P Wave and S Wave Acoustic Velocities of Partial Molten Peridotite at Mantle P-T and MHz Frequencies

Donald Weidner, Li Li, Matthew Whitaker, Richard Triplett

The speed that acoustic waves travel in a partially molten peridotite are crucial parameters to detect not only the presence of melt in the Earth's deep interior, but also understand many issues about the structure and dynamics of the mantle. Technical challenges have hindered such measurements in the laboratory. Here we report the experimental results on the ultrasonic acoustic wave velocities in a partial molten peridotite using multi-anvil high pressure apparatus located at beamline BM6 Advance Photon Source. We use the newly installed ultrasonic equipment using the pulse-echo-overlap method coupled with D-DIA device. X-ray radiography is used to measure sample length at high P-T. The X-ray diffraction spectrum is used to determine the pressure and sample conditions. Precise measurements of P and S wave velocities are obtained at 60 and 35 MHz respectively and are nearly simultaneous. We use a double reflector method to enable measurement of elastic wave velocities of cold-pressed polycrystalline sample which is sintered in situ at high P-T. Experiments were carried out up to 3 GPa and 1500 ^{o}C. Our preliminary results indicate that the KLB1 peridotite sample experienced a few percent decrease of both p and s wave velocities as partial melting occurs. The data define a small decrease in the bulk modulus as well as the shear modulus upon melting. This implies that dynamic melting is a significant process at megahertz frequencies.