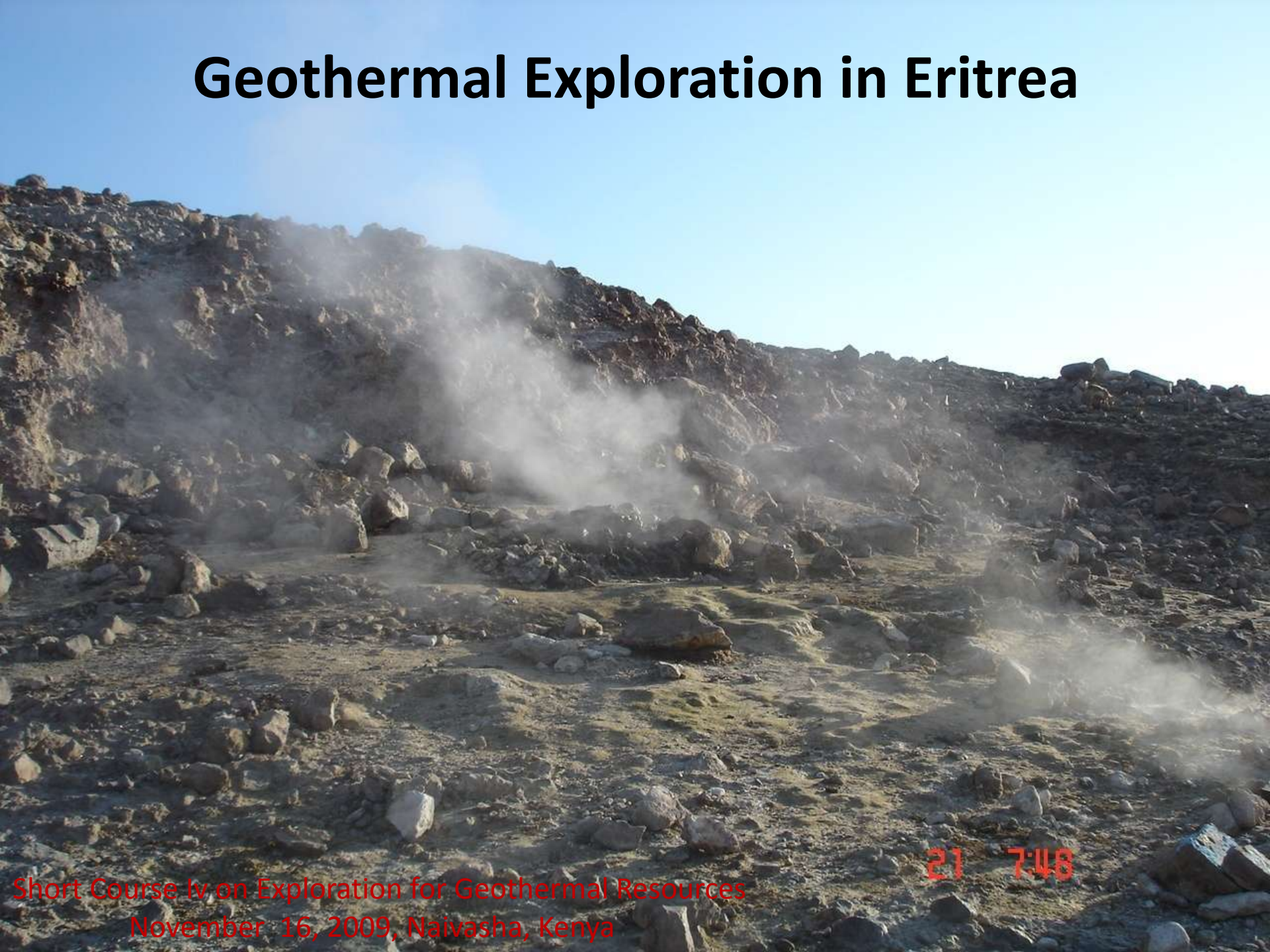
# Geothermal Exploration in Eritrea




Short Course Iv on Exploration for Geothermal Resources
November 16, 2009, Naivasha, Kenya

