

D Xenoliths and geometers

D1 ENSTATITE-DIOPSIDE SOLVUS TO 60 KB

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The width of the pyroxene solvus in the simple system enstatite-diopside as a function of pressure and temperature is an important constraint for the use of the composition of natural pyroxenes from lherzolites as a geothermometer. Experimental data have been obtained so far only up to 40 kb (only at 1200°C at this pressure). Thermodynamic models based on high pressure experiments and calorimetric data should not be extrapolated above 40 kb according to the authors (e.g. Lindsley, 1980). However pressures up to 90 kb have been estimated in some garnet lherzolites so that an extrapolation of the pyroxene solvus above 40 kb is necessary to estimate the temperature of many garnet lherzolites. With a well-calibrated belt-apparatus (against the silver-melting curve and the quartz-coesite transition) I have now embarked to determine the pyroxene solvus up to 60 kb. Pressures are controlled within 300 bars and the temperature to $\pm 1^\circ\text{C}$ (estimated accuracy ± 0.5 kb and $\pm 10^\circ\text{C}$). Starting materials are mixtures of synthetic enstatite and diopside and for reversals glass of the same bulk composition. So far experiments have been carried out at 40 kb at 1100°C, 1300°C and 1500°C and at 1300°C at 50 kb and 60 kb. The compositional brackets from the experiments for the solvus at 1300°C are given in Table 1. The data are consistent with experimental

	$x_{\text{CaMgSi}_2\text{O}_6}^{\text{En}}$	$x_{\text{CaMgSi}_2\text{O}_6}^{\text{Di}}$	data given in the literature. They indicate
40 kb	0.052	0.78-0.8	that, at 1300°C,
50 kb	0.045-0.048	0.785-0.815	the influence
60 kb	0.036-0.038	0.79-0.83	of pressure on

the position of the solvus becomes less with increasing pressure. An extrapolation of the currently available models on the P, T-dependence of the pyroxene solvus shows that temperature estimates can be too high by up to 250°C at 60 kb.

Lindsley, D.H., *Min.Soc.Rev.Min.* 7 (1980) 289

D2 GEOTHERMOMETERS AND GEOBAROMETERS FOR SPINEL-BEARING ULTRAMAFIC ROCKS

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A series of two pyroxene, spinel-bearing assemblages have been synthesized over the

temperature and pressure range from 900°C to 1300°C and 10Kb to 15Kb, respectively. Systematic compositional variations have been introduced by varying the composition of the reactants in the following synthesizing reaction.



In this way it has been possible to experimentally examine the competing effects of Cr and Al substitution in coexisting pyroxenes and spinels.

The synthesized products have been analyzed with an electron microprobe and used to empirically define expressions that describe exchange reactions between coexisting phases. The results yield a series of geothermometers for Al/Cr exchange between coexisting pyroxenes and spinels, Fe/Mg exchange between coexisting silicates and silicates and spinels. For the compositions used observed pressure dependence of the orthopyroxene-clinopyroxene solvus yields a useful geobarometer for these phase assemblages

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D3 THE OLIVINE-CLINOPYROXENE GEOBAROMETER: IMPLICATION FOR THE THERMAL STRUCTURE OF THE UPPER MANTLE NEAR THE RIO GRANDE RIFT

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Ca-Mg exchange between olivine and clinopyroxene has been studied in the system $\text{MgO}-\text{CaO}-\text{SiO}_2$ in the temperature range 1100-1500°C and pressure range 9-41 kb. Ca in olivine decreases with increasing pressure as a result of Ca going into the higher coordination M2 site of clinopyroxene. For the Ca-Mg exchange reaction between olivine and clinopyroxene, $\Delta V^\circ = 0.249$ j/bar/mole, sufficient for pressure estimates precise to ± 3 kb if temperatures of equilibration are independently known.

The olivine-clinopyroxene geobarometer can be used as an independent check on results from pyroxene barometry applied to garnet lherzolites. Also, it does not encounter the problems inherent in pyroxene barometry of spinel lherzolites. The olivine-clinopyroxene barometer has been applied to