

# Virunga Volcanoes Supersite:

**a collaborative initiative to improve Geohazards Assessment and Monitoring of Active Volcanoes in a highly populated region**

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**Goma Volcano Observatory**



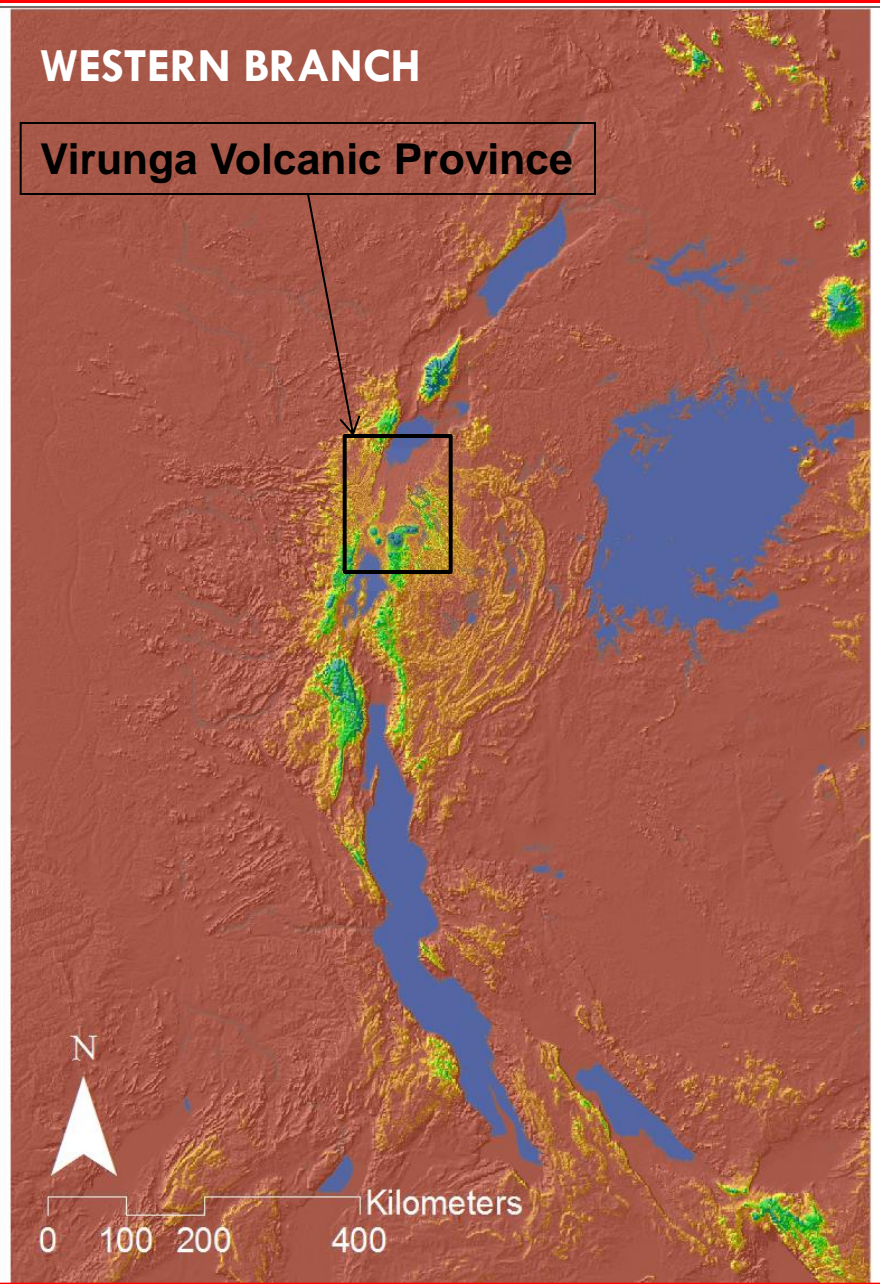
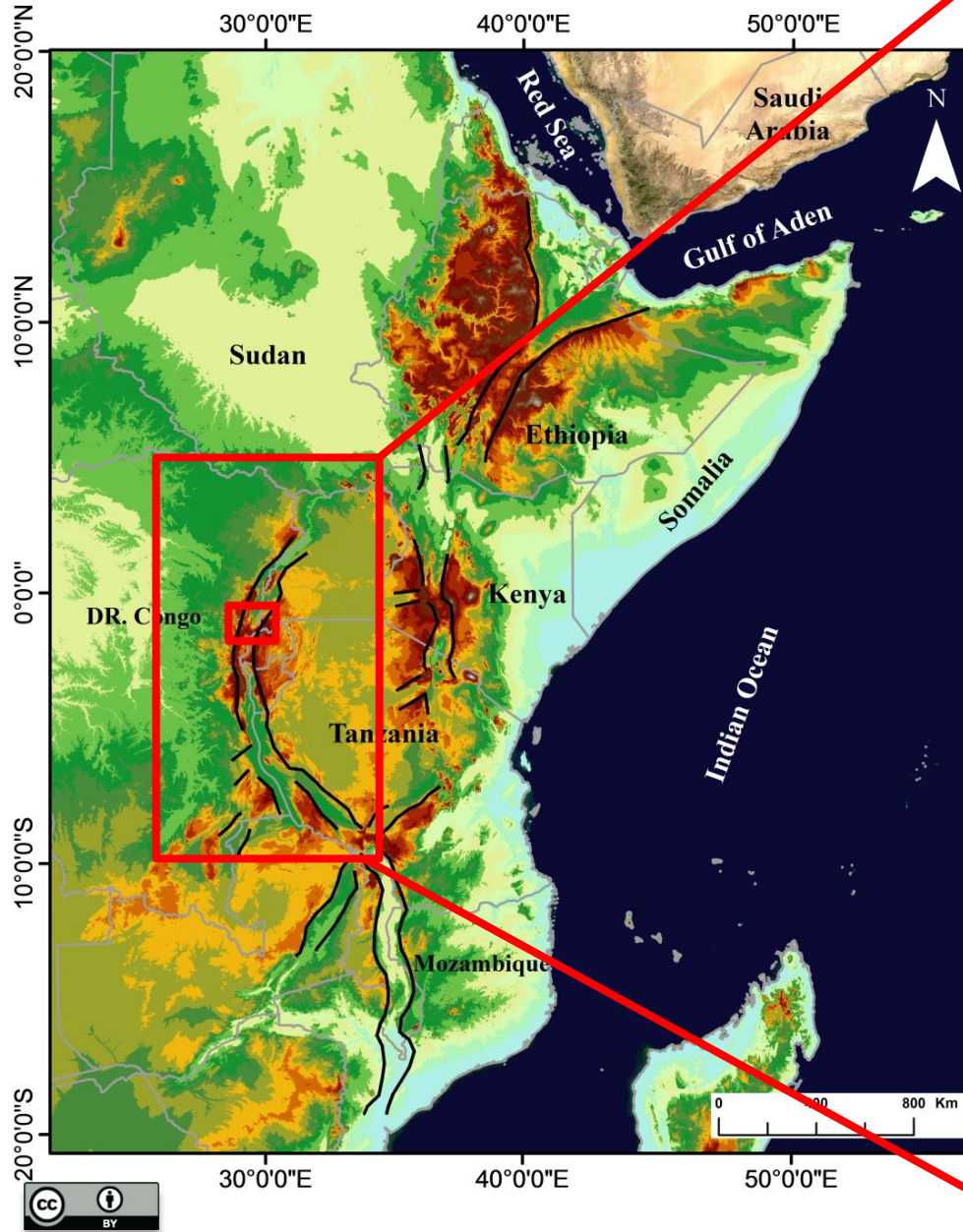
**European Geosciences Union  
General Assembly 2017**

Vienna | Austria | 23-28 April 2017



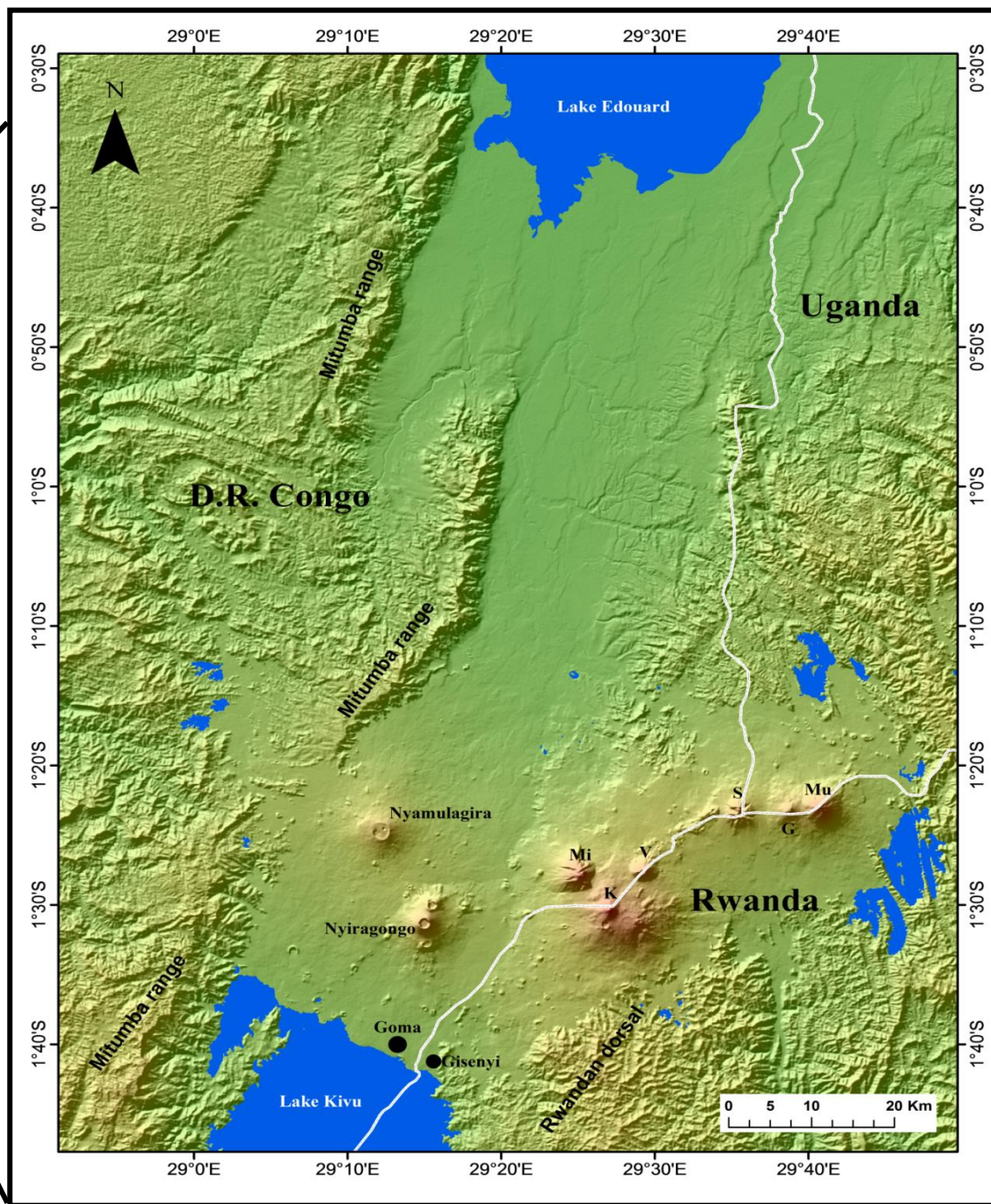
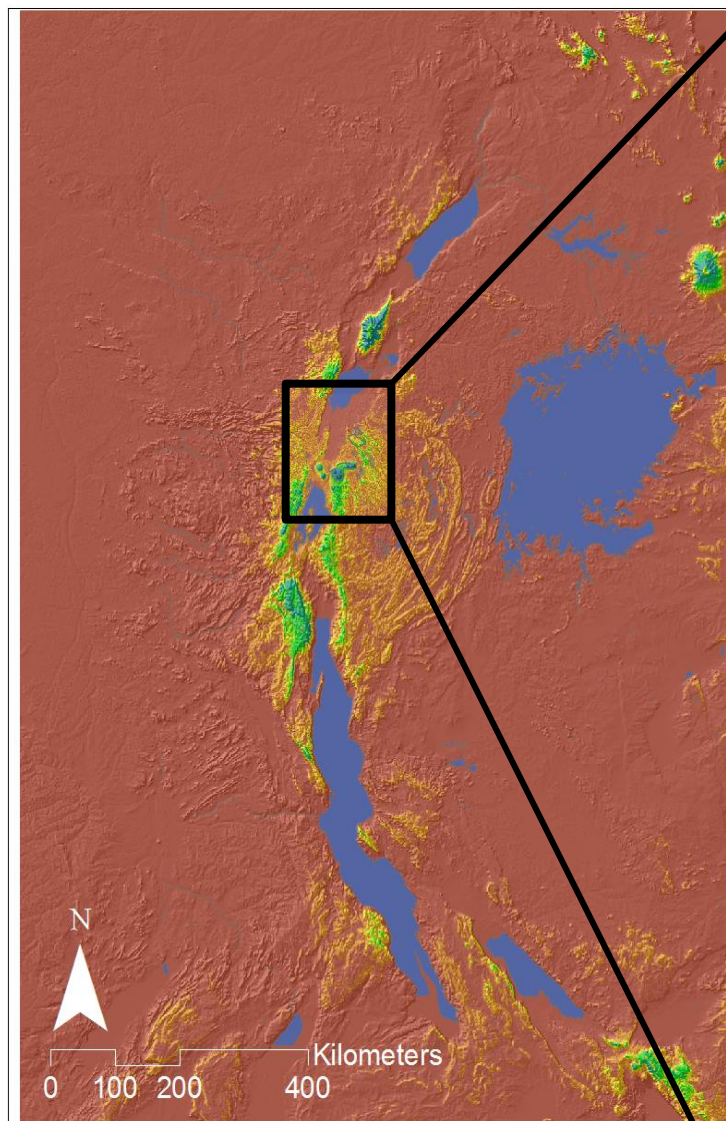


