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Boron isotope systematics in South Sandwich island arc

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The South Sandwich volcanic arc is characterized by a relatively simple tectonic context (primitive nature of the underlying crust, presence of low-K tholeiitic rocks, no complex mixture of pelagic and volcanogenic sediments on the down going slab) making it a natural laboratory to study the geochemical processes during transfer of subduction-related fluids from the slab to the mantle wedge. Boron concentrations and isotope compositions are presented for previously well-characterized low-K tholeiite and tholeiite rocks. The samples show variation in fluid-mobile/fluid-immobile element ratios with high enrichments of B/Nb (2.7 to 55) and B/La (0.7 to 13), similar to that observed in Pacific arcs. $\delta^{11}B$ is elevated (15-18‰) in the central part of the arc and decrease at the southern and northern ends of the arc (12-14‰). $\delta^{11}B$ is roughly positively correlated with B concentrations and with $^{87}Sr/^{86}Sr$ ratios, whereas no systematic variations are observed between $\delta^{11}B$ and fluid mobile elements like Rb, Ba, Sr and Th.

The $\delta^{11}B$ measured in two forearc peridotites [1] is 9.5 and 10.2‰; these two samples show Rb, Ba and Th enrichment factors very close to those observed in arc-lavas. South Sandwich trench sediments (ODP 701) display a wide range of $\delta^{11}B$ between +5 to –13‰, with negative values most common. Both, forearc peridotites and trench sediments, suggest that high $\delta^{11}B$ of South Sandwich arc-magmas is not simply inherent to the slab material as measured prior to subduction. Studies on boron isotopes indicate substantial loss of boron (particularly ^{11}B) from slab in the early stages of subduction by dehydration. Survival of the high unusually $\delta^{11}B$ signature in SSI lavas implies the presence of ^{11}B-enriched fluids (probably formed in the forearc region) in forearc materials down dragged with the subducting slab beneath this arc.

Reference

[1] Pearce J.A., Baker P.F., Edwards S.J., Parkinson I.J. and Leat P.T. (2000) *Contrib. Mineral Petrol*. **139**, 36-53.

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Heavy boron isotope compositions of back-arc lavas from the southern Lau-basin (Valu Fa Ridge)

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The chemical and isotopic compositions of back-arc volcanics is a window into the mantle behind volcanic arcs. We present new boron isotope and lithium, beryllium and boron concentration data of basaltic to dacitic fresh submarine glasses from the Valu Fa Ridge and the Central Lau basin. The analysis were performed on a Cameca 6f ion probe at the GeoForschungZentrum Potsdam using NIST 610 and 612 standard reference glasses for calibration.

Overall $\delta^{11}B$ values vary between –9.8 and +23.6 ‰. Replicate analysis on single glass shards indicate significant heterogenetity in boron isotope composition of typically a few permill on the µm scale, whereby the element concentrations are relatively homogeneous. Averaged $\delta^{11}B$ values range only between –6.9 and +17.6 ‰ and Li, Be and B concentrations vary from 3.0 to 11.0 ppm, 0.13 to 0.78 ppm and from 0.8 to 13.0 ppm, respectively.

In contrast to the MORB like boron characteristics of primitive basalts from the Central Lau basin, the Valu Fa samples range from basaltic to dacitic in composition and have dominantly heavy $\delta^{11}B$ values ranging from +4.9 to +17.6 ‰ and elevated boron concentrations. Positive $\delta^{11}B$ values and elevated B concentrations in fresh unaltered glassy samples relative to MORB require the involvement of a boron-rich, high $\delta^{11}B$ component during magmagenesis at the Valu Fa rigde.

Slab derived fluids from the downgoing Pacific plate and/or seawater or altered oceanic crust are possible candidates for the generation of the observed boron compositions. On the basis of the observed positive correlation of $\delta^{11}B$ with B/Be it is very likely that positive $\delta^{11}B$ values were generated by slab derived fluids. We speculate that serpentinized peridotite within or above the slab is a possible source, which undergoes phase transition of antigorite to prograde olivine at high pressures and temperatures, possibly releasing significant quantities of fluids with heavy boron isotope composition. In summary, $\delta^{11}B$ values and B/Be ratios are very high for a back-arc position, indicative of proximity of the Valu Fa Ridge to the Tonga arc.