The « Geothermal Village » project

Jacques Varet
Géo2D

A R&D project under progress under the EU/ACP LEAP-RE research program

The « Geothermal Village » project Presentation frame

1. Introduction : presentation Dr. Jacques Varet, Géo2D
2. Aim of the “Geothermal village” project; development of the concept
3. Status of the 4 sites selected for a demonstration project
4. R&D engaged: methodology and Feasibility expected
5. Time frame

The « Geothermal Village » project

1.Introduction : Géo2D

- **SME based in France,** R&D, expertise? advices, capacity building
- **Specialized in geothermal, mainly in the EARV,** with long experience in geology, particularly Afar triangle (CNR-CNRS since 1967)
- **Created 2011 by J.Varet, IAVCEI** prize winner, former Head BRGM geothermal, French Geological Survey director, Eurogeosurveys President with experience in Ethiopia, Kenya, Djibouti, Eritrea, Rwanda & Tanzania
- **Launched** the Geothermal Village concept in 2014 (in a first EU/ACP Facility proposal)
- **Developed the concept since** on geoscientific (1km3 approach), engineering (ORC + steam condensing for water production) & social sciences
- **Engaged a PhD** with EHESS (Paris) on social approach to geothermal development serving local needs for indigenous people (Susan Onyango)
- **Published** several papers on the issue (see references); **A guidebook** on Direct Uses in the EARV is under edition with UNEP (cf. Meseret's presentation)
- **The GV1 R&D project** is financed under EU/AU **Leap-Re**, involving 15 partners from 4 EU and 4 AU countries
- Looking for support from **GRMF** for **demonstration sites** (Ethiopia, Kenya, Rwanda, Djibouti)

