Earth's deep interior revealed by high-pressure experiments

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The interior of the Earth is under high pressure and temperature (*P*-*T*). Static compression experiments using a laser-heated diamond-anvil cell (DAC) can generate high *P*-*T*conditions, greater than 364 GPa and ~5000 K that correspond to the condition at the center of the Earth. Using such DAC techniques, we are now able to synthesize any materials that are possibly present inside our planet. Combining a DAC with synchrotron x-rays, crystal structures and phase transitions that occur in the deep Earth have been extensively explored up to inner core conditions. Sound velocities of liquid and solid, mantle and core materials have been also obtained by these high *P*-*T*experiments as well as recent theoretical calculations. These results on phase change and seismic wave velocities tell about structures and chemical compositions inside the Earth. In addition, chemical evolution of the mantle and the core has been of great interest in recent DAC studies. After melting experiments in a DAC, tiny samples (10–100 μm scale) were recovered and examined for textures and chemical compositions, demonstrating liquidus phase relations and element partitioning between coexisting liquid and solid. On the basis of these melting studies, I will discuss 1) exsolution of oxides from liquid core, which may have driven core convection and geodynamo since early Earth, and 2) the formation of bridgmanite-enriched ancient mantle structures (BEAMS) upon solidification of a deep magma ocean, which could still be present in the present-day lower mantle.

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