جامعة الانبار

كلية العلوم -قسم الجيولوجيا التطبيقية

اسم المادة بالعربي: الجيوفيزياء الجهدية - الطرق الكهربائية

اسم المادة بالإنكليزي: **Potential Geophysics- Electrical Methods**

عنوان المحاضرة: **Geoelectrical Sections**

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Geoelectrical Sections

The (VES) curves are generally used to determine electrical resistivity variations as a function of depth. The inverse problem in resistivity interpretations states that for a given vertical electrical sounding curve, obtained from field observations, a geo-electrical section, which could produce can be constructed. Several possible solutions can be admitted unless other geophysical or geological information is available (Fadhil, 2009). Figure (21), shows example of a geoelectrical section at northeastern al-madinah almunawarah (harrat al-aqul) central arabian shield (Loni , 2005) .

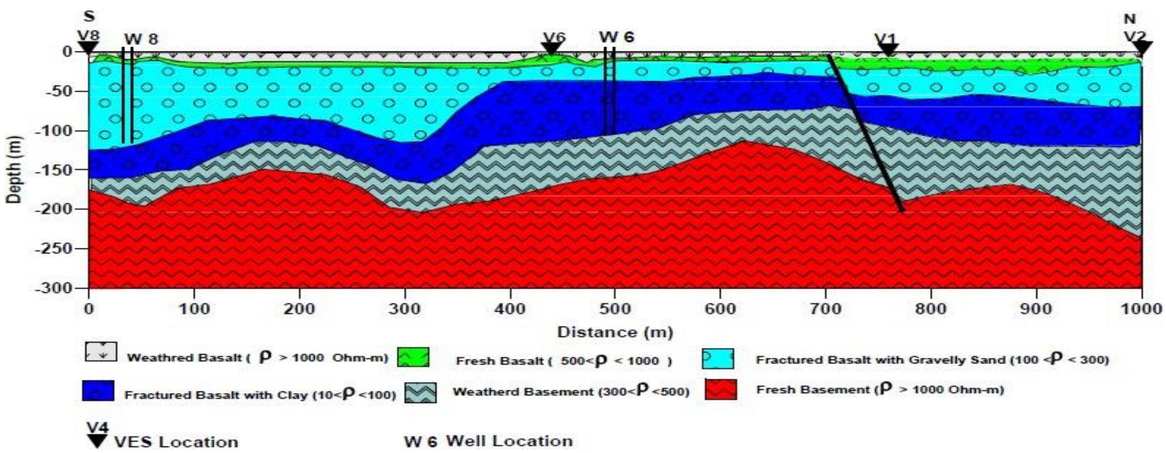


Figure (21): A Geoelectrical section in northeastern Al-Madinah AlMunawarah (Harrat Al-Aqul), central Arabian shield (Loni, 2005).

It is also possible to implement the computer software in constructing the geoelectrical sections, figure 22, showing one of computer drawn geoelectrical sections.

