

Geothermal Development in Democratic Republic of Congo (case of Geothermal prospecting project of magmatic reservoirs in the main fissure from Nyiragongo volcano towards to Gisenyi (Rwanda))

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ABSTRACT

The DRC has a hydroelectric potential estimated at 100,000 MW, spread over 780 sites in 145 territories and 76,000 villages. This potential represents about 37% of Africa's total potential and nearly 6% of the global potential.

In addition to this energy, it also has significant potential in renewable energy resources such as geothermal energy, biomass, wind, solar, biogas, biofuel, etc. Unfortunately all these sources of energy are barely exploited especially the great potential of volcanic origin in the region of Virunga.

Indeed, the country's electrification rate remains low at 9.6% and the government's vision is to increase the service rate to 32% by 2030.

But as the country does not have sufficient financial resources to exploit all these energies and to serve urban and rural areas, an Investment Code and an Electricity Code have been put in place to attract private investors to this sector.

1. Introduction

The DRC has an important renewable and non-renewable resources energy distributed almost throughout the national territory among which we can mention hydropower, solar energy, methane gas, wind energy, geothermal energy, etc. Some can be viewed in figure.1.

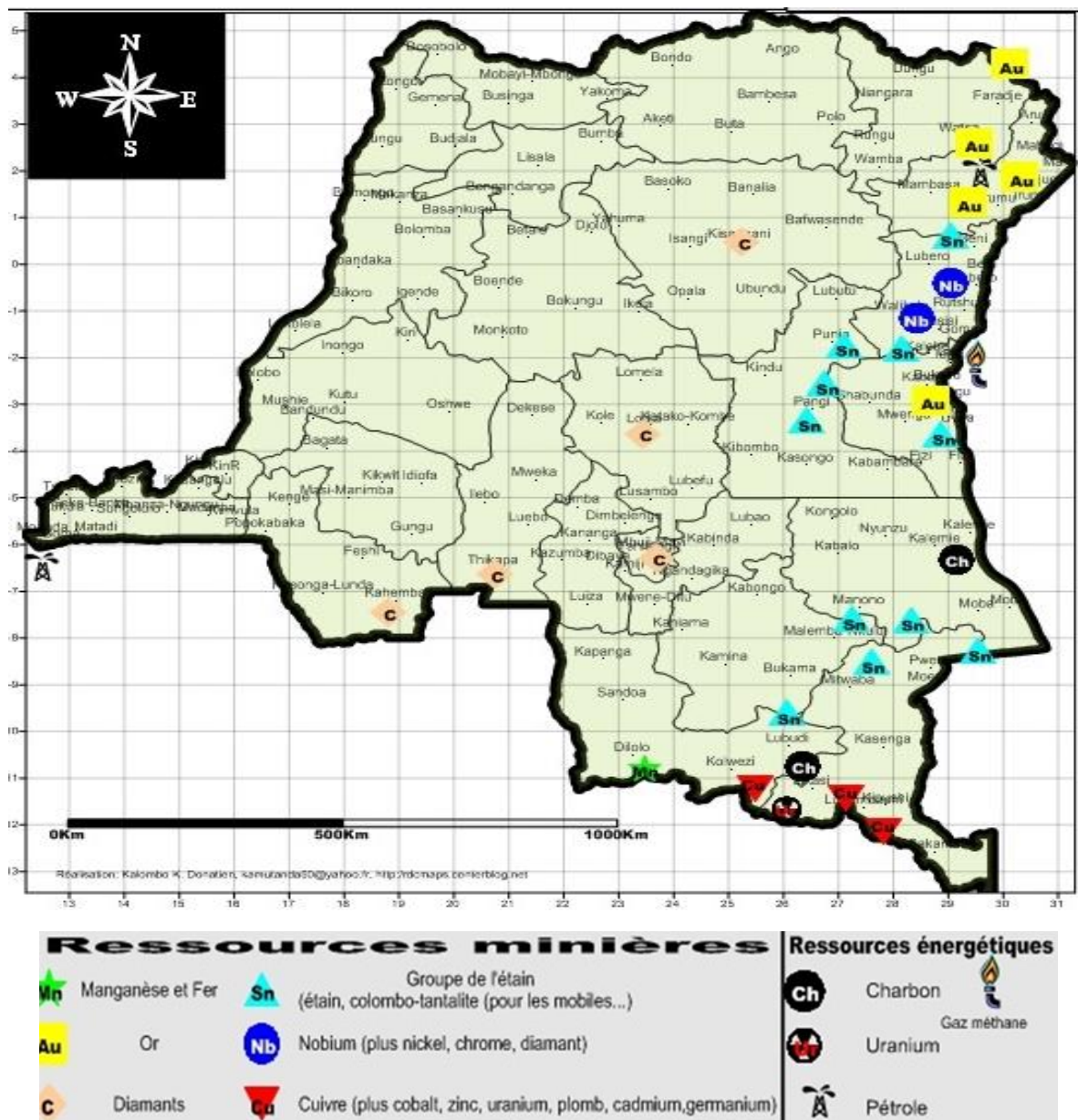
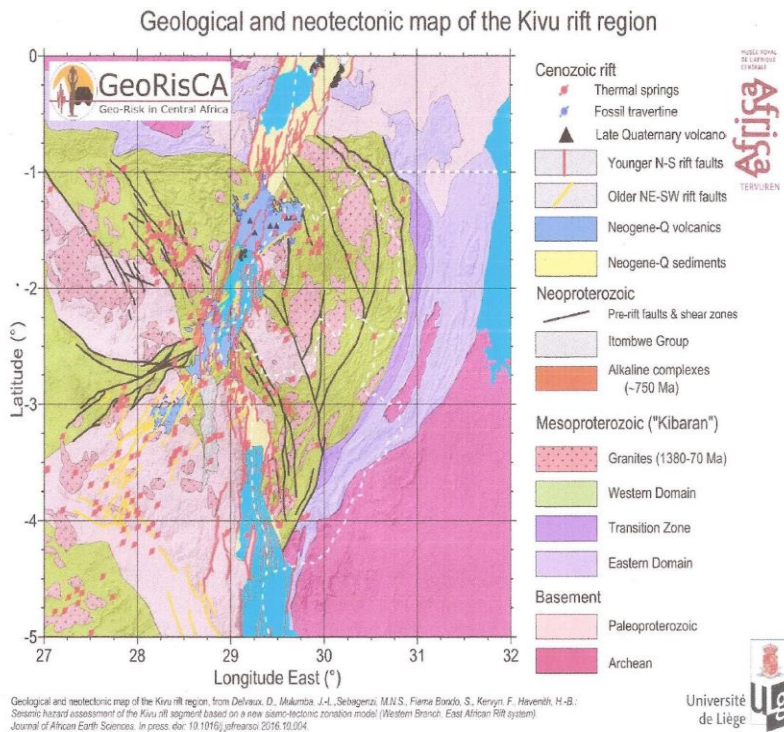


