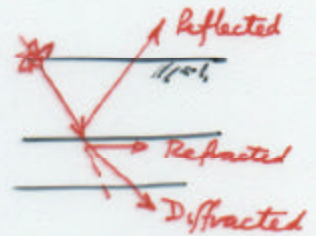


### 3. SEISMIC METHODS

- Measures elastic properties of rocks ( $v_s = ?$ ) evidenced through seismic velocity
- Locates interfaces between different  $v_s$

At interfaces; seismic waves are

- ┌ Diffracted
- ├ Refracted
- └ Reflected

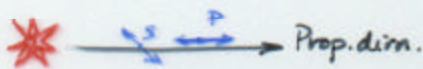


#### Procedure

1. Arrange geophones along single line
2. Provide initial shock input. Hammer/Drop hammer/Explosive/Air gun.
3. Record first (primary) and sometimes secondary (shear wave) arrivals

↓  
Evaluate

- ┌ 1. Bed thickness
- └ 2. Seismic velocity



1. Primary compressional wave (P wave)
2. Shear wave (slower) S-wave.

Swave attenuated by fluid saturated materials  
eg fluid filled fractures.

#### Typically:

1.  $v_s$  increases with depth (due to  $\uparrow E$ )
2. Weathered surface zones have  $\downarrow v_s$
3. Two methods of interpretation

