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Can oceanic mantle record pre-oceanic events: insights from the Dragon Seamount xenoliths (Tore-Madeira Rise)?

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Mantle xenoliths entrained by ascending magmas provide direct snapshots of the lithospheric mantle and offer key constraints on mantle heterogeneity and dynamics. The Dragon Seamount, located along the Tore–Madeira Rise within the Central-East Atlantic Alkaline Province, formed during long-lived activity of a stationary superplume over the past ~145 Ma, extending from the Southwest Iberian Margin to the Madeira–Canary region. The Dragon Seamount was sampled during the 2001 TOREMADERE cruise of the R/V Atalante, yielding exceptionally fresh mantle xenoliths that differ markedly from those described in the Canary Islands in both mineralogy and geochemistry.

Here we present a comprehensive dataset for more than 20 mantle xenoliths, including new bulk-rock and in situ major and trace element analyses, µ-XRF chemical mapping, and Nd–Hf isotopic compositions. Petrographic observations indicate that the suite is dominated by spinel-bearing harzburgites, with minor clinopyroxene-poor spinel lherzolites. Glassy melt pockets containing spinel cores surrounded by holly-leaf-textured orthopyroxene and secondary olivine are widespread. Mineral chemistry reveals cryptic to modal metasomatism by alkaline- to carbonate-rich melts that largely overprint the primary mantle signature. Nevertheless, a subset of samples preserves evidence of an earlier high-degree depletion event. Spinel compositions, clinopyroxene REE systematics, and Nd–Hf isotopic signatures point to melting in a supra-subduction zone setting. We propose that these xenoliths represent relicts of subcontinental lithospheric mantle depleted during Caledonian subduction and later exhumed during rifting in the northern Central Atlantic. Subsequent melt percolation linked to Madeira–Canary superplume activity produced the metasomatic overprint.

Despite their present-day location along the J-anomaly, i.e., overlying oceanic mantle, these xenoliths demonstrate that fragments of subcontinental lithospheric mantle may persist far oceanward of the ocean–continent boundary, highlighting the long-term preservation of an inherited continental signature persisting beneath oceanic settings.