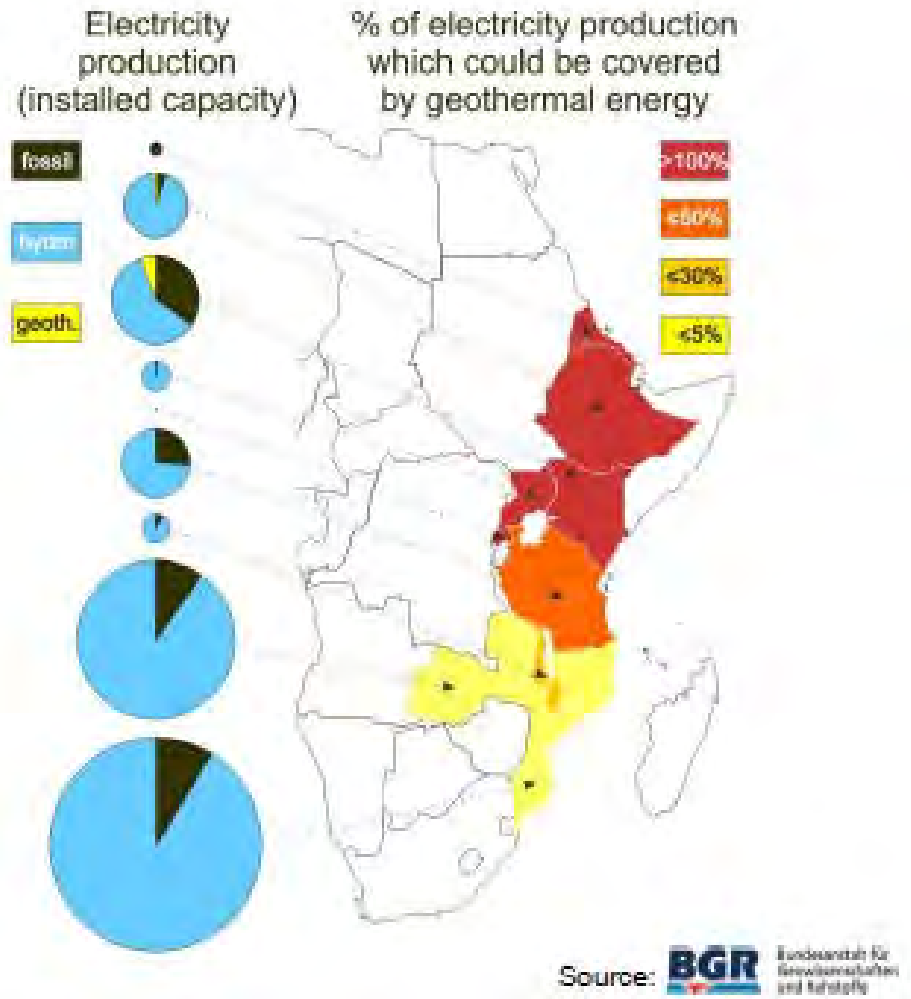
Geothermal Exploration Drilling Activities

GGDP Round table, 19.11.2013, The Hague

Dr. Horst Kreuter, Director, Geothermal Power Tanzania Ltd

Geothermal power

Geothermal in the East African Rift Valley

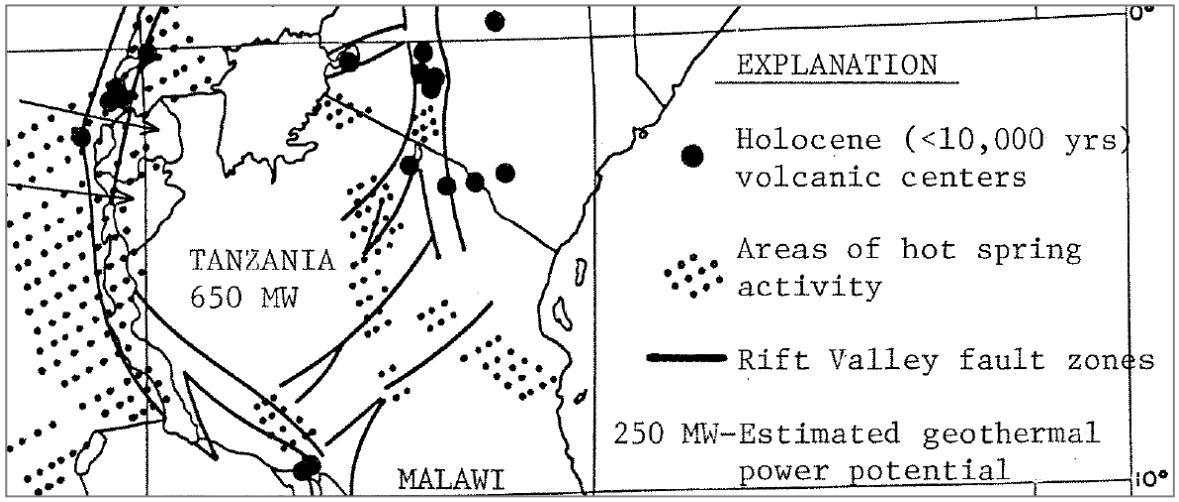


Geothermal power

Potential Tanzania

Country	Volcanic Systems: Potential Based on Number of Active Volcanic Centers, MW	Volcanic Systems: Potential Decreased Because of Absence of Acidic Volcanism, MW	Non-Volcanic Systems: Potential Based on Areal Extent of Hot Spring Occurrences, MW	Non-Volcanic Systems: Potential Decreased Because of Absence of Cover Rocks, MW	Totals, MW
Tanzania	450	---	200	---	650

