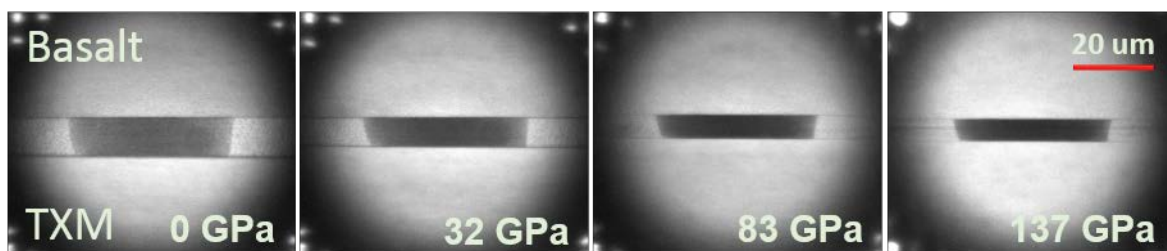


Pressure-induced densification of basalt and silica glass: A nanoscale transmission X-ray microscopy study

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Knowledge of the physical and chemical properties of silicate melts is crucial to understanding the dynamics and chemical differentiation of the early Earth and other planetary bodies. The viscosity, compressibility, and density of silicate melts are key factors that control the migration of magma in the deep mantle. In particular, the density contrast between melts and the coexisting solid phases controls the fate of subducting slabs and remnants of a deep magma ocean. To date, there have been a plethora of studies on structural changes and density measurements of silicate glasses/melts as a function of pressure (or/and temperature), but almost all are limited to the relatively modest pressures within the Earth's upper mantle and transition zone. Recently, synchrotron transmission X-ray microscopy (TXM) with high spatial resolution of tens of nanometers coupled with a diamond anvil cell (DAC) has emerged as a powerful technique for direct determination of the volume of an amorphous sample in-situ at high pressure. The accuracy of using nanoscale-TXM for direct *P-V* measurements rivals X-ray diffraction of crystalline phases making it an ideal approach to measure the volume (and therefore density) evolution of an amorphous sample as a function of pressure. We investigated the compressibility and equation of state of basalt and silica glass (as analogues to silicate melts) up to core-mantle boundary pressures using nanoscale-TXM. These experimental results provide insight into the nature of mantle heterogeneity and the evolution of magma oceans in the early Earth and other planetary interiors.