3.1 Seismic Refraction

3.2 Seismic Reflection.

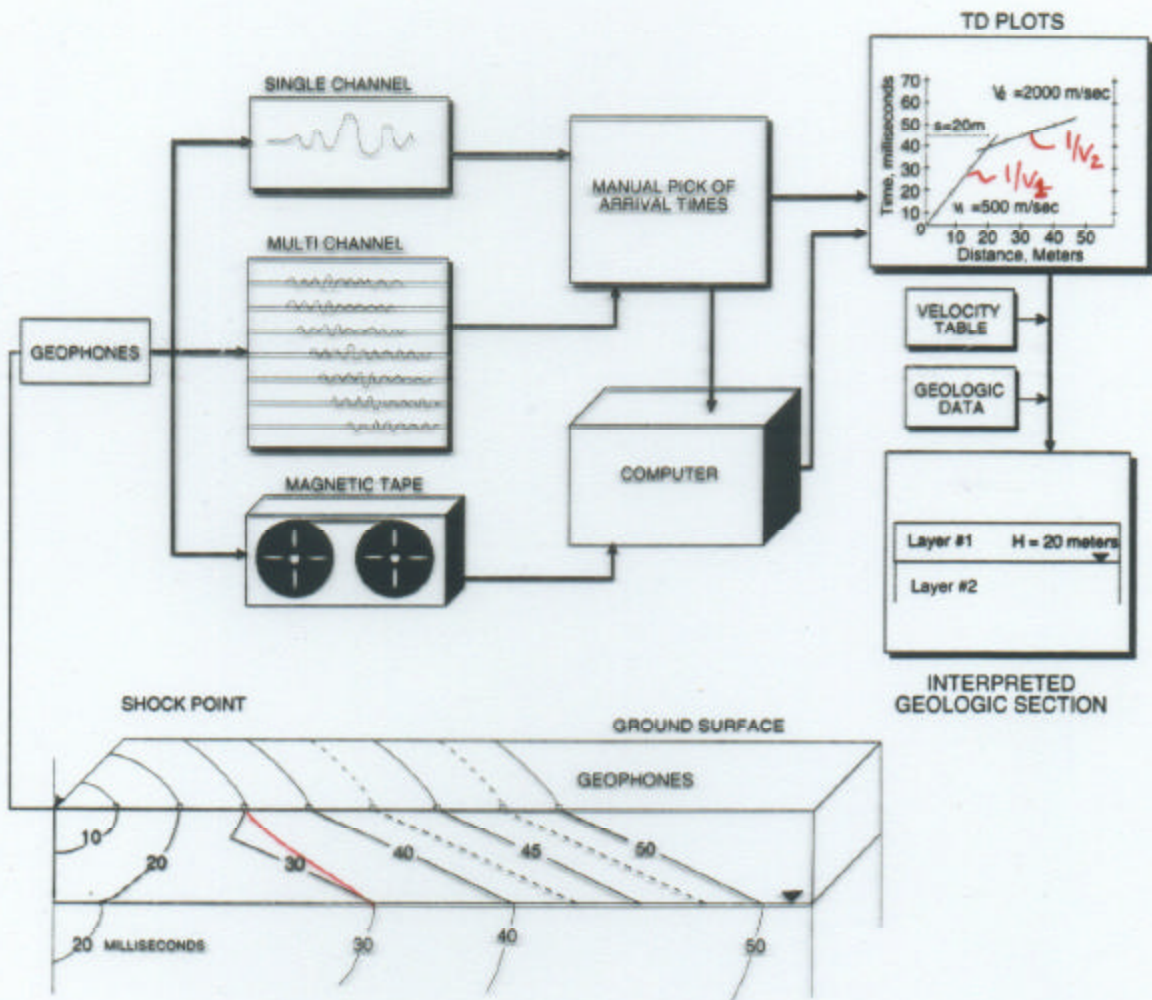


Figure 3-15 Seismic Geophysical Method

### 3.1 SEISMIC REFRACTION

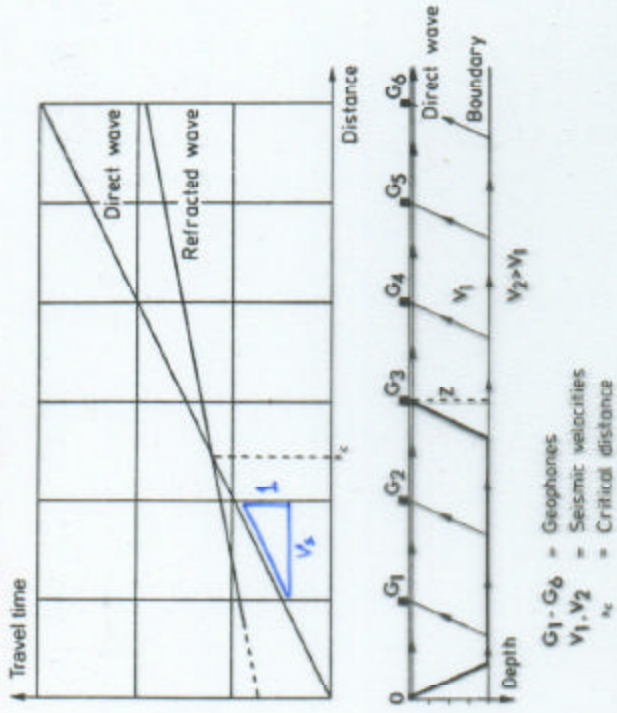


Fig. 2.18. Principle of seismic refraction

1. Fine shot and plot time distance graph of first arrivals.
2. Evaluate unit velocities of units from slope of curve
3. Evaluate layer depths from reflection points

String length defines depth penetration  
 String length  $\times 5$  = desired penetration depth  
 typical depths of  $< 50m$

