Bo2:

what is the seismic method?

what are the types of seismic wave?

change the frequency.

change the velocity.

change the step time?

How do you change the plane wave?

what is the critical angle and snell laws.

what is the seismic method?

Seismic is a method that lets us to discover the subsurface of the ground.

In this method we propagate siesmic wave to the ground and according to total time of transmitting and reflecting we can get information from subsurface.

The principle of this method is based on the snell laws. because when we propagate waves to the ground some part of waves are reflecte and some part of the refracte.

What are the types of seismic wave?

two type. P and S.

seismic waves, including S and P, carry energy away from hypocenter in all directions.

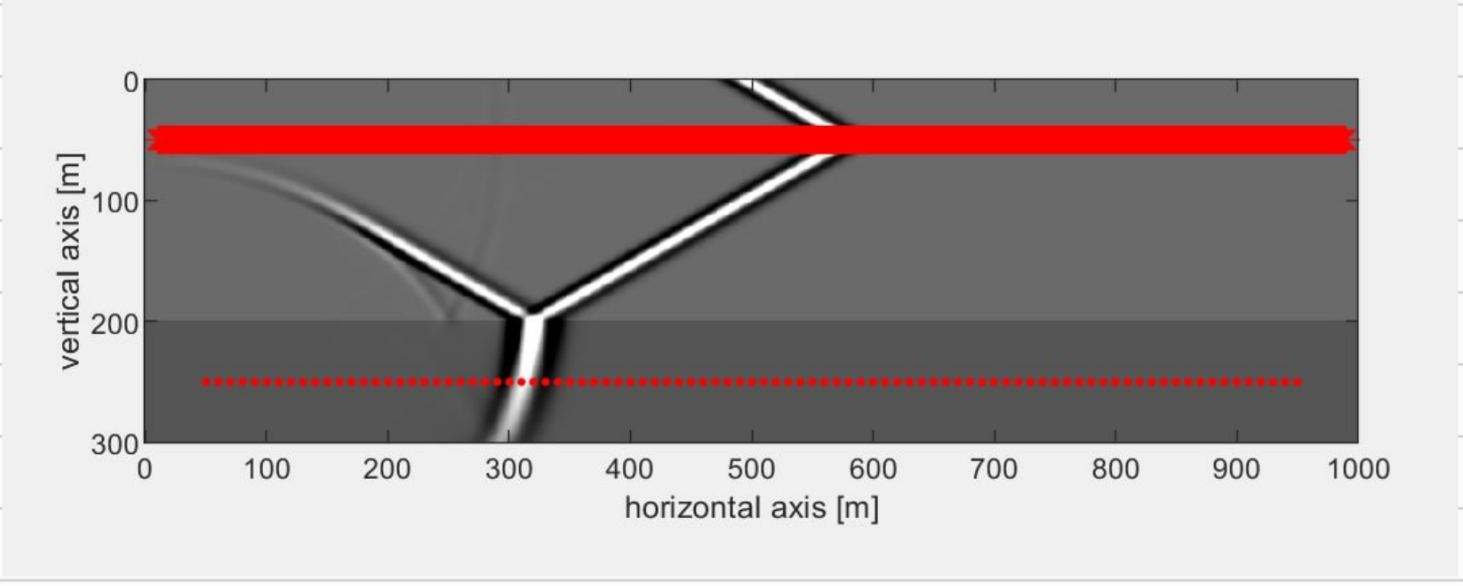
the P wave propagates with particle motions that are parralel to the direction of propagation. it has a velocity of about 6 Kilometers per second in rock.

the S wave propagates with particle motions that are perpendicular to the direction of propagation.

