

Evidence for volatile recycling from determination of the OIB mantle source halogen concentration

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Halogens have, due to their incompatibility, the potential to act as key tracers of volatile transport processes and may help us to gain a better understanding of the volatile input mechanisms into the Earth's mantle.

We measured experimentally the fluorine, chlorine and bromine partitioning behavior between forsterite (fo), orthopyroxene (opx) and silicate melt at temperatures (1500-1600°C) and pressures (1.0-2.3 GPa) representative of partial melting conditions in the Earth's mantle, particularly the OIB source region. Combining our data with results of recent studies [1,2] shows that F and Cl partitioning between fo and melt increases by a factor of 500 (F) and 2000 (Cl) between 1300°C and 1600°C and does not show any pressure dependence. Bromine appears to show a similar behavior. Partitioning between opx and melt increases by about 1.5 orders of magnitude (Cl) and 0.5 orders of magnitude (F) for a temperature increase of 100°C (between 1300°C-1600°C). Partitioning decreases with increasing pressure with Cl partitioning into opx decreasing by 1.5 orders of magnitude for a pressure increase of 1 GPa (between 1.0 and 2.5 GPa).

Halogen abundances in OIB source regions (F=35-65; Cl=11-45ppm) were estimated by combining our data with natural halogen concentrations in oceanic basalts [3, 4]. OIB source Cl abundances are in almost perfect agreement with primitive mantle estimates (18-42 ppm [4]). An isolated OIB source mantle is expected to be slightly depleted in volatiles [5]. This implies that presumably small amounts of Cl are recycled into the OIB source mantle region, possibly via marine pore fluids. F is, however, enriched in the OIB source mantle region by a factor of 1.4-3.6 relative to primitive mantle estimates (\approx 25ppm, [6]). This suggests that significant amounts of F are recycled into deeper mantle regions through subduction of oceanic crust, possibly in the lattice of hydrous amphibole, or in anhydrous high-pressure phases of eclogite.

[1]Beyer *et al* (2012) *EPSL* **337-338**, 1-9 [2]Dalou *et al* (2009)*CMP* **163**, 591-609 [3] Kendrick *et al.* (2012)*Geol.* **40**, 1075-1078 [4]Ruzié *et al* (2012)V31A-2762, AGU Fall Meeting. [5] Winter (2010) An Introduction to Ign. and Met. Petrol. [6] Palme and O'Neill (2003) *Treat. Geo.* **2**, 1-38