

Discovery of FeSiO₃ perovskite under deep lower mantle conditions

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The lower mantle is dominated by ferromagnesian silicate in the perovskite structure known as bridgmanite. Information on stability and properties of the iron endmember in the system MgSiO₃-FeSiO₃ is highly appreciated because of its importance for interpretation of the complex structure in the deep lower mantle (DLM). Furthermore, the lower mantle is a potential water reservoir[1,2]. In this study, we conducted high pressure-temperature experiments on FeSiO₃ (synthetic ferrosilite) under hydrous DLM conditions using laser-heated diamond anvil cells. Our synchrotron X-ray diffraction experiments revealed the formation of a single phase of iron silicate perovskite (FePv) at 81-102 GPa and 1700-2100 K and FePv decomposes into a mixture of wüstite and silica phases at temperatures above 2250 K. Our chemical analysis on the recovered sample further confirmed a homogeneous composition FeSiO₃. FePv is about 21% denser relative to MgSiO₃ perovskite (MgPv) at 100 GPa and its bulk sound velocity (V_{Φ}) is about 7% lower than that of MgPv. We are currently exploring the electronic properties of FePv. Our results reveal the stability field of FePv under the lower mantle conditions. Compositional heterogeneities, related to iron-enrichment, would provide insights into the dense, low-velocity anomalies observed in the DLM[3].

[1] Ni et al (2017), *National Science Review* 4, 879–891.

[2] Ohtani (2020), *National Science Review* 7, 224–232.

[3] Van der Hilst & Kárason (1999), *Science* 283, 1885–1888.