Sound velocity and elastic properties of liquid Fe–Ni–Si at high pressure

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Abstract

Sound velocity, density, and elastic properties, such as bulk modulus, of liquid Fe-alloys at high pressure give us important information to constrain interior structures and composition of molten cores of terrestrial planets. Si is one of the major light elements in the planetary core. Here, we measured compressional wave velocity (Vp) and density of liquid Fe–Ni–Si and studied the effect of pressure, temperature, and Si content on these properties.
Sound velocity and density of liquid Fe52Ni10Si38 was measured up to 12 GPa and 2100 K using ultrasonic pulse-echo method and X-ray absorption method, respectively. The measurements were carried out at BL04B1 and BL22XU beamlines, SPring-8.

The measured Vp of Fe–Ni–Si is larger than that of liquid Fe (Jing et al. 2014) and Fe–Ni (Kuwabara et al. 2016) in all the pressure range studied. The effect of Si on the Vp is opposite to that of S at present pressure conditions. The Vp of liquid Fe–Ni–Si decreases slightly with increasing temperature and the dVp/dT of this study is in agreement with that measured at ambient pressure (Williams et al. 2015). The adiabatic bulk modulus (*Ks0*) at ambient pressure and its pressure derivative (*Ks'*) were obtained by fitting the *Vp* data using the Birch-Murnaghan and Vinet equation of state. The obtained *Ks0* of liquid Fe–Ni–Si is close to that of liquid Fe–Ni (Kuwabara et al. 2016). The calculated density from the *Ks0* and *Ks'* shows a good agreement with the directly measured density.

Refs.

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