



## The distribution and Geology of the Geothermal wealth of the Kivu Province, case of the volcanic fields of Virunga and Kahuzi-Biega / DRC



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### Abstract

The knowledge of the distribution and the physicochemical characteristics of the thermal waters of the Kivu Province is an asset because it is an economic heritage whose capacities deserve to be known for its classification in different uses.

During the first vacation on African tourism, event held in Bukavu in 1939 Mr A.J.MOELLER DE LADDERSONS under his motto < *as the Alps have become the leisure place of Europe since its discovery by British tourists, the Kivu will one day become the leisure place for Africa.* >

In this outline, the location mixed to the genetic model of the geothermal spots, probably the lithology of sites and a physicochemical analysis of each of the samples will give an idea of this rare commodity of the country.

A comparative study of the sites referring to well-known will allow us to unearth the identity or not of the deep source, in case of difference, we will try to say the why.

To attend these causalities, a bibliographical study and field campaign have been done. We used the field materials GPS, Brouton, less, decameter, hand notebook,... to collect a sample of Rocks and those of the laboratory (rocks) for parameters not detectable by the senses. As natural sciences are not solitary, a team work is worth; that's why in a group of three we made the field study for data collection.

At the end of this research, we found that the thermal waters of Kivu follow a distribution around volcanoes in the south-Kivu and Southern of North-Kivu. Compared to volcanic sites, their origin is due to Panafrican orogeny mixed to volcanism. These geothermal sites are hosted by a borrowed fault from Tanganyika to Edouard lake via the Kivu Lake. In addition, most of Masisi and Walikale, specially **Kisumu, Mwima, Mitwa, bitaata** were not visited for full studies because of insecurity in the area; only **Mahyutsa** at Sake had been studied for geology and structural cases.

Three studied sites, Nyangezi-Sake-Rwindi are in the Precambrian lithologies while Katana site is in volcanic and sedimentary deposits.

### Introduction

The administrative Province, old Kivu is full of natural or anthropically developed tourist sites. Its geomorphologic, inequalities, the Rwenzori and Semuliki to the North, the Rwindi-Edouard-Kivu volcanic field in the center and Kahuzi-Biega-Ruzizi-Tanganyika valley to the South, its various bays and plain shores on all its lakes and archipelagos make this entity a tourist area.<sup>1</sup>

In this part of the country, we witness the presence of water in all states; solid (snows) to Rwenzori, liquid in its lakes, rivers and gaseous, vaporous and chemical in the magmatic chambers. In the latter case, an intermediate phase, thermal (hot) water is characteristic of active volcanism or in dormancy. Geothermal energy remains the geothermometer in the knowledge of the evolving cycle of water on the globe.

The interests of the thermal waters remain multi-factorial, from the metallogenic point of view, sanitary view, industrial

<sup>1</sup> DEVROEY .E ET VANDERLINDEN. R. , *Le Lac Kivu*, Mémoire présente a la séance du 31 mars 1939

for uses chemical and energetic.

Plate tectonics followed by volcanism are the phenomena that attest to the activism of the earth. Planetary regions are characterized by a specific ambient temperature, a parameter hosted by climatic conditions around the globe. This parameter is variable longitudinally and transversely towards the nucleus of the earth. In the last case (transversely), it is the notion of geothermal gradient. In volcanic regions, the gradient is on average 1°C/33m; in stable regions, it varies according to bedrock lithology (1°C/10m) the case of Kivu, (1°C/60m, 1°C/40m, ...).

In the Rifting region, hydrographic networks follow paleo-earthquakes. The stagnation of meteoric water is doomed to infiltrate; by continuing this infiltration its temperature increases with the lithostratigraphic column. In the drought, this phenomenon is also due to the recycling of rainwater or to the variation of the temperature day/night.

The eastern border region of DRC and Western Uganda-Rwanda-Burundi-Tanzania is a target of active regional tectonism. Apart the gas wealth of Kivu Lake, the thermal water is a witness of the geothermal wealth of the riparian countries of the African rift and in particular around the volcanic fields. For DRC, these waters are visible in the Nyangezi region, Katana around the Kahuzi-Biega; Sake, Rwindi, Bitata, Kisumu, Mwima, Mitwa, Gisenyi for the Virunga volcanic field.

The most outstanding and energetically promising African geothermal sites are Ruhwa in Burundi, Gisenyi in Rwanda and Betsiaka in Madagascar. The current increased need for electricity and the challenges of polluting fossil fuels lead communities to use wind power and hydropower known to be green energies and geothermal energy.<sup>2</sup>

The geographical and geological (tectonics) of Kivucian areas at the neighbor of the rift valley is a pointments about it's rich of geothermal sites. The known distribution of Kivucian geothermal sites is necessary in taking decision about the sweetable and detailed study about the power geothermal energies industry. The origin of these sites differs. Ones are due to the volcanoes and others are due to the tectonism orogenies regarding to the distance far from the first case. In the same case.

