

## ヨウ素に富むハロゲンの沈み込みとマントルのI/Cl比

## Subduction of iodine-rich halogens and the I/Cl ratio in the mantle

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Volatiles are continuously expelled from the mantle via volcanic activity, whilst being simultaneously transported into the Earth at subduction zones. Since the addition of even small amounts of volatiles may induce major changes in the chemical and physical properties of mantle rocks, understanding volatile recycling processes is critical for understanding mantle heterogeneity and its temporal evolution. Halogens and noble gases are powerful tracers of volatile recycling in subduction zones [1-3]. The subduction of sedimentary pore fluid-derived halogens and noble gases (i.e., sourced from seawater trapped in pores of marine sediments) via the hydrous mineral serpentine has been proposed based on sedimentary pore fluid-like halogen and noble gas signatures in seafloor and forearc serpentinites [1], mantle peridotites from the Sanbagawa metamorphic belt, Japan [2], and mantle xenoliths from volcanic fronts [3]. These subducted halogens can be readily identified by their I/Cl ratios, which are several orders of magnitude higher than those of seawater and depleted MORB mantle (DMM). Non-radiogenic, heavy noble gas compositions in the convecting mantle are similar to those in seawater and sedimentary pore fluids, indicating the 90% of <sup>36</sup>Ar in the convecting mantle was originally derived from these sources [4]. Conversely, halogen elemental ratios in mantle xenoliths from intraplate settings (Europe and North America) can be accounted for by fractionation from a DMM-like composition, obviating the need for subduction [3]. Because Re-Os model ages of the subcontinental lithospheric mantle in these localities are around 1.6 Ga [5], the DMM-like halogen signatures of the mantle must have remained constant for at least 1.6 Gyrs.

Here, we use a box model to estimate the halogen subduction fluxes required to have maintained this I/Cl ratio in the mantle over the past 1.6 Gyr. These modeled halogen fluxes are compared with those estimated from (i) halogen/H<sub>2</sub>O ratios in natural serpentine in seafloor serpentinites [1] and the amount of water subducted within the hydrous slab mantle [6], and (ii) halogen/<sup>36</sup>Ar ratios in natural serpentine [1] and the subduction flux of <sup>36</sup>Ar. The <sup>36</sup>Ar subduction flux has been constrained from its concentration in the convecting mantle and its outgassing flux at mid-ocean ridge systems, which is estimated from the <sup>36</sup>Ar/<sup>3</sup>He ratio in MORB source [4] and the <sup>3</sup>He outgassing flux from mid-ocean ridges [7], respectively.

Our data show that the estimated subduction flux of iodine carried by the hydrous slab mantle is too high to keep the I/Cl ratio in the mantle constant over the investigated time period. The present-day DMM-like I/Cl ratio can only be preserved if halogens are not efficiently released from subducting slabs and consequently do not become incorporated into the convecting mantle. In contrast, subducted noble gases should be incorporated into the convecting mantle in order to account for its seawater-like noble gas signature [4]. As such, we interpret that noble gases are readily expelled from subducting slabs at upper-mantle depths due to their high volatilities, whereas halogens are not, and so are transported to significantly greater depths in the Earth.

[1] Kendrick et al. (2013, EPSL) [2] Sumino et al. (2010, EPSL) [3] Kobayashi et al. (2015, JpGU Meeting) [4] Holland & Ballantine (2006, Nature) [5] Meisel et al. (2001, GCA) [6] e.g., van Keken et al. (2011, JGR) [7] Bianchi et al. (2010, EPSL)

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