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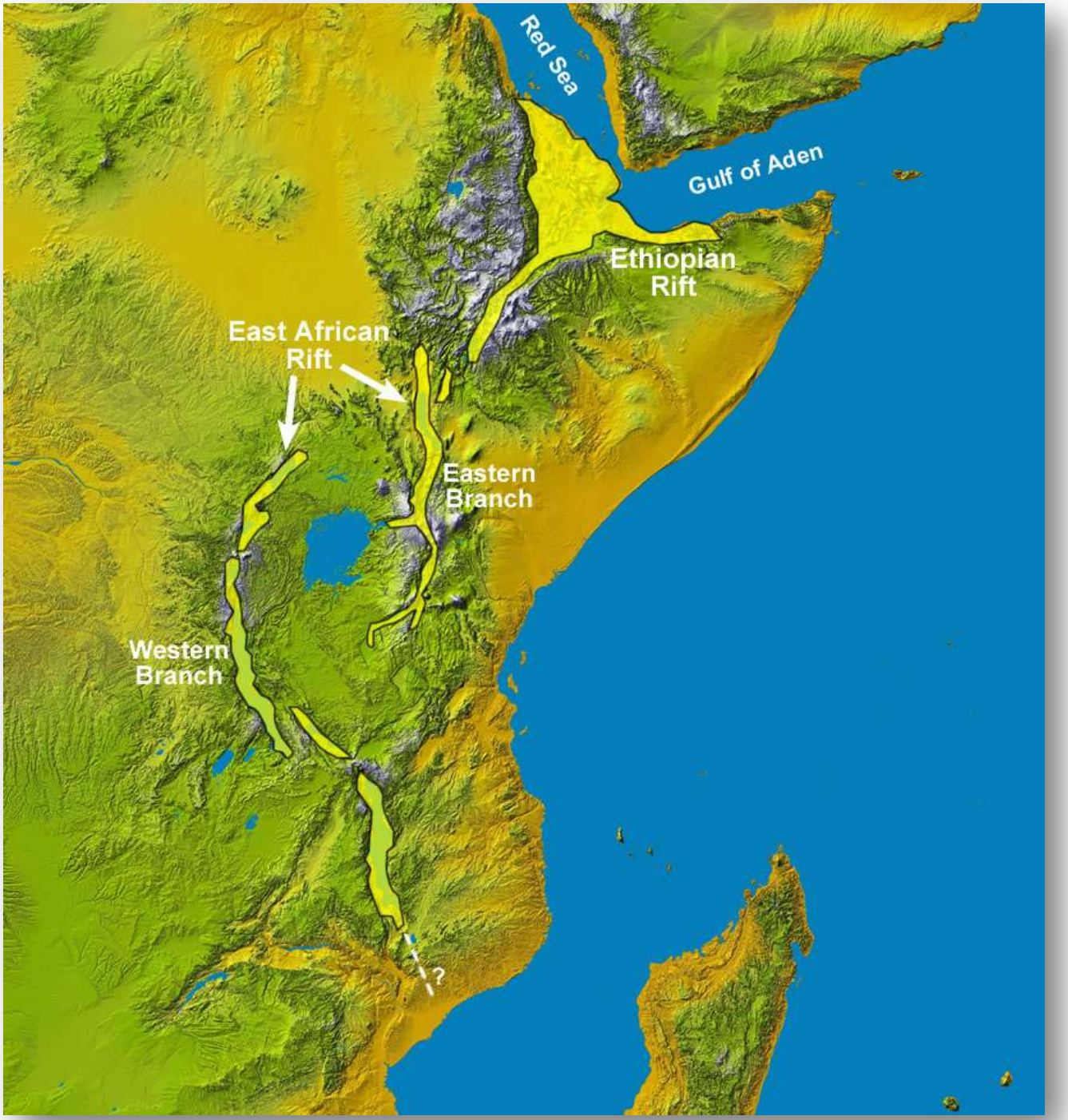
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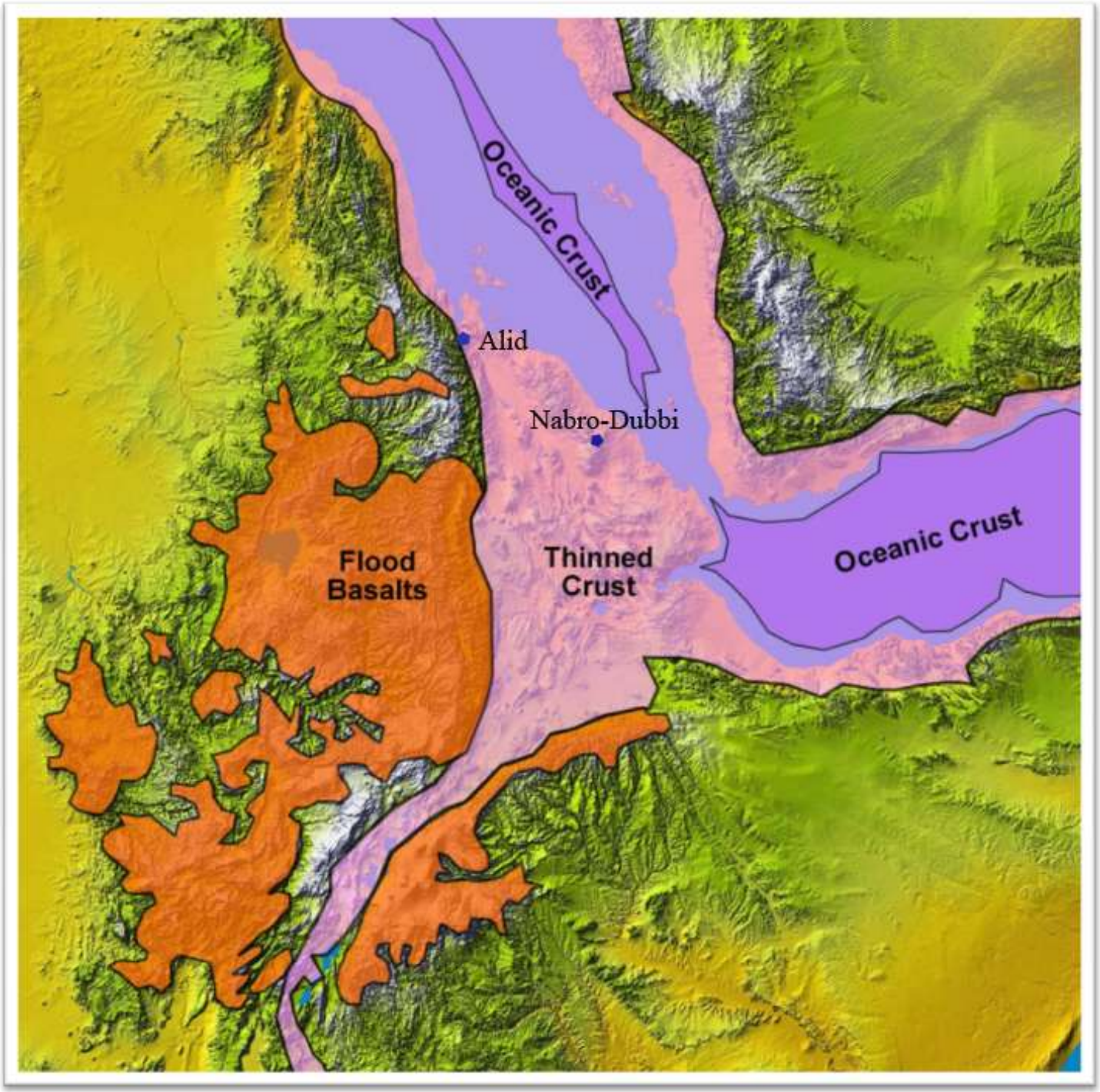
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# Introduction- Previous works

- 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 Resisistivity survey (MT and TEM) was conducted on 2008 (Eysteinsson et al, 2009).

