Slab influence of hot Philippine Sea plate on the subarc mantle: an examination of Boron contents in basaltic rocks from northern Kyushu, SW Japan

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To evaluate the influence of the young and hot Philippine Sea plate (15-26 Ma) on the compositions of the mantle beneath the SW Japan arc, we report boron (B) and other trace element data for about 50 basaltic rocks from the northern Kyushu (NKB). They are mainly from eight volcanoes: Yufu, Oninomi, Kuju, Aso, Kimpo, Unzen, Oyano and Iki. High boron content observed in the arc basaltic rocks is a strong signature of the oceanic slab, because boron is enriched in altered oceanic crust and sea floor sediments.

We estimated that the influence of the Philippine Sea plate to the subarc mantle of the northern Kyushu is extremely low from the following observations; 1) Spatial variations of the B/Sm, B/Zr and B/Nb ratios of the NKB indicate that the relatively metasomatized mantle is limited beneath Aso volcano (B/Sm = 1.6-4.3, B/Zr = 0.07 -0.16 and B/Nb = 1.4-3.7), which is located in the frontal arc; 2) Kuju, Yufu and Oninomi volcanoes, also located in the frontal arc, however produced basaltic lavas with low B/Sm, B/Zr and B/Nb ratios (0.61-2.27, 0.02-0.08 and 0.18-1.04, respectively); 3) The basalts from backarc volcanoes (Iki, Unzen, Oyano) have similar B/Nb ratios to the mantle values (0.05-0.5); 4) B/Nb ratios of most of the NKB (0.05-3.7) are significantly lower than those of the basalts from other arcs in and around Japan (3-23: Kurile, Mariana, Kamchatka and NE-Japan), and are similar to those of the young arc basalts elsewhere (Cascade, Mexican Volcanic Belt: < 15 Ma).

These weak slab signatures probably result from the early dehydration of the Philippine Sea plate before the slab subduction beneath the magmatically active region of the northern Kyushu. Dehydration and melting of the slab can take place in forearc side due to a high geotherm along it in the young subduction zone. Prominent tomographic low-velocity anomaly is absent directly beneath the frontal arc volcanoes in the northern Kyushu. However it exists beneath the forearc side of the volcanoes. This corresponds to the weak slab signature detected in the NKB.