Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.6644

Origin and Mantle Source Characteristics of Quaternary Volcanism in the Central Highlands of Madagascar

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In order to assess the origin and sources of recent volcanism in the central highlands of Madagascar, we conducted chemical and isotopic studies of basaltic lavas and tephra from the Itasy and the Southwest Ankaratra Volcanic Fields. Our age determinations provide evidence for Pleistocene volcanism in these regions, with ages between 31-104 ka for the Itasy and between 45-110 ka for the Southwest Ankaratra Volcanic Field. The data demonstrate that although the Itasy and Ankaratra volcanic fields occur in essentially identical tectonic and geological settings, they exhibit distinct chemical and isotopic signatures. They show trace element signatures similar to those of Ocean Island Basalts (OIB) with enrichment in high field strength elements (e.g. Nb and Ta) and depletion in large ion lithophile elements (e.g. Rb, Cs, and K) and exhibit high Nb/U (>45) and Ce/Pb (>25) ratios. Isotopic studies of the volcanic rocks show heterogeneity in Sr, Nd, Hf, Pb and Os isotope ratios. The Itasy volcanic rocks have less radiogenic Sr and Nd isotopic ratios but more radiogenic Pb isotopic signatures then those of the Southwest Ankaratra. Volcanic rocks from these fields display suprachondritic $^{187}Os/^{188}Os$ that can be explained by minor crustal assimilation. However, their trace element and Sr-Nd-Pb-Hf isotopic characteristics are incompatible with crustal assimilation, and instead represent features of their mantle sources. We suggest that the magmas are compositionally distinct from those expected for subcontinental lithospheric mantle (SCLM)-derived basalts, suggesting that *in situ* SCLM cannot be the sole source of these magmas. Rather, the magma compositions suggest an asthenospheric mantle source polluted by plume materials and delaminated SCLM. A two-stage, three-component mixing model indicates that a mixture of mantle containing 90% depleted asthenosphere (DMM) and 10% foundered SCLM, which is further mixed with 30 to 50 % of a plume-type mantle component, can reproduce the isotopic compositions of the Itasy magmas. A slightly different proportion of SCLM can explain the distinct signatures of the Southwest Ankaratra magmas. Based on our model, superplume materials might be widely distributed in the upper mantle underneath the EARS, and mixed with shallow asthenosphere that has incorporated eroded SCLM.