# Regional Tectonic Setting

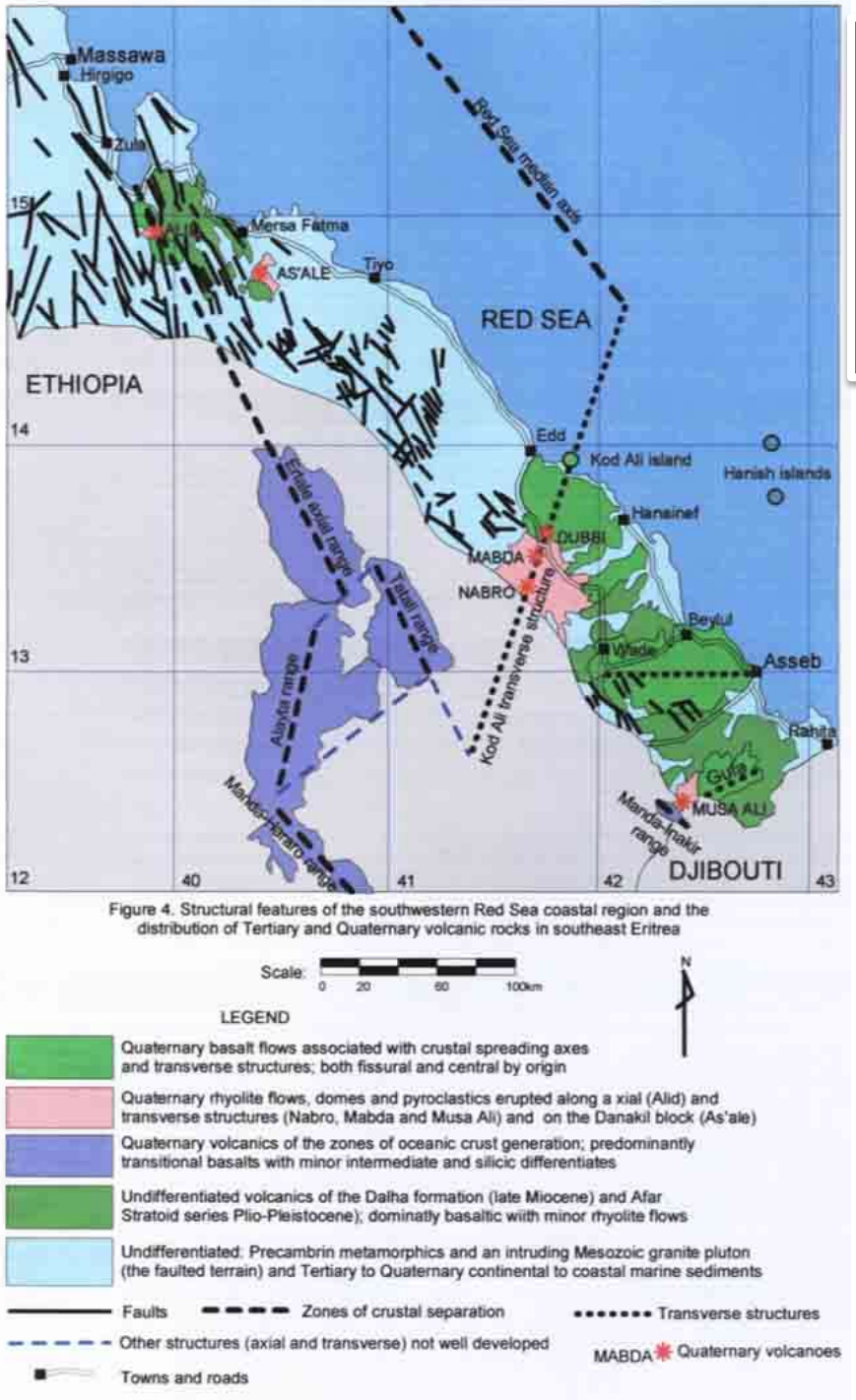
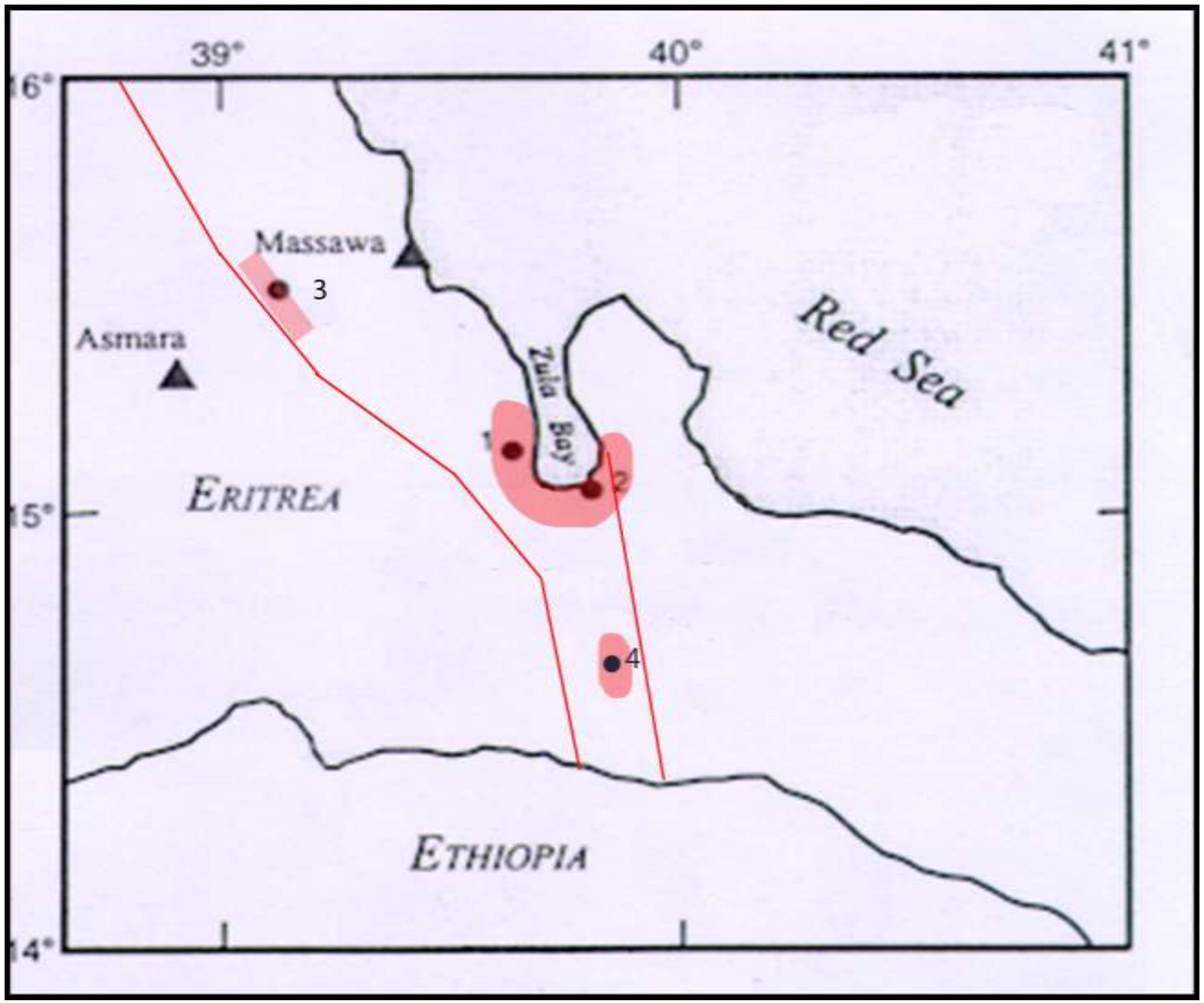


