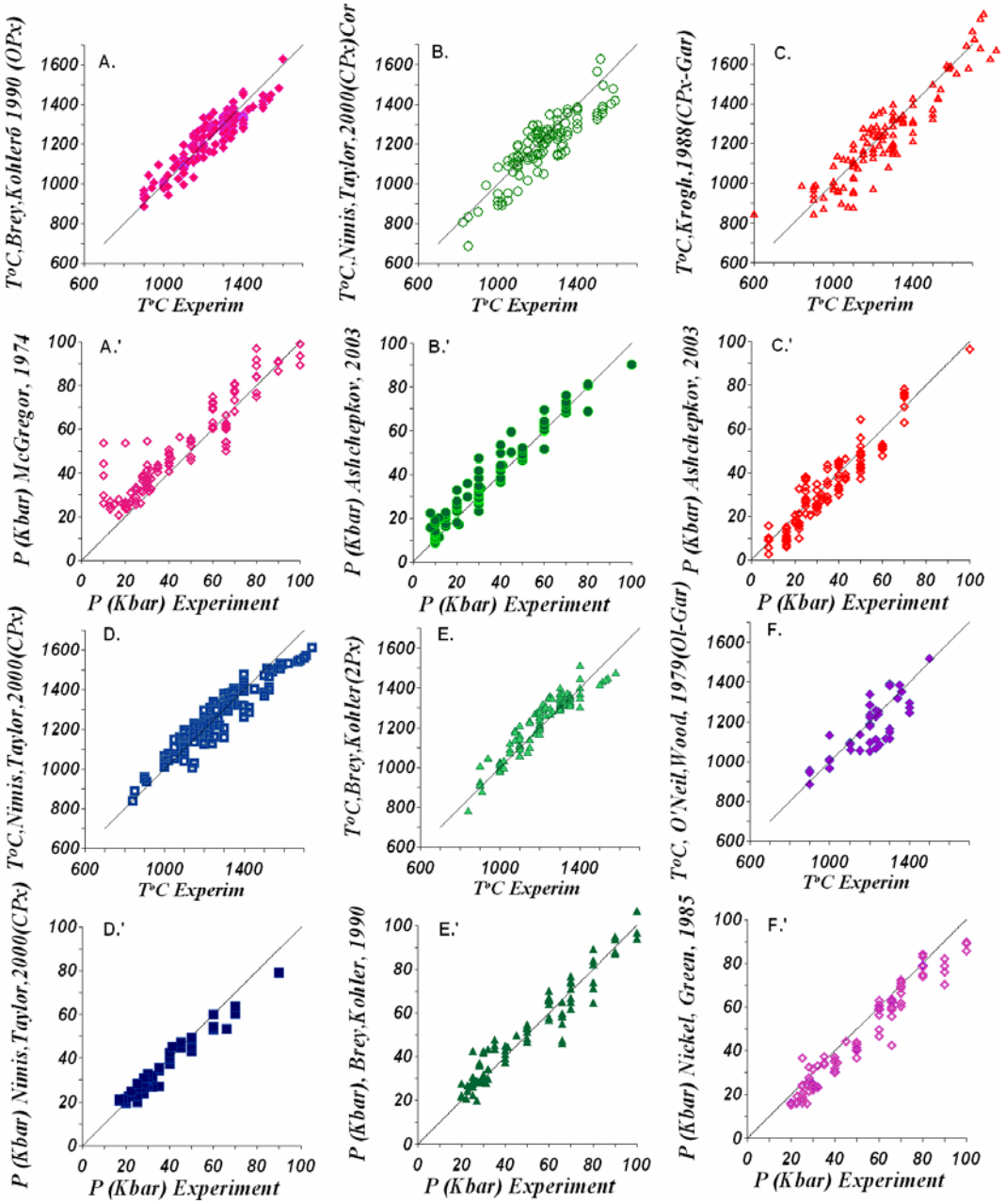

Fig.1. Correlations between the determined pressures and temperatures with barometers [3-7] and thermometers [4, 5,7-9] and experimental conditions

For GARNET

Three variants of barometer give similar results. The first is published [2]. The second is calculating the Al2O3 from Garnet for Orthopyroxene according to procedure:

xCrOpx=Cr2O3/CaO)/FeO/MgO/500

xAlOpx=1/(3875*(exp(Cr2O3^0.5/CaO-0.3)* CaO /1000+16)-XcrOpx

xAlOpx =xAlOpx*24.64/xx(5,4)**0.5*xx(5,8)**0.2/3.+xx(5,5)*(ToK-500)/900

xval=xval/((ToK-550)/850)-2.25*ln(MgO-1.5)

IF(CaO.LE.4.or. Cr2O3.ge.7) xAl2O3=(xval/alog((T0-550)*2000-2.25*ln(MgO-1.5)))*1.07

And then it supposes using of the calculated xAl2O3 in Opx barometer [3].

The third variant is transformation of the G. Grutter [4] method by introducing of the influence of temperature.

