

GEOHERMAL ENERGY EXPLORATION IN UGANDA, COUNTRY UPDATE 2006

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First East African Rift Geothermal Conference-ARGeo-CI
November 24 - December 2, 2006
United Nations Conference Center
Addis Ababa, Ethiopia

Outline

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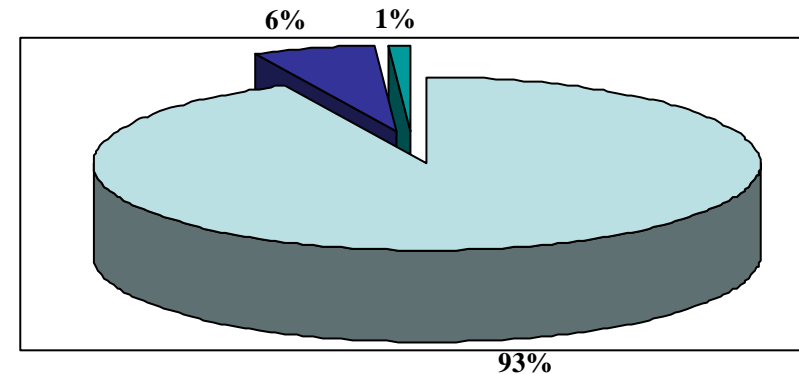
Country Overview

- 241 000 km²
- 28 million people
- Main exports: coffee, cotton, tea, tobacco, fish, flowers
- A Parliamentary democracy
- Elections held every 5 years
- Major economic reforms led to private investments
- Most parastatals privatized



Energy Sector

- Biomass represents 93% of the national energy balance
- Electricity demand growing by 10% per annum
- Oil products imported (100%)
- Low electrification rate (8%) constrain the economic and social development
- Hydroelectric potential over 2,000 MW on River Nile
- Hydropower installed capacity: 317 MW reduced to 120 MW in 2006
- Renewable energy a priority of Government
- Geothermal potential estimated at 450 MW



Base Case Forecast For Uganda - January 2006

Year	Peak demand (MW)	Net generation (GWh)	Sales (GWh)
2005 (actual)	354	1921	1131
2010	389	2110	1634
2015	548	2974	2452
2020	789	4287	3535

Current electricity supply

- 120 MW of hydro electricity to the grid (reduced from 300 MW at Jinja)
- 20 MW from Kenya
- 100 MW of thermal power to the grid
- 17 MW from small hydro's
- Small diesel generators (not quantified)



50 MW thermal plant at Lugogo, Kampala

Strategy for meeting electricity supply needs

Short term

- Reducing losses in power transmission and distribution networks
- Increasing efficiency of electricity utilization
- Installation of 100 MW of additional thermal power

Medium term

- Development of Bujagali (250 MW) and Karuma (150 MW) hydropower projects
- Development of at least 50MW from small hydros and co-generation in sugar industries

Strategy for meeting electricity supply needs

Medium term cont'd

- Acceleration of use of solar PV's for lighting
- Early petroleum production scheme which will provide Heavy Fuel Oil (HFO) for power generation
- Continuation of loss reductions and implementation of energy efficiency measures

