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New developments in Li isotope *in situ* analyses with fs-LA-MC-ICP-MS

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Previous studies have shown that metal isotope fractionation at magmatic temperatures is mainly caused by kinetic processes such as diffusion[1,2], which can be recorded as isotopic zoning in minerals. The analysis of such diffusion patterns in magmatic olivines and clinopyroxenes of the fast-moving element Li promises insights into the time scales of fast-paced volcanic processes such as cooling and degassing shortly before the eruption of a volcano. *In situ* Li isotope analyses have been performed with SIMS[3,4] and conventional LA-MC-ICP-MS.[5] However, measurements by SIMS appear to suffer from composition-dependent matrix effects, and conventional LA-MC-ICP-MS analyses of Li isotope ratios generate relatively large (50-150 µm) and deep laser spots. In order to analyze diffusion profiles of normal-sized magmatic minerals (< 500 µm) a spatial resolution of ~30 µm is required. Such a spatial resolution with an ablation depth of only a few µm is achievable using a femtosecond laser ablation system coupled to a Neptune Plus MC-ICP-MS which allows largely matrix-independent metal isotope analyses.[6,7] Here, we analyzed various silicate reference glasses with low Li concentrations (3-20 ppm) by fs-LA-MC-ICP-MS in order to establish an analytical setup for Li isotope analyses of chemically and isotopically zoned olivine and clinopyroxene crystals with <10 ppm Li.

Materials with Li concentrations down to 3 ppm can be measured with a combination of an ion counter (for ^{6}Li) and a Faraday cup with a 10^{11} Ω resistor (for ^{7}Li) with acceptable precisions of 1.2 ‰ (2 RSE). For lower Li concentrations, the combination of ^{6}Li on an ion counter and ^{7}Li in a Faraday cup with a 10^{13} Ω resistor seems to be even more promising if a τ-correction is applied to correct for the time delay of the 10^{13} Ω resistor. With this latter combination it should be possible to analyze *in situ* δ^7Li values of minerals with Li concentrations of a ~1 ppm level precisely.

References

[1]Jeffcoate et al. (2007); [2]Richter et al. (2009);
[3]Bell et al. (2009); [4]Su et al. (2015); [5]Xu et al. (2013);
[6]Oeser et al. (2014); [7]Lazarov & Horn (2015)