Geothermal Exploration and Development in Eritrea, Country Update

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Eritrea is located in Northeast Africa between longitudes 36.4 and 43.1°E and latitudes 12.3 and 18.0°N. It has a land area of 124,320 km² comprising the central highlands, the western and coastal lowlands and 350 islands in the Red Sea.
Introduction

- 5.2 million Population
- 405 USD GDP per capita
- 2.1 billion USD GDP
- Electricity access rate: 32.0%
- Total installed capacity is 145MW+50MW previous year commissioned .....fossil fuel
Previous works

- Geothermal assessment was initiated during 1902 by Angelo Marini (Marini, 1938).
- UNDP sponsored work was carried out a reconnaissance survey in 1973 by a Geological Survey of Ethiopia team (UNDP, 1973).
- In 1992, Giorgio Marinelli and a staff member from the DoEnergy visited Alid area.
- In 1994, Mikhail Beyth, Geological Survey of Israel surveyed Alid hydrothermal area.
- A team of staff from the United States Geological Survey (USGS) and the Ministry of Energy and Mines of Eritrea (MEM) carried out a geological and geochemical investigation at Alid and its surroundings during in 1996 (Clynne et al., 1996).
- Reinterpretation of the chemistry of water and gas samples (Yohannes, 2004).
- Fault and fracture analysis (Yohannes et al., 2006), resistivity survey (Goitom et al, 2006) and hydrogeological investigation (Andemariam et al., 2006) was carried out.
- An assessment of Resistivity survey (MT and TEM) was conducted on 2008 (Eysteinsson et al, 2009).
Regional Tectonic Setting
Regional Tectonic Setting

• Zone of crustal extension.
• Down dropped crustal sections, bounded by deep-rooted normal faults (forming grabens) that cut into the basaltic lavas, extruded in the resulting depressions.
Geologic setting of Nabro-Dubbi

- Nabro Lies 2218m asl and 600m above Mabda
- Trachytic lava flows and pyroclastic emplace primarily on the Nabro
- WNW faults and fractures dissects the horst
- Dubbi – the largest reported historical 1861 eruption in Africa
- Extensive basaltic lava fields cover wide area
- The major transverse structure separates the Danakil blocks into two geological set up
Geologic setting of Nabro-Dubbi
Jalua Geothermal Prospect
Geologic and Geothermal Setting of Alid Prospect

- 112 Km from Massawa and 30 Km south of Irafaile village
- 600 – 900m asl and 700 m uplifted from surrounding
- Arid to semi-arid climate 30° – 40°C
Geologic Setting

Simplified geological map of Alid on a sub-regional scale.
Geologic Setting

• Consists of rifted and faulted young deposits of sediments and volcanic flows.
• Bounded by metamorphic basement and Stratoid basalt
Regional Tectonic Setting

A section of western side of Alid.
Geothermal Setting

• Consists of rifted and faulted young deposits of sediments and volcanic flows.
• Bounded by metamorphic basement and Stratoid basalt
Gas geothermometers indicate a high temperature >220°C
Assessment from lineament

Lineament mapping

Three trends have been identified
• ENE trend
• NW
• E–W
Contour plot of Alid area using FFD analysis. Note the high values lie on the Darere-Illeghedi line.
Alid geothermal system – resistivity survey

Resistivity map at 3500 metres below sea level.
Yellow line shows the location of the vertical resistivity boundary between ½ and 2 km depth. The brown contour lines outline the low resistivity body west of Mt. Alid at about 2 km depth.
Low Temperature areas
The tectonic setting and geological make up of the Danakil depression provides a suitable environment for the occurrence of geothermal energy. Alid and Nabbo-Dubbi are the notable prospect. A high temperature reservoir (250°C) is predicted on the Alid prospect. Maximum lineament zone defined by ENE strike is well marked on the FFD analysis inline with the major fracture set of the area. Two high values depicted on the contour map are well accompanied with the thermal manifestation. The resistivity survey carried out at and around Alid dome depicted a new anomaly at the rift floor, paving a way to look for a wider perspective.
The current study recommends the following detail works on Alid:

• To complete the following UNEP ARGeo-ICEIDA program on Alid
  ▪ Conduct CO₂ and other trace element mapping of the area to clearly identify zones of heat flow.
  ▪ to finalize the gravity and microseismicity to complement the MT and TEM geophysical survey.

• Collect samples for isotopic analysis to exactly constraint the genesis and construct reaction paths

Perform prospect investigation on Nabbro Dubbi including:

• Geological mapping with emphasis on structure
• Collect water and gas samples and perform geochemical interpretation.

Carry out reconnaissance investigation on areas with indication of surface manifestation; notably Jalua volcanic complex.
Thank you