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Exotic magmatism from the western branch of the East African Rift: insights on the lithospheric mantle source.

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The northernmost sector of the western branch of the East African Rift (EAR) includes the young (~40-50 ka [1]) volcanic province of Toro Ankole, characterized by the presence of exotic volcanic products such as carbonatites, melilitites, kamafugites and foidites [2]. Among these, the occurrence of kamafugites (kalsilite-bearing volcanic rocks [3]) is noteworthy, as Toro Ankole represents the type locality for these compositions, found in only two other localities worldwide. The Toro Ankole volcanic province developed along the margin of the Archean Tanzanian craton, and its magmatic products show the influence of metasomatic processes and phases developed in the thick continental lithosphere. Indeed, MARID-like metasomatism is proposed in literature, with the formation of a veined mantle [4].

A multidisciplinary approach, based on a detailed petrographic, mineral chemical, geochemical and isotopic (Sr, Nd, Pb and B) study, has been carried out on 53 samples, which include not only lavas and tuffs, but also holocrystalline and wall rock xenoliths. Two types of lava may be identified: the first is represented by carbonatites and silico-carbonatites, characterized by low SiO_2 (4.89-21.78 wt%) and low alkali (0.44-2.03 wt%) and high CaO (25.17-47.57 wt%), while the second most peculiar lithotypes is represented by kamafugites; katungites (melilite-rich kalsilite-olivine-bearing volcanic rocks), mafurites (kalsilite-rich melilite-olivine-bearing) and ugandites (olivine-rich kalsilite-melilite-bearing). The kamafugites are strongly SiO_2-undersaturated and moderately ultrabasic, potassic to ultrapotassic volcanic rocks, with high MgO (6.08-22.20 wt%) and CaO (up to 15.46 wt%). They consist of phenocrysts of clinopyroxene and olivine set in a hypo-holocrystalline fine-grained groundmass made up of microliths of clinopyroxene, olivine, perovskite, kalsilite, nepheline, leucite, melilite, phlogopite, carbonates and opaques.

The xenolith cargo shows wide range of compositions, varying from clinopyroxenite to glimmerite, with low modal abundance of opaques and perovskite in agreement with the literature data that generally report a lack of olivine and orthopyroxene in the mineral assemblage [5]. The common presence of phlogopite, abundant clinopyroxene and carbonate-rich veins indicate the presence of veined lithosphere [6]. This is consistent with the isotopic data for lavas and xenoliths ($^{87}Sr/^{86}Sr$ = 0.70480-0.70563 and $^{143}Nd/^{144}Nd$ = 0.512515-0.512575), which outlines an enriched and complex

mantle source. $^{206}Pb/^{204}Pb$ is extremely variable, with values from the holocrystalline xenolith (19.99-19.27) being slightly higher than lava samples (19.28-19.63). The $d^{11}B$ values for lavas and xenoliths, show a wide range, varying from DMM-like values (-6 and -8‰) to more variable OIB-like values (down to -12 and up to -3‰; [7]), through to positive values (up to +6.6‰ in the lavas). These latter also exhibit the highest Sr isotopic ratios of the dataset, pointing to the possible occurrence of old and altered oceanic crust and/or serpentinite in the mantle source.

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