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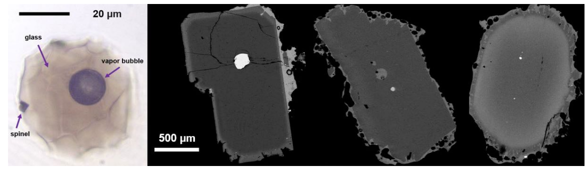

Examining volatiles and pre-eruptive storage histories of Nyiragongo's most primitive magmas

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Nyiragongo, one of the East African Rift's most active volcanoes, emits voluminous quantities of CO_2 and SO_2 (Werner et al. 2019, Sawyer et al. 2008). Due to a paucity of higher-Mg magmas erupted from Nyiragongo's central vent system, the processes that lead to the generation of its highly alkalic, silica-undersaturated, and CO_2-rich magmas are poorly constrained. To investigate magma sources and evolution, we are examining melt inclusions (MI) hosted in high-Mg olivine phenocrysts (Fo_{91-85}) from a suite of olivine-melilitite scoria cones along the flanks of Nyiragongo. Additionally, because little is known about the crustal storage histories of primitive magmas, we also measured major and trace element transects of zoned olivine phenocrysts to constrain timescales of pre-eruptive magmatic processes.

Vapor bubbles in MI exhibit high CO_2 densities (0.20-0.24 g/cm^3) and the glass phase contains 1000s of ppm CO_2. Reconstructed total dissolved CO_2 contents of entrapped melts reach 1.2 wt%, and likely extend to higher values considering carbonates at the vapor bubble – glass interface. Pre-eruptive H_2O concentrations are variable between samples, ranging from 0.25-1.2 wt% H_2O. Measurements of $Fe^{3+}/\sigma Fe$ by XANES yield values of 0.13-0.21, corresponding to oxidation states between FMQ-1 and FMQ+0.25 (Kress & Carmichael 1991). Measurements of S6+/σS by XANES are more variable, falling in the fO_2 range where S transitions from S^{2-} to S^{6+}. For the most primitive and volatile-rich samples, $S^{6+}/\sigma S$ values are 0.31-0.44. In contrast, the relatively more evolved and volatile-poor samples have $S^{6+}/\sigma S$ of 0.02-0.04. Further work is required to understand whether these differences arise from degassing, differing sources, or fractional crystallization. Major and trace element profiles of olivine mostly show broad homogeneous cores (Fo_{91-80}) and thin rims (Fo_{85-74}). Results from diffusion modeling indicate prolonged storage followed by the formation of zoned rims on timescales of days to weeks, likely caused by re-entrainment of crystals in a more evolved melt. Our results suggest that (1) triggering of flank cinder cone eruptions was associated with magma mixing events occurring in mid to lower crustal storage reservoirs and (2) future flank cinder cone eruptions might be preceded by days to weeks of seismic unrest.