Geothermal Development in Republic of Mozambique
A Country Update Report

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Abstract

Since Mozambique is intersected by a system of rift fault running north-south, the potential of geothermal energy resource for electricity generation and direct uses is high. The tectonic setting and geological set-up associated with surface manifestations indicate that the area has a good potential for development of geothermal resources.

The recent studies of geothermal, conducted in 2013, by Government of Mozambique which commissioned the Atlas for Renewable Energies of Mozambique was focused on hot springs in six provinces. The methodology of the study has focused on geology, geochemistry, hydrology and geophysics with the aim of elucidating subsurface temperatures and the spatial extent of the geothermal systems.

The overall objective of the study is to develop geothermal energy to complement hydro and other sources of power to meet the energy demand of rural areas. The results indicate that the geothermal potential is evaluate at 0.1 GW for electricity generation and direct use.

Keywords: East African rift system, Hot spring

1. Country Context

Mozambique is a vast country with a total population of 28.8 million people and a population density of 36.7 inhabitants/sq.km.[1] Annual population growth is 2.9% and the average life expectancy is 55.4 years. Most of the workforce lives of subsistence agriculture and informal activities: the informal economy has a very high rate of over 90%[2].

The annual gross domestic product (GDP) growth has averaged 7.4 percent over the past two decades facilitated by trade, manufacturing, extractive industries, transport, communication, and electricity production

1 https://data.worldbank.org/country/mozambique
2 www.ilo.org

2. Status of Electricity Production

2.1.Electricity sector

The Ministry of Mineral Resources and Energy (MIREME) is the government entity responsible for energy policy and planning, as well as monitoring sector performance and governance. The current institutional structure of the power sector was established in the 1997 Electricity Law. In terms of electricity, Mozambique has a high generation capacity for electricity compared to its domestic consumption. In 2016, a record of 18,75 TWh was produced. Less than one-third of this electricity was consumed in Mozambique. Two-thirds are sold to neighboring countries, making electricity one of the main export products of the country. The installed capacity of all generating facilities in Mozambique currently adds up to 2.905 MW (2017). The majority of the electricity is produced by HCB (Hidroeléctrica de Cahora Bassa), the operator of the Cahora Bassa hydropower dam in the Zambesi river. It has a generation capacity of 2075 MW. Of this capacity, 500MW is available for domestic use and the remaining is contracted to foreign customers as indicated above. The production is for 90% hydro-based and around 10% natural gas.

3. Status of Geothermal Development in the Country

3.1. Geology

The geology of Mozambique covers almost all periods of the Earth's history. Tectonically the Precambrian is found in three Gondwana blocks – E, W and S -, each one of them with its geostructural characteristics, and separated from each other by great structural features. For Phanerozoic, reference is made to the Karoo Supergroup (Upper Carboniferous to Early Jurassic), and to the East - Africa Rift System (Jurassic to the present), with origin linked to the Gondwana fragmentation and the opening of the Mozambique Channel, where the great sedimentary basins of Rovuma (N) and Mozambique (center-S) can be distinguished, both world-wide known for the discoveries of hydrocarbons.

