GROUNDWATER OCCURENCE IN THE MOJO-EJERE CORRIDOR, MAIN ETHIOPIAN RIFT

maWari

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Location

- Located in an approximately square grid coordinates (38°56'E, 80°34' N) and (38°56'E and 90°05'N); (39°17'E, 80°34'N) and (39°17'E, 90°05'N),
- About 75 km south-east of Addis Ababa, on a detour all weather north-eastern road from Mojo town,
- Close to the western flank of the Ethiopian Rift Valley and in the Main Ethiopian Rift,
- Agriculturally highly productive area with Teff and grains as the main products,
- Largely dependent on the seasonal rainfall for the supply of water for domestic, livestock and agriculture use,

- Water supply large ponds and shallow wells that dry up a few months after rainy season,

- Various attempts by Oromia Water Bureau to supply the area with groundwater have failed with several wells drilled found to be dry,

- It was the aim of this work, therefore, to see if geophysical investigations can help

  i) to locate potential aquifers, and also

  ii) structures that may control the movement of water

  and possibly guide future drilling works over the area.

Location (contd…)

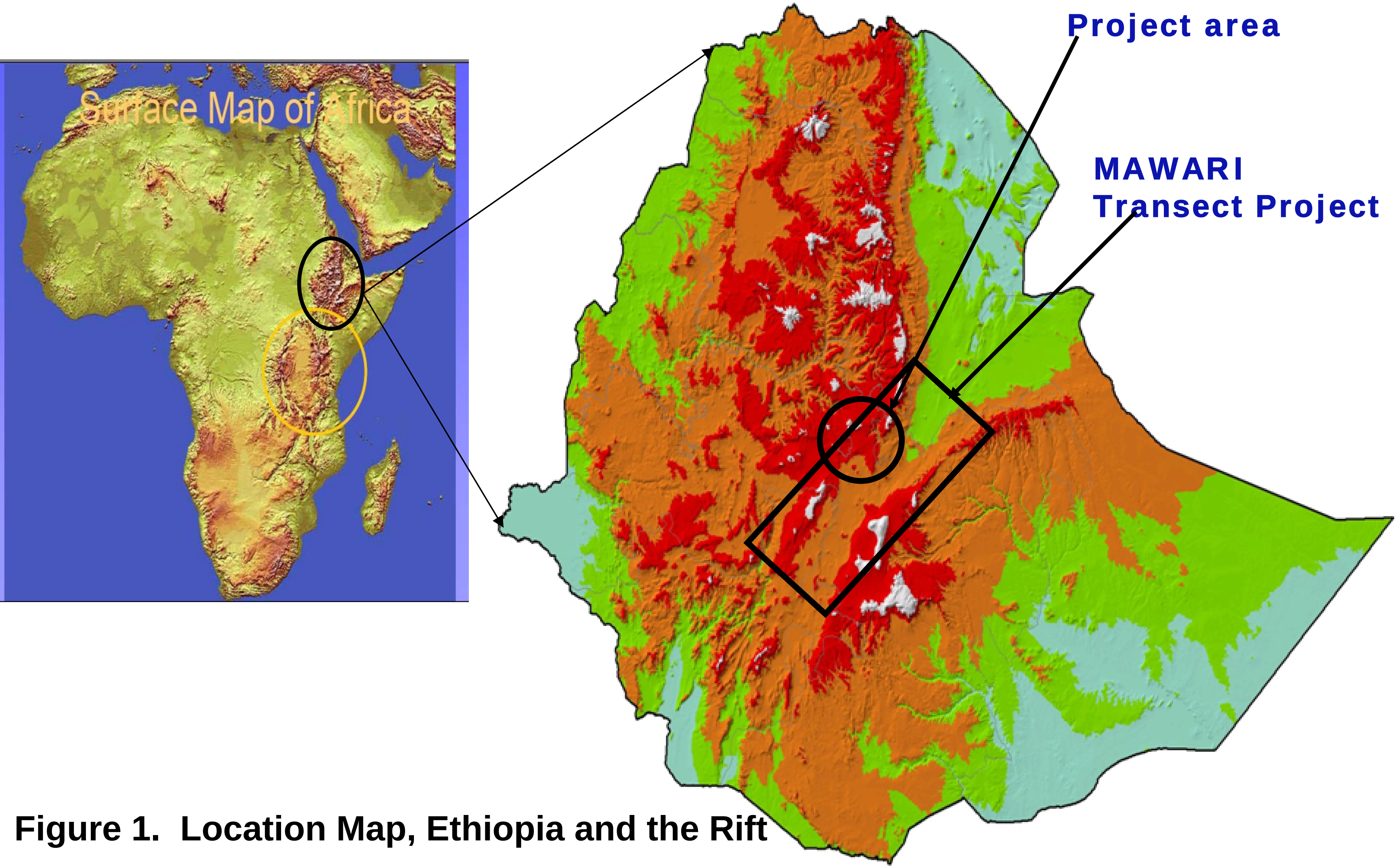


Figure 1. Location Map, Ethiopia and the Rift

Location (contd…)

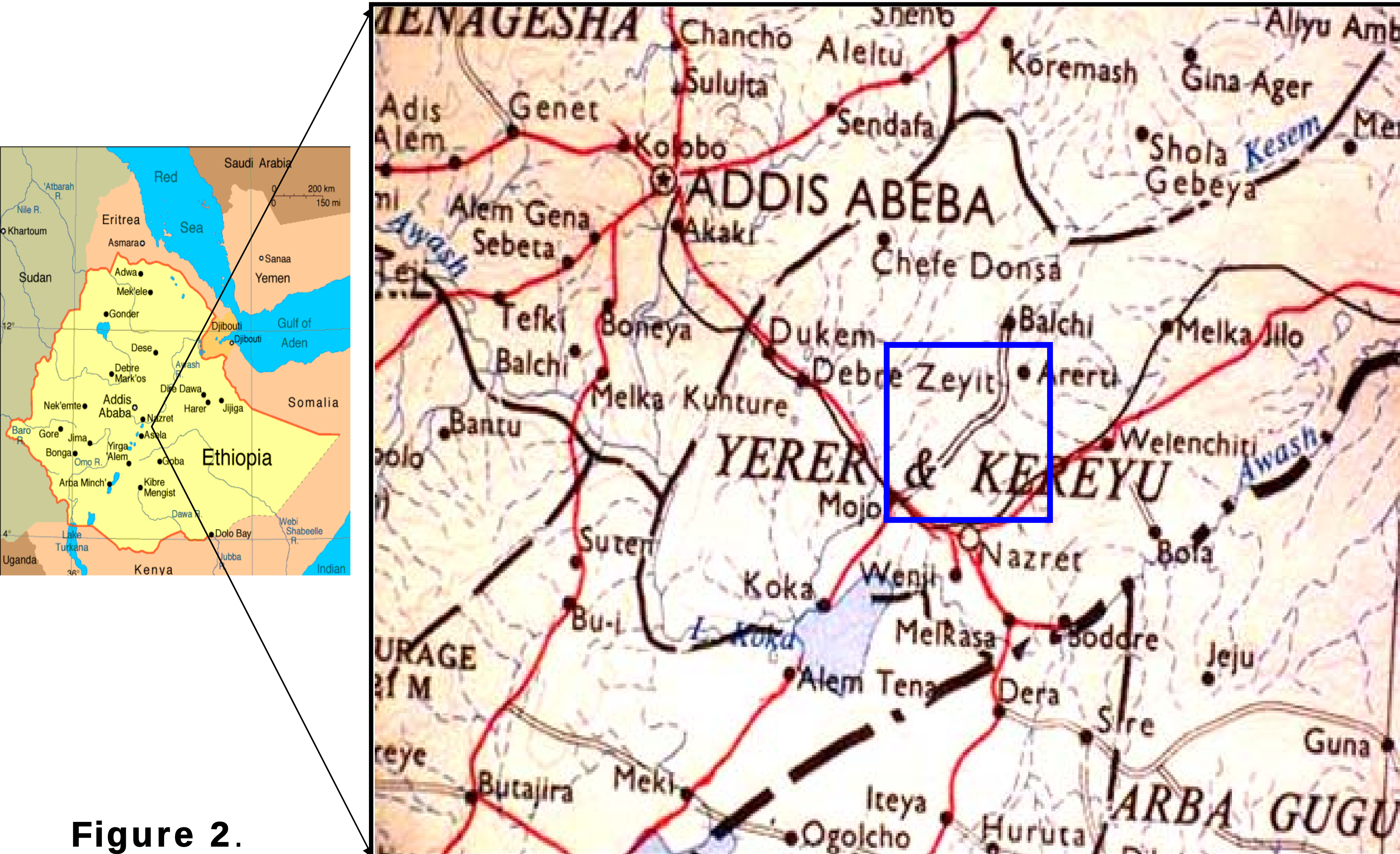


Figure 2.

