高温高圧下での非弾性X線散乱法によるFe_3Sの音速測定

Sound velocity Fe_3S at high pressure and high temperature based on inelastic X-ray scattering

*鎌田 誠司[1,2]、坂入 崇紀[2]、坂巻 竜也[2]、大谷 栄治[2]、寺崎 英紀[3]、福井 宏之[4]、Baron Alfred Q.R.[5]、鈴木 昭夫[2]、内山 裕士[6]、筒井 智嗣[6]
*Seiji Kamada[1,2], Takanori Sakairi[2], Tatsuya Sakamaki[2], Eiji Ohtani[2], Hidenori Terasaki[3], Hiroshi Fukui[4], Alfred Q.R. Baron[5], Akio Suzuki[2], Hiroshi Uchiyama[6], Satoshi Tsutsui[6]

1.東北大学学際科学フロンティア研究所、2.東北大学大学院理学研究科地学専攻、3.大阪大学大学院理学研究科宇宙地球科学専攻、4.兵庫県立大学大学院物質理学研究科、5.理化学研究所、6.高輝度光科学研究センター
1.Frontier Research Institute for Interdisciplinary Sciences, Tohoku University, 2.Department of Earth Science, Graduate school of Science, Tohoku University, 3.Dpartment of Earth and Space Science, Graduate School of Science, Osaka University, 4.Graduate School of Material Science, University of Hyogo, 5.RIKEN, 6.JSRI

Mars, the 4th planet from the sun, has been investigated since 1960s. In spite of the investigations, the interior of Mars have not been understood well. Although the surface of Mars has been investigated by Opportunity and Curiosity in the project of NASA, the structure and seismic properties of the Martian core have not been understood well. The core of Mars have been thought to include sulfur as a light element. Sohl and Spohn (1997) proposed the seismic wave velocity and density profiles of the interior of Mars. However, there were almost no data of seismic wave velocity of the Martian core materials such as FeS and Fe_3S. Therefore, we have measured sound velocities of Fe_3S under high pressures and temperatures in order to discuss the Martian core. In addition, the InSight project of NASA will observe seismic wave velocity and probably be able to give some information of the Martian core.
There have been only a limited number of works for V_P of Fe and Fe alloys with light elements, especially Fe alloys with sulfur. Recently, sound velocities of Fe, Fe-Ni, FeS, FeS_2, FeO, Fe_3C, Fe-Ni-Si alloys have reported based on an inelastic X-ray scattering (IXS) (Fiquet et al., 2001; Antonangeli et al., 2004; Fiquet et al., 2004; Badro et al., 2007; Fiquet et al., 2009; Antonangeli et al., 2010). In the Fe-S system, V_P of FeS, the end member of the Fe-FeS system, and FeS_2, more sulfur-rich compound, have been studied but these compounds are not appropriate for the core materials of Mars because Fe-S system has a lot of intermediates such as Fe_3S_2, Fe_2S, Fe_3S under high pressures (Fei et al., 1997, 2000). In addition, Fe_3S coexists with ε-Fe as a subsolidus phase from 20 GPa to at least 200 GPa (Kamada et al., 2010, 2012). Therefore, it is essential to study the V_P of Fe_3S to understand seismic properties of the Martian core. We have measured sound velocities of Fe_3S under high temperature and pressure at BL35XU of SPring-8.
In this study, a synthesized Fe_3S was used as a starting material. A symmetric diamond anvil cell was used to generate high pressures. IXS and XRD experiments were performed at the beamline 35XU of SPring-8, Japan (Baron et al., 2000). V_P of Fe_3S were measured up to 45 GPa and 1900 K. We will discuss temperature effect on V_P of Fe_3S and the Birch's law and seismic wave velocity profile of the Martian core.

キーワード：高圧高温、非弾性X線散乱法、惑星核
Keywords: High pressure and temperture, Inelastic X-ray Scattering, Planetary core

