

HIMU and EM1 Components in the Upper Mantle Beneath the Northeast Lau Spreading Center

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The Northeast Lau Basin is a young back-arc basin that opened in response to the rollback of the Tonga Trench. The trace element compositions of volcanic rocks from the back-arc spreading axes, the Northeast Lau Spreading Center (NELSC), and the Fonualei Rift and Spreading Center (FRSC) suggest a sub-arc mantle source, but the enriched Sr–Nd–Pb isotopic compositions of the NELSC lavas indicate mixing between back-arc mantle and hotspot components. Given the consistently low ³He/⁴He ratios of the NELSC and FRSC rocks relative to those of the Northwest Lau Basin basalts influenced by the Samoan plume, the enriched component in the source of the NELSC and FRSC rocks might be a remnant hotspot trail within the subducted plate. The NELSC samples have low Zr/Th ratios and distinctive ¹⁴³Nd/¹⁴⁴Nd versus $\Delta^{208}\text{Pb}/^{204}\text{Pb}$ compositions, similar to those of volcanic rocks from the Tonga forearc and seamounts at the northernmost tip of the Lau Basin, including subducted Cook–Austral hotspot components. Therefore, the mantle source of the NELSC can be modelled by sequential mixing of (1) depleted Lau back-arc mantle, (2) EM1 (enriched mantle) similar to the source of boninites from Tonga, and (3) a HIMU (high $\mu = ^{238}\text{U}/^{204}\text{Pb}$) component from the Cook–Austral hotspot. Unlike the Northwest Lau Basin, the heterogeneity in the upper mantle beneath the Northeast Lau Basin is due mainly to subducted slab components.