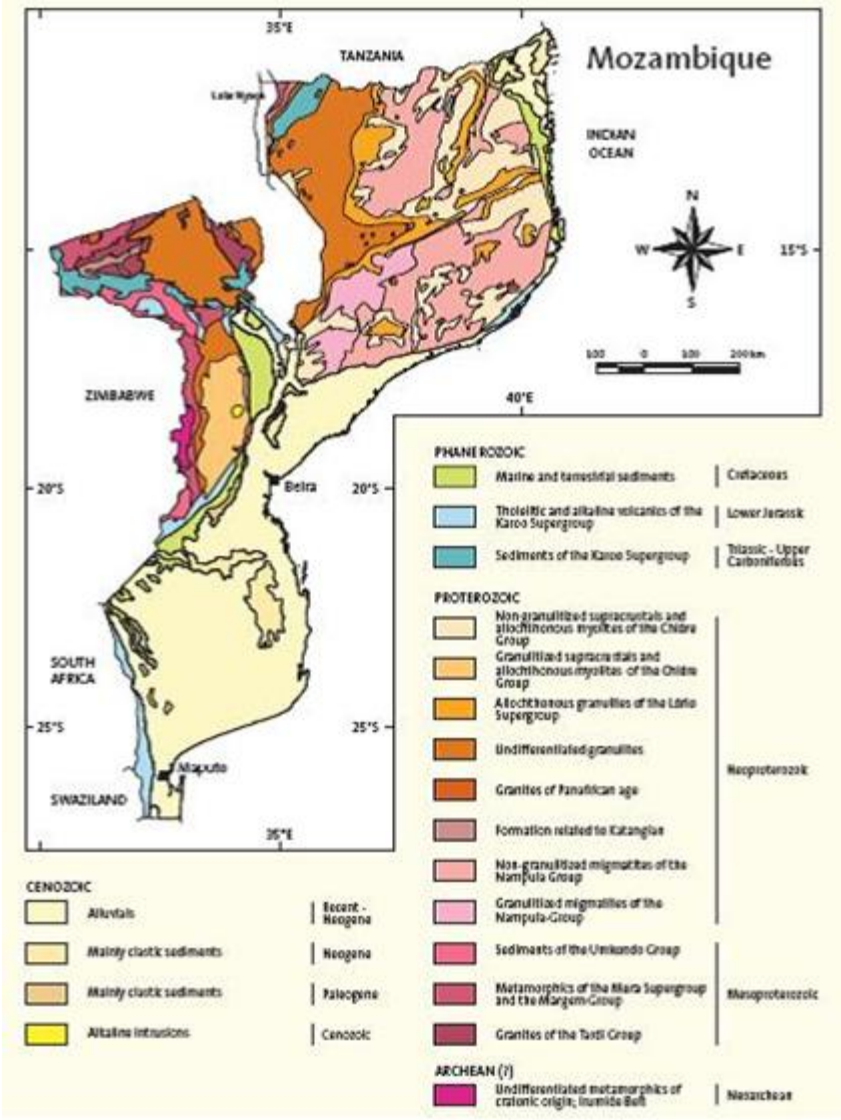

Fig.1 Geological map

3.2. Previous study

A preliminary evaluation of local geothermal potential in unexplored areas was completed by McNitt (1978) who considered the presence of recent volcanism, hot springs, and other geological indicators. Koenig (1981) evaluated geothermal potential of Mozambique at 25 electrical MW on the basis of 26 hot springs identified. Other preliminary considerations on geothermal potential of Mozambique were made by BRGM (1980), Aquater (1980) and Direcçao Nacional de Geologia (1981). Martinelli et al (1995) considered the northern and

Central Provinces of the Country most promising areas for geothermal energy development in small-scale power generation.

3.3. Recent exploratory activities

Mozambique has a complex geologic history, with several orogenic cycles, from archaic ages in the north central area to more recent ages in the south. Tectonically affected by a regional geological structure, the East African Rift has a north-south orientation that crosses the east of Africa and a section further South that crosses Mozambique and geothermal emanations occur in the form of thermal springs and reach temperatures that in some areas exceed 60ºC.

In 2013 the Government of Mozambique commissioned the Atlas for Renewable Energies, and the geothermal survey focused on geology, geochemistry, hydrology and geophysics in six provinces (Manica, Tete, Nampula, Niassa, Zambézia and Sofala.).

A geochemistry campaign was conducted, in which 22 samples of water were collected from hot springs, mineral springs, water pumps, rivers and sea.

The water samples collected were submitted to hydrochemical analysis (cations and anions) and ion and isotopic chromatography, from which geothermometers were calculated, indicating the estimated temperature at depth.

The geothermometers of 4 sites indicate enough temperature for electricity production (above 150ºC): Boroma (164ºC), Morrumbala (153ºC), Maganja da Costa and Namacurra (155ºC).

A campaign of geophysics was performed in the 6 selected locations, distributed by the provinces of Tete, Zambézia and Niassa, with the acquisition of approximately 250 magnetotelluric and gravity stations collected over more than two months. The analysis of geophysical data allowed identifying areas with low resistivities that may indicate potential geothermal reservoirs at depths ranging between 1.500 and 2.500 m.

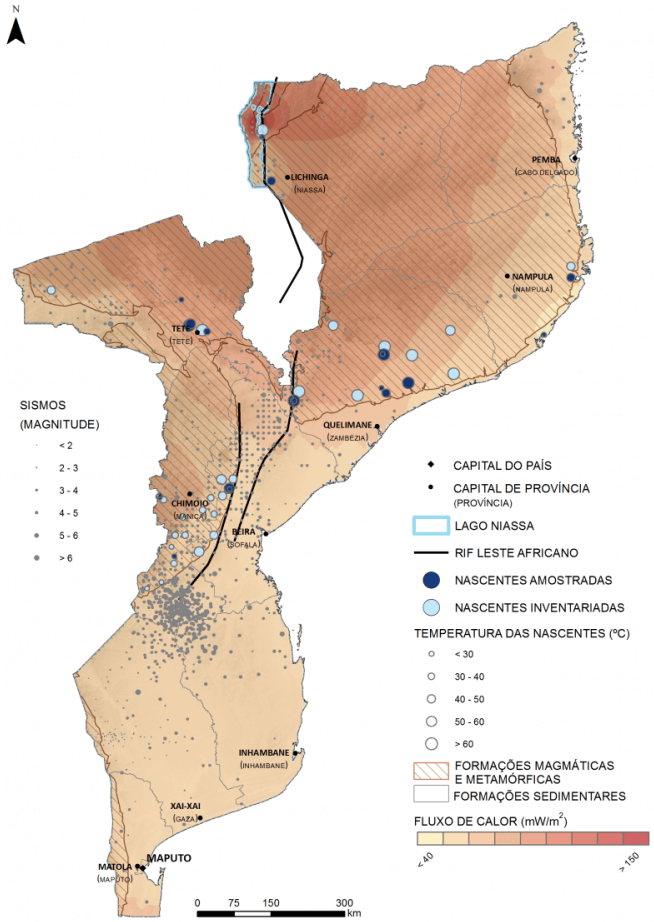

Fig. 2 Geothermal potential map

4. The Government's Vision for Geothermal Energy

In 2011, Mozambique approved the Renewable Energy Strategy which aims to introduce 450 MW of clean energy technology over a 15-year period (2011-2024). The strategy further recognizes accelerating electrification efforts, giving priority to rural areas, through the expansion and intensification of the national grid, the utilization of renewables, the optimization of low cost solutions, and the introduction of measures which will ensure productive and efficient use of electricity such as low consumption/high efficiency light bulbs. The vision of Government in this document is to develop geothermal energy to complement the energy mix and meet the energy demand of rural areas.

5. Conclusion

The potential for geothermal development exists in the center and north province controlled by rift system with predicted subsurface temperatures of 150 – 160^{o}C and the heat source for the geothermal system located at a depth of 1500 to 2500 m.

Carry out more investigations including geological, geochemistry and geophysical (seismic and gradient wells) studies to delineate the geothermal reservoir and the heat source is extremely necessary.

Major challenges delaying geothermal development in Mozambique have been the absence of both financial and technical capacity.

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