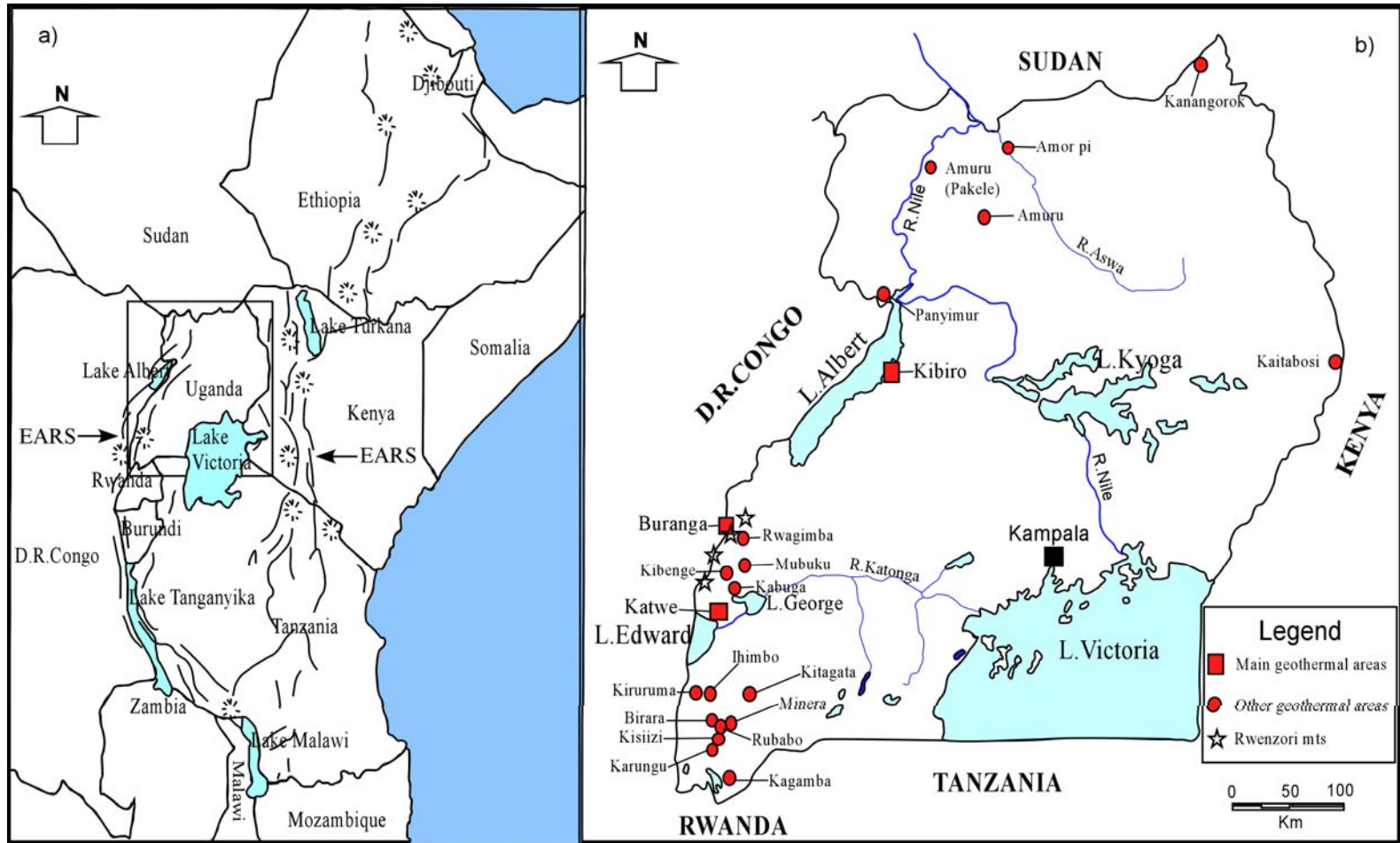
Long term

- Development of more sites on River Nile including Ayagos and Uhuru
- Development of geothermal resources in the Western Rift Valley
- Harnessing peat resources for power generation

Reasons for pursuing geothermal

- Hydro - electricity sites are more or less concentrated in one area (along the River Nile) resulting in long transmission distances and high energy losses;
- Uncertainty of continued availability of hydropower arising from climatic fluctuations and therefore need to diversify energy sources;
- Location of geothermal fields in isolated areas without grid connection;
- international treaties;
- an environmentally benign energy source.

