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Experimental investigation on iron silicates in the Earth's lower mantle

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Ferromagnesian silicate in the perovskite structure, known as bridgmanite, is the most abundant constituting mineral of the lower mantle [1]. While $MgSiO_3$ perovskite has been extensively studied due to its dominance on Earth, little is known about the iron-end-member silicate. Bridgmanite contains about 10 mol% iron silicate, and iron-enrichment has long been regarded as one of the sources for the low shear-velocity structures in the deep mantle [2]. Thus, investigation of the stability and properties of iron silicates over the *P-T* range of the lower mantle is essential for understanding the deep-mantle processes and interpretation of the lower mantle structure.

In our latest work [3], we obtained iron silicate perovskite (Pv) above 60 GPa and post-perovskite (PPv) above 95 GPa, respectively, in laser-heated diamond anvil cells with synthetic fayalite as the starting materials. Chemical analysis on the recovered sample revealed an approximate chemical formula $(Fe^{2+}{}_{0.75}Fe^{3+}{}_{0.25})(Fe^{3+}{}_{0.25}Si_{0.75})O_3$ for the iron silicate Pv, indicating the occurrence of Fe^{2+}-disproportionation in Fe_2SiO_4 under conditions of the lower mantle below 1000 km depth. Further, the Fe^{3+} in the Si-site undergoes a high-spin to low-spin transition at ~55 GPa. Our results would place constrains on the geophysical and geochemical models of the deep mantle. In addition, we are currently investigating the stability of $FeSiO_3$ perovskite under the *P-T* conditions of the lower mantle and trying to understand the effect of mantle composition on the properties of the iron silicate perovskite phase.

References:

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