P=40+(Cr2O3)-4.5)*10/3-20/7*CaO+(ToC)*0.0000751*MgO)*CaO+2.45*Cr2O3*(7-xv(5,8)) - Fe*0.5 with the correction for P>55: P=55+(P-55)*55/(1+0.9*P)

Temperature are estimating according to transformed Krogh [4]. thermometer

$Fe\#Ol\_Gar=Fe\#_{Gar}/2+(T(K)-1420)*0.000112+0.01$

For the deep seated associations P>55 kbar

$T=T-(0.25/(0.4-0.004*(20-P))-0.38/Ca)*275+51*Ca*Cr^2-378*CaO-0.51)-Cr/Ca^2*5+Mg/(Fe+0.0001)*17.4$

ILMENITE

P= ((TiO2-23.)*2.15-(T0-973)/20*MgO*Cr2O3 and next P=(60-P)/6.1+P

ToK is determined according to [5].

$Fe\#Ol\_Chr =(Fe/(Fe+Mg)_{ilm} -0.35)/2.252-0.0000351*(T(K)-973)$

CHROMITE

The equations for PT estimates with chromite compositions

P=Cr/(Cr+Al)*T(K)/14.+Ti*0.10 with the next iteration

$P=-0.0053*P^{\wedge 2}+1.1292*P+5.8059 +0.00135*T(K)*Ti*410-8.2$

For P> 57 P=P+(P-57)*2.75

Temperature estimates are according to the [6].

The Fe#Ol values are estimated according to three iterations

Fe#Ol_Chr=(Fe/Fe+Mg)/4.5-(P-32)*0.00115-0.03

Fe#Ol_Chr =(Fe#Ol -0.074)*0.45+0.086

Fe#Ol _Chr= Fe#Ol -(Fe#Ol -0.06)*(T(K)-1300)*0.000115+0.01

CLINOPYROXENE

$(Ash2009)=0.32 (1-0.2*Na/Al+0.012*Fe/Na)*Kd ^{(3/4)}*T^oK/(1+Fe)-35*ln(1273/T^oK)*(Al+Ti+2.5Na+1.5Fe3+)+(0.9-CaO)*10+Na20/Al2O3* T^oK /200$

with the second iteration $P=(0.0000002* P^{\wedge 4} +0.000002+P^{\wedge 3}-0.0027*P^{\wedge 2}+1.2241$***P)**

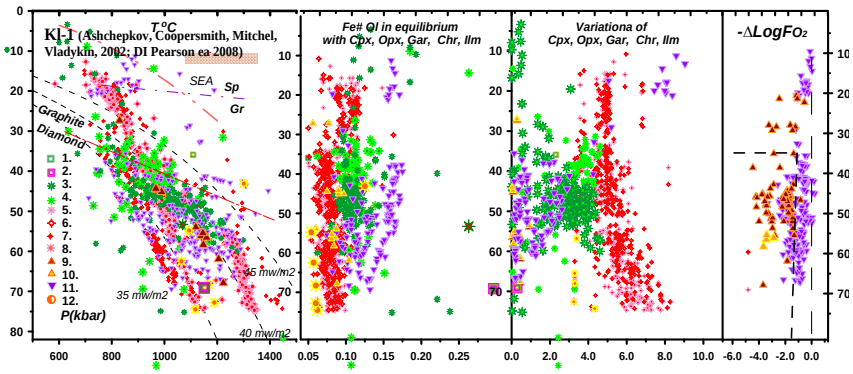

Fig.2. TP diagram for the mantle beneath the Kl-1 pipe Colorado, USA [10]. The signs see [16] in this issue

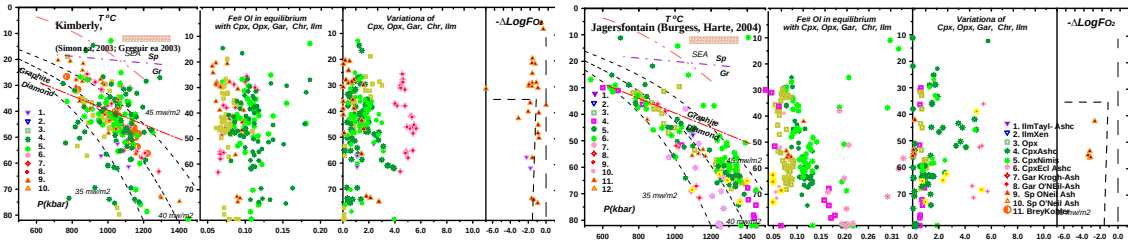

Fig.3. TP diagram for the mantle beneath the S.Africa pipes Kimberly [11] and Jagersfontain [12]

Clinopyroxene barometer [2] give the correlation (k ~1) with experimental pressure to 100 kbar (R~0.93) for peridotites and to 80 kbar (R~0.77) for eclogites. Garnet barometer [1] reveal the correlation 80 kbar for low Cr (<4) compositions (R~0.54) and much better (R~0.76) for high Cr garnet compositions determined from the minals (40 runs). Chromite barometer [1] also reveals a good correlation (~0.87). In thermometers [8,9] for garnets for ilmenite [11] and chromite [10] Fe#Ol determined according to the regression equations found from the compositions of the minerals from xenoliths (>900) allow to receive very good coincidence with the mono-mineral versions.

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