

Partial melting experiments of CMAS-Cr spinel-lherzolite at 3 GPa

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Experimental studies on the melting of the simplified peridotite system CaO-MgO-Al₂O₃-SiO₂ (CMAS) provide essential information on the fundamentals of melting of the Earth's mantle to produce basalt. However, a large contribution to the variety of primary basaltic magmas derives from minor components, among which Cr₂O₃ stands out for its role in lowering the activity of Al₂O₃ in mantle minerals and hence the Al₂O₃ concentrations in partial melts, as shown experimentally at 1.1 GPa of [1]. The aim of this study is to extend the experimental conditions, in a CMAS-Cr system, at 3 GPa, encompassing the transition between spinel-lherzolite and garnet-lherzolite. Experiments at this pressure face the difficulty that melts do not quench to glasses, but to a fine mass of quench crystals, whose bulk composition may be altered by overgrowth crystallization onto stable crystals. Accordingly, experiments were performed with a "sandwich" layout, in which a pre-sintered peridotite mix is placed at the extremities of a platinum capsule, separated by a finely ground glass with a composition close to that estimated for the equilibrium composition. The minerals assemblage consists of forsterite, enstatite, diopside and spinel mixed in the proportion of 2:1:1:1, respectively. To check for disequilibrium with respect to alumina, one mineral layer contained pyroxenes with high alumina, the other with low alumina. Spinel with molar Cr/(Cr+Al) (Cr#) between 0.1 and 0.6 was investigated. The experiments were performed in a piston-cylinder apparatus at 3 GPa and 1450-1600°C. Back-scattered images show the three distinct compositional layers within the capsule, with the middle layer quench-crystallizing into a mixture of highly Al-rich pyroxenes (up to 11 wt%Al₂O₃) and Cr-depleted spinel, challenging the determination of the melt composition. Following [1], varying concentrations of K₂O will be added to the "sandwiched" layer for identifying melt composition more robustly.

[1] Liu & O'Neill (2004), *Journal of Petrology* 45, 2261-2286.