High-pressure Equation of State of Schreibersite $Fe_{2.15}Ni_{0.85}P$: Implications for the Martian Core

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Phosphorus is thought to be an important light element existing in planetary cores. The phosphorus abundance is evaluated to be ~0.20 wt% in the Earth's core, and ~0.32 wt% in the Martian core. To fully understand its existence in planetary cores, structural and physical properties of iron-nickel phosphides should be investigated under high pressure and high temperature. $(Fe,Ni)_3P$-schreibersite is observed as a common accessory in the veinlet of iron and stony-iron meteorites, so that it is of significance to discuss and constrain the properties of planetary cores. The equation of state of a natural single-crystal schreibersite, $Fe_{2.15}Ni_{0.85}P$, has been studied up to ~50 GPa at room temperature in a diamond anvil cell using *in situ* synchrotron-radiation X-ray diffraction. The sample kept its tetragonal structure (*I*-4) up to the highest pressure with no observation of phase transition. Experimental results have shown that the magnetic collapse of $Fe_{2.15}Ni_{0.85}P$ is weakened because of the substitution of nickel, leading to an isotropic axial compressibility. The pressure-volume data were fitted by the third-order Birch-Murnaghan equation of state, yielding K_0 = 184(4) GPa, K_0' = 4.1(2), V_0 = 365.9(1) Å^3. The density of $Fe_{2.15}Ni_{0.85}P$, along with several iron sulfides and iron phosphides has been calculated under relative pressure-temperature conditions of the Martian core. The comparison with that of γ-Fe and a density model of the Martian core evidences that nickel and phosphorus dopant would result in density reduction of iron sulfides, suggesting that $(Fe,Ni)_3(S,P)$ might be a possible compound existing in the Martian core.

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