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Primary mantle carbon degassing and redistribution in the Oldoinyo Lengai volcano system

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Oldoinyo Lengai is one of the most active volcanic producers of carbon dioxide gas (∼7,200 tons/day), and combined with its extrusive carbonatite lava activity, contributes an important carbon footprint in the East African rift valley, which is a high CO2 region. Oldoinyo Lengai appears to operate on two scales, with (a) long term nearly continuous passive carbonatite lava effusion, interrupted by (b) more explosive activity (1966-7, 2007-8) dispersing ash-rich products. The metastability of major minerals in these super-alkalic volcanic rocks is well known and possibly seasonally enhanced [1] leading to a range of breakdown or secondary products and the eventual conversion to alkali-poor carbonate minerals [2] resembling calciocarbonatite, as found in neighbouring extinct Kerimasi volcano. What is less well documented is the net distribution of carbon between solid, liquid and gas species during and between different stages of volcanic activity, and how this compares with airborne and IR measurements [3,4]. Future mass balance estimates will need to assess not only the carbon outgassing, but the relative contributions of carbon drawdown into weathering products and the local volcano-sedimentary system including, for example, soluble runoff into nearby lake Natron. Data for the in-situ weathering of a 2006 carbonatite lava flow over a one year period at ambient conditions confirm unchanged δ^{13}C (VPDB) of -6.8 ‰ (+/- 0.1 ‰) compared with a contemporaneous change in δ^{18}O (SMOW) from +6.5 to +24.8. The carbon isotope data are consistent with rare gas observations from passive fumaroles at Oldoinyo Lengai [5], to require a primary mantle source for the carbon, but the rapid change on oxygen isotope data was unexpected.

References

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