

## The system $\text{K}_2\text{CO}_3\text{-MgCO}_3$ at 6 GPa and 900–1450 °C

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### ABSTRACT

Phase relations in the  $\text{K}_2\text{CO}_3\text{-MgCO}_3$  system have been studied in high-pressure high-temperature (HPHT) multi-anvil experiments using graphite capsules at  $6.0 \pm 0.5$  GPa pressures and 900–1450 °C temperatures. Subsolidus assemblages comprise the fields  $\text{K}_2\text{CO}_3\text{+K}_2\text{Mg}(\text{CO}_3)_2$  and  $\text{K}_2\text{Mg}(\text{CO}_3)_2\text{+MgCO}_3$  with the transition boundary near 50 mol%  $\text{MgCO}_3$  in the system. The  $\text{K}_2\text{CO}_3\text{-K}_2\text{Mg}(\text{CO}_3)_2$  eutectic is established at 1200 °C and 25 mol%  $\text{MgCO}_3$ . Melting of  $\text{K}_2\text{CO}_3$  occurs between 1400 and 1450 °C. We propose that  $\text{K}_2\text{Mg}(\text{CO}_3)_2$  disappears between 1200 and 1300 °C via congruent melting. Magnesite is observed as a subliquidus phase to temperatures in excess of 1300 °C.

At 6 GPa, melting of the  $\text{K}_2\text{Mg}(\text{CO}_3)_2\text{+MgCO}_3$  assemblage can be initiated either by heating to 1300 °C under “dry” conditions or by adding a certain amount of water at 900–1000 °C. Thus, the  $\text{K}_2\text{Mg}(\text{CO}_3)_2$  could control the solidus temperature of the carbonated mantle under “dry” conditions and cause formation of the K- and Mg-rich carbonatite melts similar to those found as microinclusions in “fibrous” diamonds.

The  $\text{K}_2\text{Mg}(\text{CO}_3)_2$  compound was studied using in situ X-ray coupled with a DIA-type multi-anvil apparatus. At 6.5 GPa and 1000 °C, the structure of  $\text{K}_2\text{Mg}(\text{CO}_3)_2$  was found to be orthorhombic with lattice parameters  $a = 8.8898(7)$ ,  $b = 7.8673(7)$ , and  $c = 5.0528(5)$ ,  $V = 353.39(4)$ . No structure change was observed during pressure decrease down to 1 GPa. However, recovered  $\text{K}_2\text{Mg}(\text{CO}_3)_2$  exhibited a trigonal  $R\bar{3}m$  structure previously established at ambient conditions.

**Keywords:**  $\text{K}_2\text{Mg}(\text{CO}_3)_2$ , high-pressure, experiment, carbonatite, upper mantle, potassium carbonate, kimberlite, diamond