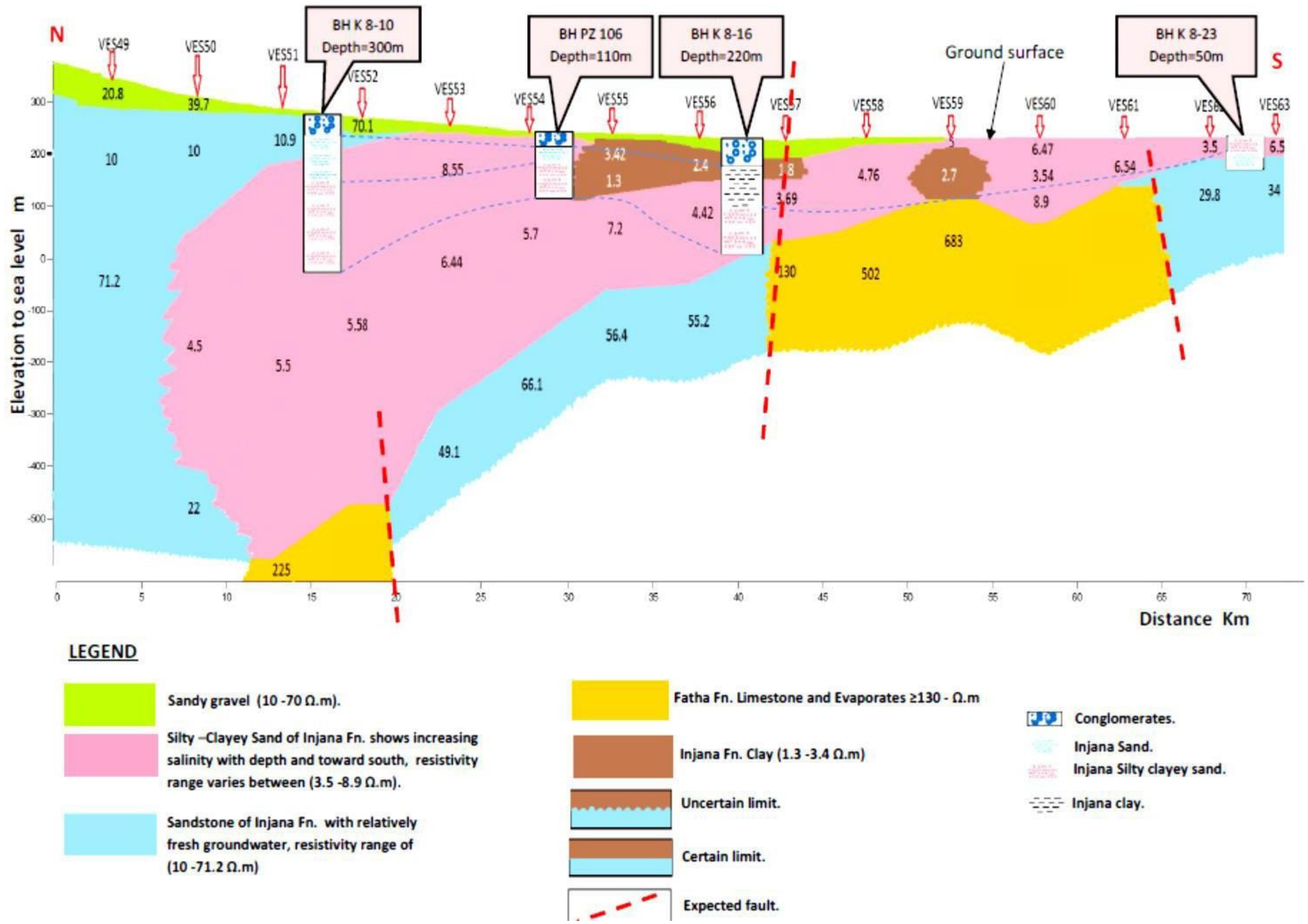


Figure (22): A computer drawn Geoelectrical section for 15 VES points by using Shlumberger array, (AL-Khafaji , 2014).

