Geochemistry of late Cenozoic basaltic rocks from Baekdusan (Changbaishan), northeast China: Implications for the mantle source

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Late Cenozoic intraplate basaltic rocks in northeastern China have been interpreted to be derived from mantle source composed of DMM (depleted MORB mantle) and EMI (enriched mantle type I) components. We have determined geochemical compositions including Sr, Nd, Pb, Hf and Mg isotopes for Baekdusan basaltic rocks from NE China to better constrain the origin of the enriched mantle component. The samples are compositionally basanite, trachybasalt, basalt, basaltic trachyandesite, and basaltic andesite. They show LREE-enriched patterns with chondrite-nomalized $(La/Yb)_N$ ratios of 3.2-20.0. Majority of the samples have positive Eu anomalies. On a primitive mantle-normalized trace element distribution diagram, they show typical oceanic island basalt (OIB)-like LILE enrichment. However, they are characterized by significant enrichments in Ba, K, Pb, Sr and Ti compared with the OIB. The Nb/U ratios are generally within the range of OIB, but the Ce/Pb ratios are lower than OIB. The samples do not show meanigful correlations between SiO_2 (wt%) and Sr-Nd-Pb-Hf isotopic compositions, suggesting a lack of crustal contamination. The low Ce/Pb ratios thus could be the mantle source characteristics. The radiogenic isotopes ($^{87}Sr/^{86}Sr$ = 0.70449 to 0.70554; ε_{Nd} = –2.0 to 1.8; ε_{Hf} = –1.7 to 6.1; $^{206}Pb/^{204}Pb$ = 17.26 to 18.12) suggest their derivation from an EM1-like source. The Mg isotopic compositions ($\delta^{26}Mg$ = –0.39 ± 0.17 ‰) are lower than normal mantle ($\delta^{26}Mg$ = –0.25 ± 0.07‰), indicating carbonate in the source. The $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios decrease and increase, respectively, with decreasing $\delta^{26}Mg$ values. These observations suggest that the mantle source of the Baekdusan basalts might be composed of at least two components: (1) asthenosphere metasomatized by K-rich melt derived from subducted ancient K-hollandite bearing-sediments in the mantle transition zone, possessing EMI-like Sr-Nd-Pb-Hf isotopic signatures with relatively high $\delta^{26}Mg$ value and (2) carbonated eclogites having MORB-like radiogenic isotopic compositions with low $\delta^{26}Mg$ value.