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Magnesite formation from MgO and CO_2 at the pressures and temperatures of Earth's mantle

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Abstract

Magnesite ($MgCO_3$) is an important phase for the carbon cycle in and out of the Earth's mantle. Its comparably large *P-T* stability has been inferred for several years based on the absence of its decomposition in experiments. Here we report the first experimental evidence for synthesis of magnesite out of its oxide components (MgO and CO_2) at *P-T* conditions relevant to the Earth's mantle.

Magnesite formation was observed in situ using synchrotron X-ray diffraction, coupled with laser-heated diamond-anvil cells (DACs), at pressures and temperatures of Earth's mantle. Despite the existence of multiple high-pressure CO_2 polymorphs, the magnesite-forming reaction was observed to proceed at pressures ranging from 5 to 40 GPa and temperatures between 1400 and 1800 K. No other pressure-quenchable materials were observed to form via the $MgO + CO_2 = MgCO_3$ reaction. This work further strengthens the notion that magnesite may indeed be the primary host phase for oxidized carbon in the deep Earth.

Keywords: Deep carbon, magnesite, carbon dioxide, polymorphism