Petrology and geochemistry of basaltic rocks from Hokkaido, Japan and Sikhote Alin, Far East Russia.

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Most middle Miocene to Quaternary basaltic rocks younger than about 12 Ma from north Hokkaido (NH) show a narrow range in initial 87Sr/86Sr (SrI: 0.70296-0.70393) and initial 143Nd/144Nd (NdI:0.51288-0.51307) isotope ratios, which are slightly undepleted, compared to MORB. There is no temporal variation in either SrI or NdI. Most of the NH basaltic rocks are isotopically similar to basaltic rocks found on the back-arc side of the NE Japan arc (BA basaltic rocks) younger than about 15 Ma. The generation of both NH and BA basaltic rocks appears to be closely related to mantle evolution. This involves upwelling of asthenosphere into the continental lithosphere beneath NH and the back-arc side of the NE Japan arc, at the same time as spreading of the Kurile back-arc basin and Japan Sea back-arc basin.

The coastal range of Sikhote Alin, Far East Russia, is characterized by intensive Cenozoic magmatism with a clear volcanic hiatus at 25-20Ma. Mafic volcanics emplaced before the hiatus possess trace element geochemical signatures of subduction zone (SBZ) basaltic rocks, whereas those younger than 20Ma have similar trace element geochemical signatures to back-arc basin (BAB) or intraplate (ITP) basaltic rocks.

The Sr and Nd isotopic ratios of the SBZ magma-derived tholeiitic basalts become to be enriched across arc from fore-arc to back-arc side. This may indicate a greater contribution of more enriched isotopic sub-continental upper mantle material for the back-arc side basaltic magmas. The along-arc variation in Sr and Nd isotopic ratios of basaltic rocks from Sikhote Alin arc, involving the southward increase in Sr isotopic ratios and decrease in Nd isotopic ratios, respectively, is identical to that observed for basaltic rocks from the Miocene and Quaternary NE Japan arc.

The BAB magma-derived tholeiite basalts possess 87Sr/86Sr ratios ranging from 0.70384 to 0.70437 and 143Nd/144Nd ratios from 0.51241 to 0.51261, and show arc basalt-like trace element. These Sr and Nd isotopic ratios of the BAB basalts are not correlated with total FeO/MgO ratio, indicating that interaction between basaltic magmas and crustal rocks during their fractionations have not occurred. These facts indicate that the BAB magmas in the Sikhote Alin region were derived from isotopically heterogeneous enriched sub-continental lithospheric mantle and are evidenced for enrichment of magma source by a subduction component, which is probably inherited from the pre-rifting subduction event.

The ITP magma-derived basaltic rocks are classified into basanite, alkali basalt and tholeiite basalt. REE modeling and some chemical features of the primitive members indicate that these basaltic magmas are formed by a different degree of partial melting. Basanite rocks have Ce/Pb ratios within a narrow range (25 - 28). A basanite from the East Sikhote Alin region shows 87Sr/86Sr and 143Nd/144Nd ratios of 0.70367 and 0.51270, respectively, and those from the West Sikhote Alin region have 87Sr/86Sr ranging from 0.70409 to 0.70411 and 143Nd/144Nd ratios from 0.51272 to 0.51276, respectively. The relatively wide Ce/Pb range (20-9) is observed in Alkali basalts and tholeiite basalts, which are also characterized by the variable 87Sr/86Sr and 143Nd/144Nd ratios; 0.70386 - 0.70505 for 87Sr/86Sr and 0.51256 - 0.51286 for 143Nd/144Nd in alkali basalts and 0.70379 - 0.70442 for 87SrSr and 0.51255 -0.51278 for 143Nd/144Nd in tholeiite rocks.

These geochemical features suggest that basanite magma was derived from an asthenospheric mantle subjected to hybridization of DMM and EMI sources, whereas alkali basalt- and tholeiite basaltmagmas are probably products from the mixture of the basanite magma source and enriched sub-continental lithospheric mantle. It is thus concluded that the ITP magmatism in the Sikhote Alin region has occurred as a result of asthenospheric mantle upwelling coupled with lithospheric extension.