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# Nyiragongo Volcanic Eruption of May 22, 2021: Human Hazards.

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**ABSTRACT**

Each eruption that erupts from a volcano's crater has consequences for the environment, both ecological and human.

The eruption of the Nyiragongo volcano on may 22, 2021 caused havoc in its path. Hot lava engulfed everything in its path. Estimates put the number of human dwellings burnt by the lava at several hundred, and the number of houses destroyed by earthquakes following the eruption at several thousand.

Human lives were lost during Nyiragongo's eruption in May 2021. Around thirty people died as a result of this eruption in the city of Goma and its surrounding areas.

***Key words:*** Nyiragongo, Eruption, Human hazard, Goma

## Introduction

Volcanic eruptions are a great threat to human, animal and plant health.

Nyiragongo volcano (1.52_S, 29.25_E; alt. 3469 m) is located on the western branch of the East African Rift System, approximately 18 km north of the city of Goma (pop. more than 1.000.000), in the Democratic Republic of the Congo (DRC).[Sawyer, et al., 2008]

In 1977, the first historical effusive eruption occurred when N-S oriented fractures opened on both the northern and southern flanks of Nyiragongo at elevations between 2700 m and 2200 m [Tazieff, 1977]

The lava lake, which had been155 m below the crater rim before the eruption, drained completely, leaving an empty crater_1000 m deep. Lava flows, with an estimated total volume of 2.2 _ 107 m3, raced down the flanks of the volcano reaching speeds of up to 60 km h_1, inundating several villages and a significant amount of agricultural land. Between 74 and 400people were killed [Durieux, 2003].

On 17 January 2002, the second historical flank eruption of Nyiragongo occurred when a series of N-S oriented fractures opened on the upper south flank of the volcano, again triggering drainage of magma stored in the shallow plumbing system. [Komorowski, J.-C., et al., 2004]

In 2002, where 14 to 34 millions cubic meters ($Mm^3$) of lava poured out. During the eruption, the lava flows followed a north-south oriented fracture network along the axis of the Albertine rift. Fractures appeared on the flank of the volcano and generated two lava flows. The first destroyed the central area of the city up to Lake Kivu, or about 15% of the city of Goma, leaving 120,000 people homeless. There were 470 injuries of various severity and 170 deaths directly or indirectly related to the eruption. This eruption provoked a massive exodus to Rwanda. The second flow was directed towards Lake Kivu, causing various limnic releases ($CO_2$ and $CH_4$).[Michel Detay, 2011]

Eruptions can produce lethal quantities of toxic gases, but long-term exposure to a lower dose also can pose a significant hazard. Although volcanic gases are only directly responsible for 1-4% of volcano-related deaths, they are nevertheless hazardous and responsible for deaths every year. They have an important effect on the regional and global environment and may contribute greenhouse gases to the atmosphere.

The composition of volcanic gases depends on the type of volcano and its eruptive state. However, the most common volcanic gases in order of abundance are water ($H_2O$,30-90 mol%), carbon dioxide ($CO_2$, 5-40 mol%), sulphur dioxide ($SO_2$, 5-50 mol %), hydrogen ($H_2$, <2 mol%),hydrogen sulfide ($H_2S$, <2 mol%), and carbon monoxide(CO, <0.5 mol%). Some of these, when emitted from active vents, react in the atmosphere or volcanic plume to form aerosols, the most important being hydrochloric acid (HCl), hydrofluoric acid (HF), and sulphuric acid ($H_2SO_4$).[Glyn Williams-Jones, et al., 2015]

Surveillance of $SO_2$ and other volcanic emissions is important for several reasons. First, acid species in volcanic plumes are known to have deleterious effects on local environments and human health [Baxter et al., 2004] and quantification of emissions provides a basis for further study and mitigation of potential hazards. [Baxter P. J., et al., 2003]

## Health hazards of eruption

Rapid population growth and rural–urban migration in disaster-prone countries will increase vulnerability to catastrophe if settlements are allowed to expand unchecked in areas of high natural hazard. [Peter J Baxter, et al., 1999]

The volcanic hazard is fairly obvious, as evidenced by the past flows that have historically reached Goma. The fact that eruptions seem to occur more and more frequently on the flanks of the volcano opposite Goma is an additional element of concern. In the case of Nyiragongo, with its very fluid lava and the steep slope towards Goma, the risk must be taken into consideration, although the volumes are generally small. Finally, gases represent a real risk, especially since they can be of volcanic origin (SO2, CO2), but also of limnic origin.[Michel Detay, 2011]

