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The lowermost subcontinental mantle sampled by Cenozioc volcanic pipes in northern Arabia

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The Cenozoic Arabian alkali basalt province is formed by large lava fields with sub-alkaline to alkaline affinity scattered from Syria and the Dead Sea Transform Zone through western Saudi Arabia to Yemen. Most of volcanism took place after the emplacement of the Afar plume in Yemen (~30 Ma) and progressively propagated northward due to the lithospheric thinning related to the Red Sea rifting starting. Few lava fields, however, formed in the Mesozoic, with the oldest volcanic activity as old as 200 Ma. Here, we report new results from unknown volcanic pipes in northern Saudi Arabia, where over a hundred pipes are aligned along NW-SE fractures in the Ordovician sandstone. New K-Ar dating limits their age to 80 and 50 Ma, thus predating the emplacement of the Afar plume and the rifting in the Red Sea. The lavas have Sr-Pb-Nd-Hf isotopic compositions that plot out of the field of the Cenozoic Arabian alkaline volcanism, being far more enriched in Nd-Hf and Pb isotopes than any lava ever reported in the Arabian plate. On this basis, we suggest that these melts generated from an spatially defined enriched lithospheric source, melted by local variations in the asthenosphere-lithospheric boundary. This mantle source has a composition similar to the HIMU-like enriched isotopic component reported in eastern Africa Rift (Rooney et al., 2014), and considered to represent the end-member lithospheric mantle component of the Nubian shield. Although apparently hidden, this enriched deep lithospheric component is therefore ubiquitous and widespread in the cratonic roots of the Arabian and African lithospheric mantle, but its geochemical signature is concealed by mixing with melts derived from more depleted portions of the asthenosphere.

Rooney, T. O., Nelson, W. R., Dosso, L., Furman, T., Hanan, B. The role of continental lithosphere metasomes in the production of HIMU-like magmatism on the northeast African and Arabian plates. Geology, 42, 419–422, 2014.