Multiple halogen components in subcontinental lithospheric mantle revealed by single-grain analysis of mantle-derived xenoliths

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Volatile recycling back to the Earth’ s mantle at subduction zones has a significant, yet poorly constrained impact to the volatile budget in the mantle. Halogens with marine pore-fluid signatures have previously been discovered in mantle wedge peridotites, suggesting that pore-fluid-derived volatiles can survive the subduction cycle to subarc depths and modify the subcontinental lithospheric mantle (SCLM) [1,2]. To better constrain how such subduction fluids modifies the halogen composition of SCLM, we analyzed halogens in single grains/ a few grains of olivine, ortho- and clino-pyroxene crystals separated from mantle xenoliths from Southern Patagonia, Kamchatka, and the Philippines, in which several halogen components in addition to a MORB-like one have been previously identified in bulk and mineral separates [2,3]: (A) a pore-fluid-like component with high Br/Cl and I/Cl ratios similar to bulk mantle wedge peridotites [1,2]; (B) a Cl-enriched component relative to MORB, similar to bulk altered oceanic crust (AOC) and metasomatised intraplate mantle xenoliths [4,5]; and (C) a component enriched in Br and moderately in I compared to MORB, which resembles fluids in AOC, diamonds and mantle xenoliths in Russian kimberlites [4,6,7]. Halogens in the mineral grains were measured with neutron-irradiation and noble gas mass spectrometry combined with crushing and laser heating extraction.

Whereas only component (A) was observed in bulk samples from Kamchatka and the Philippines containing abundant water-rich fluid inclusions [2], components (B) and (C) were also identified in their olivines. In contrast, the component (A) is a relatively minor component in Southern Patagonian samples. These suggest that mantle wedge metasomatism by pore-fluid derived volatiles would be obscured by fractionation processes in SCLM [5], while AOC-related signatures survive more robustly.

[1] Sumino *et al.* (2010) *EPSL*. [2] Kobayashi *et al.*(2017) *EPSL*. [3] Sumino *et al.* (2018) *Goldschmidt abstract*. [4] Chavrit *et al.*, (2016) *GCA*. [5] Kobayashi *et al.* (2019) *G-cubed*. [6] Burgess *et al.* (2009) *GCA* . [7] Broadley *et al.* (2018) *Nature Geo*.

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