Behaviour of boron isotopes in the streams and springs of Aso caldera, Kyushu, Japan

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Boron isotopes are fractionated during weathering: while rock dissolution releases B with $^{11}B/^{10}B$ ratio similar to that of the rock, ^{10}B is preferentially incorporated into (or adsorbed onto) secondary minerals, leaving the solution enriched in ^{11}B. Boron isotopes in river waters, sediments and soils are thus used as a weathering proxy. This weathering signal can however be partly masked by anthropogenic B inputs as well as by B uptake/release by plants. Moreover, the surface weathering B signal can be affected by high temperature water-rock interaction, with large amounts of B released, and by admixture of groundwaters.

A two years seasonal sampling of the streams and springs within the Aso caldera provide us the opportunity to explore the variability of the boron isotope signatures through both time and space. In this work we combine boron isotope ratios, major and trace element concentrations, as well as hydrologic and residence time constraints to determine the sources of boron within the Aso caldera and the bio-geochemical processes boron isotopic ratios could possibly trace within this volcanic environment.

The preliminary $^{11}B/^{10}B$ ratios measured in Aso waters sampled during autumn 2014 show a large range of $\delta^{11}B$, from -10 to +15 ‰. The lowest $\delta^{11}B$ values (and highest boron content) correspond to thermal springs or to rivers where hydrothermal inputs are suspected. The highest $\delta^{11}B$ values (and lowest B content) are observed for small rivers sampled just after or during a heavy rain. Those are however not as high as the $\delta^{11}B$ measured on other volcanic islands such as Guadeloupe[1] or Réunion[2], up to 45 ‰. The variability of this $\delta^{11}B$ signal for rivers draining volcanic settings is to be linked with the weathering conditions of each island, but most likely also reflects the origin of the water (surface/ soil/ groundwater…), which probably records differently the vegetation impact upon the boron isotope cycle.

[1] Louvat et al., 2011, Appl. Geochem., 26, S76-S79; [2] Louvat et al., 2014, Proc. Earth Planet. Sci., 10, 231-237.