

# Geothermal potential in Eastern D.R. Congo

*By*

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# Introduction

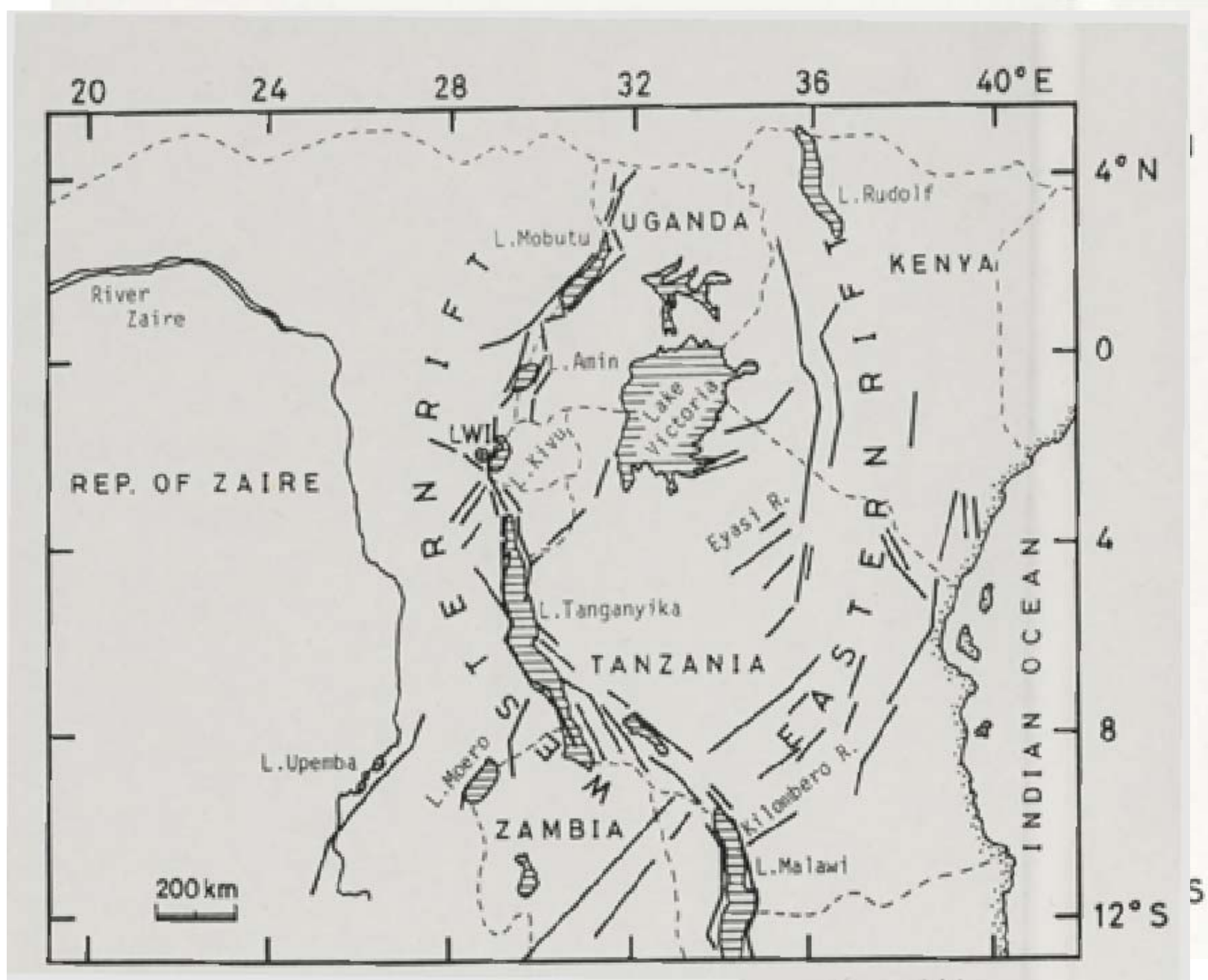
- D.R. Congo is known to be endowed with natural resources:
  - *Minerals*
  - *Fresh water*
  - *Timber*
- Electricity is therefore mainly obtained from Hydropower plants with enormous untapped resources.
- Current production: 1740 MW
- Only 10% of population benefit from electricity