A few shield volcanoes have persistent active lava lakes in their summit caldera. The most famous lava lake was that in Halemaumau pit crater (Kilauea), which persisted for more than a century until it drained into fissures in 1924. Drainout was accompanied by violent groundwater explosions. Others are found in Erta Ale (Afar, Ethiopia), Mount Erebus (Antarctica), and Nyiragongo (Congo). Lakes are sustained by strong magma convection in the conduit that joins them to their magma chamber. The escape of a flood of highly fluid lava from Nyiragongo lava lake in 1977 gave rise to remarkably fastmoving (ca. 60 km/hour) lava flows that killed many people.[GEORGE P. L. WALKER, 2000]

As a consequence, the beginning of unrest at a dormant volcano presents investigators with the intrinsic dilemma as to whether the unrest will culminate in an eruptive phase, hence posing a direct threat to life and property around a volcano, or whether the “unusual” behaviour will eventually dissipate, causing little disruption to communities and hence little socio-economic damage.[J. Martí, et al., 2009]

Explosive volcanoes are the most dangerous, at least 10-15 explosive eruptions occurring in the world every year. The main hazards arise from the sudden release of hot volcanic material, heavy ashfalls and devastating mud flows. On the other hand, the lava flows of effusive volcanoes can cause immense destruction but, as the flow is usually no faster than walking pace, it can be readily avoided. Both types can produce large amounts of gases that may harm people living downwind and scientists studying the eruption. [Baxter P. J., 1983]

The durations of single eruptions also cover a large range and, while some may reach decades, the majority lie between days and months. Rates of flow lengthening thus rarely exceed a brisk walking pace, so that it is usually possible for people to escape immediate danger. Exceptions occur during the start of effusions, when lavas can sometimes advance as fast as a galloping horse. In the saddest example, on Nyiragongo (Congo) at 10:15 in the morning of January 10, 1977, a fluid lava swept down slope at least 5 km in 20 minutes (15 km/hour), catching a small village unawares and roasting 70 people alive. The Nyiragongo tragedy ghoulishly illustrates the need to prepare against lava invasion even before an eruption begins. To identify the most vulnerable districts, it is necessary to recognize probable locations of future eruptions and to forecast the likely travel distance of at least the initial lava flow. The first task is achieved by applying statistical analyses to the known distributions of vents at a volcano. The second requires a model that can link probable flow length to factors that can be measured before the next eruption begins, and it is here that the evolutionary sequences of lava flows assume a fundamental importance. [CHRISTOPHER R. J. KILBURN, 2000]

Most volcanic ash finer than 125 lm settles out of the atmosphere as particle aggregates that have higher settling velocities than individual constituent particles[Carey and Sigurdsson, 1982; Lane et al., 1993].

While aggregation exerts a first order control on the dispersal of fine ash within eruption clouds, the physical and chemical processes involved are not completely understood despite significant progress over the past 20 years[Schumacher and Schmincke, 1995; Gilbert and Lane, 1994; James et al., 2002, 2003; Durant et al., 2009; Costa et al., 2010]

The atmospheric residence time of fine ash determines the hazard to aviation[Casadevall, 1994], and ash fallout impacts local environments and infrastructure[Stewart et al., 2006; Spence et al., 2005; Wardman et al., this issue]and may present a health hazard over an extended period of exposure [Horwell and Baxter, 2006].

## Hazard of the 2021 Nyiragongo’s eruption

In the city of Goma, millions of people were exposed to various volcanic hazards. The gases emitted by Nyiragongo, amounting to thousands of tonnes of $SO_2$ and $CO_2$, were directed by the wind towards the city of Goma.

On the evening of May 22, 2021, millions of people in the city of Goma were menaced by lava from the Nyiragongo volcano.

Nearly twenty villages were partially or totally destroyed by the Nyiragongo flow, and at least 5,000 people have lost their homes, according to some estimates. Approximately 3,500 were destroyed. Hundreds of destroyed houses were burnt by the Nyiragongo lava.

Volcanic ash fell over the entire city of Goma and the entire region.

During the Nyiragongo eruption of May 22, 2021, several deaths were recorded. Human lives were lost both in the lava flow and through collateral effects. The official death relative to this eruption was thirty-two (32).

## Conclusion

Volcanic eruptions cause enormous damage around the world. Since the documentation of the Nyiragongo volcano's eruptions, its damage has not ceased to be talked about.

During the recent eruption on its southern flank, Nyiragongo devastated everything in its path. Ecological and human losses were recorded. Hundreds of houses burned by hot lava, thousands of homes destroyed as a result of the volcano's eruptive events were recorded during Nyiragongo's recent eruption.

Some thirty people lost their lives in this eruptive episode on May 22, 2021. In all, thirty-two (32) people died, some engulfed by lava, others as a result of collateral damage caused by the eruption of this stratovolcano.

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