The studies we tried to make load on the real distribution of geothermal sites in North and South Kivu. We would like to annex even Maniema but the period of field campaign allowed yet, so another paper.

The study could be completed by field slavery, but some sites are in the National parks (Virunga) around volcanoes and others are milicians zones (Masisi, Lubero). In this case, we referred to old or/and oral dates.

The General goal of the paper is to identify the origin and the relationship of geothermic sites of the Geological province, lithological dates around the sites that can help the understanding of responsible events, in detailed site, the anthropic roles of outcrop or no of hot water is to take in consideration by deciding about the importance of the site.

This geothermal sites distribution allows Professors and students to prepare the practical of General and applied Geophysics to mining exploration, in the same case, this is the preliminary point to prospect borrowed faults under sedimentary rocks.

## METHODOLOGY AND MATERIALS

Geographical this study carries on the flats of the west side of the Congolese Rift valley. For the moment, the paper is about the Ruthuru-Masisi-Kabare-Walungu territories.

For the realization of this research, we made the use of materials of the field studies, the use of GPS for the geographical

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<sup>2</sup> BRGM, *Etude de faisabilité d'une microcentrale en source thermique en Afrique*, Rapport N°2, Faisabilité, Juillet 1983  
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positioning of the studied sites, a compass for the geometric identification of the geological units of the sites, a thermometer to read the temperature of the water, plastic jars to transport the samples. The section laboratory was proposed of microscopy for rock geochemistry and heavy elements in water. The last case is yet completed because of missing a quick and nearest equipment.

To achieve our goals, we used large-scale field survey, collection of samples for analysis at the laboratory level. The results of the laboratory were submitted to a treatment in order to deduce the nomenclature of some rocks around of the geothermal waters of the studied area. To verify the quality of rocks unities, the outcrops are the affirmation of untransportation wherever the pebble determine the transported sols.

Before the field surveys, we took quick propositions such as:

The positionnement of each one indicate his origin, the neighbor lithologies are probably metamorphic, and many of the sites might be upstairs faults.

## **DATA PRESENTATION, ANALYSIS AND INTERPRETATION**

Most of the Kivucian hydrothermal sites are located on areas of magma upwelling, and at proximity of borrowed faults. In this area hydrothermal activity are concentrated on sites separated from a few tens of meters to some kilometers, characterized by multiple outlets of fluids in certain cases.

When the warm waters rise, they can reduce temperature in contact with more superficial geological layers. These temperature variations modify the chemical characteristics of hot water. The temperature of thermal water is a characteristic on the solubility of the suspicioned minerals, thus, solutions are saturated with certain mineral species and these elements precipitate, the chemical deficiency affects their physico-chemical map. The geothermal water gives a mineral character to the soils of the crossed pedoligical profile; it provides information on the fracturing rate of the bedrock.

## **SOUTH KIVU**

Apart from the Precambrian basement, the geology of the Northern Bukavu region has two types of volcanism: Cibinda-Kalehe in the East and Kahuzi-Biega in the West. The first one is the last manifestation (lower Pleistocene) of volcanism of South-Kivu. Cones are built on four faults (F1, F2, F3 and F4) figure N °4 sub-parallel general management NNE-SSW. Sedimentary land of the Ruzizi plain was evaluated about 1500 m thanks to gravimetric measurements (YZQUIERDO, 1960)<sup>3</sup>.

This Province is full of geothermal sites, Lubugaa, Kavimvira, Katogota, Masuza à Runingu site in Uvira territory; but also thermalism at Ubwari, Kichula, Musigilwa in Fizi Territory; Mahyuza at Luhihi in Kabare and thermal sources at Kamanyola and Nyangeziin Walungu<sup>4</sup>

## **Nyangezi Hydrothelism**

The city of Nyangezi is a geographical entity 35 km South of Bukavu city, on the road linking Bukavu-Uvira. It is an integral part of Walungu territory. The region is part of the Southern flanks of the Biega volcano. Depending on the current rocks in this area, lava is spreading so that forests and rivers disappear. It was covered by a layer of basalt just a few million years ago. This lava in contact with rivers has developed cracks that open on the occasion of next jolts. In this warm and mostly humid climate, part of the lava slowly cools in this plain covered with rivers where it shrinks and cracks

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<sup>3</sup> ILUNGA Lutumba. 1991, *Morphologie, volcanisme et sédimentation dans le rift du Sud-Kivu* in Bulletin de la Société géographique de Liège, 27, 209-228

