

Revision of the CaMgSi₂O₆-CO₂ *P-T* phase diagram at 3–6 GPa

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ABSTRACT

We reexamined the phase relationships in the system diopside-CO₂ in the range of 3–6 GPa and 850–1500 °C in multi-anvil experiments, including reversal ones lasting up to 169 h. The reaction CaMgSi₂O₆ (clinopyroxene) + 2CO₂ (fluid) = 2SiO₂ (quartz/coesite) + CaMg(CO₃)₂ (dolomite) passes through 3 GPa/950 °C with a slope of 6 MPa/°C and terminates at an invariant point near 4.5 GPa/1200 °C, where carbonate liquid coexists with clinopyroxene, coesite, dolomite, and CO₂ fluid. The newly determined boundary has the equation $P(\text{GPa}) = 0.006 \times T(^{\circ}\text{C}) - 2.7$. As temperature increases to 1250 °C at 4.5 GPa, liquid, dolomite, and coesite disappear, and clinopyroxene coexists with CO₂ fluid. As pressure increases to 6 GPa, the solidus temperature increases to 1300 °C revealing a slope of 15 MPa/°C. At 4.5 and 6 GPa, solidus melts contain about 1 wt% SiO₂. As temperature increases to 1400 and 1500 °C at 6 GPa, the silica contents in the carbonate melt increase to 6 and 13 wt%, respectively. Our data, combined with that of Luth (2006), indicate that above 4.5 GPa the liquidus reaction involving clinopyroxene and CO₂ sweeps down through 350 °C via a pressure maximum near 5.3 GPa to meet the invariant point at 4.5 GPa. The shape of the diopside-CO₂ solidus resembles that of lherzolite-CO₂ (Wyllie and Huang 1975a) but shifted by 2 GPa to higher pressure. Thus, the deep depression along the solidi in the system CaO-MgO-SiO₂-CO₂ is a fundamental feature of both ultramafic and mafic assemblages at depths of 70–150 km.

Keywords: CO₂ fluid, carbonation, clinopyroxene, phase relations, high pressure, multi-anvil experiments, Earth's mantle