

Possible contributions of HIMU and EM1 components in magma generation beneath the northern Lau back-arc Basin

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The northeast Lau Basin is seemingly uninfluenced by OIB or hotspot, based on their MORB-like $^3\text{He}/^4\text{He}$ values (~ 8 R/Ra), while the northwest region with high helium isotope ratios up to 22.6 R/Ra is considered to be influenced by toroidal flow of Samoan plume around the slab edge. However, the northeast Lau Basin spreading center (NELSC) lavas show radiogenic Sr-Nd-Pb isotopic compositions and incompatible element-enrichment, which are distinguished from the lavas from the southern back-arc spreading centers (i.e. East Lau Spreading Center and Valu Fa Ridge) showing typical characteristics of the depleted back-arc basin basalt. This discrepancy between geochemical parameters of the NELSC allowed us to consider some other enriched mantle source, yet helium-degassed, such as subducted hotspot trails. We here constrain possible mantle sources contributed on the distinctive geochemical characteristics of the northeast Lau Basin using isotopic mixing models.

First, longitudinal variations of Sr-Nd-Pb isotopes within the region, from Niuafu'ou island to northern Tonga arc, intimate significant contribution of HIMU (high $^{238}\text{U}/^{204}\text{Pb}$)-type component at the NELSC relative to the western region. The Pb isotopic compositions of NELSC are more radiogenic than even the northern Tonga arc (Tafahi and Niuatoputapu), which are thought to be influenced by subducted Louisville volcanic chain, indicating requirement of the stronger HIMU signature. In addition, EM1 component mixed with depleted mantle (DM) represented by the composition of Niuafu'ou also needs to describe isotopic behaviors of NELSC lavas. Thus, the upper mantle beneath the northeastern Lau is comprised with the DM, EM1 and HIMU as noted in the previous studies for the northern end tip of basin. For the helium-degassed EM1, HIMU sources, we also adapt the model of subduction of Rarotonga (EM1) and Rurutu (HIMU) hotspot trails comprising Cook-Austral volcanic chain into the Tonga arc.