1.2.32

Coupled boron and oxygen isotope variations in subglacial basaltic glasses from northern Iceland

P.J. LE ROUX[1], J.A. BAKER[1,2], E.H. HAURI[3] AND S.B. SHIREY[3]

[1] Danish Lithosphere Centre, Copenhagen, Denmark (plr@dlc.ku.dk; jab@dlc.ku.dk)
[2] School of Earth Sciences, Victoria University of Wellington, Wellington, New Zealand
[3] Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, DC, USA (hauri@dtm.ciw.edu; shirey@dtm.ciw.edu)

The study of boron isotopes in oceanic basalts has lagged behind other isotope systems due to (1) low boron abundances (generally < 3ppm) in MORB and OIB, (2) significant analytical challenges, and (3) impact of magma assimilation on boron isotope ratios. Therefore, few OIB boron isotope data exist (e.g. < 50 analyses, mostly melt inclusions, with analytical uncertainties > ±3‰ on $\delta^{11}B$ (2σ) for Iceland; [1] and references therein). This limits our understanding of mantle boron isotope compositions and recycling of boron into the deep mantle.

We present new boron isotope data with analytical uncertainties < ±1‰ on $\delta^{11}B$ (2σ), obtained by in situ LA multiple-multiplier ICP-MS [2], as well as SIMS volatile and halogen data for a suite of well-characterized subglacial basaltic glasses from the NRZ, Iceland [3] (major-, trace-element, and He-Sr-Nd-Pb-O isotope data available). The large range in $\delta^{11}B$ between relevant geochemical reservoirs (mantle -10‰; seawater +39.5‰ [1]) provides a further constraint on the origin of compositional variability in these Icelandic magmas.

We observe significant correlations between incompatible element ratios, $^{87}Sr/^{86}Sr$, H_2O (0.09 to 0.40 wt%), $\delta^{18}O$ (+3.18 to +5.19‰), and $\delta^{11}B$ (-4.40 to –11.1‰) data; all samples are high-MgO basaltic glasses (Mg# 59 to 70). The samples are significantly degassed (CO_2 7.8 to 34 ppm), with no evidence of Cl addition (Cl/Nb 6.2 to 14.2). Together, these data seem to preclude significant late-stage contamination of the magmas by either crustal, seawater-derived or meteoric water components. Rather, the $\delta^{18}O$ and $\delta^{11}B$ variations appear to be primary features of the magmas, inherited from melting of heterogeneous mantle sources or mixing of heterogeneous melts.

References

[1] Gurenko A.A. and Chaussidon M. (1997) *CG* **135**, 21-34.
[2] le Roux P.J., Shirey S.B., Benton L., Hauri E.H. and Mock T.D. (2004) *CG* **203,** 123-138.
[3] Breddam K., Kurz M.D. and Storey M. (2000) *EPSL* **176**, 45-55.

1.2.33

Carbon isotopic evidence for two-component mixing in the Iceland mantle source

K.A. KELLEY[1], E.H. HAURI, K. GRÖNVOLD[2] AND D. MCKENZIE[3]

[1] Department of Terrestrial Magnetism, Carnegie Instiution of Washington, Washington, DC, USA (kelley@dtm.ciw.edu)
[2] Nordic Volcanological Institute, Reykjavik, Iceland (karl@norvol.hi.is)
[3] Department of Earth Sciences, University of Cambridge, Cambridge, UK (mckenzie@esc.cam.ac.uk)

CO_2 has a low solubility in silicate melts at low pressures, and the isotopic composition of carbon fractionates during degassing of basaltic melts. Carbon isotopes in mantle melts have thus been difficult to interpret with respect to the carbon isotope signature of the original mantle source, due to uncertainties in mechanisms and extent of degassing and open-system loss or gain of bubbles (vesicles). New constraints on the initial carbon isotopic composition of the mantle are now possible, thanks in part to advancements in microbeam analytical techniques [1] and to the recent identification of silicate melt inclusions undersaturated with respect to pre-eruptive volatiles including CO_2 [2,3]. In these melts, CO_2 concentrations correlate with incompatible trace elements such as Nb and LREE.

Here, we present the first SIMS measurements of C isotopes in undersaturated, clinopyroxene-hosted melt inclusions from the Borgarhraun lava flow in NE Iceland. These new data show that $\delta^{13}C$ correlates positively with CO_2 concentration in these melt inclusions, along a trend that cannot be explained by closed- or open-system degassing. The data range from ~250 ppm CO_2 at $\delta^{13}C$ of –5‰ to ~700 ppm CO_2 at >0‰. $\delta^{13}C$ correlates with incompatible element concentrations (e.g. Nb, La), and with ratios of HFSE to CO_2. These relationships suggest mixing of two components in the Iceland mantle source: one with trace element and C characteristics of northern Atlantic MORB (depleted, $\delta^{13}C$=-5‰) and an enriched component with high trace element concentrations and enriched C isotopes that may originate from the Iceland plume.

References

[1] Hauri, E.H. et al. (2002) *Chem. Geol.* **183,** 99-114.
[2] Saal A.E., Hauri, E.H., Langmuir, C.H., and Perfit, M.R. (2002) *Nature* **419,** 451-455.
[3] Hauri, E.H., Grönvold, K., Oskarsson, N., McKenzie, D., and Shimizu, N. (2002) *EOS, Transactions, AGU* **83,** V21C-08.