

## Determination of the noble gas partition coefficients between metal-silicate melts under high-pressure and high-temperature conditions

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Analyses of ocean island basalts reveal a geochemical reservoir characterized by unradiogenic, “primordial” noble gas signatures (e.g., high  $^3\text{He}/^4\text{He}$  and low  $^{40}\text{Ar}/^{36}\text{Ar}$  ratios), likely residing in the deep mantle. There has been much debate about the area holding the “primordial” noble gases deep in the Earth (Porcelli & Ballentine, 2002), including that the “primordial” noble gases have been retained in the deepest region of the mantle since 4.4 Ga (Mukhopadhyay, 2012), or in the core since the core-mantle separation (Trieloff & Kunz, 2005; Bouhifd et al., 2013). However, the validity of latter strongly depends on the quantity of noble gases the core incorporates during accretion and can hold in the present day.

In order to investigate noble gas partitioning behavior between the core and mantle, noble gases were dissolved into metal-silicate melts under high temperature and pressure conditions, and then the samples were quenched, recovered, and analyzed for noble gas concentrations. Sample synthesis was performed at the Geodynamics Research Center, Ehime University. Noble-gas doped silicate glass and iron were melted and equilibrated under high pressure and temperature (3-6 GPa, 1700 and 1800 °C) using a multianvil apparatus. The sample capsule was cut and the polished surface of the section was investigated with scanning electron microscope and Raman spectroscopy. The chemical compositions of silicate and metal phases were determined with electron microprobe. And then, the noble gases in the silicate phase were extracted by an ultraviolet laser ablation apparatus and analyzed using a noble gas mass spectrometer at the University of Tokyo.

From the Raman spectra, it was found that crystallization (clinopyroxene) had occurred in samples synthesized at pressures of 6 GPa or higher, indicating that the sample quenching was not enough rapid. There is a possibility that noble gas may not be contained much in the crystallized part because a previous study showed that noble gas content in pyroxene crystal is smaller than those in glass (melt) by about  $10^{-4}$  (Heber et al., 2007). The noble gas concentrations in silicate glass phase are fairly homogeneous, even where a crack is formed during quenching. In future we will measure the noble gases in the iron part and determine the partition coefficient of the noble gases.

References: Bouhifd et al, *Nature Geoscience*. **6**, 982-986, 2013; Mukhopadhyay, *Nature* **486**, 101-104, 2012; Porcelli & Ballentine, *Rev. Mineral. Geochem.* **47**, 411-480, 2002; Trieloff & Kunz, *Phys. Earth Planet. Inter.* **148**, 13-38, 2005; Heber et al, *Geochim. Cosmochim. Acta.* **71**, 1041-1061, 2007