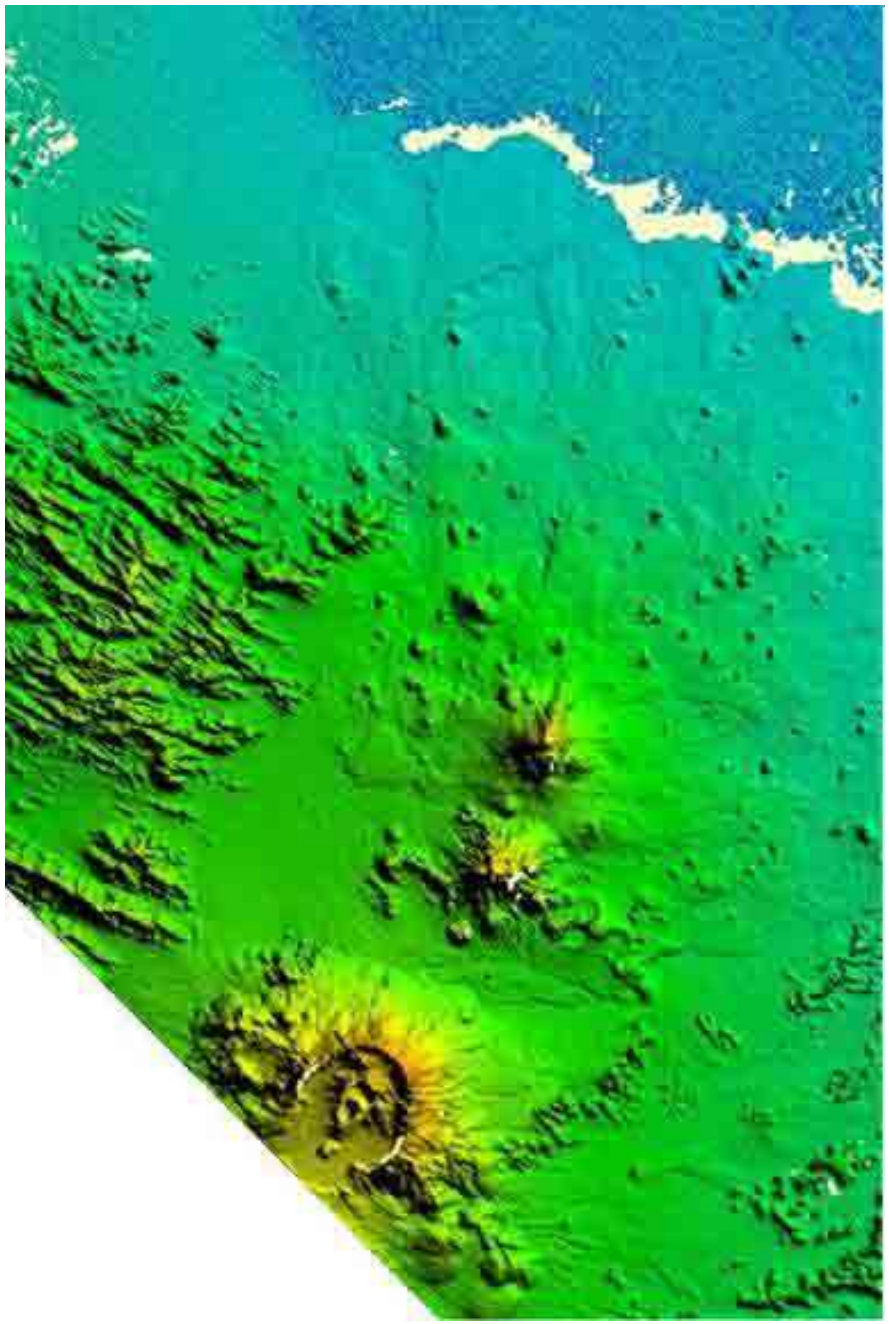

Figure 4. Structural features of the southwestern Red Sea coastal region and the distribution of Tertiary and Quaternary volcanic rocks in southeast Eritrea

- 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.

