

# Seismic Reflection

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# Reflection surveying

- Sensitive to impedance contrasts
- Use near-normal incidence i.e. P-waves
- ❖ Target scale:
  - ▶ 10's m: Ground water, engineering and environmental studies
  - ▶ km's: Oil exploration
  - ▶ 10's km: Crustal structure

# SEISMIC REFLECTION



HAMMER

PLATE

TO SEISMOGRAPH



GEOPHONES

SEDIMENT

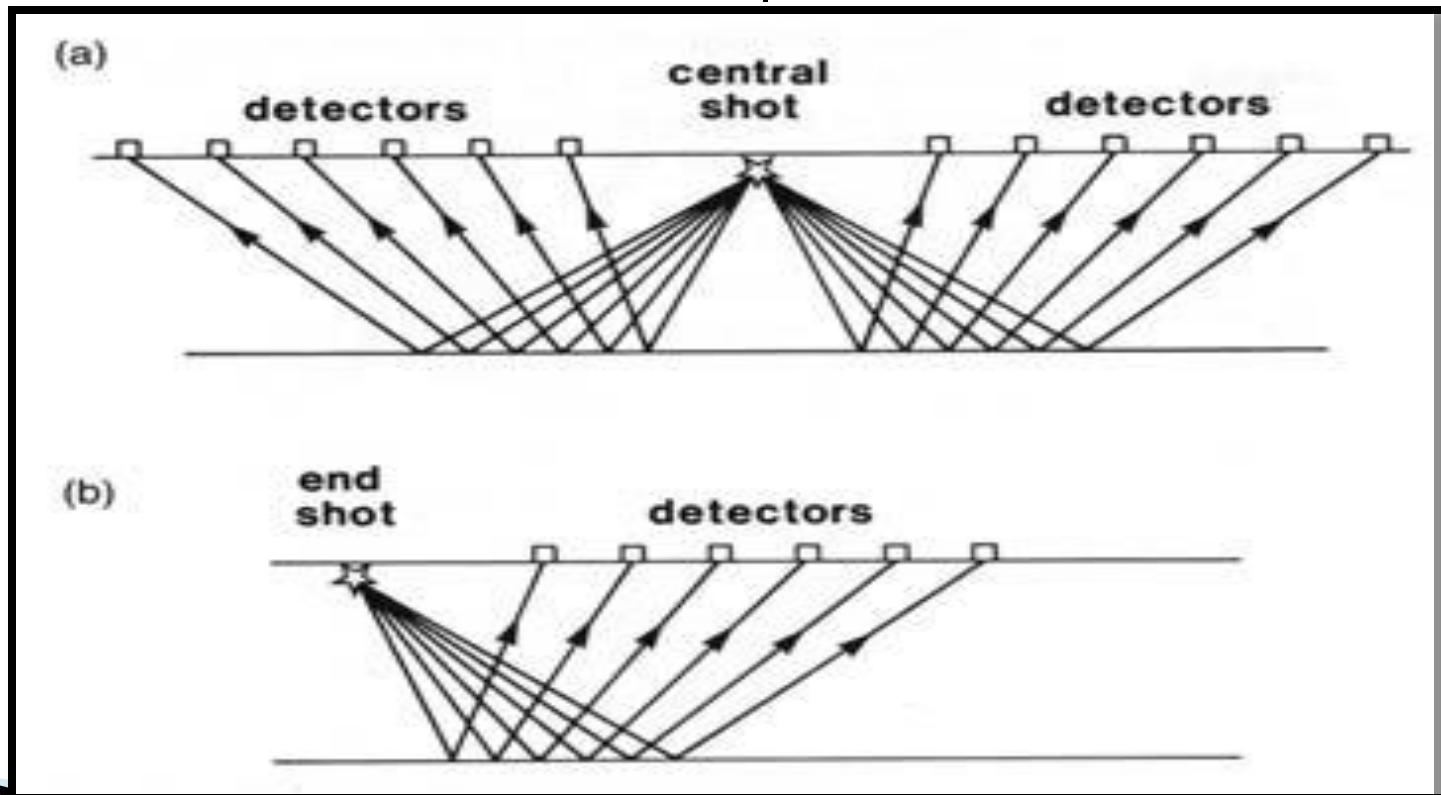