Figure.1. Map of DRC with some Energy Resources

These resources are under-exploited and particularly the geothermal. Despite this situation, since 2008, DRC scientists have been effectively involved in the exploration of geothermal sites in the Western Branch of the East African Rift system and preliminary results are in the Fig.2 and in the tables 1, 2. ,



From the province of North Kivu to that of South Kivu, the results of the samples of the thermal waters have been presented in various national and international symposia. More recently, samples of hot spring at Kisuma (Masisi territory, North Kivu, DRC) were analyzed at the Laboratories of the Institut National d'Enseignement Supérieur (INES)/ Ruhengeri (Musanze) /Rwanda and the University of Florence (Italy) (tables 1 and 2).

Figure, 2. Geological map of the Kivu region with some thermal springs locations (After Delvaux D. & al, 2016)

Table 1: Geographic coordinates of hot spring sites

NAME OF SITE	TERRITORY	LOCATION		
		Latitude	Longitude	Altitude
Maziba	Kabare/ South Kivu	S02°14.279'	E28°48.432'	1721 m
Kankule	Kabare/ South Kivu	S02°14.944'	E28°50.123'	1595 m
Mahyuza	Kabare/ South Kivu	S02°14.615'	E28°50.448'	1582 m
UVIRA	Uvira/ South Kivu	S3°24 .333'	E29°7.715'	855 m
NYANGEZI	Walungu/South Kivu	A visiter		
KISUMA	Masisi/North Kivu	S01°28.263'	E28°51.570'	1796 m
	Walikale/North Kivu	S01°19.092'	E29°59.780'	724 m
Mayi ya Moto	Rutshuru/North Kivu	S00°53.906'	E29°21.115'	953 m
KAMBO/KASINDI	Beni/ North Kivu	N00°03.768'	E29°40.167'	1014 m
	Batalinga/North Kivu	A visiter		
MUTSORA	Beni/ North Kivu	N00°18.354'	E29°44.486'	1094 m
MASAMBO	Beni/ North Kivu	N00°10.852'	E29°41.748'	1006 m

