GYEOPHYSICAL METHODS OF PROSPECTING

SEISMIC REFLECTION METHOD

Disclaimer:

This presentation is a part of the assignment for MSc III Semester Mineral Exploration theory paper. This is an attempt to enable the students to collect and review the literature, prepare powerpoint presentation and present the work, independently. The data and literature used here has been taken from various sources, and duly acknowledged. This can help as a guideline, and should not be treated as final.

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submitted by

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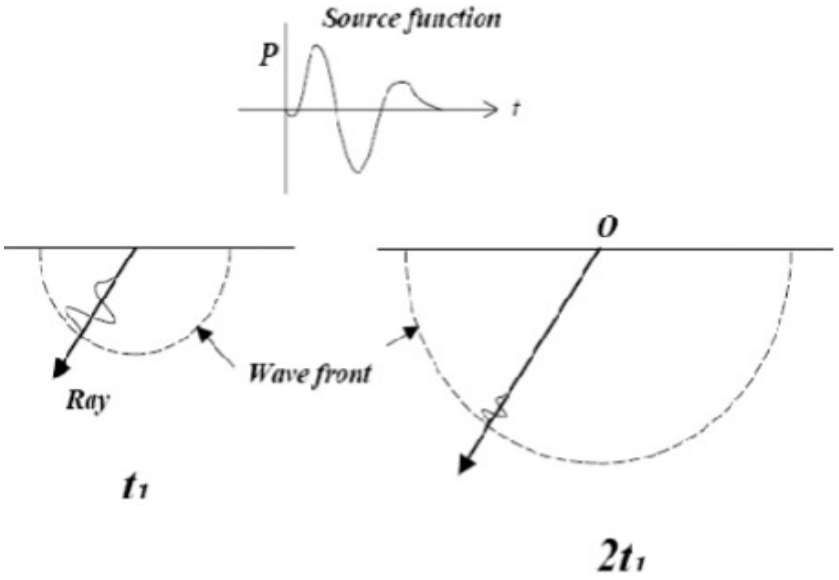
GEOPHYSICAL METHODS OF PROSPECTING

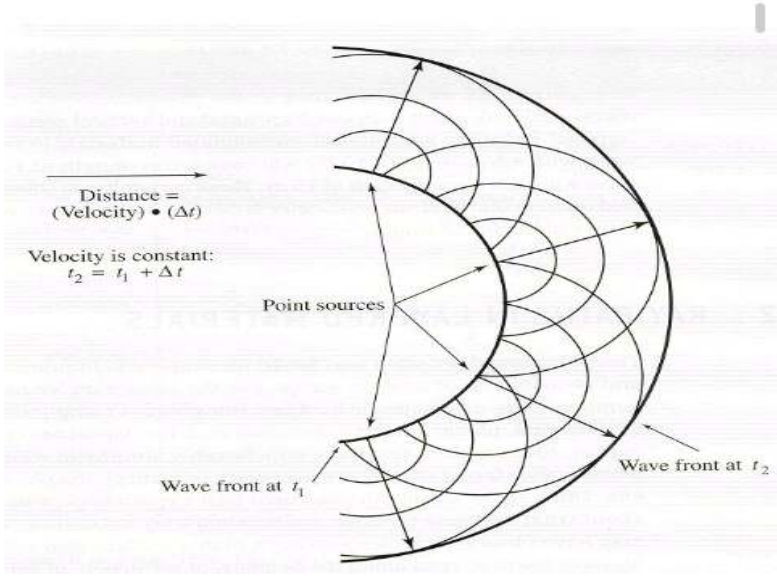
- ***Seismic method***

➢ **seismic method based on the measurement of seismic wave velocity contrast obtained from available time distance curve .**

➢ **This method utilizes the variation in behaviour of waves generated in the various layers of the earth's crust, by the use of explosive charges, placed at the bottom of the drill holes.**

- **HUYGEN'S PRINCIPLE**
- **Huygen states that every point on the wave front is the source of the new wave that also travels out from it in spherical shells .if the spherical wave have large enough radius they can be treated as planes. Line perpendicular to the wave front is called wave path or rays.**





- **Seismic Waves**

- Referred to as elastic waves because they causes deformation of the materials in which they propagate
- These are messenger that convey earth's interior.
- These waves test the extent to which earth materials can be streched or squeezed.
- They cause the particles of material to vibrate.
- These properties used to distinguish different material.
  The capacity of material to be deformed by passing seismic waves is depend on its properties of elasticity..