Source: McNitt 1982



Source: McNitt 1982

Potential Tanzania

1. North-Eastern area;
   Lake Natron, Lake Manyara and Musoma

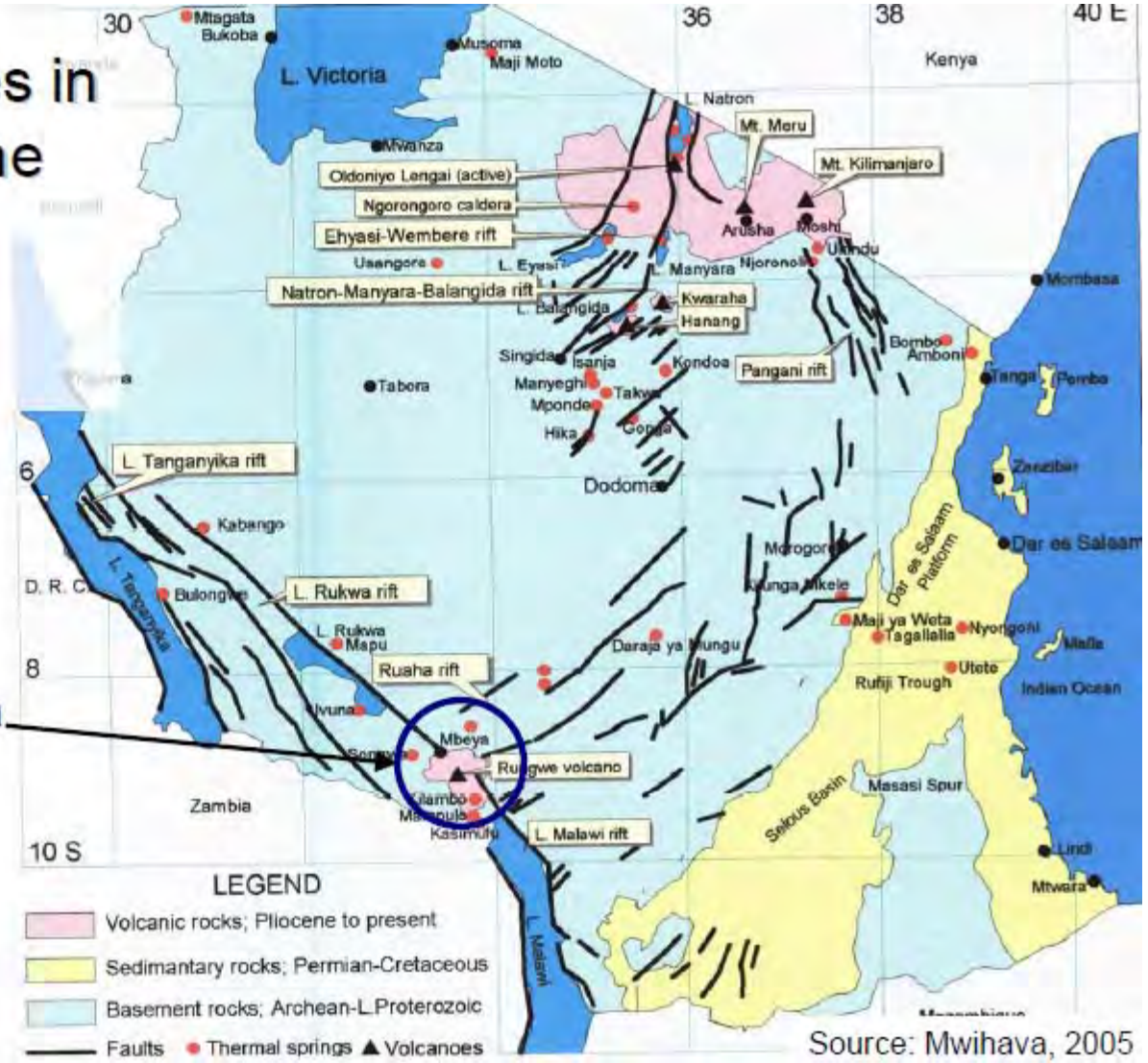
2. South-Eastern coastal area;
   Kisaki, Utete, Luhoi and Luhombero

3. South-Western area;
   Songwe River, Rukwa trough, Kasumulo,
   Mampulo and Rungwe volcanic complex

Geothermal Potential in Tanzania

Geothermal sites in Tanzania and the selected GEOTHERM project region

Project region Mbeya (Rungwe volcanic complex)



