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A new garnet-orthopyroxene thermometer based on reversed Al_2O_3 solubility in FeO-Al_2O_3-SiO_2 orthopyroxene

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ABSTRACT

Reversed phase-equilibrium data, collected over the *P-T* range 12–20 kbar at 850–1100 °C, define the solubility of Al_2O_3 in ferrosilite (Fs) in equilibrium with almandine garnet (Alm). The new data indicate significantly lower Al_2O_3 solubility in Opx in the Fe-bearing system compared with the Mg-system and extrapolate well to merge with the higher pressure bracket of Kawasaki and Matsui (1983). Orthopyroxene-garnet thermometry in crustal rocks, based on the equilibrium studied here (Alm = 3 Fs + Al_2O_3), is considerably more robust than previous calibrations based on the equivalent equilibrium in the Mg system. Results for several granulite terrains show that Al-Opx temperatures based on the new experimental data are generally higher than results based on Fe-Mg exchange thermometry, consistent with suggestions of previous workers. For many samples, the difference in apparent closure temperature between these equilibria (generally 50–130 °C) is within the combined uncertainty of their calibration (~75 °C) and is not as extreme as differences calculated on the basis of Harley's (1984) unreversed experimental data (Bégin and Pattison 1994). The lack of sensitivity of this new thermometer to late Fe-Mg exchange makes it a powerful tool for deciphering near-peak *P-T* conditions for high-grade rocks.