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Untangling multiple mantle sources with continental alkaline magmatism: a case study from the Cenozoic volcanism in Jordan

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The continental rift system spanning from the Afar triple junction to the Red Sea and the Dead Sea Transform produced widespread magmatism distributed from the Oligocene to the Quaternary. This volcanic activity formed one of the largest alkali basalt provinces on Earth scattered from the Afar region to Arabia and Levant. The volcanic activity was also abundant in Jordan along the Dead Sea Transform Zone, suggesting a link between volcanism and transform tectonics. This study presents new major and trace element data on previously uncharacterized samples collected from small lava-fields scattered along the Dead-Sea Transform Fault, in Jordan. The samples are high MgO basalts and basanites, with basanites being significantly more enriched in TiO_2 and highly incompatible trace elements (e.g., Cs, Rb, Ba, Th, U, Nb, Ta, LREE). Basanites have high contents of HFS elements and extremely fractionated heavy rare earth elements with Chondrite-normalized Sm/Yb ratios up to 12, significantly higher than most of the synchronous Cenozoic Arabian alkaline magmas. Notably, these lavas are distinct from the volcanics forming the large neighboring Harrat Ash Shaam. Overall, the studied rocks show negligible evidence of contamination by either upper or lower continental crust and display incompatible trace element patterns and specific trace element ratios (e.g., low Rb/Nb, Rb/Th) similar to those of Ocean Island Basalts having an HIMU signature, although being slightly enriched in Sr. Covariations in Dy/Yb vs La/Yb indicates that the erupted magmas were formed by mixing melts from lithospheric sources, with small-degree melts formed by garnet-bearing asthenospheric source. Moreover, the extremely low Rb/Sr ratio and K negative anomaly, together with the relatively high Nb/Ta of some samples, indicate the contribution of another distinct component, which points toward the average composition of East African Rift carbonatites. This carbonatitic component was possibly preserved within the subcontinental lithospheric mantle, then melted and mixed with the ascending asthenospheric magmas due to lithospheric thinning in time of rifting. Isotopic analyses will be performed to better constrain the contributions from different mantle sources, as well as their origin and temporal evolution. The research is funded by the project PRIN NextGenerationEU (MUR: 2022PC9NME).