# The East African Rift and the Virunga Volcanic Province

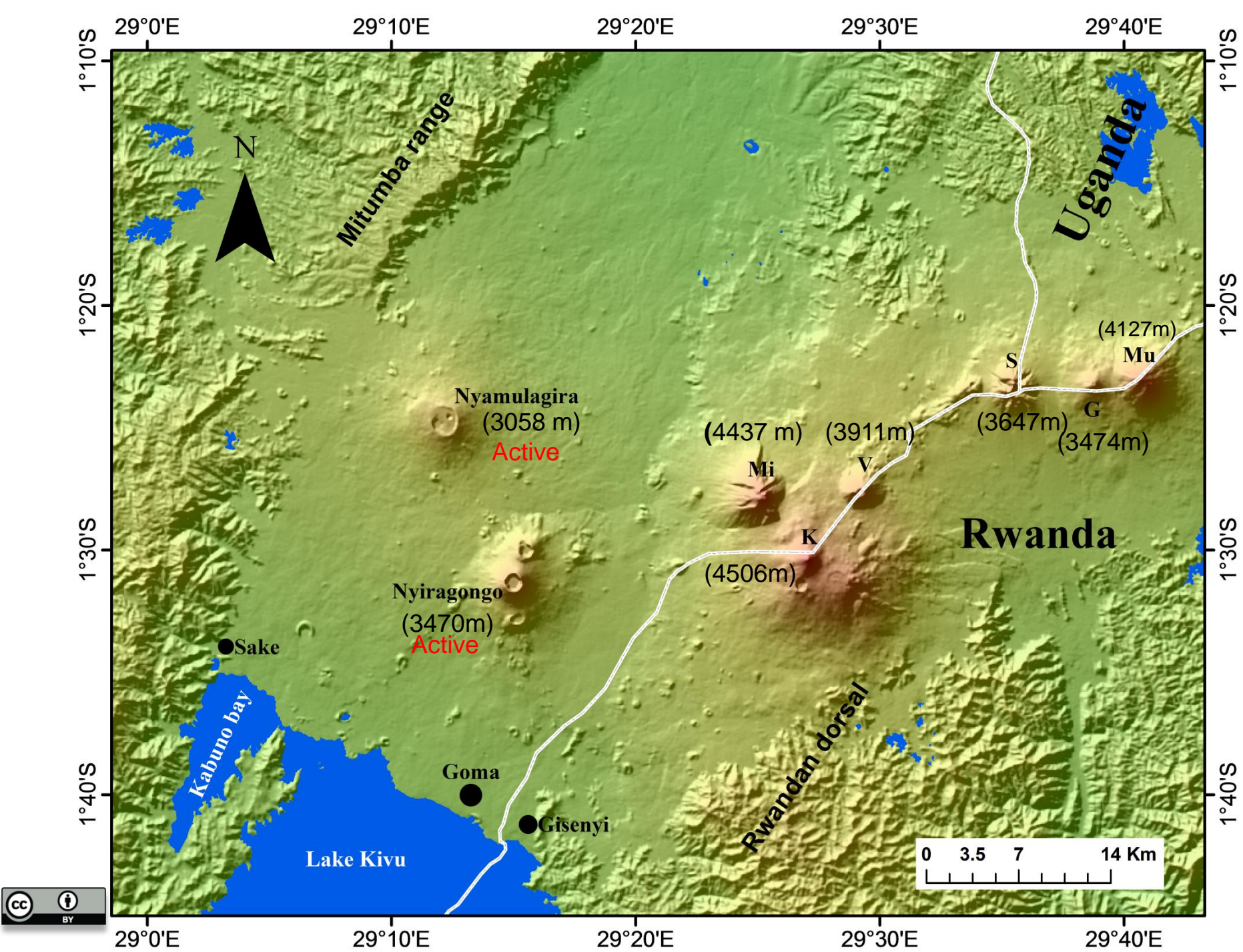




# The Virunga Volcanic Province









Nyirangongo

Nyamulagira



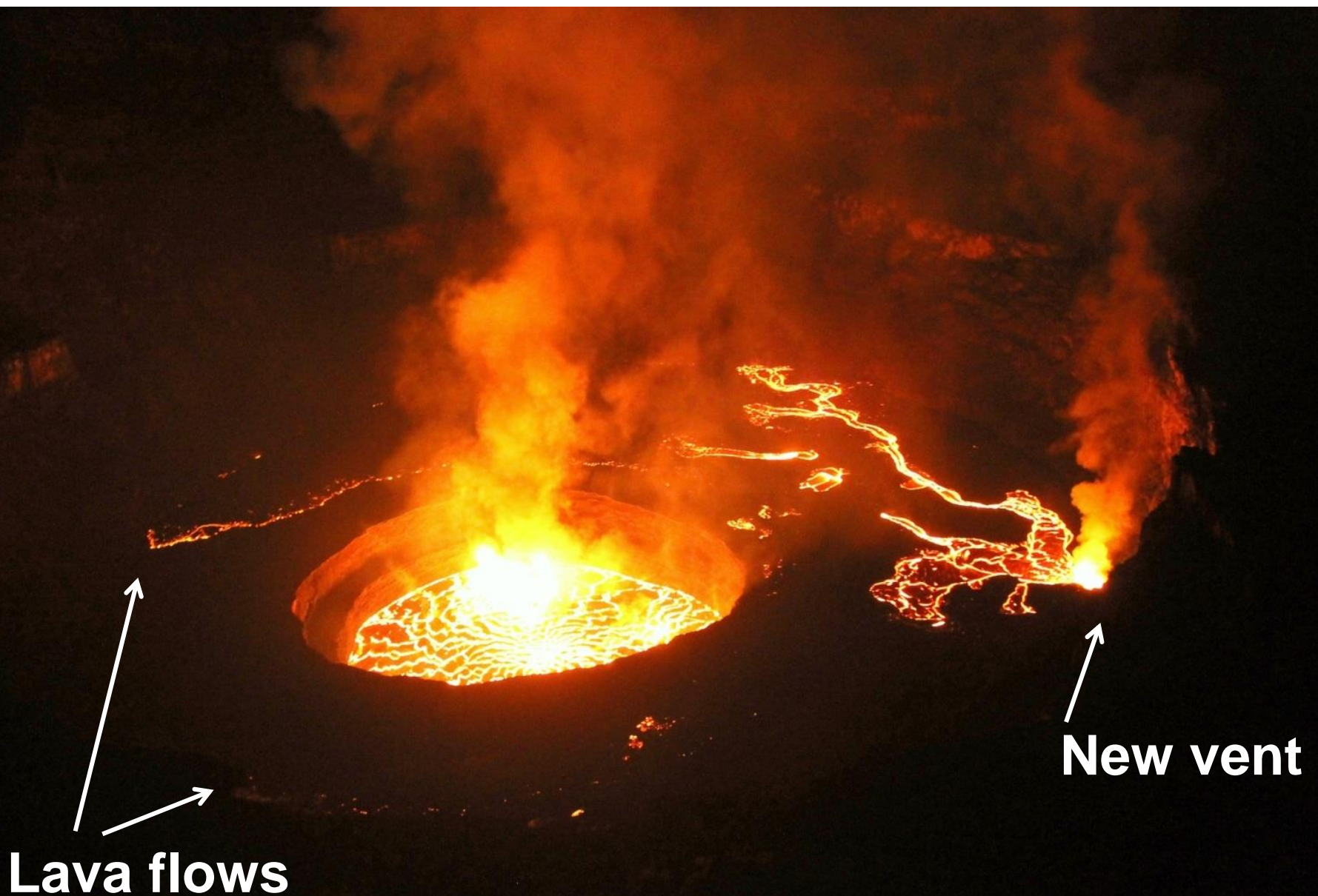








**February 29, 2016 New vent opened in Nyiragongo crater**







17.01.2017 18:36



# Nyamulagira 2010 eruption





# Nyamulagira lava lake, February 12, 2015



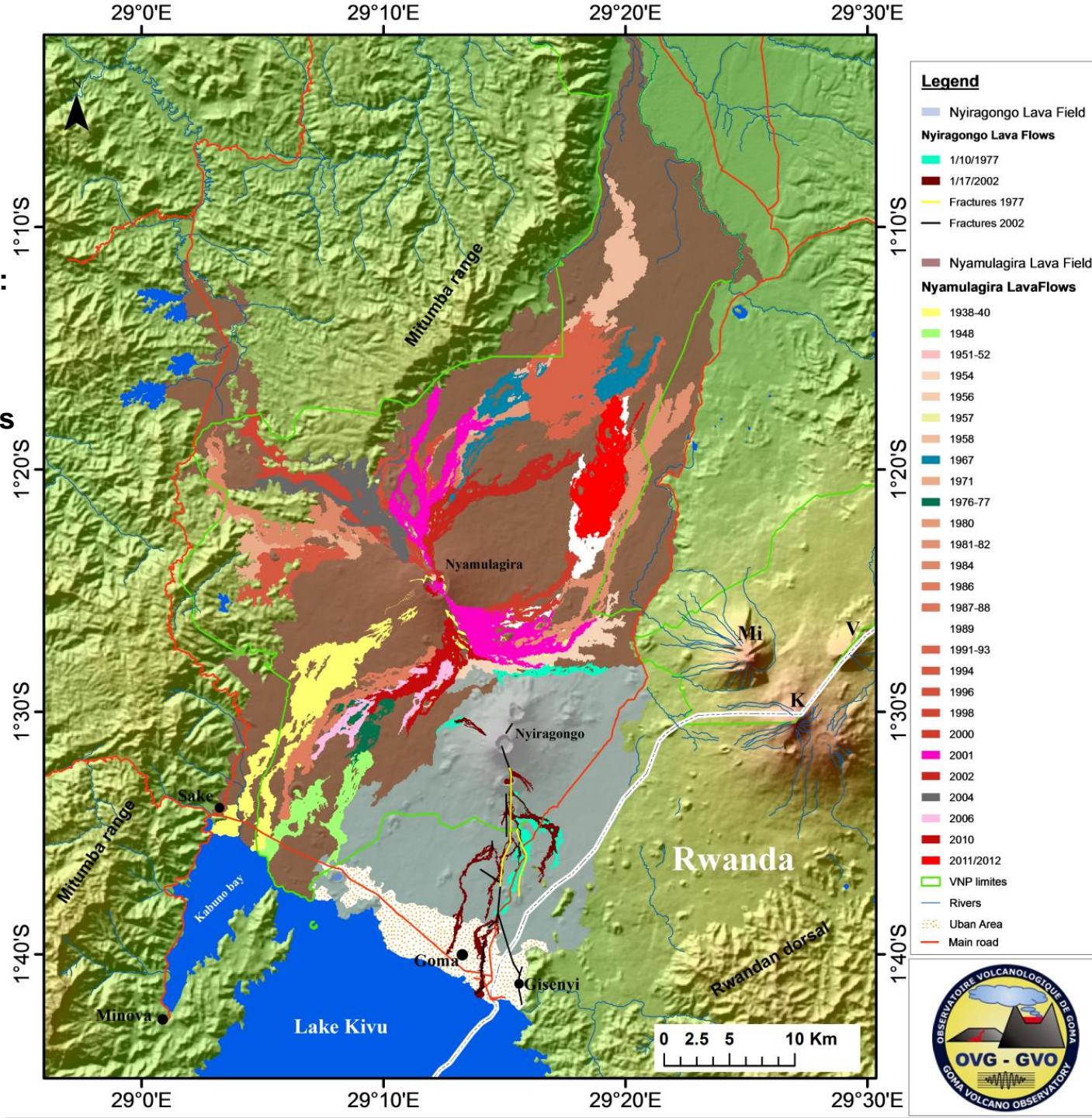


# Volcanological map

Know eruptions since 1882:

- Nyiragongo : 2 eruptions

- Nyamulagira: 44 eruptions





# Major Geohazards in the Virunga

Nyiragongo 2002 eruption





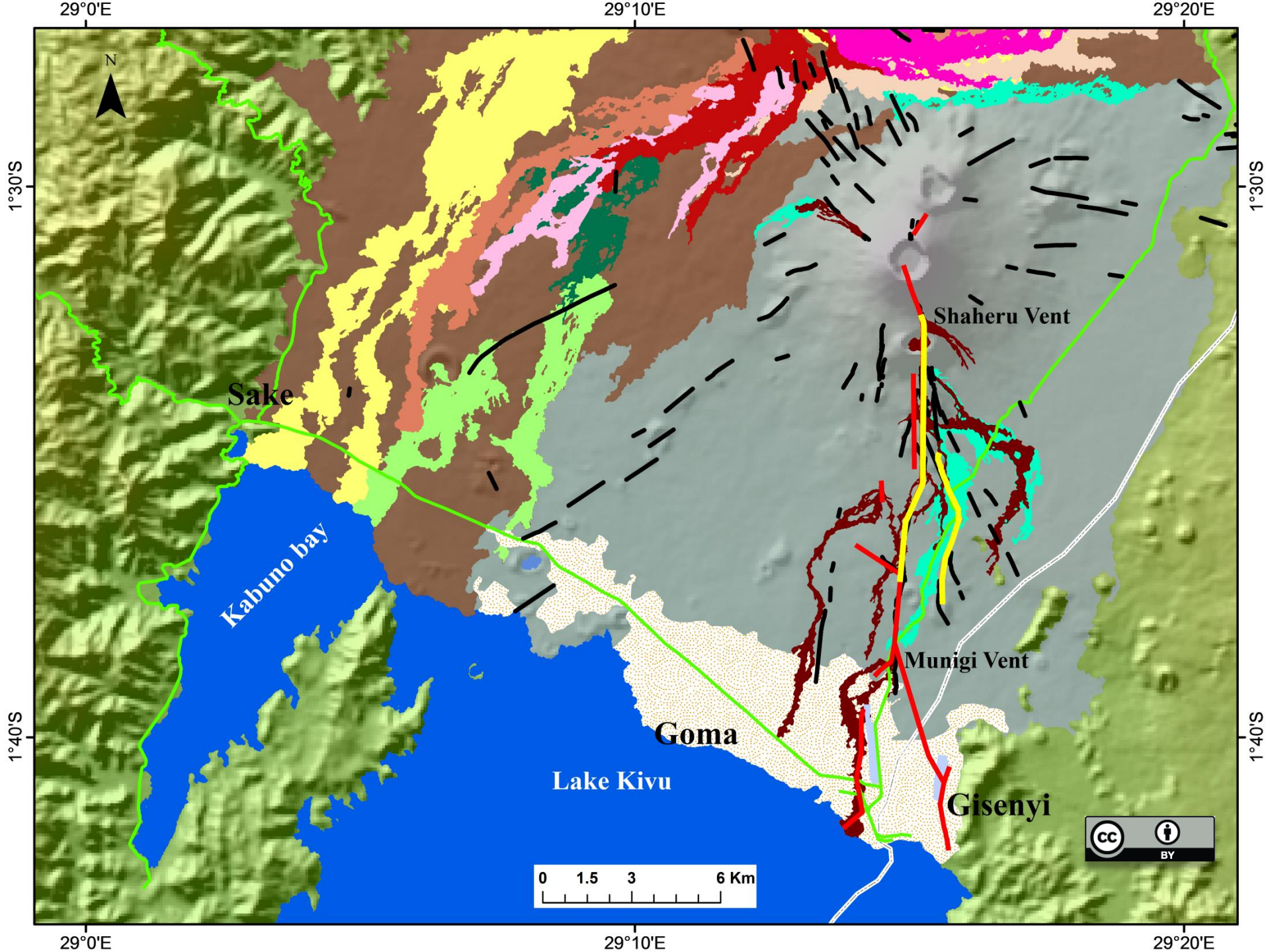
~ 1,1 million people live in Goma city, 2013