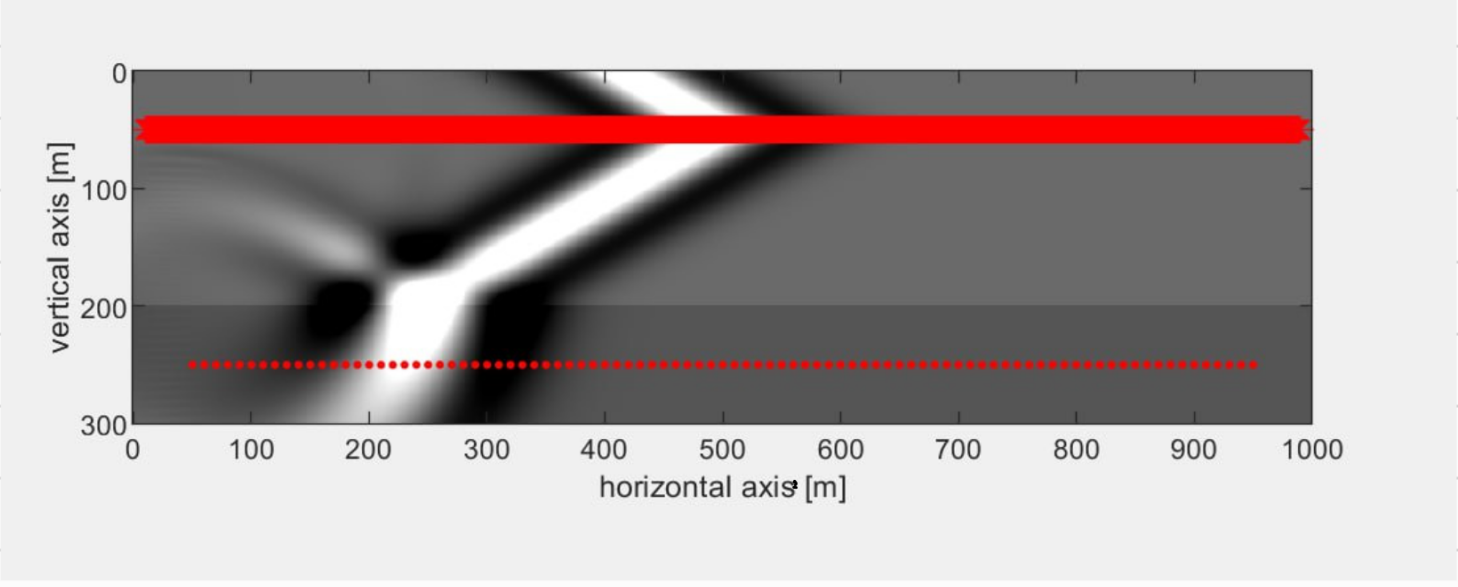
● change the frequency.

according to this law we have $V = f \cdot \lambda$ so V is a fixed variable and when we decrease f, the number of λ increases and we can see that the width of incident wave increased.

50 Hz



10 Hz



- change the step time?
- How do you change the plane wave?

For changing the angle of plane wave we can chang the number of t

t is equal $t_e = t = \frac{d \sin\theta_I}{V_1}$

$$\sin\theta_I n_1 = \sin\theta_t n_2$$

$$\sin\theta_I \frac{c_1}{V_1} = \sin\theta_t \frac{c_2}{V_2} \Rightarrow c_1 = c_2 \Rightarrow$$

$$\frac{\sin\theta_I}{\sin\theta_t} = \frac{V_1}{V_2}$$

$$\frac{3\alpha}{\frac{1}{2}} = -$$

For having a critical angle we know that θ_t is perpendicular on the surface of layer 2 so

$$\sin\theta_t \cdot \sin 90^\circ = 1$$

Then:

$$\sin\theta_i = \frac{V_1}{V_2} \Rightarrow \sin\theta_i = \frac{1000}{2000} = \frac{1}{2} \Rightarrow \theta = 30^\circ$$

What is the application of seismic method

Seismic Refraction should be considered in the planning of hydrologic studies and used as a tool by hydrologist to solve problem associated with pump test, simulation models, test holes, geologic maps, borehole geophysical techniques.

What does it difference between reflection and refraction?

Reflection involves a change in a direction of waves when they bounce off a barrier. reflection of waves involves a change in the direction of waves as they pass from one medium to another medium.

