Field Training Report - Day 01 on

Resistivity Survey using Schlumberger Array

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Theory:

- **Apparent resistivity** is a concept used in geophysics, particularly in the field of resistivity imaging. It is a measure of how much a material resists the flow of electric current and is expressed in ohm-meters (Ωm).

In electrical resistivity tomography, electrodes are typically placed on the ground surface, and a small electric current is injected into the ground through one pair of electrodes, while the potential difference is measured using another pair of electrodes. The apparent resistivity is then calculated from these measurements.

The formula for apparent resistivity (ρ_a) is given by:

$$\rho_a = K \times I / V$$

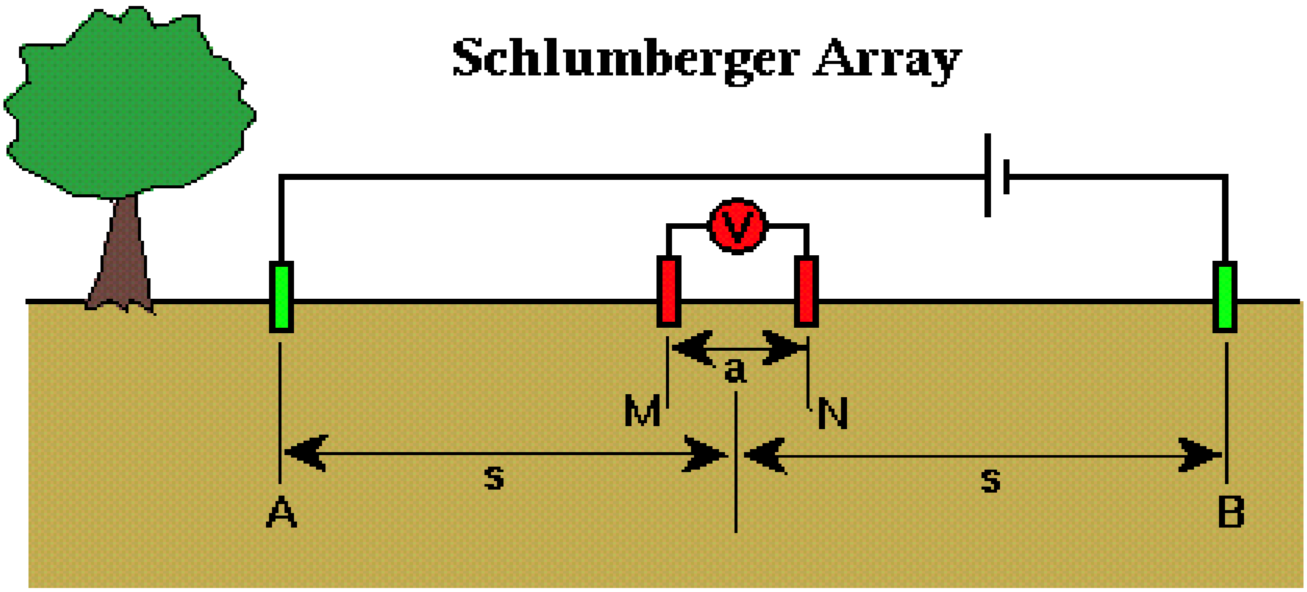
where:

- ρ_a is the apparent resistivity,
- K is a geometric factor that depends on the electrode configuration and the subsurface structure,
- V is the potential difference (voltage) measured between the electrodes,
- I is the injected current.

Different electrode configurations (e.g., Wenner, Schlumberger, dipole-dipole) yield different sensitivity to different subsurface features. The apparent resistivity values obtained are not the true resistivity of the subsurface materials but are instead influenced by the distribution and resistivity of materials at various depths.

- The **Schlumberger array (sounding)** is a specific electrode configuration used in electrical resistivity imaging (ERI) for subsurface exploration. This array is commonly employed in geophysical surveys to determine the distribution of electrical resistivity in the Earth's subsurface.

