Petrogenesis and mantle source characteristics of volcanic rocks on Jeju Island, South Korea

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The Quaternary volcanic rocks on Jeju Island, South Korea, are dominantly alkaline suites with small amounts of intercalated tholeiitic (TH) basaltic rocks. The alkaline suites can be subdivided into high-Al alkaline (HAA) and low-Al alkaline (LAA) sub-suites. We determined the major- and trace-element abundances, and Sr–Nd–Pb–Mg isotopic compositions to understand their petrogenesis and mantle source characteristics. On a primitive-mantle-normalized trace-element diagram, Jeju basaltic rocks exhibit typical OIB-like LILE enrichments without significant Nb or Ta depletions. However, some samples, especially the TH and HAA suites, exhibit positive Eu and Sr anomalies, coupled with elevated $^{87}Sr/^{86}Sr$, $\Delta 7/4Pb$, and Pb/Ce ratios, indicating an important role of ancient anorthosite assimilation during its evolution. Furthermore, they show negative K and Rb anomalies. The basaltic rocks have fractionated Nb/Ta and Zr/Hf ratios with negative Ti anomalies. They have elevated Dy/Yb ratios within the range of melts derived from garnet lherzolite, but have Yb contents much higher than those of garnet lherzolite melts, instead plotting close to those of eclogite-derived melts. They also have high Fe/Mn ratios (>~60) and $FeO/CaO–3MgO/SiO_2$ values (>0.45), similar to melts from pyroxenite/eclogite sources. The Sr–Nd–Pb isotopic compositions display a good linear array between depleted MORB mantle and enriched mantle type 2 (EM2). There are no discernible $^{143}Nd/^{144}Nd$, $\Delta 8/4Pb$, and $\delta^{26}Mg$ isotopic differences among the three suites, implying their derivation from a compositionally homogeneous source by variable degrees of melting. The Mg isotopic compositions yield $\delta^{26}Mg$ values of −0.53‰ to −0.20‰, extending to a much lower value than normal mantle ($\delta^{26}Mg$ = −0.25‰ ± 0.04‰). These observations suggest the presence of recycled rutile-bearing eclogite, carbonate, and sedimentary components in the mantle source of the Jeju volcanic rocks together with a peridotite component. No significant spatiotemporal changes in the mantle sources and melting conditions were observed.