## Introduction (cont.)

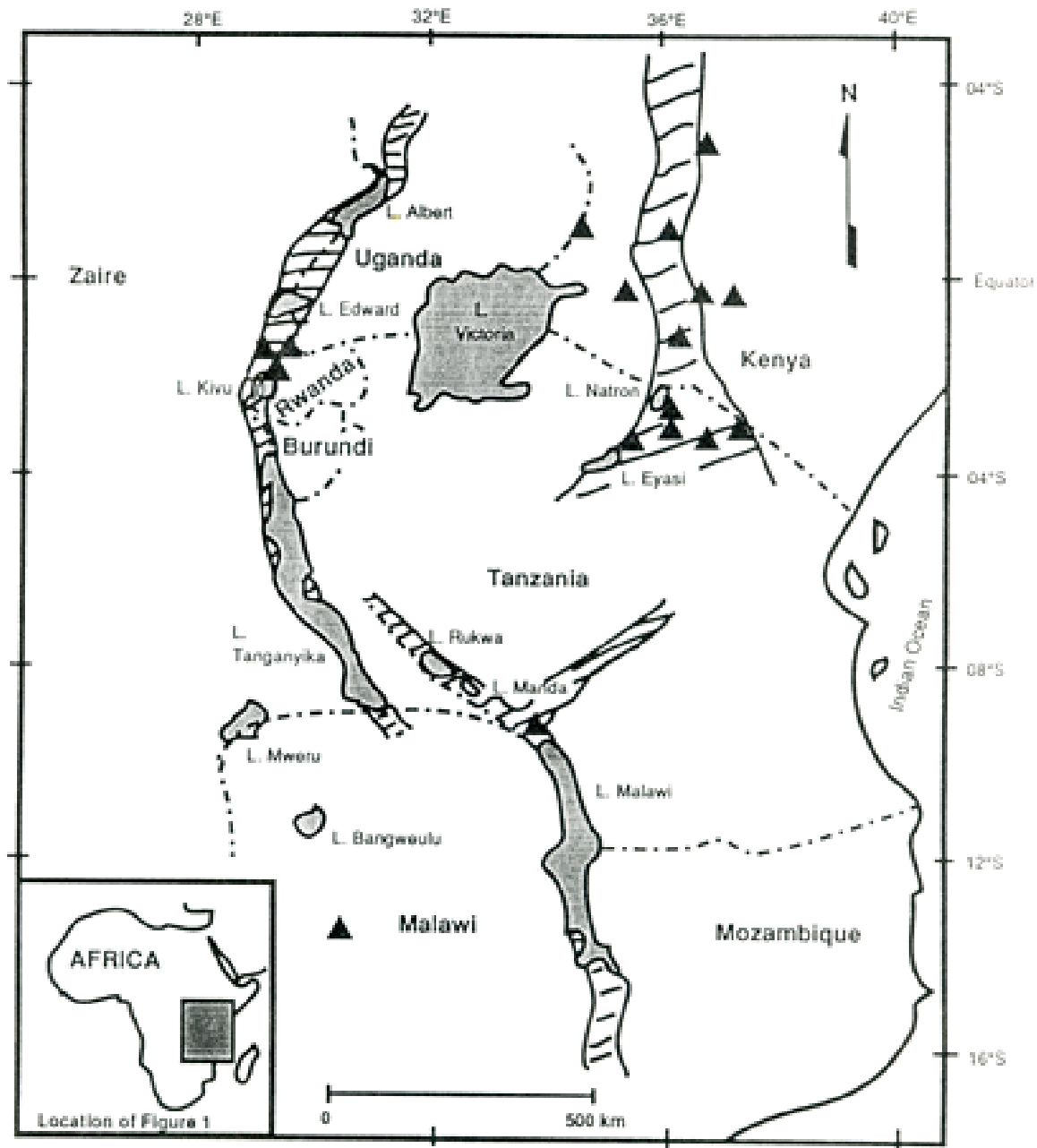
- Due to the country's large size, it is not evident that remote areas like the Kivu provinces will soon benefit from the main hydropower.
- There is need to develop alternative sources of power generation, esp. for remote country side.
- Geothermal energy can be a good alternative power source for Eastern Congo.