Objectives

General objective:

- To make a geophysical input to a groundwater exploration project (identifying areas of potential groundwater supply) for the rural communities in Mojo-Ejere area, Oromia,

Specific objectives

- To map the general subsurface resistivity stratification, and as a result, establish the geoelectric section of the area.
- To map geological structures (faults, joints, fissures, etc...) that may control the movement of groundwater.
- To determine the location and depth of a possible potential aquifer and determine the preferred location for sinking of borehole.
- To acquaint oneself with the field methodology for data acquisition and the techniques of interpretation of geophysical data.

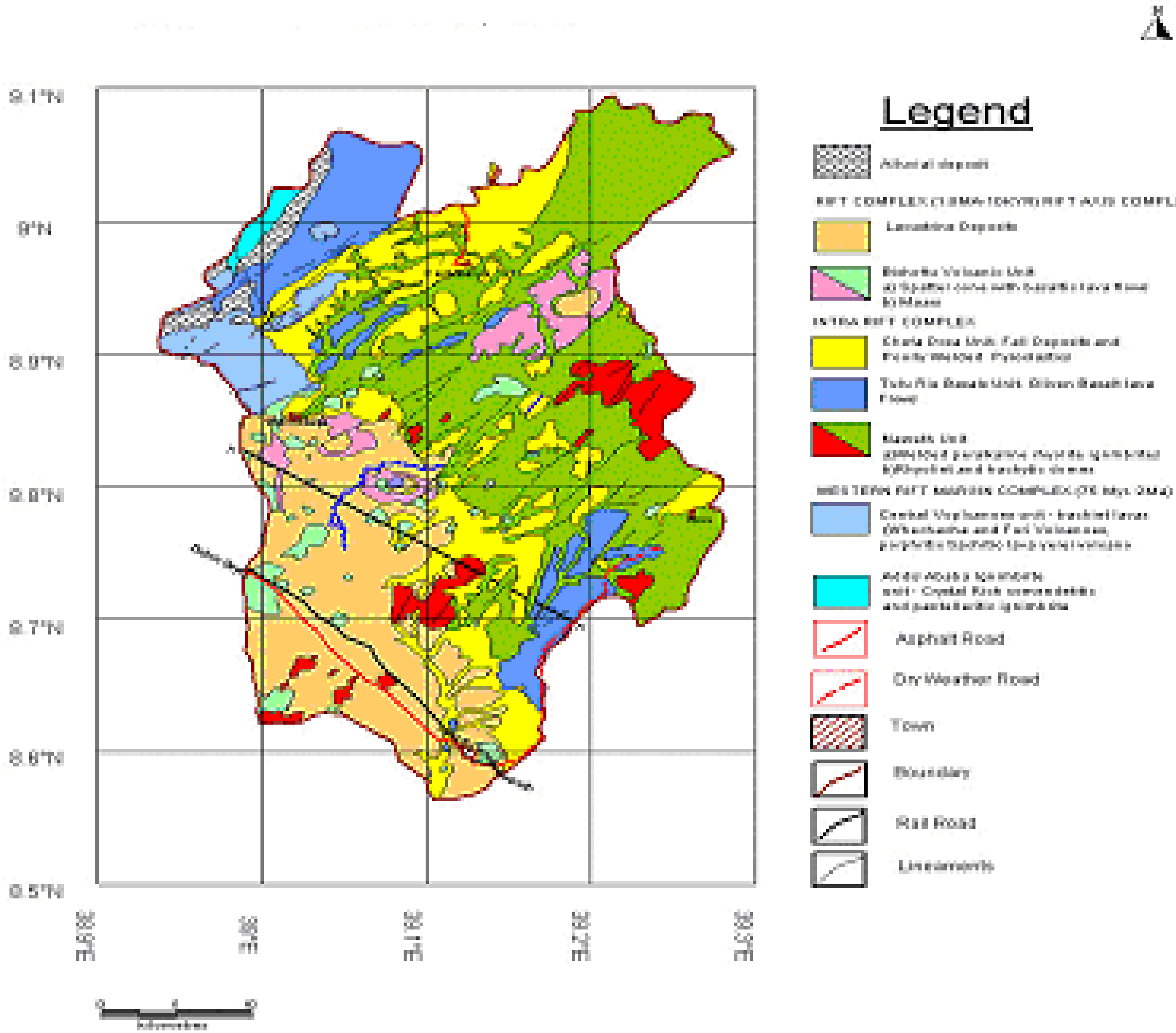


Figure 3. Geology of the study area (after Alem Tiruneh, 2004)

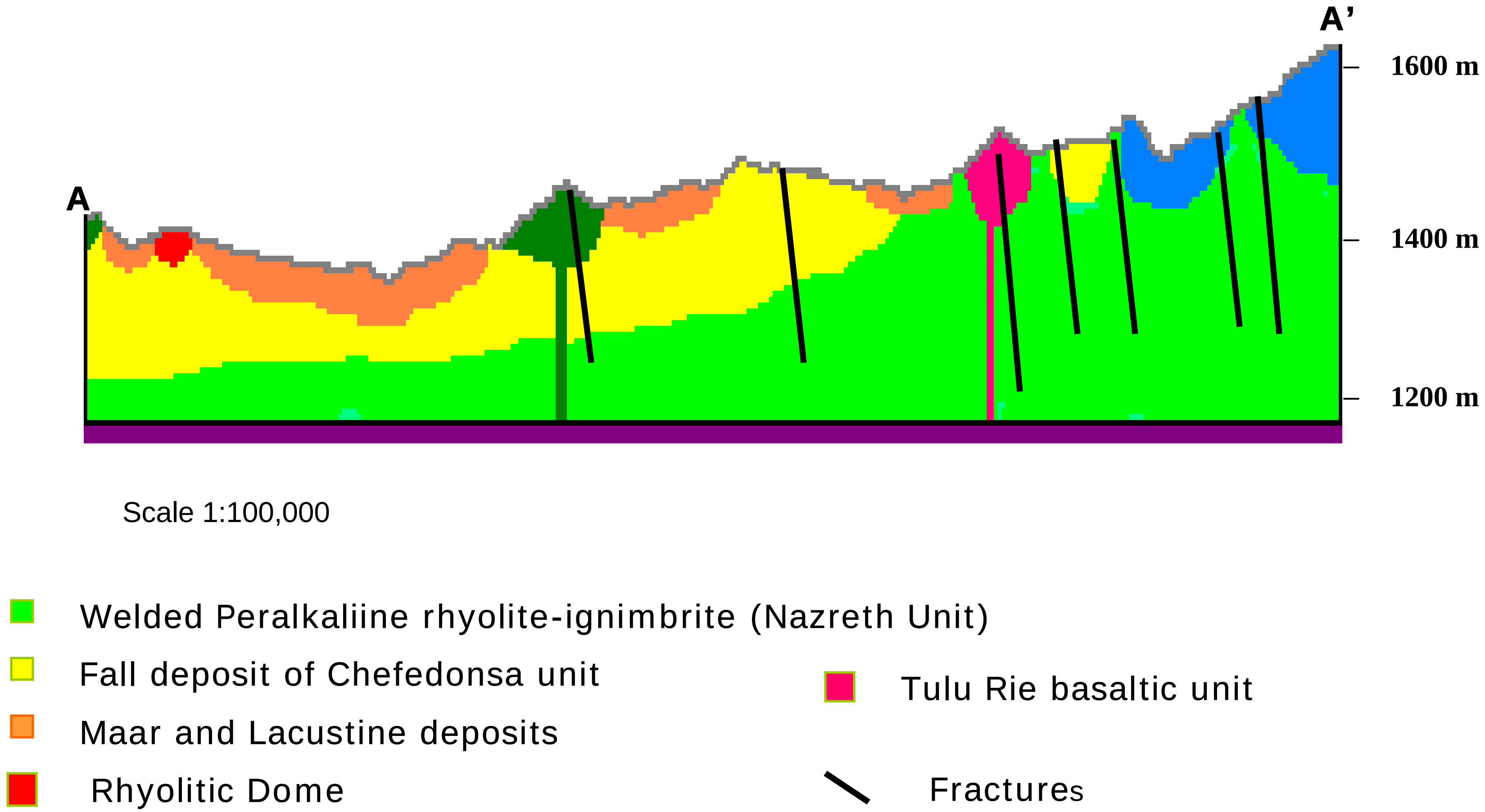


Figure 4. Geological sections along line AA’ (from Alem Tiruneh, 2004).

