

高圧下における Fe-S および Fe-Si の音速測定 Sound velocity measurements of liquid Fe-S and Fe-Si at high pressure

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P-wave velocity (V_P) is one of the most useful physical properties to understand the structure and dynamics of the liquid core of the Earth, terrestrial planets and satellites. These liquid cores are thought to contain the light element such as S and Si. Thus, it is important to understand effect of S and Si on V_P in liquid Fe. Direct V_P measurement of liquid Fe-alloy at high pressure using ultrasonic was developed by Nishida et al. (2013). V_P of liquid Fe57S43 were reported up to 5.4 GPa. Here we report the results of direct V_P measurements of liquid Fe84S16, Fe50S50, and Fe82Si18 up to 5.4 GPa.

High-pressure experiments were performed using a 1500-ton Kawai-type multi-anvil apparatus (SPEED-1500) at the BL04B1 beamline, SPring-8, Japan. The starting materials were pellets consisting of a mixture of Fe and FeS, or Fe and FeSi powders. Single-crystal sapphire or sintered Al₂O₃ was used as a buffer rod and a backing plate with an hBN capsule. V_P measurements were carried out using the pulse-echo-overlap method. P-wave signals with a frequency of 37 or 42 MHz were generated and received by a 10° Y-cut LiNbO₃ transducer. The series of reflected signals were acquired using a digital oscilloscope. The sample lengths at high pressure and high temperature were determined from the X-ray radiographic image.

The V_P of liquid Fe84S16, Fe50S50, and Fe82Si18 increased almost linearly with increasing pressure. The V_P of liquid Fe82Si18 was faster than that of liquid Fe (Anderson and Ahrens, 1990) and Fe-S. The V_P of liquid Fe-S decreased with increasing S content.

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