



## **Combining experimental results and seismic observations to understand iron-alloys in Earth's core**

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Cosmochemical studies suggest Earth's core is composed primarily of an iron-nickel alloy that likely contains some amount of light elements to reconcile the properties of pure iron and their deviation from seismically-inferred values. In addition, regional seismic studies have provided further insight to this remote region of the planet, suggesting evidence for an anisotropic inner core. We present high-quality powder x-ray diffraction data on bcc- and hcp-structured  $\text{Fe}_{0.91}\text{Ni}_{0.09}$  and  $\text{Fe}_{0.8}\text{Ni}_{0.1}\text{Si}_{0.1}$  at 300 K up to about 170 GPa. The alloys are loaded with tungsten powder as a pressure calibrant and helium as a pressure transmitting medium into diamond anvil cells, and their equations of state and  $c/a$  axial ratios were measured with high statistical quality. These equations of state are combined with thermal parameters from previous reports to improve the extrapolation of the density, adiabatic bulk modulus, and bulk sound speed to the pressures and temperatures of Earth's inner core. We propagate uncertainties and place constraints on the composition of Earth's inner core by combining these results with available data on light-element iron-alloys and seismic observations. We also investigate the relationship between the  $c/a$  axial ratios and anisotropy of hcp-structured materials to enhance interpretations of regional seismic observations of the inner core.