Geophysical Research Abstracts,
Vol. 11, EGU2009-8513, 2009
EGU General Assembly 2009
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The evaluation of the statistical monomineral thermobarometric methods for the reconstruction of the lithospheric mantle structure

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The modified versions of the thermobarometers for the mantle assemblages were revised sing statistical calibrations on the results of Opx thermobarometry. The modifications suggest the calculation of the Fe# of coexisting olivine Fe#Ol according to the statistical approximations by the regressions obtained from the xenoliths from kimberlite data base including >700 associations. They allow reproduces the Opx based TP estimates and to receive the complete set of the TP values for mantle xenoliths and xenocrysts.
For GARNET
Three variants of barometer give similar results. The first is published (Ashchepkov, 2006). The second is calculating the Al2O3 from Garnet for Orthopyroxene according to procedure:
xCrOpx=Cr2O3/CaO)/FeO/MgO/500
xAlOpx=1/(3875*(exp(Cr2O3$\hat{0}$.2/CaO)-0.3)*CaO/989+16)-XcrOpx
Al2O3=xAlOp*24.64/Cr2O3$\hat{0}$.2*CaO/2.+FeO*(ToK-501)/1002
And then it suppose using of the Al2O3 in Opx barometer (McGregor, 1974).
The third variant is transformation of the G. Grutter (2006) 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)
Average from this three methods give appropriate values comparable with determined with (McGregor,1974) barometer.
Temperature are estimating according to transformed Krogh 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*Cr2-378*CaO-0.51)-Cr/Ca2*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 (Taylor et al , 1998)
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$\hat{2}$+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 O'Neill- Wall, 1987
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 $\hat{}$(3/4)*ToK/(1+Fe)-35*ln(1273/ToK)*(Al+Ti+2.5Na+1.5Fe3+)+(0.9-CaO)*10+Na20/Al2O3* ToK /200
with the second iteration P=(0.0000002* P$\hat{4}$ +0.000002+P$\hat{3}$-0.0027*P$\hat{2}$+1.2241*P)
The TP estimates were statistically tested wit the available experimental results in peridotite (315 runs) and

eclogite (302 runs) system and show good agreement with the TP conditions of runs.
The methods are joined together with the other 40 thermometers and 30 barometers for mantle associations in the FORTRAN program allowing simultaneous calculations of 10 pairs of T and P and write the matrix of calculated TPFO2 values together with the compositions of minerals or their formula coefficients. Grant RBRF 05-05-64718.