American Mineralogist, Volume 100, pages 223–232, 2015

Phase relationships in the system K_2CO_3-$CaCO_3$ at 6 GPa and 900–1450 °C

Anton Shatskiy[1,2,*], Yuri M. Borzdov[1], Konstantin D. Litasov[1,2], Igor S. Sharygin[1,2], Yuri N. Palyanov[1,2] and Eiji Ohtani[3]

[1]V.S. Sobolev Institute of Geology and Mineralogy, Russian Academy of Science, Siberian Branch, Koptyuga pr. 3, Novosibirsk 630090, Russia
[2]Novosibirsk State University, Pirogova Str. 2, Novosibirsk 630090, Russia
[3]Department of Earth and Planetary Material Science, Tohoku University, Sendai 980-8578, Japan

Abstract

Phase relations in the system K_2CO_3-$CaCO_3$ have been studied in the compositional range, $X(K_2CO_3)$, from 100 to 10 mol%, at 6.0 GPa and 900–1450 °C. At 900–950 °C, the system has three intermediate compounds: $K_6Ca_2(CO_3)_5$, $K_2Ca(CO_3)_2$, and $K_2Ca_3(CO_3)_4$. The $K_2Ca(CO_3)_2$ compound decomposes to the $K_6Ca_2(CO_3)_5 + K_2Ca_3(CO_3)_4$ assembly above 950 °C. The $K_6Ca_2(CO_3)_5$ and $K_2Ca_3(CO_3)_4$ compounds melt congruently slightly above 1200 and 1300 °C, respectively. The eutectics were established at 64 and 44 mol% near 1200 °C and at 23 mol% near 1300 °C. K_2CO_3 remains as a liquidus phase at 1300 °C and 75 mol% and melts at 1425 ± 20 °C. Aragonite remains as a liquidus phase at 1300 °C and 20 mol% and at 1400 °C and 10 mol%. $CaCO_3$ solubility in K_2CO_3 and K_2CO_3 solubility in aragonite are below the detection limit (<0.5 mol%).

Infiltration of subduction-derived K-rich Ca-Mg-Fe-carbonatite into the Fe^0-saturated mantle causes the extraction of $(Mg,Fe)CO_3$ components from the melt, which shifts its composition toward K-Ca-carbonatite. According to our data this melt can be stable at the *P-T* conditions of subcratonic lithosphere with geothermal gradient of 40 mW/m^2 corresponding to temperature of 1200 °C at 6 GPa.

Keywords: Alkaline carbonates, buetschliite, fairchildite, high-pressure experiment, carbonatite, Earth's mantle