Single-crystal Elastic Properties of Augite

Paul Ginsberg and Jay D Bass

Abstract

Augite is one of the two major mineralogic constituents of basalt and gabbro. Thus, the properties of augite are essential for identifying the presence and understanding the behavior of mafic-to-ultramafic rocks at depth. The single-crystal elastic moduli of an intermediate composition of augite from the Bradley Mine, NY, have been measured at ambient conditions through Brillouin spectroscopy. Measurements were performed on three non-degenerate planes of general crystallographic orientation. Data were collected for phonon directions within each plane in 15° increments over a total angular range of 180°. This is the first study of the single-crystal elastic moduli of augite through Brillouin scattering or any other spectroscopic technique. Neither the elastic properties nor acoustic wave velocities are simply related to the properties of the major pyroxene end-members by a linear mixing model. The polycrystalline isotropic aggregate properties were calculated from the C_{ij}'s using Voigt-Reuss-Hill averaging. From the single-crystal elastic moduli the isotropic aggregate bulk modulus (VRH), K_s = 115.51 ±5.9 GPa, and the shear modulus μ = 61.32 ±2.6 GPa. The stated errors include uncertainties due to the differences between the Voigt and Reuss bounds. K_s is roughly proportional to density for clinopyroxenes diopside, augite, and hedenbergite as well as for the orthopyroxene orthoenstatite. However, orthoferrosilite is highly inconsistent with the trend for other pyroxenes, the cause of which is uncertain. μ is inversely proportional to density and decreases in a smooth monotonic fashion.