

液体 Fe-Ni-S 合金の弾性波速度 Sound velocity of liquid Fe-Ni-S alloy at high pressure: Sulfur in the core?

今田 沙織^{1*}; 中島 陽一²; 廣瀬 敬¹; 駒林 鉄也⁴; 小澤 春香³; 館野 繁彦¹; 桑山 靖弘⁵; 筒井 智嗣⁶; BARON. Q.R. Alfred²
IMADA, Saori^{1*}; NAKAJIMA, Yoichi²; HIROSE, Kei¹; KOMABAYASHI, Tetsuya⁴; OZAWA, Haruka³; TATENO, Shigehiko¹; KUWAYAMA, Yasuhiro⁵; TSUTSUI, Satoshi⁶; BARON. Q.R., Alfred²

¹ 東京工業大学 地球生命研究所, ² 理化学研究所 播磨事業所, ³ 独立行政法人海洋研究開発機構, ⁴ エジンバラ大学, ⁵ 愛媛大学, ⁶ 公益財団法人高輝度光科学研究センター

¹Earth-Life Science Institute, Tokyo Institute of Technology, ²RIKEN SPring-8 Center, ³Japan Agency for Marine-Earth Science and Technology, ⁴University of Edinburgh, ⁵Ehime University, ⁶Japan Synchrotron Radiation Research Institute

The liquid Earth's outer core is composed mainly of iron (Fe)-nickel (Ni) alloy. Birch (1952) first found that the core is less dense than pure iron based on comparison between seismological observations and experimental measurements of the density of solid iron. This is the so called "core density deficit" problem. He suggested the existence of lighter component(s) in the core, and hydrogen (H), carbon (C), nitrogen (N), oxygen (O), silicon (Si), and sulfur (S) have been identified as likely candidates from cosmochemical and geochemical arguments (e.g., Poirier et al., 1994). The density difference between the outer core and the pure iron has been estimated to be 5-10%, depending on the assumed outer core geotherm (e.g., Anderson and Isaak, 2002). The nature of light elements has remained one of the biggest enigmas for the more than half-century since the Birch's work (1952). To justify the kind and quantity of the light elements in the core, sound velocity measurements of liquid iron alloying with possible lighter elements are fundamental because they link directly to seismological observations. We have launched the project on the sound velocity measurements for liquid iron alloys at high pressure in externally-heated and laser-heated diamond-anvil cells (DAC). The sound velocity of liquid (Fe,Ni)₃S was measured via a high resolution inelastic X-ray scattering (IXS) measurements at BL35XU of the SPring-8 synchrotron facility, Japan (Baron et al, 2001). We successfully determined the sound velocity of liquid (Fe,Ni)₃S up to the pressure of 50 GPa, which corresponds to the center of Mars. With our newly obtained results, we discuss the possibility of sulfur in the liquid cores of Earth and Mars.

キーワード: 弾性波速度, 液体鉄合金, 硫黄, 外核, 火星核

Keywords: Sound velocity, liquid iron alloy, sulfur, outer core, Martian core