Source: Mwihava, 2005

BGR Bundesanstalt für Geowissenschaften und Rohstoffe

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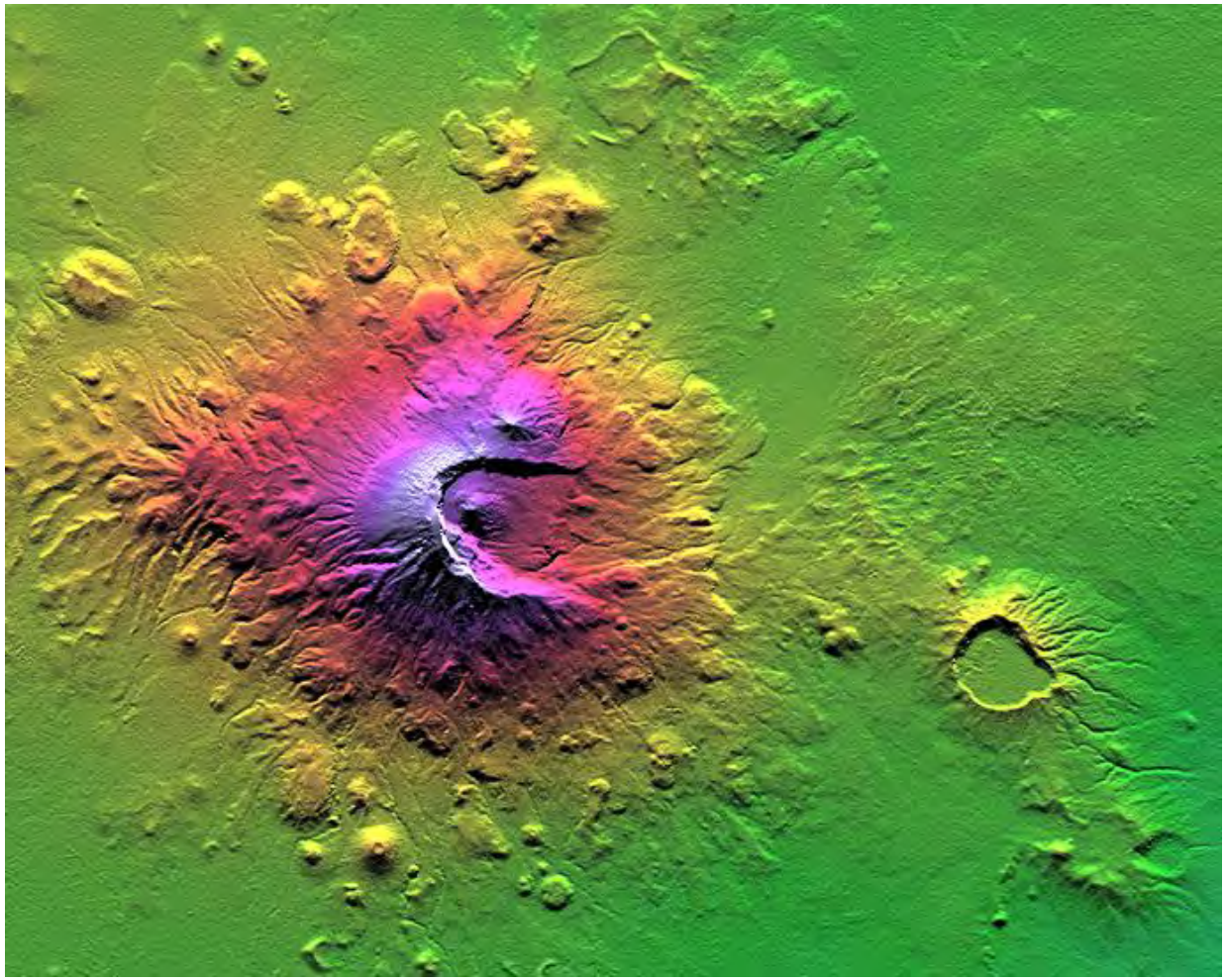
Geothermal Potential in Tanzania



Mount Meru

Type: stratovolcano with 3.5 km wide breached caldera; sector collapse (Klaudius 2006)
Last eruption: 1910 (Wilkinson et al. 1986)
Location: 3.25S, 36.75E within Arusha National Park
Elevation: 4566 m (slopes covered by forest that hosts diverse wildlife)

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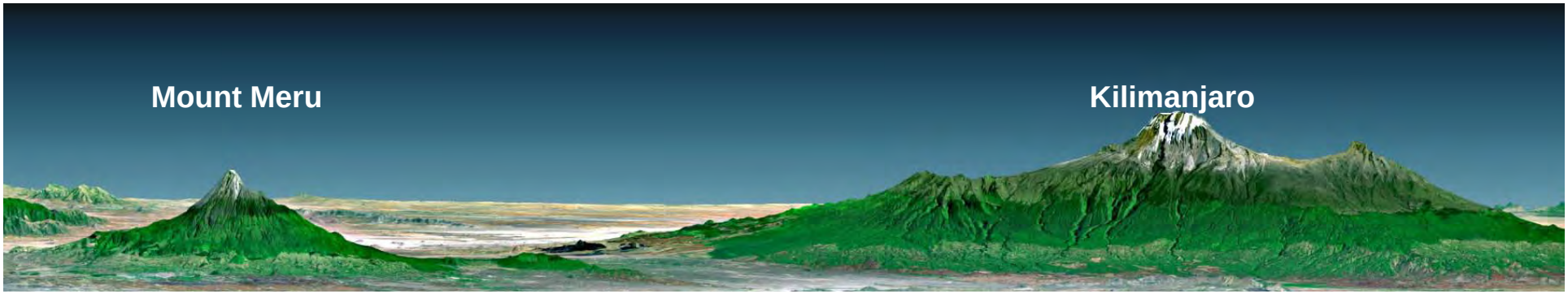
Geothermal Potential in Tanzania



Source: http://photojournal.jpl.nasa.gov/catalog/PIA03355 (SRTM data plus Landsat-7 image and artificial sky added; elevation exaggerated)

Kilimanjaro

Type: three overlapping stratovolcanoes with 2.4×3.6 km wide caldera @ Kibo summit peak
Last eruption: Pleistocene with possibly Holocene nested summit craters (Nonnotte et al. 2008)
Location: 3.07S, 37.35E within Kilimanjaro National Park - UNESCO World Heritage Site
Elevation: 5895 m (ice cap)

