

Geochemistry and degassing systematics of silicate magma at Ol Doinyo Lengai, Tanzania

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Abstract

Ol Doinyo Lengai (OL) volcano is unique in that it produces natro-carbonatite lavas. However, every ~25 years the volcano explosively erupts nephelinitic ash. OL entered an explosive phase in September 2007, which lasted until November 2008, and carbonatite activity resumed early in 2009. This study assesses the composition of the 2007-2009 eruptive products and volatiles to characterize degassing and magmatic processes during the explosive eruption. Ash samples collected in 2008 and 2009 are extremely crystal-rich with scarce scoria. Bulk compositions show that the ash is dominated by alkali- and volatile-rich silicate ash with a secondary carbonatite component (SiO₂ 37.3%, CO₃ 4.3%, MgO 1.8%, CaO 15.4%, Na₂O 11.2%, K₂O 3.5%, S 0.14%, Cl 0.20%). Electron microprobe analyses of vesicular scoria show that the matrix glass (SiO₂ 41.0%, Na₂O but enriched in incompatible elements compared to nepheline-hosted glass inclusions (SiO₂ 43.2%, Na₂O 15.8%). S correlates positively with Cl and F in nepheline-hosted glass inclusions (S 0.2-0.4%, Cl 0.3-0.5%, F 0.3-0.8%) showing that these species behaved incompatibly and were not saturated in the parental melt. Matrix glass extends to higher S concentrations (up to 0.7%) at relatively constant Cl and F (Cl ~0.5%, F ~0.7%) resulting in

increasing S/Cl and S/F in the residual melt. This is interpreted to reflect Cl and F saturation in the melt due to further crystallization and partitioning of these species into the gas phase while S was undersaturated. Reflectance FTIR shows that the matrix glass has no detectible H₂O and ~3% CO₂. Glass inclusions have