

Equations of state of ZrSiO₄ phases in the upper mantle

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ABSTRACT

The compressibility of zircon and reidite (ZrSiO₄) was investigated by powder X-ray diffraction (XRD) up to 20 GPa using a synchrotron radiation source. Reliable equations of state for zircon and reidite were obtained using a diamond anvil cell (DAC) coupled with yttrium-aluminum-garnet (YAG) laser-heating. Samples were heated with the laser at each pressure increment to relax deviatoric stress. XRD measurements were carried out at 300 K using an angle-dispersive technique. Data refinements yield third-order Birch-Murnaghan equations of state parameters: the bulk modulus $K_0 = 205(\pm 8)$ GPa when the first pressure derivative of the bulk modulus, K'_0 , is fixed at 4 for zircon, $K_0 = 392(\pm 9)$ when K'_0 is fixed at 4 for reidite. The volume reduction of the phase transition from zircon to reidite is about 10%. The tentative phase boundary between zircon and reidite is located at about 10 GPa.