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Benchmarking analysis of $\delta^{11}B$ in low B Mid Ocean Ridge Basalt (MORB) volcanic glasses

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The recycling of lithospheric components influences the chemical evolution of Earth's mantle, by addition of geochemically distinctive, surface-processed material. The addition of components with isotopically anomalous boron via the subduction process is a notable example. Despite the potential of this system, resolution of significant differences in $\delta^{11}B$ within the mantle remains hampered by poor precision and questions over accuracy of analyses. The precise determination of the B isotopic composition of whole rock or volcanic glass is challenging due to B volatility during traditional chemical processing, low abundances (< 2 µg/g) and high analytical blanks, and difficulty in controlling instrumental fractionation during analysis. The latter problem is now well controlled using Multi-Collector Plasma Mass Spectrometry (MC-ICP-MS) and standard procedures allow blanks to be controlled. Yet, reliable processing of silicate samples still poses problems. We present B isotopic data obtained from well characterised reference material (JB-2 Basalt, IAEA-B5 Basalt, IAEA-B6 Obsidian) which has been processed by protocols involving flux fusion at relatively high (>850°C, Potassium carbonate) and low (60°C, Hydrofluoric acid) temperatures. The B is separated by ion exchange chromatography using the Amberlite IRA 743 and AG50W x8 resin, in a three-column procedure to minimise artificial mass bias by impurity interferences. Finally, we present B isotopic data obtained from unknown MORB glasses to investigate the B isotope composition of the Earth's mantle by MC-ICP-MS. A direct comparison with Secondary Ionisation Mass Spectrometry (SIMS) is drawn, illustrating the advantage of solution MC-ICP-MS over SIMS analyses, when B concentration are < 2 µg/g, a value typical of e.g. unaltered MORB volcanic glass. Improved precision in $\delta^{11}B$ on these low B unaltered MORB volcanic glass imply a greater variability of the Earth's upper mantle, than the previously inferred value of 7.1 ± 0.9‰ [1]. The MC-ICP-MS $\delta^{11}B$ data range from -6.2 to -8.8‰ with no overlap within analytical uncertainty (2sd <0.6‰), compared to SIMS uncertainty that typically range from 2 to 4‰ on individual MORB samples.

[1] Marschall, H. R., Wanless, V. D., Shimizu, N., von Strandmann, P. A. P., Elliott, T., & Monteleone, B. D. (2017), *Geochimica et Cosmochimica Acta 207*, 102-138.