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Sound Velocities of Earth's Deep Materials

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Average composition and structure of the Earth's deep interior can be approached by comparing observed seismic velocities to appropriate laboratory data collected for candidate materials under relevant conditions. Precise knowledge of the elastic properties of Earth's deep materials under high-pressure condition is crucial for constructing the accurate mineralogical model of the Earth's deep interior. However, only few experimental acoustic measurements exist under relevant high-pressure conditions. Recent technical advances in high-pressure Brillouin spectroscopic measurements combined with diamond anvil cell apparatus extended significantly the upper pressure limit for acoustic measurements [1, 2] and also enable us to explore the sound velocities under high-pressure and high-temperature conditions using infrared laser heating technique [3]. Here we present the recent progress of elastic wave velocity measurements on Earth's deep materials by Brillouin spectroscopy in a diamond anvil cell (DAC) in conjunction with synchrotron X-ray diffraction technique under ultrahigh-pressures. Based on the results we have recently obtained on mantle minerals [4] and glass materials [5], the mineralogy of deep mantle and the structure of the silicate melt in the deep magma ocean will be discussed.

[1] Murakami et al. (2007) Earth Planet. Sci. Lett. 256, 47-54.
[2] Murakami et al. (2007) Earth Planet. Sci. Lett. 259, 18-23.
[3] Murakami et al. (2009) Phys. Earth Planet. Inter. 174, 282-291.
[4] Murakami et al. (2009) Earth Planet. Sci. Lett. 277, 123-129.
[5] Murakami & Bass (2010) Phys. Rev. Lett. 282, 124-128.

Keywords: lower mantle mineralogy, structure of glass/melt, elastic wave velocity measurement