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Experimental test of the Cr-in-Cpx geobarometer

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Experiments in CMAS+Cr and NCMAS+Cr systems were carried out at P = 3 GPa, T = 1100–1300˚C in a piston-cylinder apparatus (84–173 h) and at P = 4–7 GPa, T = 1100–1300˚C in a multi-anvil apparatus (14–70 h). Different types of H_2O-fluxed starting materials (i.e. crystalline mixtures or sintered oxides $\pm$ high- and low-Cr Cpx and Grt crystal seeds) were used in attempts to reverse Cpx and Grt equilibrium compositions. The experimental products were Cpx–Grt–Ol–Opx-bearing assemblages with or without a melt fraction. Runs using crystalline starting materials yielded texturally poorly equilibrated assemblages of highly inhomogeneous minerals and were generally discarded. Runs using sintered oxides produced the best equilibrated textures, relatively homogeneous or patch-zoned (high- and low-Cr) Cpx and strongly zoned Grt. The use of mineral seeds simply increased mineral zoning due to ubiquitous path-looping in Grt and preservation of unreacted cores, making it impossible to obtain true reversals. Although not reversed, the more homogeneous Cpx compositions (N = 22) showed consistent variations with $P-T-X$ changes and allowed us to monitor compositional variations of this mineral in a variety of Grt-buffered systems. When applied to Cpx compositions from these and other experimental peridotitic systems, the Nimis and Taylor (2000) Cr-in-Cpx geobarometer reproduced well P_{expt} to 4.5 GPa (SEE = 0.22 GPa; N = 73), but showed progressive underestimation at higher P_{expt} (up to –1 GPa at 7 GPa). Cpx thermobarometry will distinguish well between graphite- and diamond-facies mantle Cpx, but may yield unduly compressed P estimates and somewhat distorted geotherms for $P_{Cr-in-Cpx} \geq$ 4.5 GPa.

Nimis P. and Taylor W.R. (2000) *Contrib. Mineral. Petrol.* 139:541-554