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Melting curve minimum of barium carbonate $BaCO_3$ near 5 GPa

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Abstract

The melting point of barium carbonate ($BaCO_3$) was determined at pressures up to 11 GPa using the ionic conductivity and platinum (Pt) sphere methods in a multi-anvil press. The melting point decreases with pressure from 2149 ± 50 K at 3 GPa to a fitted local minimum of 1849 K at 5.5 GPa, and then it rises with pressure to 2453 ± 50 K at 11 GPa. The fitted melting curve of $BaCO_3$ based on the ionic conductivity measurements is consistent with the Pt sphere measurements that were carried out independently at selected pressures. The negative slope of the $BaCO_3$ melting curve between 3 and 5.5 GPa indicates that the liquid is denser than the solid within this pressure range. Synchrotron X-ray diffraction (XRD) measurements in a laser-heated diamond-anvil cell (LH-DAC) showed that $BaCO_3$ transformed from the aragonite structure (*Pmcn*) to the post-aragonite structure (*Pmmn*) at 6.3 GPa and 1026 K as well as 8 GPa and 1100 K and the post-aragonite structure remained metastable upon quenching and only reverted back to the witherite structure upon pressure release. The local minimum near 5 GPa is attributed to the triple point where the melting curve of $BaCO_3$ meets a phase transition to the denser post-aragonite structure (*Pmmn*). Local minima in the melting curves of alkaline earth carbonates would lead to incipient melting of carbonated rocks in Earth's mantle.

Keywords: Barium carbonate, melting point, density crossover, phase transition, negative melting slope, post-aragonite structure; Earth in Five Reactions: A Deep Carbon Perspective