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Partitioning behavior of U and Th between metal and silicate at the Mercury's core mantle boundary

Miho Ishii[1*], Eiji Ohtani[1], Jun-Ichi Kimura[2], Hidenori Terasaki[1]

[1]Graduate School of Science, Tohoku Univ., [2]JAMSTEC

Mercury has a dipole magnetic field which was discovered by Mariner 10. But its origin has not been proven clearly yet. The most appropriate model for producing the dipolar magnetic field is core dynamo, which requires a high electrical conductive fluid in the interior (Elsasser, 1956). However, the size of Mercury is small enough to have completed internal cooling. Thus, any other heat source is needed to maintain the molten Mercury's core. One of the most plausible heat sources in the core is radioactive elements such as U and Th. In this study, in order to confirm the possibility of the existence of radioactive elements in the core, partitioning experiments of U and Th between Fe-alloy liquids (Fe-S, Fe-Si and Fe-S-Si) and solid silicate were conducted at the Mercury's core/mantle boundary condition (7 GPa, 1500 ^{o}C). High pressure experiments were performed using multi-anvil apparatus. Chemical analysis for major elements was performed using SEM-EDS, and for trace elements (U and Th) were performed using LA-ICP-MS at JAMSTEC.

Observed silicate assemblages were Olivine, Opx and Garnet, and their compositions were different depending on the coexisted metal compositions. Olivine was not observed in the experiments contained Fe-Si and Fe-S-Si metal.

As Garnet is considered to contain more U and Th compared to other coexisting silicate minerals, we measured the partitioning of U and Th between Garnet and metals. The amounts of U and Th in Garnet were two orders of magnitude higher than those in metal phases, suggesting that U and Th show the lithophile character at the experimental condition. The partitioning coefficients (D) of U and Th between metal/Garnet were almost 0.05 and 0.009, respectly. We estimated the effects of pressure, temperature, oxygen fugacity and light elements contents in metal on D by comparing with the previous works (Wheeler et al., 2006; Malevergne et al., 2007).

Keywords: Mercury, core mantle boundary, partitioning behavior, U, Th