Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30497

Oxygen isotope systematics for subduction-related magmatism and crustal recycling: Insights into Cretaceous and Cenozoic volcanism in South Korea

JI-IN KIM AND DR. HYUNWOO LEE
Seoul National University

This study comparatively assesses the geochemical and oxygen isotope compositions of Cretaceous and Late Cenozoic volcanic rocks from the Korean Peninsula. Recent efforts in South Korea have applied oxygen isotope systematics to constrain magma sources and understand crust-mantle interactions. By integrating our new measurements with recently reported data, we investigate the role of subduction in volcanic activity and crustal recycling in East Asia.

During the Cretaceous, paleo-Pacific plate subduction beneath the Eurasian margin triggered extensive arc magmatism in East Asia, with significant volcanism in the Korean Peninsula from ca. 120 to 66 Ma. The erupted volcanic rocks exhibit arc-like geochemical signatures, including enrichment in LILEs and pronounced negative anomalies in HFSEs (e.g., Nb, Ta, and Ti). The mafic rocks have enriched Sr–Nd–Pb isotopic compositions ($^{87}Sr/^{86}Sr_i$ up to 0.7095 and $^{143}Nd/^{144}Nd_i$ as low as 0.5118), suggesting that their mantle source was metasomatized by subduction, with some magmas subsequently undergoing crustal assimilation. Zircon $\delta^{18}O$ values in intermediate to felsic volcanic rocks are within or generally higher ($\delta^{18}O$ = 5.4 to 6.1 ‰) than the range of typical mantle zircon ($\delta^{18}O$ = 5.3±0.3 ‰), supporting the incorporation of ^{18}O-enriched supracrustal materials.

Following reduced magmatic activity after 66 Ma, Late Cenozoic intraplate volcanism (6 to 0.1 Ma) occurred, producing volcanic rocks characterized by OIB-like geochemistry without negative Nb-Ta anomalies. They have relatively unradiogenic Sr–Nd–Pb isotopic compositions (mostly $^{87}Sr/^{86}Sr<0.7060$ and $^{143}Nd/^{144}Nd>0.5125$), indicating a minor contribution of continental crustal components to the mantle source. Olivine $\delta^{18}O$ values of the volcanic rocks generally fall within or slightly above the range of upper mantle olivine ($\delta^{18}O$ = 5.2±0.2 ‰), in agreement with the Sr–Nd–Pb isotopic signatures. However, Jeju basalts, located at the southernmost part of the Korean Peninsula, exhibit relatively lower $\delta^{18}O$ values (5.3 to 4.7 ‰), suggesting localized heterogeneities in mantle source composition. These observations imply that prior subduction may have reintroduced variable crustal components into the mantle and/or induced mantle metasomatism, leading to prolonged geochemical heterogeneity in the region. Oxygen isotopes, integrated with radiogenic isotopes and geochemistry, provide a refined approach to understanding the role of subduction in volcanic activities and mantle heterogeneities beneath East Asia.