Noble gas and halogen variation of volcanic rocks from the Izu-Mariana subduction zone

H. SUMINO[1]*, M. KOBAYASHI[2], R. BURGESS[3], L. JEPSON[3], S. MACHIDA[4], A. SHIMIZU[5], D. HAHM[6,7], D.R. HILTON[6] AND C.J. BALLENTINE[8]

[1] Dept. Basic Sci., Univ. Tokyo, Tokyo 153-0041, Japan (*correspondence: sumino@igcl.c.u-tokyo.ac.jp)
[2] GCRC, Univ. Tokyo, Tokyo 113-0033, Japan
[3] SEAES, Univ. Manchester, Manchester M13 9PL, UK
[4] JAMSTEC, Kanagawa 237-0061, Japan
[5] TIRI, Tokyo 135-0064, Japan
[6] Scripps Inst. Ocean., UCSD, California 92093-0244, USA
[7] Dept. Ocean., Pusan National Univ., Busan 46241, Korea
[8] Dept. Earth Sci., Univ. Oxford, Oxford OX1 3AN, UK

The subduction of sedimentary-pore-fluid-like noble gases and halogens is supported by several studies. These include noble gases and halogens with seawater and sedimentary pore-fluid signatures in exhumed mantle wedge peridotites from the Sanbagawa-metamorphic belt, southwest Japan [1], mantle-derived xenoliths from Kamchatka and Luzon arcs [2], and in seafloor and forearc serpentinites [3] along with seawater-like heavy noble gases in the convecting mantle [4]. Here we present noble gas and halogen compositions of olivines in arc lavas of the Izu-Mariana subduction zone to develop a better understanding of the processes that control the return of these volatile and highly incompatible elements into the mantle.

The MORB-like $^{3}He/^{4}He$ of most samples are consistent with those of the subduction zone mantle xenoliths [2], which indicate a considerably low contribution of radiogenic ^{4}He in the subduction fluids observed in the Sanbagawa samples [1]. In contrast, the $^{40}Ar/^{36}Ar$ indicate significant involvement of atmospheric Ar in the magma source. Systematically higher atmospheric contribution in the volcanic front compared to the rear arc in the Izu arc suggests that subduction of seawater-derived Ar has a significant effect on the noble gas composition at the magma-generation region. Although the halogen compositions of most samples are close to that of MORB-source mantle, some rear-arc samples show a significant contribution from pore-fluid-derived halogens. The results suggest that halogen-poor fluid may be dominantly released from the subducting slab beneath the arc, while halogen supply from the slab is limited beneath some volcanoes in the rear arc. This implies the relative persistence of halogens in the subducting slab compared to noble gases.

[1] Sumino *et al*., *EPSL* 2010. [2] Kobayashi *et al*., *Mineral. Mag*. 2013. [3] Kendrick *et al*., *Nat. Geosci*. 2011. [4] Holland & Ballentine, *Nature* 2006.