

## **Bromine partitioning between olivine and melt at OIB source conditions: Indication for volatile recycling**

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Halogens play a key role in our understanding of volatile transport processes in the Earth's mantle. Their moderate (fluorine) to highly (iodine) incompatible and volatile behavior implies that their distribution is influenced by partial melting, fractionation and degassing processes as well as fluid mobilities. The heavy halogens, particularly bromine and iodine, are far more depleted in the Earth's mantle than expected from their condensation temperature (Palme and O'Neill 2014), so that their very low abundances in basalts and peridotites (ppb-range) make it analytically challenging to investigate their concentrations in Earth's mantle reservoirs and their behavior during transport processes (Pyle and Mather, 2009). We used a new experimental technique, which combines the irradiation technique (Johnson et al. 2000), laser ablation and conventional mass spectrometry. This enables us to present the first experimentally derived bromine partition coefficient between olivine and melt.

Partitioning experiments were performed at 1500°C and 2.3 GPa, a P-T condition that is representative for partial melting processes in the OIB source region (Davis et al. 2011). The bromine partition coefficient between olivine and silicate melt at this condition has been determined to  $D_{Br}^{ol/melt} = 4.37 \cdot 10^{-4} \pm 1.96 \cdot 10^{-4}$ . Results show that bromine is significantly more incompatible than chlorine (~1.5 orders of magnitude) and fluorine (~2 orders of magnitude) due to its larger ionic radius.

We have used our bromine partitioning data to estimate minimum bromine abundances in EM1 and EM2 source regions. We used minimum bromine bulk rock concentrations determined in an EM1 (Pitcairn: 1066 ppb) and EM2 (Society: 2063 ppb) basalt (Kendrick et al. 2012), together with an estimated minimum melt fraction of 0.01 in OIB source regions (Dasgupta et al. 2007). The almost perfect bromine incompatibility results in minimum bromine abundances in EM1 and EM2 OIB source regions of 11 ppb and 20 ppb, respectively. The effect on the partitioning behaviour of other minerals such as pyroxene, mantle inhomogeneity, incongruent melting, a potential effect of iron, temperature, pressure or the presence of fluids, would be to shift the estimated bromine mantle source concentration to higher but not to lower values. Comparing our minimum bromine OIB source region estimate with the estimated primitive mantle bromine abundance (3.6 ppb; Lyubetskaya and Korenaga, 2007) implies that the OIB source mantle is enriched in bromine relative to the primitive mantle by at least a factor of 3 in EM1 source regions and a factor of 5.5 in EM2 source regions. One explanation is that bromine may be efficiently recycled into the OIB source mantle region through recycling of subducted oceanic crust.

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