Direct Use Market Sounding

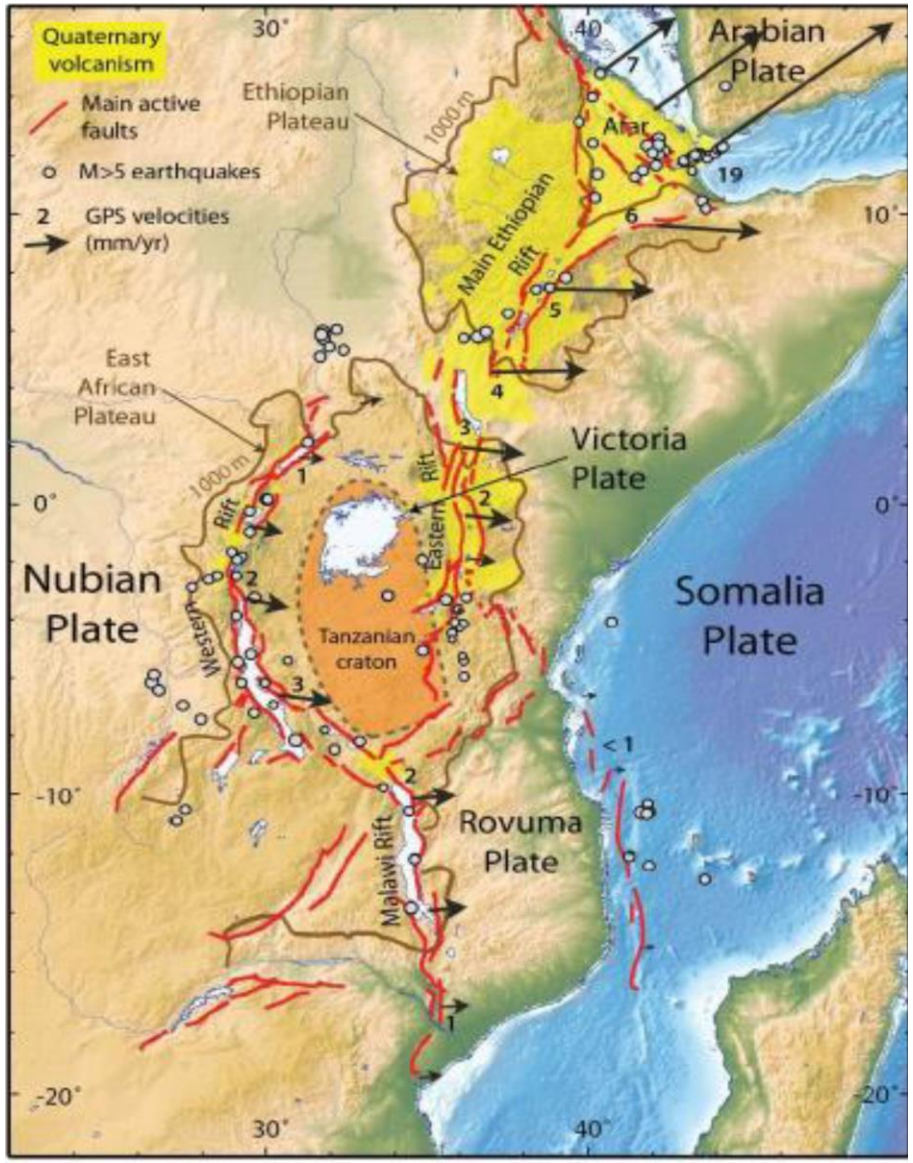
Geothermal Village Project-Pitch

Geothermal Risk Mitigation Facility for Eastern Africa

The GV project is a close collaboration between East African and European countries.

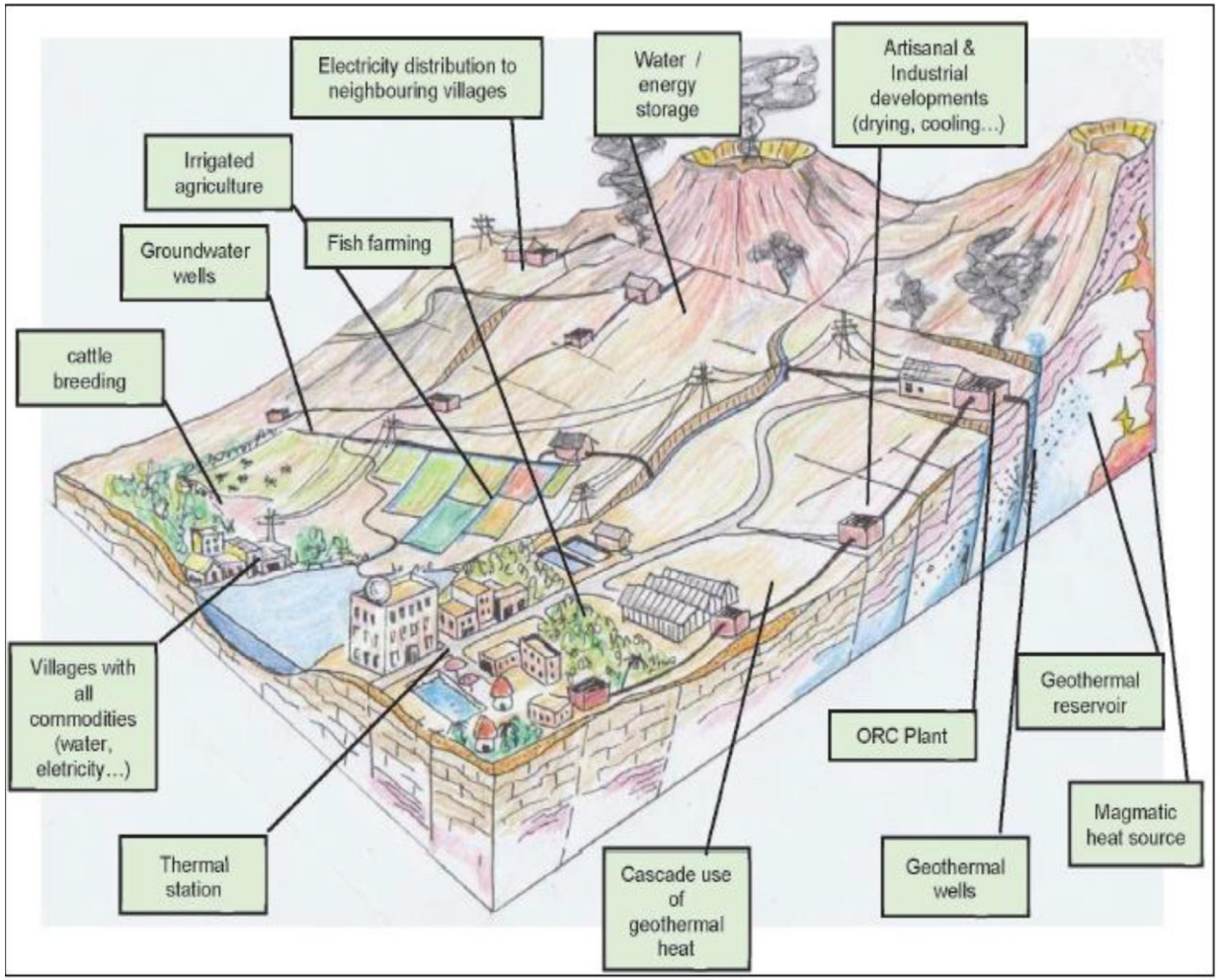
The GV project will carry out a feasibility analysis of such a system.