<sup>4</sup> <http://www.sudkivu.cd/index.php/explore/potential/attractions>

regularly (shrinkage cracks) from where volcanic orgue formation here, rocks seen in Bukavu and Goma . **Photograph N°1**



**Photograph N ° 1** riparian lithology of the thermal spring of Nyangerzi, respectively the basaltic orgues , Quartzite and plain of Ruzizi's deposit hosting the studied site

At the site, no large than hundred diameter circle, four outcrops of geothermal are sown at geographical coordinates 0708353 of latitude and 9705105 of longitude and on an elevation of 1526 m of elevation, the second on 0708252, 9704973m 1521, followed by 0708361, 9705129, 1526 and lastly 0708385, 0705128, 1524 this case of noncentralized sources on resurgence indicate surely the borrowed fault in the depth. Differently to other sites of the region, artesianisme attested by the rarity of froth is poor on this site. At the source, the profile is essentially a place, a grayish-black clay deposit, some meters to the South-East a mega deposit as flow of the plain Ruzizi takes place. It flows on a short distance around 50m on NE-SW before waiting Mugeru River.

As part of the hydrography of the plain of Ruzizi in its Northern part, surroundings of the hydrothermal site is a sedimentary deposit, **Photograph N°2**, the sense of this section of the plain does not deviate at all the sens of the rift orientation. On this site, in a broad valley bordered by hills: Bangwe, Lubona and Randayi is an interior Graben around in this region whose Rizizi river would be main axis. The geomorphology and outcrops of the site allowed concluding to be in hidden fault. Sources of Uvira should be the continues of the fault in the south of this site.

The potential of this hydrothermal source, recognized by the turbulence and the richness of foam is less representable compared to the other sites of the same fault in the North.





*Photograph N ° 2 thermal spring of Nyangezi. Ab) Resurgence, c) casting*

In the same region, around the Kahizi-Biega, another geothermal site is probably seen in Kamanyola according to its position it may belong to another fault network near the Ruzizi river. This must be dedicated to a volcanic branch from Bukavu city. This one did not be visited and does not appear in this section.