Refraction or bending of the path of the waves, is accompained by a change in speed and wavelenght of the waves.

B.3:

How do you change the polarity.

why refraction wave doesn't follow the red line?

- How do you change the polarity.

when we go from a media with high velocity to another layer with lower velocity we have changing in our velocity and direction so changing in direction leads to have rotation and changing the polarization

- why refraction wave doesn't follow the red line?

we know that the Exact formula for is in this shape:

$$V_{rms} = \sqrt{\frac{\left(\sum V_n^2 \alpha Tw t_n\right) \frac{1}{\cos\theta}}{\left(\sum Tw t_n\right) \frac{1}{\cos\theta}}}$$

Elastic Medium:

Can change its shape when any defining force is applied, then its come back to orginal shape when the defining force is removed & air, water.

Elastic wave:

a motion in medium that when particles displaced due to it, a force proportional to the displacement restore them to their orginal position.

Hookes law:

There is a linear relation btw stress (the force is applied in vertical or Horizental) and strain. (change in length due to deformation).

- **Homogenous medium:**

The elastic properties are constant along position. Like velocity.

- **Isotropic medium:**

The properties are constant along the direction.

- **p wave,**

primary wave, spherical shape, arive sooner than

- **s wave:**

s wave, vertical amplitude is maintain.
slower than p wave, spherical shape,

- **Acoustic media:**

Media that seismic waves can propagate in them (seismic wave = vibration).

Wave amplitude attenuation:

Decreasing the wave amplitude during propagation due to ① spherical divergence, ② Mei scattering ③ absorption.

Resolution:

Minimum distance bw 2 targets in which their corresponding reflected waves do not over lap. (Duration of wavelenght should be less than their time difference).

Electrical methods:

Objectives:

Measure electrical properties (resistivity) of the ground.

Application:

Search for groundwater sources, monitor ground water pollutions, locate subsurface cavities, faults and fissures, leak detection.

principle:

Inject the current to the ground (current electrodes) and measure voltage drop, btw two electrodes.

Current conduction through a rock:

Electrolytic conduction:

Slow movement of ions within an electrolyte. Depends upon type of ion, ionic concentration, mobility.

Resistivity decreases with temprature, as more ion are released. Typical resistivity range:

$10^{-6} < \rho < 10^{-3}$.

Electronic conduction:

Rapid movement of electrons which are free to move, through the molecular matrix. Resistivity increases with temprature, due to increase in particle collisions.

Typicall resistivity range: $10^{-5} < \rho < 10$

Dielectric conduction:

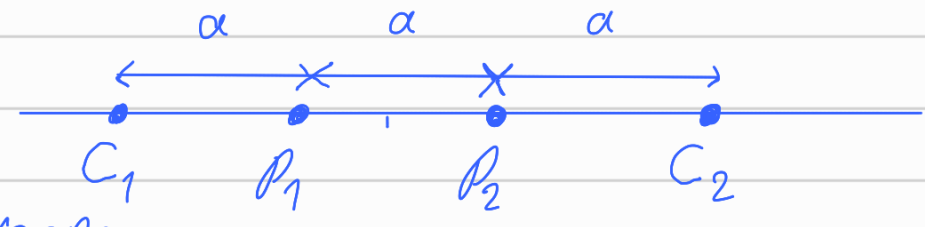
Atomic electrons or molecules are shifted / rotated with respect to their equilibrium position, due to external applied current.

Typical resistivity range $10^{6} < \rho < 10^{14}$.

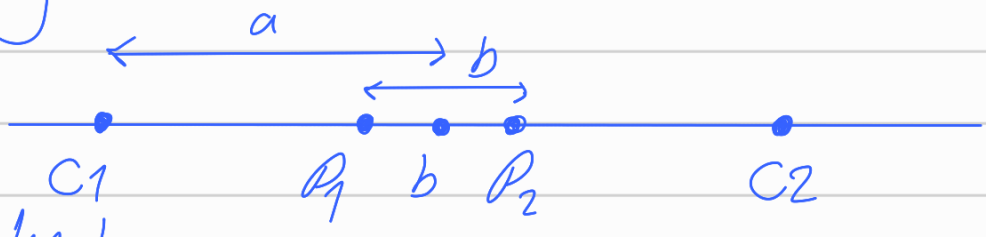
Electrode Configurations.

