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The system Na_2CO_3-$FeCO_3$ at 6 GPa and its relation to the system Na_2CO_3-$FeCO_3$-$MgCO_3$

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

[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, Novosibirsk 630090, Russia
[3]Department of Earth and Planetary Material Science, Tohoku University, Sendai 980-8578, Japan

Abstract

The phase relations in the Na_2CO_3-$(Fe_{0.87}Mn_{0.06}Mg_{0.07})CO_3$ system have been studied in Kawai-type multi-anvil experiments using graphite capsules at 6.0 GPa and 900–1400 °C. Subsolidus assemblages comprise the stability fields of Na_2CO_3 + $Na_2Fe(CO_3)_2$ and $Na_2Fe(CO_3)_2$ + siderite with the transition boundary at $X(Na_2CO_3)$ = 50 mol%. Intermediate $Na_2Fe(CO_3)_2$ compound has rhombohedral $R\overline{3}$ eitelite structure with cell parameters a = 4.9712(16), c = 16.569(4) Å, V = 354.61(22). The Na_2CO_3-$Na_2Fe(CO_3)_2$ eutectic is established at 1000 °C and 66 mol% Na_2CO_3. $Na_2Fe(CO_3)_2$ disappears between 1000 and 1100 °C via incongruent melting to siderite and a liquid containing about 55 mol% Na_2CO_3. Siderite remains a subliquidus phase at 1400 °C at $X(Na_2CO_3) \leq 30$ mol%.

The ternary Na_2CO_3-$FeCO_3$-$MgCO_3$ system can be built up from the corresponding binary systems: two systems with intermediate $Na_2(Mg,Fe)(CO_3)_2$ phase, which melts congruently at the Mg-rich side and incongruently at the Fe-rich side, and the $(Mg,Fe)CO_3$ system with complete solid solution. The phase relations suggest that the maximum contribution of $FeCO_3$ component into the lowering solidus temperatures of Na-bearing carbonated mantle domains could not exceed several tens of degrees Celsius.

Keywords: Natrite, siderite, eitelite, high-pressure experiment, carbonatite, phase relations, mantle, melting