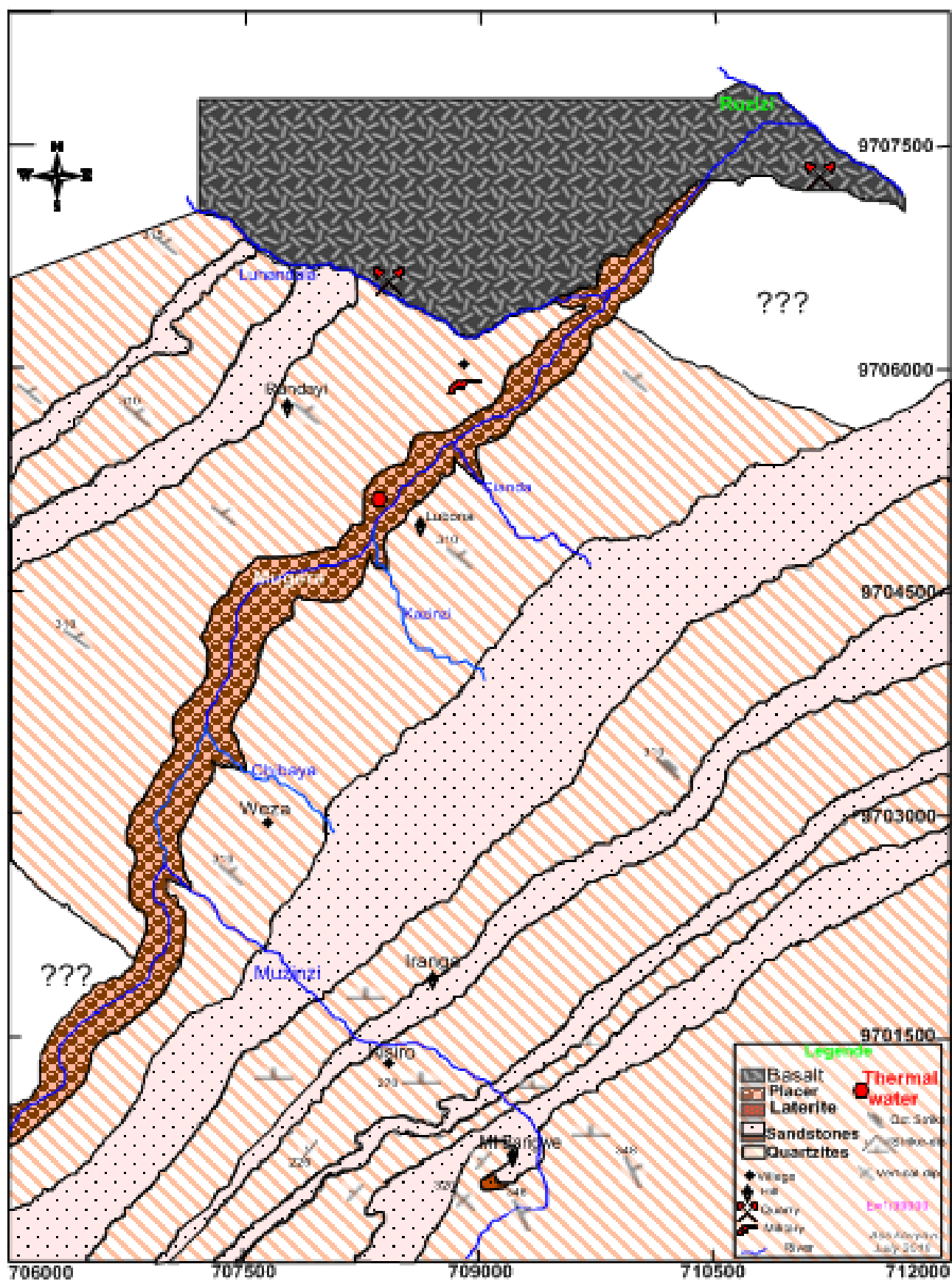


Figure N°1 Nyangezi liho-structural map indicating the geothermal site, our works

### **Katana Hydrothelism**

In opposition to Nyangezi site, this agglomeration is located 14 km North East of Bukavu town in Kabare territory. This thermal unit, belong likely to the Cibinda-Kalehe volcanism. A plurality of thermal waters points in this area noncolinearly attests a fault or a continuation of the micro faults. Being in the rifting zone, the origin is due to a fracturation of the basement lithology. At some points of water, carbonates colonize the abounded outcrops.

In Katana region, the thermal waters are mainly located in more than five sites including Buhandahanda, Kankule, Cimenki, Ciziri and Maziba<sup>5</sup>. It is a volcanic region characterized by break Kahuzi volcano. The classification of thermal springs of Katana according to their hydro-chemical characteristics and their plant environment show a temporal variation of the parameters. Some results show that, depending on the temperature, the thermal waters of Katana are hyperthermal or mesothermal (40-70 ° C) and vary from one year to another. In the same way, the pH recorded in the study sites are usually between acids and basic and varies from year to year too. This physicochemical complexity shows an independent thermal system of each other. For the moment it is not possible to imagine hydraulic connections between the different geothermal zones studied. But as geologist, the site is held by micro branches of faults as middle of the mean one across the Kivu.

### **NORTH KIVU**

The North-Kivu remains the most and worn full touristic Province of the DRC; it is the most volcanic of Central Africa nowadays and carries a strong thermal gradient till now. It is the only one site to have so many geothermal sites of the country and can even be counted among those of the continent.

Most of thermamism sites of this area are in non-accessible zone because of milissians. Some of them around the Rwenzori Pic, **Mutshora** in Northen of Virunga National parc and **Mayi ya Moto** in it's south ssector. Others are distribuated by hazard in the province **Musigha** in Lubero Territory and **Masambo, Kambo** in Beni Territory, these last sites may be due to the sleeping volcano of Kayivumba on the Butemb-Beni road. **Mahyutsa** is the nearst of North West of Goma in Masisi, We recognize **Kisumu, Mwima, Mitwa, bitaata**.

### **RUTSHURU TERRITORY**

This territory in turn attracts tourists due to its roughness, whose cause is volcanic (cones, lava, arbors) caves (Nyamabere, Bukima, Kanombe, Nyabikere). The volcanic field activism in the territory of Nyiragongo is accompanied by hydrothermalism, which seeps into the park, Mayi ya moto, Kanyangwazi. The other one is localized in Nyanzale, Rutshuru Territory. All of these sites as in protected area and red zone are till now non studied or less and these studies might belongs to foreigners as tourists welcomed by PNVi.

#### **The hydrothermal source of Rwindi**

Known vernacularly under the name Mayi-ya-moto (hot water) is located on the national road connecting Goma-Butembo in the Park. The thermal waters come out of a crack on five points of slope inclined towards the East. These waters flow over a distance not more than 250m from the left bank of the Ruthsuru River. For this site, the hydrothermalism springs on five points, **Photograph N°4**, insecurity overlapping this part did not allow us a physical contact, we expired bibliographical data from surveys of memory study.

