

Interagency Program « Volcanic Risk Mitigation »
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Volcano Nyiragongo May 2004

PROGRESS REPORT

March – June 2004

I - BACKGROUND :

On January 17th, 2002, the Nyiragongo volcano (3469 m.), about 18 km N of Lake Kivu in the Democratic Republic of Congo (DRC) and close to the border with Rwanda, has erupted an estimated volume of 20 millions cubic-meters of lava. Lava flows originated from several locations along a huge system of fractures rapidly developed along the entire S flank of the volcano towards the city of Goma . Two main flows entered the town producing major devastation, and forcing the rapid exodus of 300,000 to 400,000 people. About 15% of the surface of the town was destroyed, including parts of the airport, most of the business centre and the housing of an estimated 120,000 people. An estimated 150 people died as an immediate consequence of the eruption, and many thousands have had their lives severely affected by it.

The January 2002 eruption of Nyiragongo was related to an important rifting event that is affecting the entire region from N of the volcano down to at least the Southern shores of Lake Kivu. The rifting process in the Nyiragongo – Lake Kivu area is still active, as testified by the seismic activity daily registered by the GVO seismic network.

The eruption of Nyiragongo in January 2002 represents the first historical case of a volcanic eruption producing only lava flows that has impacted a city of such a size and made such a large number of people homeless. In a previous eruption in 1977, extremely fluid, fast-moving (up to 60 km/h) lava flows drained from the summit lava lake of Nyiragongo and entirely covered several villages, killing an estimated 500 persons without reaching Goma.

Very fast and potentially extremely dangerous lava flows were also produced during the January 2002 eruption, but fortunately lava flows which entered the town of Goma were slowly advancing ‘aa’ type lava flows, resulting in big destruction of structures but letting time for people to escape from them.

The Goma Volcano Observatory

The Goma Volcano Observatory (GVO) is part of the Centre de Recherches en Sciences Naturelles (CRSN – Lwiro), and it is in charge to monitor the Virunga volcanoes and give the alarm in case of impending eruption. At the time the eruption occurred, the observatory had only two seismic stations. As a consequence of the socio-economical disasters that affected the DRC, and particularly its Eastern territory, the personnel of the GVO hadn’t received their salaries for almost 4 years. The instrumental network, which was once constituted by a partly telemetered seismic network of 7 stations, and by a network for the monitoring of volcano deformation, had been nearly totally destroyed by several years of civil war and social disasters. In spite of this, and thanks to their dedication and consciousness, the GVO personnel always maintained the GVO as functional as possible, and were able to communicate repeatedly their concerns to the local authorities, being always ignored, as the seismic signals from the volcano and rifting activity were becoming more and more apparent.

International Activities Aimed at Improving the GVO Monitoring Capabilities

Following the January 2002 eruption, a great international movement has started to support the GVO activities and re-establish an efficient monitoring network and service. It has led to the constitution of an international 'crisis response' team sent in the area, and the organization of a rotating turn of international experts on volcano crisis and surveillance who spend a period of about one month each at the GVO, with the aims of supporting the GVO monitoring activities, introducing new (for the area) and modern monitoring techniques, strengthen the capabilities of the GVO researchers in setting up the volcano monitoring network and the early alert system, and improving and updating the scientific knowledge and skills of GVO scientists. At the same time the UN promoted the collection of funds from international donors, mainly European and US governments, for the funding of international scientific projects to be performed in collaboration with the GVO.

From March 2003, has started a new UN inter-agency program dedicated to volcano risk reduction in the Goma area through support and improvement of GVO, capacity building for GVO staff, development and support of a regional policy of risk mitigation, public and authorities education in volcanoes and related risks.

PRESENT SITUATION

Volcano Nyiragongo:

In early July 2004, the Nyiragongo volcano is still very active, with the permanent presence of an active lava lake at the very bottom of the central crater. The sustained activity of this lava lake is throwing into the air volcanic ash and Pele's hairs. This activity, including ash falls and large, sometimes glowing, gas clouds on top of the volcano are seen from the towns of Goma and Gisenyi, as well as from all the villages surrounding the volcano, frightening the population and producing concern in the personnel working with the international organizations in the area.

