

Geothermal Resource Exploration in DRC: A Country Update

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Summary

Geothermal resources across the Democratic Republic of the Congo are still poorly researched. This country lays the West Branch of the East African Rift System, EARS the easiest example of continental rifting. It is subdivided into two rift branches which developed substantial magmatic events with high-temperature volcanoes. The west branch named Albertine rift has also several volcanic systems with geothermal systems where the heat source is not yet well known.

The Democratic Republic of the Congo (DRC) has the entirety of the west flank of the Albertine Rift. Most of the Congolese thermal springs are situated on a NE-SW azimuthal line. In mitigating the effects of climate change the UN agenda is to move gradually from fossil fuel by 2030. DRC is applying this mission by diversifying its energetic network by the use of Hydropower as the only renounceable energy. As research chair, the Steering Committee for the Development of Geothermal Resources works with the main goal of a geothermal power plant in the country. The surficial identification is ongoing and the geophysical is the next planed. Four geothermal entities made the DRC heat flux in the volcanic zone except one of them, Kiabuka is out of the rift. Recent studies showed a tectonic control of the predicted geothermal reservoir. Direct Geothermometer showed different depths of the roof to be attested by geophysics surveys.

Keywords: DRC, Geothermal energy, Albertine rift, Exploration

1. Introduction

The western branch of the East African rift system (EARS) is divided into three segments. The Kivu rift region lies in the central part is actually erupting, It is also located in the middle of the western branch of EARS. It comprises Rwanda and Burundi and parts of the Eastern DRC, Tanzania, and Ugand (**Damien Delvaux and al. 2017**). The exploration of geothermal manifestations is mostly concentrated in the eastern provinces, Tanganyika, South, and North Kivu along the Rift. The exploration in the DRC began around 1980. Geothermal energy was first used in Katanga at the Kyabukwa geothermal power plant (**Mukandala.S.P and Mahinda.K.C, 2020**). Although the rift has fuel reserves, its geothermal energy is better because it produces little or no carbon emissions. The eastern part of the country is an intracratonic blanket of Proterozoic orogeny with the Virunga volcanic province known for lava flows, seismicity, and heat flow from deep magma sources. Geothermal manifestations are identified in particular around the magmatic constructs, Mount Rwenzori, Nyiragongo-Nyamulagira, Kahuzi-biega Biega, Tanganyika and the isolated islets of Walikale Walikale west of the craton. No borehole has yet been drilled to estimate the depth of the geothermal reservoir. Its potential has not yet been evaluated and no application has been made to date.

2. Results

The eastern part of DRC has huge geothermal potential but has not been exploited until now. Several geothermal sources are found in this part of DRC belonging to the western branch of the East Africa Rift (**Levesque Makuku. 2019**). The geothermal activities are offered by a Provincial Decree n°298/CAB /GP-NK/2015 of October 30, 2015, establishing in North Kivu Province of a Comité de Pilotage pour le

Développement des Ressources Géothermiques du Nord-Kivu (Steering Committee for the Development of Geothermal Resources, CPDRG) is intended to revive of this sector (**Mukandala.S.P and Mahinda.K.C, 2020**).

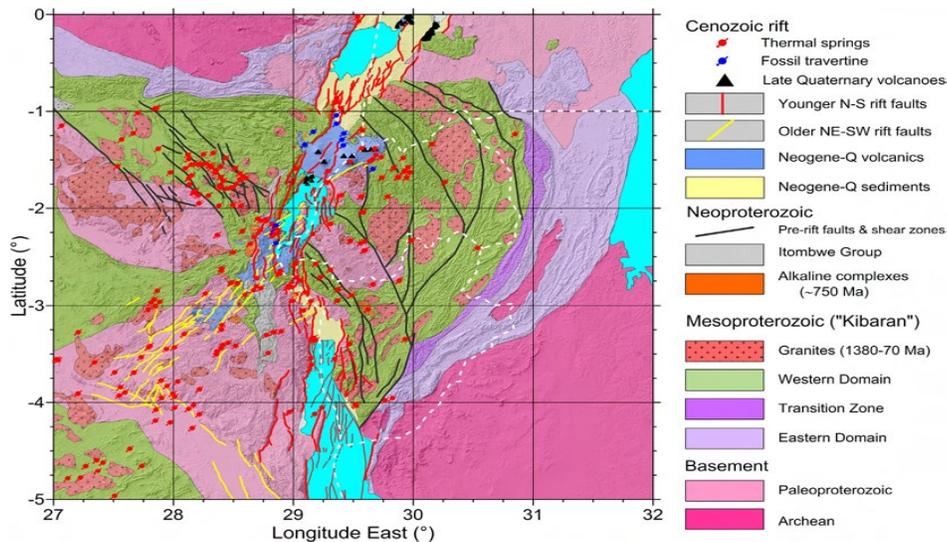


Fig. 1: Homogeneous cross-border synthetic geological map of the study region (background) with overprinted neotectonic features (neotectonic faults, late Quaternary volcanic

2.1 Geology and volcanic settings

The geology of eastern DRC is dominated by Archean, Paleoproterozoic, and Mesoproterozoic formations. The thermal springs of this region are directly linked to the fractures of these geological formations. Many DRC hot springs are located in the east within rift-related tectonic activity and the majority of occurrences are located in the rift itself. They belong to the "Southern Katanga" group of thermal springs, occurring in the folded Katangan cover of the Upper Proterozoic age (Kaku site, Katanga). In the Kivu, from the activation of the Virunga Volcanic Province chambers heat flux comes out as hot springs, and the lake undergrounds are to be investigated for extended studies.