The Schlumberger array consists of four electrodes: a current electrode (current source) and a potential electrode on one side of the survey line, and another current electrode and potential electrode on the opposite side. The distance between the current electrodes is gradually increased while keeping the potential electrodes at a fixed separation.



The Apparent resistivity for Schlumberger Array,

$$\rho = \frac{\pi\left(\frac{s^2 - a^2}{4}\right)}{a}\frac{\Delta v}{I}$$

Where, ρ is the apparent resistivity,

s is half of the current electrode spacing (AB/2 in general),

a is the potential electrode spacing (MN in general),

Δv is potential difference between M and N,

I is the injected current.

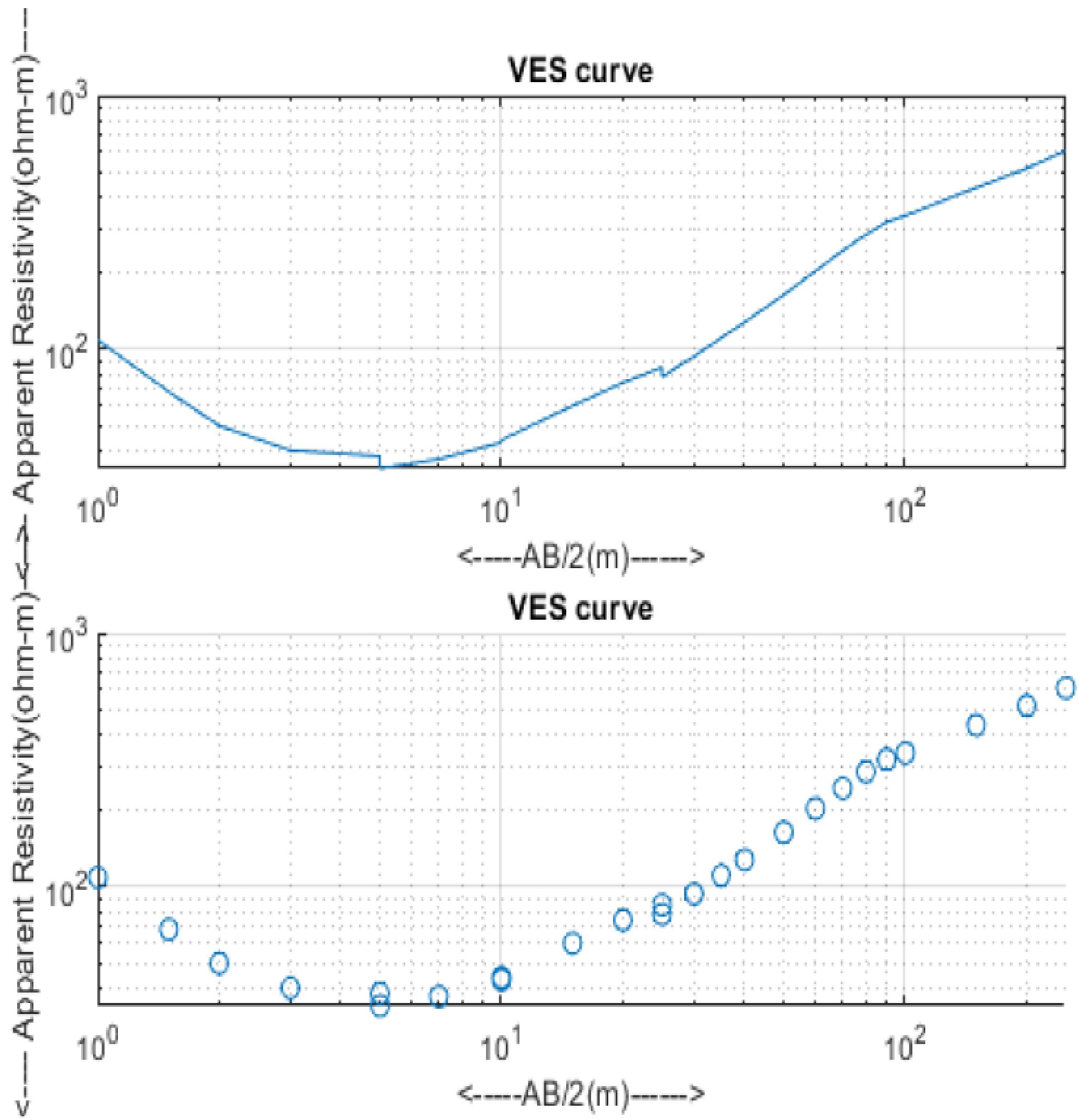
Observation :

