

Existence of Carbon in the Earth' s inner core

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Carbon is an important candidate for light element in the Earth' s core. There have been contradictory results on the stability of Fe–C compounds, such as Fe_3C and Fe_7C_3 under the core conditions. We observed Fe_3C melts incongruently to form Fe_7C_3 and liquid at 4200 K and 200 GPa. Additionally, it was shown that the C content of the liquid coexisting with Fe_7C_3 decreases and the Fe– Fe_3C eutectic composition shifts toward the Fe-rich direction with increasing pressure. The present result revealed that Fe_3C and Fe_7C_3 are plausible constituents of the inner core, with a possible layering of Fe_7C_3 in the central region and Fe_3C in the outer region of the inner core formed during cooling of the core. We also conducted the equation of state and sound velocity measurements at high pressure and temperature by using XRD and IXS measurements at Spring-8. The results indicate that the sound velocity of the mixture of Fe– Fe_3C is higher than the PREM inner core under the Earth' s core conditions. Thus, it is difficult to explain that the Earth' s inner core is composed of only a Fe– Fe_3C mixture. Since the inner core temperature is very close to the eutectic temperature of the Fe– Fe_3C system, pre-melting effect of Fe_3C could be important to account for the sound velocity of the PREM inner core.

Keywords: Carbon, Fe_3C , Melting relation, equation of state, Sound velocity