Types of seismic waves

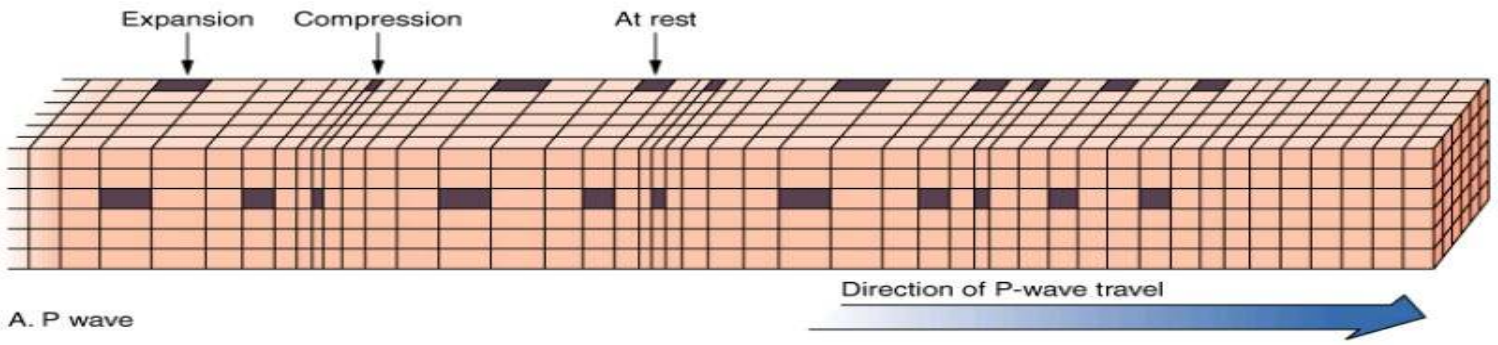
1)P waves (primary,compressional,push pull)

. motion of particles in the solid is in direction of wave propagation

. have highest speed.

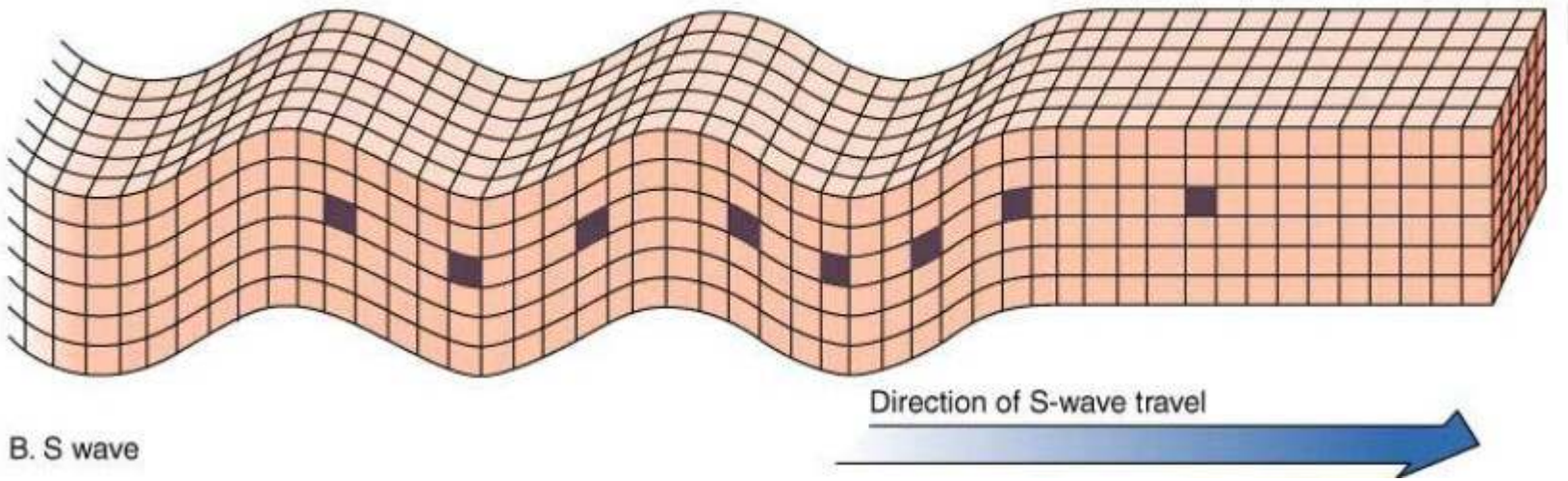
. volumetric change.

