In-situ boron isotope determination for mantle carbonate by laser ablation MC-ICP-MS

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Boron isotopic compositions are well accepted as a useful tracer in diverse geological processes. The application is relatively limited in high-temperature geology mainly due to the analytical difficulties, i.e., the extreme low boron content in mantle rocks (≤1 ppm). Boron isotopic determination with the wet chemistry involves the choice of resins and notorious contamination. Recently, development of in-situ boron isotope analysis has been improved, especially the technique with laser ablation MC-ICP-MS. Here we present the first work with attempts to obtain precise in-situ boron isotopic ratios for mantle carbonates ([B]<1 ppm).

The boron isotopic ratios ($\delta^{11}B$) is determined using a Resonics 193nm excimer laser ablation system coupled to a Nu Plasma II MC-ICP-MS. Ion counters are adopted with the consideration of the low boron contents. NIST612 glass is used as the external standard in the standard bracketing procedure to monitor and correct for instrumental fractionation and drift. The methodology was first tested with MPI-DING glasses (GOR128, GOR132 and StHs6/80), which yield boron isotope compositions in good agreement with the reported values at a reproducibility of ~ 1‰ (SD). Matrix effects and varied settings in the laser system (e.g., spot size) could cause fractionation between sample and standard for the light isotopes as boron. The obtained $\delta^{11}B$ of 22.11 ±0.79‰ for an in-house coral standard is consistent with the value determined by solution mode MC-ICP-MS, which indicates that the matrix effect between carbonate and the soda-lime glass is negligible for boron isotope determination. Different spot sizes have been used for the analysis of NIST614 (190μm) with NIST612 (75μm) as the standard, the obtained B isotopic ratio (-0.27 ±0.92‰) agrees well with the reported value. This suggests that varied spot size cause limited fractionation in the standard bracketing procedure. As a first application, calcite from the Oka carbonatite complex is determined with a $\delta^{11}B$ value of 3.4 ±1.8‰, which overlaps that obtained by solution mode MC-ICP-MS.