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Petrology of the Nyiragongo volcano, DR Congo

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The Nyiragongo volcano is one of the most alkali-rich volcanic centers on the planet, characterized by a semi-permanently active lava lake which hosts silica-undersaturated (SiO_2 < 40 wt.%), low viscosity lavas with highly elevated alkali contents ($Na_2O + K_2O$ > 10 wt.%).

In order to better understand this exotic magmatic system, we present a set of 274 samples from Nyiragongo volcano, acquired during new field excursions between 2017 and 2021. The major and trace element composition of all samples was measured, revealing a lithological range extending from primitive picrites (Mg# 82) erupted from parasitic cones to a variety of highly evolved nephelinites, leucitites, and melilitites erupted from the main edifice as recently as 2002, 2016, and 2021.

We measured major and trace element compositions from the full spectrum of minerals present in all sampled lithologies from Nyiragongo. From these we calculated that the main magma reservoirs feeding Nyiragongo are at approximately 10 and 20 km depth. Detailed fractional crystallization modelling was performed to quantitatively link the lithologies to specific remaining liquid fractions assuming evolution from an olivine-melilite parental melt.

Our modelling indicates that fractionation in deep chambers at 20 km depth reduces the melt fraction remaining to 60%, after which melts are injected into upper, liquid dominated magma chambers at 10 km where fractionation and accumulation of clinopyroxene and feldspathoids dominate.

Extensive mineralogical characterization of major and trace element geochemistry, reveals high crystal mobility in a plumbing system split between collections of liquid-dominated, evolved magma chambers and more solid-dominated, primitive mushes, decreasing in liquid fraction with depth.