



Nd, Sr and Pb isotopic systematics of the Oldoinyo Lengai volcano

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The Oldoinyo Lengai volcano is characterized by a large range of radiogenic isotope compositions. The magmatic system of the Oldoinyo Lengai volcano have experienced two main stages of activity. During the first stage, the magmas originated from an EMI-like source ($^{87}\text{Sr}/^{86}\text{Sr} = 0.70495\text{-}0.75154$, $^{143}\text{Nd}/^{144}\text{Nd} = 0.51248\text{-}0.51254$, $^{206}\text{Pb}/^{204}\text{Pb} = 18.715\text{-}19.078$, $^{207}\text{Pb}/^{204}\text{Pb} = 15.539\text{-}15.575$, and $^{208}\text{Pb}/^{204}\text{Pb} = 39.123\text{-}39.361$). This is in contrast with products of the second (recent) stage, which are characterized by more radiogenically depleted isotopic compositions ($^{87}\text{Sr}/^{86}\text{Sr} = 0.70418\text{-}0.70467$, $^{143}\text{Nd}/^{144}\text{Nd} = 0.51254\text{-}0.51270$, $^{206}\text{Pb}/^{204}\text{Pb} = 18.771\text{-}19.872$, $^{207}\text{Pb}/^{204}\text{Pb} = 15.561\text{-}15.693$, and $^{208}\text{Pb}/^{204}\text{Pb} = 38.760\text{-}39.751$). The compositional shift can be explained by interaction (partial remelting and assimilation) between ijolite-series type cumulates belonging to the first stage of activity at Oldoinyo Lengai, and melilititic to nephelinitic magmas with isotope characteristics similar to magmas erupted within the neighbouring Lake Natron – Engaruka monogenetic volcanic field. Isotope mixing calculations and fractional crystallization modelling indicate that the recent products of Oldoinyo Lengai are likely the result of partial assimilation in a proportion of 70 to 30. The evolved rocks, erupted during the transition between the first and the second stage, have intermediate isotopic compositions, which can be explained by isotope mixing of Oldoinyo Lengai cumulates and LNE-MVF type magmas in proportion of 90:10 ($^{87}\text{Sr}/^{86}\text{Sr} = 0.70425\text{-}0.70487$, $^{143}\text{Nd}/^{144}\text{Nd} = 0.51250\text{-}0.51256$, $^{206}\text{Pb}/^{204}\text{Pb} = 18.052\text{-}18.738$, $^{207}\text{Pb}/^{204}\text{Pb} = 15.440\text{-}15.540$, and $^{208}\text{Pb}/^{204}\text{Pb} = 38.238\text{-}39.206$).