Ambiguities - weathering  
 water-table

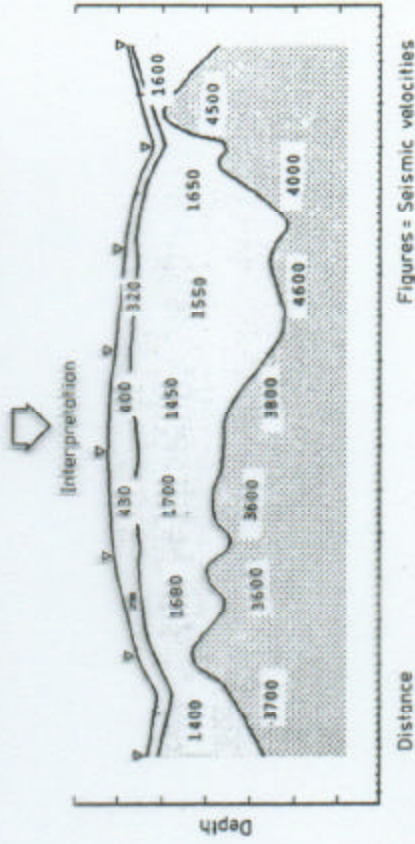
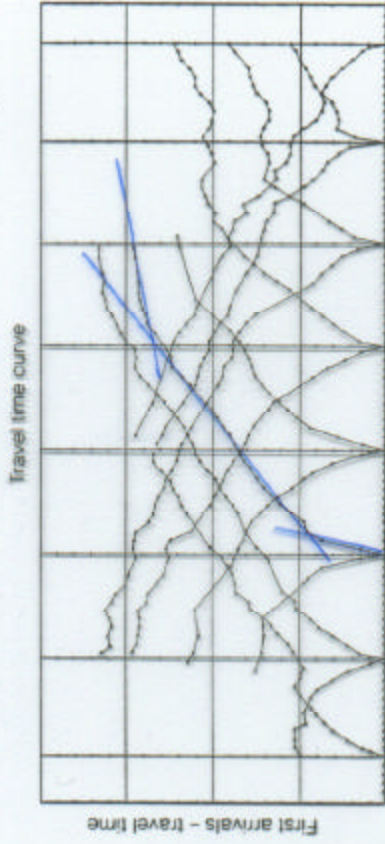
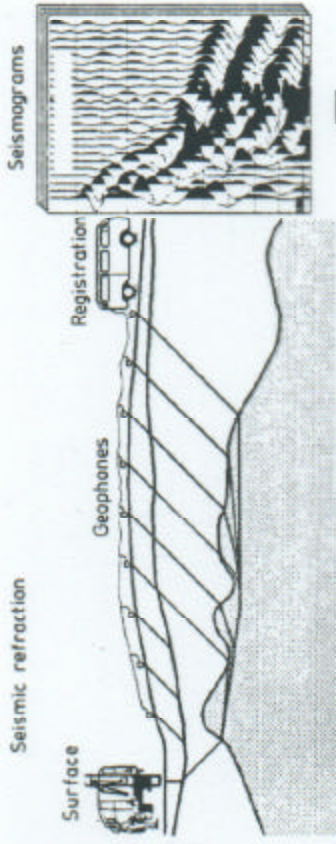


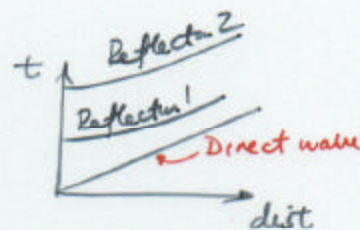
Fig. 2.19. Pattern of seismic refraction

Figures - Seismic velocities

### 3.2 SEISMIC REFLECTION

Source impulse creates shock front reflected by interfaces.

Reflection occurs @ interfaces with "seismic impedance" changes. Seismic impedance =  $\rho V_s$   
density



Measure arrival times and plot as time - distance.

#### Advantages over Refraction

1. Increased depth penetration with small string length.

#### Disadvantages

1. Reflected wave arrives so quickly that surface waves are present and must be filtered out.

To use @ depth  $< 50$  m, need:

- ① Receivers with high sampling rate and high frequency source
- ② Sophisticated filtering and data analysis methods.

