Sr and Nd isotopic composition of ~1.7Ma volcanic rocks in Hokkaido, Japan: Implication for magma source at the arc-arc junction

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Hokkaido Island is located at the arc-arc junction of two active island arcs, Northeast (NE) Japan and Kurile. Many authors discussed lateral geochemical variation of volcanic rocks from NE Japan arc using abundant major, trace and isotopic data (e.g. Shibata and Nakamura, 1997; Kimura and Yoshida, 2006). Recently, general features of isotopic compositions of the rocks from Kurile Islands are also revealed (Martynov et al., 2007). However, the data on isotopic composition of volcanic rocks from Hokkaido are scanty. In this study, we newly present Sr and Nd isotopic composition of volcanic rocks from ~1.7Ma volcanoes in Hokkaido. We focus on the basaltic rocks (SiO_2 <54wt.%) and compare these with northern NE Japan and Kurile Islands to clarify isotopic feature of arc-arc junction.

The ~1.7Ma volcanoes are distributed in three volcanic fields, southwestern Hokkaido (SWH), Taisetsu-Tokachi-Shikaribetsu (TTS) and Akan-Shiretoko (AKS) volcanic fields (Figure 1). In each field, the volcanic rocks range from basalt to rhyolite. The rocks from SWH and AKS clearly show across-arc compositional variations, whereas those from TTS do not show spatial variations (Nakagawa, 1999). The basaltic rocks from each field are clearly distinguishable on $^{87}Sr/^{86}Sr - ^{143}Nd/^{144}Nd$ diagram (Figure 2). The rocks from SWH show largest variation among three fields and are divided into two compositional clusters, the frontal and the rear-arc region. The rear-arc volcanoes of SWH have clearly lower $^{87}Sr/^{86}Sr$ than the frontal volcanoes with distinct compositional gap. Although the rocks from TTS and AKS also have lower $^{87}Sr/^{86}Sr$ composition in the rear-arc volcanoes than in the frontal volcanoes, they show continuous and narrower variations than those from SWH. The rocks from TTS have similar $^{143}Nd/^{144}Nd$ to those from SWH, and medium $^{87}Sr/^{86}Sr$ between the rear-arc and the frontal volcanoes of SWH. The rocks from AKS clearly show higher $^{143}Nd/^{144}Nd$ than those from TTS and SWH.

Comparing with the basaltic rocks from northern NE Japan and Kurile Islands, the rocks from northern NE Japan show large $^{87}Sr/^{86}Sr$ variation similar to those from SWH. In the Kurile Islands, the rocks from central and northern islands show higher $^{143}Nd/^{144}Nd$ than those from southern Islands, as the longitudinal along-arc chemical variation (Ishikawa and Tera, 1997; Martynov et al., 2007). The rocks from southern Kurile Islands (Kunashir and Itrup) show comparable composition to those from AKS. Although the rocks from TTS are plotted on the more fertile field than those from Kurile Islands, these compositions are consistent with along-arc variations in Kurile Islands.

Based on the spatial isotopic variations of the basaltic rocks, SWH can be considered as the northern end of the NE Japan arc, whereas AKS and TTS as the southern end of Kurile arc. The presence of rear-arc volcanoes of NE Japan is the distinct characteristic of NE Japan arc. In contrast, Kurile arc shows clear along-arc variation from TTS to Kurile Islands. These characteristics must reflect regional difference not only in magma generation processes but also in specific tectonic history of each arc.

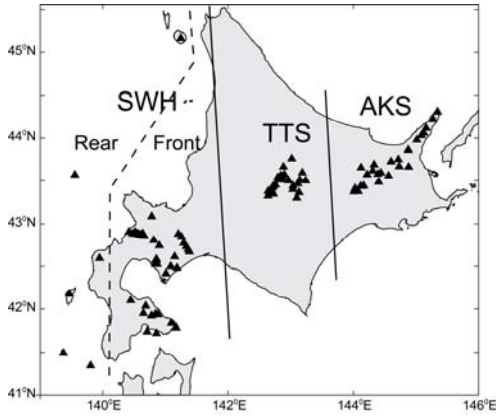

Figure 1
Distribution of ~1.7Ma volcanoes in Hokkaido.

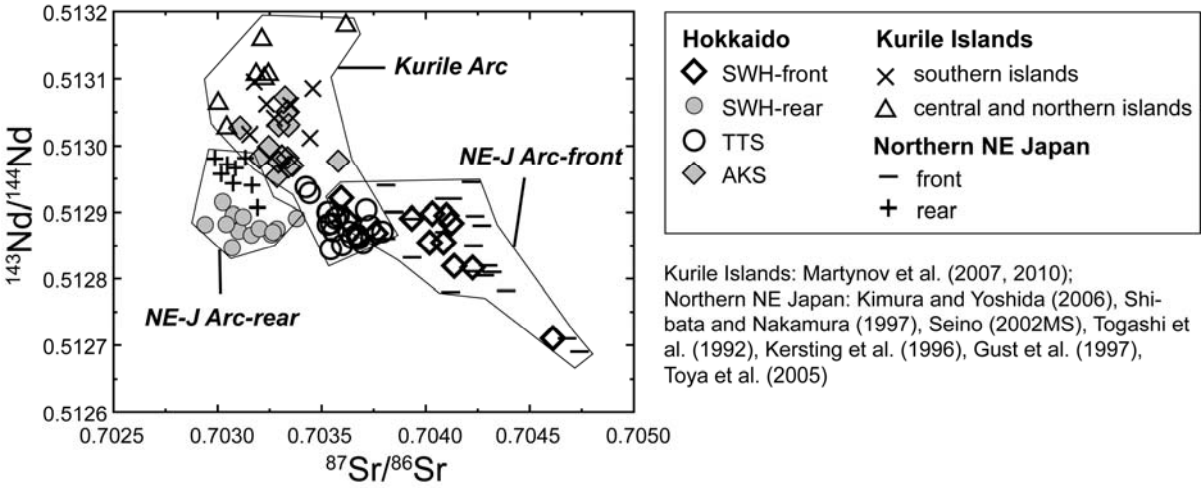

Figure 2
$^{87}Sr/^{86}Sr - ^{143}Nd/^{144}Nd$ diagram of the basaltic rocks (SiO_2 <54wt.%) from Hokkaido and neighbors

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