Microscale geochemical analysis of primitive lavas from Bufumbira, East Africa: implications for lithospheric stability and heterogeneity

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The East African Rift System (EARS) is earth's largest continental divergent boundary and an unparalleled natural laboratory for understanding magmatism related to continental rifting. In the EARS Western Rift, magma compositions lack evidence for asthenospheric mantle plume input—rather, most show evidence for metasomatized lithospheric mantle sources. We focus on the Bufumbira cinder cones in the Virunga Volcanic Province (Uganda), where bulk geochemistry demonstrates that primitive mafic lavas are derived from garnet+phlogopite+amphibole+zircon-bearing pyroxenite, indicating a deep metasomatized SCLM source. Isotopic and trace element data suggest that extent of melting increased with depth of melting, a signature of lithospheric drip magmatism, which may play an important role in facilitating successful continental rifting. Source isotopic and mineralogical compositions vary on a short spatial scale in the Western Rift, suggesting metasomatic heterogeneity in the regional lithospheric mantle.

Mineralogical composition data from primitive Bufumbira lavas, with a focus on olivine and clinopyroxene, provide additional constraints on melting depth and magma evolution and reveal distinct differences from other Western Rift volcanic provinces. Preliminary analysis reveals that olivine phenocrysts are highly magnesian (Fo_{87-91}). Clinopyroxene is present as diopside with minor non-quadrilateral components. Multiple populations of pyroxene appear to be present, and petrographic observations—including zoning and resorption—indicate that some are xenocrysts. One population of diopside displays distinct zoning in Al, Cr, Fe, and Mg and variable Wo-En-Fs compositions that suggest abrupt changes in magma composition and crystallization conditions. Variations in compositional zoning and textures are used to constrain conditions of petrogenesis, source compositions, and the extent and variability of metasomatism in the region.