Sr, Nd and Pb isotopic investigations of ultramafic xenoliths and their host basalts from Jeju Island, Baekryeong Island, Boeun and Ganseong, Korea: Implications for a large-scale difference in the source mantle beneath East Asia

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We report Sr, Nd and Pb isotope data of clinopyroxene separates from ultramafic xenoliths and their host basaltic rocks in Jeju Island, Baekryeong Island, Boeun and Ganseong, Korea. The isotopic data of the xenoliths and host basalts are distinctly different from those of Korean basement rocks. Except for two xenoliths from Ganseong, all samples in this study have isotopic ratios within the combined range of MORB-OIB data. All basaltic rocks have Nd-Sr-Pb isotope compositions different from those of xenoliths, indicating that the host basaltic magma did not derive from the lithospheric mantle where the xenoliths originated. The range of isotopic composition of xenoliths is much greater than that observed in host basalts, which reflects small-scale heterogeneity of the lithospheric mantle. The greater isotopic heterogeneity of the lithospheric mantle probably reflects its long-term stability.

The spinel peridotite xenolith data of Jeju Island, Baekryeong Island and Boeun display mixing hyperbolas between DMM and EM II end members. Since Jeju basalts have EM II-like isotopic signature, the mixing relationship shown by the isotopic data of the Jeju xenoliths can be interpreted as the result of infiltration of metasomatic fluid or melt derived from basaltic magma into DMM-like lithospheric mantle. In contrast to other xenolith sites, the Ganseong xenoliths are dominantly clinopyroxene megacryst and pyroxenite. Clinopyroxene megacrysts have different isotopic ratios from their host basalt, reflecting its exotic origin. Two Ganseong xenoliths (wherlite and clinopyroxenite) have much enriched Sr and Nd isotopic ratios and Nd model ages of 2.5-2.9 Ga, and plot in an array away from the MORB-OIB field. The mantle xenoliths from Korean Peninsula have similar $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$ and $^{207}Pb/^{204}Pb$ ratios to, but higher $^{208}Pb/^{204}Pb$ ratios than, those from eastern China, indicating that Korean xenoliths are derived from the lithospheric mantle with higher Th/U ratio compared with Chinese ones.

The isotopic data of xenolith-bearing basalts of Baekryeong Island and Ganseong, along with Ulreung and Dok Islands, show a mixing trend between DMM and EM I in Sr-Nd-Pb isotopic correlation diagrams, which is also observed in the northeastern Chinese basalts. However, the Jeju volcanic rocks show an EM II signature that is observed in southeastern Chinese basalts. The isotopic variations in volcanic rocks from the northern and southern portions of the East Asia reflect a large-scale isotopic heterogeneity in their source mantle.