# REFLECTION

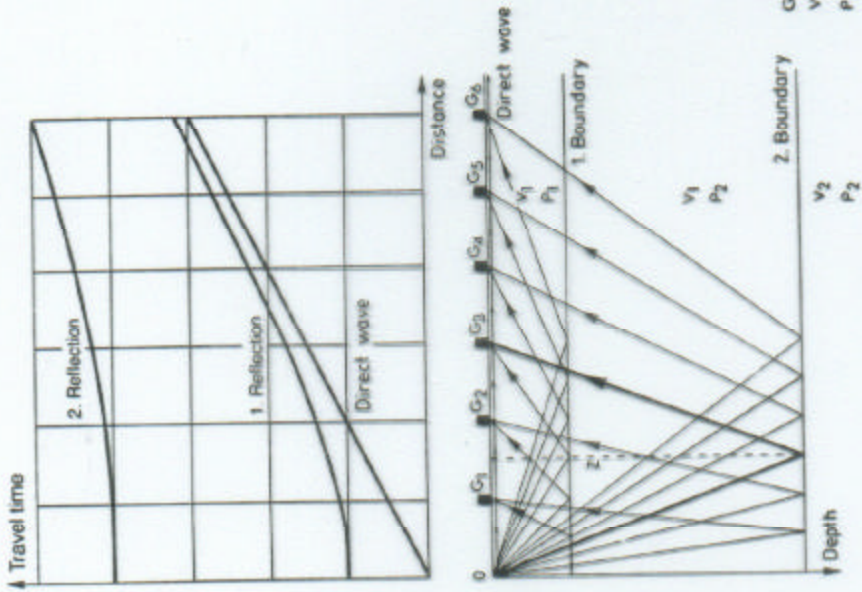


Fig. 2.21. Principle of seismic reflection

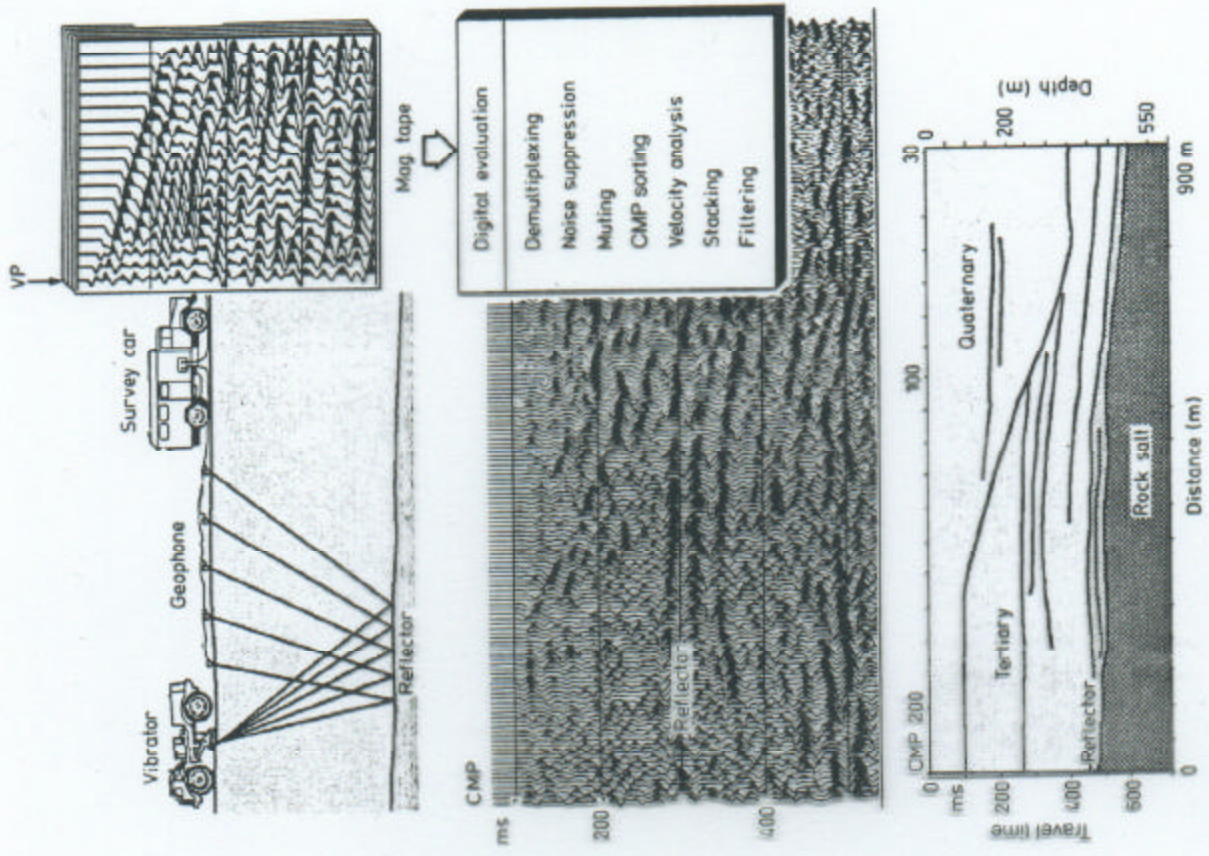


Fig. 2.22. Pattern of seismic reflection