Formation of iron melt channels in silicate perovskite at Earth's lower mantle conditions

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Core-formation represents the most significant differentiation event in Earth's history. Our planet's present layered structure with a metallic core and an overlying mantle implies that there must be a mechanism to separate iron alloy from silicates in the initially accreted material. Many previous experimental results have ruled out percolation as a major core formation mechanism for Earth at upper mantle conditions, but until now experimental results at lower mantle conditions were not possible due to the ultrahigh pressure-temperatures which lead to very small sample sizes requiring nanoscale resolution. We investigated the ability of a liquid iron alloy to form an interconnected melt network with (Mg,Fe)SiO3 perovskite (pv) under Earth's lower mantle conditions by combing laser-heated diamond anvil cell with nanoscale synchrotron X-ray tomography [1]. We imaged a dramatic change in the shape of the iron-rich melt in the three-dimensional (3D) reconstructions of samples prepared at varying pressures and temperatures, providing evidence that percolation would be a viable mechanism at Earth's lower mantle conditions. This has significant implications for the evolution of the planet, Earth's early thermal history, and the large scale geochemical distribution of elements.

[1] Shi *et al* (2013) *Nature Geoscience*. doi:10.1038/ngeo1956.