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Alpine-Style Petit Plume in Northern Iran: Evidence from Damavand Basalts

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Small-volume intraplate basalts in collision-zone settings provide a global test of whether mantle upwellings are primarily thermal or thermochemical. We integrate mineral-scale petrology, geochemistry, olivine $\delta^{18}O$, nominally anhydrous mineral H_2O, thermobarometry and mantle potential temperature estimates from primitive basalts of Damavand and the adjacent Little Damavand field (Alborz, Iran), and frame them against Alpine–European "hot-finger/petit-plume" upwellings feeding the European Cenozoic Rift System. Olivine (Fo88–84) with olivine-hosted Cr-spinel (Cr# up to ~0.60) indicates near-primary melts; olivine–spinel and olivine–liquid equilibria yield ~1200–1260 °C at ~1.9–2.3 GPa, implying $T_p \approx 1360 \pm 20$ to 1370 ± 10 °C [1]. Ca-in-olivine hygrometry suggests ~3 wt% H_2O in parental melts [2], yet olivine FTIR mostly records very low lattice H_2O (<1–4 μg/g), consistent with diffusive H loss during ascent/storage. In situ olivine $\delta^{18}O$ spans ~5.3–5.9‰ (Little Damavand) and ~6.1–6.6‰ (Damavand), exceeding canonical mantle values [3] and indicating recycled, EMII-like volatile-bearing components. European hot-finger systems are similarly focused (~100 km scale) and may show only modest thermal anomalies in tomography [4] while remaining seismically elusive if narrower. Damavand thus records a thermochemical, hydrous "petit-plume" in collision-zone lithosphere, offering a globally relevant analogue for small, compositionally buoyant upwellings lacking classic plume-head signals.

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