# 1. Lava flows











## Goma, 2002 eruption





**Goma city**  
**Invaded by the Nyiragongo 2002 eruption lava flows**





Goma, 2002 eruption







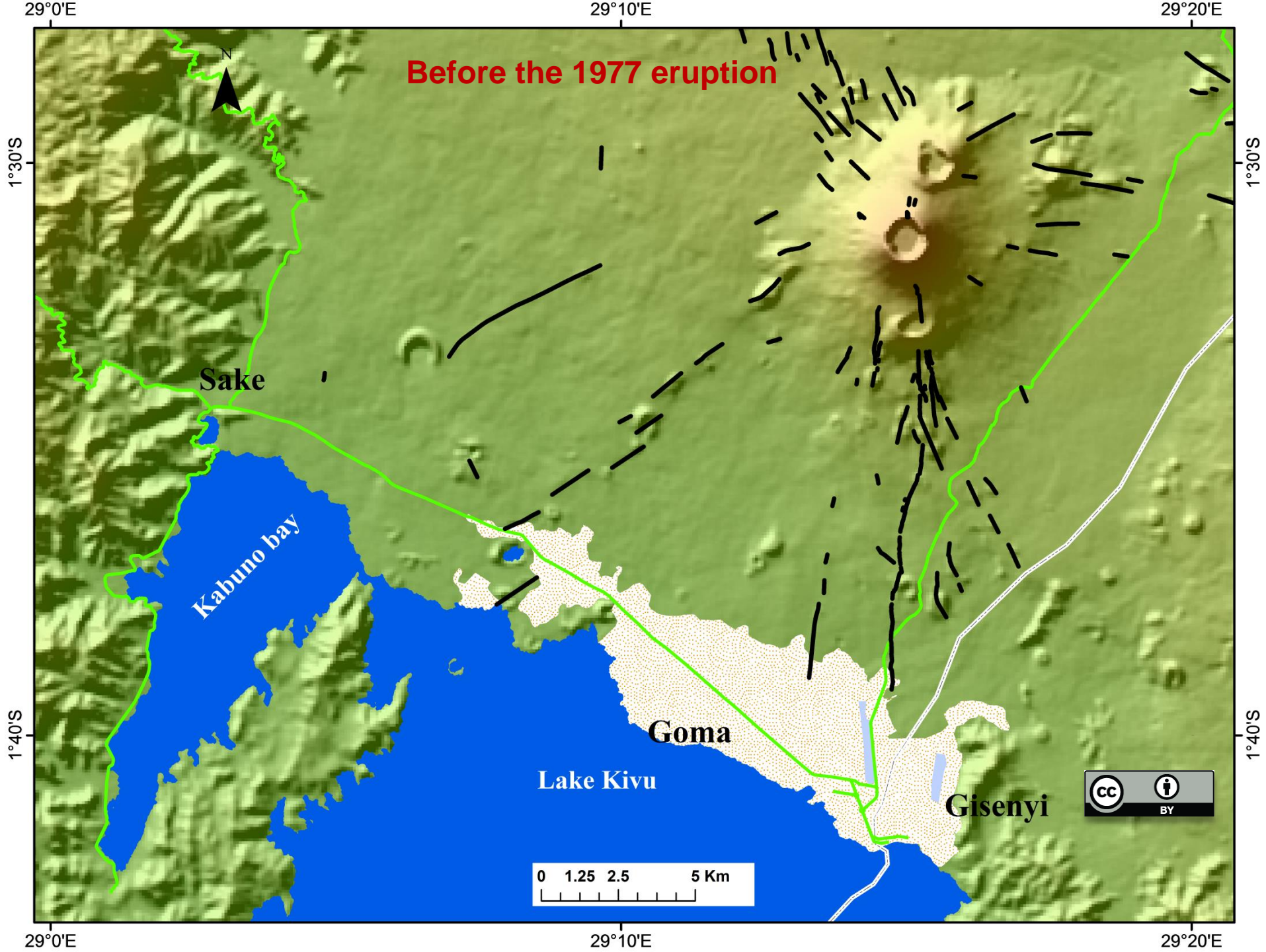




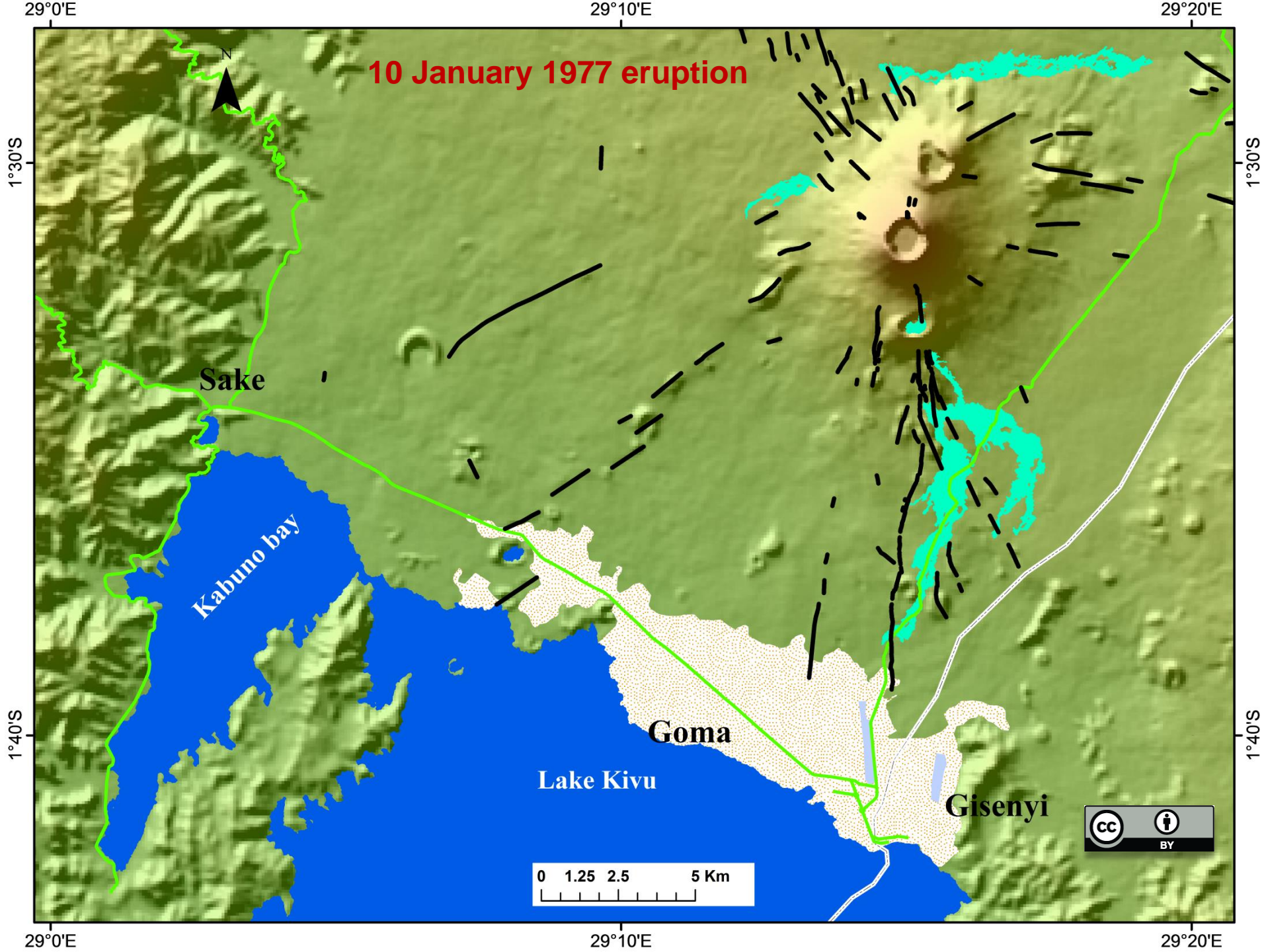




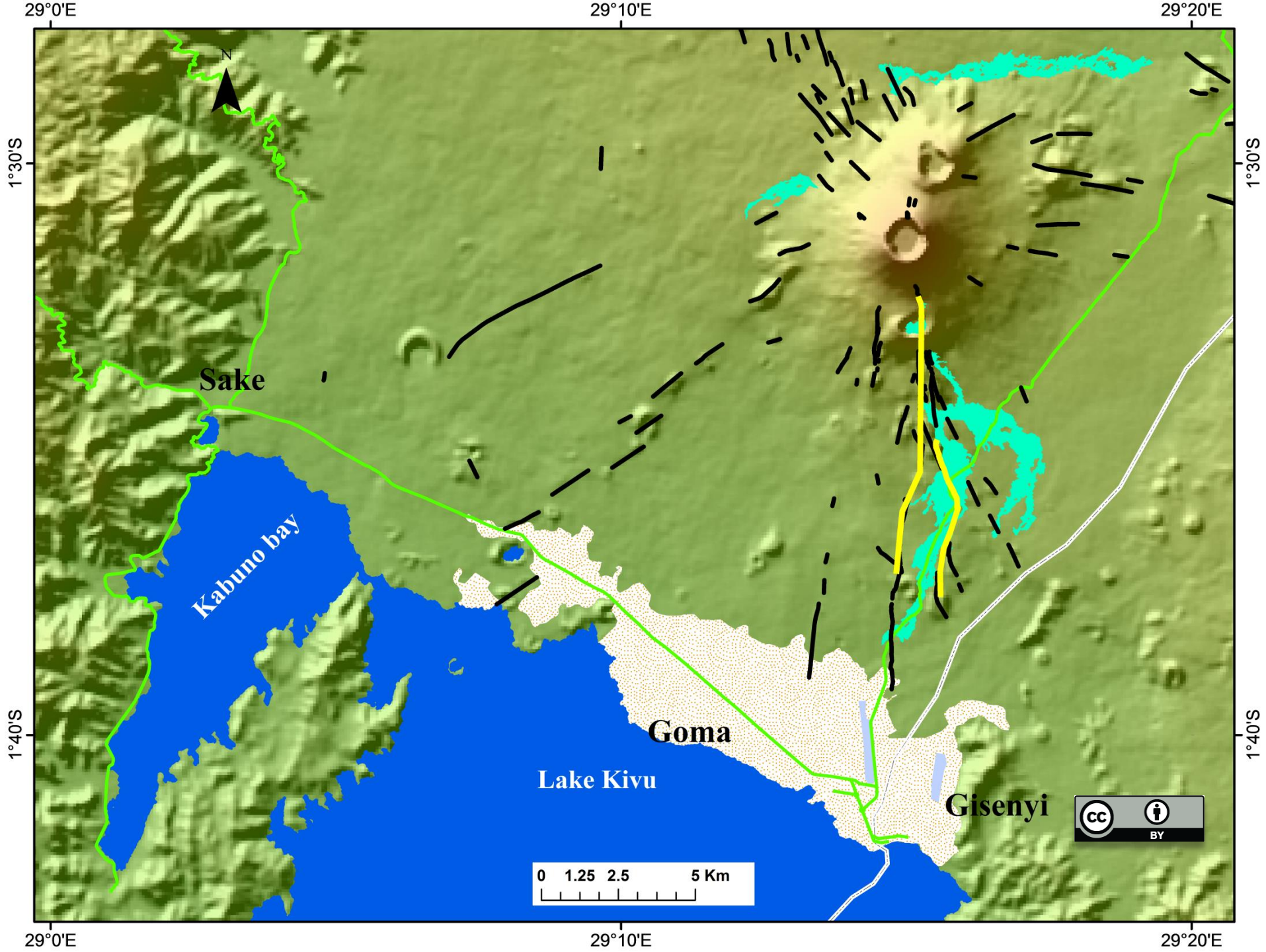




