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Effects of hydrostaticity and Mn-substitution on dolomite stability at high pressure

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Abstract

Studying the structural evolution of the dolomite group at high pressure is crucial for constraining the deep carbon cycle and mantle dynamics. Here we collected high-pressure laser Raman spectra of natural Mg-dolomite $CaMg(CO_3)_2$ and Mn-dolomite kutnohorite $Ca_{1.11}Mn_{0.89}(CO_3)_2$ samples up to 56 GPa at room temperature in a diamond-anvil cell (DAC) using helium and neon as a pressure-transmitting medium (PTM), respectively. Using helium or neon can ensure samples stay under relatively hydrostatic conditions over the investigated pressure range, resembling the hydrostatic conditions of the deep mantle. Phase transitions in $CaMg(CO_3)_2$ were observed at 36.1(25) GPa in helium and 35.2(10) GPa in neon PTM from dolomite-II to -III, respectively. Moreover, the onset pressure of Mn-dolomite $Ca_{1.11}Mn_{0.89}(CO_3)_2$-III occurs at 23−25 GPa, about 10 GPa lower than that of Mg-dolomite-III, suggesting that cation substitution could significantly change the onset pressure of the phase transitions in the dolomite group. These results provide new insights into deep carbon carriers within the Earth's mantle.

Keywords: Deep carbon cycle, Raman spectroscopy, high pressure, dolomite, phase transition