. eg. Sound waves



2) S waves (secondary, shear ,shake)

- Motion of the particles always perpendicular to the direction of propagation.
- No volumetric change.
- Can not exist in fluid because fluid unable to support shear stresses.



B. S wave

3) Surface waves;

Ryleigh waves

•propagate along the surface of earth (solid material)

•Amplitude decreases experimentally with depth.

•Near the surface the particles motion is retrograde elliptical.

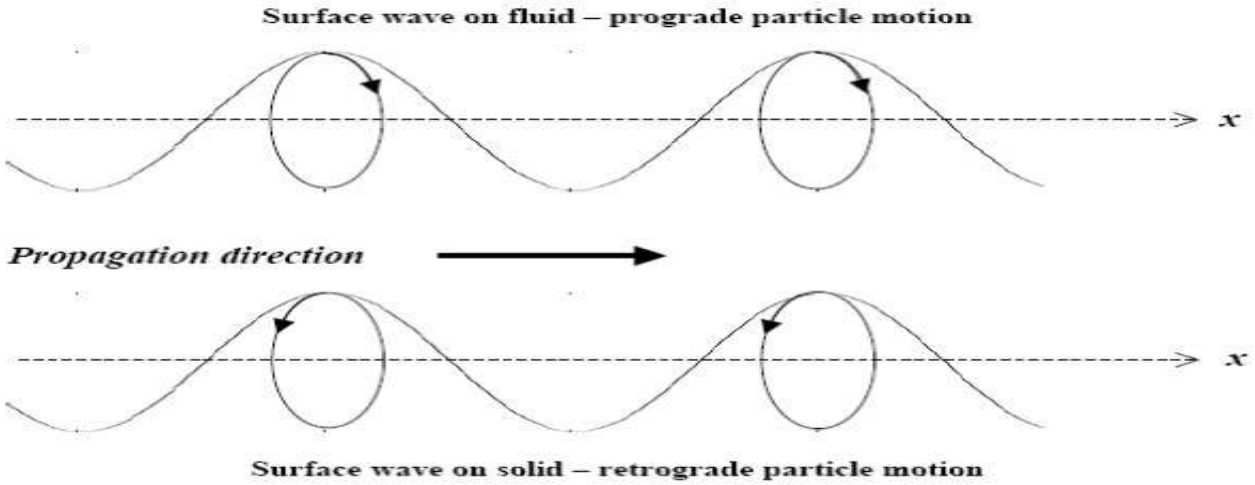
•.speed is slightly less than S waves.

Love

•.Observe only when there is low velocity layers overtlying a higher velocity substratum.

•The wave motion is horizontal and transvers

.



Seismic surveying

1) Seismic reflection method
2)Seismic refrection method

Seismic reflection method;

The seismic signals reflected back to the surface and it is recorded at receivers which are placed at the distances less than depth of the investigation

GENERATION OF WAVES fOR PROSPRCTING APPLICATION

- Generated by explosion
- Dynamite were detonated in boreholes for seismic prospecting operation.

SEISMIC REFLECTION METHOD

- Seismic wave generated in the earth by a near surface explosion of dynamite ,waves or vibration reflected from interfaces between formation having different physical properties .
- The reflection are recorded by detecting instruments responsive to ground motion .they are laid along the ground at small distance compare with the depth of the reflector.
- The structures of subsurface formation is mapped by measuring the time required for seismic waves
- Variation in reflection time from place to place on the surface usually indicate structural features in the strata below

- Depth to reflecting interfaces can be determined from the time using velocity ,information that can be obtained either from the reflected signal themseleves or from surveys in wells.
- Reflection from depth as great as 20000feet .
- The seismic survey can be done on land or at sea.