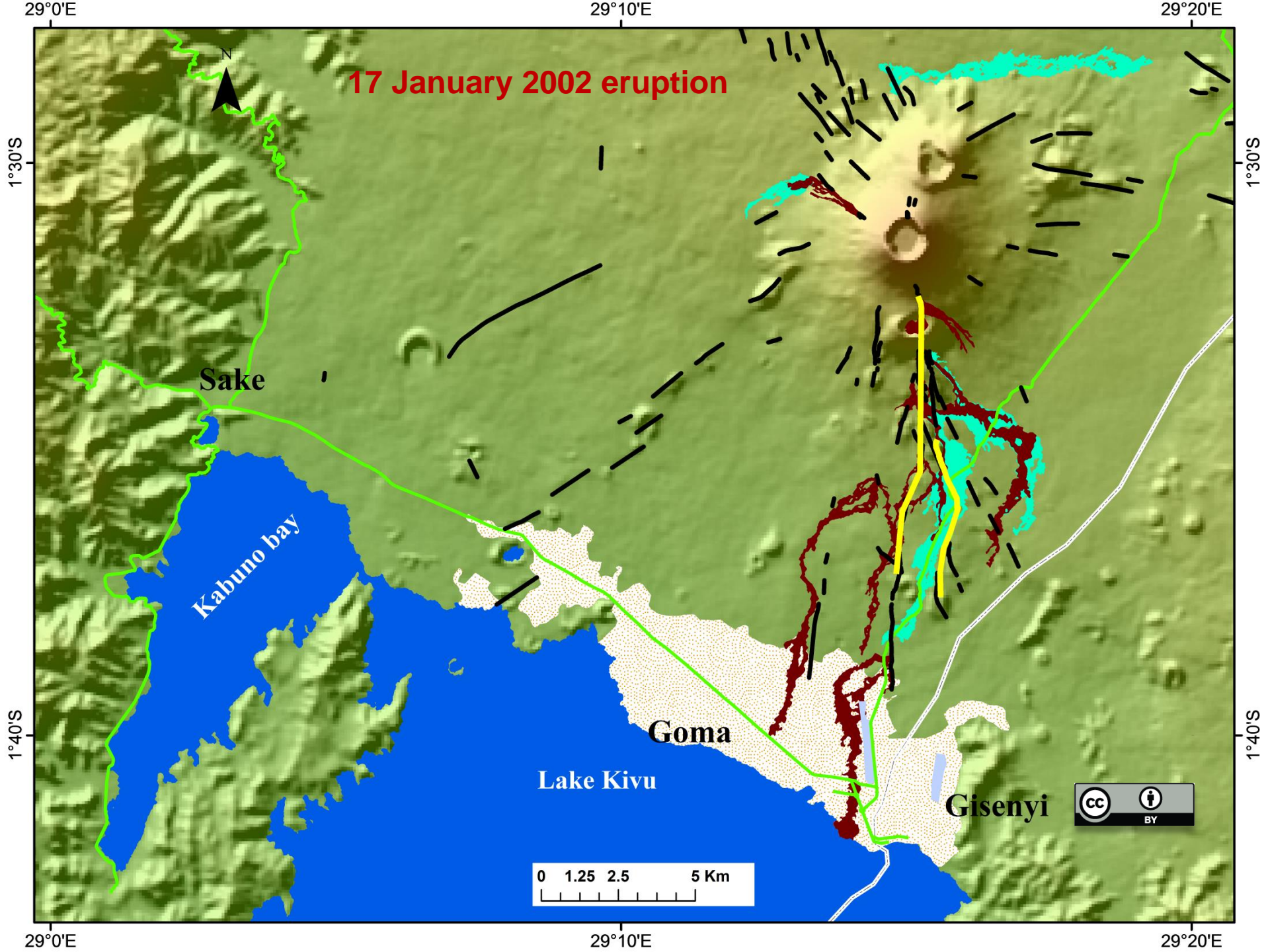




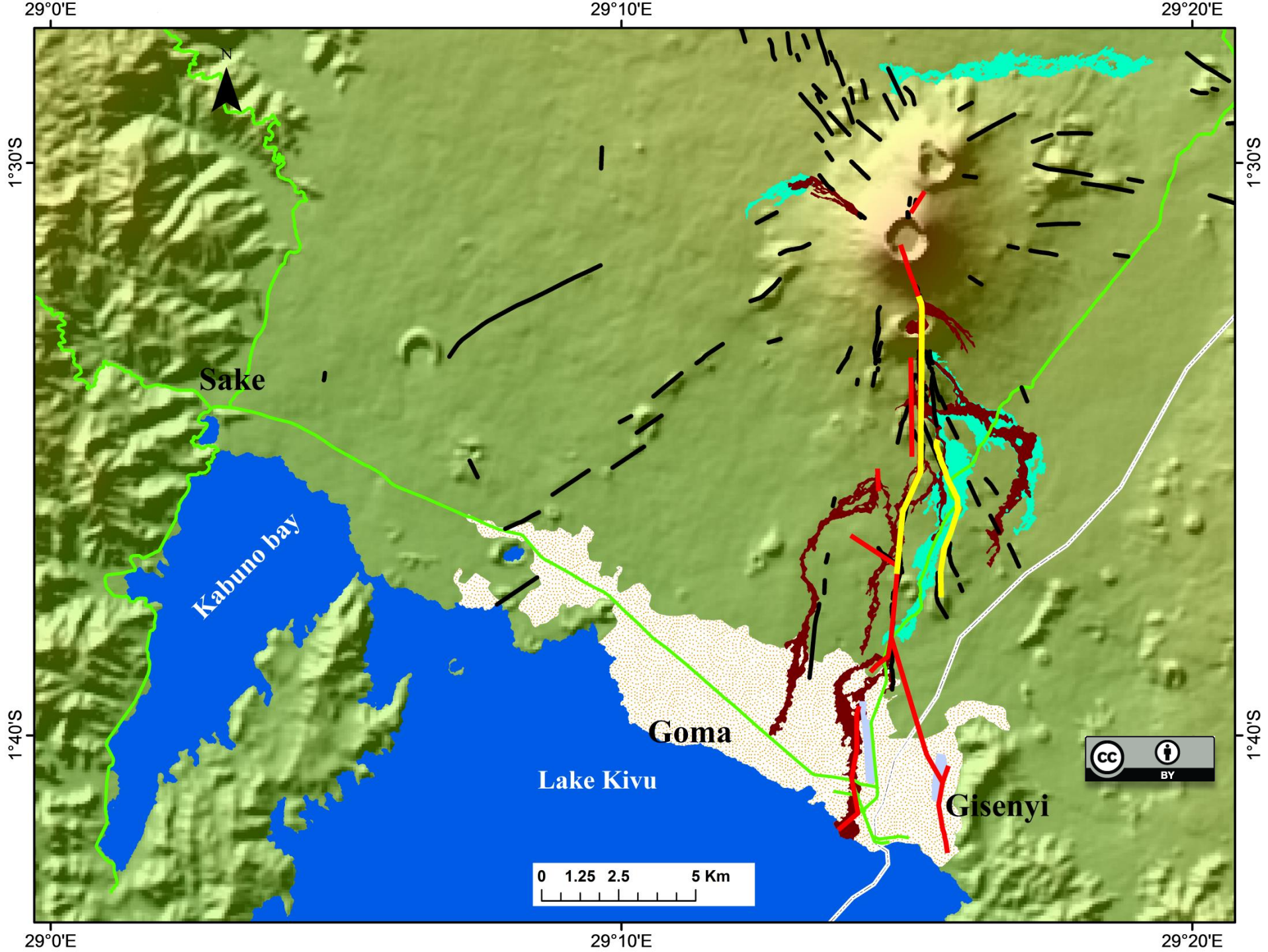










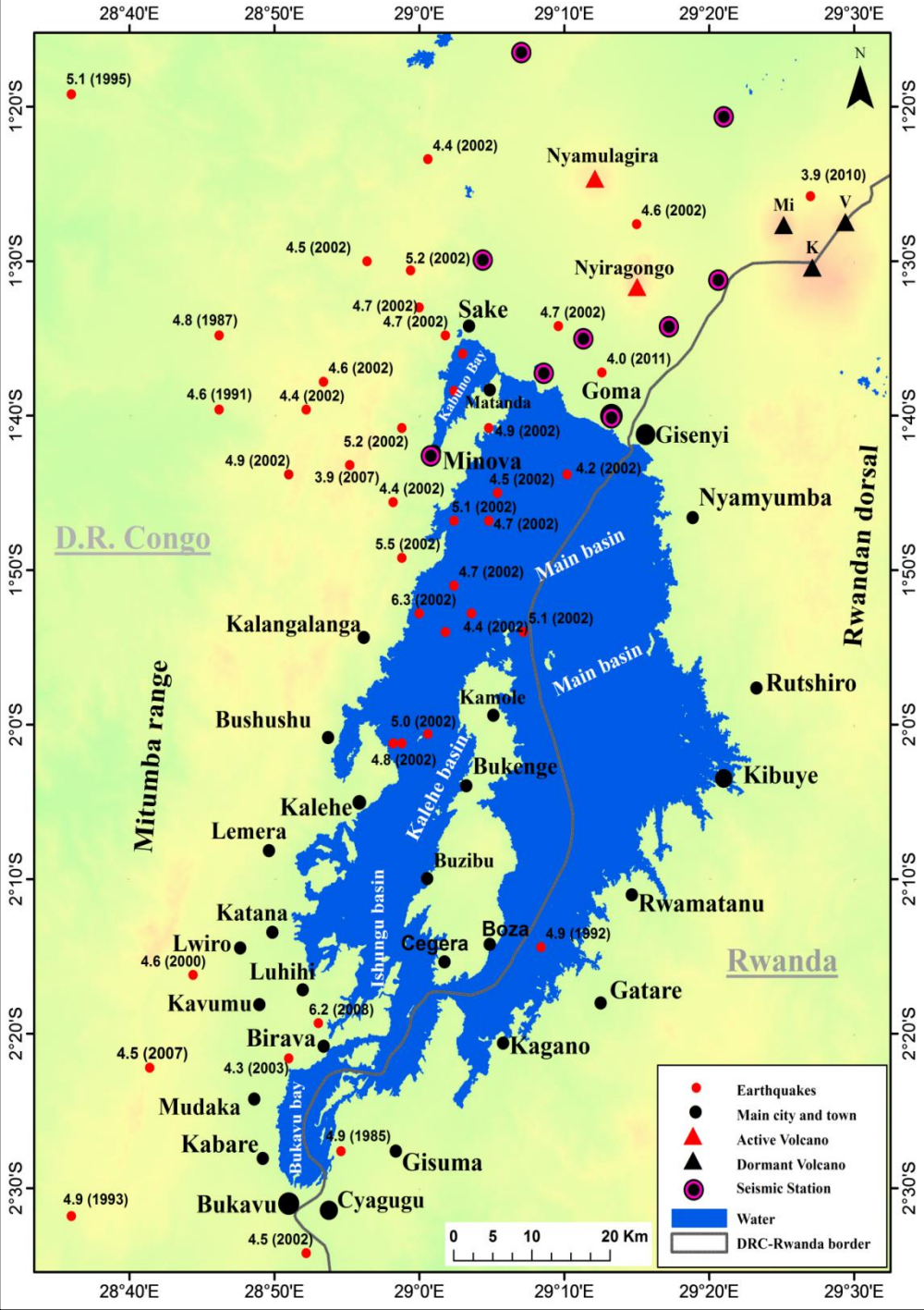




## **2. Earthquakes, landslides and mudflows**



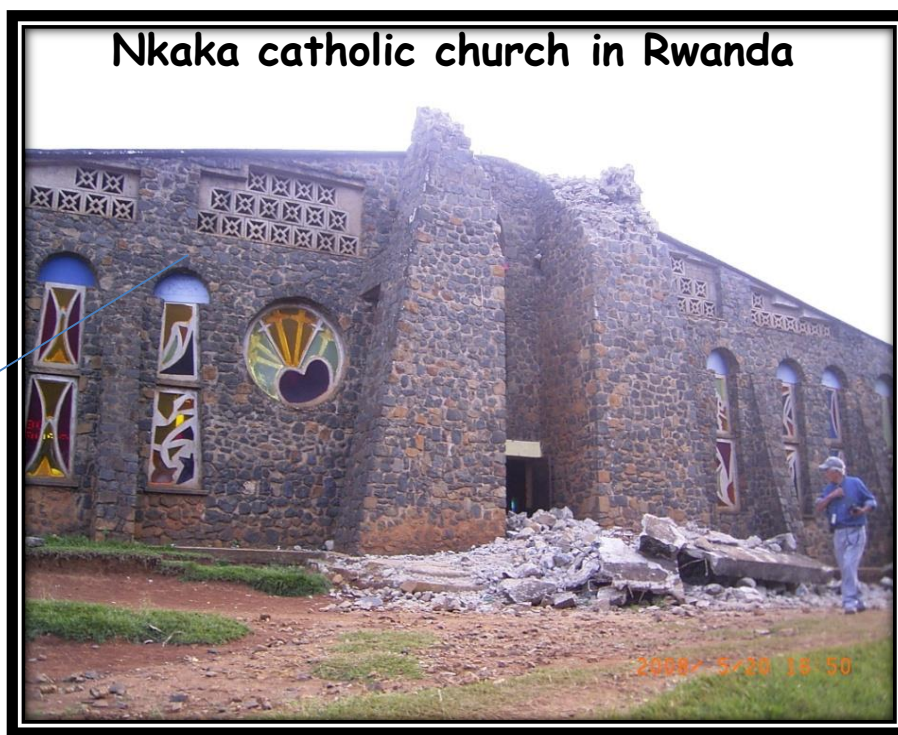
# Major Earthquakes in the Lake Kivu Basin



