Halogen fluxes at mid-ocean ridges and budget in surface environments

TAKANORI KAGOSHIMA[1]*, LORRAINE RUZIÉ-HAMILTON[2], RAY BURGESS[2], NAOTO TAKAHATA[1] AND YUJI SANO[1]

[1]Atmopshere and Ocean Research Institute, University of Tokyo, Japan (*correspondence: kagoshima@aori.u-tokyo.ac.jp)

[2]School of Earth, Atmospheric and Environmental Sciences, University of Manchester, United Kingdom

In order to elucidate whether the halogen budget in surface envoronments is explained by input from the mantle, we estimate halogen fluxes at mid-ocean ridges (MOR) based on the chemistry of submarine vent fluids, MORB vesicles and glass matrix. The fluorine flux was constrained as follows:

1) Combining F/^{3}He ratios determined in MORB vesicles and the known ^{3}He flux: We analyzed eight MORB vesicles (13°N,17°S on EPR; 15°N,30°N,37°N on MAR; 24°S-25°S on CIR) by crushing. Fluorine was extracted into alkaline solution and measured by an ion chromatography ICS-2100, while helium was measured by a VG5400 noble gas MS, both housed at AORI, University of Tokyo. Cl/^{3}He ratios were also determined using this method.

2) Combining the fluorine concentrations in submarine hydrothermal fluids with the fluid flux at MOR.

The calculated fluxes using these methods are 1000-2000 times lower than those estimated based on the F contents in MORB glass matrix and the MORB production rate [1], or the F/CO_2 ratio in the MORB source and CO_2 flux [2]. This implies that the majority of the F resides in the melt and is not released during oceanic crust production.

Chlorine, Br, and I contents in vesicles and the matrix of MORB glasses described in 1) have been determined using extension of the ^{40}Ar-^{39}Ar method which converts halogens into proxy noble gas isotopes by neutron irrradiation. Argon, Kr, and Xe isotopes were measured using MS-1 and ARGUS VI mass spectrometers in Manchester. Chlorine, Br, and I fluxes were constrained using Br/Cl and I/Cl ratios determined by this method, Cl/^{3}He ratios in MORB vesicles observed by 1), and the worldwide hydrothermal fluid datasets. The resulting fluxes are lower than values estimated based on halogen contents in MORB glass matrix and the MORB production rate. Preliminary indications from these datasets are that, like F, relatively small amounts of heavy halogens are released from MORB during degassing processes and the major fraction is retained in the melt as suggested in an early study [3]. Comparing MOR, arc, and hotspot fluxes, the global cycles of halogens will be discussed in the presentation.

[1] Tajika (1998) *GRL* **25**, 3991-3994. [2] Fischer (2008) *Geochem. J.* **42**, 21-38. [3] Schilling et al. (1978) *Nature* **273**, 631-636.