Methods employed

Gravity surveys

- measurments of relative gravitational field
- at 50 m station spacings
- along four Lines each nearly perpendicular to the road and
- extending almost equally to both sides

Magnetic surveys

- measurments of total field
- at 50 m station spacings
- along the same four VES lines

Vertical Electrical Sounding (VES) surveys

- Schlumberger expanding spread, $(AB/2)_{max}$ = 500, 750 m
- four travesres spread out over the area
  traverses conviniently selected to cross local geology
- 5 VES points on each traverse

Instrumentation

- **Gravity Surveys**

  W. Sodin (WS-910) Gravimeter- gravity readings
  Surveying Micro Altimeter (MM-1)- elevation
  GPS (GARMIN 12)- position location

- **Magnetic Surveys**

  Scintrex IGS-2 Proton precision magnetometer- total field
  GPS (GARMIN 12)- position location

- **Electrical Surveys**

  PASI 16GL Earth Resistivity Meter,
  P-300 Energizer,
  GPS (GARMIN 12), and
  associated accessories


DON'T DROP
DELICATE INSTRUMENT
HANDLE WITH CARE
SODIN (GRAVITY) LTD
GPS 12
12 CHANNEL
GARMIN


SCINTREX
IGS-2
System Control Console
Batt.
Sensor 2
Sensor 1
Record
Method 1
Data 2
Memory 3
Line 4
5
Start/Stop
On/Off Clear
Aux. 6
Info. 7
Memory 8
Station 9
0
Change Enter


GPS 12
12 CHANNEL
GARMIN

Field Procedure

Gravity Surveys

- Base station at Addis Ababa Geophysical Observatory,
- Secondary base stations at Mojo High School and another one in the field,
- Station spacing of 50 m,
- Traverse length of about 2 km,
- Field base station reading retaken at approximately 2 hr intervals.

Magnetic Surveys

- Field base station, station spacing and line length are the same as that of gravity surveys,
- Base station reoccupied every one hour interval for diurnal correction.

Electrical Surveys

- along four Lines of the gravity and magnetic surveys,
- expanding Schlumberger spread with $(AB/2)_{max}$ of 500 m,
- sounding point spacing of 500 m,
- four-five VES points on each line

Data Interpretation

- Electrical surveys
  - RESIXIP, RESIST, SEV softwares
- Magnetic surveys
  - Data reduction, Geosoft, OASIS Montaj software
- Surfer and Grapher plotting softwares

Data Presentation

- Gravity and magnetic anomaly contour maps,
- Joint gravity and magnetic modeled sections,
- Apparent resistivity pseudo sections,
- Geoelectric sections.

INTERPRETATION RESULTS

Gravity

Magnetic

Electrical

Gravity Survey

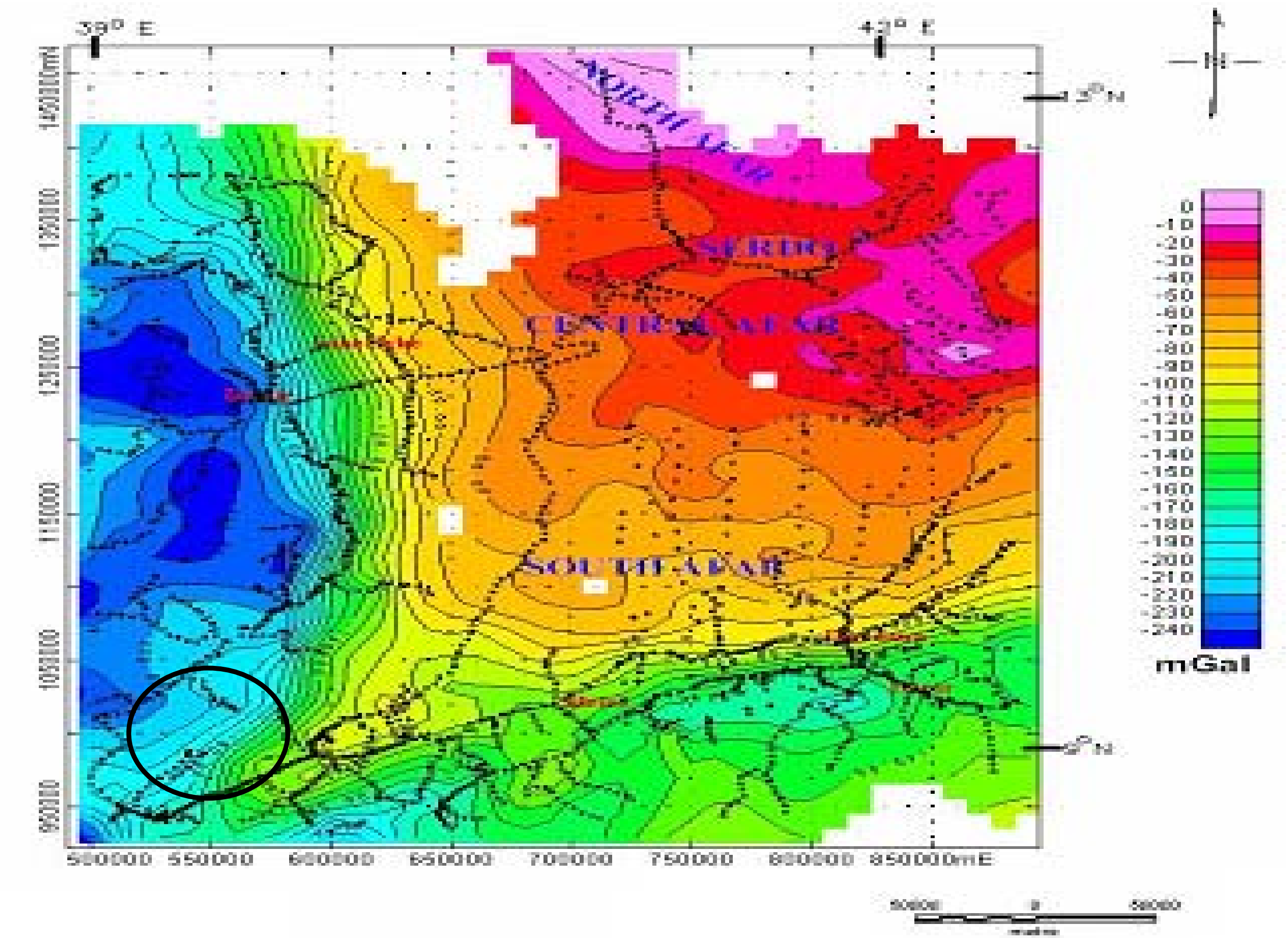


Figure 5. Bouguer anomaly map of Northeastern Ethiopia (GSE, 2005)

