

[S-IT25] Deep Carbon: Diamond formation and carbon speciation in Earth and planetary processes

convener: Eiji Ohtani (Department of Earth and Planetary Materials Science, Graduate School of Science, Tohoku University), Konstantin Litasov (V.S. Sobolev Institute of Geology and Mineralogy SB RAS), Hiroyuki Kagi (東京大学大学院理学系研究科附属地殻化学実験施設, 共同), Craig E Manning (University of California Los Angeles)

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Diamonds are observed in various localities including terrestrial and extraterrestrial environments. However, there are several reports on the diamond localities from non-traditional sources including ultra-deep seated diamonds, ultrahigh pressure metamorphic rocks, various magmas, some meteorites and terrestrial craters. These diamonds might be formed by shock events, crystallization from fluids, magmas, or metallic melts, and CVD process. In this session, we welcome papers on occurrence and origin of diamonds from traditional and non-traditional sources in earth and meteorites. We also encourage the experimental studies on diamond genesis, speciation of carbon bearing compounds in terrestrial rocks and meteorites. We welcome papers on formation mechanisms of diamond in natural metal-carbon systems, chromatographic study of deep seated and experimental fluids. We also welcome papers dealing with behavior of organic materials at high pressure and high temperature corresponding to the deep earth and planets. In some chromitites, various enigmatic high pressure phases have been reported as inclusions together with diamond. We also encourage the presentations on descriptions and discussions on the origin of these materials.

[SIT25-P02] The T - X phase diagram Na_2CO_3 – CaCO_3 at 3 GPa

Ivan Podborodnikov¹, Anton Shatskiy², Anton Arefiev¹, Artem Chanyshev², *Konstantin Litasov² (1. Novosibirsk State University, Novosibirsk, Russia, 2. V.S. Sobolev Institute of Geology and Mineralogy SB RAS, Novosibirsk, Russia)

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Phase relations in the system Na_2CO_3 – CaCO_3 have been studied at 3 GPa and 800–1525 °C. The system has one intermediate compound, $\text{Na}_2\text{Ca}_3(\text{CO}_3)_4$, at 800 °C, and two intermediate compounds, $\text{Na}_2\text{Ca}(\text{CO}_3)_2$ and $\text{Na}_2\text{Ca}_3(\text{CO}_3)_4$, at 850 °C (Fig. 1a). CaCO_3 crystals recovered from experiments at 950 °C and 1000 °C are aragonite and calcite, respectively. Maximum solid solution of CaCO_3 in Na_2CO_3 is 20 mol% at 850 °C. The Na-carbonate– $\text{Na}_2\text{Ca}(\text{CO}_3)_2$ eutectic locates near 860 °C and 56 mol% Na_2CO_3 . $\text{Na}_2\text{Ca}(\text{CO}_3)_2$ melts incongruently to $\text{Na}_2\text{Ca}_3(\text{CO}_3)_4$ and a liquid containing about 51 mol% Na_2CO_3 at ~ 880 °C. $\text{Na}_2\text{Ca}_3(\text{CO}_3)_4$ disappears above 1000 °C via incongruent melting to calcite and a liquid containing about 43 mol% Na_2CO_3 . At 1050 °C, the liquid, coexisting with Na-carbonate, contains 87 mol% Na_2CO_3 . Na-carbonate remains solid up to 1150 °C and melts at 1200 °C (Fig. 1c). The Na_2CO_3 content in the liquid coexisting with calcite decreases to 15 mol% as temperature increases to 1300 °C. CaCO_3 remains solid up to 1500 °C and melts at 1525 °C (Fig. 1d).

Considering the present and previous data, a range of the intermediate compounds on the CaCO_3 – Na_2CO_3 join changes as pressure increases in the following sequence: $\text{Na}_2\text{Ca}(\text{CO}_3)_2$, $\text{Na}_2\text{Ca}_2(\text{CO}_3)_3$ (0.1 GPa) \rightarrow $\text{Na}_2\text{Ca}(\text{CO}_3)_2$, $\text{Na}_2\text{Ca}_3(\text{CO}_3)_4$ (3 GPa) \rightarrow $\text{Na}_4\text{Ca}(\text{CO}_3)_3$, $\text{Na}_2\text{Ca}_3(\text{CO}_3)_4$, $\text{Na}_2\text{Ca}_4(\text{CO}_3)_5$ (6 GPa) (Fig. 1b). Thus, the nyerereite stability field extends to the shallow mantle pressures, whereas the shortite stability field terminates somewhere between 0.1 and 3 GPa. Consequently, findings of nyerereite and shortite among daughter phases in the melt inclusions in olivine from the sheared garnet peridotites are consistent with their

mantle origin.

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Fig. 1. (a) The system Na_2CO_3 – CaCO_3 at 3 GPa. (b) Comparison with previous data at 0.1 GPa (Cooper et al. 1975) and 6 GPa (Shatskiy et al. 2013). (c) Na_2CO_3 melting. (d) CaCO_3 melting. Arg = aragonite; Cal = calcite; Na_2 = solid solution of CaCO_3 in Na_2CO_3 ; $\text{Na}_4\text{Ca} = \text{Na}_4\text{Ca}(\text{CO}_3)_3$; $\text{Na}_2\text{Ca} = \text{Na}_2\text{Ca}(\text{CO}_3)_2$; $\text{Na}_2\text{Ca}_3 = \text{Na}_2\text{Ca}_3(\text{CO}_3)_4$; $\text{Na}_2\text{Ca}_4 = \text{Na}_2\text{Ca}_4(\text{CO}_3)_5$; L = liquid; F = CO_2 fluid.