

## Elastic wave velocities of $\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12}$ -pyrope garnet to 10 GPa

GANGLIN CHEN,<sup>1,\*</sup> JOSEPH A. COOKE JR.,<sup>2</sup> GABRIEL D. GWANMESIA,<sup>1,3</sup>  
AND ROBERT C. LIEBERMANN<sup>2,†</sup>

<sup>1</sup>Center for High Pressure Research, and Mineral Physics Institute,  
State University of New York at Stony Brook, Stony Brook, New York 11794-2100, U.S.A.

<sup>2</sup>Center for High-Pressure Research, and Department of Geosciences,

State University of New York at Stony Brook, Stony Brook, New York 11794-2100, U.S.A.

<sup>3</sup>Department of Physics and Pre-Engineering, Delaware State University, Dover, Delaware 19901, U.S.A.

### ABSTRACT

Elastic wave velocities of  $\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12}$  pyrope garnet were measured to 10 GPa at ambient temperature, using ultrasonic interferometry in a 1000 ton split-cylinder, multi-anvil apparatus (USCA-1000). The sample used in the ultrasonic measurements was a polycrystalline specimen hot-pressed at 5 GPa and 1350 °C in a 2000 ton uniaxial split-sphere apparatus (USSA-2000) from a homogeneous glass of pyrope composition. Special  $P$ - $T$  paths used during synthesis minimized effects of decompressing and thermal cracking; the bulk density of the sample was indistinguishable from the X-ray density. The elastic wave velocities measured at the ambient condition agree with the Hashin-Shtrikman averages of the single crystal values within the mutual uncertainties. The high-pressure experiments yielded the elastic moduli and their pressure derivatives (finite strain fit) for the shear modulus  $G_0 = 92 \pm 1$  GPa,  $G_0' = (\partial G/\partial P)_T = 1.6 \pm 0.2$  and for the longitudinal modulus  $L_0 = 294 \pm 1$  GPa,  $L_0' = (\partial L/\partial P)_T = 7.4 \pm 0.5$ , ( $L = K_S + 4/3G$ ), from which the bulk modulus  $K_0 = 171 \pm 2$  GPa,  $K_0' = (\partial K_S/\partial P)_T = 5.3 \pm 0.4$  was calculated. The pressure derivative for the shear modulus of pyrope did not differ from those of natural pyrope-almandine-grossular garnets. For the bulk modulus, the pressure derivative for pyrope agreed with that for pyrope-almandine but was substantially higher (25%) than that for the Ca-bearing garnet. In the pyrope-majorite series,  $K_0'$  remained constant, whereas  $G_0'$  increased by 25 for 38% majorite content.