# Low temperature areas - springs

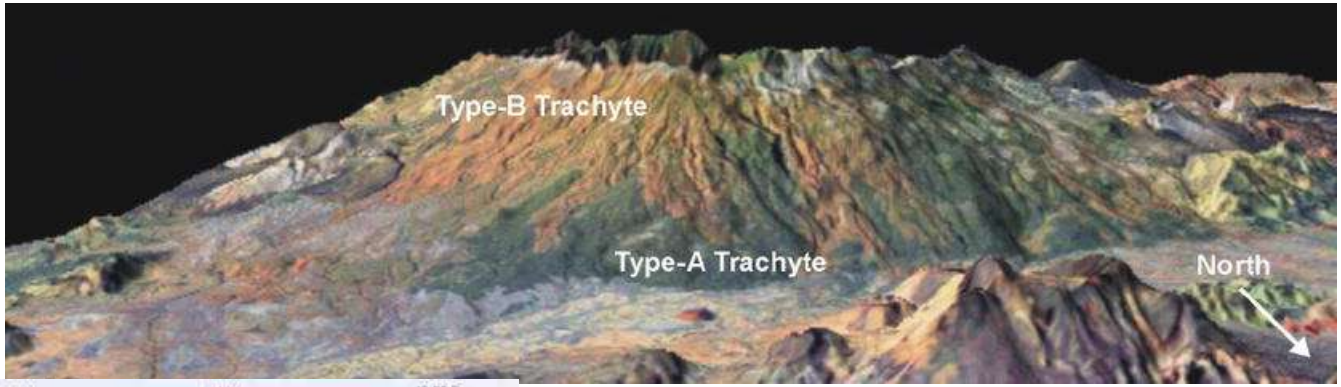


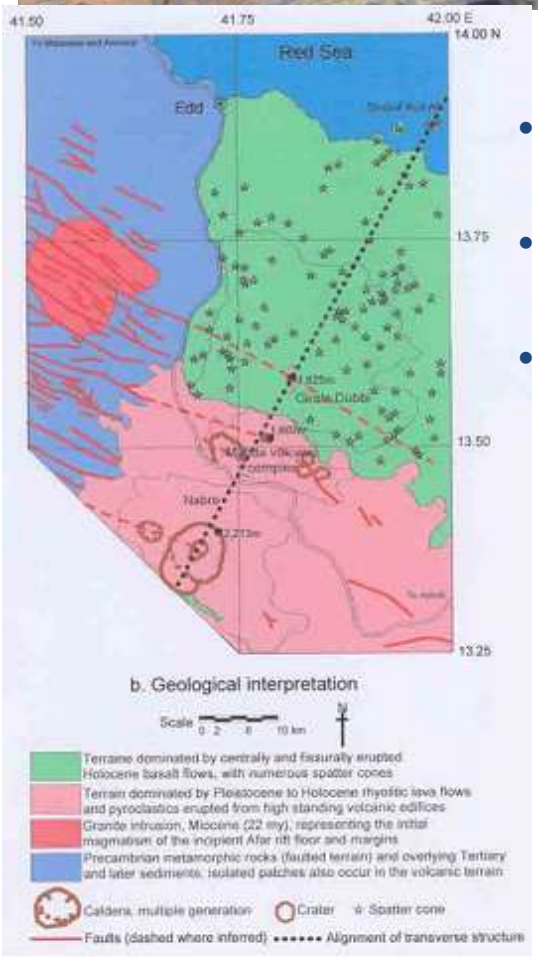
# SAMOTI SPRING WITH HIGH FLOW



# Outline geology of Nabro-Dubbi area

- 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

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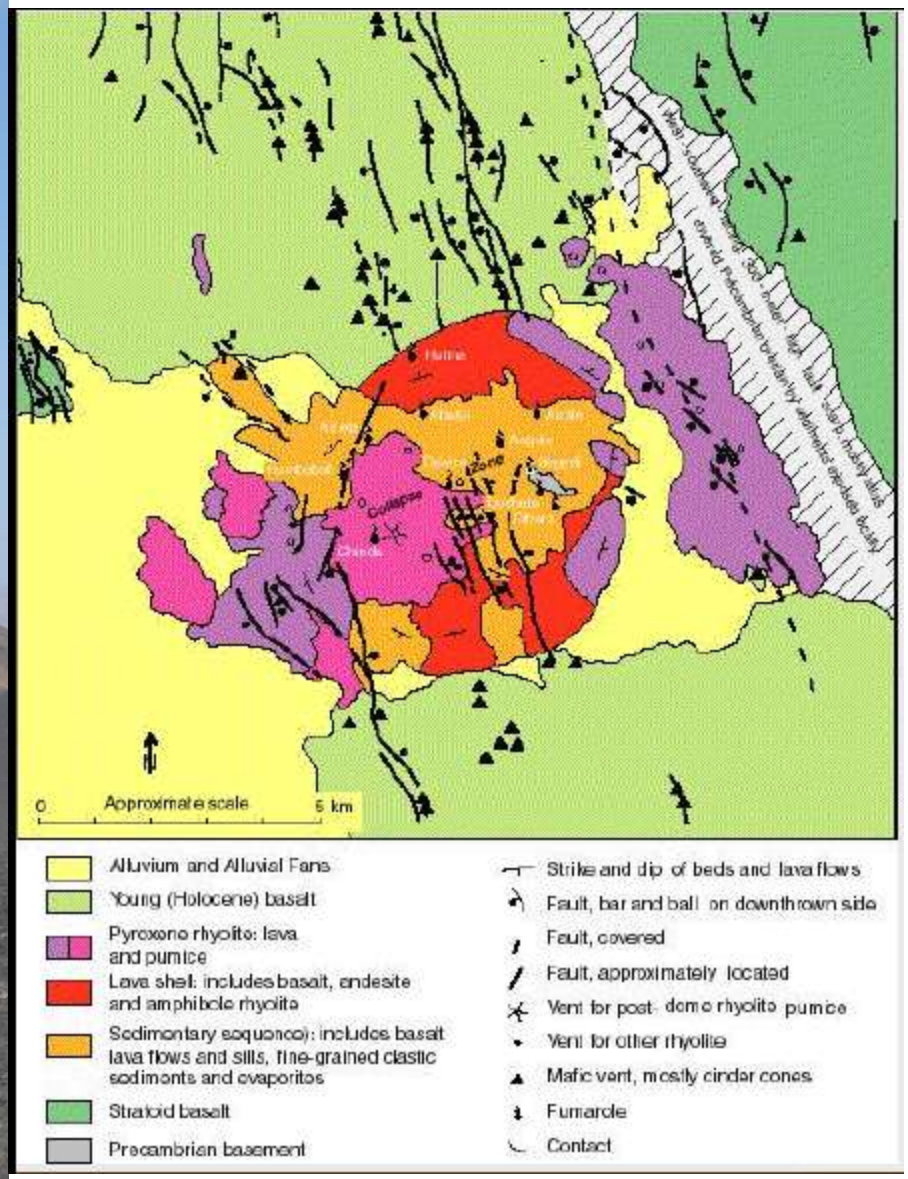
# Geological and Geothermal Setting-Alid


- 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 $35^0$ – $40^0$C

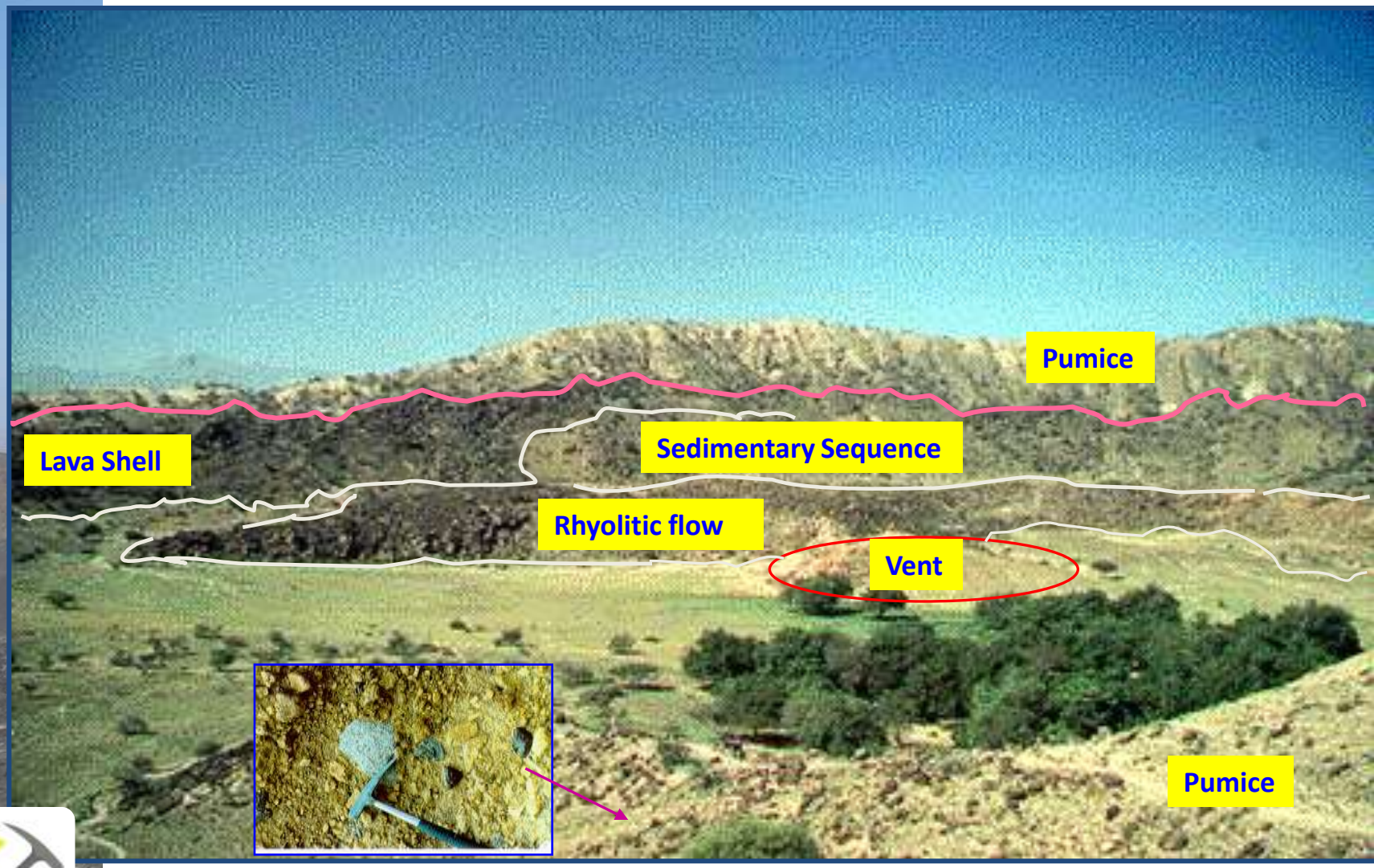



Geological setting:

- Consists of rifted and faulted young deposits of sediments and volcanic flows.

