Geochemical and Mineral Physics Constraints on the composition of the Inner core

E. OHTANI[1], T. SAKAMAKI[1], T. SAKAIRI[1], R. TANAKA[1], S. KAMADA[1], H. FUKUI[2], A. Q.R. BARON[3]

[1]Graduate School of Science, Tohoku University, Sendai, Japan (ohtani@m.tohoku.ac.jp)
[2] Graduate School of Material Science, University of Hyogo, Hyogo, Japan (fukuih@spring8.or.jp)
[3] Materials Dynamics Laboratory, RIKEN SPring-8 Center, Hyogo, Japan (baron@spring8.or.jp)

The Earth's core is considered to contain light elements based on seismological observations and mineral physics data. The major candidates of the light elements of the core are S, Si and O. Recent studies on the Fe-Si-O system revealed that Si and O have mutually avoidable nature in metallic liquid [1], and precipitation of silicates such as SiO_2 [2] or $FeSiO_3$ occurred during cooling of the liquid core. Therefore, the metallic inner core coexisting with liquid outer core should be ether the Fe-O-S or Fe-Si-S alloy, i.e., metallic inner core cannot be crystallized from the Fe-Si-O outer core in which silicates can be precipitated from the outer core. Our sound velocity measurements of FeO revealed that oxygen is not likely to be the major light element of the inner core [3], and the most plausible candidates of the light elements in the inner core are silicon and/or sulphur. Based on measurements of the sound velocity of iron [4], iron-silicon alloy [5], and Fe_3S [6] and partitioning of Si and S between the solid and liquid metals, we constrained the composition of the inner and outer cores as follows: the PREM inner core is enriched in silicon with minor sulphur without oxygen, whereas the outer core is enriched in sulphur. Oxygen may not be a major light element in the core.

[1] *e.g.,* Tsuno *et al.* (2013). *Geophys. Res. Lett.* **40**, 66-71. [2] Hirose *et al.* (2015) AGU 2015 fall meeting, abstract, DI41B-03, 14-18. [3] Tanaka *et al*. (2017) JPGU meeting abstract, C00102. [4] Sakamaki *et al*. (2016) *Sci. Adv.* **2**: e1500802. [5] Sakairi *et al.* (2017) *Am. Min*., in review. [6] Kamada *et al.* (2014). *Am. Mineral*. **99**, 98-101, 342,

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