Halogen and noble gas systematics within mantle xenoliths from intraplate settings

M. KOBAYASHI[1*], H. SUMINO[1], R. BURGESS[2], T. IIZUKA[1], J. NAGAO[1], M. NAKAMURA[3], E. TAKAHASHI[4] AND C. J. BALLENTINE[5]

[1]The University of Tokyo, Japan (*correspondence: kobayashi@eqchem.s.u-tokyo.ac.jp)
[2]The University of Manchester, UK
[3]Tohoku University, Japan
[4]Tokyo Institute of Thecnology, Japan
[5]The University of Oxford, UK

Halogens and noble gases are powerful tracers of volatiles. Mantle wedge peridotites with I/Cl ratios higher than the depleted MORB mantle (DMM) values, has been interpreted as evidence for subduction of sedimentary pore fluid halogens. [1]. However, it is unknown how far the influence of iodine-rich halogens extends into the mantle. Here, we present halogen and noble gas compositions of mantle xenoliths from intraplate settings in Europe (Eifel) and North America (San Carlos and Kilbourne Hole), where the subcontinental lithospheric mantle (SCLM) has been isolated from the convecting mantle since ~1.6 Ga as recorded by their Re-Os model ages [2].

Noble gases in the fluid inclusions were extracted by *in vacuo* crushing and subsequently analyzed through mass spectrometry. Halogens were also analyzed by noble gas mass spectrometry after conversion to noble gas proxy isotopes by neutron irradiation [3]. Halogen compositions of the whole rocks were determined by melting extraction.

Br/Cl and I/Cl ratios of the mantle xenoliths show possibly non-linear correlation extending from within the range of DMM values. Non-linearity points to elemental fractionation from a DMM-like composition rather than mixing between DMM and a subducted component. $^{4}He/^{40}Ar^{*}$ ratios of the xenoliths are lower than DMM [4] and show a negative correlation with the I/Cl ratios. Helium and chlorine have higher diffusivity and solubility in melts than other noble gases and heavy halogens, respectively [5]. Therefore, halogen and noble gas elemental ratios could have fractionated during partial melting. In this context if the inferred halogen elemental ratios prior to fractionation were similar to present-day DMM, then the influence of subducted iodine-rich halogens has been insignificant in DMM over the past 1.6 Gyrs.

[1] e.g., Sumino et al. (2010, EPSL) [2] Meisel et al. (2001, GCA) [3] e.g., Johnson et al. (2000, GCA) [4] Graham (2002, Rev. Mineral. Geochem.) [5] e.g., Bureau et al. (2000, EPSL); Heber et al. (2007, GCA)