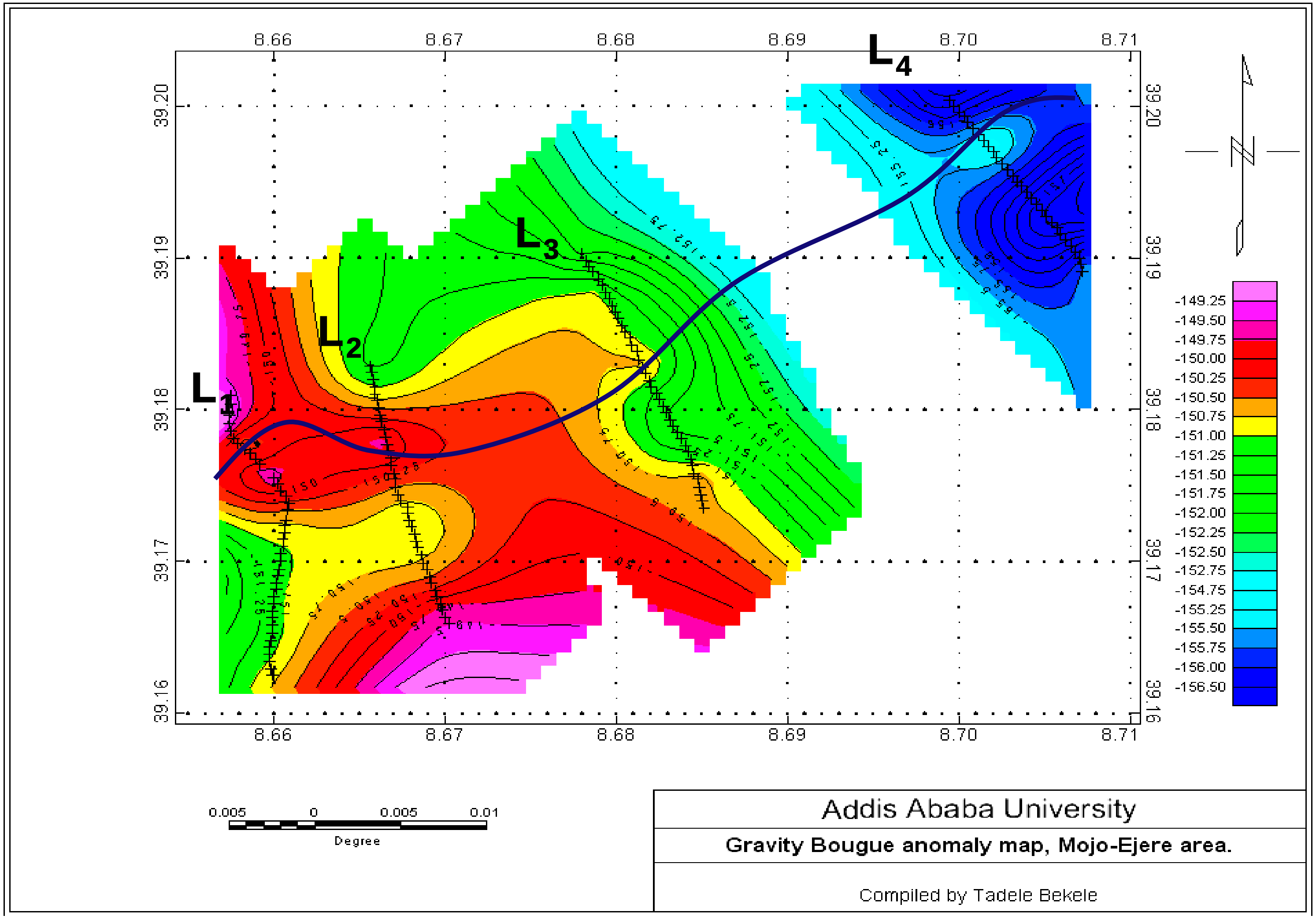


Figure 6. Bouguer gravity anomaly contour map of the study area.

Modelling

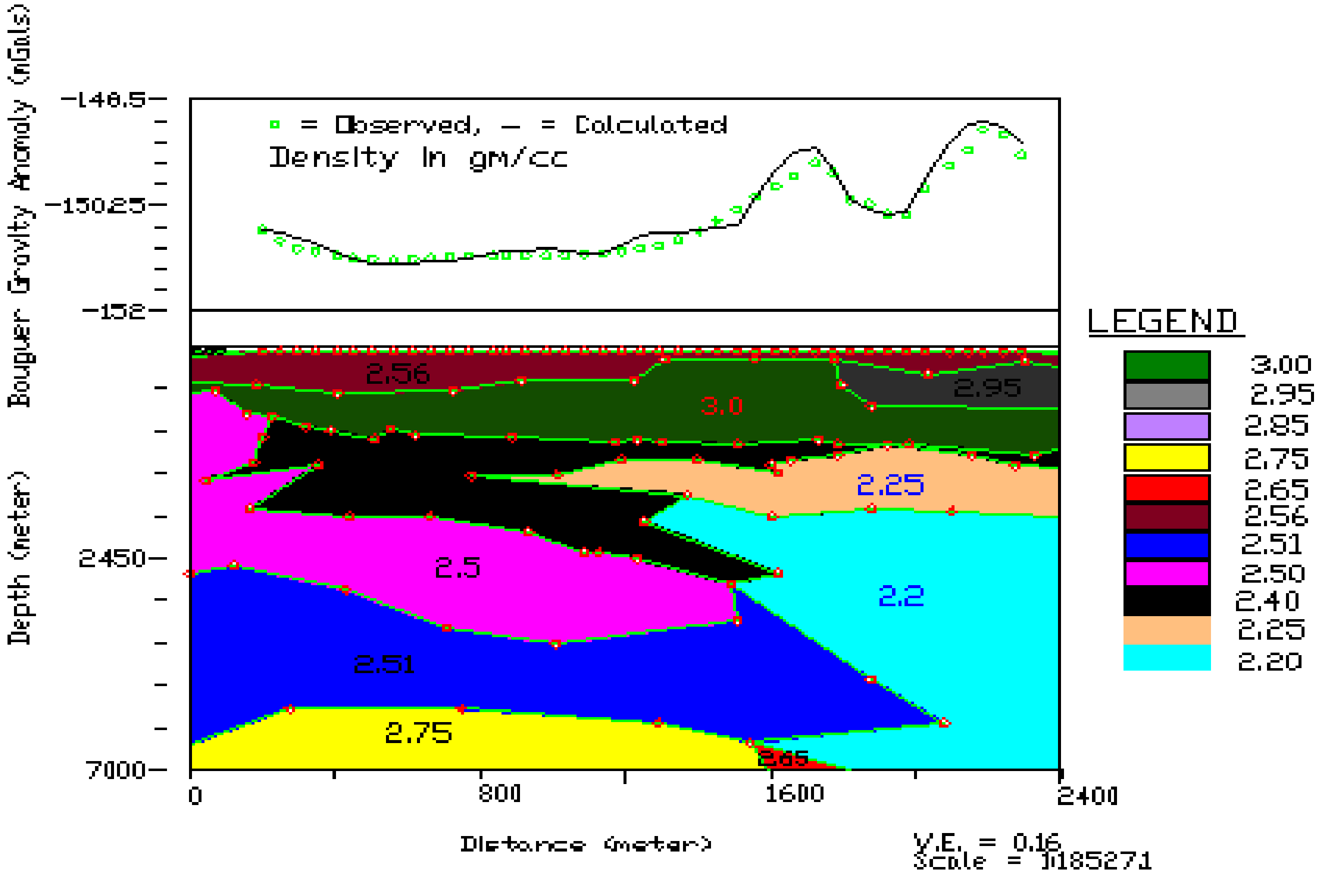


Figure 7. Modeled Bouguer anomaly along Line 1.