The presently working monitoring seismic network of GVO is recording permanent tremor attesting a constant magmatic activity below the area. Such a situation requires permanent surveillance and attention in order to detect the early signs of a possible reappraisal of a bigger volcanic activity that could threat habited areas. Fracturing of the volcano flanks in January 2002 produced large and long fissures that arrived close to the town of Goma and the shore of Lake Kivu. A reactivation of this system of fractures allowing movements of magma towards Goma could have catastrophic consequences, including the formation of lava fountains and fluid lava flows in town.

At the time of writing this report, GVO is recording high fluctuations in the tremor level with some "crisis" of very high and intense tremor, giving patterns only known during important volcanic eruptions. Location of the signals confirms their origin inside Nyiragongo crater. These episodes of intense tremor are marked also by a much more important volcanic plume above the volcano. Measurements taken by TOMS Satellite are showing important gas release by the Nyiragongo crater with some daily average reaching 51.000 metric tons of sulfur dioxide. This represents by far the highest SO₂ output ever known during permanent volcanic activity on Nyiragongo but also on any other volcano on earth.

Further inspections of the crater and more detailed studies should precise the level of activity of the lava lake, but a first approach seems to confirm a regional stress caused by an important tectonic activity along the western escarpment of the rift valley. This stress is exacerbating magmatic activity below the volcanoes.

Volcano Nyamulagira :

Since September 2003, the volcano Nyamulagira has shown clear signs of renewal of activity. This volcano is very well known for its regular eruptions of Hawaiian type : construction of new volcanic cones along fractures, lava fountains and long lava flows. These eruptions are not threatening directly any human life : lava flows are generally contained inside the National Park boundaries, an area where nobody is supposed to live.

GVO has sent several alert messages quoting that a new eruption was in preparation: the latest information was released early May 2004. As rightly forecasted by GVO, the eruption actually started on May 8th. An important lava lake was active in the Nyamulagira summit caldera and in the meantime a 2km long fracture opened on the N-W flank of the volcano. More than 10 individual volcanic cones were built on the fracture by important lava fountains. Several lava flows were emitted and the main one travelled some 30 km long. These flows were all located inside the National Park boundaries and didn't reach any populated area. Nevertheless the important quantity of volcanic ashes and volcanic gases has had a very strong impact on the vegetation, crops and cattle from the neighbouring areas.

Despite security problems, GVO has done a 4 days field mission on the eruption site and many over flights have been performed.

The volcanic eruption of Nyamulagira is considered to have ended around July 1st.

Risk Mitigation Prospective

The city of Goma, and surroundings are currently under threat due to the changed activity of Nyiragongo volcano, considered today among the most dangerous in the world. The volcano has completely changed its routine activity known from at least 80 years. At the moment, GVO is facing and totally different volcanic activity and a totally different threat. The very important impact on the environment by the permanent activity of Nyiragongo and its huge gas release is a new hazard to be taken into account; at the same time the possibility that a new, more devastating eruption might happen in the next years is quite high.

Today, the Goma Volcano Observatory strongly needs to be reorganized for the new tasks he faces. This new organization is not only fundamental in the scientific monitoring but also in work distribution, fieldwork, data analyses, daily routine, etc.

Actually, the level of the GVO staff, despite the strong investment which have followed the January eruption (mainly technical), is still quite low and needs, in the medium or in the long run, to be increased, in order to allow the GVO to get self sufficient in the decision making process.

Volcano Risk Reduction Project

FROM MARCH TO JUNE 2004 : ACTIVITIES AND PROGRESSES

1) Equipment :

Thanks to some funds remaining from the former OCHA program, but also thanks to some help received by different donors and partners, equipment of GVO has been deeply improved during this 3 months period.

