Ion microprobe analyses of carbon isotope ratios in MORB

M. LE VOYER[1,2]*, E. DELOULE[3], K.A. KELLEY[4], P. CARTIGNY[5], E. COTTRELL[2] AND E. H. HAURI[1]

[1]Carnegie Institution, Washington, DC 20015, USA (*correspondence: mlevoyer@dtm.ciw.edu)
[2]Smithsonian Institution, Washington DC, 20013, USA
[3]CRPG, Vandoeuvre les Nancy, 54500, France
[4]University of Rhode Island, Narrangansett, RI 02882, USA
[5]IPGP, Paris, 75005, France

As carbon is poorly soluble in silicate melts, basalts from mid-oceanic ridges (MORB) contain little dissolved carbon (170±70 ppm CO_2, 1σ, n=440). In order to look at small-scale variations in carbon degassing flux, we performed a pilot study of in situ carbon isotope measurements in MORB, using the ion microprobe Cameca 1280-HR2 from CRPG. Instrumental mass fractionation was assessed using a serie of natural and experimental glasses with known carbon content (100-7000 ppm CO_2) and known carbon isotope ratios ($\delta^{13}C$ from -21.9 to -5.7 ‰, relative to marine carbonate standard, with $^{13}C/^{12}C$ of 0.0112246). The best results were obtained in monocollection, using a 10 kV, Cs^+ primary beam with a 15 nA intensity, a mass resolution of 5000, and 20% gating. Each analysis consisted of 30 cycles of signal collection using electron multipliers on masses 11.5 (background, 3s), 12 (4s) and 13 (20s). The instrumental fractionation was important (32‰) but constant over a 3 day period. Carbon contamination on the surface causes some instability; nonetheless, we achieve an analytical error of 1.0-1.5 ‰ (2σ over 30 cycles) and spot-to-spot reproducibility of ±2.0-3.0‰ (2σ, n=3-6) on standards with low carbon contents (100-400 ppm). We analyzed 8 MORB from the Equatorial Mid-Atlantic Ridge that range from -12.8±1.1‰ to -1.1±0.8‰ (2σ). These results are in good agreement with degassing rates inferred from rare gas measurements in samples from the same area [1]. Applications of this technique to small samples such as arc melt inclusions are very promising.

[1] Tucker *et al* (2012) *Earth Planet. Sci. Lett.* **355-356**, 244-254.