Magnetic Survey

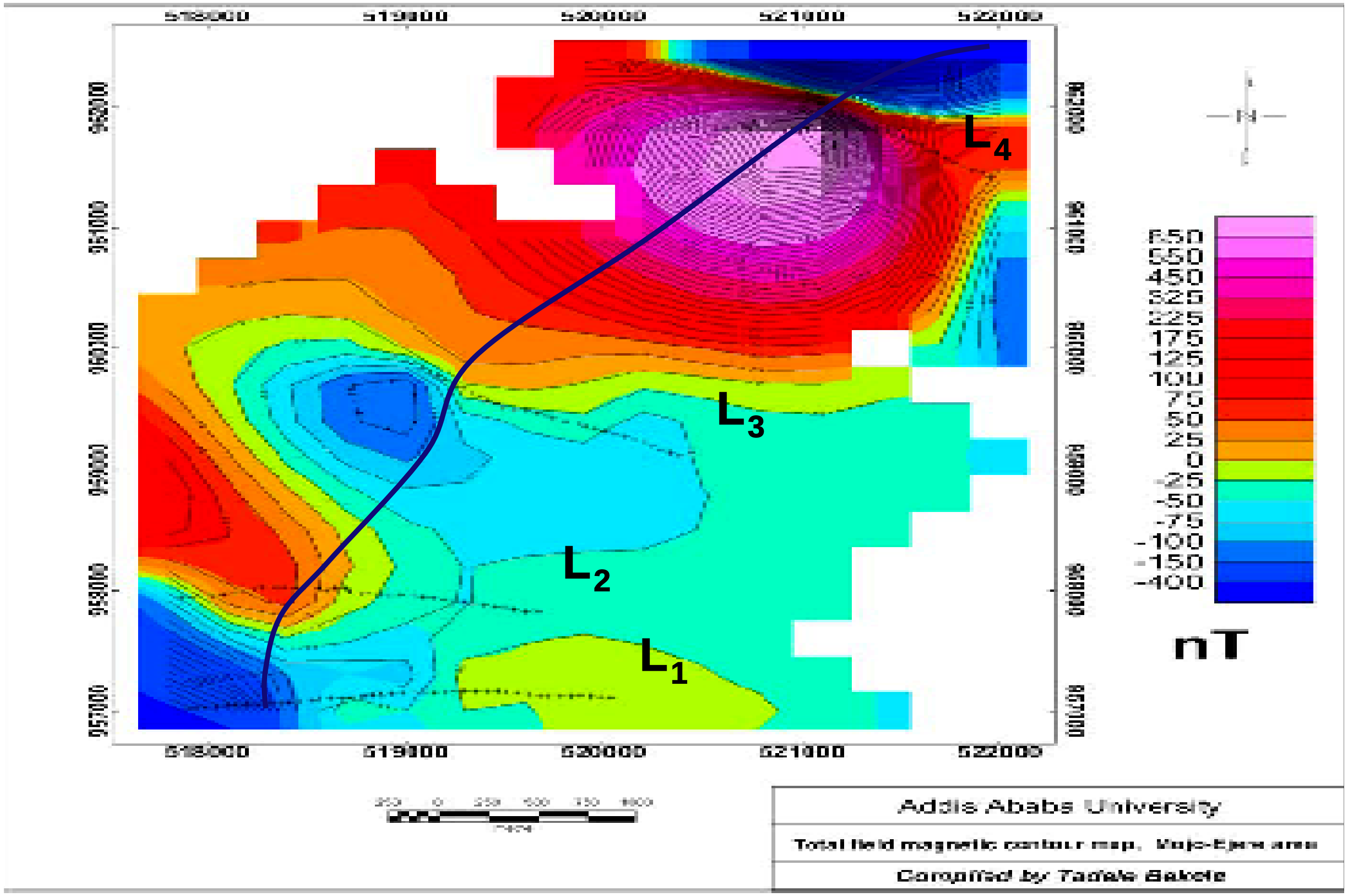
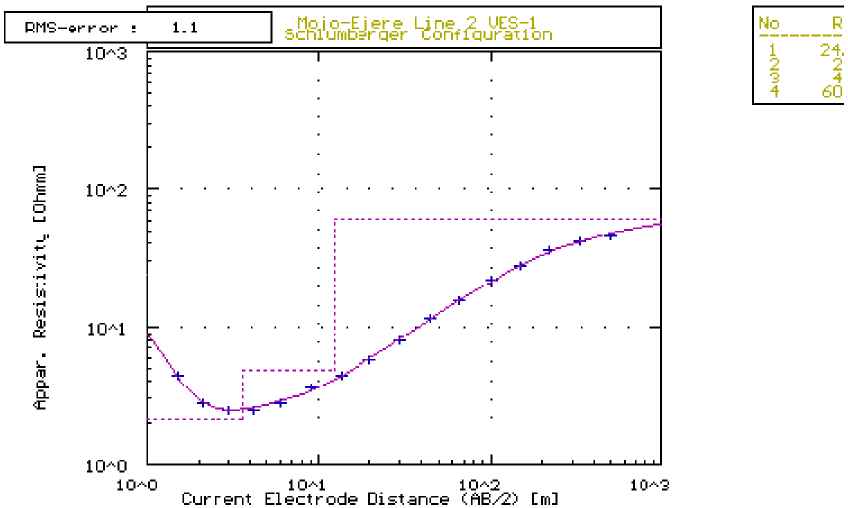
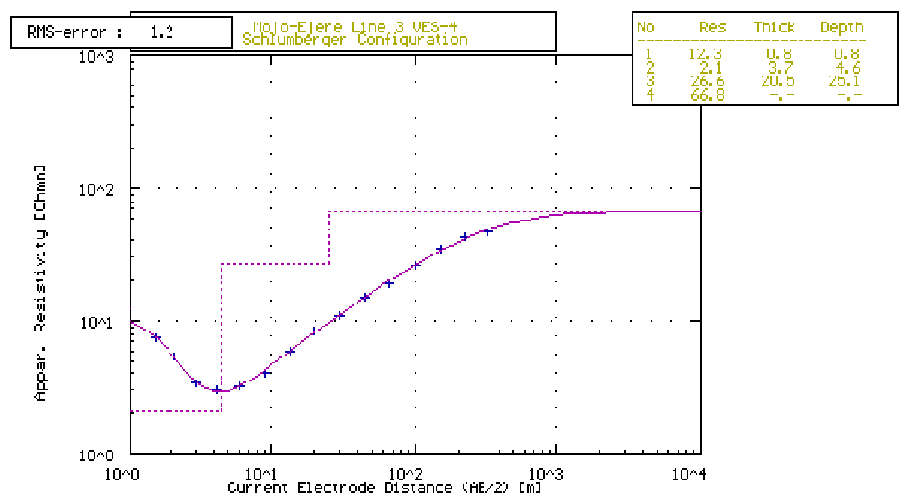


Figure 8. Magnetic contour map of Mojo-Ejere area.

Electrical Survey Results



VES-1, Line 2



VES-4, Line 3

Electrical Survey Results (contd ...)

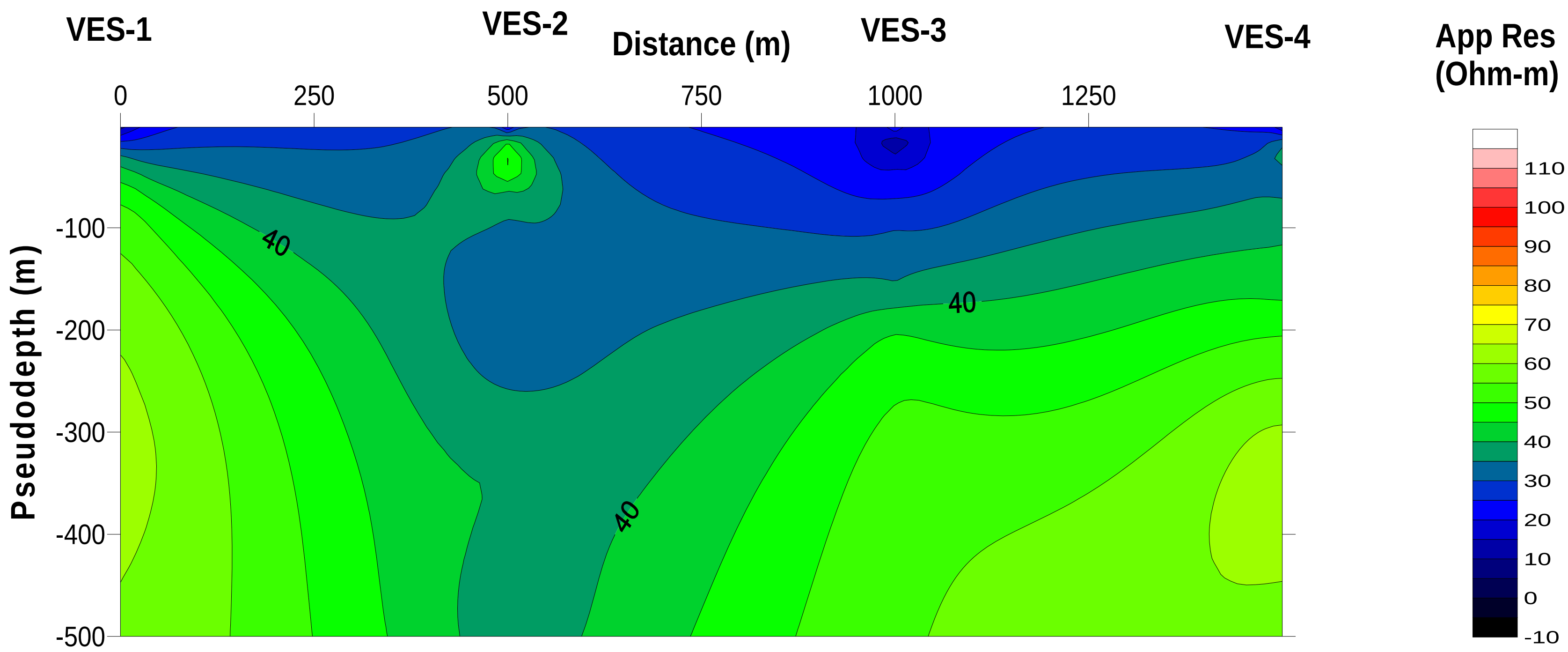


Figure 9. Apparent resistivity pseudo sections along the survey Line 1.

