RHEOLOGY OF CRYSTALLIZING BASALTS FROM NYIRAGONGO AND NYAMURAGIRA VOLCANOES, D.R.C.

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ABSTRACT

Nyiragongo, a stratovolcano located within the Virunga Volcanic Province on the western branch of the East African Rift, is known for persistent lava lake activity and devastating eruptions in 1977 and 2002. The latter eruption created channelized lava flows that entered the city of Goma killing 170 people and displacing ~350,000 others. These lavas are unusually low in silica (39-42 wt.% SiO_2) making them very fluid, allowing flows to move rapidly. The rheology of lavas from Nyiragongo was measured by concentric cylinder viscometry over a range of temperatures between 1221°C and 1145°C. Viscosity at the liquidus temperature of ~1213°C is similar to that of Hawaiian lavas. Over this temperature range, crystal fraction remains very low ($\phi_c \leq 0.05$) implying the change in viscosity is due primarily to cooling effects rather than physical or chemical effects of crystallization. The data are well reproduced using a power-law model with exponents decreasing from 0.96 (1221°C) to ~0.78 (1145°C) and no detectable yield strength. Crystal fraction and lava viscosity both increase rapidly below 1145˚C preventing lower temperature experiments. Lavas from the neighboring shield volcano, Nyamuragira, show significant crystallization and pseudo-plastic behavior much closer to the liquidus. Data are well reproduced by a power-law fit with flow indices ranging from 0.89 (1255°C) and ~0.42 (1154°C). While still fairly fluid, it is more viscous than Nyiragongo lavas and also crystallizes more rapidly upon undercooling. Recently, Nyiragongo has erupted lava more fluid than lavas erupted by Nyamuragira, producing fast-moving flows that pose imminent danger to the inhabitants of Goma.