The objective is the development of demonstrators in the frame of a succesive project within the framework of Green Deal, with GRMF support.

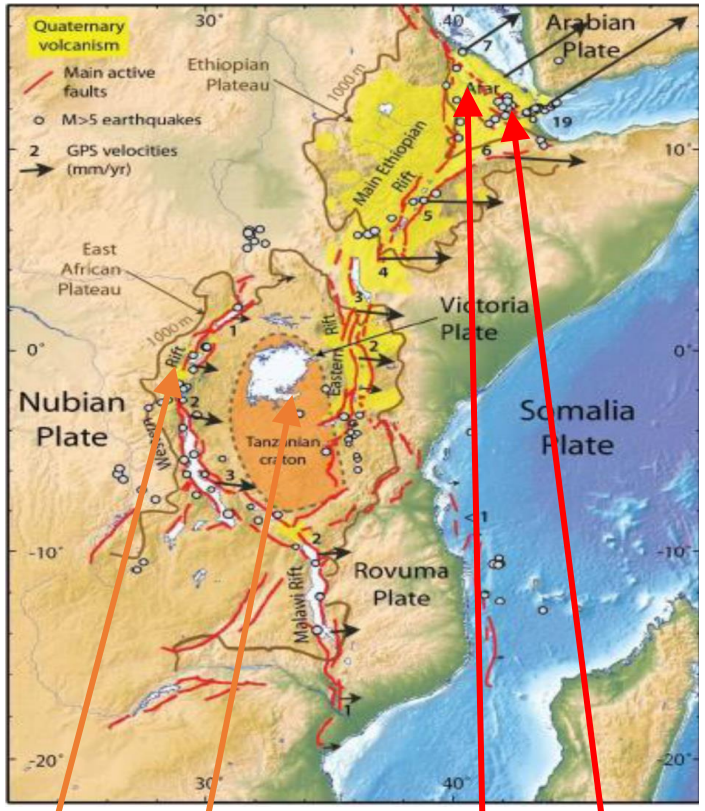


2. Aim of the project; development of the concept

- A project to build geothermal-based stand-alone electric and thermal energy systems to off-grid African communities.
- A project that brings together skills across the entire geothermal value chain: resource exploration, resource exploitation, societal acceptance, local economic development.



3 A variety of sites representative of the diversity aof the EARS



(From Calais, 2016)

Low temperature
Direct use

High temperature
Electricity prod.

High geothermal heat flow inducing shallow resource

- **Geodynamics allowing for :**
  - ➢ **high temperature (electricity generation) in the Easter Branch and Afar**
  - ➢ **Medium temperature in the western branch and southern rift (direct uses applications)**
- **Social and economic demand vary due to climate and anthropology**
- **Wide range of contexts and applications** but **same challenge of:**
  - ➢ **Shallow resources implying specific approach & technologies**
  - ➢ **Local management capacities off-grid systems**