The resistivity value is associated to the center of the geometry.

Wenner:



schlumberger:



dipole-dipole:

How to build sensitivity map?

1. start with the constant resistivity simulate measurment.
2. Apply some variation in point P.
3. Simulate above.
4. repeat.

Acquisition procedure (cst, VES, pseudosection).

Constant seperation Traverse (cst)

Obtain apparent resistivity along the horizental axis by moving all the electrodes.

Vertical Electrical sounding (VES):

Obtain apparent resistivity data for increasing depth, by increasing electrodes separation with respect to the same central point.

Pseudosection:

Obtain apparent resistivity along the horizental axis by moving all the electrodes and along the vertical axis by increasing n.

Apparent resistivity displayed as contour lines and or colour map.

EQupment :

1) Electrode.

2) Multi core cable.

3) Resistivity Meter.

Techniques:

1) Automated array scanning

2) Interpretation technique.

3) Misse_ala_messe

4) self_potential method.

5) Induced polarization. (IP)

6) Frequency domain. Time domain methods.

- **Apparent resistivity :**

Resistivity based on the observation.

- **True resistivity :**

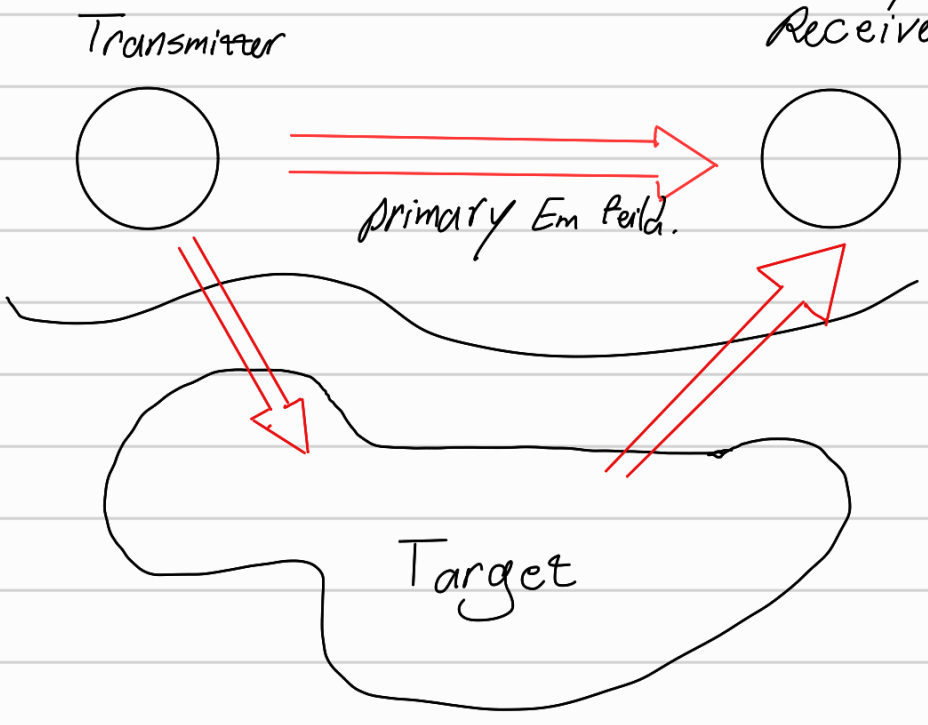
Resistivity that obtain by interpretation technique.

Limited of electrical methods:

1. Limited depth of investigation.
2. Laborious to use hard terrains.
3. Electrical methods need to flow a current into the ground. (ice, dry sand - non conductive rocks).

Electromagnetic fields principles (fundamentals Em waves in general).

