NEW HIGH P-T EXPERIMENTAL RESULTS ON ORTHOPYROXENE-CHROME SPINEL EQUILIBRIUM AND A REVISED ORTHOPYROXENE-SPINEL COSMOTHERMOMETER; A.B.Mukherjee, Dept of Geology and Geophysics, Indian Institute of Technology, Kharagpur-721302, W.Bengal, India; V. Bulatov, Institute of Lithosphere, 22 Staromonetny Per.,109180 Moscow, USSR; and A. Kotelnikov, Institute of Experimental Mineralogy, Chernogolovka 142432, Moscow District, USSR

Reversed equilibration experiments between 800° and 1200°C and 2.3 and 22 Kbar were carried out with a set of natural high Mg orthopyroxene-high Cr spinel assemblages employing both cold seal hydrothermal and solid media piston-cylinder techniques. The run products were analyzed by electron microprobe and the orthopyroxene and spinel composition data were used to supplement Mukherjee and Viswanath's(1) analysis of the compositional relationships of equilibrated orthopyroxene and spinel from wide-ranging P-T regimes. The new data fill the gap in the 1200°C regression of $Mg\text{-}Fe^{2+}$ orthopyroxene-spinel distribution coefficients against the Cr-mole fraction of the Cr-rich spinel and yield an improved formulation of the orthopyroxene-spinel thermometer (Mukherjee and Viswanath,ibid).The revised thermometric expression is as follows.

$$T(K) = \frac{1175.549 + Y_{Cr}^{Sp}\,(2580.473)}{\ln K_D^o + Y_{Cr}^{Sp}(0.282) + 0.328}$$

where $K_D^o$ is the ferric-free distribution coefficient $\dfrac{X_{Mg}^{Opx} \cdot X_{Fe}^{Sp}}{X_{Fe}^{Opx} \cdot X_{Mg}^{Sp}}$

$Y_{Cr}^{Sp} = \dfrac{Cr}{Cr + Al + Fe^{3+}}$ and Opx and Sp represent orthopyroxene and spinel respectively. The new calibration gives temperatures for terrestrial ultramafic rocks which agree well with that of Fabriès (2) and are well within 0.7 to 6% of the estimates obtained from the earlier calibration of Mukherjee and Viswanath. However, the revised estimates for the high temperature diogenites viz. Y-74013, Y-74136 and Y-6902 are in the range 1020° - 1104°C, which still sets them apart from the slowly cooled, deep-seated diogenites e.g. Johnstown and Y-75032 with equilibration temperature range: 700°-800°C. The new thermometer should be useful in delineating the thermal history of a wide range of orthopyroxene-spinel parageneses, including diogenites with histories of shock-heating, remelting and recrystallization (3). A set of representative calculated temperatures for both terrestrial and extraterrestrial orthopyroxene-spinel assemblages obtained from the new cosmothermometer is given in Table-1.

A Gibbs energy minimization analysis suggests that orthopyroxene-chrome spinel form a stable cotectic pair from basic magmas of terrestrial and extraterrestrial lineages.

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Table-1. Mineral compositions and calculated temperatures of some orthopyroxene-spinel parageneses

| Sample | Orthopyroxene | Spinel | | | T°C |
|---|---|---|---|---|---|
| | $X_{Mg}$ | $X_{Mg}$ | $Y_{Cr}$ | $Y_{Fe^{3+}}$ | |
| **Alpine peridotites** | | | | | |
| Lizard,Cornwall(4) | | | | | |
| No. 90683 | 0.81 | 0.77 | 0.19 | 0.052 | 1040 |
| No. 90681 | 0.81 | 0.77 | 0.19 | 0.056 | 1115 |
| Ronda, Spain(5) | | | | | |
| No. R501(m) | 0.87 | 0.72 | 0.26 | 0.01 | 822 |
| No.R196 | 0.86 | 0.81 | 0.12 | 0.025 | 1116 |
| Red Mt., New Zealand(6) | | | | | |
| No.37010(rim) | 0.91 | 0.46 | 0.61 | 0.052 | 693 |
| No.37140(rim) | 0.91 | 0.68 | 0.32 | 0.012 | 768 |
| **Ultramafic nodules** | | | | | |
| Tasmania(7) | | | | | |
| No. LJ7 | 0.85 | 0.80 | 0.12 | 0.021 | 979 |
| No.SC4 | 0.86 | 0.78 | 0.10 | 0.012 | 927 |
| **Diogenites** | | | | | |
| Johnstown(8) | 0.72 | 0.15 | 0.75 | 0.029 | 693 |
| Y-74013(9) | 0.70 | 0.26 | 0.73 | 0.024 | 1020 |
| Y-6902(10) | 0.73 | 0.30 | 0.81 | 0.028 | 1086 |
| Y-74136(M)(11) | 0.71 | 0.31 | 0.70 | 0.035 | 1058 |
| Y-75032(11) | 0.65 | 0.10 | 0.77 | 0.077 | 789 |

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