Instruments

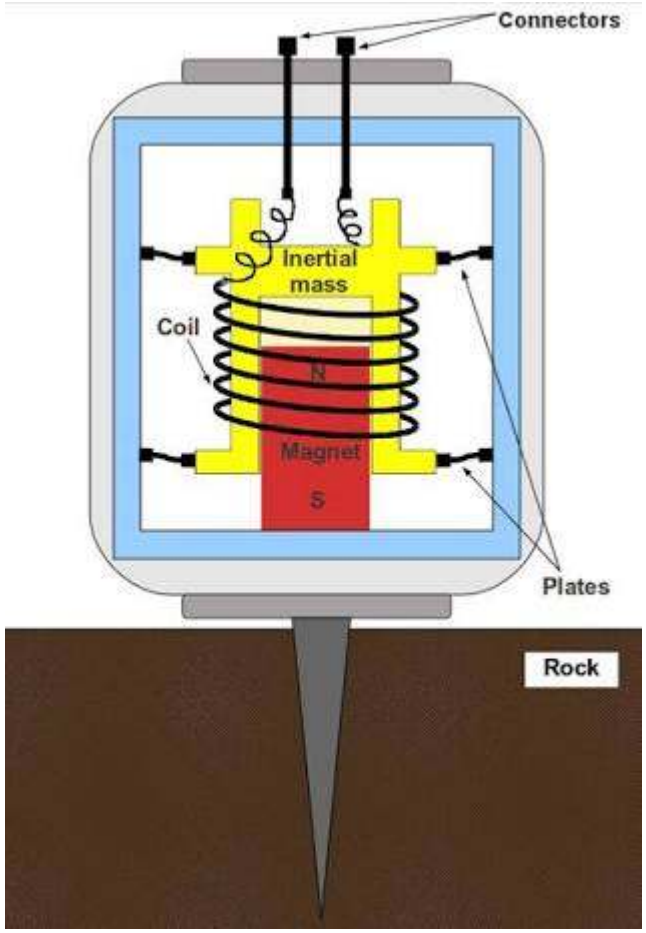
Geophone;

- the receiver used to detect ground vibration is called geophone or a seismometer.

Electromagnetic Geophone

Principle

- In electromagnetic type due to vibrations caused by seismic waves an electro magnetic field (e.m.f.). Is generated by the relative movement,in a fixed coil ,located between the yolk of the parmanent magnet.


Connectors
Inertial mass
Coil
N
Magnet
S
Plates
Rock


SONY

Pressure phone (hydrophone)

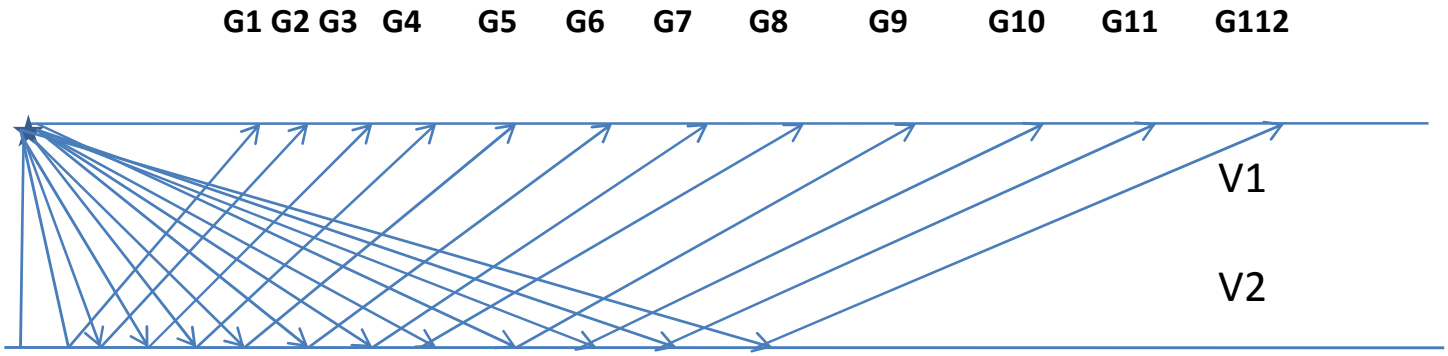
- Used for receiving seismic signals in appreciable depth of water.
- Water proof cases have been fixed to permit planting of moving coil phones in mershy ground .
- Use peizolectric crystals (quartz,tourmaline,barium, tantanate) or comparable ceramic element as pressure sensor.
- They generate the voltage proportional to the instantaneous water pressure associated with seismic signals.

