At temperatures between 300 and 400 K, σ increases with pressure in all orientations. This agrees with macroscopic continuum theory that predicts a positive pressure coefficient of diffusivity (negative activation volume ΔV^*) for a material in which point-defect formation and migration are related to a negative thermal expansion coefficient. A negative ΔV^* (-3.1 to -5.8 cm^3/mol at atmospheric pressure) in the supposed extrinsic region means that conduction in this region is caused by more than one type of charge carrier or involves nonequilibrium or complexed defects.

An irreversible increase in σ in the a-direction and a decrease in the c-direction is observed at pressures in excess of 0.1 GPa at temperatures below 390 K. This suggests a fundamental change in the crystal lattice. However, the crystals are visibly unchanged after pressure cycling, and σ gradually changes to equilibrium values with increasing temperature and time. These facts are not consistent with a reconstructive phase transformation, and their directional dependence suggests one-dimensional stacking disorder.

Between 300 and 400 K, we obtained a Grüneisen γ of -0.9 to -1.1 calculated from continuum theory for activated processes. In general, these values are in agreement with values of -0.4 to -0.5 calculated by using independent physical property measurements and Grüneisen's equation of state. This consistency suggests that at higher temperatures ($T > \theta_D$) Frenkel defect formation plays a more important role than vibration frequencies in determining the negative thermal expansion coefficient.

SCHOCK, R. N., Duba, A., Heard, H. C., and Stromberg, H. D., The electrical conductivity of polycrystalline olivine to 5.0 GPa (50 kbar), Sixth Lunar Sci. Conf., Houston, March 17-21, 1975. [UCRL-76402, Abstract]

The electrical conductivity (σ) of a sintered natural olivine has been measured to 5.0 GPa (50 kbar) and 1200°C in a girdle-anvil device. The purpose of these experiments was to determine if the σ values of single crystals measured in the laboratory are realistic representatives of polycrystalline material in planetary interiors. The sample was prepared from material that had been sintered at 1200°C and 5.0 GPa. The starting powder was ground from olivine (Fo92) collected at Mt. Leura, Australia. Platinum was used to replace graphite as the furnace to ensure that volatilized carbon would not affect the measured σ. Temperature was measured by two thermocouples in contact with the sample.