Table 2. Chemical Composition of thermal springs in North and South Kivu, D.R. Congo (*in mg/l*)

A. North Kivu

N	Samples	Date	pH	T °C	F	Br	NO ₃	NH ₄	Li	HCO ₃	Cl	SO ₄	Na	K	Ca	Mg
1	Mayi ya Moto 1	27/03/1994	8,94	94,7						4540	1120	478	2730	126	1	0,9
2	Mayi ya Moto 2	20/02/2003	8,1	100	21	2,1	<	5,9	2,6	3400	1035	400	2170	117	9,6	1,2
3	Mayi ya Moto 3	30/08/2003	8,2	96,4	25,5	2,5	0,08	4,5	3	5069	1140	480	2745	100	1,1	2
4	Mayi ya Moto 4	17/02/2004	7,99	94,5	25	2,4	<	6,2	2,6	4927	1070	590	2660	97	2,4	1,2
5	Tingi/Sake 1	01/03/2003	8,42	20	2	0,75	4,50	0,77	2,8	2990	275	80	830	165	70	120
6	Tingi/Sake 2	08/08/2003	6,9	30	1,7	10	3,50	5,96	3,1	2800	276	78	785	149	37	134
7	Tingi/Sake 3	28/08/2003	6,86	29,2	1,9	0,63	<	2,1	3,3	2795	284	90	787	141	48	137
8	Tingi/Sake 4	04/11/2003	6,97	30	1,65	0,85	0,35	1,33	3,1	3080	305	90	770	142	170	124
9	Tingi/Sake 5	18/02/2004	6,68	30,0	1,25	0,87	0,50	1,00	3,03	2654	311	95	812	142	157	126
10	Kisuma/Masisi 1	08/08/2003	6,2	38,5	1,1	0,02	0,35	0,19	0,1	423	9	24	33	29	57	32
11	Kisuma/Masisi 2	08/08/2003	6,5	39	0,5	0,05	0,06	0,7	0,11	454	11	29	34	26	59	37
12	Kisuma spring	08/08/2003	6,8	19,5	1,8	<	0,25	0,22	0,02	259	6	12	18	23	48	15
13	Kalieri/Katale	13/03/2003	7,63	-	1,5	0,05	0,65	0,04	<0,01	401	35	4	52	61	45	17
14	Nyabugezi	13/03/2003	6,95	-	1,2	<0,05	0,09	0,77	<0,01	431	3	5	52	72	50	15
15	Bukomo	16/06/2003	6,85	18,0	2,00	0,01	8,50	0,04	<0,01	203	4	10	14,75	19	35	14
16	Kambo/Kasindi	19/07/2008	6,97	40,0	3,50		3,10				118	700				
17	Masambo	20/07/2008	7,63	46,0	6,65		0,44				100	615				
18	Mutsora	20/07/2008	7,80	57,0	6,65		0,44				132	655				

B. South Kivu

[illegible]

Recently, the Government, which alone had a monopoly on the production of electricity, is making efforts to promote and liberalize the use of the various energy resources for decentralized entities and private companies. Thus the situation at the level of the whole country is presented by the following paragraphs:

2. Status of Electricity Production (from all sources of energy)

2.1. Current Total Installed and Effective Capacity

- Installed generation capacity in DRC is 2500 MW of which 99% (2,463 MW) come from hydropower
- According to the report of the Ministry of Energy, the percentage of access of the population is 30%, with only 1% for the rural population
- Firewood and charcoal account for more than 95% of total energy consumption
- In the current decade, DRC's forest area has been reduced by an average of 400,000 hectares per year. Therefore, protecting DRC forests is a key opportunity in the fight against climate change

2.2. Modes of Generation and their Contributions

2.2.1. Hydropower: 2,463 MW distributed as follows:

- 1,751 MW at Inga I and II and 75 MW at Zongo I
- 460 MW of Katanga's state-owned hydropower plants
- Availability rate of installed capacity: 56%
- Current supply of Katanga (575 MW + 50 MW)
- Local production: 255 MW
- Inga injection: 220 MW
- Import: 100 MW of day + 50 MW at night
- Main supply of the provinces of North and South Kivu:
 - Production of Ruzizi I: 16 MW
 - Ruzizi II rate: 9 MW

2.2.2. Contribution from Geothermal

Currently, there is no operational geothermal power plant in DRC. However, it should be pointed out that the first ever geothermal power plant in Africa was installed in DRC in 1952. The current research can help revive this activity.

