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Geothermal Development and Exploration in Malawi-Country Update

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ABSTRACT

Malawi continues to experience insufficient and intermittent hydro-electric power supply so much that the country is now looking for other alternative sources such as geothermal energy resources. The country has geothermal manifestations in form of hot springs which can be used to generate electricity.

In view of this, the country applied for a financial assistance to the World Bank through Energy Sector Support Project to initiate geothermal resources exploration. The Ministry of Natural Resources Energy and Mining through the Department of Energy Affairs and Geological Survey Department contracted ELC-Eletroconsult, an Italian private company in 2016 to do the exploration for geothermal resources in Malawi.

The implementation of the project was done in three phases. The work included detailed geological, geochemical as well as geophysical surveys among others. This led to the selection of two geothermal potential sites such as Kasitu and Chiweta in the third phase. The selection was based on technical and non-technical criteria. It is therefore planned that, when funds become available, the exploratory drilling programme will be considered for both sites starting with Chiweta .

In terms of capacity building, a number of officers from various organizations such as Geological Survey of Malawi, Department of Energy affairs, Malawi Energy and Regulatory Authority (MERA) and others received training at different levels in different countries ranging from short to long term trainings.

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1.0 Introduction:

Malawi has a number of natural resources that could be tapped for the development and production of electric power to feed the country's growing domestic and industrial needs. These natural resources range from hot springs, biomass produced from sugar production, tea processing and timber processing plants; uranium reserves, coal reserves and water in rivers and lakes that could be used for power generation. In addition to that, the country has over twenty five (25) known geothermal manifestations spread throughout the country. However country. However, there could be other manifestations which are yet to be identified.

Some geothermal resources are manifested in form of hot springs, as such, geothermal energy appears to be a possible alternative energy source for the country. However, Malawi did not have enough information and data relative to geothermal resources to determine whether or not it is feasible to develop these resources to economically provide power generation or serve as sources for any of the many direct uses of geothermal energy

This necessitated the Government of Malawi through the Ministry of Natural Resources, Energy and Mining to ask for a financial assistance (in form of credit) from the World Bank to support the implementation of the Malawi Energy Sector Support Project (ESSP). The ESSP was expected to build capacity in the electricity generation subsector by bringing about diversification in the use of alternative sources of energy for power generation, including the possibility of generating power from wind, solar, thermal (using coal), biomass obtained through sugar, tea and timber processing and from geothermal sources.

The overall objective of the project was to increase the reliability and quality of electricity supply in the major centers of Malawi. Currently, the country's power is exclusively generated by hydro projects from the Shire River, located in the southern region of the country, and the Wovwe River in the northern region.

2.0 Malawi's Geographical Location

Malawi is geographically located within the Great East African Rift System, where both Kenya and Ethiopia are successfully generating power from geothermal resources. Specifically, it lies between latitudes 9º S and 17º S and longitudes 32º E and 36º E in the southern end of the Western branch of the East African Rift System and has over 25 geothermal manifestation sites in form of warm and hot springs, (Dulanya, 2006).

Most of the geothermal springs occur closer to the shore of Lake Malawi, especially in the north and central part of the country while in the southern part, they are scattered with no clear structural control. The geothermal manifestations consist of warm to hot springs with surface temperatures ranging from 40-80 °C and subsurface geothermal reservoirs of temperature between 119° and 135° C at maximum depth of 500-750m with electric potential of about 7 to 15 MW.