2.2 Exploration of Geothermal resources in the DRC

Eastern DRC is rich in geothermal potential, with numerous occurrences along the western branch of the rift (Gerald A.W., 1965). Prospecting and identification of these hot springs could lead to the search for clean and affordable energy sources (Odhpio.A.D. et al, 2020) The first studies were conducted in 1911 (Levesque Makuku. 2019). Geothermal uses are reported in 1960 with the Kiabuka power plant. The springs did not appear to have a volcanic connection and were thought to be due to deep circulation in an otherwise normal geothermal gradient environment of 30oC/km 139 t/h at 91oC, but if the natural overflow level of the spring was lowered by about a meter, the flow rate could be increased to 243t/h at 93oC. It offered in the mines uses about 1,000,000 kWh per year (Brian White). More than 100 thermal springs and associated salt deposits have been identified in Katanga, without any details in the "Upemba Graben".

The Rwenzori geothermal prospect has about sixty thermal springs located in the large Oriental Province bordering Uganda, this group has a superficial thermal spring with temperatures ranging from 20°C to 100°C. The following springs are the best known: Lilida (40°C), Mutsora hot spring, Kambo hot spring, Bakoma hot spring, Kalumia hot spring, Luama hot spring, Nyawatu hot spring, Mabitabo hot spring, Kikura hot spring, Kingi hot spring. We have stopped the studies in 2019 due to lower security.

The Virunga geothermal prospect carried by the Kivu Rift is the middle section of the West Branch of the EARS. It is activated by the Nyiragongo volcano rounded by the Mayi-ya- Moto hot spring (96°C), the Sake cool springs, the Kisuma hot spring, and others covered by Quaternary lava.

The Kahuzi Biega Ruzizi geothermal prospecting segment located around the Kahuzi Biega volcano has the Namoya hot spring, and the Nyangezi hot spring (40°C). The Uvira hot spring (44°C) and the Kasongo thermal spring are still well documented and probably affiliated with the volcanic system as well. The geothermal group of Walikale has 46 thermal springs with remote sensing views in the valley of the Lova and elsewhere. It seems to be unknown to scientists as located in a deep forest with low demography. It's also linked to the quaternary volcano attested by fractured lavas by the Buynakiri fault network.

2.3 Geothermal Development in DRC

The development of this energy in the DRC is stimulated by the African Rift Geothermal Association under the aegis of UNEP. Congolese geothermic experts are active members of this continental cell and are retrained every 2 years through courses and workshops. Congolese geothermal surface exploration is gaining ground with the insertion of young students and scientists from the University. Data collected so far indicate that a geothermal system may have developed along the DRC-Rwanda border. Other thermal springs are present at the bottom of Lake Kivu, but their precise location and characteristics are still unknown. (**Jacques Varet, 2018**). The training of young scientists through masters and doctoral degrees and professional training is a priority of the project. This is possible thanks to the collaboration of foreign universities or research centers to the rescue. The chemical composition of these thermal waters is for most springs dominated by the abundant presence of sulfides (**Stanley et al., 1878**). The springs sampled that have an equilibrium temperature and a minimum of carbonates-Sulfide-chloride. Analysis estimates these reservoirs at 162.9°C to 177.9°C from Giggenbach (1988) while Fournier (1976) 143.6°C to 169.3°C and Truesdell (1973) 99.6°C to 129.4°C. (**Kavyavu K.W, et al, 2020**). The K-Na-Ca results must be complemented by Ca-B-Li and isotopic quantification, geophysical studies are also mandatory.

2.4 Issues affecting the development of geothermal energy in DRC

The main challenge is the lack of qualified staff for adequate data. The geothermal energy domain is a high project for its costs, it needs to be proved and have the before all drilling. Presently the geophysical survey is a necessity for Congolese geothermal projects. The role of geothermal energy is still unknown due to the large hydropower.

3. Conclusions

DRC has positive indicators of geothermal potential to be confirmed. This potential is dispatched along the fractured volcanic fields. The mentor of the geothermal projects is to be set in the Rift and to be extrapolated. Undoubtedly, the promotion of Congolese geothermal energy as a renewable energy source in rural areas is a trigger of the economy through direct use (Greenhouses, fish farming) and tourism (Spas, saunas, indoor pools).

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