

Estimation of slab fluid contribution using Boron: Subduction influence of Philippine Sea plate on the mantle beneath Kyushu

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Volcanism in Kyushu is associated with subduction of young (26-15 Ma) Philippine Sea Plate (PSP) in the north and old (60-40 Ma) PSP in the south. The Kyushu-Palau Ridge subducts nearly at right angles to central Kyushu, marking the boundary between these two segments. Prior work has shown that the subducted PSP contributes to the volcanic front however it does not reach the backarc region.

We have analyzed boron (B), fluid mobile trace elements and high field strength elements in Quaternary volcanic rocks from Kyushu to investigate the influence of contrasting PSP segments on the mantle composition. Since B and other fluid-mobile elements are concentrated in slab-derived fluids, we can use these data to estimate the subducted contribution to the subarc mantle composition. Results show that along-arc variations of B ratios are not regular. Lavas from Aso and Kirishima volcanoes (central volcanic front) show the highest B/Nb (3.0-3.7), B/Be (5.4-18.6) and B/La (0.5-1.9). B/Nb, B/Be and B/La ratios of the southern Kyushu basaltic rocks (Sakurajima and Kaimon volcanoes) are higher than those of the northern Kyushu basaltic rocks (Kuju, Yufu, Oninomi). Other fluid-mobile and LIL element ratios (i.e. Cs/Th, Li/Yb, Ba/La) show much less along-arc variation than B. Basalts from these three regions show distinct trends on a plot of Ba/Zr vs. B/Zr: the Kirishima suite shows the highest slope array, while Aso, and the southern Kyushu volcanoes follow an intermediate trend, Yufu and Oninomi in northern Kyushu have the lowest B/Zr and the highest Ba/Zr.

These observations are compatible with distinct contributions from the old and young segments of PSP. In northern Kyushu young, hot oceanic slab is probably strongly devolatilized before it reaches the volcanic front. In contrast, slower dehydration of the older and cooler PSP segment likely occurs beneath southern Kyushu. Higher B/Nb, B/Zr, B/Be and B/La ratios observed in Kirishima basalts may reflect the subduction of a seamount chain which is the extension of Kyushu-Palau Ridge.