Measure the modifications produced by the conductivity of the target on an artificially or naturally.



Measured variables, output display:

Frequency Range : 50 Hz - 10 KHz
TX - RX distance : 3 - 1000 meter
Frequency domain Em (FDEM) : measurment as a function of fre
Time domain (TDEM) : measurment as a function of time.
passive / active EM : source of Em are respectively natural / artificial.

what should we do exactly:

Firstly, we generate EM field and propoge it to the target for example that is located under the ground.
the EM field induced a current (Eddy) to the target then Eddy current can make another electro magnetic field.
finally we can measure the electromagnetic field of that current by reciever.

skin depth:

It's a reason for attenuation when we have EM field.

$$\delta = 5.3/2\sqrt{\frac{1}{f\sigma}}$$

is a depth of a material in which the incident EM field reaches 37% of its power.

GPR:

A High frequency EM impulse is transmitted by the TX antenna.

The reciever antenna RX records the reflections, produced by variations of the electrical impedance in the subsurface.

Applications:

Location of subsurface structures.

Ice.

Detection of bedrocks.

Detection of water table.

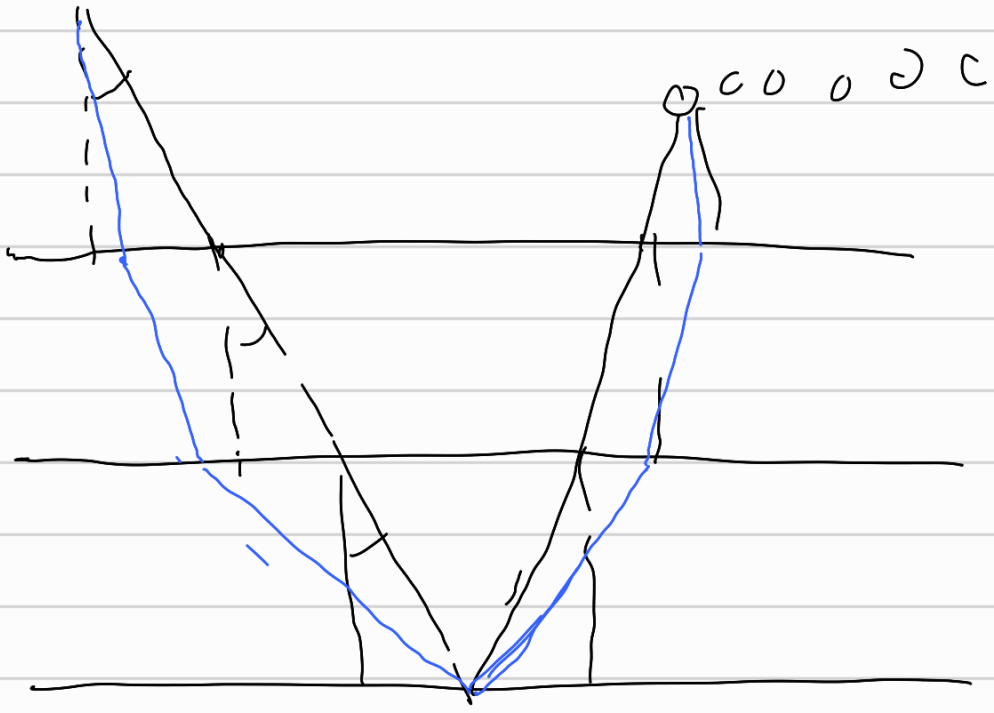
Em wave velocity:

$$V = \frac{C}{\sqrt{\varepsilon_r}} \rightarrow \text{Di Electric} \quad \text{water} \uparrow \; V \downarrow$$