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<sup>5</sup> BAGALWA.M et al, 2015, *Caractérisation physico-chimique et identification des espèces végétales indicatrices des eaux thermales de Katana, Sud Kivu, République Démocratique du Congo* in *Revue internationale des sciences et technologie*, N°5

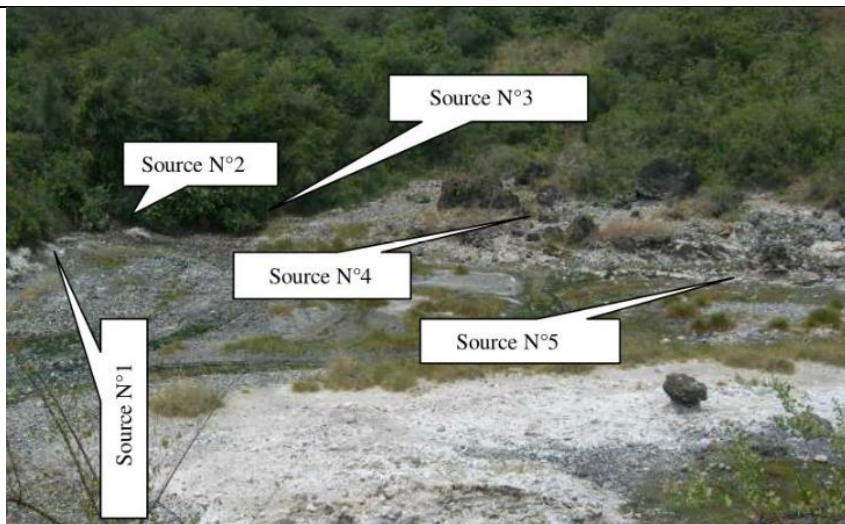


Figure N °2 illustration of the Rwuindi thermal site

The surrounding geological facies of the source is essentially metamorphic consisting of schists. This site is probably to be counted among the most notable easily accessible because located about ten meters from the road, but the milicians lead us difficulties. The essentially deep origin of C, Cl, S are at the base of the mineralization of this source, their presence is associated with volcanic and/or tectonic phenomena<sup>6</sup>. The same research states that from these three elements to which must be added water vapor and Nitrogen constitute the greater part of gas or fumaroles found in an active volcanic zone. The presence of a site on a sidewall at a height apart from the fissure belonging but rather the model associated with the magma chamber of Virunga, Nyamulagira the nearest caldera whatever the distance. The **Table N°1** gives a chemical analysis of the site.

Table N°1 gives some of the chemical characteristics of this sample

Parameters	Source 1	Source 1	Source 1	Source 1	Source 1
<b>T°</b>	90	92	92	85	89
<b>pH</b>	6,85	6,60	6,94	6,79	6,70
<b>Cl (mg/l)</b>	1060	1135	1095	1100	1120
<b>CaCO<sub>3</sub> (mg/l)</b>	0	0	0	1	1
<b>CO<sub>2</sub> (mg/l)</b>	124,2	129,1	119,3	122	117,6
<b>S0<sub>4</sub> (mg/l)</b>	988,8	1056	1367,04	2019,3	1036,4
<b>P0<sub>4</sub> (mole/l)</b>	0,11	0,155	0,106	0,109	0,175
<b>N (mole/l)</b>	87,12	66,56	110,34	87,86	94,65
<b>N0<sub>2</sub> (mole/l)</b>	69,77	49,29	82,23	65,98	75,12
<b>MS g/l</b>	1,8	2	2	1,8	1,57
<b>Ammonium (mole/l)</b>	8,44	5,69	6,25	3,89	4,73

From the data in Table 1, it should be concluded that the waters of this site are rich in S-Cl and yet low in Carbonate. This deficiency is explained by the great depth from which waters originate, while the other elements are attributed to fumaroles, which gives this spring a volcanic origin. The temperature probably meets this conclusion.

Contrary to the feasibility studies of a geothermal power plant in Africa by P.VERWIER in 1983, as for the temperature, this site returns more worthy than the three (Gisenyi, Ruhwa and Betsiaka) the best of the study. The potentiality of this site is more given to the volcanism of the region.

The lower security in this territory doesn't allow us to reach the site of Kanyangwazi, and it seems till now no monography is about the rest of Rutshuru area, the membership of the Virunga National Park does not allow too a site survey to highlight the conformal geology of the first site.

<sup>6</sup> CIRHALWIRWA B.A, 2010-2011, Etudes des sources thermales du Parc National de Virunga/Province du Nord Kivu Distribution et composition chimique et genèse, mémoire Inédit UNIGOM



## MASISI TERRITORY

This agglomeration, opposed to Ruthuru by Nyamulagira volcano hill, it is rich in salt water as seen in the bed flat of Luhinsi, Kitobo, kwiriba, Maliba, Kisumu; the geothermal energy of this Territory is in the city of Sake at 23 Km NW from the Goma city, Kisumu, Mwima and Mitwa while Bitata (Bulinda) belongs to Walikale.

