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Trace element partitioning between Fe-Ni Alloy and sulfide melt under high pressure

SUZUKI, Toshihiro[1*], HIRATA, Takafumi[2], IMAI, Takamasa[3], YOKOYAMA, Takaomi D.[2]

[1]JAMSTEC/IFREE, [2]Lab. Planet. Sci., Kyoto University, [3]Dep. Earth Planet. Sci., TITECH

Knowledge of the partitioning behavior of elements between solid-liquid metal is fundamental for resolving the evolution in metallic core of the terrestrial planets. Hence we performed high pressure melting experiments of Fe-Ni-S system at 10 and 15 GPa, and measured the partitioning coefficient of elements.

We synthesized Fe-Ni(95:5) alloy doped with 14 trace elements (Co, Cu, Ge, Mo, Ru, Ph, Pd, W, Re, Os Ir, Pt, Au, Pb) in approximately 150 ppm, by arc-melting method. A small chip of this alloy and a small amount of FeS powder were packed in the MgO capsule, and high pressure melting experiments were performed using Kawai-type multi-anvil press installed at Tokyo Institute of Technology. Quenched samples were polished and major element compositions were measured by EPMA. Trace element abundances were determined by fs-laser ablation system with sector-type ICP-MS installed at Kyoto University.

Among measured elements, Ru, Re, Os, Ir, and Pt were distributed into the solid metal, while Mo, Pd and Au were enriched in the sulfide melt. These observations may suggest the influence of sulfur in the partitioning behaviors. In the case of silicate mineral-melt system, it is well known that the partition coefficients are controlled by the crystal structure and ionic radius (e.g., Onuma et al., 1968). Similar relationship has been also pointed out for metallic system that the partition coefficients are correlated with atomic radius (e.g., Orman et al., 2008). However, we cannot found any relationships between atomic radius and the observed partition coefficients. Further investigations are required to find out the systematics in the partition behaviors of metallic solid-liquid systems.

References

Onuma N., Higuchi H., Wakita H., Nagasawa H. (1968), Trace element partition between two pyroxenes and host lava. Earth Planet. Sci. Lett., 5, 47-51.

Orman J.A.V., Keshav S., Fei Y. (2008), High-pressure solid/liquid partitioning of Os, Re and Pt in the Fe-S system. Earth Planet. Sci. Lett., 274, 250-257.

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