# Occurrence of surface manifestations

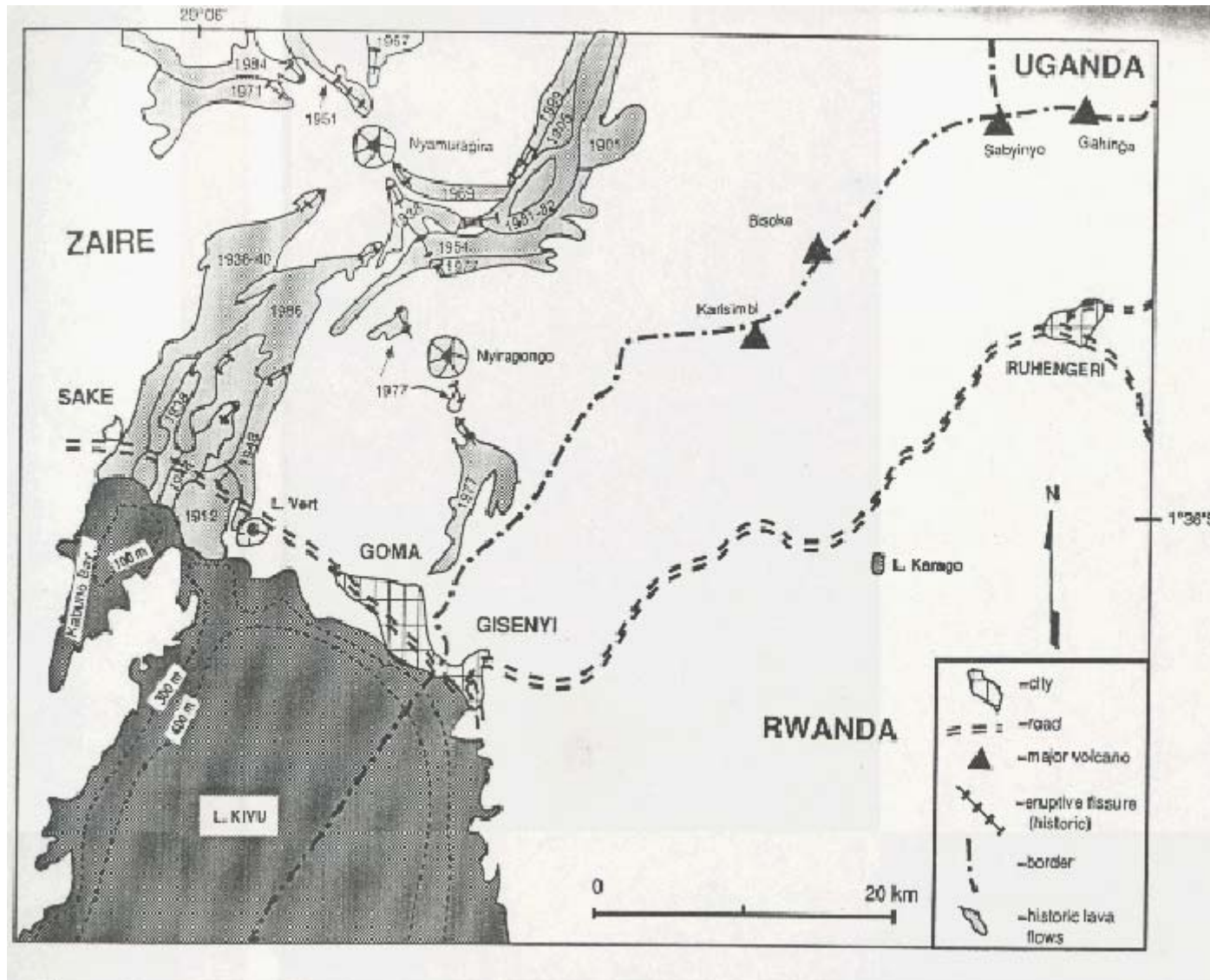
- The eastern border of DRC lies in the western branch of the EARS, on more than 1500km.
- It consists of seismic active zones with occurrence of earthquakes of high magnitude
- It also has active 2 volcanoes : Nyiragongo and Nyamulagira.
- Several hot springs are found in the area.



