Sound velocity of iron alloys and composition of the core

E. OHTANI[1]*, T. SAKAMAKI[1], S. KAMADA[1], Y. SHIBAZAKI[1], S. TAKAHASHI[1], H. FUKUI[23], S. TSUTSUI[4] AND Q. R. BARON[34]

[1]Tohoku University, 980-8578, Sendai, Japan. (*correspondence: ohtani@m.tohoku.ac.jp)
[2]University of Hyogo, 678-1297, Hyogo, Japan. (fukuih@sci.u-hyogo.ac.jp)
[3]RIKEN SPring-8 Center, 679-5148, Hyogo, Japan.
[4]SPring-8/JASRI, 679-5198, Hyogo, Japan

The Earth's core is considered to be composed of iron-nickel alloy with minor light elements [1]. The light elements in the core constrain the formation conditions of accretion, magma ocean and core formation stages of the early Earth. There are several studies on sound velocity measurements of the iron-light elements alloys to identify their abundance in the core [2]. However, the measurements are not enough to constrain the light element abundance in the core tightly due to the experimental difficulty to make measurements under the Earth's core conditions. We measured the compressional velocity of the core forming materials by using the inelastic X-ray scattering at high pressure at the beamline BL35XU, Spring-8 [3]. We measured the compressional velocity of Fe_3S [4], FeH [5], Fe_3C, and FeSi alloy at high pressure and room temperature. Whereas, we measured the compressional velocity of hcp-Fe up to 163 GPa and 3000 K, and derived the temperature dependence of the Birch's law for hcp-Fe. Combining our new data and previous data on the compressional velocity of hcp-Fe and iron-light element compounds, we estimated the light element abundance of the earth's inner core. The present analysis implies that S, Si, and H can be the candidates for the major light elements in the inner core, whereas O and C may not be important light elements in the inner core. We also estimated the outer core composition based on the partition behavior of light elements between hcp-Fe and the metallic liquid determined at high pressure and temperature.

[1] Birch (1952) *JGR* **57**, 227–286. [2] e.g., Badro *et al*. (2007) *EPSL* **254**, 233-238. [3] Ohtani *et al*. (2013) *GRL* 40, 5089-5094. [4] Kamada *et al*. (2014) *Am Min*, **99,** 98-101. [5] Shibazaki *et al*. (2012) *EPSL*, **313-314**, 79-85. .