4 sites selected: Ethiopia, Djibouti, Kenya, Rwanda

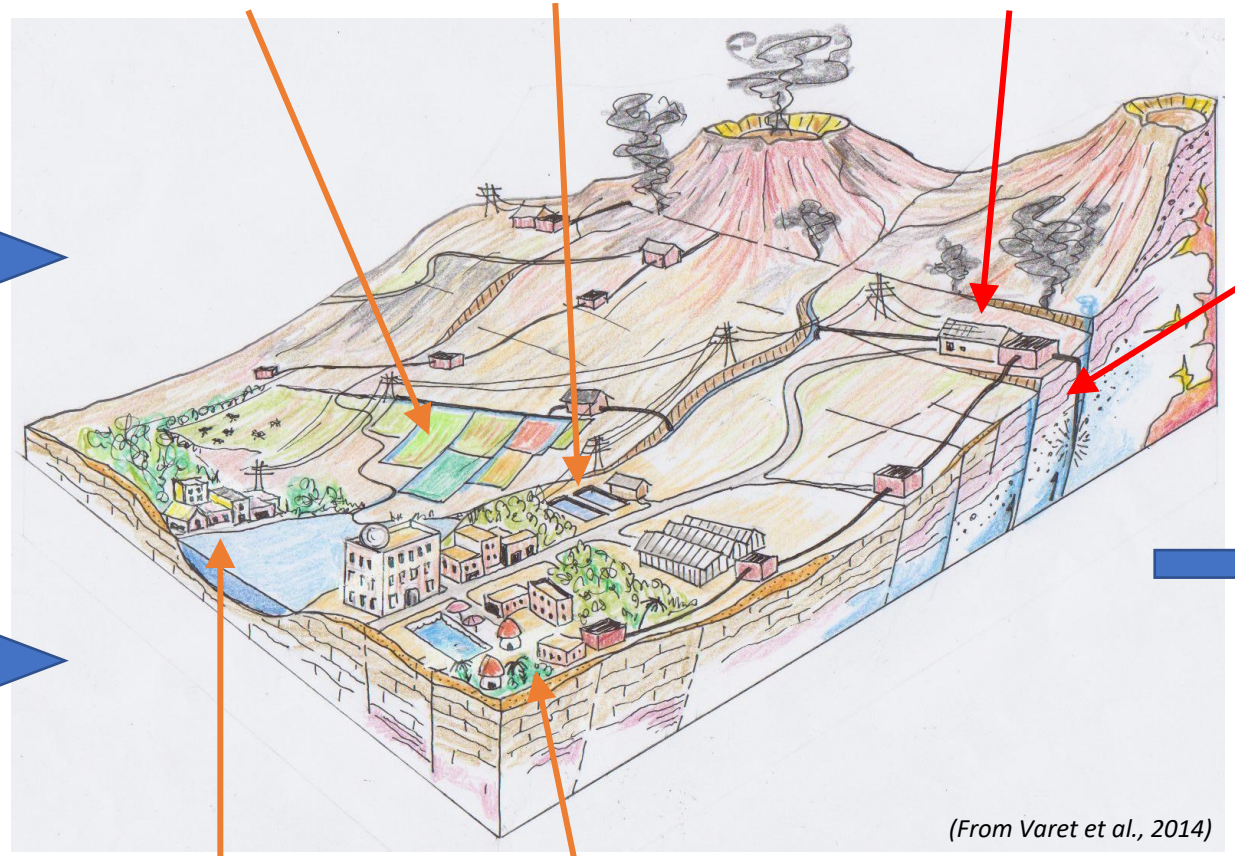
Srtucture of the Project - Methodology

Analysis of **site characteristics**

- Geosciences
- Social-eco. sciences

Assessment of **available resources and needs**

- Social-eco. sciences
- Engineering sciences



Outcome :

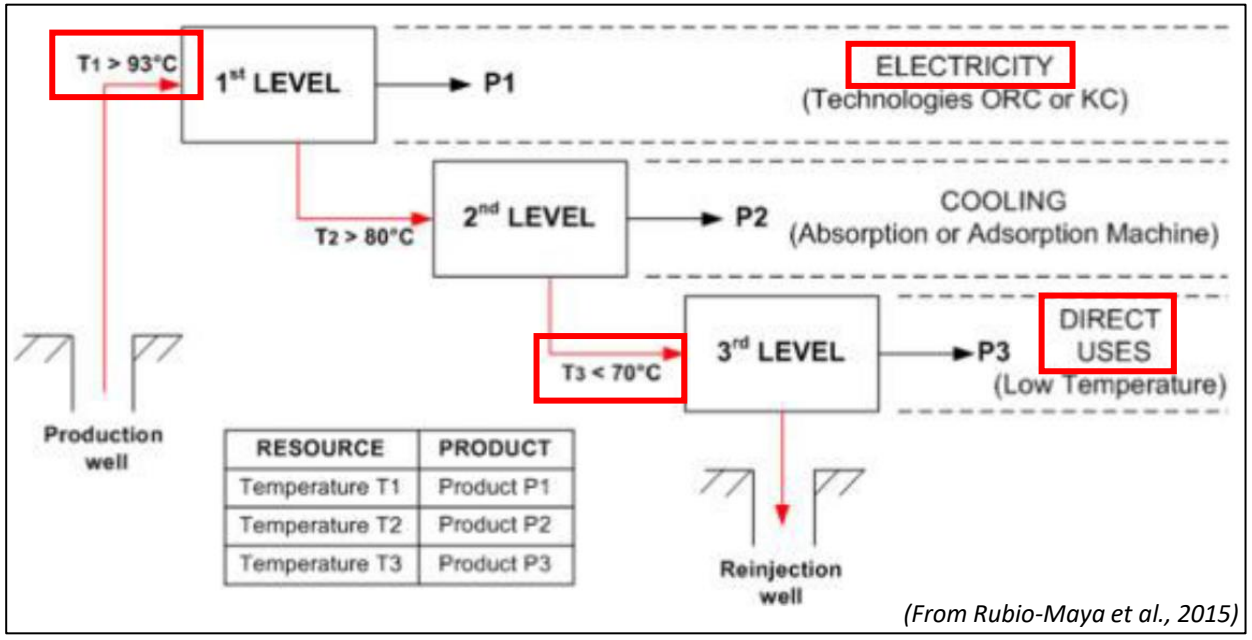
- **Feasibility studies**
- **Implementation strategies**

