Volatile Chemistry of the 2007 to Present Explosive Eruption of Oldoinyo Lengai Volcano, East African Rift

Abstract

We characterize the volatile chemistry of the ongoing explosive eruption at Oldoinyo Lengai (OL) in the Gregory Rift Valley of N Tanzania. Fieldwork was conducted from 4-8 April 2008, during which time OL exhibited Strombolian to ash plume-producing activity. Eight distinct ash lapilli layers were sampled 900m from the crater. Mini-DOAS SO2 flux measurements were conducted on 6, 7, and 8 April. Despite moderate eruptive activity, SO2 concentrations were very low, from ~ 20ppm.m to below detection. A low concentration plume was detected on 7 April, allowing a SO2 flux estimate of 0.2-0.4 tons/day. SIMS analyses of carbonatite lavas erupted in 2005 show very high S concentrations (0.62wt %), suggesting that the low SO2 flux is due to partitioning of S into the melt. Ash leachates were analyzed as a proxy for plume chemistry and to assess health risks associated with mobile elements in the ashes. The solutions had high pH of 10.6 to 11.1. This has implications for pH fluctuations of Lake Natron (pH ~10; located 20km N of the crater), which may correlate with lacustrine ash deposition during passed explosive activity at OL. In the uppermost ash layer (deposited on 4/5/2008; not influenced by rain) dominant mobile ions are Cl (18120mg/kg), SO4 (26616mg/kg), PO4 (2393mg/kg), and F (534mg/kg), Na (101679mg/kg), K (22544mg/kg), Ca (721mg/kg), and Si (189mg/kg). Leachate S/Cl from this pristine ash is 0.49, compared to 0.29 measured by SIMS in lavas from 2005. Using the SO2 flux and the S/Cl in the leachates, the Cl flux was 0.5-0.8 tons/day. High concentrations of leachable ions, particularly F, on ash presents health hazards (F poisoning; water source contamination) to local communities. Concentrations in the underlying ashes are lower (40-129 mg/kg Cl, 965-3223 mg/kg SO4 , 66-104 mg/kg F, 40-335 mg/kg PO4) than those in the upper deposit due to leaching by rain prior to deposition of the uppermost ash layer. FTIR spectroscopy of ashes shows at least two carbonate minerals in the uppermost ash sample: calcite and a hydrous carbonate, possibly containing Na, Ca, K and/or Mg, spectrally most similar to nesquehonite (MgCO3.3H2O). Bulk ash samples were analyzed for C and O isotopes to investigate sources of CO2 and carbonate. Samples from 2007 have delta13CPDB ~ -6.30/00 and delta18OSMOW ~9.90/00, which overlap with mantle values (Keller and Hoefs, 1995). Samples from 2008 have delta13C values from -6.53± 0.190/00 to -5.44 ±0.100/00. The more

enriched delta13C values can be explained by fractionation by degassing of CO2 that is enriched in 13C relative to the CO2 dissolved in the magma, which agrees with the C isotope compositions of gases from OL (~-2.60/00; Javoy et al., 1988). Oxygen isotope compositions of the ashes collected in 2008 vary systematically from delta18O15.32 ±0.240/00 to 10.46± 0.130/00. This trend may be due to assimilation of altered carbonatite with delta18O values of (>)+160/00 (Keller and Hoefs, 1995) by a magma with delta18O of ~+100/00. Javoy, M., et al. 1998. The Gas Magma Relationship in the 1988 Eruption of Oldoinyo Lengai (Tanzania). EOS Tans. AGU 69,1466. Keller, J., Hoefs, J., 1995. Stable Isotope Characteristics of Recent Carbonatites. in: Bell, K., Keller, J. (Eds.), Carbonatite Volcanism: Oldoinyo Lengai and the Petrogenesis of Natrocarbonatites. IAVCEI Proc. in Volc. 4, 70-86.