

Xe isotopes in carbonatites: Oldonyo Lengai, East African Rift

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Sample Description

Oldonyo Lengai, Tanzania, is the only volcano on Earth that is actively erupting carbonatitic lavas. In order to further constrain the origin of the Oldonyo Lengai magmas, an expedition to Oldonyo Lengai in July 2005 sampled volcanic gases emanating from the actively erupting crater. Two fumaroles were sampled, one with a discharging temperature of 124 °C, the other >168 °C.

Results

The chemical composition of discharging gases is dominated by H₂O (~77 mol%) and CO₂ (~22 mol%), SO₂, H₂S and HCl make up < 1 mol%, combined. The inert gases (N₂, He, Ar) show that these samples contain virtually no air and He isotopic compositions are consistent with an upper mantle origin. He/Ne ratios are between 2000 and 5000 and He/Ar ratios are up to 0.3.

The Xe isotopic composition of the gases sampled has been measured using a multicollector noble gas mass spectrometer (HELIX-MC) with a precision of ≤3 permil on the ¹²⁹Xe/¹³⁰Xe isotope ratio (and ≈5 permil on ¹³⁴Xe/¹³⁰Xe and ¹³⁶Xe/¹³⁰Xe ratios).

All Xe isotope ratios measured to date (3 samples) are atmospheric within error: there is no evidence for Xe produced by decay of extinct ¹²⁹I (no ¹²⁹Xe excess) or by U-series decay (no ¹³⁴, ¹³⁶Xe excess) in the Oldonyo Lengai gases. Given that, on the basis of the He/Ne ratios, these samples are free of atmosphere added to the volcanic gases at the time of sampling, it seems probable that Xe with atmospheric isotope ratios has been entrained in the magmas, most likely through assimilation of crustal material rich in atmospheric Xe during ascent through the crust. Continuing work will analyse the remaining samples for Xe isotopic composition and all gases for Ne and Ar isotopic composition in order to constrain the origin of noble gases in this unique volcano.