Based on critieria:
- Local communitiy needs, lifestyle & capacities
- Type of income sources ;
- Appropriate level of technology, etc.

Structure of the Project - Technology

- → Use of **geothermal energy in cascade**, through Organic Rankine Cycle (ORC) systems
- → **ORC** : stand-alone, flexible and portable production modules for small applications, in the range of 20 to 200 kWe, a size **adapted to the needs and production expected**
- → Selection & adaptation of African technology and local (regional) engineering solutions (drilling, pipes, heat exchangers, etc.)

180 kW ORC plant by Enogia
https://enogia.com/wp-content/uploads/2021/10/180LT-EN.pdf



(From Rubio-Maya et al., 2015)

→ Wide array of applications:

- Electric production ; Cooling
- Fish & agri. product drying -> *Kenya, Rwanda*
- Domestic water production -> *Ethiopia Djibouti*
- Balneology -> *Djibouti, Kenya*

Structure of the Project – Capacity Building

Research mobility & partnership :

- Involvement of Master and PhD students in the project
- Summer schools/workshops about RE, in synergy and coordination with the other LEAP-RE WPs

Capacity building :

- Based on needs assessments, training for local communities **to ensure proper mastering of the whole chain** of basic knowledge (from technology and financial handling to administrative and social management) → *This should guarantee maintenance, extension and replication of such community-based geothermal projects.*
- Trainings through CBOs and NGOs involved in the GV (e.g. Kenya -> **HHCBO** ; Ethiopia -> **AGAP**)

→ Vote on the status of the newly created (2015) Afar Geothermal Alternative Power Company (AGAP), an Ethiopian CBO.

(From Varet et al., 2020)

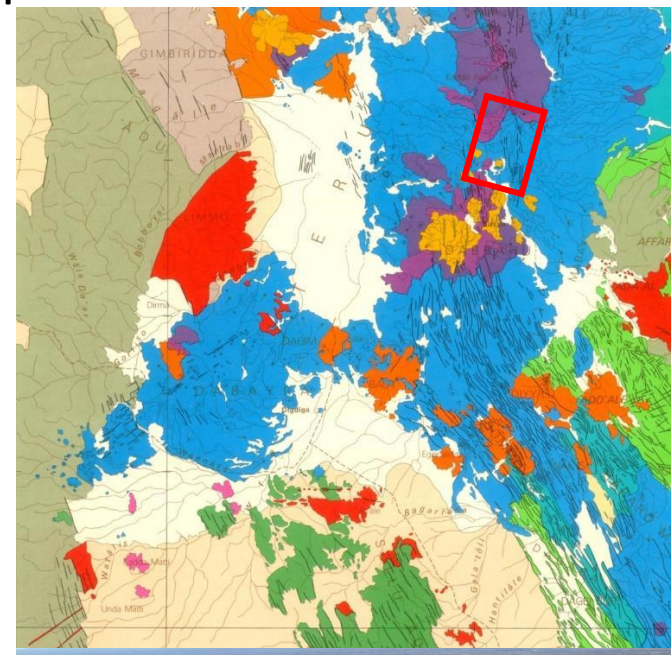
Sites selected : (1) Era Boru, Afar Regional State, Ethiopia

