Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)
©2015. Japan Geoscience Union. All Rights Reserved.

SGC50-05 Room:102A Time:May 25 15:15-15:30

Partitioning behavior of elements between metal and sulfide melt

SUZUKI, Toshihiro[1*] ; HIRATA, Takafumi[2] ; TAKAHASHI, Eiichi[1]

[1]Earth and Planet. Sci., Tokyo Tech., [2]Earth and Planet. Sci., Kyoto Univ.

The partitioning behavior of elements between solid and liquid metal is key information to resolving the evolution of metallic core of the terrestrial planets. In the case of silicate mineral-melt system, it is well known that partition coefficients closely relate to size of cation and crystal structure. Thus similar size dependences in partition coefficients were also considered in metallic systems. For example, Van Orman et al. (2008) measured partition coefficient of Re, Os and Pt in Fe-S system under high pressure, and proposed that partition coefficients of these elements are fitted by Lattice Strain Model (Blundy & Wood, 1994) when they are plotted against atomic radius. Stewart et al. (2009) proposed that partitioning behaviors in metallic system can be explained by Lattice Strain Model when Neutral Atom Radius (Clementi et al. 1967) is adopted. However, it seems very strange that maximum of partition coefficient is found in Os, whose size is considerably larger than that of iron, which constructs the fundamental framework of crystal structure. In these metallic systems, it is well known that partition coefficient strongly depend on light element contents (sulfur, phosphorus or carbon) of metallic liquid. Therefore, we have to carefully consider the chemical affinity of elements to find the systematics in partitioning behaviors. In this study, we performed melting experiments of FeNi-S system under high pressure in various sulfur contents, and examined the systematic change in partitioning behaviors.

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 LA-ICP-MS installed at Kyoto University.

The observed partition coefficients in the present experiments were generally in agreement with the previous works, and indicating strong dependences to sulfur content in liquid phase. When we accept that partition coefficients are mainly controlled by chemical affinity of elements, then size dependence of partition coefficients must be found in sulfur free system, which includes no chemical affinity effects on partition coefficients. Although we have no data for such pure metallic system, partitioning behavior in the pure metal system can be predicted from the observed sulfur dependence in partitioning behaviors. It was found that the differences in partition coefficients between elements become smaller with sulfur content of liquid phase decreases. This means that partition coefficients in pure metal system may show similar values, even if in large sized elements, such as Au or W.

Blundy & Wood(1994), Nature 372, 452-454.
Clementi et al.(1967), J. Chem. Phys., 47, 1300-1307.
Stewart et al.(2009), Earth Planet. Sci. Lett. 284, 302-309.
Van Orman et al. 2008), Earth Planet. Sci. Lett. 274, 250-257.

Keywords: element partitioning, metal, sulfide, high pressure