Phase relations and equations of state of alkali carbonates at pressures up to 18 GPa

Litasov K.D., Shatskiy A., Suzuki A., Ohtani E.
Tohoku University

The fate of subducted carbonates has profound implications for the global carbon cycle in the Earth's system. The behavior of $MgCO_3$ and $CaCO_3$ has been investigated by previous studies, because high-pressure polymorphs of carbonates could indeed be the host phases of carbon in the mantle. Alkali metal carbonates also play essential role in the mantle processes at present (active volcano of natro-carbonatites in Oldoinyo Lengai) and through the past history (potassium-rich carbonate-silicate kimberlitic magma and alkali-rich carbonatitic inclusions in diamond containing up to 60 wt.% K_2O). It is generally accepted that alkali carbonates enabled the natural diamond formation and acted as a metasomatic agents in the mantle. Since alkali carbonates drastically reduce mantle solidus, up to 1150±50°C at 20 GPa, they could initiate magma generation in the deep Earth's interior. To account significance of alkali carbonates in the mantle processes their high-pressure (HP) high-temperature (HT) phase diagrams and equation of states (EOS) are required.

The present study covers the investigation of Na_2CO_3 and K_2CO_3 by means of energy dispersive X-ray (EDX) at temperature ranging from 27 to 1200° C and pressures up to 18 GPa. The EDS experiments were carried out *in situ* using the MAX-III 700 ton press recently installed at the beamline AR-NE7A, Photon Factory, Tsukuba. This press has a flexible system of detachable guide-blocks allowing variety of HPHT studies. This time we used DIA-type guide-block to compress the Kawai-type cell with 22-mm cubic Toshiba-F WC anvils with 3.5-mm truncation edge length. The measurements were completed in several heating cycles with about 2 GPa and 200 K steps. The temperature was measured using WRe(3/25) thermocouple. The pressure was calculated from the equation of state of Au which was admixed with the sample. ZrO_2-based ceramics and TiB_2 were employed as a pressure transmitting medium and tube heater, respectively. High-temperature Birch-Murnaghan equation of state was used to fit P-V-T data to obtain thermoelastic parameters. In this presentation we discuss P-V-T data and phase relations for Na_2CO_3 and K_2CO_3 and compare them with those predicted theoretically.