Geographic Coordinates 12°40'N – 40°20' E; *Altitude* : 700m

Surface thermal manifestations are numerous (steam vents) and well known by the Afar pastors, as they are engineered to condensate the steam and produce water that is used for both livestock's and human consumption

- digging holes in the fumarole site,
- use the clay (red kaolin-iron hydroxides mixtures) produced by the hydrothermal decomposition of the volcanic rock to create an impermeable basin for condensate water collection,
- close the system with a chimney made of blocks of lava covered by branches (acacias trees) that will allow to condensate the steam (as in condensation towers of thermal plants).
- Example of such devices, are quite common all over Afar particularly at Era Boru where 150 families live from this resource

The project will allow to identify shallow drilling targets and answer the needs of the communities on site (energy and water production)



African Union

Direct Use Market Sounding

Geothermal Village

Project-Pitch

Geothermal Risk Mitigation Facility for Eastern Africa

Sites selected : (2) Djibouti, Lac Abhé

Georgaphic Coordinates: 11°09’16 N; 41°53’00 E *Altitude* : 245-313 m

Geosciences :

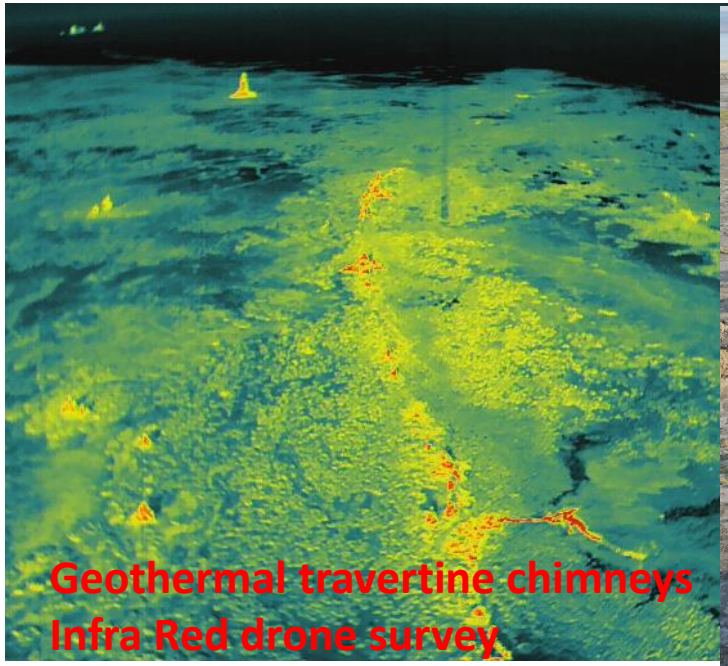
Successful geosciences field work in the Lac Abhé area (Oct. – Nov. 2021)

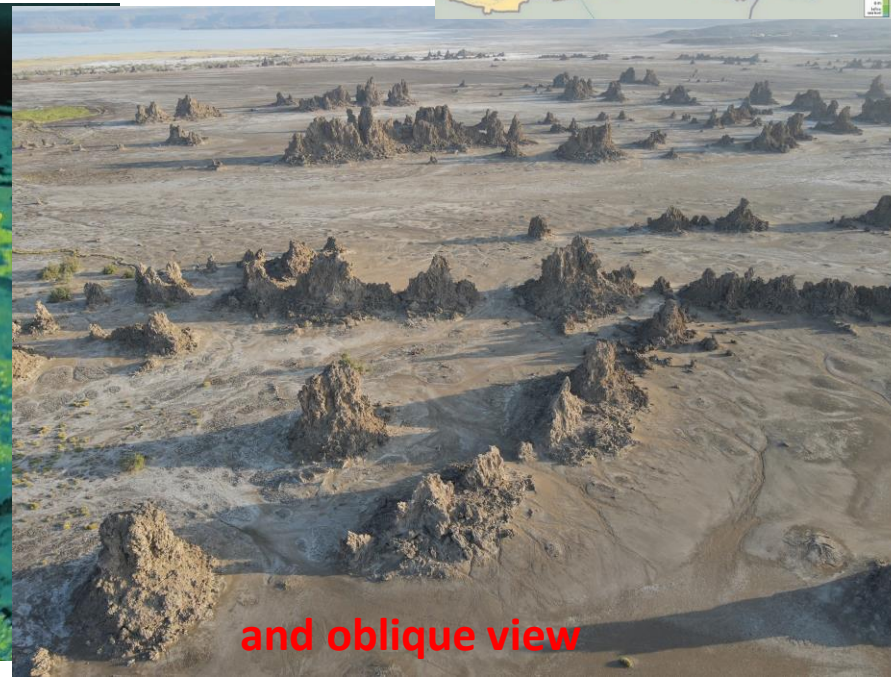
- *Gelogy*
- *Geochemistry*
- *Geophysics*
- *Characterization of the potential drilling site and of the geothermal reservoir*
- Starting of data processing with all the involved partners

