Petrochemistry of volcanic rocks in Bure area, northwestern Ethiopia: Implications for Cenozoic Plume-related volcanism

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The East Africa Rift System (EARS) is failed arm of the Afro-Arabia triple junction that comprises the Red Sea and Gulf of Aden oceanic rifts. It is initiated in the Oligocene-Miocene time as a result of lithospheric extension in response to the Afar plume upwelling. The EARS includes the NNE-SSW trending Ethio-Kenyan rift, the encircling plateaus and the Afar depressions. The magmatism mainly divided into two groups: 1) an older group of predominantly transitional to subalkaline flood basalts (pre-rift volcanism) with intercalated pyroclastic rocks and 2) younger group of predominantly alkaline volcanics (syn- to post-rift volcanism). Various proportion of old subcontinental lithospheric mantle (SCLM), an HIMU-type plume and depleted mantle (DM) components were involved in the genesis of these continental flood basalts. However many authors questioned the role of SCLM and they illustrate the involvement of crustal component in the genesis of the east Africa continental flood basalts. Thus the role of mantle and crustal sources in the genesis of these flood basalts are still debated. To investigate the processes that involved in the genesis of the erupted magma and its source composition during plume-induced continental rifting, the whole-rock major and trace elements data have been analyzed for the Bure volcanic rocks from the northwestern Ethiopian plateau of east Africa continental flood basalt province. The Bure area is mainly composed of stratified basalts (lower and upper), recent basalts, scoria cones and trachyte plugs. The successions of the erupted basalts are from transitional tholeiites (lower) to alkaline (upper and recent) basalts. The transitional tholeiites have higher Zr/Nb (7.76-18.83), Ce/Nb (1.75-3.53) and lower La/Sm (1.80-2.64) than those of the alkaline basalts; Zr/Nb =1.94-6.65, Ce/Nb=0.83-1.69 and La/Sm=3.06-12, indicating that they were originated from distinct magma sources. The compositional variation in the transitional tholeiites cannot be explained in terms of fractional crystallization of common (or similar) primary magma; instead it reflects the involvement of various mantle components in their petrogenesis. By contrast, the variation in the alkali suite can be explained by fractional crystallization process of OIB-like primary basalts that were derived from the Afar mantle plume. The strong lithospheric signature observed in transitional tholeiites suggests pronounced interaction between the Afar plume and the lithosphere at the initial stage of continental break-up.