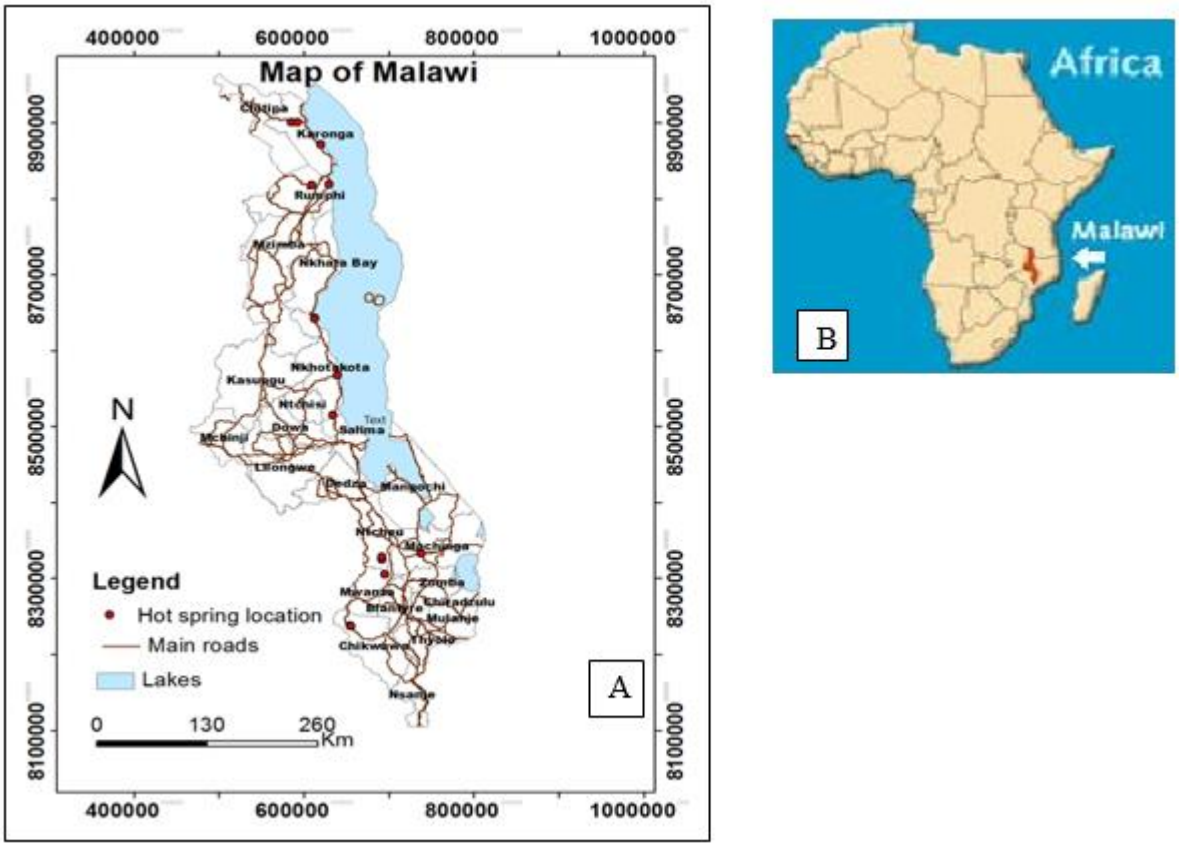

Figure 1 (A & B): Map of Malawi (A) showing the study area and Africa (B) (source-google map, insert) showing location of Malawi

In order to stimulate the geothermal development in Malawi, the government hired an Italian company (ELC-Electroconsult) to carry out a general assessment of all geothermal resources in Malawi, do the Pre-feasibility Study and make recommendations to the Government accordingly.

3.0 ELC-Electroconsult project.

The project was divided into three phases as follows:

3.1 Phase I:

In this phase, the focus was mainly on the reconnaissance study of all the geothermal manifestations. This involved visiting all geothermal sites to get a general overview of their geological setting, collecting water as well as rock samples to get information regarding the origin of the fluids and the underground temperatures. The Geological and Geochemical surveys were also done as follows;

3.2 Geological Survey.

The survey involved assessing the main stratigraphic, structural and hydrogeological features which were believed to have control over the formation and distribution of the geothermal system. The survey included Remote sensing study over a surface of 200 km^2 as well as Geological mapping over a surface area of some 100 km^2. Rock samples were also collected for petrographic analysis.

3.3 Geochemical Survey.

This involved collection of about sixty (60) water samples from thermal and cold springs, boreholes and surface drainage. In addition to that, about eighteen (18) thermal water samples were collected for the determination of dissolved gas species.

4.0 Ranking of geothermal sites (prospects)

After the assessment of the geothermal prospects or sites in stage I, they were ranked basing on a set of indicators. These indicators were considered as factors that were likely to affect the future development of these prospects or sites. The factors were grouped into technical and non-technical parameters. Examples of Technical parameters were temperature, flow rate, geology and chemistry while the non-technical parameters were distance from grid, morphology, accessibility and environment. The Technical and non-technical parameters were given a score basing on their assumed relative importance. Those geothermal prospects with higher scores qualified into stage or phase two.

4.1 Phase II

In this phase, six (6) prospects were selected basing on rankings as described in (4.0). **Thesewere Chiweta, Kanunkha, Kasanama, Mawira, Chupudzi and Kasitu prospects**. The prospects were subjected to detailed work which involved remote sensing study, geological mapping and geochemical survey. The geochemical survey involved collection of water and gases. At the end of stage II, a new ranking was defined and two prospects were selected.

Figure 3: Some members of the exploration team doing water sampling at one of the geothermal spring site (Source: Field photo)

4.2 Phase III:

In this phase, the two singled out prospects namely: **Chiweta (Figure 3) and Kasitu** were subjected to additional geoscientific investigations. This included detailed geological, geochemical and ground geophysical surveys. The geophysical work mainly focused on magnetotelluric/transient electromagnetic (MT/TEM) and gravimetric surveys. Finally, the integrated based conceptual models revealed subsurface geothermal reservoirs of temperature

between 110° and 135° C at maximum depth of 500-750m with electric potential of 7 and 15 MW for Chiweta and Kasitu geothermal prospects respectively, (ELC-Electroconsult, 2016).

Figure 3: Part of Chiweta hot spring (Source: Field Photo)

5.0 Way forward

Currently, the government is looking for funds to do exploratory drilling programme at Chiweta prospect.

6.0 Capacity building

On capacity building, the United Nation University Geothermal Training Programme (UNU-GTP), Geothermal Development Company and Kenya Electricity Generating Company have trained about fourteen (14) Malawians in Geothermal Surface Exploration since 2010. By 2017, four Malawians had benefitted from the six months training fellowship under UNU-GTP in Iceland. Amongst them, two attained Geothermal Sciences Master's Degree at Reykjavik University and University of Iceland. Three officers received on job training by ELC-Eletroconsult through the World Bank funded project.

In addition to that, the ELC-Electroconsult offered basic training in Geothermal exploration to some officers from different institutions and also organized a study tour to Italy for five government officials to appreciate the successfully implemented geothermal power project and geothermal direct use applications with respect to high, medium and low enthalpy fluid.

Finally, in 2016, one officer from Geological Survey Department also attended a two week long first International Summer School in Geothermics at Pisa University in Italy.

7.0 Conclusion

In conclusion, Malawi has made some strides in geothermal development by having all geothermal sites fully assessed and also training her staff in various geothermal related fields. It is hoped that these efforts will bear positive fruits in the near future.

8.0 REFERENCES

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