Single-crystal Brillouin spectroscopy with laser heating and variable q: Design, demonstration and new results on olivine

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We have developed a novel Brillouin spectroscopy system integrated with CO_2 laser heating and Raman spectroscopic capabilities. High-pressure laser heating experiments on liquid water compressed in a diamond-anvil cell up to 2500 ± 150 K demonstrate the flexibility and performance of the system. Temperature is determined from the grey-body thermal radiation of the heated samples,. New single-crystal laser heating Brillouin measurements were made on San Carlos Olivine in the (111) plane at pressures up to ~13 GPa, and T~1300 ± 200 K. We obtain quantitative values for the thermal pressure in the diamond cell. Using KCl and KBr and pressure-transmitting media, we show that pressure gradients in the sample chamber are small at high P-T conditions based on observations of the olivine-wadsleyite transition. This system is additionally designed for continuously varying scattering angles from near forward scattering (0º scattering angle) up to near back scattering (~141°). Our results on the sound velocities of olivine at high pressure-temperature conditions have implications for the nature of the 410 km discontinuity and the olivine content of the transition zone.