

Equation of state of (Fe,Ni)₃S phase - Implications for Mars internal structure

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The existence of lower mantle (MgSiO₃-perovskite layer) has an important role on Mars thermal evolution. The layer thickness of Mars lower mantle depends on the depth of the core-mantle boundary (CMB). The depth of CMB is related to the Mars core density. Although the structure model of Mars core was discussed based on the equation of state of pure iron and FeS (e.g., Urakawa et al., 2004), Fe₃S phase and also the effect of nickel on the density should be considered.

We newly established the equation of state (EoS) of (Fe_{0.89}Ni_{0.11})₃S up to about 40 GPa by high pressure experiment using diamond anvil cell. Considering EoSs of γ -Fe (Tsjino et al., 2013), γ -FeNi (Tsjino, 2012), Fe₃S (Seagle et al., 2006), and (Fe_{0.89}Ni_{0.11})₃S, the effects of nickel and sulfur on the density was determined. Then, we determined the Mars core density corresponding to the composition model based on SNC meteorites. Our new model shows relatively thin lower mantle compare to previous one. Moreover, if Mars core contains 16 wt.%S and 7 wt.%Ni (Sanloup et al., 1999) and if Mars has an entirely liquid core (Fei and Bertka, 2005), there is a possibility of disappearance of Mars lower mantle.

Keywords: Mars core, equation of state, Mars lower mantle