### Sake Hydrothermal

This geothermal source is located in the neighbor of Sake at 1000m North from the center in the valley. The thermal waters come out of an emergence in four nonlinear points; they each constitute a halo whose diameter is less than 1m. These waters flow over a distance less than a half Km on the left bank before mixing with the Kihira River. As seen, they have a greyish to blackish and yellowish color like those of Nyangezi. The last color may be due to Sulfide concentration in water and can be attributed to fumeroles of volcano in the region. *Photograph N°5* the table N°2 locate them.

**Table N°2** Location of emergence points of Sake's hydrotherapy.

N°	Northing (m)	Easting (m)	Elevation (m)
1	0727610	9827186	1495
2	0727638	9827191	1495
3	0727653	9827199	1493
4	0727769	9871896	1494

Source N° 1 of Table and *Photograph N°5d* is the hottest due its foam and ebullition, a video can be present to show more details.



*Photograph N° 5 the geothermal site of Sake / North Kivu*

The surrounding facies of the source is essentially metamorphic consisting of schisto-Gneissic whose structural data is weightily N25°E-70°ESE. In addition to this foliation (schistosity), we can see cracks whose direction varies from N20°E-70°ESE to N36°E-88°ESE, *Photograph N°6ab*. Generally, the source is located in a flat wide about 500m and a sudden slope is seen on all sides. These springs emerge after concentrating on a bed for a shorter distance and escape under slag. On some points, precipitous construction yellowish sulfur from volcanic H<sub>2</sub>S is built on the plants, *Photograph N°6c*. The Geological survey recognizes this hydrothermal source as shown in the *figure N°3* of the Sake Geological mapping in pyrolytic projectiles of scoriaceous appearance up to 10m thick. The Basalt is also among the mean rocks in the region.

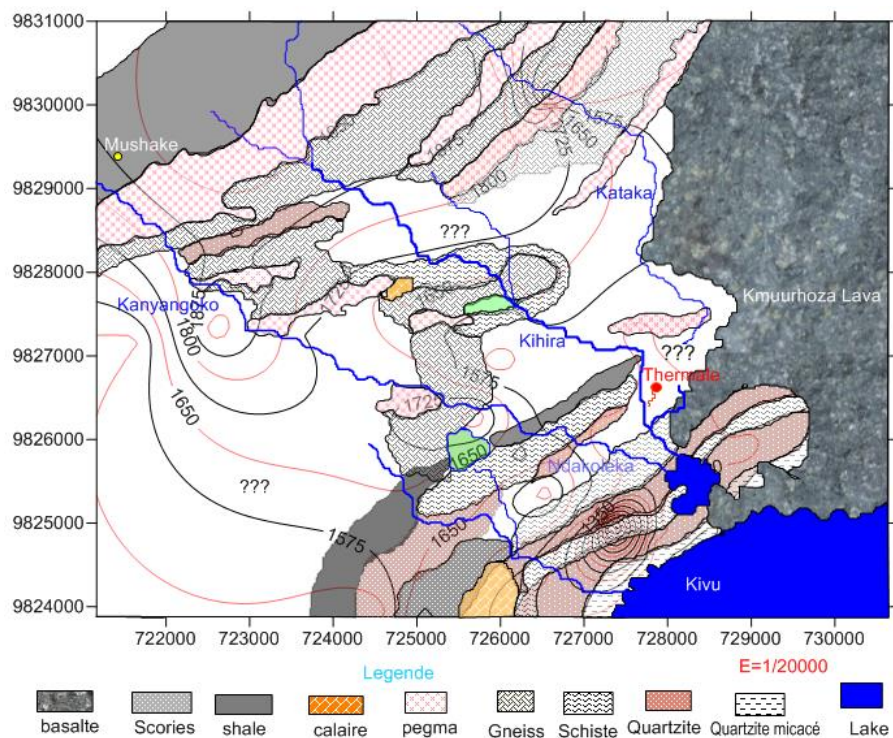




Photograph N ° 6 lithological aspects of the vicinity of the geothermal site, Schist and Gneiss, deposition of sulfur around.

G. PASSAU reports the existence of the thermal spring of Sake, while N. BOUTAKOFF exposes the part that can be drawn from thermo-mineral sources from the tectonic view.

The genetic model of this site is attributable to a blind fault or fled under the basaltic pyroclastites that covers the hills and around the vallies per erosional system. This fault would be the continuation of that which hosts the site of Katana; this is materialized by the Bubandano-Makelele Mylonitic in shear zones, with basculment at Rwamiko-Bitabanga-Kahanga.