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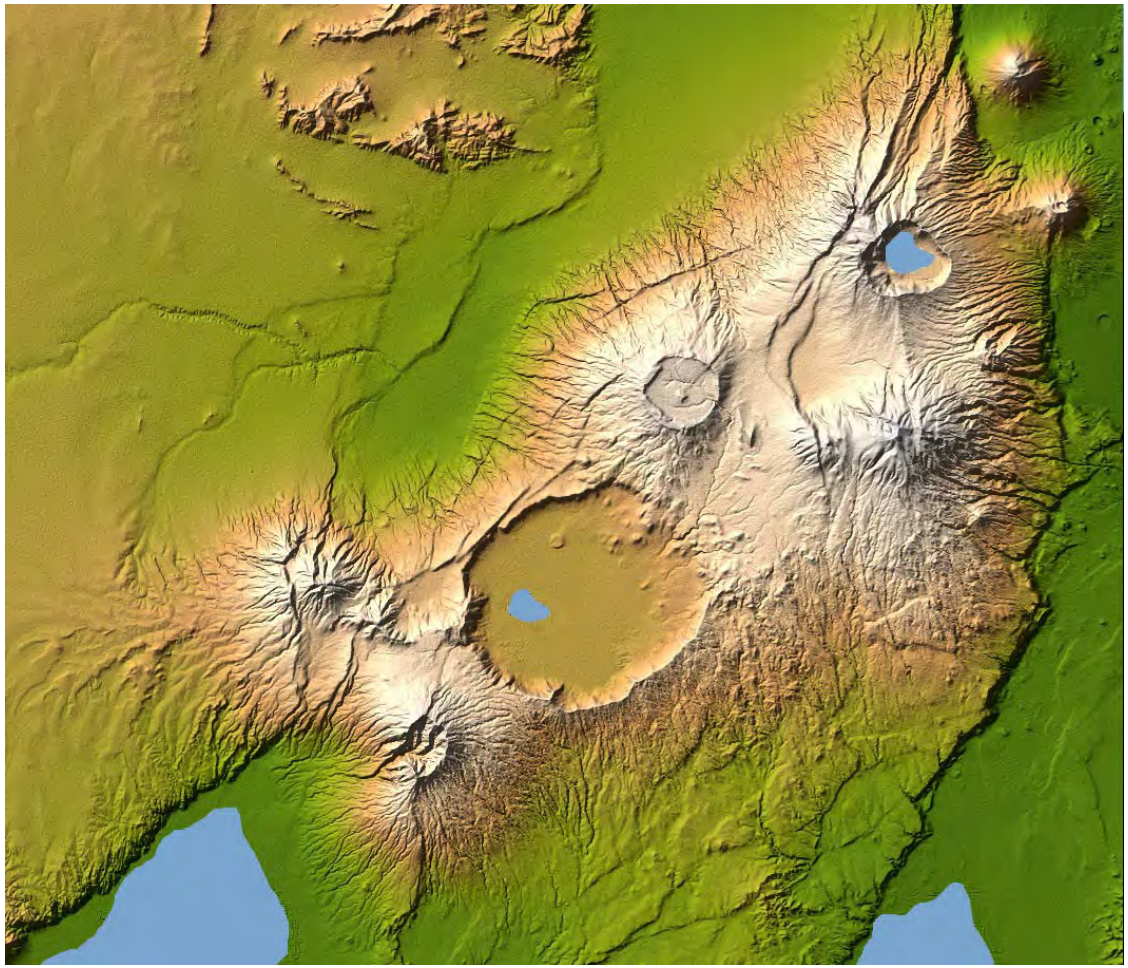
Geothermal Potential in Tanzania



Source: NASA (SRTM data February 2000)

Ngorongoro
Type: caldera (22.5km widest diameter, 610m deep)
Last eruption: 2 Ma => extinct?
Location: 3.15S, 39.30E within Ngorongoro Conservation Area - UNESCO World Heritage Site (>75,000 animals; Ngorongoro Conservation Area includes L. Eyasi & L. Manyara)
Elevation: Caldera rim 2,286 m

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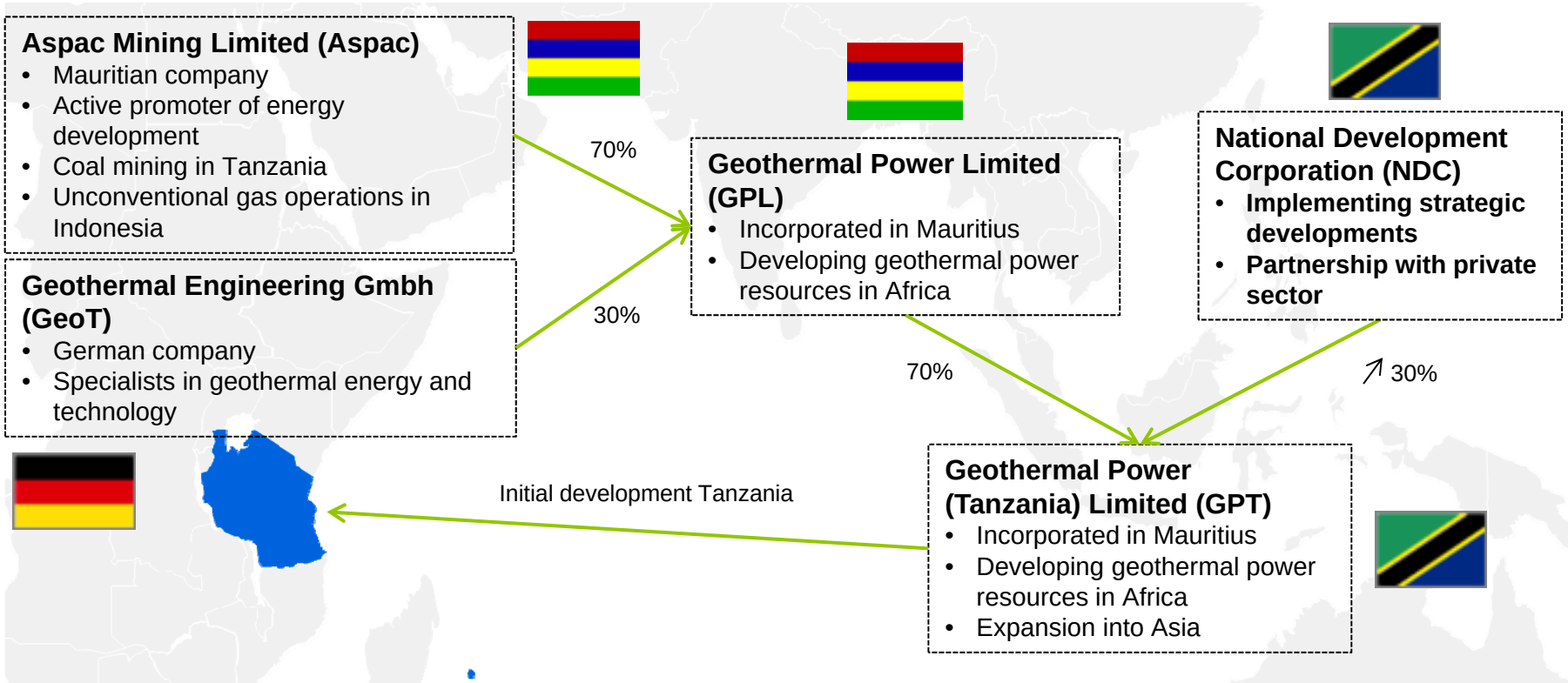
Overview



