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# Solid Solubility Limit of Argon in Synthetic Polycrystalline Forsterite.

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The transport properties of argon in geologic system provide important constraints on geodynamic models including partial melting, mantle degassing and atmosphere formation (Hart et al., 1985; Allegre et al., 1986/76). Argon solubility and diffusion in silicate liquids has been studied extensively, leading to robust models for predicting solubilities based on the amount of open space in the melt structure that can accommodate noble gas atoms (e.g., White et al., 1989; Carroll and Stolper, 1993; Schmidt and Keppler, 2002). Constraining Ar solubility and diffusion in minerals has, however, proven to be more complicated due to several effects such as microstructure (pore, crack), impurity, contamination of base material, and lattice damage that may have occurred during sample preparation such as cutting, grinding and polishing (e.g., Heber et al., 2007; Thomas et al., 2008).

We synthesized highly-dense and fine-grained forsterite aggregates by vacuum sintering method. The polycrystalline forsterite samples were used for the Ar diffusion experiments without cutting and polishing. As a preliminary study, we performed Ar diffusion experiments in Ar pressure of 1 bar for 10h, 100h and 133h. Argon concentrations and diffusivities were measured using stepwise heating extraction in vacuum and noble gas mass spectrometry. Extremely small amounts of Ar in the samples (10-50 ppb), which was close to the detection limit of analytical system, imply low Ar solubility in forsterite and/or slow Ar diffusion into the sample causing insufficient Ar uptake during the diffusion experiments. To investigate more detail of Ar diffusion in forsterite, we introduced $^{37}$Ar into the samples via nuclear reaction of Ca by neutron irradiation in the JRR-3 reactor, JAEA. This method is expected to achieve homogeneous distribution of $^{37}$Ar because Ca had been distributed homogeneously in the forsterite. Step heating analysis of the recovered samples from the reactor is ongoing.