HIMU-like magmatism on the northeast African and Arabian plates: The role of continental lithosphere metasomes

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Melting of metasomes within the lithospheric mantle provides a viable mechanism for generating the geochemical characteristics of many intraplate alkaline basalts. The origins and distribution of these metasomes have been attributed to recent enrichment of the lithosphere by a mantle plume or ancient events that occurred during the early evolution of the sub-continental lithosphere mantle. We present a geochemical study of Ethiopian Miocene intraplate mafic alkaline lavas that are notably depleted in silica and enriched in most incompatible trace elements. Preliminary high-precision minor element data from olivine phenocrysts is inconsistent with an origin of these alkaline lavas from standard peridotite melts. Instead we suggest the lavas represent melts of a lithospheric mantle that was metasomatically-enriched during lithospheric stabilization, and subsequently remobilized by recent plume-lithosphere interaction. Melting of an amphibole-bearing lithospheric-mantle metasome could account for the geochemical characteristics of the erupted lavas. While the origin of high-Ti Ethiopian flood basalts has been attributed to melt of similar lithospheric metasomes, Pb and Hf isotope data for our alkaline lavas require a HIMU-like source component, similar to other alkaline lavas erupted through the Horn of Africa, Sudan, and Egypt, and adjacent Arabian plate lithospheres. The isotopic characteristics of this component are distinct from the Afar plume mantle source and instead are consistent with the long-term evolution of a lithospheric metasome created during a Neo-Proterozoic subduction event associated with the Pan-African orogeny. The widespread distribution of easily fusible lithospheric metasomes within the continental lithosphere mantle may facilitate magma generation without the need for substantial lithospheric thinning or elevated mantle potential temperatures.