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Phase relationships of the Fe-Ni-S system at 15GPa

Ryota Kamuro[1], Satoru Urakawa[1*], Akio Suzuki[2], Katsuyuki KAWAMURA[3]

[1]Dept Earth Sci, Okayama Univ, [2]Dept Earth Mater Sci, Tohoku Univ, [3]Dept Sound Material-Cycle Sci, Okayama Univ

The melting relations of the iron and light elements system are fundamental information to understand the formation and evolution of the planetary liquid core. Here we report the results of high-pressure experiments on the phase relationships of the Fe-Ni-S system. We have studied the entire filed of the Fe-Ni-S system at 15 GPa based on the textural observation and chemical analysis of the quenched samples. The melting relation of the Fe-Ni-S system is a pseudo-binary eutectic system between the Fe-Ni alloy and (Fe, Ni)S monosulfide. The eutectic trough divides the liquidus surface into the metallic field and the sulfide field. Eutectic temperature shows a minimum point at Ni/Ni+Fe=0.75, and sulfur content of the eutectic point is about 30 at%. We revealed the stability fields of $(Fe,Ni)_3S_2$ and $(Fe,Ni)_3S$ phases, intermediate phases which affect the melting relations of the Fe-Ni-S system. $(Fe,Ni)_3S_2$ makes a complete solid solution between Fe_3S_2 and Ni_3S_2, which melts incongruently into (Fe, Ni)S and liquid. On the other hand, $(Fe,Ni)_3S$ is stable at Ni-rich side and melts incongruently into Fe-Ni alloy and liquid. We also study the subsolidus stability of $(Fe,Ni)_3S_2$ by synchrotron-based in situ X-ray observation, and those results will be discussed.

Keywords: core, melting, high pressure, iron sulfide