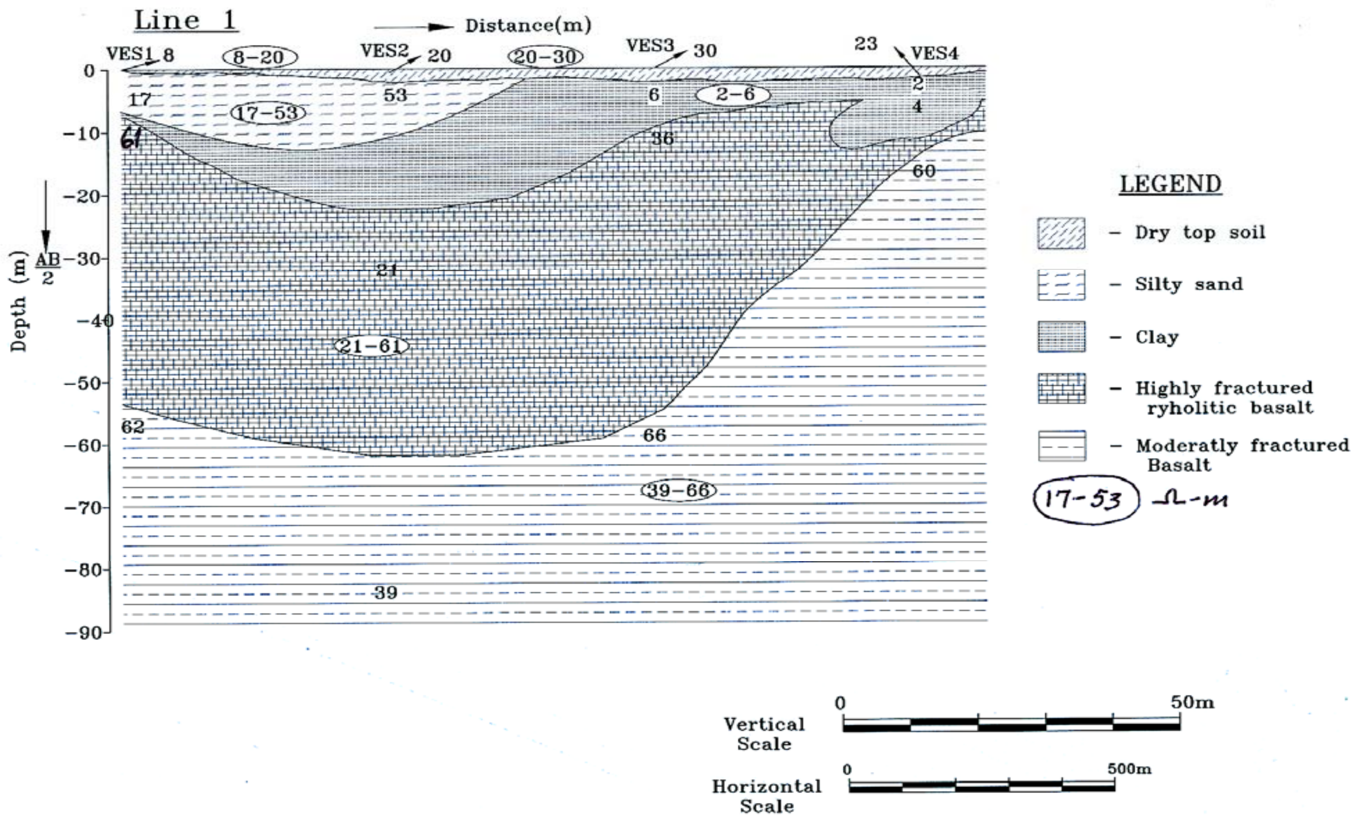


Figure 10. Geoelectric sections on Line 1.

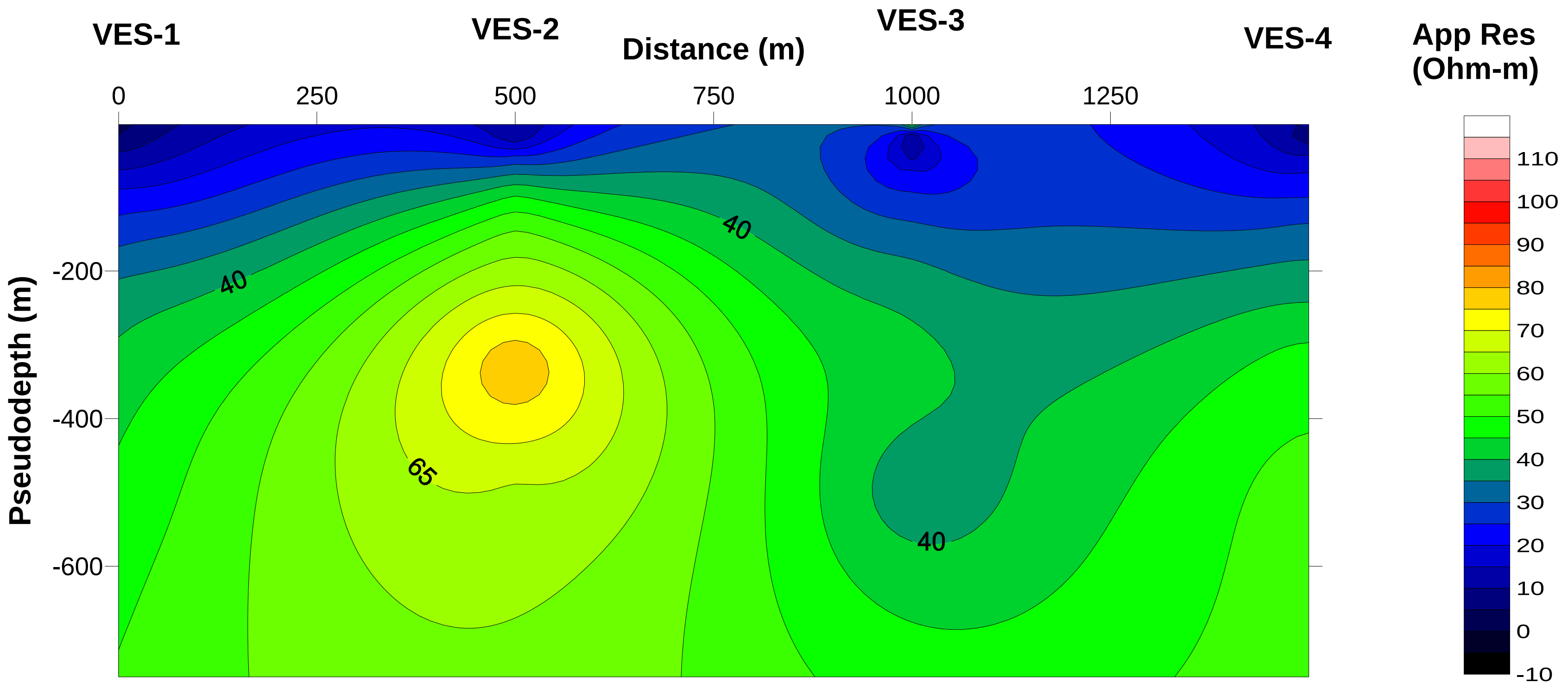


Figure 11. Apparent resistivity pseudo sections along Line 2.

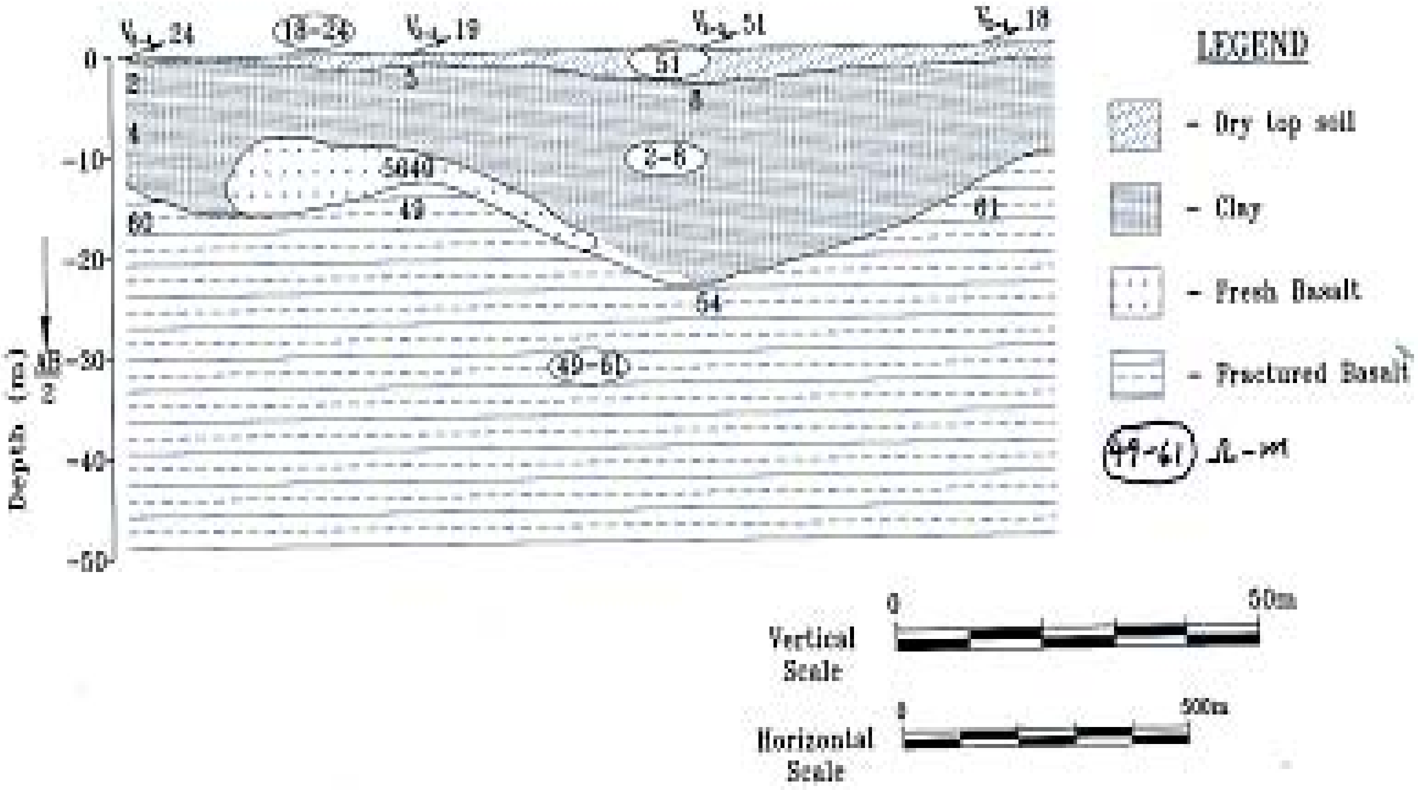


Figure 12. Geoelectric sections on Line 2.