SEISMIC WAVE RAYPATHS

BEDROCK

# Reflection surveying

## ❖ Shot gathers

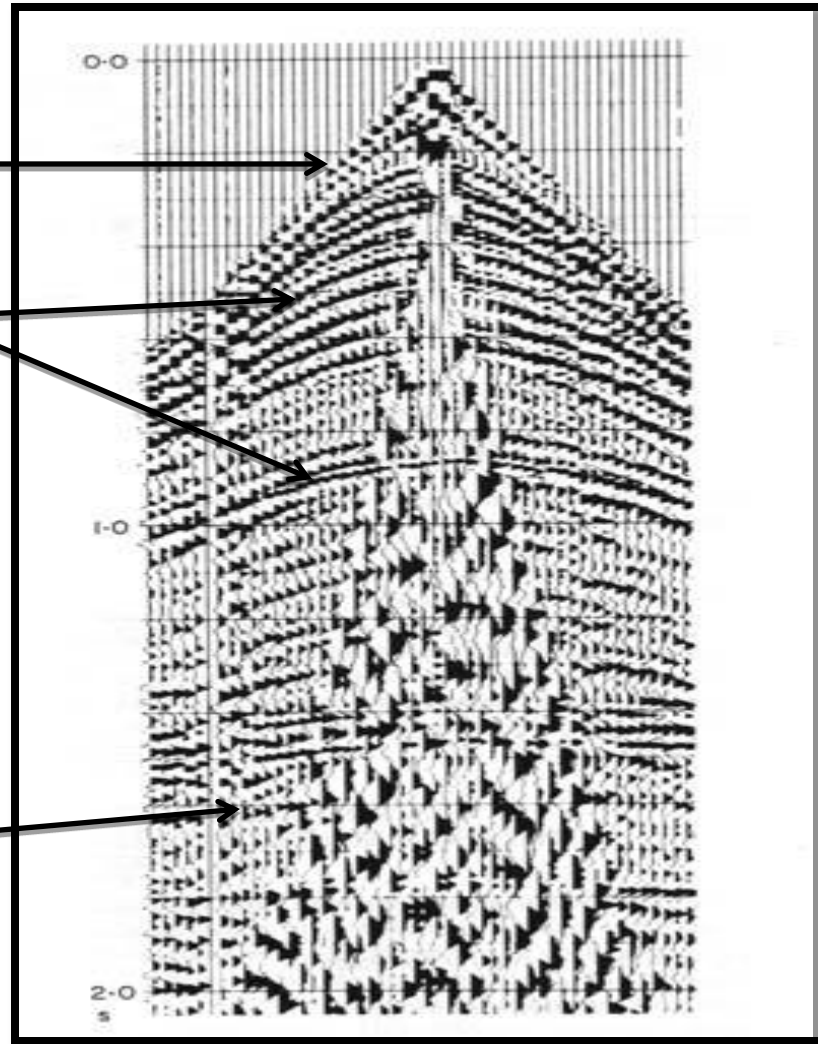
offset ← |



Direct Arrival

Reflection  
Hyperbola

Surface  
waves  
“Ground roll”  
I.e. noise





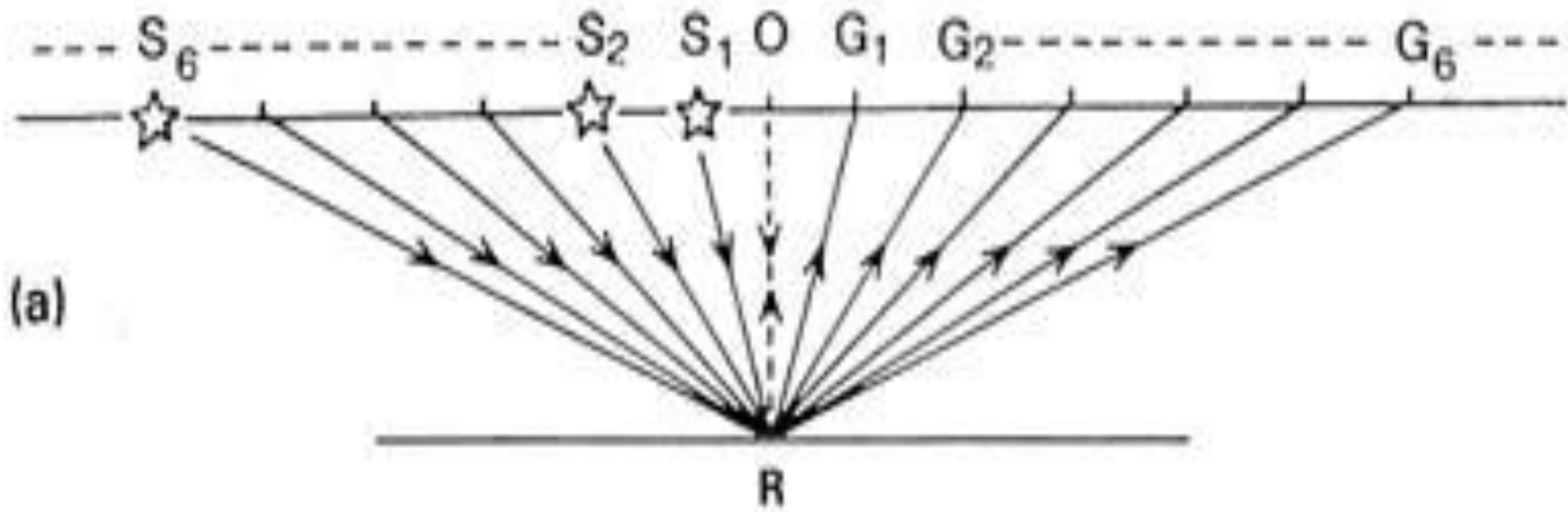
# Common midpoint gathers

- ❖ We use this technique to enhance signal to noise. We use more than one shot.
- ❖ Reflections from the same point are recorded by different source–station pairs.