- Bounded by metamorphic basement and Stratoid basalt

# A SECTION OF THE WESTERN SIDE OF ALID CRATER

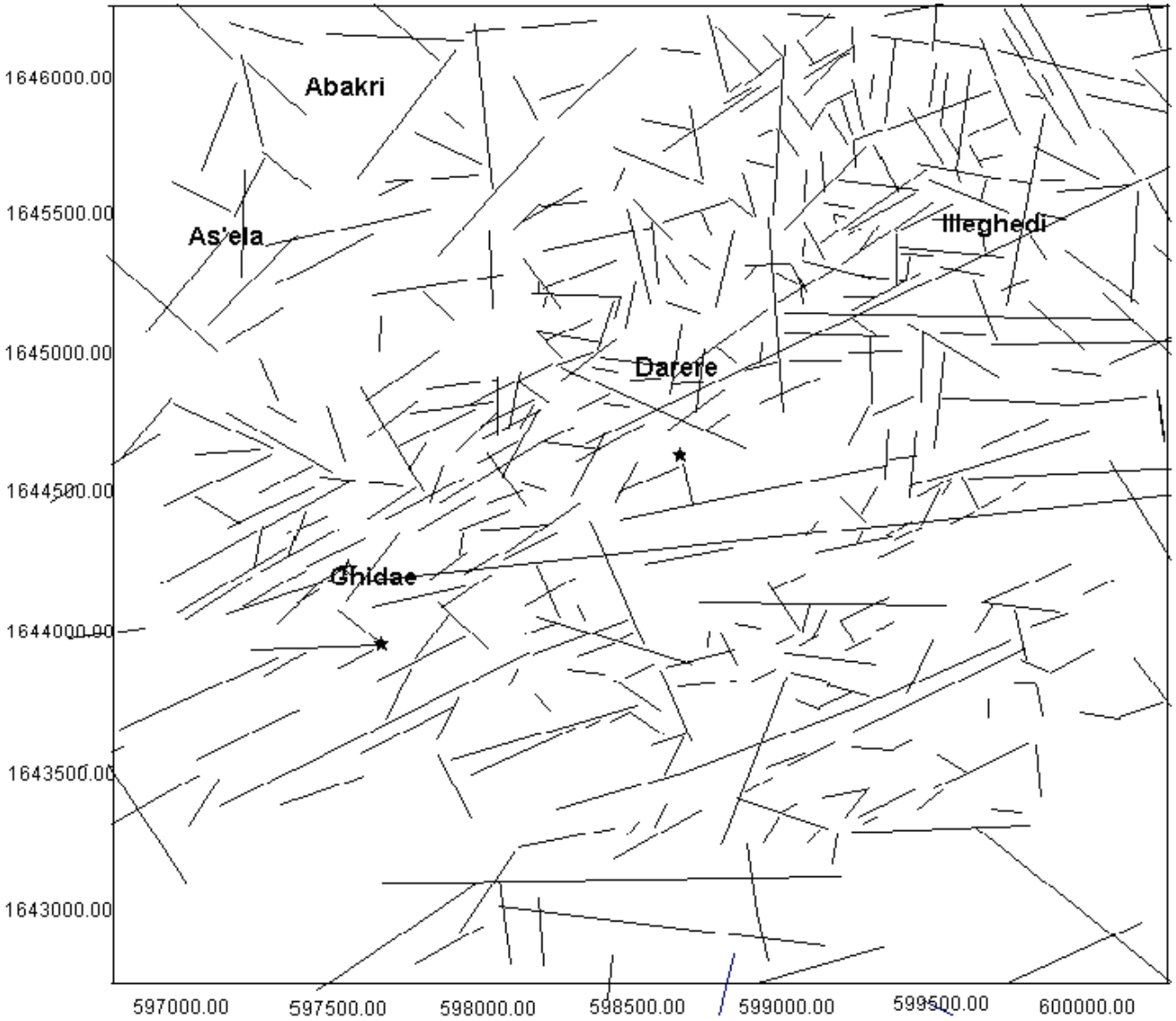


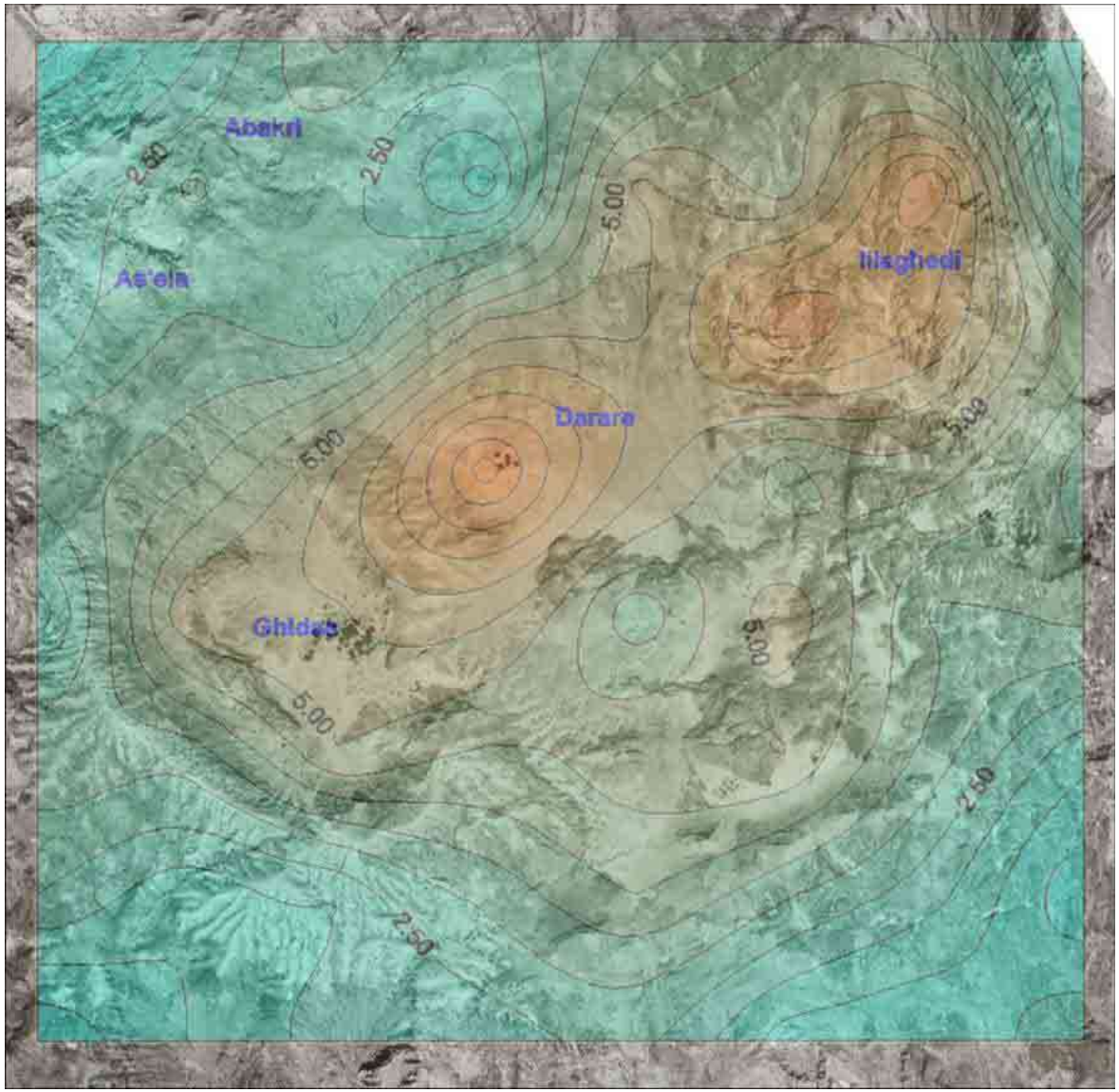
# Geothermal Setting

Geothermal setting

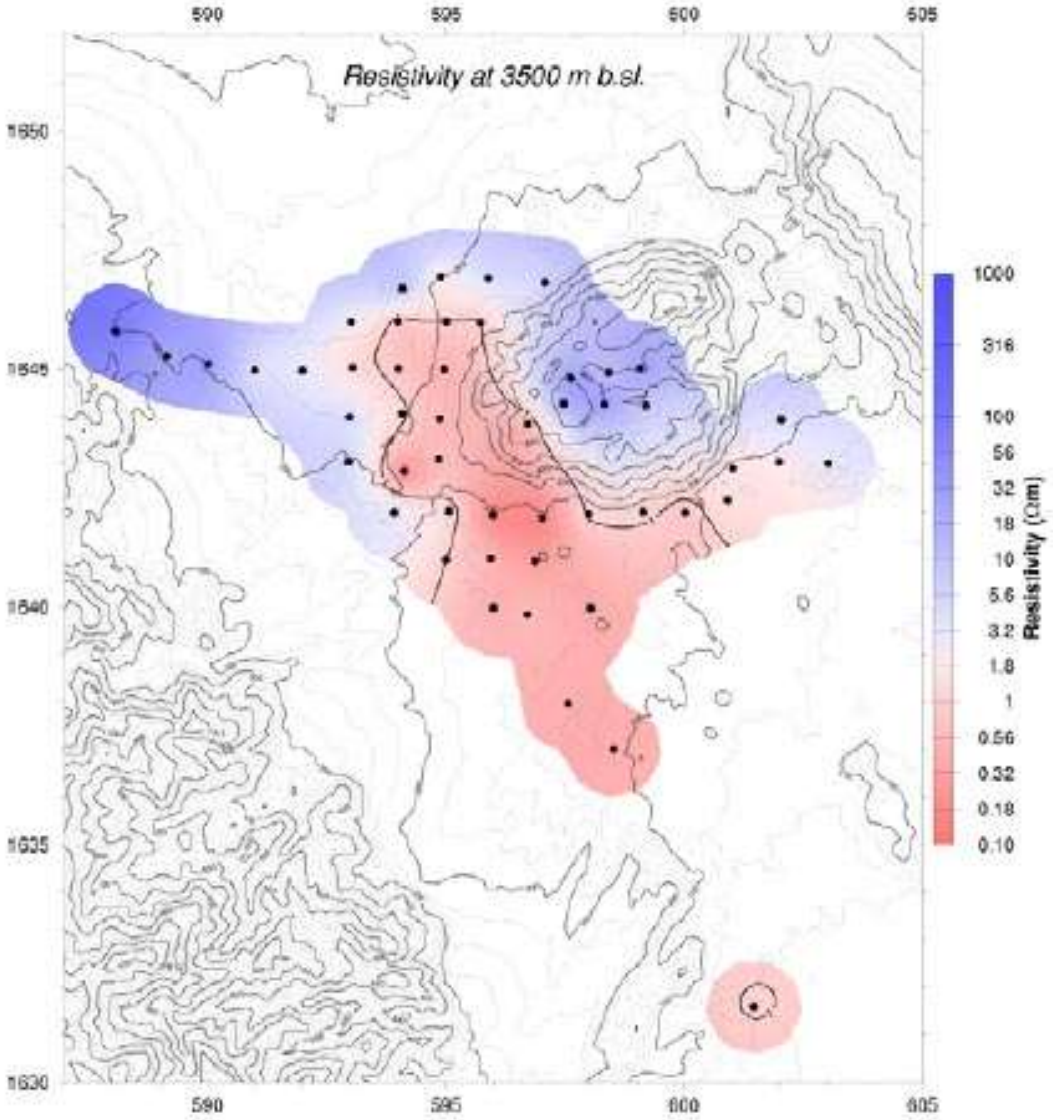
- Hot mineralized fluids discharge from many locations.
- Precipitates in the form of sulpho-salts and clays.
- Steaming grounds are common.

# Assessment from Lineament

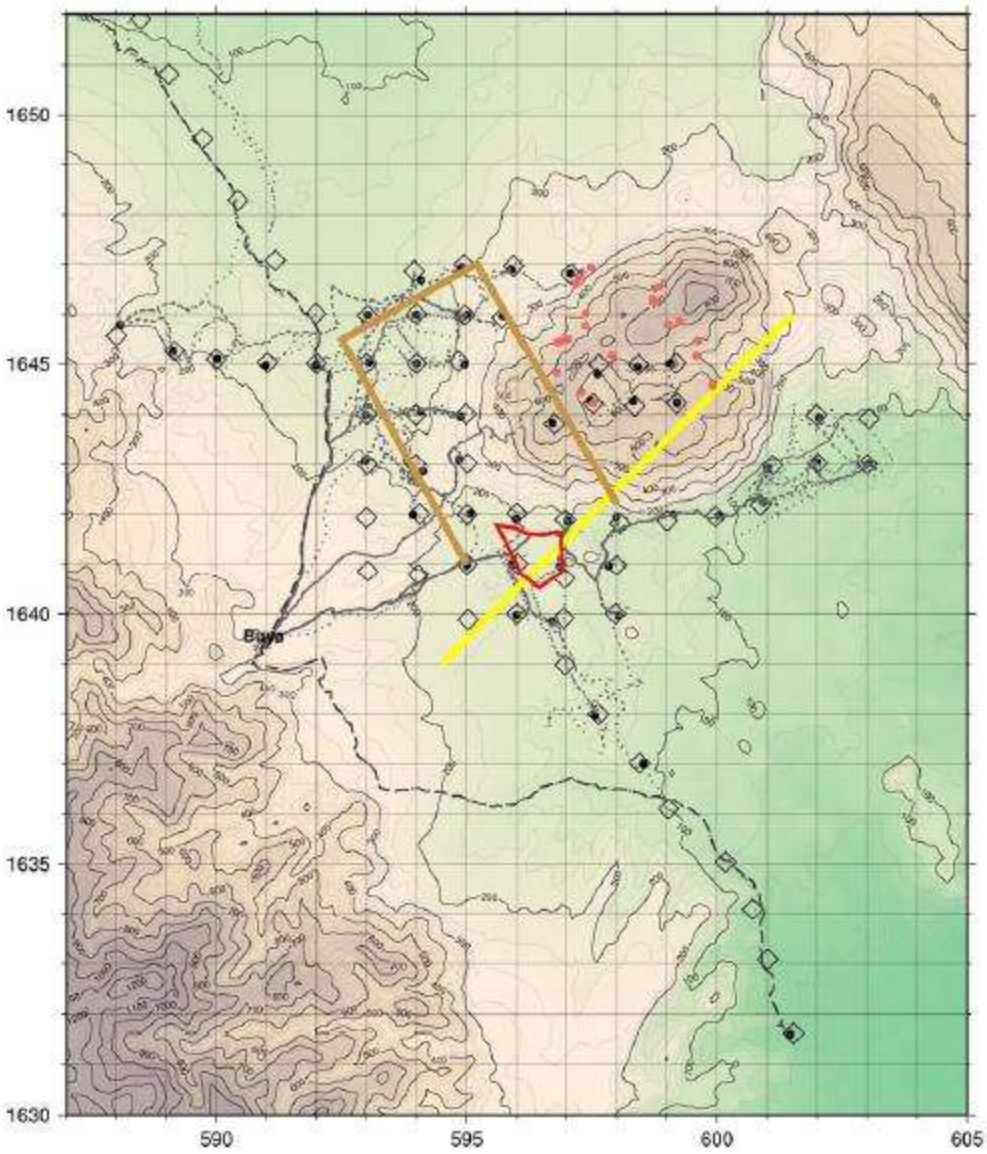





**Contour plot of Alid area using FFD analysis. Note the high values lie on the Darere-Illeghedi line.**




**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.

# Conclusion

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

Alid and Nabbro-Dubbi are the notable prospect

A high temperature reservoir ($250^0$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 resisitivity 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.

