Phase relations of silicon-bearing Earth's core

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The phase relations of Fe-alloys under high pressure (P) and temperature (T) are fundamental data when one discusses the physical and chemical properties of Earth's core. In this talk, I will summarise our recent results of phase relations in the system Fe-Si and Fe-Ni-Si constrained in a diamond anvil cell (DAC). Silicon is considered a plausible candidate for the light element in Earth's core, which is a consequence of metal-silicate equilibration during core formation process.

An important phase relation for the iron alloys is the transition between face-centered cubic (fcc) and hexagonal close-packed (hcp) structures, as this is central to address the solid inner core structure, and the *P-T* location of the phase boundary can be used to deduce thermodynamic properties. Notably, the triple point *P-T* location where the hcp, fcc, and liquid phases coexist can be constrained from the fcc-hcp boundary and melting curve. We visited the boundary in Fe-Si and Fe-Ni-Si alloys in an internally resistive heated DAC [1], [2]. The internally heated DAC heats the sample by its resistance, with improved accuracy in temperature with respect to conventional laser-heated DAC.

High-P-T in-situ X-ray diffraction experiments were conducted at ID27 ESRF and P02.2 PETRA III. Results show that the transition temperature under high pressure from the hcp to fcc phases was increased with the addition of silicon to iron. However, the simultaneous addition of silicon and nickel reduces the transition temperature. The temperature reduction is more enhanced compared to the case for the system Fe-Ni. We will show the experimental data and discuss the location of the triple point where the hcp, fcc, and liquid are stable in a compositional range of the system Fe-Ni-Si. Also we will discuss the effect of simultaneous inclusion of Ni and Si on the Fe properties under high P-T and propose a new phase diagram for Earth's core.

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[1] Komabayashi et al., *Am. Mine.* 2019, **104,** 94-99.
[2] Komabayashi et al., *Earth Planet Sci. Lett.* 2019, **512,** 83-88.