2.2.3. Medium Term and Long Term Power Development Plan and the Role to be Played by Geothermal

In the very short term (actions in progress):

- Completion of the reinforcement and modernization of the Inga - Kolwezi line;
- Commissioning of Karavia substation static voltage compensator for the improvement

- of the voltage plan in Katanga;
- Reliability and re-commissioning of Mwadingusha Group No. 6;
- Maintenance and, if necessary, increase the import of electricity from Zambia;
- Better management of available energy.

In the medium term (until December 2016): Recover 559 MW

- Rehabilitation and commissioning of Inga I (Group 1), Inga II (Group 7), Mwadingusha (Group 1), Nseke (Group 1) and Zongo I (Group 2) hydroelectric plants, for a recovery of 181 MW;
- Commissioning of Zongo II (150 MW) and Rudahira / Rutshuru II (12.8 MW) hydropower plants;
- Construction works for the Busanga hydroelectric plant (240 MW);
- Solar power plant at Likasi or Kolwezi (2 x 50 MW);
- Completion of work on the Inga-Kolwezi line and Kolwezi Synchronous Compensators Nos. 2 and 3 to allow the transit of 500 MW.
- Rehabilitation and commissioning of Inga I (Group 5), Inga II (Group 1 and 2) and Mwadingusha (Group 3) hydroelectric plants;
- Start of the rehabilitation works of the Nzilo and Koni hydroelectric plants (reduction of the available capacity of 52 MW);
- Completion of all converters of the Inga - Kolwezi line (capacity increased to 1000 MW);
- Construction of a 300 MW coal-fired power plant in Luena and / or a 300 MW gas-fired power plant in Muanda;
- Commissioning of Kibali Gold Mining (2 x 20 MW) hydropower plants in Ituri (Watsa)

Long term (2016 - 2020)

- Commissioning of the hydroelectric plants of Busanga (240 MW) and Nzilo II (120 MW);
- Commissioning of the Grand Katende hydroelectric power station (64 MW)
- Commissioning of the Mambilima (124 MW) and Mambilima II (201 MW) hydroelectric plants + Construction of the Mombutula CX (300 MW) hydroelectric plant shared with Zambia;
- Commissioning of the Inga III hydroelectric power station (4,800 MW including 1,300 MW for Katanga and 2,500 for RSA);
- Construction of the Ruzizi III hydroelectric plant (147 MW) shared with Burundi and Rwanda, the Tshopo II (15 MW) and the Goma methane gas (20 MW);
- Drawing of 220 kV lines Goma - Rutshuru - Butembo - Beni and Nkenda (Uganda) – Beni - Butembo - Bunia.

3. Other Resources of Energy

Solar energy: Average sunlight throughout the year ranges from 3.5 to 6.75 kWh / m² / day depending on the locality.

Wind energy: District of Lulua (5.5 m / s); Kabinda District and Tanganika (6 m / s); District of

Lualaba (5 m / s).

Biomass energy: 125 million hectares of Equatorial forest. Huge plant growing opportunities for wood energy, biofuel and biogas production

Geothermal energy: Not evaluated in the DRC. But 11,000 MW throughout the Great Lakes region, in the Eastern Rift of Africa (including the DRC)

Natural gas and Methane gas

Natural gas (50,000 CFA / day) is flared by PERENCO in Moanda (Atlantic Ocean, Central Kongo Province); 65 billion Nm³ of methane gas in common with Rwanda in Lake Kivu.

Uranium : 1800 tons of confirmed reserves.

Oil : Reserves of more than 1.5 trillion barrels; Production: 230 million barrels

Coal ; 720 million tones of unconfirmed estimates; 54 million tons of proved reserves

4. Status of Geothermal Development in the Country

Pls Cut from the introduction part, what you have written about geology and thermal springs including tables and geological maps and paste it under this section. Then write a sentence indicating that DRC have not yet reached to the level of drilling and power production.

5. Investment Opportunities

5.1. Investment opportunities for potential investors

The Government has enacted laws that create favorable investment conditions for any moral or physical person wishing to engage in this activity.

An important consumer market is available especially in rural areas.

5.2. Incentives offered to developers

Tax and security facilities will be granted to any contractor.

Outlook and Conclusions

The DRC is bursting with a huge diversified energy potential, including geothermal resources whose exploitation would contribute to the fight against climate change and the development of the country. The need for equipment in the prospecting of the reservoirs of heat remains recurrent for the scientists of the DRC. The partnership with other scientists involved in this field is highly desirable. The market is open to any local, national and foreign entrepreneur

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