American Mineralogist, Volume 87, pages 1486–1489, 2002

LETTERS

Equation of state of Al-bearing stishovite to 40 GPa at 300 K

SHIGEAKI ONO,[1,*] TAKUMA SUTO,[2] KEI HIROSE,[2] YASUHIRO KUWAYAMA,[2] TETSUYA KOMABAYASHI,[2] AND TAKUMI KIKEGAWA[3]

[1]Institute for Frontier Research on Earth Evolution, Japan Marine Science & Technology Center, 2-15 Natsushima-cho, Yokosuka-shi, Kanagawa 237-0061, Japan
[2]Department of Earth and Planetary Sciences, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro, Tokyo 152-8551, Japan
[3]High Energy Acceleration Research Organization, Tsukuba 305-0801, Japan

ABSTRACT

The compression behavior of Al-bearing stishovite was investigated by powder X-ray diffraction up to 40 GPa with the BL13A beamline at the Photon Factory (KEK, Japan). A reliable equation of state for stishovite was obtained using a diamond anvil cell coupled with a yttrium-aluminum-garnet (YAG) laser-heating. A sample containing 2.1 wt% Al_2O_3 was heated using a YAG laser at each pressure increment to relax deviatoric stress. X-ray diffraction measurements were carried out at 300 K using the angle-dispersive technique. A least squares refinement of the data yielded equation of state parameters where the bulk modulus Ko = 282 (±2) GPa when the first pressure derivative of the bulk modulus Ko' was fixed at 4. The effect of Al is to decrease slightly the bulk modulus of stishovite and increase the density of the subducted oceanic crust. The enhanced compressibility of Al-bearing stishovite certainly has geophysical and geochemical implications for the fate of the subducted slab, as this mineral is the main constituent of subducted mid-oceanic ridge basalt (MORB) in the Earth's mantle.