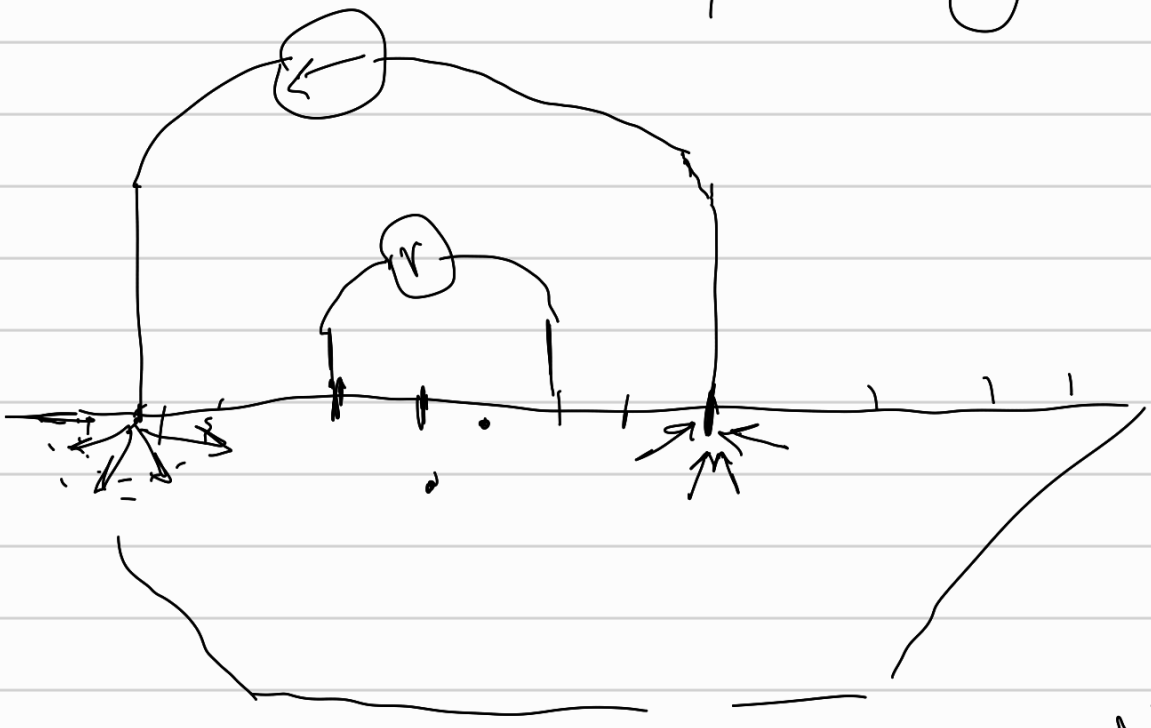
$$R << \frac{\sigma}{2\pi\varepsilon}$$

$$f \uparrow \quad \lambda \downarrow \quad R \uparrow$$

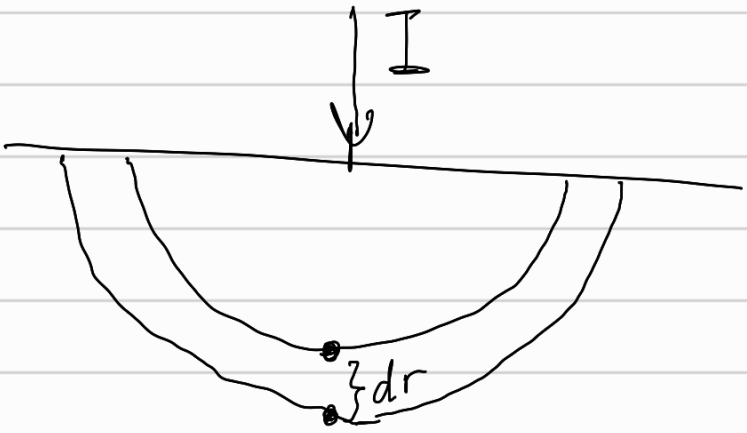
$$w \uparrow \rightarrow V \downarrow \rightarrow \lambda \downarrow \rightarrow R \uparrow \rightarrow \text{small objects}$$



در روش الکتریکی مقاومت وجود آب داخل زمین Penetration
را کاهش میدهد. چون که با بیشتر افزایش Conductivity
با بیشتر شدن عمق نفوذ کم.



$V = RI$



dV