FIELD PROCEDURE

- the seismic survey consist s of placing some receivers at different locations and then using them to detect vibrations produced by energy source.
- The receivers convert the mechnical vibrations into electric current that transmitted to a recorder. The recorder is designed to preserve the informatrion in a form that can be displayed and analyzed.
- The structure of subsurface formation is mapped by measuring the time required foe seismic wave.
- Seismic wave generated in the earth by explosion of dynamite, vibration return to the surfaces between layers which have different physical properties.

- Variation in the reflection time from place to place on the surface usually indicate structral features in strata below
- Depth to reflecting interfaces can be determined from the using velocity information that can be obtained from the reflected signals themselves or from survey in wells

Reflection from a single horizontal surfac



If V is the velocity and T is the time interval, then the distance travelled by the wave is 2SX= VT

$2SX= 2v\ d^{2+(L/2)2} = VT$

L= Distance between s and D

$T^2=2/v\ D2 +(L/2\ )2$

$T2=4/V2[d2+(L/2$

$V^2T^2/4=d^2+(L/2)^2$

$V2T2/4=(L/2)2=d2$

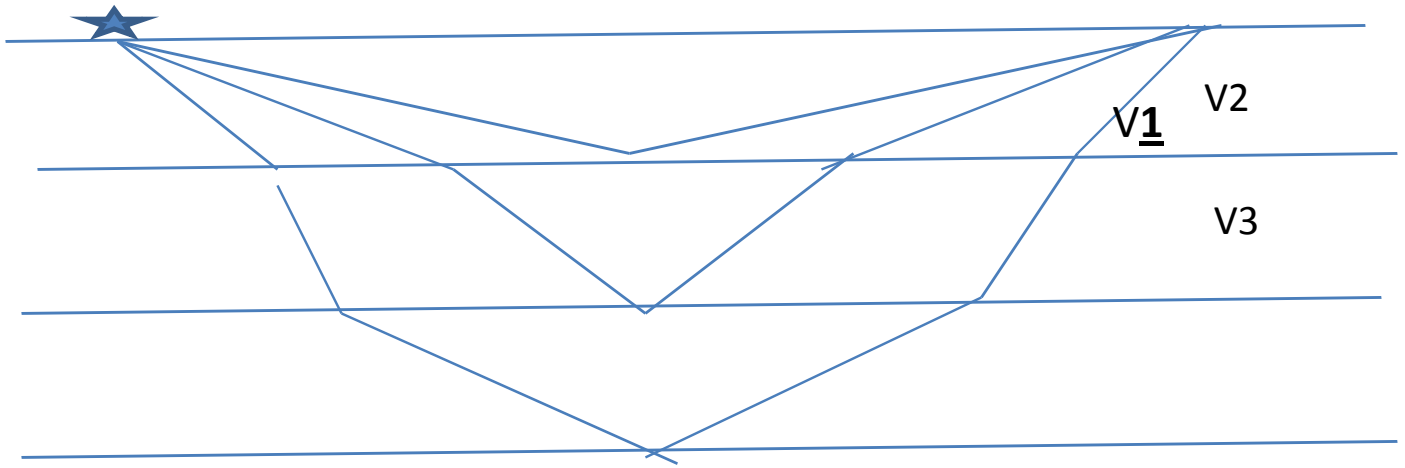
$d=1/2v(VT)^2-L^2$

Reflected wave in a multilayered structure

$t_{0,1}=2h_1/v_1=2\Delta t_1$

$t_{0,2}=2h_1/v_1+2h_2/v_2=2\Delta t_1+2\Delta t_2$

$t_{0,3}=2h_1/v+2h_2/v_2+2h_3/v_3=2\Delta t_1+2\Delta t_2+2\Delta t_3$



Depth to the reflectors that are

$H1=h1$