Social sciences : Preliminary survey

- 70 families near the site;
- a school just built and started operating
- More families will join the village that the geothermal resource will power,
- also providing water

The detailed social study will be engaged in the coming months





Direct Use Market Sounding

Geothermal Village

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Geothermal Risk Mitigation Facility for Eastern Africa

Sites selected : (3) Bugarama, southern Rwanda

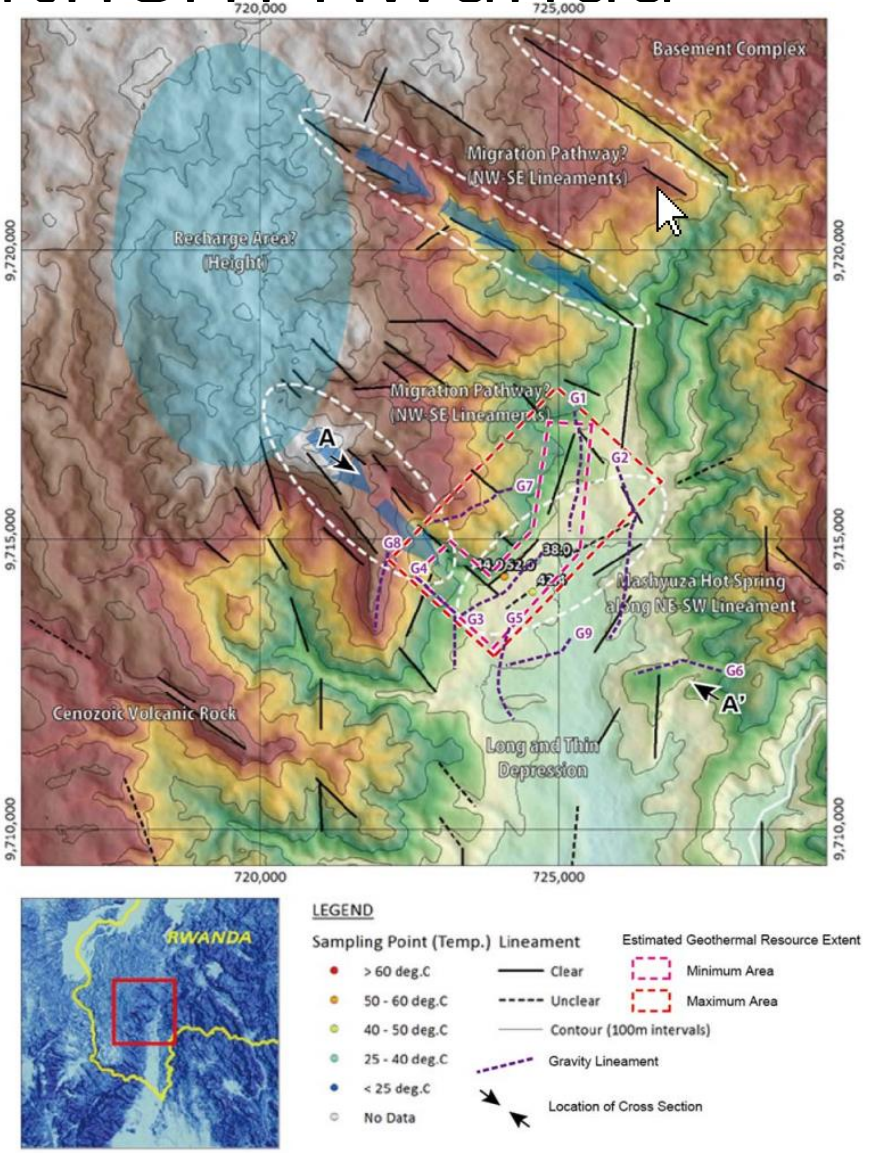
Coordinates: 2°42’ S ; 25°01 E *Altitude*: 956m

Access (distance & time): 288km from Kigali, 6 hours drive

Bugarama, is rather rich in thermal manifestations. At least 3 sites are gifted with hot springs, with characteristics not suitable for electricity production. One of them will be selected in the frame of GV project in February 2022;

Given the local economy based on agriculture, Direct Uses (DU) applications will be studied in the area (crop drying and fish farming in particular),

Further exploration works to be engaged with EDCL early 2022, implying both earth science and social science teams, followed by technology assesments.



