Behaviour of boron isotopes during magmatic degassing

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Boron, a fluid mobile trace element, is routinely employed as a tracer of slab-derived fluids in subduction zones since the heavy isotope (^{11}B) preferentially partitions into the fluid phase. However, it has been shown experimentally that boron isotopes (expressed as δ^{11}B) fractionate by up to several permil (‰) during subsequent magmatic evolution and degassing at high temperature, calling into doubt the fidelity of boron isotopes in volcanic glass as accurate tracers of slab degassing. In order to test for isotopic fractionation during magmatic degassing in a well-constrained natural case and to further elucidate isotope fractionation during pre-eruptive magma storage and degassing in the shallow crust, we carried out SIMS analyses of boron-rich rhyolitic glass from a post-subduction extensional setting at Lesbos Island, Greece. Analytical points were set as traverses from bubbles into the surrounding glass in order to test for changes in δ^{11}B values during volatile exsolution. The glass records pre-eruptive magma storage at ~90 MPa and 800-850^{o}C, and an average water content of 3.4 wt.% (FTIR). This water content is very close to the water calculated to be soluble in the final pre-eruptive melt, indicating that pre-eruptive degassing during final ascent and eruption was minor. With respect to its boron content and δ^{11}B value, the glass is statistically homogeneous at the 2σ level, although minor heterogeneity can be observed at the 1σ level. The average boron concentration and δ^{11}B of the volcanic glass is 102 µg/g (n=61) and -4.9‰ (2SD=1.6‰, n=60), respectively. Our data imply that boron isotopes undergo no detectable fractionation beyond 2σ uncertainty during degassing at magmatic temperatures in rhyolitic systems. This finding allows us to reconstruct the Lesbos magma's δ^{11}B values at its final holding stage prior to eruption. We interpret this to indicate a slab fluid input, as the analysed glass has slightly heavier δ^{11}B values and significantly elevated B/Ce ratio (0.66) than depleted mantle (δ^{11}B = -7.1 ±0.9‰, B/Ce = 0.10). Therefore, during closed system magmatic evolution, δ^{11}B values in volcanic glass may reliably record the δ^{11}B values of undegassed magma, and may thus be useful for investigation of subduction fluids in arcs.