Melting relation in the Fe-S-Si system at 10 GPa : Implications for Mercury's core

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Observations of the dipolar magnetic field and libration suggest that Mercury could have a liquid metallic core. Mercury's core would consist of iron and light elements. Especially, silicon and sulfur are considered to be major candidates as light elements in the core [1,2]. Therefore, the melting relations of Fe-S-Si system can provide knowledge of the Mercury's core structure. However, high-pressure phase relations of this system are not yet known precisely. In order to get the better understanding of the core structure, it is needed to perform melting experiments under the core conditions.

In this study, we performed high-pressure and high-temperature experiments for the Fe-S-Si ternary system with Fe-26.5at%S-8.4at%Si and Fe-15.5at%S-8.8at%Si at a pressure of 10 GPa and temperatures between 720 °C and 2000°C using a Kawai-type multi-anvil apparatus. Our experiments show that the composition of solid iron is silicon rich while the composition of the melt is enriched in sulfur. Based on our results, when the solidification of the core started in the early period of Mercury's evolution, the solid Fe_2Si might firstly appeared and then the residual liquid might become sulfur rich.

Reference

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