- With the help of INGV (Italy) the new digital seismic network has been developed and 5 stations are now properly working with a direct and real-time radio link to the GVO main building. At the same time the 7 stations in analogic one-component seismology are normally working.
- An integrated database with automated back-ups is being developed and should be effective in the very next weeks.
- ICRC (CICR) following its collaborative program with GVO on water quality control has provided the geochemistry lab with new equipment and reactants allowing the analyses of acids and fluoride dissolved in the rainwater.
- For the same project, ICRC (CICR) has provided GVO with three complete meteorological stations for the study of gas dispersion from the Nyiragongo volcanic plume.
- Sets of barometers and thermometers have been acquired to make corrections during EDM measurement campaigns.
- Extensometer for the widening survey of the fractures has been received.
- Special GPS for mapping, plus software and computer connections have been acquired
- Main extension (two offices, one electronic room, one secure storage room, one bathroom, one library) has been done to GVO building. Complete reorganization of the different offices has helped to turn former GVO building into a modern and efficient tool.
- In a common program by GVO and ngo Concern, a new building called "Centre d'Information sur les Volcans" has been erected close to GVO. It provides offices and a main conference and exhibition room hosting approx 60 persons. It is fully equipped with office furniture, computer, projector, screen, etc.
- The UN interagency program "Volcano Risk Reduction" has received A Toyota Land-Cruiser car from the Swiss Cooperation (DEZA). At the end of the program, this car will become property of GVO.

2) GVO Functioning :

The normal and daily functioning of GVO is not part of this project. Work gratifications (= "salaries"), offices small expenses, transportation, fuel, etc. have been covered by a transitory ECHO grant. This grant comes to its end on July 1st. A project, covering the same needs of GVO, has been proposed to the European Union. It should be signed mid-July and once again Save The Children will be the NGO responsible for the funds management in Goma.

This new support to GVO will cover the next three years. In addition to the regular expenses, the grant covers one or two new vehicles to be given to GVO, some repairs or maintenance to the GVO building in Goma plus the acquisition of some equipment. This support to GVO, left without any financial means by the Congolese government for about nine years, is the necessary base for the survival of the staff members and will allow normal work of the staff. It is also indispensable for any future development.

3) Volcano Monitoring :

During the period considered here, the volcano has been permanently monitored with all systems presently working at GVO. Continuous survey of seismology (both analogic and digital systems) by 7 stations; survey of deformation by EDM measurements, by extensometry and by levelling ; thermal survey of main fractures have been performed. Flux estimation of gas output in the volcanic plume by both automatic fixed DOAS and mobile DOAS have been done regularly. All data collected by these networks have been treated and archived in GVO, they were also the base of the weekly and monthly reports.

Seismic monitoring was also done on Nyamulagira volcano and GVO has been able to publish an accurate forecast (time and location) of the volcano eruption having started on May 8th.

4) Risk Assessment :

Analyses of water quality in villages receiving rainwater polluted by the volcanic plume have been regularly performed. Information about this pollution by acids and fluoride has been given to relief agencies and to local authorities. A complete mapping of the area threatened and damaged by the acid rains is under completion.

Information has also been given by the local radio networks in view to inform the population about the potential risk of drinking rainwater.

Mapping by GPS of all mazuku (ground gas pockets with CO₂) between Gisényi and Sake has been done. All data have been translated into shapefiles ready to feed the future GIS integrate map on volcanic hazards.

During the meantime, foreign experts having worked in Goma have refined their respective assessments on fractures, gas composition, lava flows

simulation and lake Kivu stability. All these data will be transferred to the GIS volcanic hazard map to be published soon.

Presently, the city of Goma knows an important increase : new habited areas are defined by the authorities and soon offered to the population. GVO is quite concerned by this because, even before the publication of the first draft of the hazard map, we know that most of these areas are in the higher risk zone. GVO staff and the UN Programme Manager have had several meetings with Congolese authorities but without too many results... Development of the city is planned on a very short term only and nobody wants to take care about possible future risks... GVO staff will pursue its efforts in educating the City and Province authorities in volcanic hazards and risk mitigation.

5) Public Education :

The public education programs are still managed by the NGO Concern. Theses programs went to their end in June 2004. Concern will publish and distribute a final report on their activities from 2002 to 2004. GVO and Concern have worked together on the building of a new public education project. It has been decided that for the next two years the project will address principally to youngsters and to students in schools from different levels. It has been decided also that the form and the content of the program will follow continuously the new knowledge acquired by GVO on the volcano and the related volcanic risks as well as the possible new directives given by the Contingency Plan to be revised soon. The new Concern program is mainly based on an intensive use of the "Centre d'Information sur les Volcans" and on modern educational techniques : video, computer animations, etc. Special animations, exercises and workshops for kids are under study.