Sites selected : (4) Homa Hills, E. Lake Victoria, Kenya

Geographic Coordinates: 0°20’20 N ; 34°31’ E ; *Altitude* : 1131-1180 m

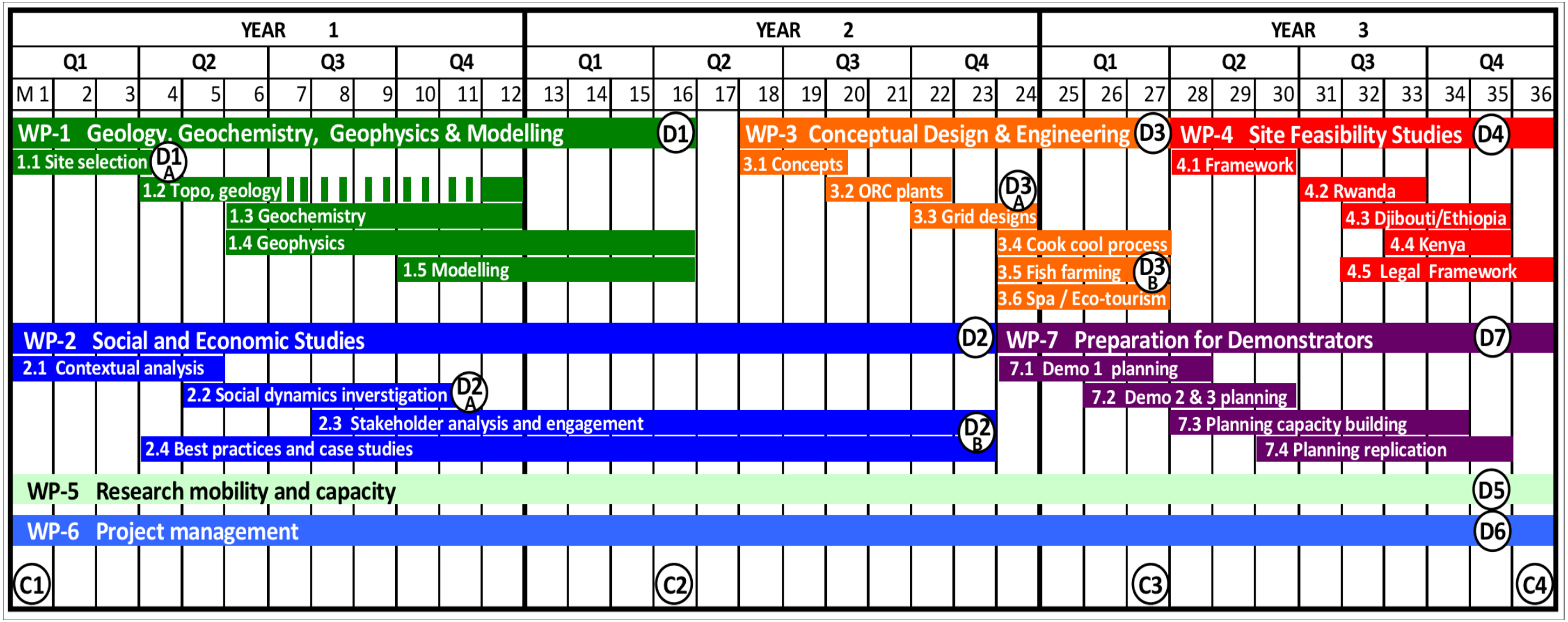
Previous investigations confirmed:

- Low to intermediate temperature geothermal system in the prospect.
- Heat source associated with magmatic intrusive.
- Estimated reservoir geothermometry from 160ºC to 235ºC.
- A resource to be utilized both for electricity generation (using ORC) and direct uses (fish drying, thermalism).

Field works (geoscience and social sciences) to be engaged march 2022

- structural geology, geochemistry geophysics to establish a 3D picture of the hydrothermal system plumbing at 1 Km3 scale.
- Anthropological study & analysis of the local socio-economic demand (present and future) being quantified.

5. Time frame & work packages



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