- GPL has assembled some of the world's leading geothermal scientists.
- Tanzania identified as having strong geothermal potential and the right commercial and political environment to launch GPL's operations
- Geothermal Power Tanzania Ltd founded in 2011 to explore and develop geothermal resources in Tanzania

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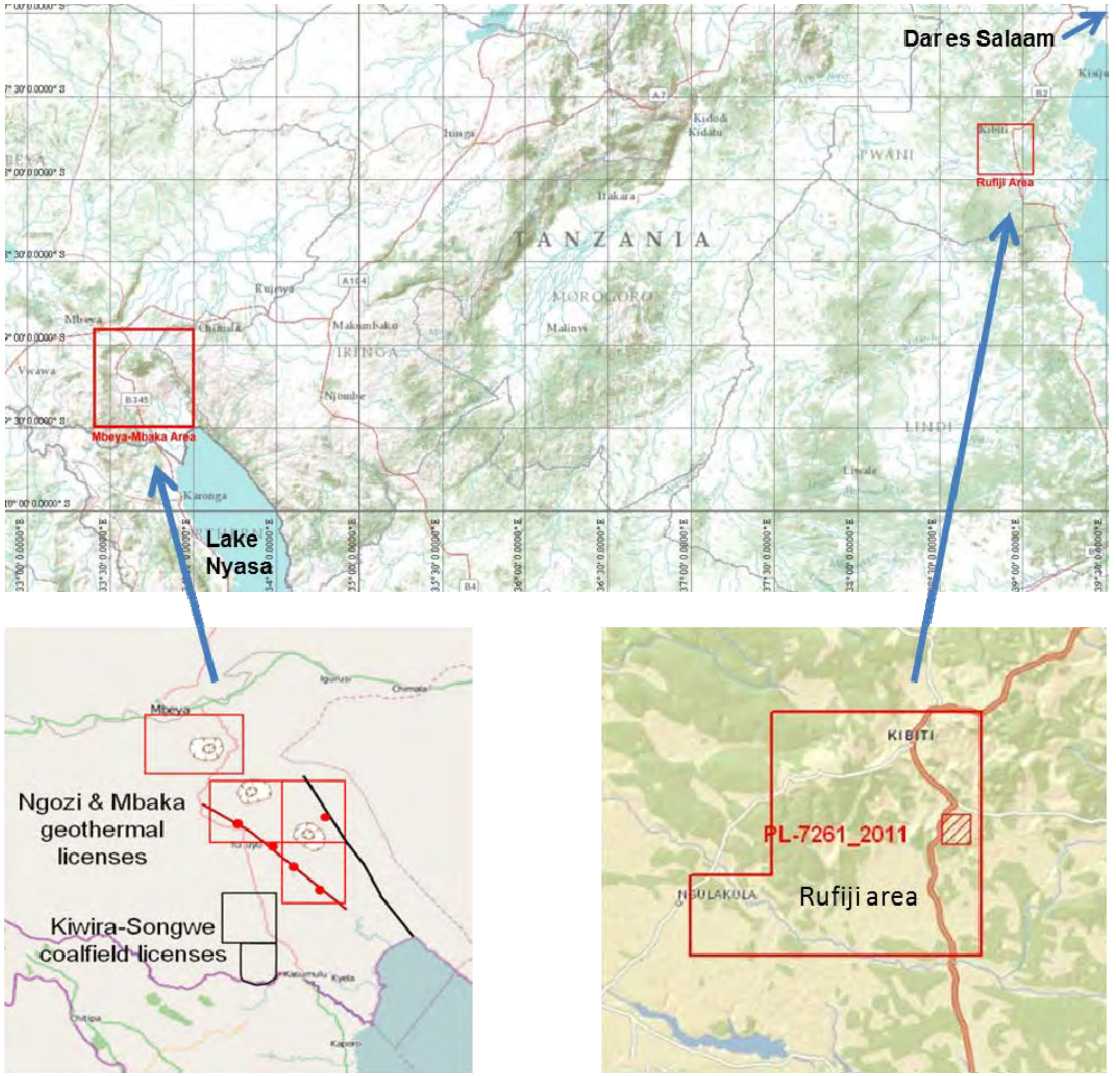
GPT Prospecting Licenses