Geothermal: Study areas



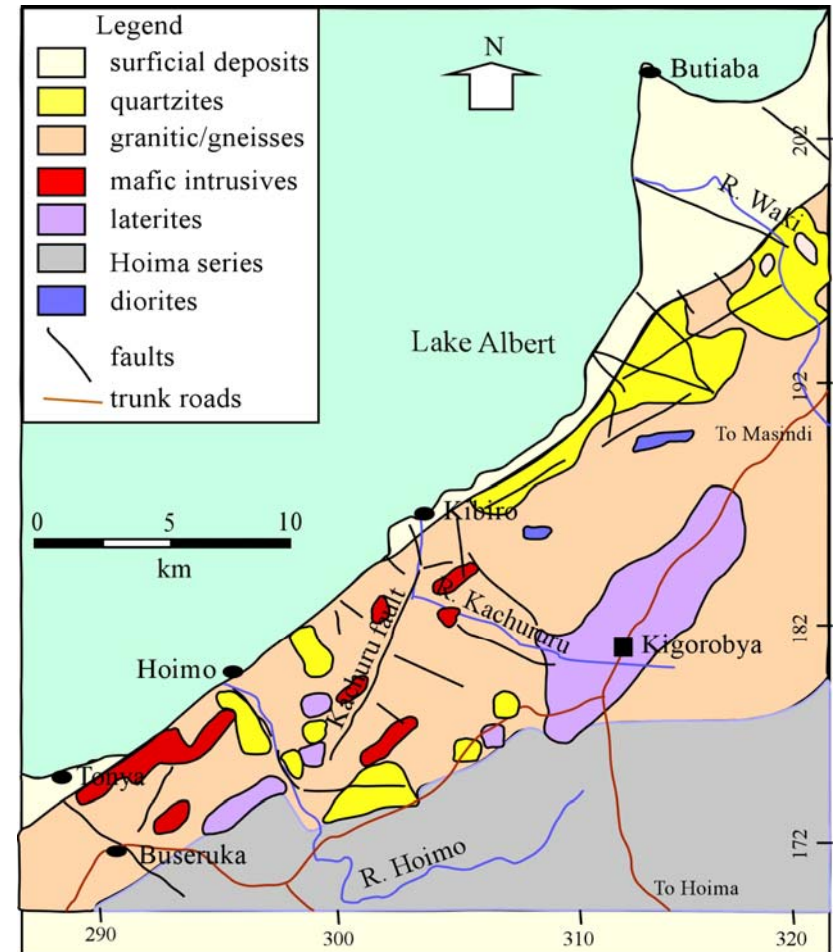
Recent Studies

- **1993–1994:** Geochemical and geological investigation on three areas Katwe, Buranga and Kibiro. GoU and Iceland, UNDP and OPEC.
- **1999 to present:** Isotope hydrology studies to delineate flow characteristics of geothermal waters and identify their recharge areas. GoU & IAEA.
- **2003:** Geological, geochemical and the first geophysical surveys in Katwe. GoU & AfDB.
- **2004:** Geological and first geophysical surveys in Kibiro. GoU & Iceland (ICEIDA).
- **2004:** First geophysical surveys in Buranga. GoU & BGR.
- **2005-2006:** Micro-seismic survey of Buranga. GoU & BGR.
- **2005-2006:** Further detailed geological and geophysical surveys and temperature gradient measurement in Katwe and Kibiro. GoU, WB and ICEIDA.

Current Exploration Results

Geology

- Geology of Katwe is dominated by explosion craters, pyroclastics, tuffs with abundant granites and gneisses.
- Kibiro: west of the escarpment-sediments of 4-5 km thickness and east of the escarpment- ancient crystalline basement with granites and gneisses.
- Buranga: sedimentary environment.