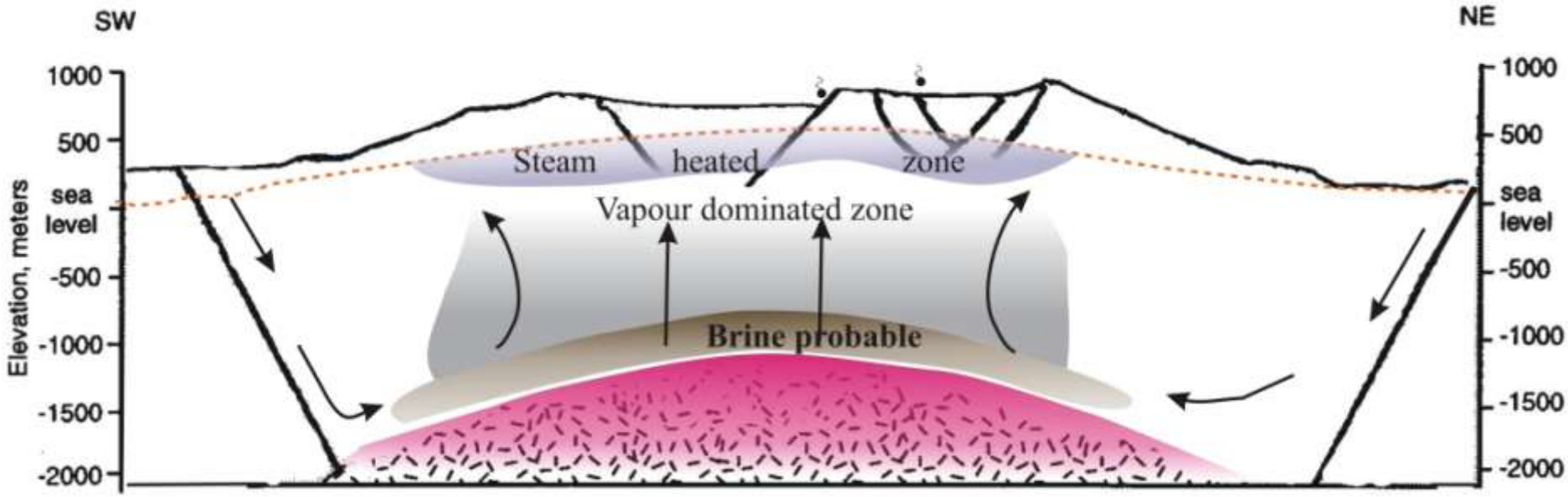
The current study recommends the following detail works on Alid:

- Conduct $CO_2$ and other trace element mapping of the area to clearly identify zones of heat flow.
- worth to commence 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.

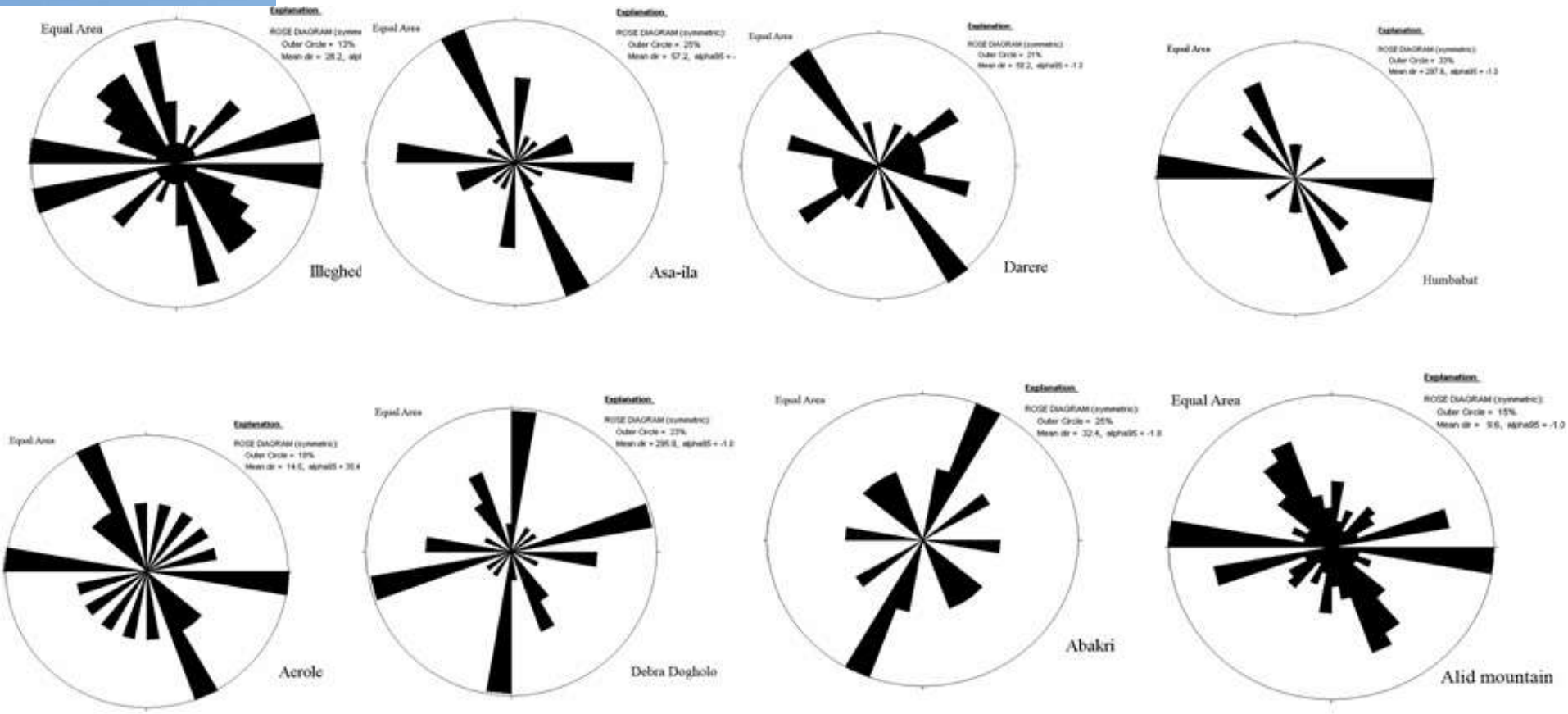
Perform prospect investigation on Nabbro Dubbi including:

- Conduct geological mapping
- Collect water and gas samples and perform geochemical interpretation.

# Conceptual model of Alid geothermal field



# Thank you




Rose diagram plots of a) Illeghedi, b) Darere, c) Asa-ila, d) Humbebet, e) Abakri, f) Debra Docholo, g) Aerole or Miski-Merehada , and h) Synoptic of the whole area.