(1) Introduction & Study Aim

- Lithium and Boron are fluid-mobile elements, naturally dissolved in minor concentration in magmas and commonly used for tracing subduction-related processes. 
- Because of their properties these elements are potential proxies for asent-related degassing processes in volcanic systems.
- Currently available data on Lithium transport properties are mostly obtained from dry silicate melts (Fig. 3), while literature on Boron diffusion and isotopic fractionation is almost nonexistent.
- AIM: extending Lithium and Boron diffusion coefficient data to hydrated silicate melts, while also investigating isotope fractionation.
- Correlate diffusion and isotope fractionation with our future experiments, studying Lithium and Boron behaviour during decompression-induced magma degassing.

(2) Experimental Setup

LITHIUM

- Diffusion coefficients have been calculated by the Fick’s law, following Zhang (2010a).

$$D_{Li} = \frac{C_{Li}(t) - C_{Li}(0)}{t} \times \frac{L^2}{2}$$

- The time used in the calculations is the sum of t_{diff} with Δt_{diff} (Tab. 2), because our low-temperature zero-hour experiment (DIFF 1, see Tab. 2) indicates Li migration starting already during the heating ramp at around 600 °C.

- Elemental Lithium profiles (Fig. 2) confirm fast diffusion in the range of 7.5 x 10^{-11} to 1.32 x 10^{-10} m²/s (Tab. 2) showing similar values to Holycross et al. (2018).

- The difference of calculated D_Li values with Holycross et al. (2018) may be related to the presence of Fe-Ti oxides (0.64 and 1.0 wt %) and higher water content (-6 wt %.) in their starting material.

- The slope of the trendlines in the Arrhenius plot (Fig. 3) graphically define the activation energy for diffusive transport. Here it significantly decreases with the presence of water. This agrees with the Li property of being a fluid-mobile element.

(3) Results: Elemental Diffusion

- Lithium diffuses faster than Boron.
- Variations in the isotopic ratios have been modelled following Richter et al. (1999), where the coefficient β defines the relation between the diffusion coefficient of the two isotopes:

$$β = D_{Li} / D_{B}$$

- The four sample calculation give an average β value of 0.234 ± 0.006, that confirms the findings from Holycross et al. (2018).

- The variability of the Boron isotopic results by SIMS analyses remains within the analytical error of the measurement made on the starting material (Fig. 4).

- Even at 1100 °C, the 6 seconds experiment does not show significant isotope fractionation for Boron, highlighting its reduced mobility in comparison to Lithium.

(4) Conclusion & Outlook

- Boron mobility is too slow or inexistent for both elemental diffusion and isotopic fractionation at our experimental run conditions to show measurable changes.
- Experimental runs with longer duration and higher temperature are required and are planned in order to induce significant Boron migration and produce a clear diffusion profile as well as isotopic ratio variation.

EXPERIMENTAL OUTLOOK

- Sets of continuous (and multi-step) degassing experiments have been performed and are currently being expanded, investigating Li and B behaviour during ascent-induced magma degassing in dependence on the decompression rate.