## Discussion

The target in this paper is water whose temperature is higher than the average temperature of the water table of the region. In general, for a region, the temperature of the regional waters is very near to the average annual temperature of the air in this same region. Soil and subsurface water temperatures track changes in air temperature with a time lag and damping that increases with depth<sup>7</sup>. As the convection current densifies the matter in the evolution of the globe (Ocean Ridge-subduction) it is the same to understand the evolution of the hydrothermal system. The phenomenon is like water in a boiling pan, hot water from the bottom, over pressured and expelled in the form of steam to gain the surface leaving room for the cold one.

Thermal waters, due to the temperature of the reservoir, acquire special chemical properties, different from the characteristics usually observed for cold surface waters.

The existence of magma chamber being at small depth in Kivu, the quantity of vaporized water changes state in its ascending course and reappears on surface being liquefied; its chemical composition is enriched in metals resulting from the leaching of the facies (strata) traveled. The cases of Rwindi sites are the model and have this origin.

The hydrograph of a hydrothermal sample is a function, as mentioned above, of the rocks and the couriered mineralization. At the outcrop, they deposit metalliferous concentrations characteristic of their thrusting. The site of Sake is one of this, the yellowish concentrations simulated to Sulfide of volcanic system, whitish mounds; even taken as due to the fault, the fault is linked to the volcano chamber.

The exploitation of Kivucian Geothermic must be preceded by a good and main knowledge about the sites distribution in the lands, their origins might be known because future phases such as building and equipping (geotechnics) of sites may be decided taking care of neighbor lithologies and some structural dataes. This identification helps students, professors and government hold to have idea about the geographical repartition of this richness.

Our studies don't go much out of the past one, in some cases there are few complements the specialty of the paper is including sites' lithologies and dedicate the origin of each one because of signs on out crops. In the past studies, efforts are made on chemistry of samples and were ignoring the rocks that can influence the behavior of analyses and all decisions.

## Geological appearance

For all geological project, to get a complete idea about geothermal, a cartographic study preceded by the interpretation of satellite Photographs, petrography and petrological study of surrounding geological formations of the target sites, a field tephrochronology, and probably the volcano aspect -structural, the location of active and passive thermal water sites, the identification of the depth and physico-chemical properties of geothermal reservoirs are concepts that the prospecting phase must take into account.

In the Kibarien, geothermal activity is linked to lands metamorphosed by intrusions. These lands carry mega cracks communicating with the deep zones. Geothermal exploration begins with the structural geology phase because in many cases, thermal waters are related to tectonics. It is advisable to seek thermal waters preferably in the vicinity of major faults and sometimes in the chimneys in collaboration with the neighborhoods of the magma chamber. If their existence on the submerged flanks of volcanoes has always been known, they are the sources of the great depths.

If we consider the location of the sites in the central massif chain volcanoes in France, there is a certain alignment along the fault Limagnes (stations Clermont Ferrand, Chatelguyon, Royat ... which shows the important link between Structural Geology and the localization of thermal lifts, thus providing a guide for blind faults.

The fault or the fault bundle that limits the Kivu tectonic trench to the west is located on the edge of Lake Kivu, the small

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<sup>7</sup> Vincent VALLES, Cours sur les eaux thermales



hydrothermal source of Sake is certainly related to this fault. However, during the ascent, the warm waters can cool in contact with the more superficial geological layers and according to the mineralogy of these layers, which modifies its physical chemistry<sup>8</sup>.

In Kivu there are mega structures relatively separated from each other by plains or vallies parallel to the rift, these zones are well, locally, the seat of hydrothermal manifestations. Their frequency does not account for the hydrothermal activity, the segments of which they limit. South-Kivu is a target of the faults; the *figure N °4* gives a view North and South Kivu Panafrikan orogeny. Given on the same Photograph, the alignment of hot springs from Nyangezi to Sake is carried by a fault attested by mylonite as shear zone. The case near of electrical cutted hotline each year on Nyamukanga river side, at border of provinces at Minova is due to a rhythmic faults activity in the region.

The hydrothermalism results from the condensation of water vapors escaped from the magmas. The deep firing of rocks of superficial origin, hydrated, leads indeed to the release of water vapor, the "juvenile" origin. Certainly, thermal water is essentially vadose water. Sometimes it can be fossil water, containing mineralization characteristic of its deposit conditions. It should therefore be noted that, in general, thermal water contributes to the general circulation of the water cycle.