Table: 1

AB/2	Apparent Resistivity	MN/2	MN
1	109	0.5	1
1.5	68	0.5	1
2	50	0.5	1
3	40	0.5	1
5	38	0.5	1
5	34	1	2
7	37	1	2
10	43	1	2
10	44	3	6
15	60	3	6
20	74	3	6
25	85	3	6
25	78	10	20
30	94	10	20
35	111	10	20
40	128	10	20
50	164	10	20
60	204	10	20
70	245	10	20
80	284	10	20
90	318	10	20
100	337	15	30
150	434	15	30
200	517	15	30
250	608	15	30

Result:

To get the log-log plot we have used Matlab and here are the output below:



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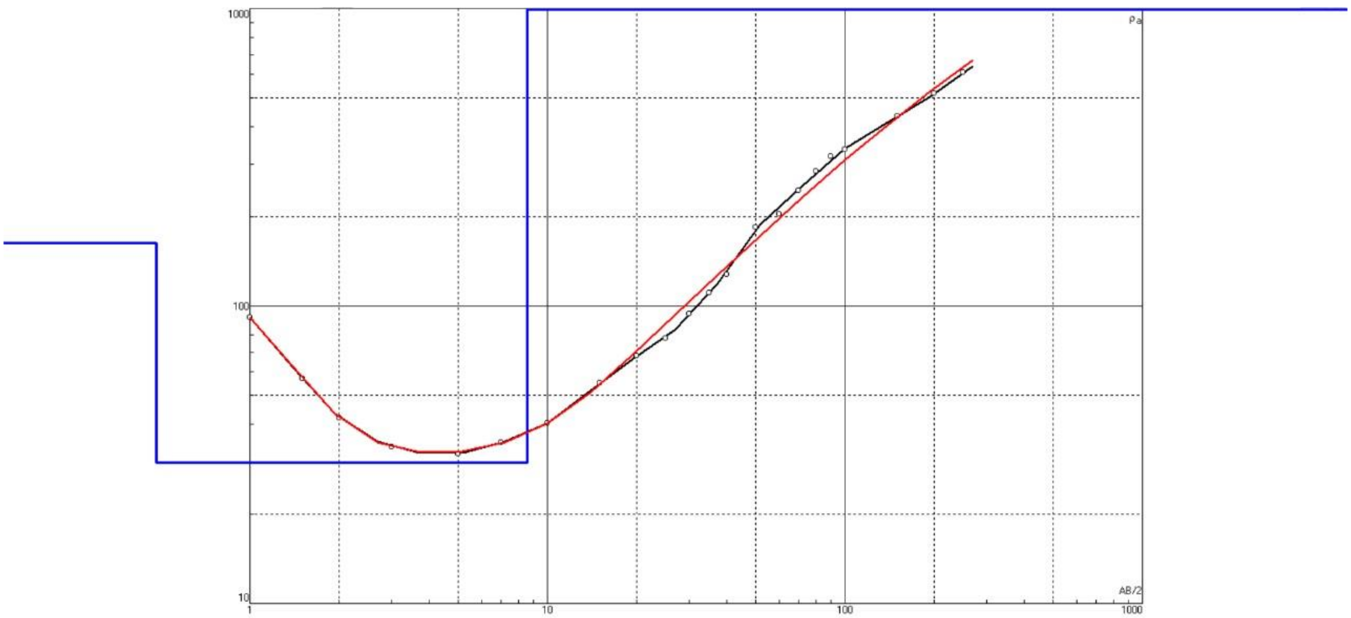
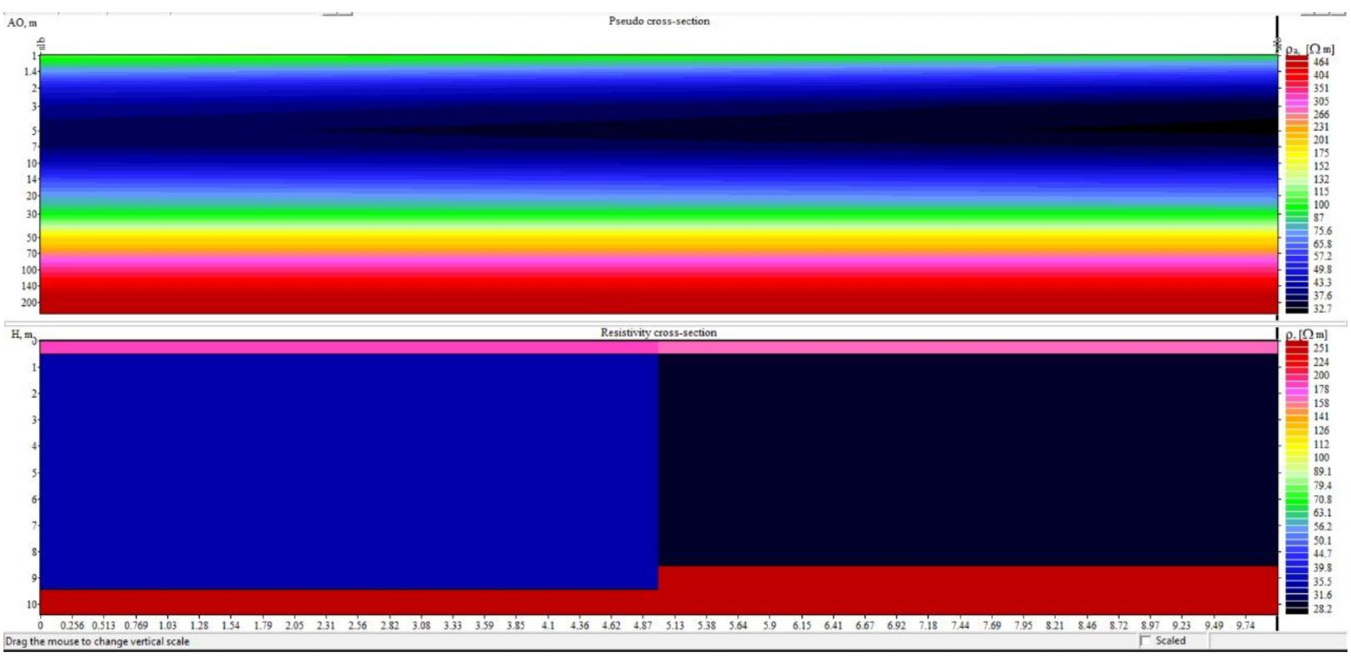


1000
100
10
1
10
100
1000
ρa
AB/2



AO, m
Pseudo cross-section
ρa, [Ω m]
464
404
351
305
266
231
201
175
152
132
115
100
87
75.6
65.8
57.2
49.8
43.3
37.6
32.7
H, m
Resistivity cross-section
ρ, [Ω m]
251
224
200
178
158
141
126
112
100
89.1
79.4
70.8
63.1
56.2
50.1
44.7
39.8
35.5
31.6
28.2
Drag the mouse to change vertical scale
Scaled

Interpretation:

From the data we have acquired in the Schlumberger Vertical Electrical Sounding (VES) resistivity survey, we can say that value of apparent resistivity changes very sharply at depth 150m by the color contrast of image, which might represent the basement.