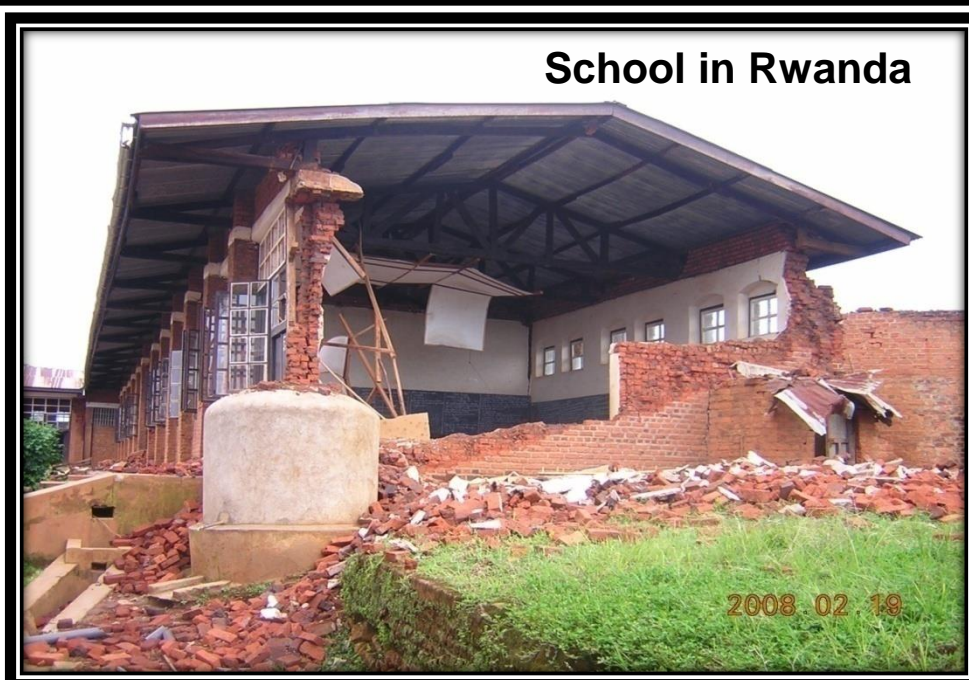




Building in Bukavu



Nkaka catholic church in Rwanda



School in Rwanda







in Bukavu

Increasing in the flow thermal water after  
the earthquake in Bukavu





## Karisimbi May 16, 2010 bud flow, destroyed 2 villages in the Kibumba district

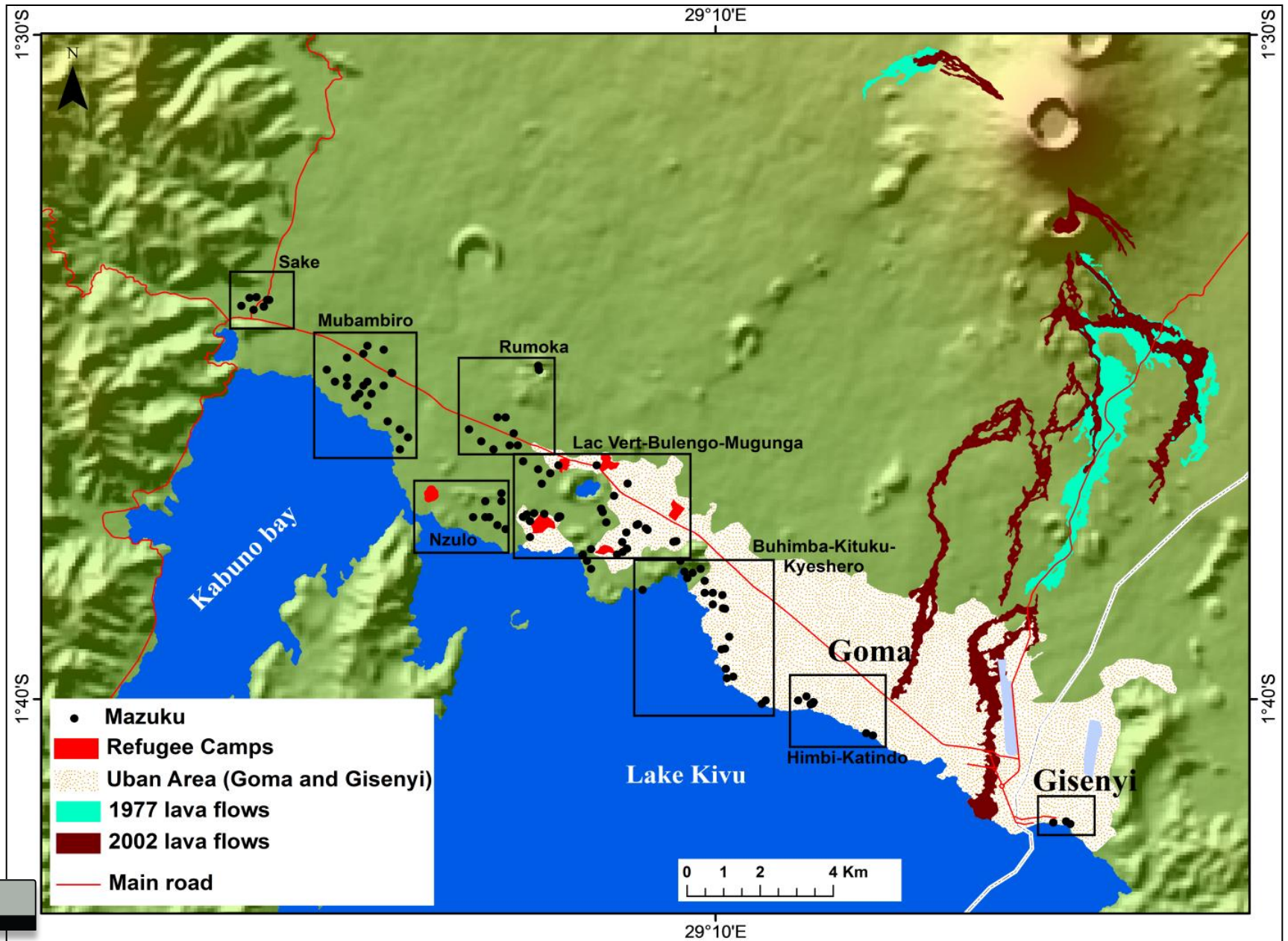




### **3. Mofettes dry gas vents (Mazuku)**

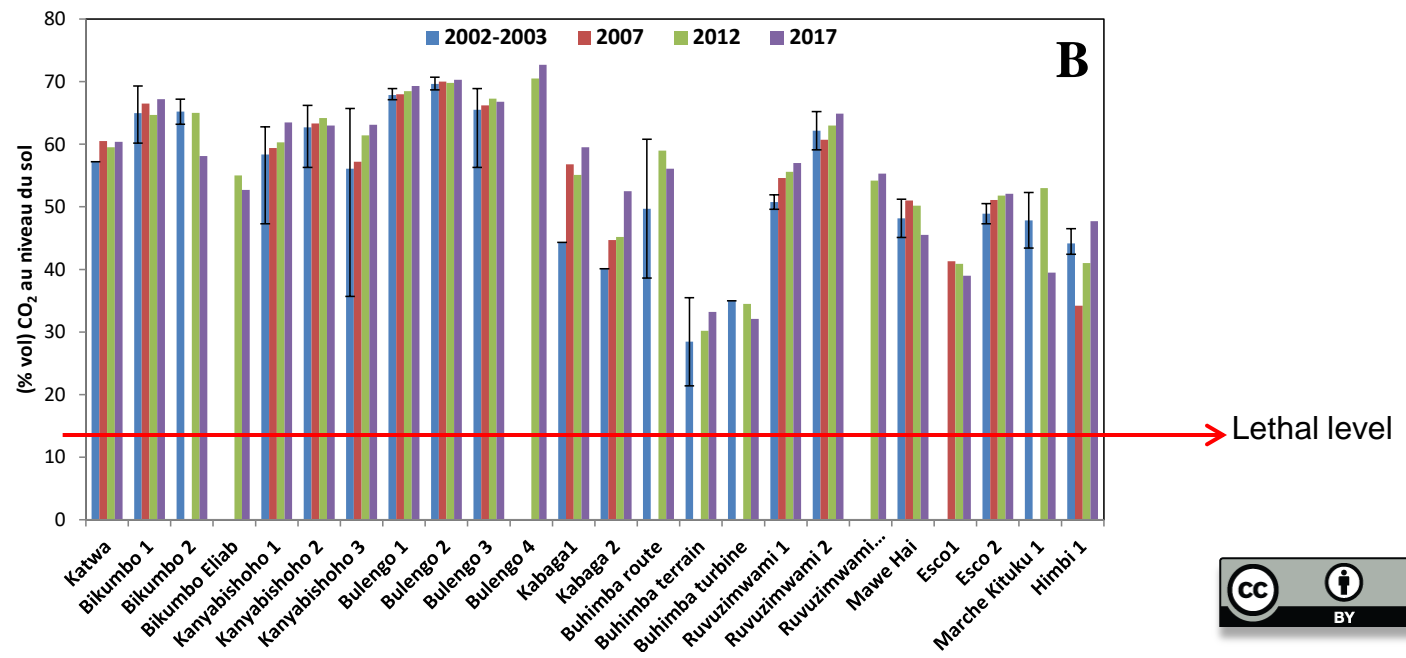
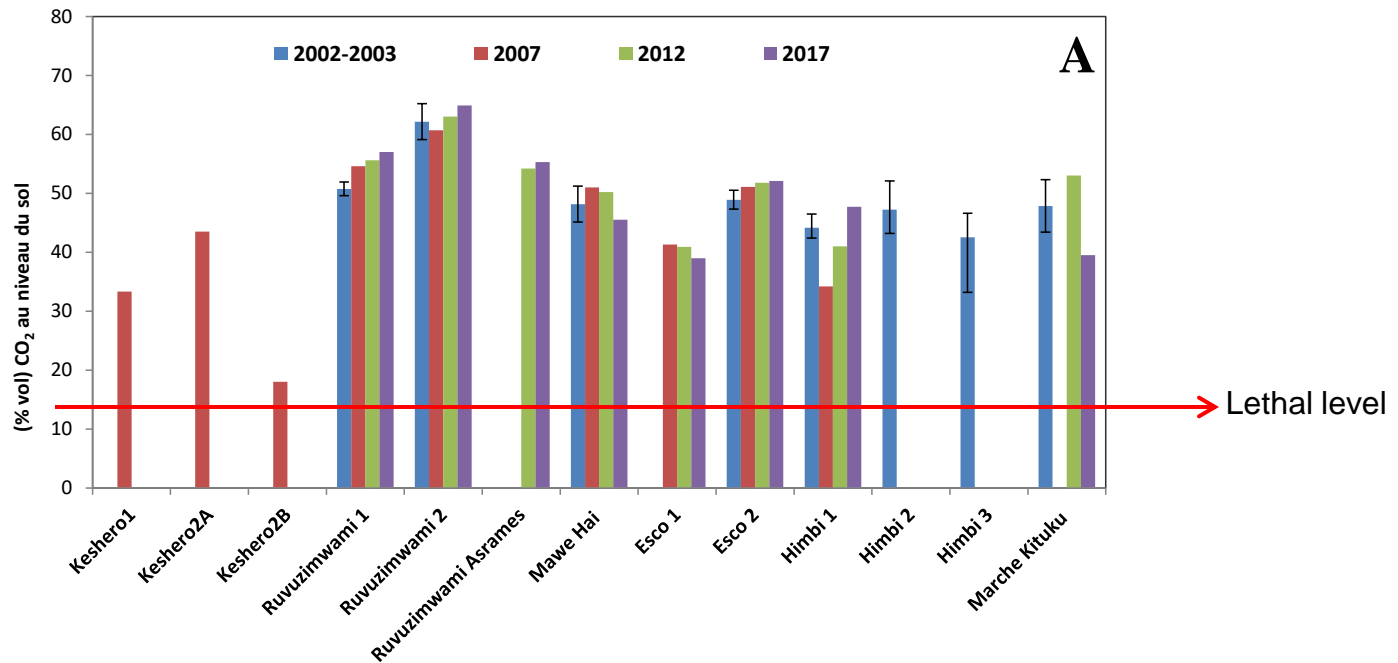


# Map of Mazuku dispersion in Goma city and surroundings





# CO<sub>2</sub> concentration in the Mazuku of dispersion in Goma city and surroundings





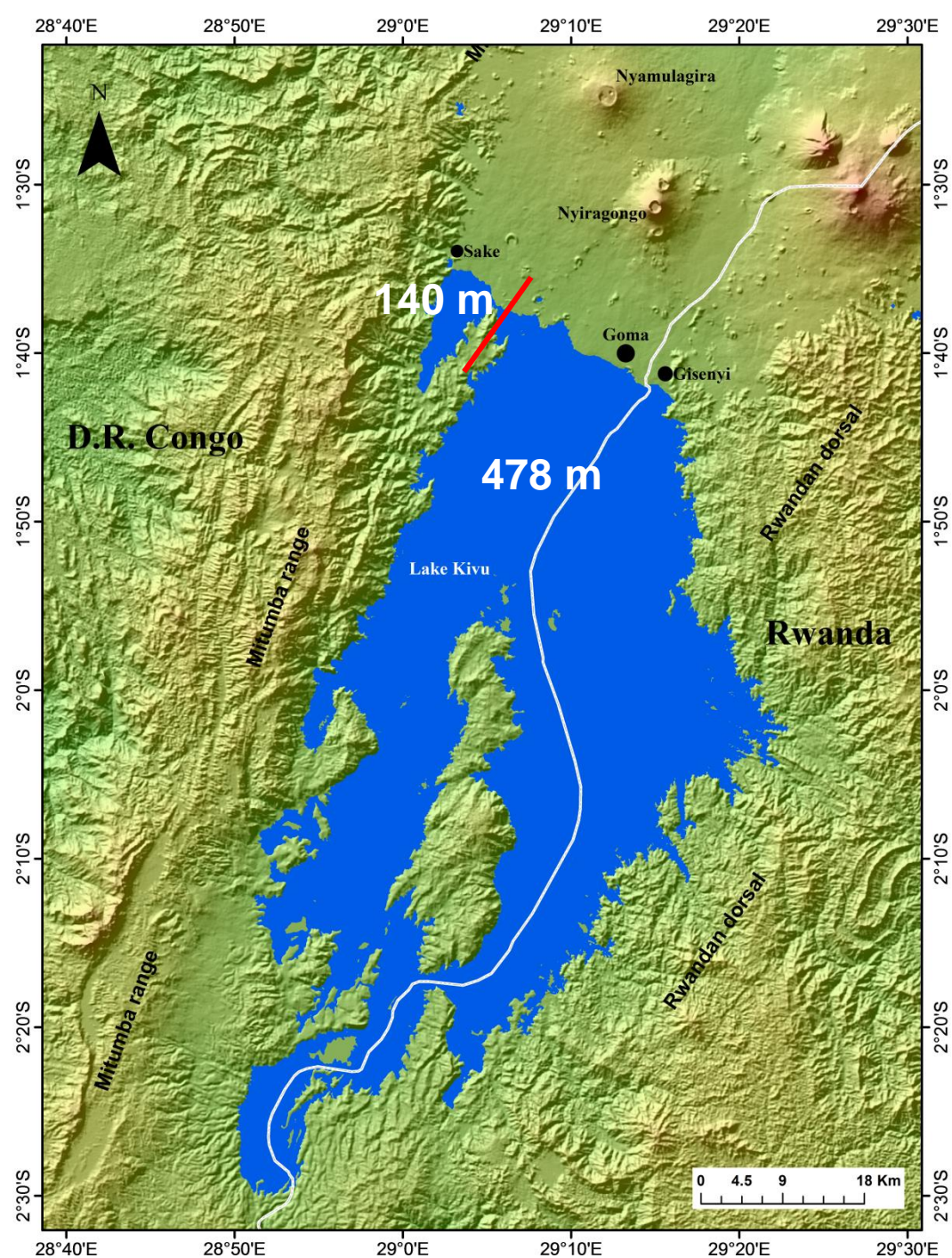
## A refugee camp near a Mazuku





# 4. Gases dissolved in Lake Kivu





# Lake Kivu

Meromictic Lake

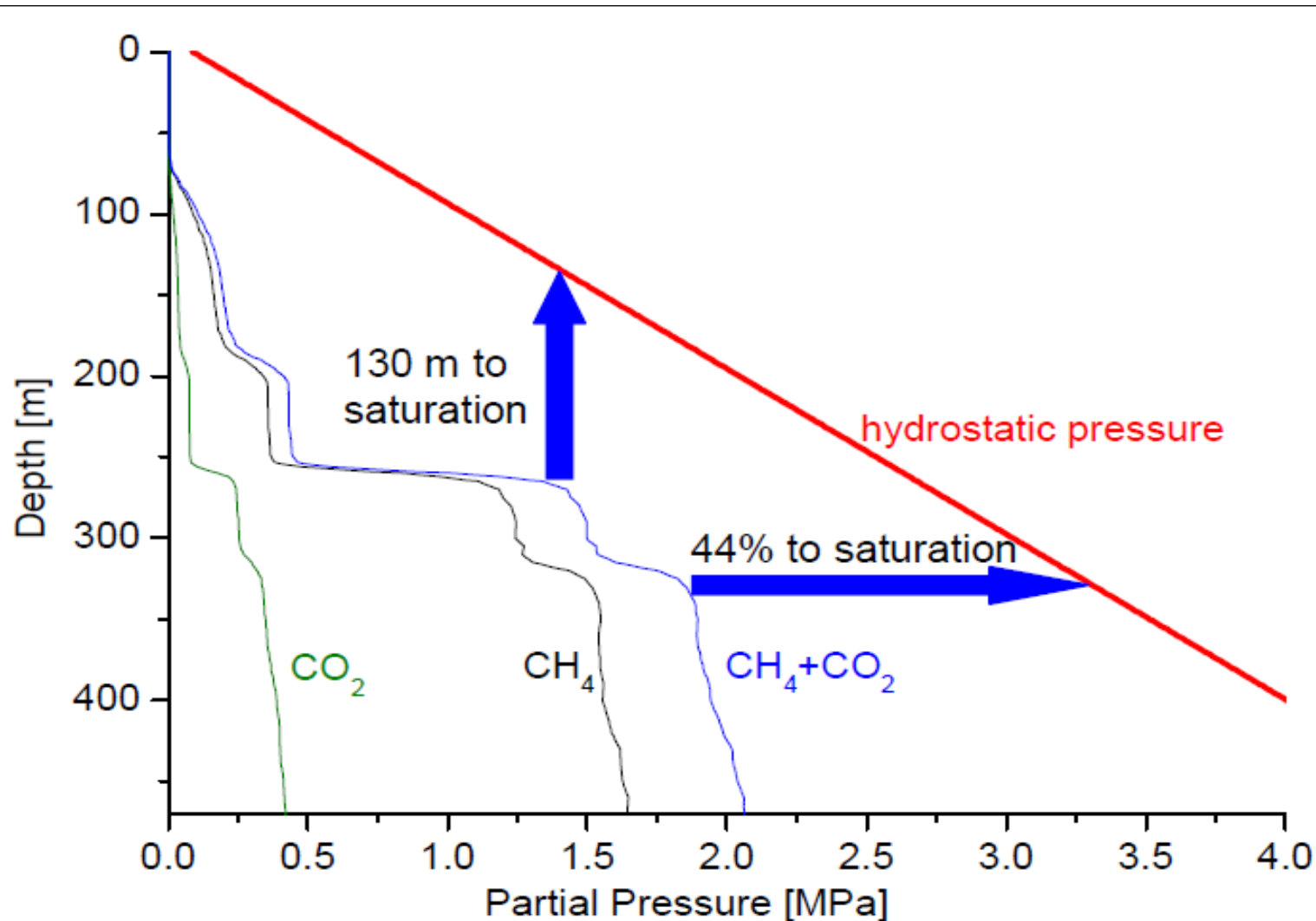
Area of the Lake : 2,370 Km<sup>2</sup>

Volume of CO<sub>2</sub> : 300 Km<sup>3</sup>

Volume of CH<sub>4</sub> : 60 Km<sup>3</sup>

Main basin, High CO<sub>2</sub> and CH<sub>4</sub>  
Kabuno bay, High CO<sub>2</sub> ~11m

