Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SIT39-15 Room:105 Time:May 24 14:45-15:00

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 struc-ture 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 appa-ratus (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 meas-urements were carried out using the pulse-echo-overlap method. P-wave signals with a fre-quency of 37 or 42 MHz were generated and received by a 10^o 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.

Keywords: high pressure, core, sound velocity, liquid, Fe-S, Fe-Si