Subduction metasomatism beneath northern Kyushu: an examination from spatial and temporal variations of boron contents in basalts

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Boron (B) is a useful tracer to evaluate recycling of oceanic crust and sediment during subduction processes, because it is enriched in altered oceanic crust (AOC) and sea floor sediments. Evidence for recycling of sediments and /or AOC to the arc crust by magmatism is observed in higher B/Nb, B/Sm and B/Zr ratios of arc basaltic lavas compared with those of MORBs and OIBs. Therefore, boron is the best element to investigate the influence of subducting oceanic crust. We determined boron contents of basaltic rocks from Kyushu Island in order to investigate spatial and temporal variations of subduction component to the source materials in this part of SW Japan arc. Boron and other selected trace elements were determined by neutron induced prompt gamma-ray analysis (NPGA) at the thermal neutron beam guide of the JRR-3M reactor, Japan Atomic Energy Research Institute. Spatial change of boron content was investigated by comparing fore-arc basaltic rocks (from Aso, Yufu, Kuju) with back-arc basaltic rocks (from Unzen, Oyano-jima, Kita-Matsuura and Iki Island). The former has higher B/Sm (1.2-4.8) and B/Nb (1.3-4.2) ratios than the latter (B/Sm, B/Nb = less than 1). This probably reflects the irregular shape of subducting Philippine Sea Plate. In the northern and central Kyushu, the oceanic plate subduct beneath Aso, however it does not reach the area below back-arc volcanoes. Therefore, it is possible that the subduction metazomatism does not extend into the source materials of back-arc basaltic rocks. Temporal change of boron content was detected in Aso basaltic rocks. The pre-caldera basaltic products (2.2Ma) have lower B/Sm (1.2-1.4) and B/Nb (1.3-1.7) ratios than those of the caldera-forming (270-90ka) stage and the post-caldera (90ka-present) stage (B/Sm=2.9-4.8, B/Nb=2.2-4.2). B-enrichment of the Aso basaltic rocks is unlikely to be produced by contamination of the arc crustal rocks because upper granitic rock and lower gabbroic rock are not enriched in Boron. These observations indicate that metazomatism of the source material beneath Aso was progressed by subduction of the Philippine Sea Plate from 2.2Ma to present. Basaltic rocks from Kyushu Island are characteristically low in subduction component in comparison with typical volcanic arc. They are low in B/Sm (= less than 5) and B/K2O (less than = 15) ratios, whereas those from NE Japan arc are high in B/Sm (3-12) and B/K2O (= greater than 30) ratios. The sharp contrast between them probably reflects the difference in the age of subducting plate. The Philippine Sea Plate (4-6Ma) is extremely young when compared with the Pacific Plate (90-118Ma) the underthrusts NE Japan arc. Young and hot Philippine Sea Plate probably contributes fewer amounts of AOC and/or sea floor sediment components than the old and cold Pacific Plate to the source mantle of basaltic magmas. Younger subducting slab perhaps carries less sediment than the older one. It is likely that hot slab releases hydrous fluid that contains boron and other subduction components before reaching the source area of arc magmas.