

Experimental calibration of aluminum partitioning between olivine and spinel as a geothermometer

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ABSTRACT

The temperature dependence of the partitioning of Al_2O_3 between forsterite-rich olivine and Cr-rich spinels has been experimentally calibrated at 100 kPa between 1250 and 1450 °C under reducing conditions. For spinel with values of Y_{Cr} between 0.07 and 0.69, and containing $<0.1 \text{ Fe}^{3+}$ atoms and <0.025 Ti atoms per 4 O atoms the experimental data can be fit to an equation:

$$T(^{\circ}\text{C}) = \frac{10\,000}{0.512 + 0.873Y_{\text{Cr}} - 0.91\ln(K_{\text{D}})} - 273$$

where $Y_{\text{Cr}} = \text{Cr}/(\text{Cr} + \text{Al})$ in spinel in atomic proportions and $K_{\text{D}} = \text{Al}_2\text{O}_3^{\text{ol}}/\text{Al}_2\text{O}_3^{\text{sp}}$ in wt%. This equation reproduces the temperature of the experiment for the calibration data set within ± 22 °C. Empirical tests suggest that this geothermometer has little pressure dependence within the range of pressures encountered in the crust and upper mantle.

Keywords: Olivine, spinel, aluminum, thermometer, experiment