Sound velocity of Fe_3C and Carbon in the Core

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Sound velocity is one of the most important physical properties to understand the Earth's interior. Sound velocity of Fe_3C was measured by the inelastic X-ray scattering (IXS) method. The high pressure was generated using a symmetric-type diamond anvil cell. The Fe_3C foil was sandwiched between NaCl layers, which served as a pressure-transmitting medium and as a thermal insulator. The sound velocity of Fe_3C was measured by the inelastic X-ray scattering method at BL35XU [1] and BL43LXU at SPring-8 [2]. Sound velocity measurements at high pressure and temperature were conducted at BL35XU by a double sided laser heated DAC using a fiver laser, the COMPAT system [3]. IXS measurements were carried out from 32.8 GPa to 85.8 GPa and the temperature range from 300 K to 2300 K. The present measurements revealed that the Birch's law, the density and V_p relation, has almost no temperature dependency. Present estimations of V_P and V_S of Fe_3C were 12 % and 48 % faster than those of PREM at 329 GPa and 5000 K. The equation of state of Fe_3C can be accounted for the density of the inner core at ICB (329 GPa and 5000 K), however the present results on sound velocity of Fe_3C indicate that we need to introduce the premelting effect on V_p and V_s in order to account for the sound velocity of the inner core by Fe_3C.

[1] Baron *et al*. (2000) *Phys. Chem. Solids* **61**, 461–465. [2] Baron et al. (2010) *SPring-8 INFORMATION*. **15**, 14–19. [3] Fukui *et al*. (2013) *Rev. Sci. Inst*. **84**, 113902.