Mbeya area

- Ngozi volcano
- Mbaka fault
- Livingstone fault

Rufiji area

- Rufiji sedimentary basin



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Projects

- **Mbaka fault**
  - North of Lake Nyasa in southwest Tanzania
  - Geochemical results from hot springs indicate geothermal reservoirs of between 160°C-180°C at Mbaka fault.
- **Ngozi Volcano**
  - South of Mbeya
  - High temperature reservoir
  - Temperatures in excess of 220°C as indicated by fluid geo-thermometers
- **Rufiji**
  - In central east Tanzania south of Dar es Salaam
  - Geothermal water potential
  - Expected temperatures at 1,200 m are 140°C

Projects

Geothermal electricity production

- Mbeya area
  - Ngozi: up to 100 MW conventional geothermal depending on reservoir capacity
  - Mbaka fault: up to 10MW
- First geothermal power production in 2014 at Mbaka
  - 1.5 – 3.5 MW wellhead generator power plant

Develop the Mbeya area to be an energy center in East Africa

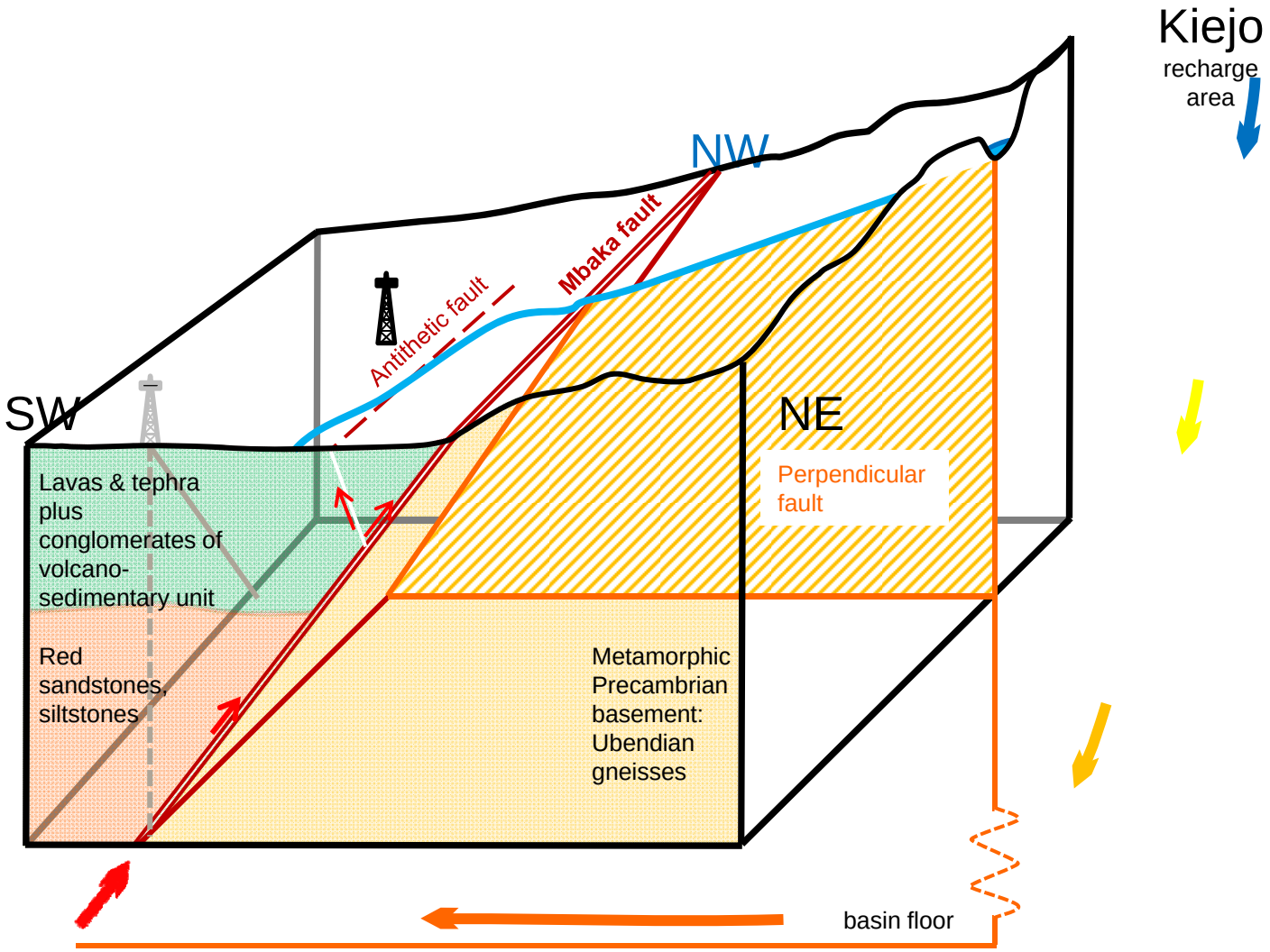
- Large scale power plants
  - Coal (> 100 MW)
  - Conventional Geothermal at Ngozi (up to 100 MW)

Small scale power plants (rural electrification)

- Geothermal (< 10MW)
- Biomass (< 10MW)