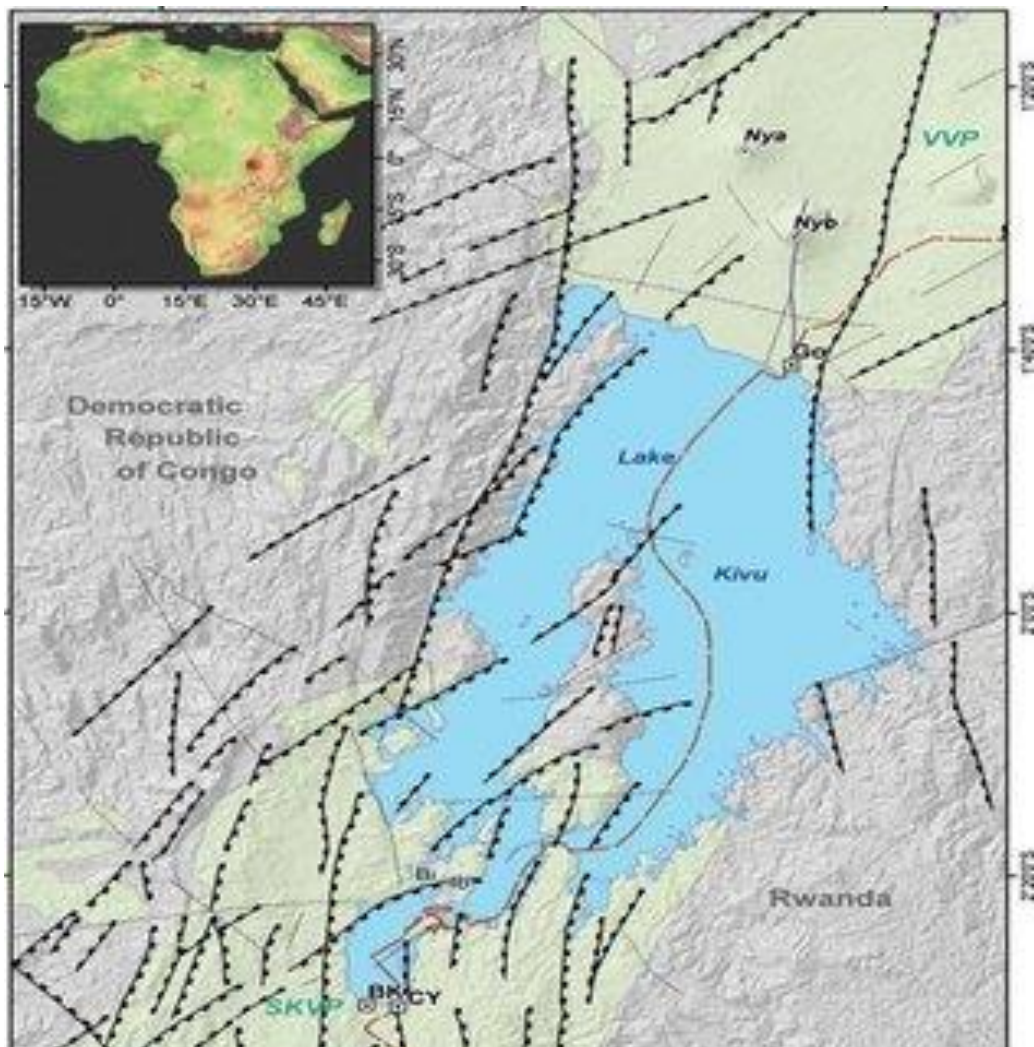


Fig N ° 4 Strutural aspect of rift in Kivu

<sup>8</sup> **Paul PASTEELS, 1961, Géologie et Pétrographie de la Région de Kiotshe (kivu), Mémoires in-8°. Nouvelle série. Tome XV, fase. 2.**



## Conclusion

The geothermal wealth of the DRC remains to be found in some corners and in most cases, in connection with the pan-African demonstrations and in other cases in connection with the volcanic field under the liquefaction of later volatiles.

The territory of Walungu and Kabare remain colonized by volcanic outflows whose cracking surfaces hot springs as seen at Nyangezi in the South and Katana in the North of Bukavu city. For this part of the region, all geothermal sites are in sedimentary lands hosting faults. This system is around the Kahuzi-Biega volcanic field but not necessary due to it.

Around the volcanic field of Virunga, it is undoubtedly to retain hydrothermal emanations whose origins are diversified, on the one side following the infiltrated meteoric waters emerging through the NNE-SSW faults or parallel to the Rift (Sake) and other side due to the liquefaction of magmatic vapors from the magmatic chamber (Rwindi).

Compared with the Ruhwa geothermal site in Burundi, Gisenyi in Rwanda and Bitsiaka in Madagascar, the Kivucian sites are, as depending on the temperature, high level of potentiality and merit a thorough study according to precise objectives.

The ICCN authority specially Virunga National Park's must be flexible for accompanying researchers to attend the site of Rwindi, on which deep studies might be good in the region,

The government must also guaranty the security and allow research by equipping and permit research center per province, this can emulate young students to make efforts and have supervisors.

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