## CO<sub>2</sub> and CH<sub>4</sub> partial pressure and gas total pressure

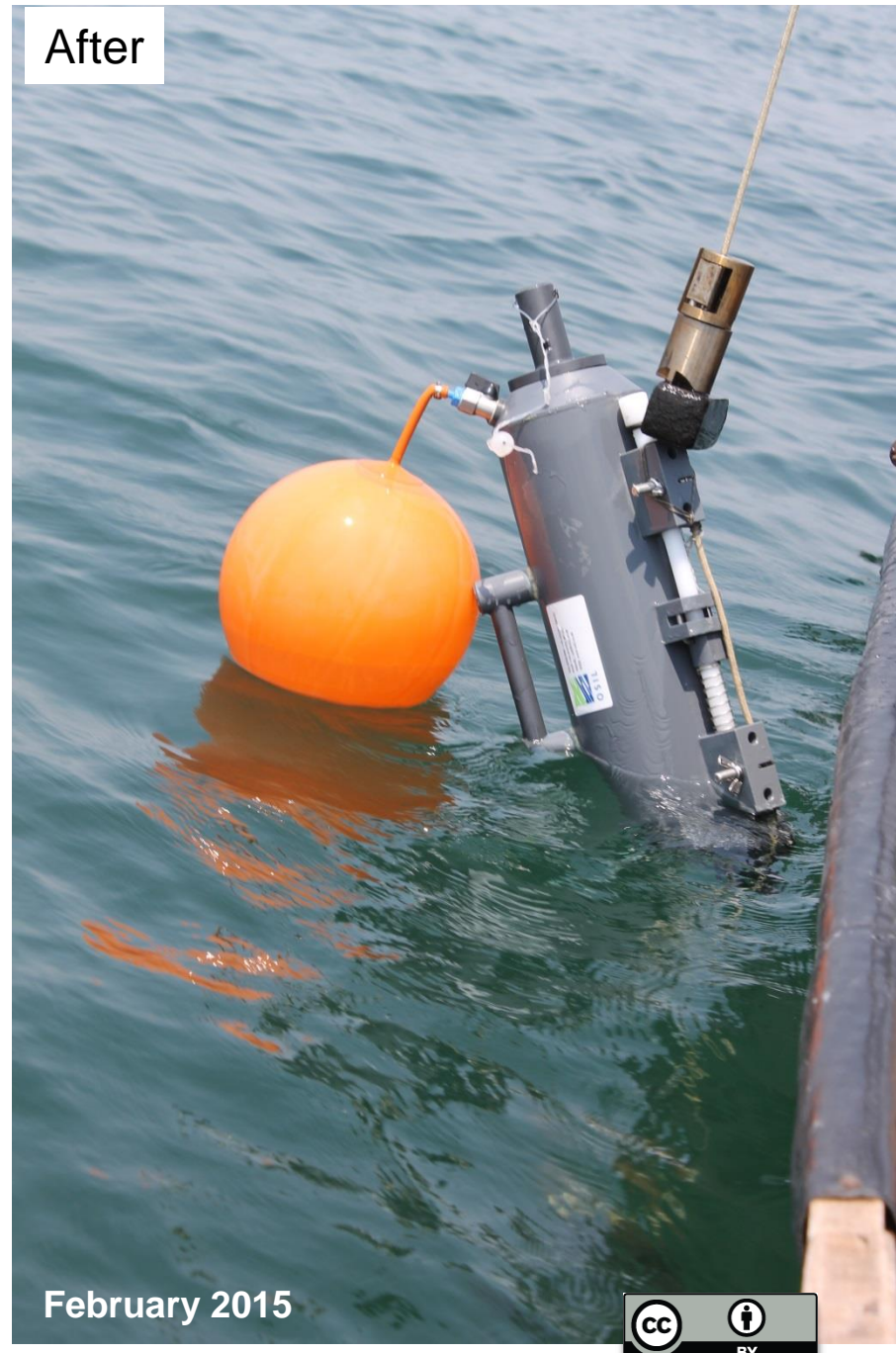




Before



After



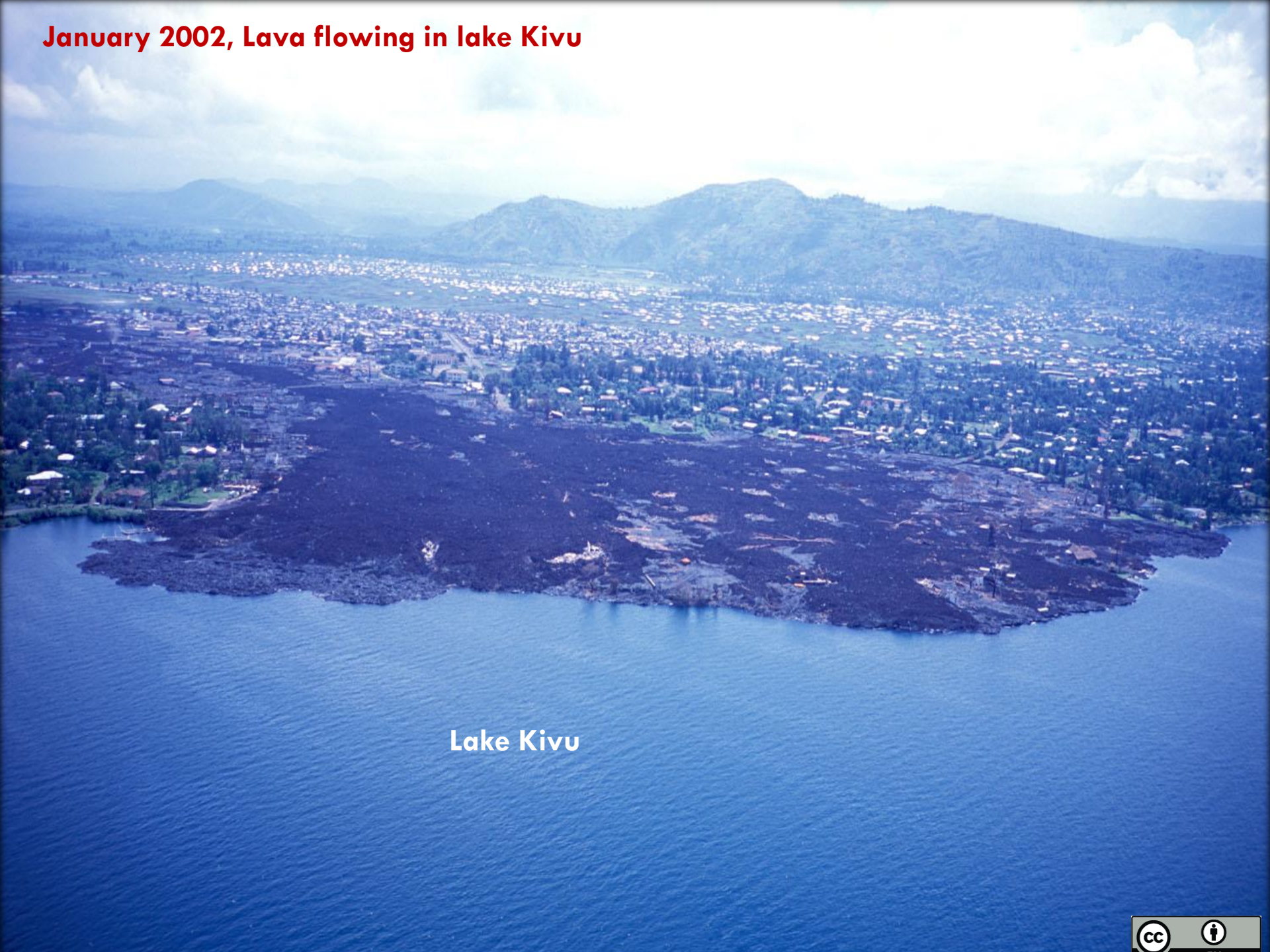
February 2015





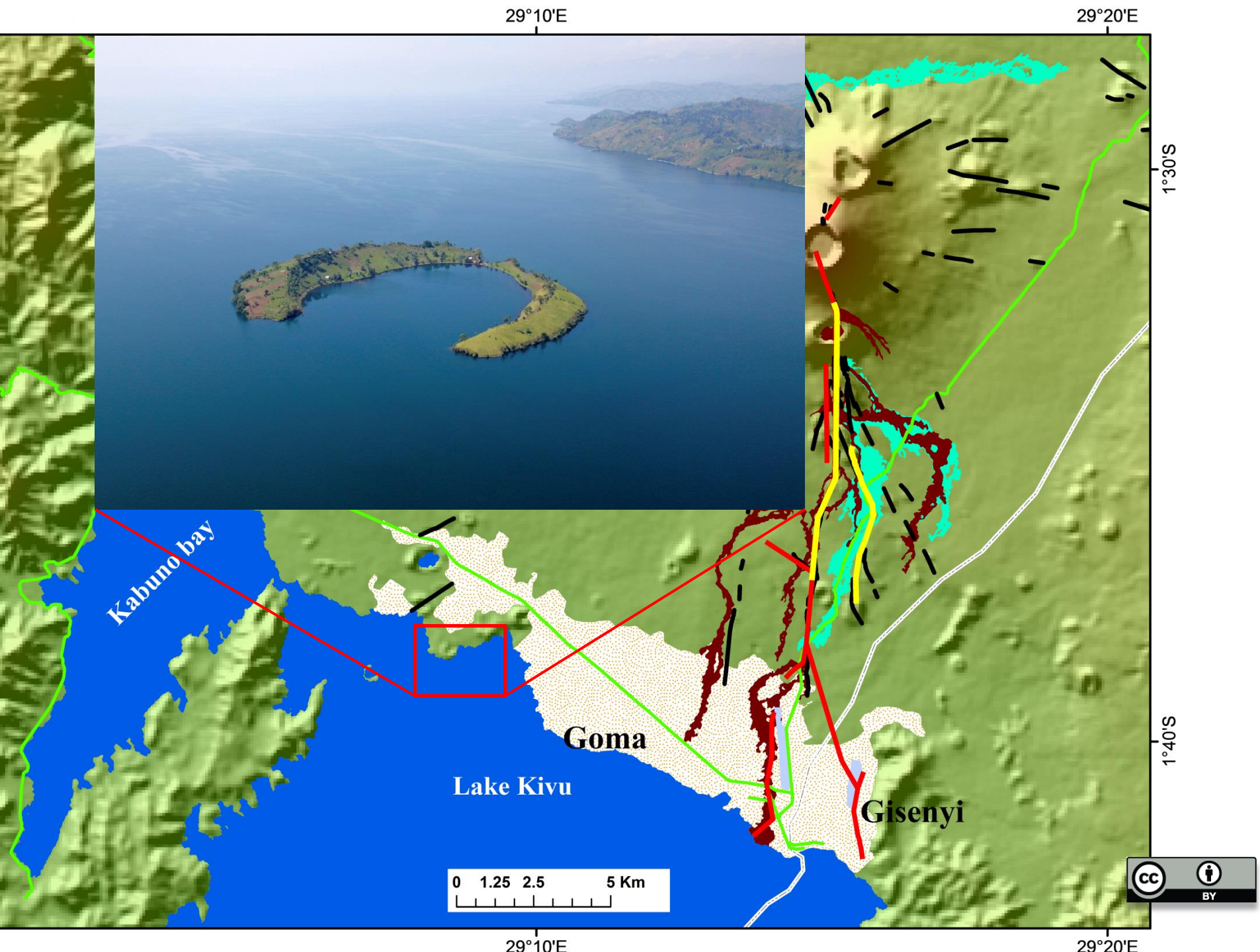


**January 2002, Lava flowing in lake Kivu**



**Lake Kivu**







## Methane extraction



Photo: Charles Balagizi  
Goma Volcano Observatory

Degassing.....

PM 1:56 25/OCT/2010



## ➡ Need for Scientific Lake Kivu monitoring



- 5. - Gas plume and ash emissions**
  - Water contaminated by Volcanic Products**