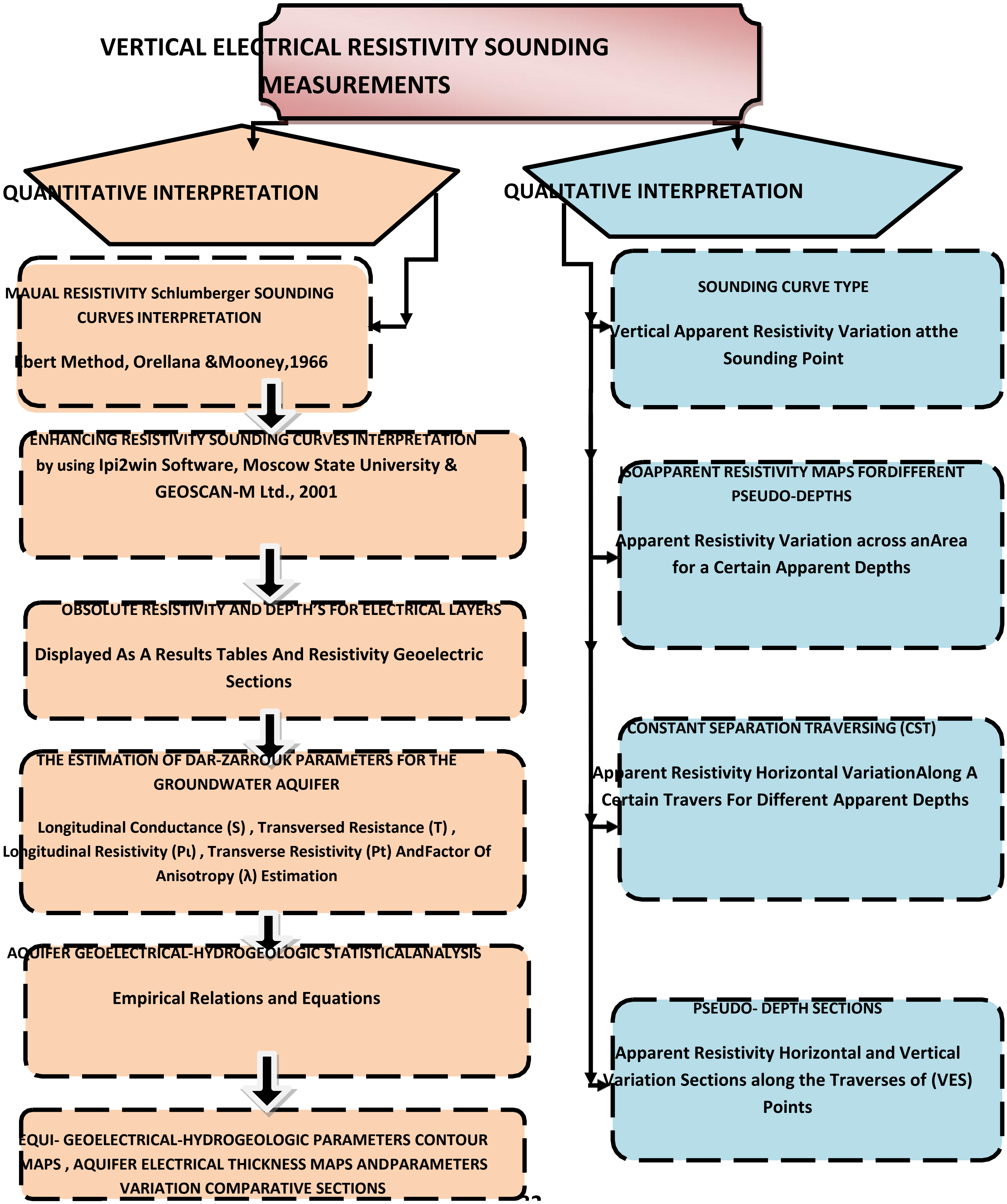


Figure (23): A flow chart showing the processing and interpretation procedures of (VES) fi

It’s rather easier to describe the procedures of interpreting Vertical electrical Sounding data qualitatively and quantitatively by following the flow chart which shown in the figure 23.

<u>The Main Types Of Resistivity Surveying Electrode Arrays</u>

There are several forms of electrod arrays used in resistivity method , but they all used to measure the electric field (E) or the potential difference (ΔV), and they areall depends on the distances which separate between the potential electrodes MNand the distance which separate between the current current electrodes AB. The electrode arrays could be classified into the following:

A- Bipole-Dipole arrays

B- Dipole-Dipole arrays

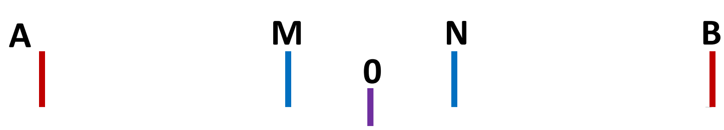
C- Bipole-Bipole arrays

A- <u>Bipole-Dipole arrays</u>

In such electrode arrays the distance MN remains smaller that the distance AB, inother words (MN=1/5 – 1/10AB) and it includes the following sub-arrays:

1- Symmetrical and linear Schlumberger:

AB $\geq$ 5-10 MN



$$\rho_a = \pi * \frac{(AB/2)^2 - (MN/2)^2}{MN} \quad \frac{\Delta V}{I}$$

$\pi \frac{(AB/2)^2-(MN/2)^2}{MN}$ Is called the geometrical factor (K).

Were: 0 is the array midpoint or the measurement point.AB is the distance between the current electrodes.

MN : is the distance between the potential electrodes.

ΔV : is the potential difference.

I : the applied current .