Index map of the Western and Eastern Rifts in Africa



Major 'Great Lakes' of the East Africa rifts valleys 6



Major volcanoes and distribution of major 20th Century lava flows



# The most recent eruption

- Mt. Nyiragongo eruption
  - Date : January 17, 2002
  - Death toll: 100 people (60 deaths by explosion of petrol stations)
  - Damages: 30 % of Goma town destroyed or covered with thick lava



# Volcanic Disaster in 2002



**Lava flow pushes Lake Kivu 100m  
as the Lava enters 70m deep**



**A house covered with lava  
(6 personnes died inside)**



## **Destruction of Goma town, mostly the business area**

# The recent major earthquakes

- Kalehe earthquake occurred on Oct 24, 2002 with 12 deaths
- Bukavu earthquake on February 3, 2008 with 44 deaths



## **Damages caused by earthquake in Kalehe (70 km south of Goma) on 24 Oct 2002**

ARGeo\_C2, Ebb, DRC Presentation

# Earthquake parameters and disaster in Bukavu

- Time ; Sunday Feb. 3, 2008 07:34 (UT)
- Location; 2.314°S, 28.896°E, Depth 10 km  
Birava (ca 20 km north of Bukavu)
- Magnitude (M); 6.0

**The largest earthquake in south Kivu since 1950**

- Mechanism ; Normal fault type  
**Crustal block vertically faulting**

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• Death toll;	RD Congo	7 (1)
	Rwanda	37 (19)
	<b>Total</b>	<b>44 (20)</b>



# Damages of Steeple, on 3 Feb 2008

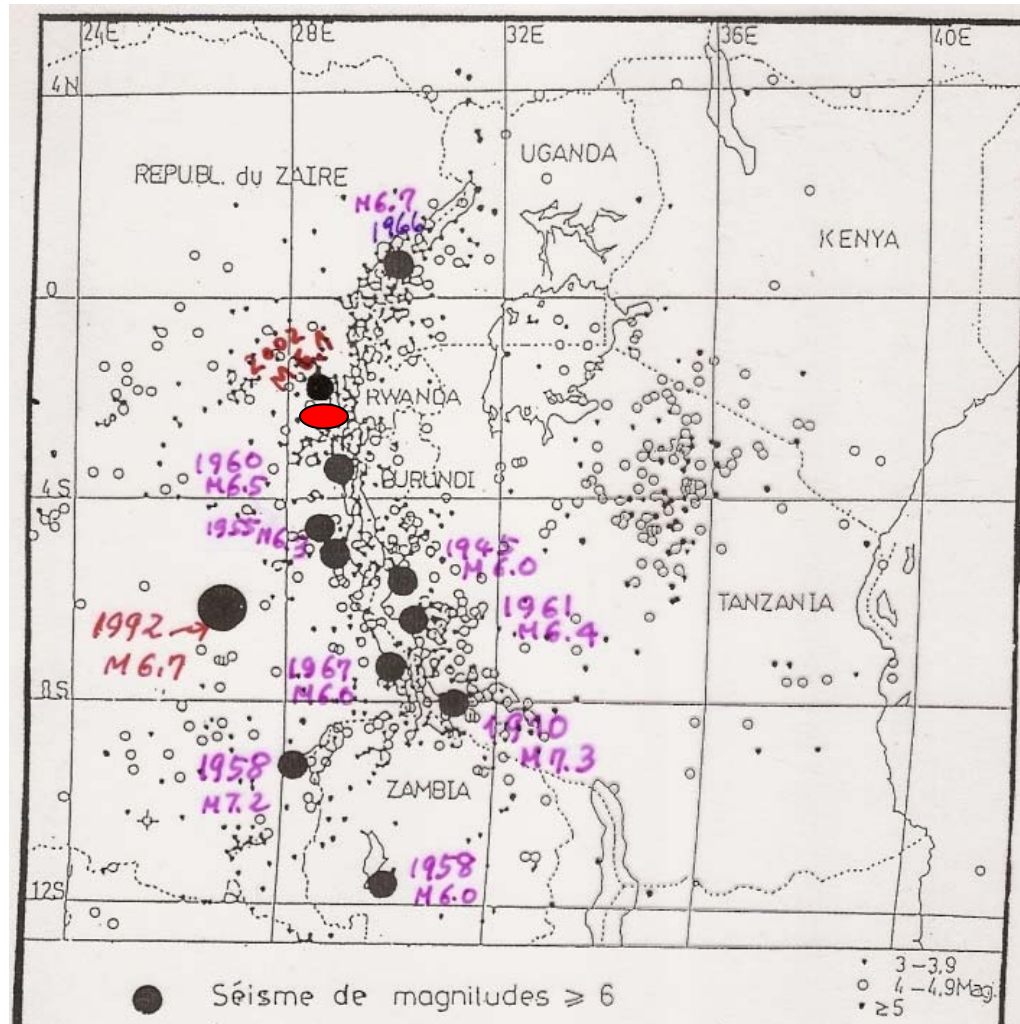
Birava, RDC →



↑ Shangi, Rwanda

Nkanka, Rwanda →





● Bukavu felt earthquake on Feb. 3, 2008

**The eastern border of D.R. Congo: the western branch of EARS.  
 The most recently recorded seisms of magnitude >6 are also indicated, with the year of occurrence.**