Concern has also participated to the mazuku mapping and, in total cooperation with GVO scientists and authorities, 20 large signs (in French and Kiswahili) have been place along the most critical mazuku within the habited area, two signs in French, Kiswahili and Kinerwanda have also been placed in Gisényi (Rwanda).

6) GVO Development and Capacity Building :

As per the past, the capacity building of GVO staff has been mainly done by foreign scientists working regularly in Goma since the January 2002 eruption.

Trainings in Goma were held mainly in geochemistry, geodesy and fracture survey, seismology. A main effort has been done in seismology with 4 Italian scientists installing the new telemetered digital network but also teaching GVO technicians in hardware installation and maintenance. Educational curses have also been given to Congolese scientists.

A special workshop leaded by an expatriate expert has been organized on GIS database and mapping. This should be followed by the publication of the

first preliminary map on volcanic hazards in the Virunga. Completion of this map will be done under the leadership of an expatriate expert and will constitute also another educational workshop for GVO staff.
A software and computer engineer working as UNV is in GVO for the next six months. He plays now a very important role in capacity building for GVO staff.

6) Communication :

GVO is always maintaining the regular publication of reports, widely distributed to authorities, media, agencies and NGO's working in the area, national and international scientific institutions.

A weekly report details all information about the volcanoes and their activity and explains briefly the basic information collected by the different monitoring networks.

A more detailed scientific report is also published on a monthly base.

In view to increase public education about volcanoes and their activity, a short simplified bulletin is published every Friday in French and in Swahili. On Fridays late afternoon, there is a regular broadcast, always at the same hour and under the same form, on all local radio networks. All journalists working in the area are receiving the same bulletin.

7) Programme Management :

A programme manager has arrived in Goma on March 1st, 2004.

For an efficient and coordinate management of the Programme, a workspace has been conveniently given inside the main GVO building. It allows permanent exchanges between the programme manager, the GVO scientific director and all GVO staff. It allows also continuous capacity building by informal but regular help in resolving daily problems in data acquisition and treatment, computer use, etc.

Authorities have declared to be extremely satisfied by the existence of the present interagency program and by the presence of a UN programme manager beside GVO.

From time to time, the programme manager is also participating to some data acquisition field mission and participate also in the analysis of some data : this allows permanent capacity building in volcanology, eruptive dynamism, risk assessment.

The programme manager is also involved in fund raising operations : so far, a grant and a car has been obtained from the Swiss Cooperation, the normal functioning of GVO will be covered by a grant from the European Union, funding and cooperative programme on rainwater pollution has been established with ICRC. A possible grant for specific programme in volcanic gas plume monitoring is about to be given by the National Geographic Society.

Volcano Risk Reduction Project

FROM MARCH TO JUNE 2004 : Problems and Failures

- The UN program “Volcano Risk Reduction” has started on March 1st 2004. Due to several administrative problems and despite the fact the program has been funded well before this date, no funds arrived in Goma before the end of May. The program had to survive without any means and activities have been extremely reduced or even totally suspended for a while.
- Activities were also restricted because no car was provided to the program during the first months. This problem was solved later by the gift of a car by the Swiss cooperation and finally by the loan of an old UNHCR car, available on July 15th.
- Insecurity was important in the whole area, and still is today... We had to dismantle two seismic stations because of the possibility of looting. Several field missions have been cancelled also.
- On June 19th, GVO staff has had a major car accident when coming back from a field mission. Fortunately, people were not badly hurt but the GVO Land-Rover is totally destroyed and definitively out of use...
- A main bush fire has burnt all Mount Goma where GVO is established. The power line feeding the observatory was cut and it has taken a dozen of days to find a new 70m long special cable to re-establish power. The integrate digital system for seismic monitoring does not suffer power cuts and after this incident it took almost one week to restart the system properly.
- The GVO staff and the UN Programme Manager are repeatedly displaying information about the pollution of rainwater by acids and fluoride coming from the volcanic plume emitted by Nyiragongo volcano. Despite long efforts of communication done since more than one year now, nothing has been done by UN agencies, international or local NGO's, and authorities in finding a solution for the several thousand persons having rainwater as unique source of drinking water....

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