Geochemistry of olivine melt inclusions in Pitcairn Island basalts: A multiple-instrument approach

*Takahiro Ozawa[1], Takeshi Hanyu[2], Hikaru Iwamori[2,1], Morihisa Hamada[2], Takayuki Ushikubo[2], Kenji Shimizu[2], Motoo Ito[2], Jun-Ichi Kimura[2], Qing Chang[2], Tsuyoshi Ishikawa[2]

1. Tokyo Institute of Technology, 2. Japan Agency for Marine-Earth Science and Technology

Ocean island basalts (OIBs) provide essential information on evolution of the Earth’ s mantle, because OIBs are sourced from plumes from the deep mantle that include recycling materials. OIBs at the Pitcairn Island show distinct geochemical characteristics from other OIBs with their enriched isotopic signatures, so called enriched mantle 1 (EM1) component. This particular feature could have been caused by the involvement of recycled materials including chemically differentiated oceanic plate slab or delaminated continental lithosphere and lower crust (e.g., Eisele et al., 2002). In order to understand behavior of volatile elements during mantle recycling, we analyzed H_2O, CO_2, F, S, and Cl in the olivine-hosted melt inclusions in the Pitcairn OIBs using a secondary ion mass spectrometry (SIMS). Major and trace elements, and Pb isotope compositions were also determined on the same melt inclusions with an electron probe micro analyzer (EPMA) and a laser ablation-inductively coupled plasma-mass spectrometer (LA-ICP-MS). Most of the olivine-hosted melt inclusions contain microcrystals due to slow cooling after emplacement of the host lavas. In the preliminary study, we found that measured element concentrations were blurred by the microcrystals. Therefore, we homogenized the melt inclusions by a heating and quenching method. Homogenization experiment was performed in a CO_2 + H_2 atmosphere using an electric furnace. For the first step, liquidus temperature of the melt inclusions was explored by altering the furnace temperature at every 25 ˚C between 1100 ˚C and 1350 ˚C. We found that the liquidus temperature was between 1150 ˚C and 1175 ˚C. All the olivines were then heated just above the liquidus temperature at 1150 ˚C or 1175 ˚C for 10 minutes and quenched. Previous studies showed that H_2O may be diffused out from a melt inclusion through host olivine during homogenization. In order to assess the effect on H_2O diffusion, we also heated naturally homogeneous melt inclusions in a pyroclastic rock and compared H_2O concentrations before and after heating. In this presentation, effects of homogenization on volatile compositions will be discussed. After corrections for the effects of post-entrapment crystallization, concentrations of the volatile elements together with the major and trace elements, and Pb isotopes in the melt inclusions are used to explore volatile contents in the source mantle of the Pitcairn OIBs.