# Some water sampling sites



**Hot spring**



**Cold spring**



**Rift limit**



**Major regional faults**



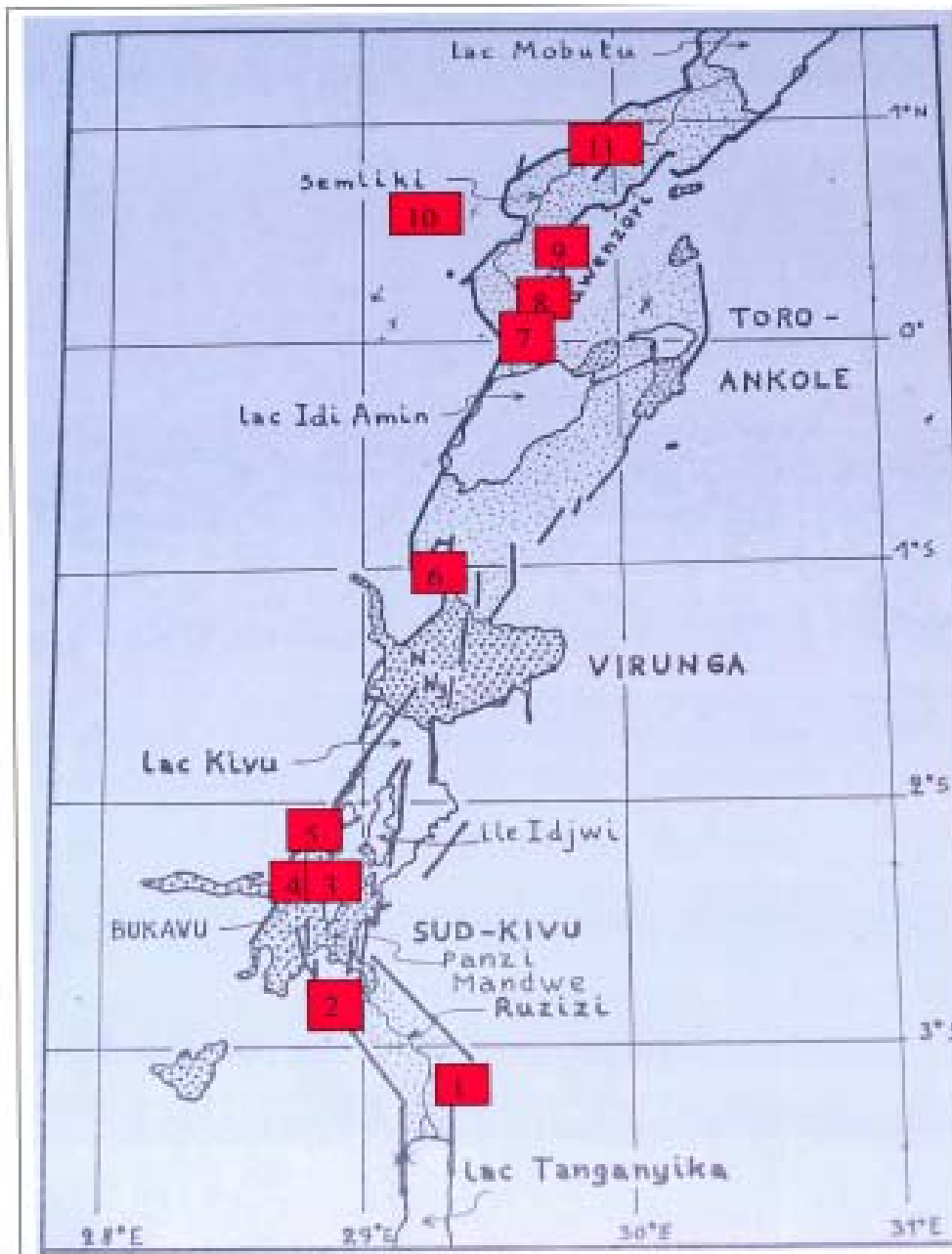
**Active Volcanic Centres**

# Sample and site information

South-Kivu Province						
No	Site Name	District	T °C	Longitude	Latitude	Altitude (m)
1	Uvira	Uvira	44	29.07.72E	03.24.33S	855
2	Nyangezi	Walungu	40			
3	Mahyuza	Kabare	47-65	28.50.45E	02.14.62S	1552
4	Kankule	“	72	28.50.12E	02.14.94S	1595
5	Maziba	“	40			
12	Muganzo	“				

## Sample and site information (Cont.)

<u>North Kivu Province</u>						
No	Site Name	District	T °C	Longitude	Latitude	Altitude (m)
<b>6</b>	Mayi ya Moto	Rutshuru	95-100			
<b>7</b>	<b>Kambo</b>	Beni	<b>40</b>	29.40.17E	00.03.77N	1094
<b>8</b>	<b>Masambo</b>	“	<b>43</b>	29.41.75E	00.10.85N	1006
<b>9</b>	<b>Mutsora</b>	Beni	<b>57</b>	29.44.49E	00.18.35E	1094
<b>13</b>	Tingi/Sake	Masisi	<b>30</b>			
<b>15</b>	<b>Kisuma</b>	“	<b>39</b>			



- 1. Uvira**
- 2. Nyangezi**
- 3. Mahyuza**
- 4. Kankule**
- 5. Maziba**
- 6. Mayi ya Moto**
- 7. Kambo**
- 8. Masambo**
- 9. Mutsora**
- 10. Mbau**
- 11. Kikingi**

Fig. 3: Water sampling sites: the numbers are the same as the bold numbers of Table 1.  
 1. Uvira 2. Nyangezi 3. Mahyuza 4. Kankule 5. Maziba 6. Mayi ya Moto  
 7. Kambo (Kasindi) 8. Masambo 9. Mutsora 10. Mbau 11. Kikingi

# Sampling and Analysis

- Date of sampling:
  - 1994: one sampling at Mayi ya Moto
  - 2002-08: other samples
- Chemical analysis:
  - 1994: in Japan (total analysis)
  - 2002-2003: Italy (total analysis)
  - 2008: Goma, OVG (only a few anions)

# Results of Chemical Analyses

- All hot spring samples are characterized by high CO<sub>2</sub> content.

