

SECOND AFRICAN RIFT GEOTHERMAL CONFERENCE 24th - 28th NOVEMBER, 2008 ENTEBBE, UGANDA

Ministry of Infrastructure P.O. Box:24, Kigali Rwanda

GEOTHERMAL EXPLORATION AND DEVELOPMENT IN RWANDA

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Introduction



- **Area**: 26,338 Km²
- Population: 9 million of inhabitants
- Energy consumption
 - Biomass: 95%
 - Oil products: 4 %
 - Electricity: 1%

Electricity context

- Installed capacity: 77 MW
 Available capacity: 70 MW
- Available capacity: 59 MW
- Sources of electricity
 - Hydro: 56%
 - Thermal: 39%
 - Solar: 0.3%
 - Methane gas: 5.7%
 - Electricity tariff : 22 US cents/KWh



Electricity context

Category	Name	Installed Capacity (MW)	Available Capacity (MW)		
In house Hydro Power		27.25	20		
	Ntaruka	11.75	6		
	Mukungwa	12.5	11		
	Gihira	1.8	1.8		
	Gisenyi	1.2	1.2		
Imported Hydro Power		15.5	11.5		
	Rusizi 1 (SNEL)	3.5	3.5		
	Rusizi 2 (SINELAC)	12	8		
Micro Hydro Power	Nyamotsi	0.075	0.075		
In House Thermal		14.37	7.8		
Power	Jabana	7.8	7.8		
	Gatsata 1	1.8	0		
	Gatstata 2	4.77	0		
Rental Thermal Power		15	15		
	Aggreko 1	10	10		
	Aggreko 2	5	5		
Solar Power	Kigali Solar	0.25	0.25		
Methane gas	Kibuye Power 1	4.5	4.5		
TOTAL		76.945	59.125		

Interest in geothermal energy development

- Indication of existence of geothermal resources
- High demand of electricity
- High electricity prices
- Diversification of energy resources
- Clean source of energy

Geothermal potential and development in Rwanda

The East African Rift system



Geothermal potential in Rwanda 170-300 MW



Hydrothermal manifestations





Thermal area in Gisenyi





Thermal area in Mashyuza

Geothermal development History

Evaluated prospects



- Studies: BRGM (1982-1983); Chevron (2006)

- Reconnaissance and limited surface exploration carried out in the Western (*Rusizi, Rubavu and karongi*), Southern (*Karaba*)and Northern (*Musanze and Nyabihu*) parts of the country

- 18 hydrothermal and mineralized springs identified and analyzed

Geothermal zones: Volcanoes National Park



The National Volcanoes in the Northern part of Kivu Lake comprises eight big volcanic structures. Five of them are situated in Rwanda:

- Muhabura
- Gahinga
- Sabyinyo
- Bisoke
- Karisimbi

Geothermal zones:

Cyangugu zone

Located in the Southern part of Kivu Lake.

It is situated in the Eastern part of the distensive system on Rusizi Graben with an orientation similar to the National volcanoes system N-S.

The hydrothermal manifestations (hot springs and the travertine deposit) are linked to this type of structure.





a) Normal fracturation of the basement leading to the formation of the Graben and small horsts on the Eastern compartment



 b) distensive system of constraints allows the drawdown of a portion of the graben



c) Shearing components affect the septentrional part of the graben causing an important axial shift.

Geothermal zones of interest

Thermal sources of Mashyuza

Geochemical parameters

Gisenyi Prospect

- Defined by One Hot Spring on Lakeshore
 - 70-75 °C
 - 2-5 kg/s Flow Rate
 - Dilute Na-HCO₃ Chemistry
 - Minor Silicification in Brecciated Quartzite
- Evidence of older travertine deposits along shoreline
- Proximity to Virunga Volcanics
 - Possible distal outflow from higher temperature system

Geochemical parameters

Mashyuza Prospect

- Defined by Single Hot Spring Complex
 - 40-55 °C
 - >50 kg/s Flow Rate
 - Dilute Na-HCO₃ Chemistry
 - Massive Travertine Deposits
- In Proximity to Older Volcanics