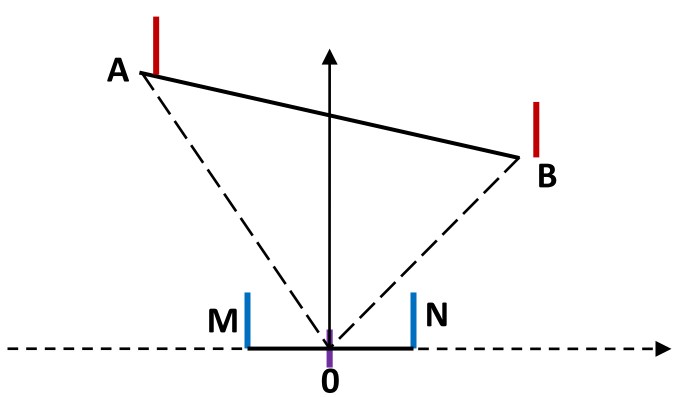
And when MN is close to zero then the ρ_a equation will be:

$$\rho_a = \pi(AB/2)^2 * \frac{E}{I}$$

Were E: is the electric field.

2- Asymmetrical or non linear Schlumberger array:

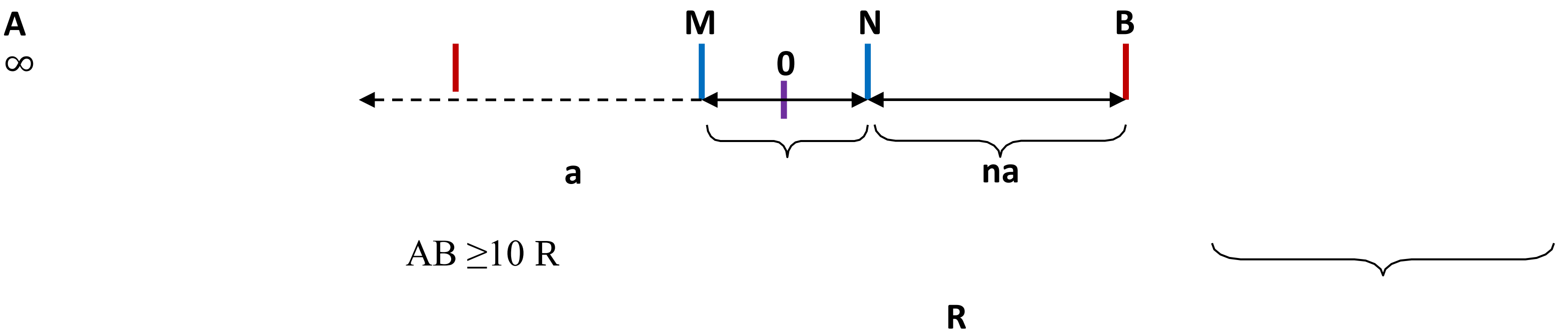
This array gives the same ρ_a value of the symmetrical - linear Schlumberger array,but with more precise geometrical factor.



In this array the distance A0 is equal to distance B0.A0=B0

, and, 0.75≤ A0/ B0 ≤ 1.3

3-Half Schlumberger or (pole-Dipole) array:



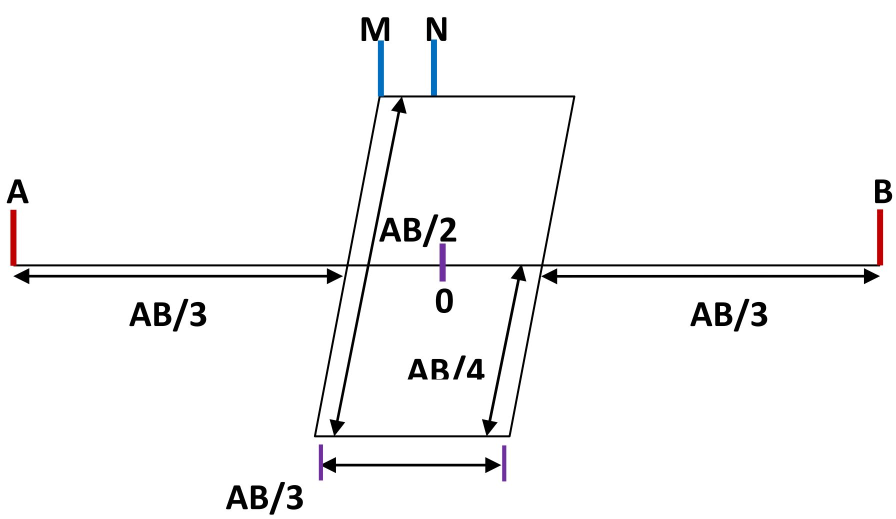
AB ≥10 R

n=BM/BA

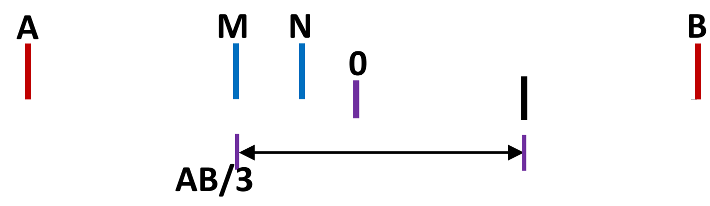
R is the distance from the midpoint to the current pole

$$\mathbf{K= 2\pi n\ (n+1)\ a}$$

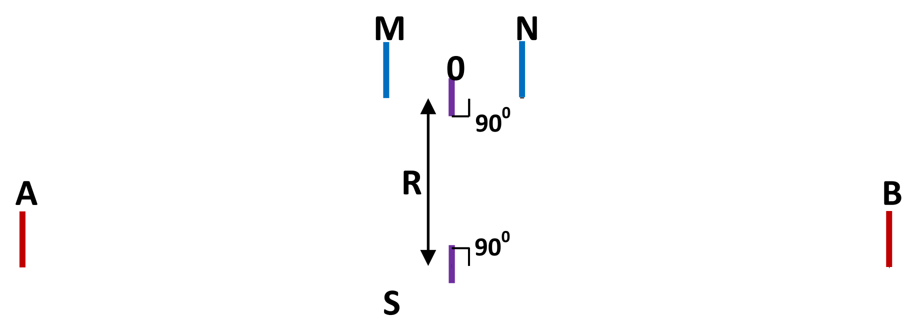
4- AB- Rectangular array:



5- AB- profile array:

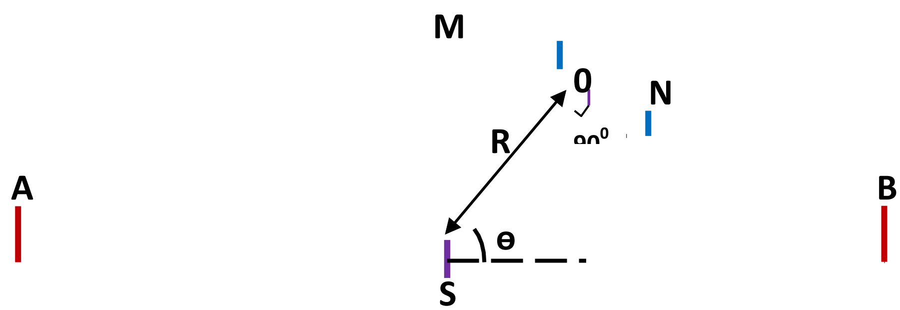


6- Bipole-Dipole Equatorial:



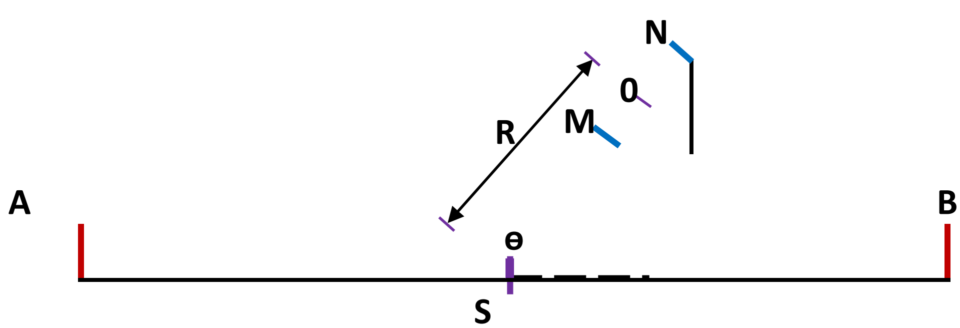
R ≤ 3-AB

7-Bipole-Dipole Azimuthal:



R ≤ 3-5AB

8-Bipole-Dipole Radial:

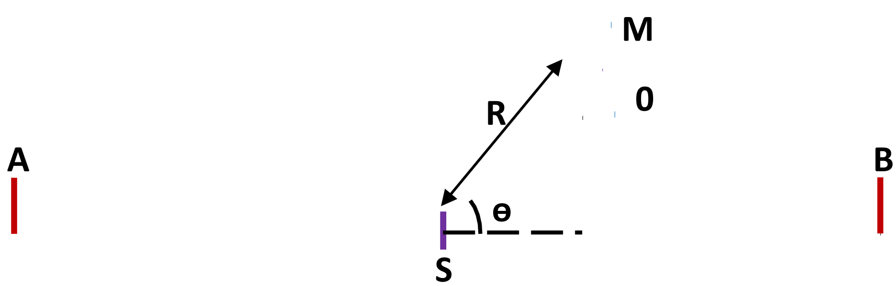


R ≤ 3-5AB MN=1/5 – 1/10 AB

9-Bipole-Dipole Polar:

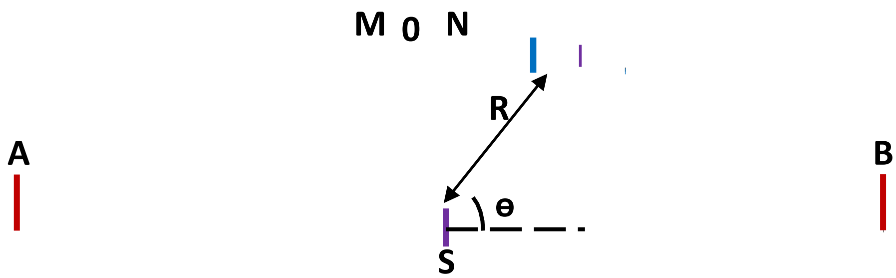
$R \geq 3\text{-}5AB$

10-Bipole-Dipole Perpendicular:



$R \geq 3\text{-}5AB$ $MN=1/5 – 1/10\ AB$

11-Bipole-Dipole Parallel:

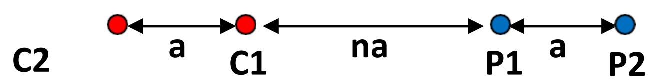


R ≥ 3-5AB

<u>B-D ipole-Dipole arrays</u>

In these types of electrode arrays the distance between the current electrodes (AB) or (C1C2) is almost equal to the distance between the potential electrodes(MN) or (P1P2), but the distance between the midpoint of current electrodes and the midpoint between the potential electrodes (R) or (na) is always larger or equal to 1/3AB to 1/5 AB. The dipole – dipole arrays could be classified to the following arrays:

1- Ordinary Dipole-Dipole array (Axial or Polar):



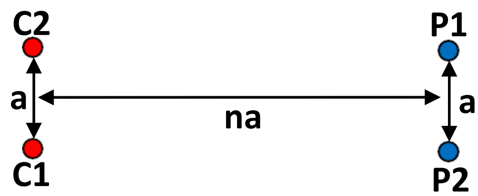
R=3-5AB

K=πn(n+1)(n+2)a

$$\rho_a = K\,(\Delta V/I)$$

Where: $n = C1P1/C1C2$, and called the spacing factor.

2- Equatorial Dipole-Dipole array :



AB=MN

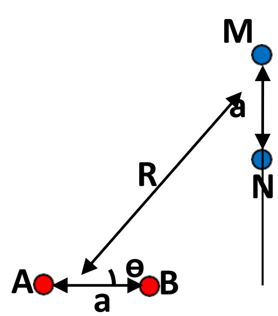
na=b=R

R or b ≥3-5AB

$$L=\sqrt{a^2+b^2}$$

$$K=\frac{2\pi Lb}{L-b}$$

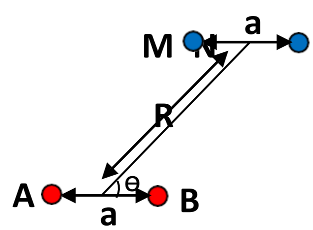
3-Perpendicular Dipole-Dipole array:



AB=MN

R ≥3-5AB

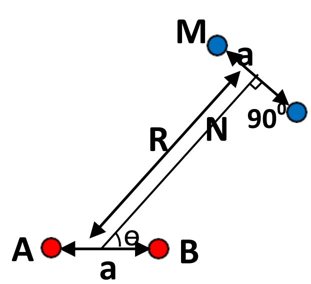
4-Parallel Dipole-Dipole array:



AB=MN

R ≥3-5AB

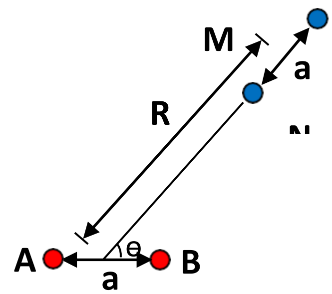
5-Azimuthal Dipole-Dipole array:



AB=MN

R ≥3-5AB

6-Radial Dipole-Dipole array:



AB=MN

R ≥3-5AB

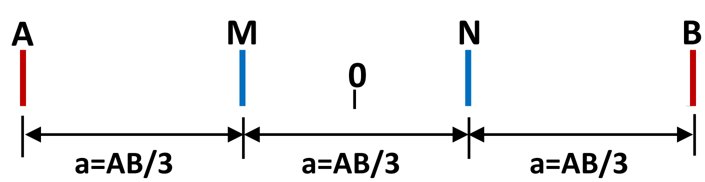
C-Bipole-Bipole arrays

Used to measure the potential difference ΔV between MN, where: MN ≥ 1/3AB .

These arrays could be classified as the following:1-

Wenner array

MN = 1/3 AB

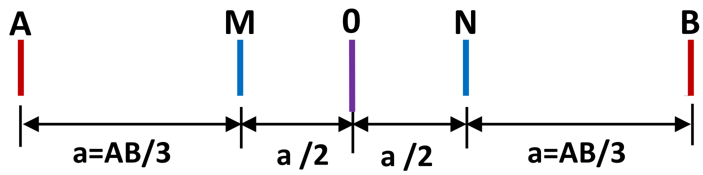


$$K=2\pi a$$

$$\rho_{a\ winner} = 2\pi a \frac{\Delta V}{I}$$

2- Lee Partitioning array:

This array is similar to Wenner array but with an additional electrode at themidpoint 0 .

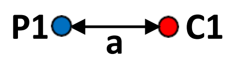


$$K=4\pi a$$

$$\rho_{a\,L.P.} = 4\pi a \frac{\Delta V}{I}$$

3- Pole- Pole array:

In this array two electrodes from the four electrodes, one for potential and other forcurrent are stacked in a very far distance or to infinity.



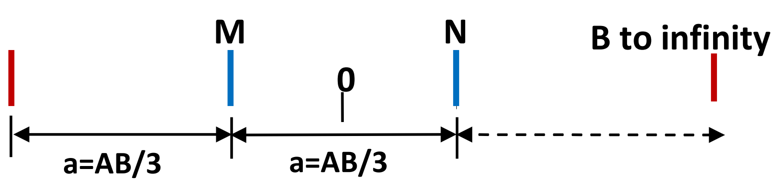
$$K=2\pi a$$

$$\rho_a = 2\pi a \frac{\Delta V}{I}$$

4- Half-Wenner or Three electrode array:

A

∞

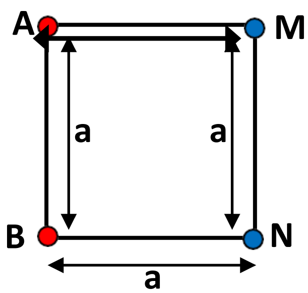


$$K=4\pi a$$

$$\rho_a = 4\pi a \frac{\Delta V}{I}$$

5- Square array:

a



$$\mathbf{K_{Sq.}}\ \frac{\mathbf{2\pi a}}{\mathbf{2-2\sqrt{2}}}$$

$$\mathbf{2\pi a} \qquad \mathbf{\Delta V}$$

<u>Reference</u>

Wadhah M. Shakir (2021) Electrical Geophysical Methods AL-Karkh University of Science, College of Geophysics and Remote Sensing, Department of Geophysics. **77** PUBLICATIONS **36** CITATIONS.

Kearey P. , Brooks M. , Hill I., (2002) An Introduction Geophysical Exploration", 3rd ed. Blackwell Science Ltd., USA, 281 pages.