Ultrasonic wave propagation measurements of polycrystalline samples of olivine, clinohumite and phase A at high pressures of 2 to 8 GPa

Huong T. Phan, Eric Reusser & Peter Ulmer.

Institute of Mineralogy and Petrology, ETH Zürich, CH-8092 Zürich.

Polycrystalline aggregates of forsterite [Mg_2SiO_4], the dense hydrous magnesium silicate phases clinohumite [$Mg_9Si_{24}O_{16}(OH)_2$] and phase A ($Mg_7Si_2O_8(OH)_6$] have been produced by combining sol-gel techniques to obtain homogenous, very fine grained samples. The porosity of the samples was further minimized by hot-pressing in a piston cylinder and multi-anvil apparatus. The procedure results in specimens that are homogeneous with small grain sizes of less than 20 micrometers, free of microscopic cracks, devoid of preferred orientation, and with bulk densities greater than 97% of the theoretical value.

Ultrasonic wave propagation experiments were conducted in a 6/8 multi-anvil device using a Li-Niobate P-wave transducer with a resonant frequency in the range of 30-50 MHz. The seismic response is collected in reflected geometry by the same transducer that emits the primary signal. A sin(x)/x-(sinc)-function is used as primary signal to obtain simultaneously the response for a broad range of frequencies. A combination of digital filtering, demodulation and cross-correlation is used to extract the travel time from the obtained seismic response.

Measurements for P-wave propagation velocities will be presented for the different samples. So far, experiments have been performed in the pressure range 2-8 GPa at room temperature. The measured values for P-wave velocities of forsterite are consistent with published values. Future experiments will be conducted to measure the propagation velocities of S-waves and of both wave types at high temperatures and high pressures. The results will help to evaluate the effects of hydrous phases in deeply subducted oceanic lithosphere on the resultant seismic velocity profiles.