GEOTHERMAL EXPLORATION IN ALID - STATUS

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INTRODUCTION

Location
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.
1. INTRODUCTION

• 5.2 million Population
• 405 USD GDP per capita
• 2.1 billion USD GDP
• Export includes agriculture and Mining
• Electricity access rate: 32.0%
• Total installed capacity is 195MW .....fossil fuel
INTRODUCTION – 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, the late Prof. Giorgio Marinelli and a staff member from the Department of Energy visited Alid area.
❖ In 1994, Mikhail Beyth of the Geological Survey of Israel surveyed the 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 on Alid and surroundings.
❖ An assessment of Resistivity survey (MT and TEM) was conducted on 2008 (Eysteinsson et al, 2009).
1. 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 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 35° – 40°C
GEOLOGIC SETTING OF ALID

Simplified geological map of Alid on a sub-regional scale.
GEOLOGICAL SETTING

Lithology

- Consists of rifted and faulted young deposits of sediments and volcanic flows.
- Bounded by metamorphic basement and Stratoid basalt
GEOLOGIC SETTING

• A section of the western side of Alid
Schematic cross section of Alid volcanic center (after Clynne et al. 1997).
ALID GEOTHERMAL SYSTEM – ASSESSMENT FROM LINEAMENT

Lineament mapping
Three trends have been identified

• ENE trend
• NW
• E-W
ASSESSMENT FROM LINEAMENT

- Contour plot of Alid area using FFD analysis. Note the high values lie on the Darere-Illeghedi line.
GEOTHERMAL SETTING

• Geothermal setting
• Hot mineralized fluids discharge from many locations.
• Precipitates in the form of sulpho-salts and clays.
• Steaming grounds are common.
• Gas geothermometry indicates high reservoir temperature > 250°C
• Gas geothermometers indicate a high temperature >220°C
Chemical Composition And Possible Origin
Of Some Gases Of Alid Fumaroles

- Non-condensable gas composition of all samples range from 95.5-99 mol% of CO$_2$ 0.5-2.5 mol% H$_2$

- Isotopic composition of $\delta^{13}$C in CO$_2$

- The N2/Ar /He relations in the fumarolic gases are strongly indicative of a parent geothermal reservoir water that initially was air saturated groundwater.
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.
CONCEPTUAL MODEL OF ALID GEOTHERMAL FIELD
CONCLUSION

The tectonic setting and geological make up of the Danakil depression provides a suitable environment for the occurrence of geothermal energy.

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.
RECOMMENDATION

• The current study recommends the following detail works on Alid:
• To complete the following UNEP ARGeo-ICEIDA program on Alid
  ▪ Conduct CO₂ and Rn 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.
• Construct conceptual modeling to exactly pinpoint target area for drilling
THANK YOU