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Pressure effect on element partitioning between Fe-Ni Alloy and sulfide melt

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Understanding the partitioning behavior of elements between solid and liquid metal is key to resolving the evolution in metallic core of the terrestrial planets. Crystallization history of iron meteorites have been investigated from the partitioning data of trace elements at normal pressure conditions. In order to reveal evolution process in the larger bodies, partitioning data under high pressure conditions are required. Although a several high pressure researches on partitioning behavior have been reported, data are still insufficient. We performed high pressure melting experiments of Fe-Ni-S system at 10 and 25 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.

The observed pressure dependences of partition coefficients in the present experiments were generally in agreement with the previous works (e.g., Hayashi et al. 2009, Chabot et al. 2011); partition coefficient of Cu, Ge, Pd, Au increased with pressure while that of Mo, Ru, W decreased. Partition coefficient of Re, Os, Ir, Pt showed no significant pressure dependence. However, in some elements, present results were slightly different from the previous works. For example, in previous works, it was suggested that partition coefficient of Co and Ni decrease with pressure, but our results showed no pressure dependence in partition coefficient of Co, and partition coefficient of Ni slightly increased with pressure. Therefore, more detailed experiments are required to resolve the pressure dependence of these elements.

References

Hayashi et al. (2009), Geochim. Cosmochim. Acta 73, 4836-4842.
Chabot et al. (2011), Earth Planet. Sci. Lett., 305, 425-434.

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