Ratio **Cl/HCO<sub>3</sub>** is **0.007 – 0.3**

Ratio for Ugandan hot springs: **0.2 – 3.5**

*(Bazaale-Dolo, 1971)*

- It is well known that volcanic gases of Nyiragongo volcano contain almost 50% CO<sub>2</sub> unlike other high temperature gases where SO<sub>2</sub> is the most abundant after H<sub>2</sub>O *(Gerlach, 1983)*

## Results of Chemical Analyses *(cont.)*

- It is also known that Lake Kivu contains large amount of CO<sub>2</sub> and CH<sub>4</sub> (*Tietze et al., 1980*)
- Suggestion from this study: High CO<sub>2</sub> content in hot springs of Eastern Congo is due to magmatic supply



# Chemical Geothermometry

- Analytical data were used to estimate underground temperature
- Ca not used and no data for SiO<sub>2</sub>
- Na-K temperature were calculated using Truesdell, Fournier & Giggenbach formulas
- Calculations using Mg gave very low temperatures

# Chemical Geothermometry (*cont.*)

- **North-Kivu**
- Mayi-ya-moto: 163-177 degree
- Tingi-Sake: *unreliable*
- Kisuma/Masisi: *wide discrepancy of data*

# Chemical Geothermometry (*cont.*)

- **South Kivu:**
- Kankule: 337-369
- Mahyuza: 345-374
- Maziba: *unreliable*

# Conclusion/Recommendations

- This is a preliminary study showing, on basis of geochemical data that geothermal potential exist Eastern DRC
- Further investigations are required including:
  - In-situ measurements of CO<sub>2</sub>, H<sub>2</sub>S, Rn, discharge rates, and heat flow.
  - Geological and geophysical surveys
  - Isotope Hydrology
  - Expand to wider area

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Thank you