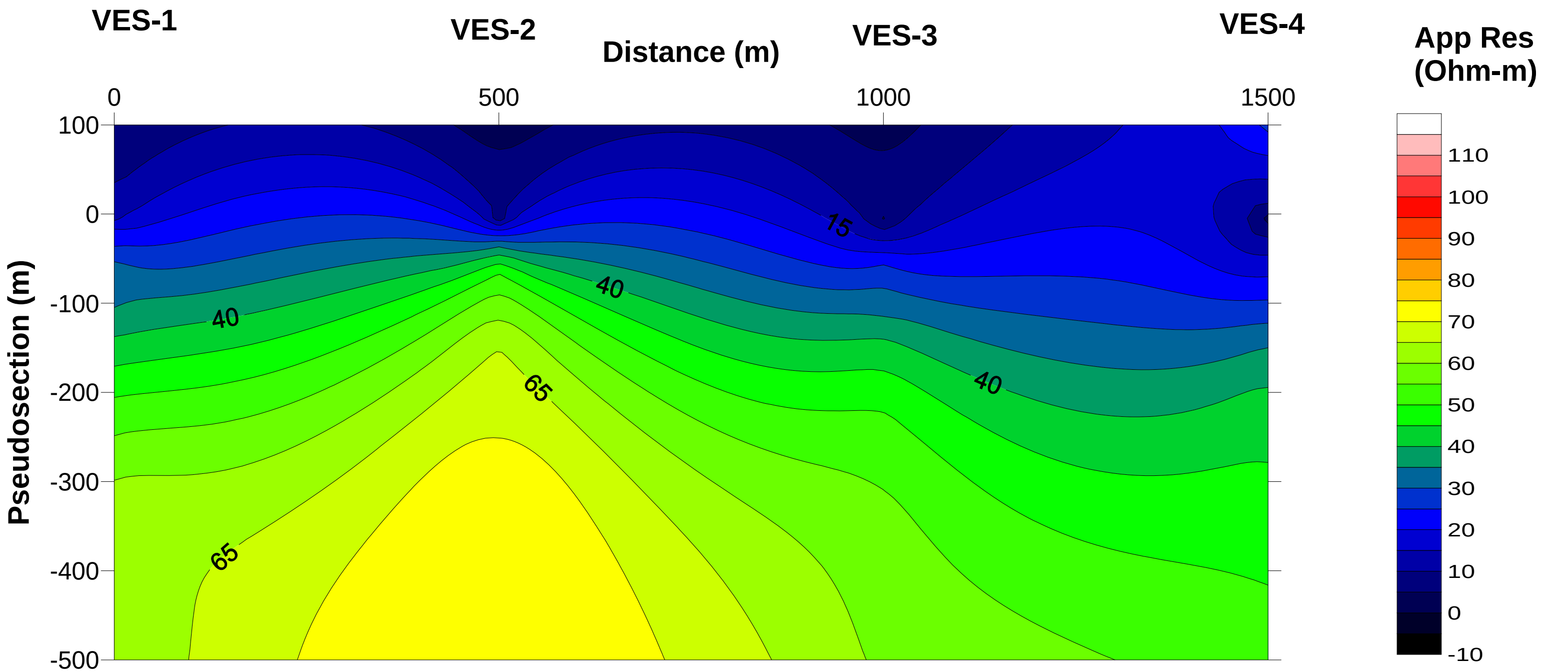


Figure 13. Apparent resistivity pseudo sections along Line 3.

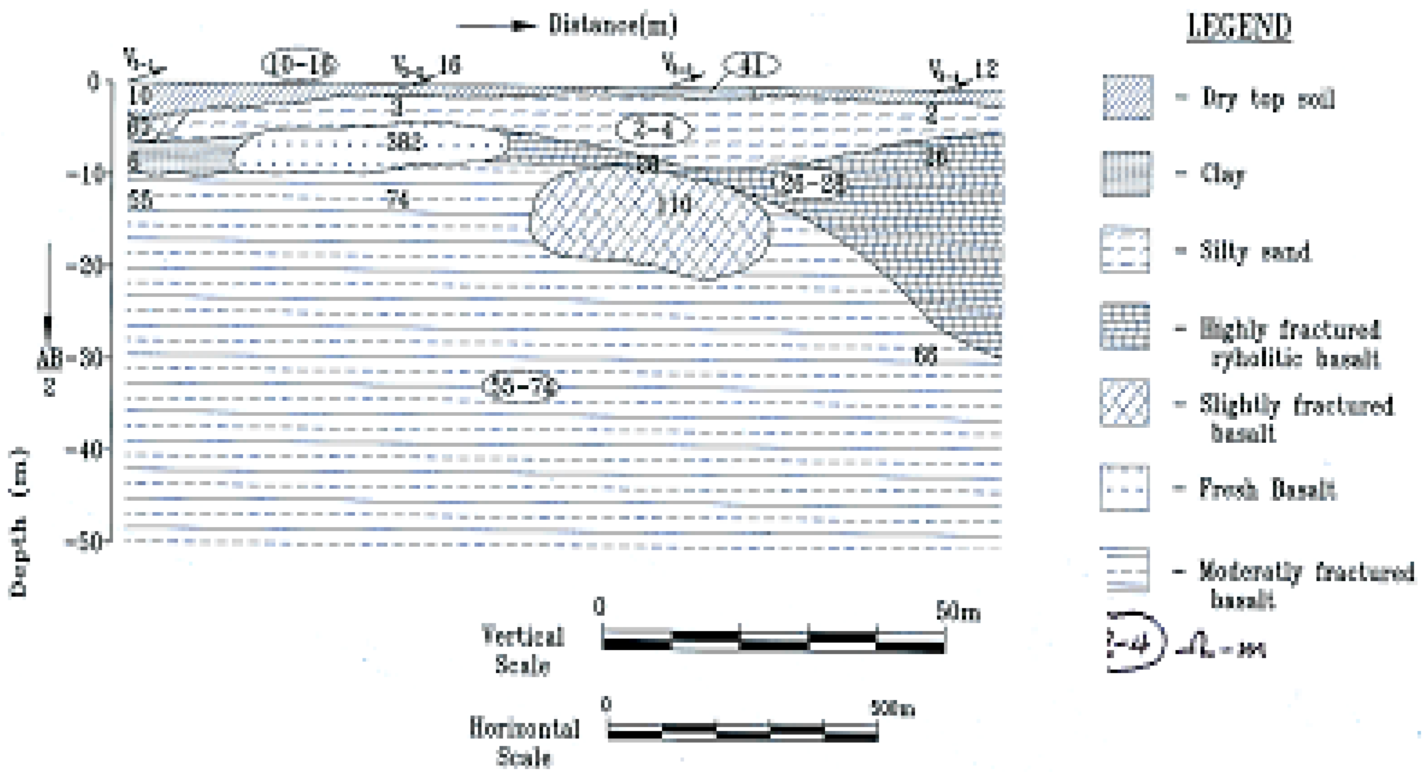


Figure 14. Geoelectric sections on Line 3.

