High-pressure melting experiments on Fe-Si-C; Implications for Si in the core

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We performed melting experiments on the Fe-Si-C ternary system in a laser-heated diamond-anvil cell (DAC) at ~50, ~135, and ~200 GPa. Samples were recovered from a DAC and their cross-sections were prepared by focused ion beam (FIB). The chemical composition of quenched liquid and coexisting crystals were determined with a field-emission-type electron probe micro-analyzer (FE-EPMA). The results demonstrate the liquidus phase relations (showing a solid phase that crystallizes from liquid with a certain composition) in the Fe-Si-C ternary at each pressure. The Fe-Si-C ternary eutectic point moves toward more C-rich composition at higher pressure, which is in good accordance with the eutectic melting temperatures in the Fe-C and Fe-Si binary systems. In addition, in contrast to our previous work by Ozawa et al. (2016) that suffered contamination by carbon, we found that the Fe-Si binary eutectic point shifts toward the Si-rich side with increasing pressure. It likely includes more than 15 wt% Si at 330 GPa, suggesting that Si can be a major light element in the core, which explains the high Mg/Si ratio observed in the upper mantle.

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