# Experimental and numerical simulations of Li isotope fractionation during degassng of rhyolitic magma

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Ascending hydrous magma in nature often undergoes segregaton of vapor phase. Given this is a fundament driving force of volcanic eruption, there have many efforts to understand degassing process of magma. In this study, we have focused on an aspect of Li segregation during degassing process. Natural rhyolitic obsidian was pre-saturated in $H_2O$ at 210 MPa, 800 °C giving approximately 6 wt%. Subsequently the pre-saturated samples were isothermally decompressed at the rate of 500 kPa/s. The final pressure before quench was approximately 70 MPa. The duration of bubble growth was 40 sec. Some experiments were kept at constant pressure conditions immediately after decompression for up to 3 days.

Lithium abundance in degassed melt varies between above and below the initial lithium concentration, from 69 to 74 ppm (71 ppm initial concentration). Its isotopic composition of Li is heavier by 3 to 5 permil compared to the initial. The annealed sample shows similar heavy isotope values, but Li abundance is only higher than the initial, no concentraton depletion is detected. Due to limited spatial resolution of mircoanalytical techniques (SIMS, LA-ICPMS), and dense nucleation sites, no systematic profile was found around the bubble. Numerical simulaiton accounting for bubble growth and Li diffusion shows profiles in melt that are variable in concentration and isotopically heavy value due to diffusion fractionation. Specifically, significant variaton of Li concentration and shift to the heavy value is favored for the condition at which Li is compatible to gas phase over melt. When Li is incompatible, insignificant quantify to Li leaves the melt thus resulting in negligible isotopic fractionation. The profile caused by degassing relaxes during steady state anneal. This relaxation results in the profile consitent with the composiiton observed in the degassing-anneal run. Lastly, our experimental result indicate that D(gas/melt) of Li must be between 1 and 10. Further tuning of the model is required to determine the ragne of Li partition coefficients and equilibrium isotope fractionation factors that are consistent with observation.