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Enriched mantle generated through persistent convective erosion of continental roots

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The origin of geochemically enriched mantle in the asthenosphere is important to understanding the physical, thermal and chemical evolution of Earth's interior. While subduction of oceanic sediments and deep mantle plumes have been implicated in this enrichment, they cannot fully explain the observed geochemical trends found in some oceanic volcanoes. We present geodynamic models to show that enriched mantle can be liberated from the roots of the subcontinental lithospheric mantle by highly organised convective erosion ultimately linked to continental rifting and break-up [1]. We demonstrate that a chain of convective instabilities sweeps enriched lithospheric material into the suboceanic asthenosphere, in a predictable and quantifiable manner, over tens of millions of years—potentially faster for denser, removed keels. We test this model using geochemical data from the Indian Ocean Seamount Province, a near-continent site of enriched volcanism with minimal deep mantle plume influence. This region shows a peak in enriched mantle volcanism within 50 million years of break-up followed by a steady decline in enrichment, consistent with model predictions. We propose that persistent and long-distance lateral transport of locally metasomatised, removed keel can explain the billion-year-old enrichments in seamounts and ocean island volcanoes located off fragmented continents. Continental break-up causes a reorganisation of shallow mantle dynamics that persists long after rifting, disturbing the geosphere and deep carbon cycle.

References

[1] Gernon, T.M., Brune, S., Hincks, T.K. et al. Enriched mantle generated through persistent convective erosion of continental roots. Nat. Geosci. 18, 1311–1318 (2025). https://doi.org/10.1038/s41561-025-01843-9