Geothermal power

Mbaka



Source: Kraml et al. 2012 modified

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Exploration Drilling Mbaka

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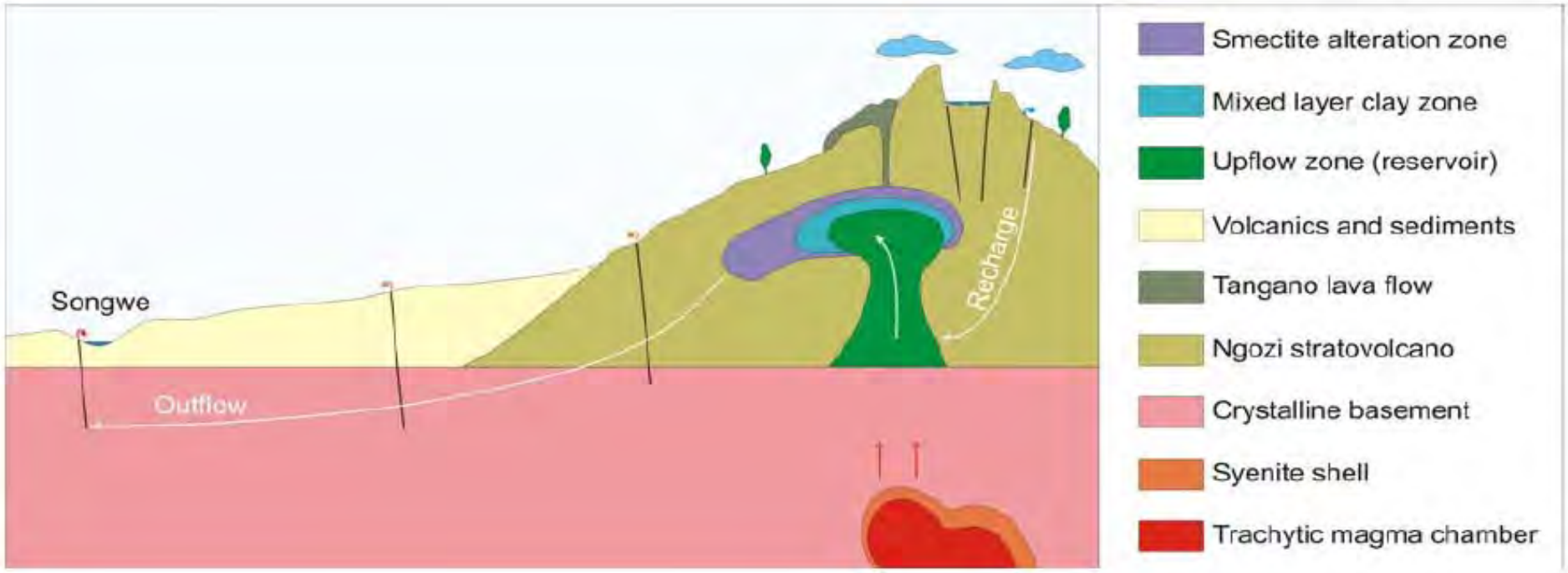
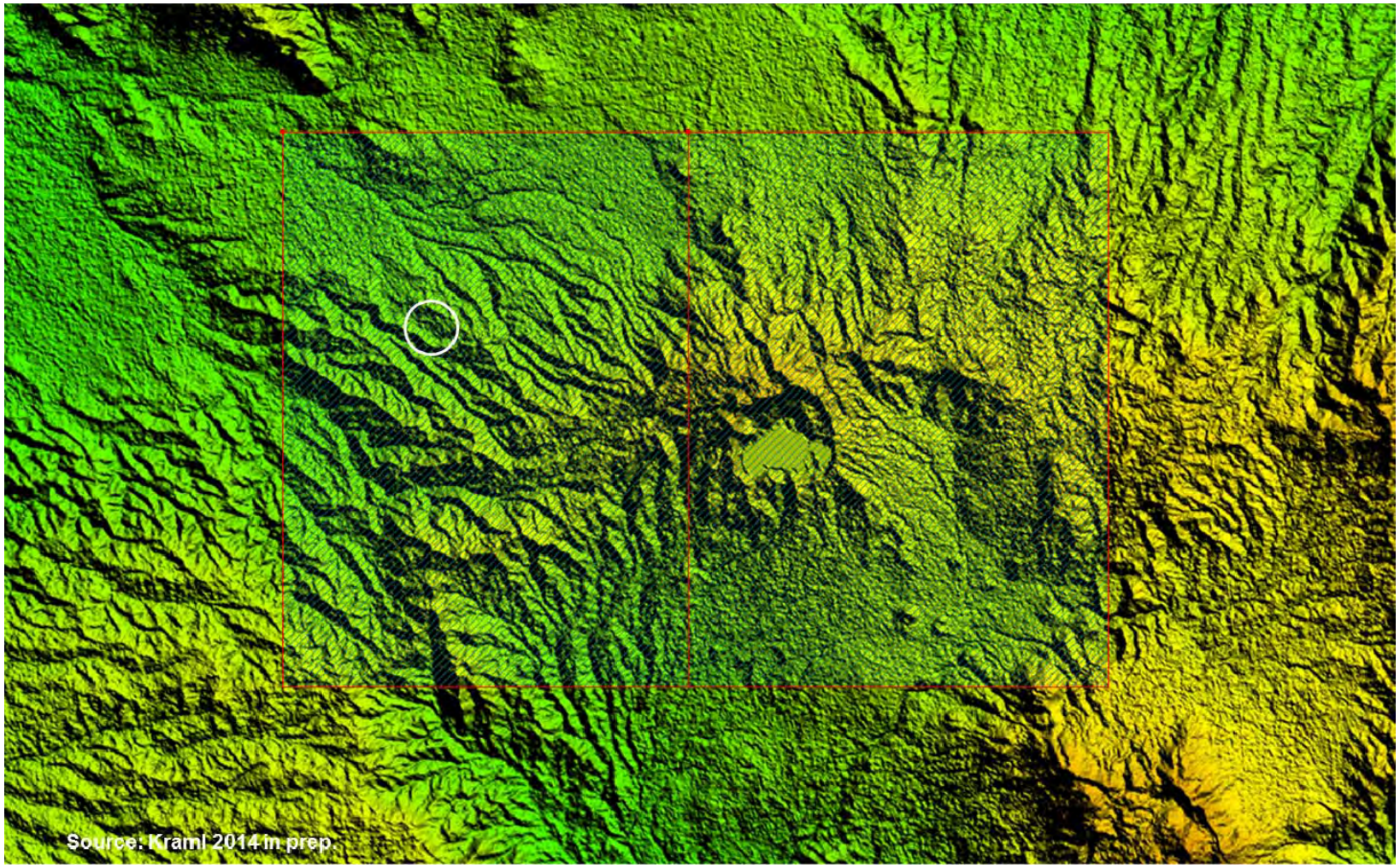
Ngozi