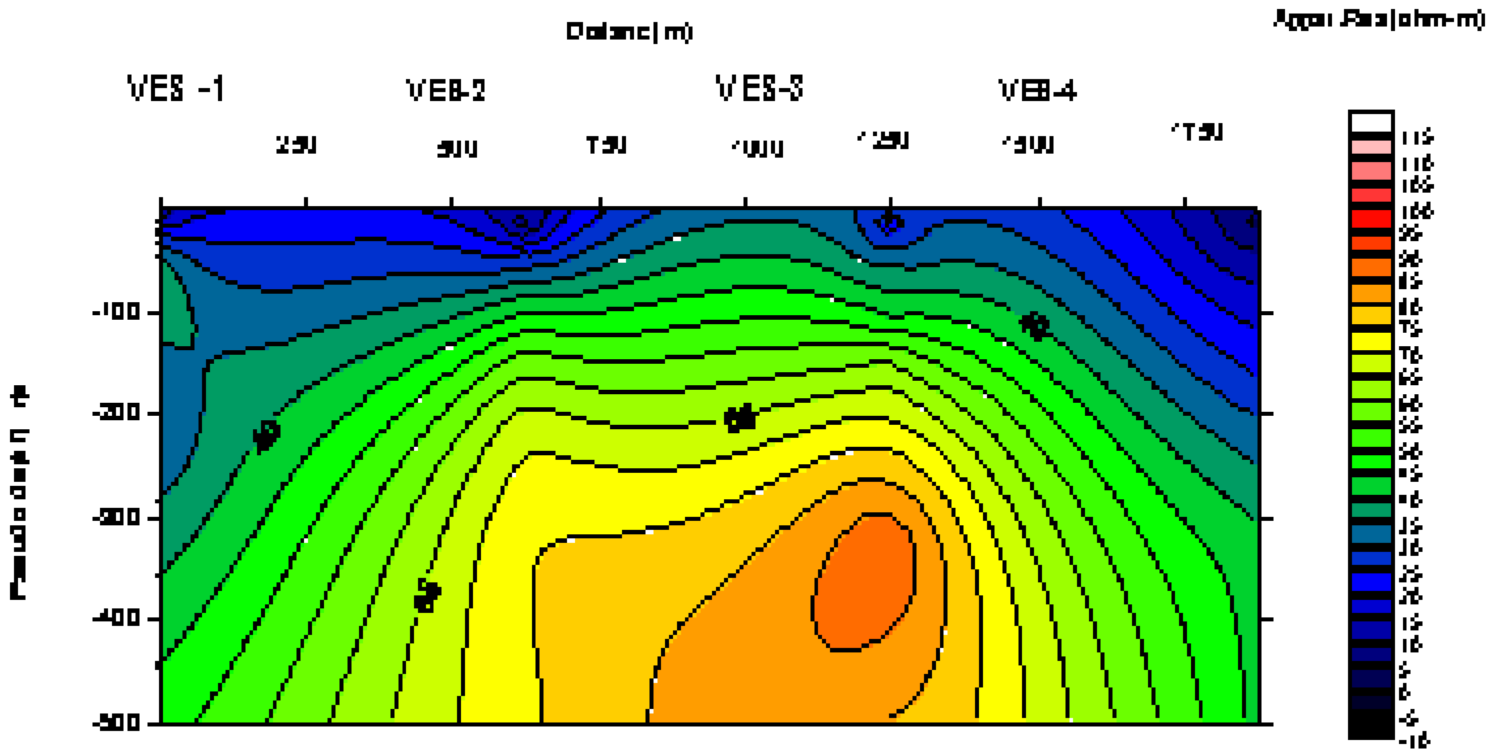


Figure 15. Apparent resistivity pseudo sections along Line 4.

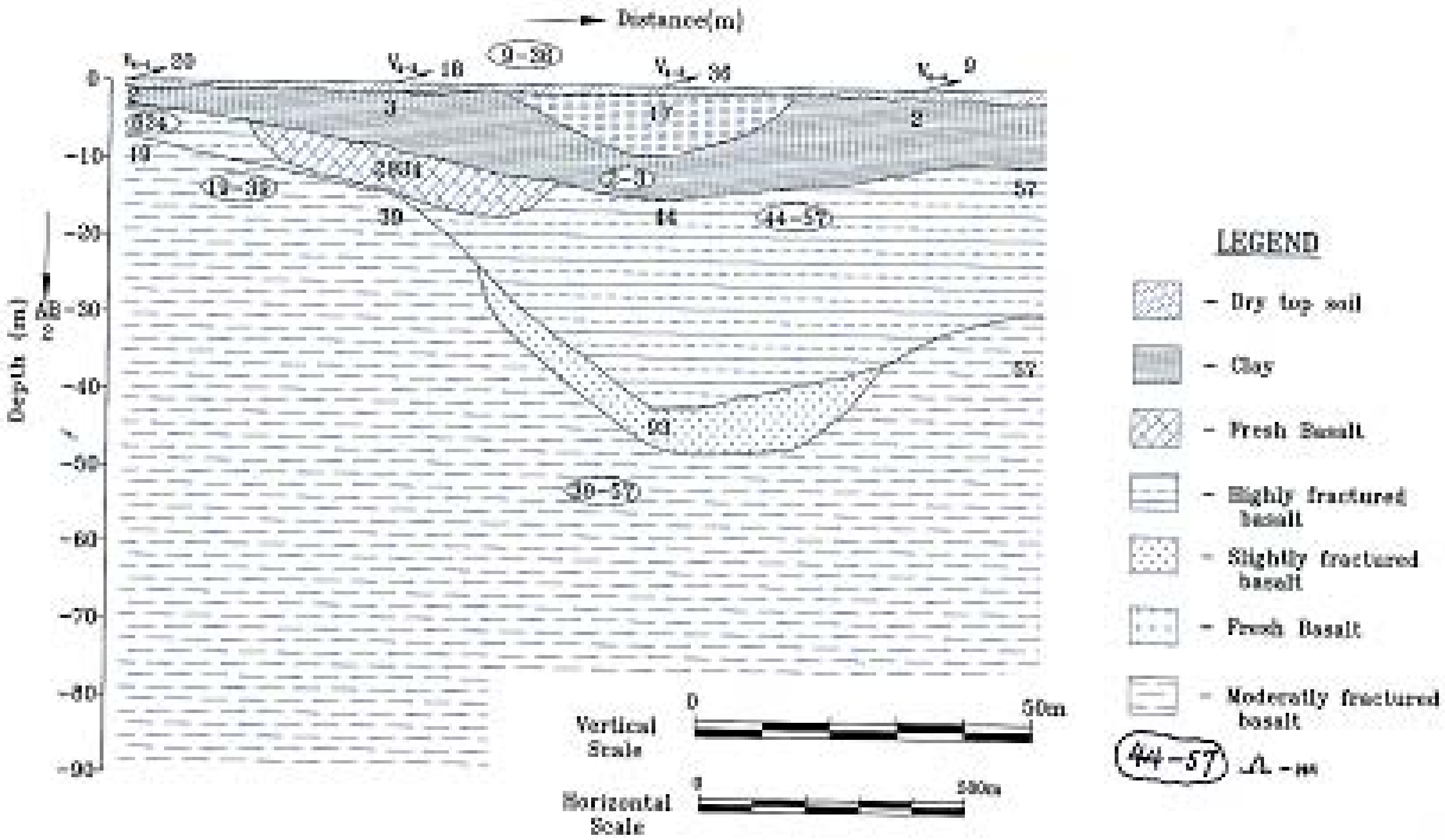


Figure 16. Geoelectric sections on Line 4.

Conclusions

- The top soil cover is of low resistivity and thin in thickness,
- The layer beneath topsoil cover has clay character which is known for its very low resistivity,
- The sections beneath clay section are characterized by their moderate apparent resistivity values and may represent the potential aquifer zones,
- Accordingly, the potential aquifer is found to be located in layer 3 and 4 on Line 1 having an average depth of 82.2 m and resistivity range of 21-66 Ω-m.(see Figure 10),
- Furthermore, the potential aquifer has considerable thickness range (46-56m) and extension. It is also moderately to highly fractured,

- Attempt was made to correlate the electrical DC resistivity, gravity and magnetic survey results,
- The Bouguer gravity anomaly contour shows that the geologic units that cause the Bouguer anomaly in the south-west and south near profile Lines 1and 4 are expected to be found at larger depth,
- The anomalous geologic bodies in the central and northeast part of the study area are found at relatively shallow depth.
- The magnetic anomaly contour shows that negative anomalies are found in the southwest, south, central and eastern parts of the study area. In the western and northeastern parts of the area, the anomalies are positive and of considerably large magnitudes,
- These anomalies are associated with soil covered areas and areas where the basalitic rocks outcrop, respectively.
- No major structures were mapped with the techniques employed.

Recommendations

- Preferred sites for sinking of boreholes have been suggested, this may need verification through drilling or other survey methods.
- Seismic refraction investigations over the promising site to constrain the layer boundaries.
- Further work on the modeling of the gravity and magnetic data, to look for possible structures.

THANK YOU