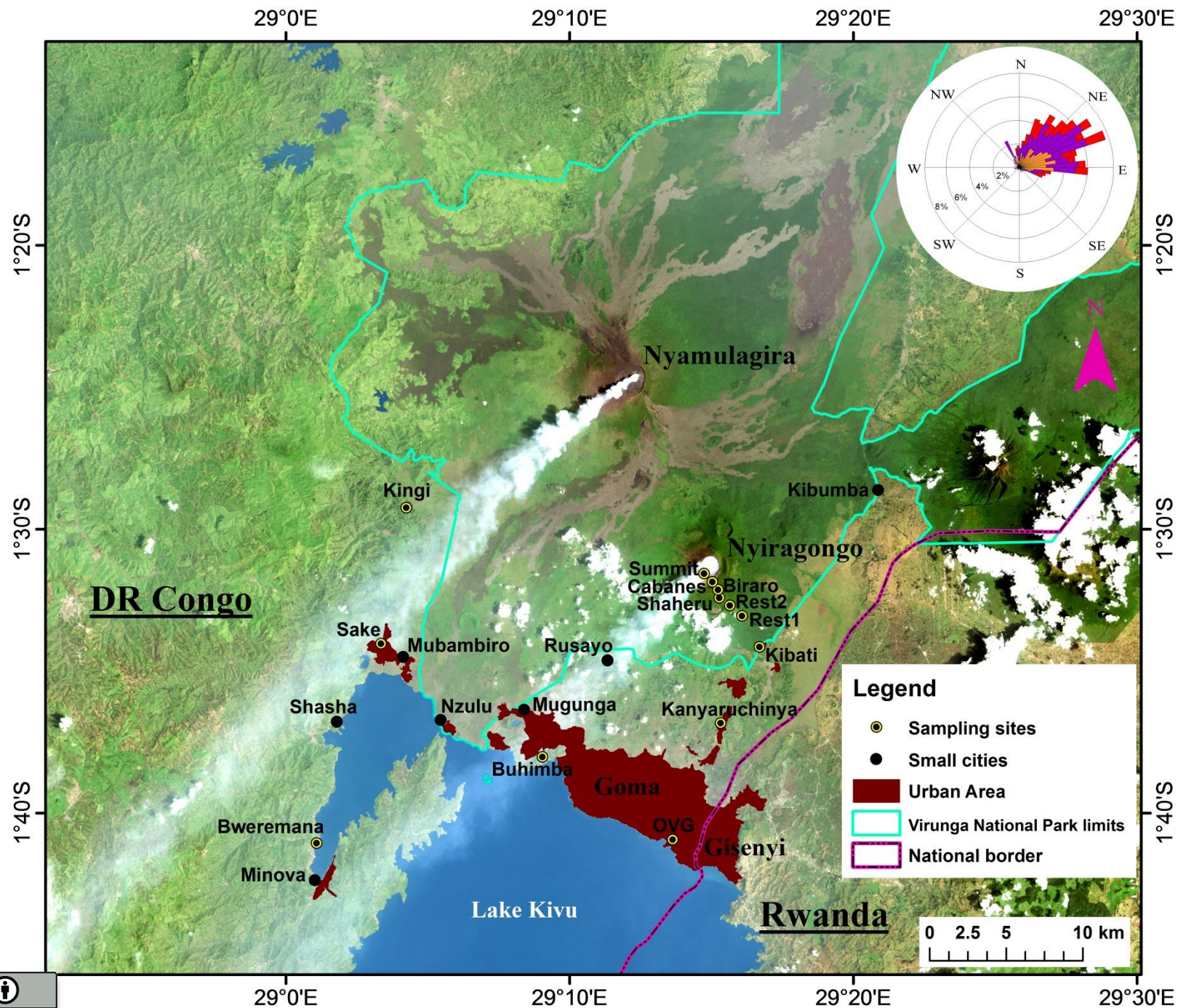


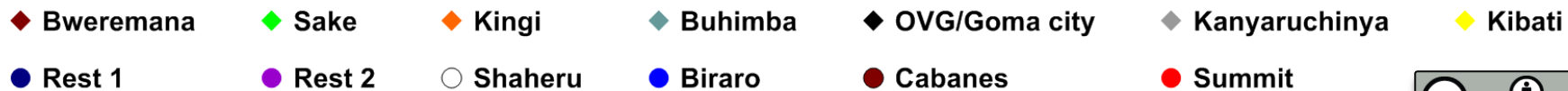
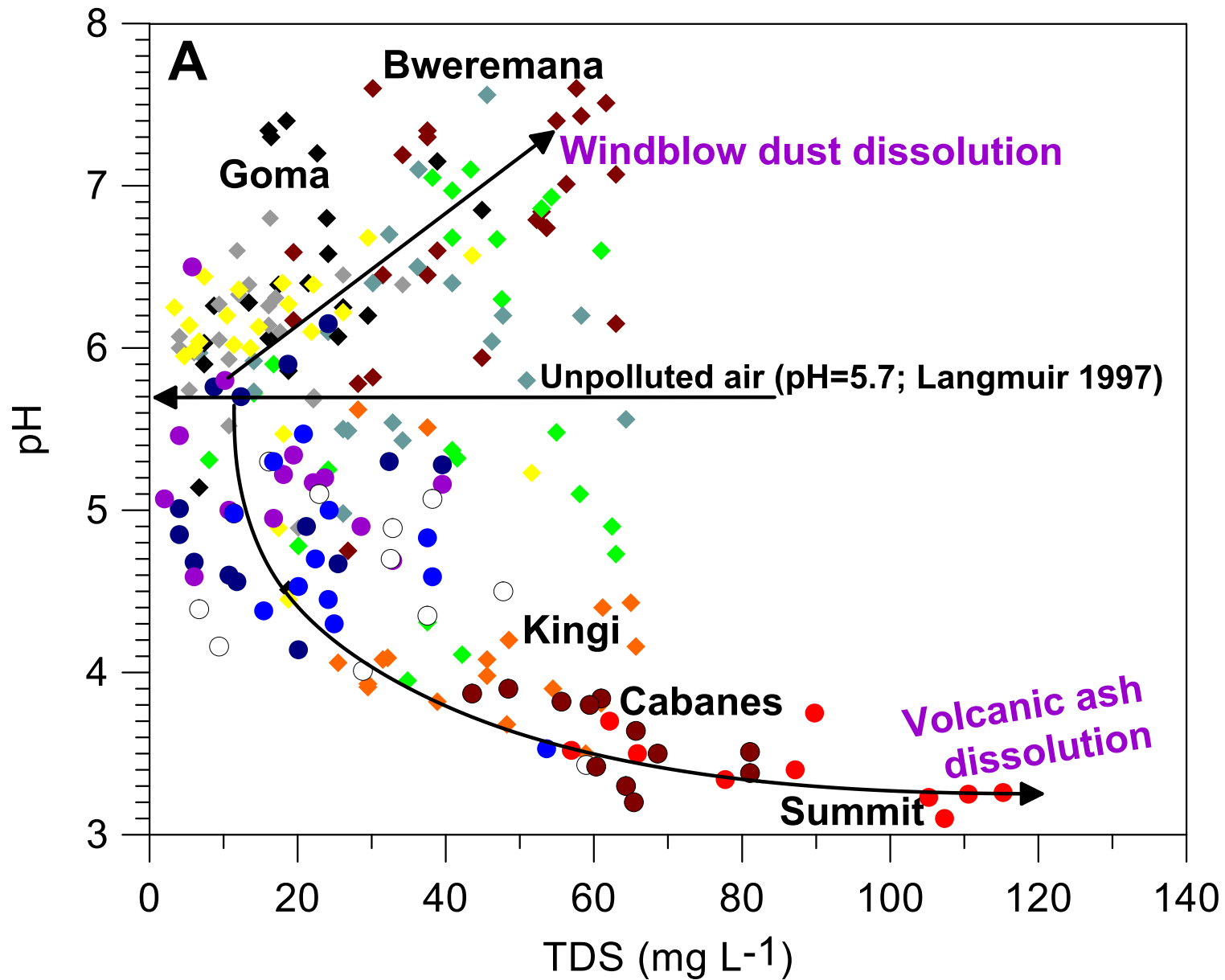
Nyirangongo

Nyamulagira







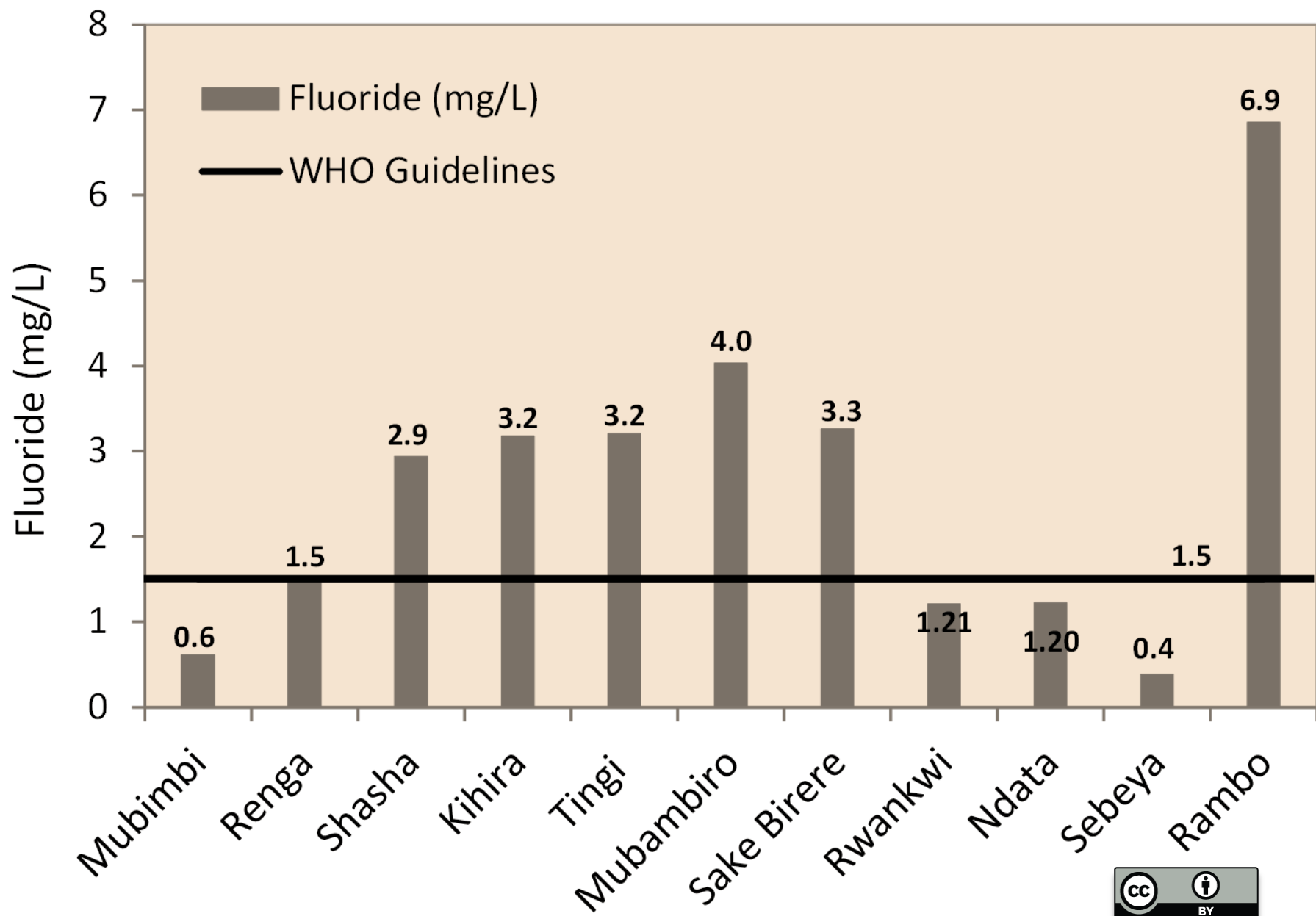








# Fluoride in Rivers in Virunga Volcanic Province





F in surface and rainwater exceeds the WHO recommendations for drinking water





# Goma Volcano Observatory mission

## To conduct Research to understand:

- the functioning and evolution of the EARS, particularly the Western branch,
- the plumbing and eruptive mechanism of Virunga Volcanoes

**Monitoring:** to conduct a real time monitoring of Virunga volcanoes, particularly Nyiragongo and Nyamulagira

## Risk prevention and management:

- the inventory and study of Geohazards in the Virunga region and Lake Kivu basin;
- prevention and management of risks in the Virunga



## Available field data

Type of data	Data source / Type of sensor	Number of station	Type of monitoring
Seismic waveforms	Broadband Sensor	14	Continuous
SO <sub>2</sub> data	FIX DOAS, Scanning remote sensing UV absorption spectroscopy (280 - 420 nm, Novac Network)	4	Continuous
GPS	Leica GNSS high performance system	7	Continuous
Soil temperature	Tinytag Plus data logger (HYDREKA SAS, -50 to +600 °C range)	10	Continuous
Soil Radon emission	Rad7	5	Continuous Field campaign
Soil CO <sub>2</sub> emission	GA2000 portable landfill gas analyser (Geotechnical Instruments)	10	Continuous, Field campaign



## Available field data

Type of data	Data source / Type of sensor	Number of station	Type of monitoring
<b>Virunga rivers water geochemistry</b>	Monthly field campaigns: <ul style="list-style-type: none"> <li>- Physicochemical parameters</li> <li>- major and trace elements</li> <li>- stable and radiogenic isotopes (e.g. O, H, C, Sr)</li> <li>- Gases concentrations (e.g. CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O)</li> </ul>	14 rivers  7 cold springs 7 hot springs	Field campaign
<b>Virunga rainwater geochemistry</b>	Monthly field campaigns: <ul style="list-style-type: none"> <li>- Physicochemical parameters</li> <li>- major and trace elements</li> <li>- stable and radiogenic isotopes (e.g. O, H, Sr)</li> </ul>	14	Field campaign
<b>Lake Kivu physicochemical</b>	Field campaigns, profiles of: <ul style="list-style-type: none"> <li>- Physicochemical parameters</li> <li>- major and trace elements</li> <li>- stable and radiogenic isotopes (e.g. O, H, Sr)</li> <li>- secondary mineral saturation</li> </ul>	Main basin Kabuno Bay	Field campaign





# Important key points for priority resource support

The Goma Volcano Observatory expects the following from Geohazards Supersites

- support to establish a collaboration between local and international scientists
- support to access space data
- support to access equipment for field data acquisition
- Support for local scientists capacity building, which will help to better collect field data and their interpretation
- Support to attract funds from local and international agencies to achieve the above objectives.



**European Geosciences Union  
General Assembly 2017**

Vienna | Austria | 23–28 April 2017

**Thank you for your attention**

