Across-arc noble gas and halogen variation of volcanic rocks from the Izu-Ogasawara subduction zone

H. SUMINO[1]*, R. BURGESS[2], L. JEPSON[2], D. CHAVRIT[2], A. SHIMIZU[3], S. MACHIDA[4] AND C. J. BALLENTINE[5]

[1]GCRC, Univ. Tokyo, Tokyo 113-0033, Japan
(*correspondence: sumino@eqchem.s.u-tokyo.ac.jp)
[2]SEAES, Univ. Manchester, Manchester M13 9PL, UK
[3]TIRI, Tokyo 135-0064, Japan
[4]SCSE, Waseda Univ., Tokyo 169-8555, Japan
[5]Dept. Earth Sciences, Univ. Oxford, Oxford OX1 3AN, UK

Halogens and noble gases with seawater and sedimentary pore-fluid signatures were discovered in exhumed mantle wedge peridotites and eclogites from the Sanbagawa-metamorphic belt, southwest Japan [1] [2]. These findings along with seawater-derived heavy noble gases in the convecting mantle [3] provide observations that allow us to investigate the processes that control the return of volatile and highly incompatible elements into the mantle. To verify whether and how such subduction fluids may modify the composition of the mantle beneath subduction zones, we have determined the noble gas and halogen compositions of olivines in arc lavas from the northern Izu-Ogasawara subduction zone and IODP sediments and basalts recovered from the northwestern margin of the Pacific plate.

The MORB-like $^{3}He/^{4}He$ ratios in samples from the volcanic front and rear-arc show no systematic variation across the arc, indicating the contribution of radiogenic ^{4}He from subductions fluids is negligible compared to that observed in the Sanbagawa samples [1] [2]. In contrast, the $^{40}Ar/^{36}Ar$ ratios (299-620) are close to the atmospheric value (296) and significantly lower than the MORB source (up to 32,000 [3]). Systematically higher $^{40}Ar/^{36}Ar$ ratios in the rear arc than in the volcanic front, and a comparison with those of subducting materials, suggest that subduction of seawater-derived Ar significantly affects the noble gas composition of the magma-generation region. Although the halogen compositions of most of the olivines are close to that of the MORB source, some rear-arc samples show a significant contribution from pore-fluid-derived halogens. The results suggest that halogen-poor fluid associated with atmospheric noble gases may be predominantly released from the subducting slab beneath the arc, whilst halogen-rich fluid is released at greater depths and is a significant contributor to the magmas of some rear-arc volcanoes.

[1] Sumino et al. (2010) *EPSL* **294**, 163. [2] Sumino et al. (2011) *Mineral. Mag.* **75**, 1963. [3] Holland & Ballentine (2006) *Nature* **441**, 186.