$H2=h1+h2$

$H3=h1+h2+h3$

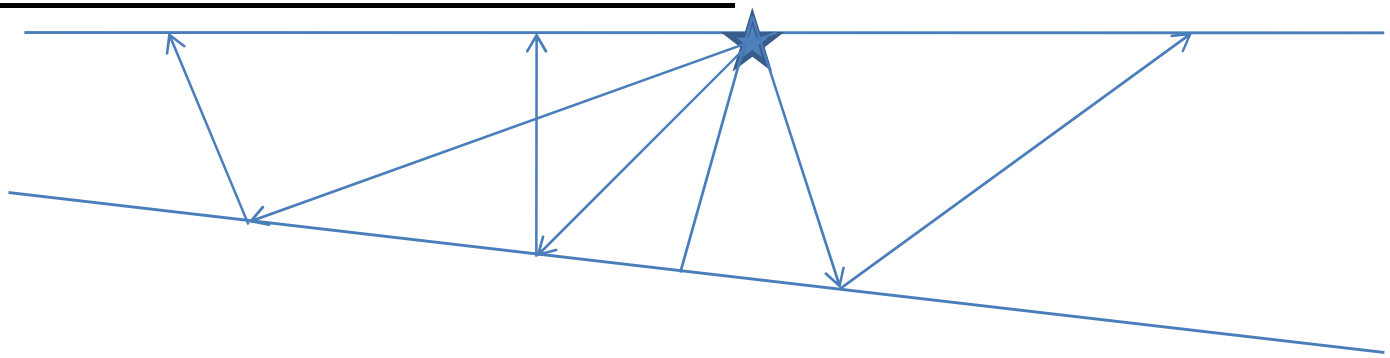
Velocity of each layers

$V_1=2H_1/t_{0,1}=h_1/\Delta t_1$

$V_2,ave=2H2/t0,2=h_1 + h_2/\Delta t_1+\Delta t_2$

$$V_3 = 2H_3/t_{0,3}= \frac{h1+h2+h3}{\Delta t1+\Delta t2+\Delta t3}$$

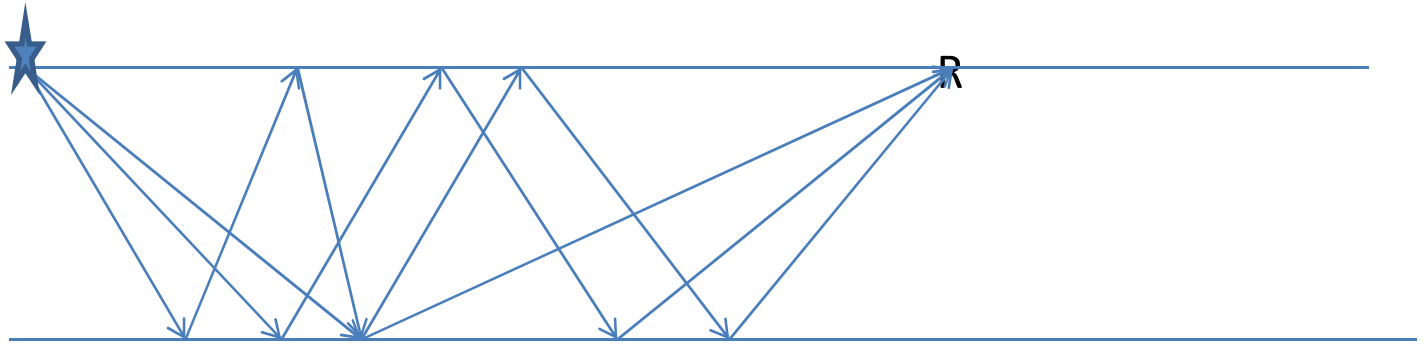
REFLACTION FROM A SLOPING SURFACE



- Reflaction from a sloppig boundary .S is the source ,R1, R2 can be cosider as wave from s', the mirror image of s with respectbto the reflector.
- Which is the boundry between the layers characterised by V1, V2 .
- S" is the vertical projection of the image onto the surface,this POINT IS THE LOCATION FOR The minimum reflection line

. **Multiple reflected waves** -

- Seismic waves reflected more than one time from the same boundary



USES

- With reflection method can locate and map such features as anticlines , fault, salt dome ,reef ,many of these are associated with the accumulation of oil and gas.
- Reflection data also been used for identifying lithology .
- These method make it possible to produce strucyural map of any geologic horizons.
- Major convergence caused by depositional thinii g can be located from reflection sections.
- Use for locating water aquifers..
- Hydrocarbons exploration(coal, gas, oil)
- Engineering site investigation.
- Detaction of subsurface cavity.

Disadvantage

- not use for mineral exploration
- There are Still places where reflection does not yield reliable information

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