ABSTRACT FOR THE AGU FALL MEETING 2021, NEW ORLEANS, U.S.A.

TITLE

Flank failure at open-vent volcanoes: lessons learned from Nyiragongo volcano, Democratic Republic of Congo

AUTHOR LIST

Benoît Smets[1,2], Julien Barrière[3], Corentin Caudron[4], Nicolas d'Oreye[3,5], Louise Delhaye[1,2], Raphaël Grandin[6], Ephrem Kamate Kaleghetso[7,8], Sander Molendijk[8], Adalbert Muhindo Syavulisembo[7], Olivier Namur[8], Adrien Oth[3], Sam Poppe[9], Delphine Smittarello[3], Subira Josué[1,7,10], Nicolas Theys[11], François Kervyn[1]

AFFILIATIONS

[1] Natural Hazards Unit, Department of Earth Sciences, Royal Museum for Central Africa, Belgium
[2] Cartography and GIS Research Group, Department of Geography, Vrije Universiteit Brussel, Belgium
[3] European Center for Geodynamics and Seismology, Luxembourg
[4] Institut des Sciences de la Terre de Grenoble, France
[5] Department of Geophysics/Astrophysics, National Museum of Natural History, Luxembourg
[6] Institut de Physique du Globe de Paris, France
[7] Goma Volcano Observatory, D.R. Congo
[8] Department of Earth and Environmental Sciences, Katholieke Universiteit Leuven, Belgium
[9] Université Libre de Bruxelles, Belgium
[10] Department of Geography, University of Liège, Belgium
[11] Royal Belgian Institute for Space Aeronomy, Belgium

PLANNED SESSION

V026 - The storage, transport, and eruption of magma using field observations, laboratory approaches, and modeling

ABSTRACT *(2000 characters without space)*

Volcanoes hosting a persistent lava lake are scarce on Earth. Such a persistent activity may be seen as an open window to the plumbing system, potentially offering direct information on the pressure state of the volcano. By freely releasing volcanic gases, these open systems also prevent, at least partially, large overpressures leading to more explosive eruptions. However, these open systems fail at some point, producing lava flows on the flanks of the volcano. This is the case of Nyiragongo, in Democratic Republic of Congo, which is popular for its large persistent lava lake within its summit crater. On January 10th 1977, January 17th 2002 and, more recently, May 22nd 2021, eruptive fissures opened on the flanks of the main volcanic edifice, draining the lava lake system and feeding lava flows that destroyed villages and part of the city of Goma (>1 million inhabitants). In 1977 and 2002, flank failure was preceded by a series of events that destabilized the volcano, such as >M5 tectonic earthquakes and a voluminous flank eruption of the neighboring Nyamulagira volcano, and some precursors showing that Nyiragongo was about to erupt. Although the three known recent flank eruptions of the volcano opened eruptive fissures in the same fracture network,

producing lava flows following the exact same paths, the May 2021 eruption was, however, devoid of any similar precursory events that would have indicated that the volcano was about to erupt along its flanks. In the present work, we provide a comparison between the 1977, 2002 and 2021 eruptions of Nyiragongo in order to shed light on the mechanisms and dangerousness of flank eruptions at that type of volcano. This work is based on an extended bibliographic review including historical unpublished scientific notes and reports, series of observations, measurements and mapping using multiple remote sensing data and techniques, and recent works in the fields of geodesy, seismology and petrology. This multidisciplinary investigation reveals the complex interplay between magmatism, rifting and pre-existing structures, shows that system failures leading to magmatic intrusions often occur at Nyiragongo, and reveals the difficulties to monitor a persistently active volcano where a significant volume of magma is already in place close to the surface.