Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37883

Long-Lived Intraplate Magmatism Fed by a Heterogeneous Carbonated Lithospheric Mantle Beneath NW Arabia

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Mantle heterogeneity is a key factor in sustaining long-lived intraplate magmatism, since it can facilitate melt generation even when thermal or structural perturbations are minor. The Levant margin, northwest Arabia, records ~200 Myr of episodic mafic alkaline magmatism that can not be demonstrably explained by regional tectonism or mantle plume activity. Its temporal persistence and pronounced compositional variability make it a suitable setting to examine the role of mantle heterogeneity in intraplate magmatism.

Three magmatic periods in the Levant margins, Late Triassic, Early Cretaceous, and Neogene to Quaternary, are studied here using olivine-hosted melt inclusions. Major and trace element and volatile contents, including CO_2 and H_2O, and Sr and Nd isotope ratios, were measured in melt inclusions and integrated with a regional whole rock data inventory to constrain magma sources and evolution.

Trace and volatile element contents in melt inclusions (up to 3.19 wt.% CO_2) indicate a compositionally heterogeneous lithospheric mantle source comprising at least three distinct lithologies: garnet pyroxenite, titanate-bearing hornblendite, and carbonated peridotite. During ascent, melts derived from these domains interacted and mixed to produce the observed compositional spectrum.

Despite lithological variability, spatially and temporally consistent Sr-Nd isotope affinity to HIMU-type mantle source suggests a shared precursor formed during late Proterozoic processes associated with the amalgamation of the Arabian-Nubian Shield.

While melting mechanisms likely varied between magmatic phases and acted intermittently, making them difficult to resolve, the inferred metasomatized- readily fusible- lithospheric mantle likely played a central role in sustaining intraplate alkaline magmatism over 200 Myr in the Levant region.