Geochemical analyses from Gisenyi, Mashyuza and Lake Kivu

Prospect	SampleID	Sample Type	Date	Temp., C	pH (field)	pH (lab)	Na	К	Ca	Mg	Li
Gisenyi	G (1982)	Water	1982	70.6		6.47	528.8	40.7	37.8	11.1	0.41
Gisenyi	G (2006)	Water	2006	69	7.0	7.03	518.8	39.8	36.4	11.1	0.42
Lake Kivu	LK (1982)	Water	1982	24.6		8.89	116.1	92.7	9.0	82.9	0.04
Lake Kivu	LK (2006)	Water	2006		8.0	9.05	110.9	87.5	8.1	80.1	0.05
Mashyuza	M-1 (1982)	Water	1982	41.8		6.45	287.4	45.4	77.0	51.8	0.90
Mashyuza	M-1 (2006)	Water	2006	33	6.5-7.0	6.76	291.2	45.3	89.5	53.1	0.93
Mashyuza	M-2 (1982)	Water	1982	54.2		6.26	298.9	47.3	72.9	54.0	0.95
Mashyuza	M-2 (2006)	Water	2006	47	6.5	6.72	307.8	48.0	76.0	55.0	0.96
Prospect	SampleID	Sample Type	Date	В	SiO2	Cŀ	SO4	HCO3	TDS		
Gisenyi	G (1982)	Water	1982	5.01	105.8	234.0	44.0	1122.7			
Gisenyi	G (2006)	Water	2006	0.55	58.5	236.8	62.1	1137.3	2101.90		
Lake Kivu	LK (1982)	Water	1982	4.00	19.0	36.2	18.0	799.3			
Lake Kivu	LK (2006)	Water	2006	0.10	7.9	32.0	22.3	796.1	1145.09		
Mashyuza	M-1 (1982)	Water	1982	1.50	84.7	120.9	48.0	1049.5			
Mashyuza	M-1 (2006)	Water	2006	1.18	50.2	141.0	50.5	1115.8	1836.78		
Mashyuza	M-2 (1982)	Water	1982	4.50	75.1	128.0	46.0	1061.7			
Mashyuza	M-2 (2006)	Water	2006	1.07	48.3	137.9	55.3	1122.6	1855.00		

Ongoing geothermal activities

Ongoing study

Geothermal Resource assessment

- An implementation agreement for a joint geothermal assessment and capacity building project signed in November 2007 between the Government of Rwanda (GoR) and the German Federal Institute for Geosciences and Natural Resources (BGR)
- ✓ Study area: Gisenyi –Volcanoes area
 - Geological analysis, geochemical sampling of springs and Geophysical exploration in the study area completed in collaboration with the Kenya Electricity Generating Company KENGEN.

Capacity building

- WB geosciences and geothermal capacity building needs assessment completed.
- Training of four Rwandans in a short course on surface exploration for geothermal resources (2007, 2008) in Kenya
- Training of one Rwandan for a six month course (April-October 2008) at the United Nations University Geothermal Training Programme (UNU-GTP)in Iceland
- Contact made with the UNU-GTP for training of more Rwandan candidates in Iceland for the years 2009-2011

Future development

Future Development

- Detailled geophysical surveys in the Gisenyi-Volcano area
- Drilling of exploratory wells on the promising area
- Development of a pilot power plant
- Detailled geological, geochemical and geophysical surveys on promising sites.
- More training of Rwandans for each steps

Conclusions

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- Development of geothermal energy : A priority for the Government of Rwanda
 - Evaluate properly Rwanda geothermal resources
 - Look for financing for the development of geothermal energy
 - Assistance for training of experts required in Rwanda
 - Participation of private and public partnership in the sector is encouraged
 - Existence of incentives to attract private sector investments in the sector
 - Rwanda to be a member of and benefit from the African Rift Geothermal Development Facility