Kibiro: Geology

Current Exploration Results

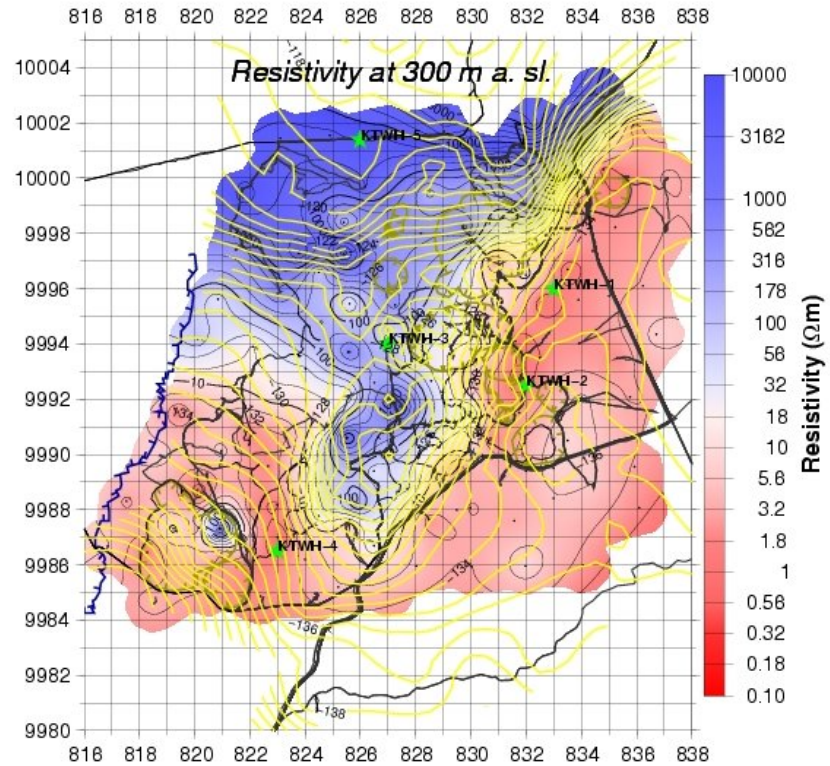
Geochemistry and hydrology

- Subsurface temp. of 140-200°C, 120-150°C and 200-220°C for Katwe, Buranga and Kibiro respectively, predicted by geothermometry.
- Recharge of the thermal fluids is from high ground in the Rwenzori Mts., for Katwe and Buranga; and Mukihani-Waisembe Ridge for Kibiro.
- Source of solutes is water rock interaction and magmatic for all the three areas.
- Reservoir rocks: Basalt for Katwe, granites and gneisses for Buranga and Kibiro.

Current Exploration Results

Geophysics

- Geophysical surveys (resistivity and gravity) have delineated anomalous areas for drilling in Katwe and Kibiro.



Katwe: Resistivity & gravity results

On going programmes

- Drilling of shallow boreholes of 200-300 m for temperature gradient measurement in Katwe and Kibiro to confirm the low resistivity anomalies.



1. Air drilling at Kibiro



2. Mud drilling at Katwe

On going programmes

- Preliminary geothermal investigations on other areas across the country.



Sampling at Kachuru, east of the escarpment in Kibiro area

On going programmes

- Micro-seismic survey of the Buranga geothermal area.



1. Taking measurements



2. Laying an underground sensor

Future projects: Geothermal Exploration II

- Katwe and Kibiro: drilling of deep exploratory wells,
- Buranga: detailed geophysical exploration and additional geological and geochemical surveys are needed before the area is recommended for drilling.
- Other areas: geological and geochemical surveys are needed to select promising areas for detailed surface analysis.

Conclusions

- Uganda is in a terrible energy deficit with hydropower production reduced tremendously from 300 MW to 120 MW. The situation is not likely to improve in the near future and the country must diversify its energy sources.
- Geothermal energy could provide an alternative source of electricity if properly explored and developed.
- Subsurface temperatures of 140-200°C, 120-150°C and 200-220°C have been predicted for Katwe, Buranga and Kibiro respectively. The temperatures suitable for electricity production and direct use in industry and agriculture.
- Katwe and Kibiro, have reached advanced stages of surface exploration and their surface geothermal models are nearing completion.

Recommendations

- The Government of Uganda should diversify its sources of electricity by promoting renewable energies among which geothermal is a potential resource that could produce base load electricity.
- The ongoing geothermal programs should be completed as soon as possible as their results will be needed to upgrade the geothermal models that will be a basis for drilling deep exploration wells in Katwe and Kibiro prospects.
- It is recommended that Uganda should move the geothermal exploration to the next stage, exploratory drilling that will pave the way to a feasibility study in at least one prospect.
- Exploration and development of other geothermal areas should continue following the results of the current preliminary geochemical investigations.

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