Source: Kraml et al. 2008

Ngozi



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Ngozi

Ngozi

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Challenges

- Technical
- Legislation and administration
- Country lack of geothermal experience
- Politics (managing expectations)
- “Strange” projects
- Lack of specialized services – drilling, geophysics, laboratory
- Commercial risk (country risk)
- Power distribution infrastructure

Government of Tanzania (GoT)

- The GoT through MEM established a National Geothermal Task Force which comprise of members from MEM, GST, TANESCO, REA, UDSM, and TAREA.
- The overall objective is to monitor and facilitate the development of geothermal resources in the country
- Main task is to strategize and advise the Government on how Geothermal Resources Development could be effectively strengthened, coordinated and streamlined to enable the country to achieve the envisaged goal in geothermal energy sector.

Government of Tanzania

- **Technical Expertise – Inadequate human capacity and equipment to develop geothermal resources**
- **Financial – Large upfront investment in geothermal exploration and test drilling.**
- **Attracting private sector: Inadequate interest of the private sector investment in geothermal projects especially in the resource confirmation phase.**

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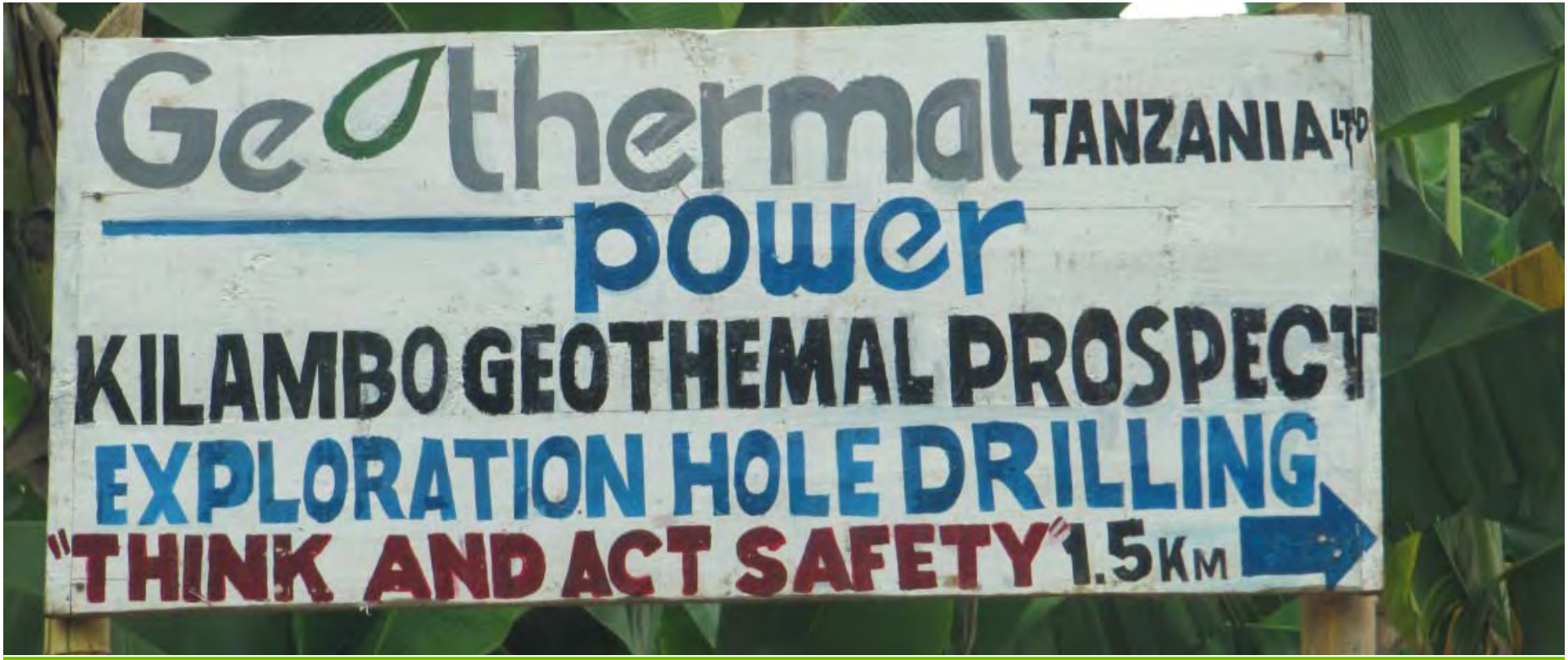
Government of Tanzania

- Establish partnerships with experienced countries / geothermal companies.
- Implementation of SREP project; prepare and put in-place strategy, legislation and regulations for geothermal industry
- Raise awareness to decision makers to win support for development of geothermal resources.
- Capacity building to geothermal experts
- Institutional arrangements: Establishment of Geothermal Unit/Section and a Geothermal Company.
- Resource Assessment



Thank you for your attention !

GeoThermal Power Tanzania Ltd / GeoThermal Engineering GmbH

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