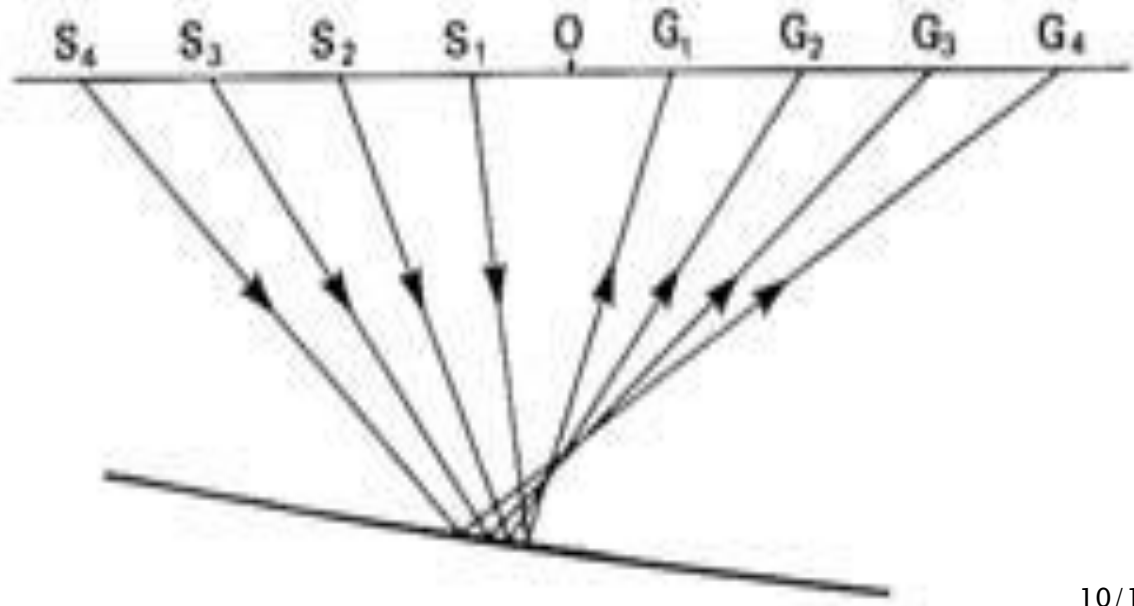
## Common depth point gather

- ❖ For dipping layers the reflection points are “smeared”

## — Common midpoint gather



(a)



(b)

# Common midpoint gathers

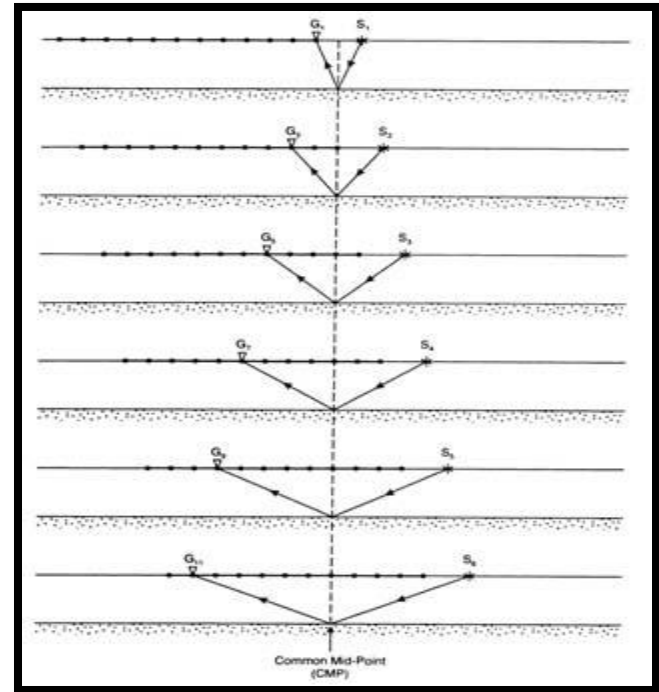
## ❖ Collecting

- Common midpoint gathers sequentially move shot and receiver string across the surface.
- Fold
- ▶ The number of times the same point on a reflector is sampled.
- ▶ In this case: 6 fold



# Common midpoint gathers

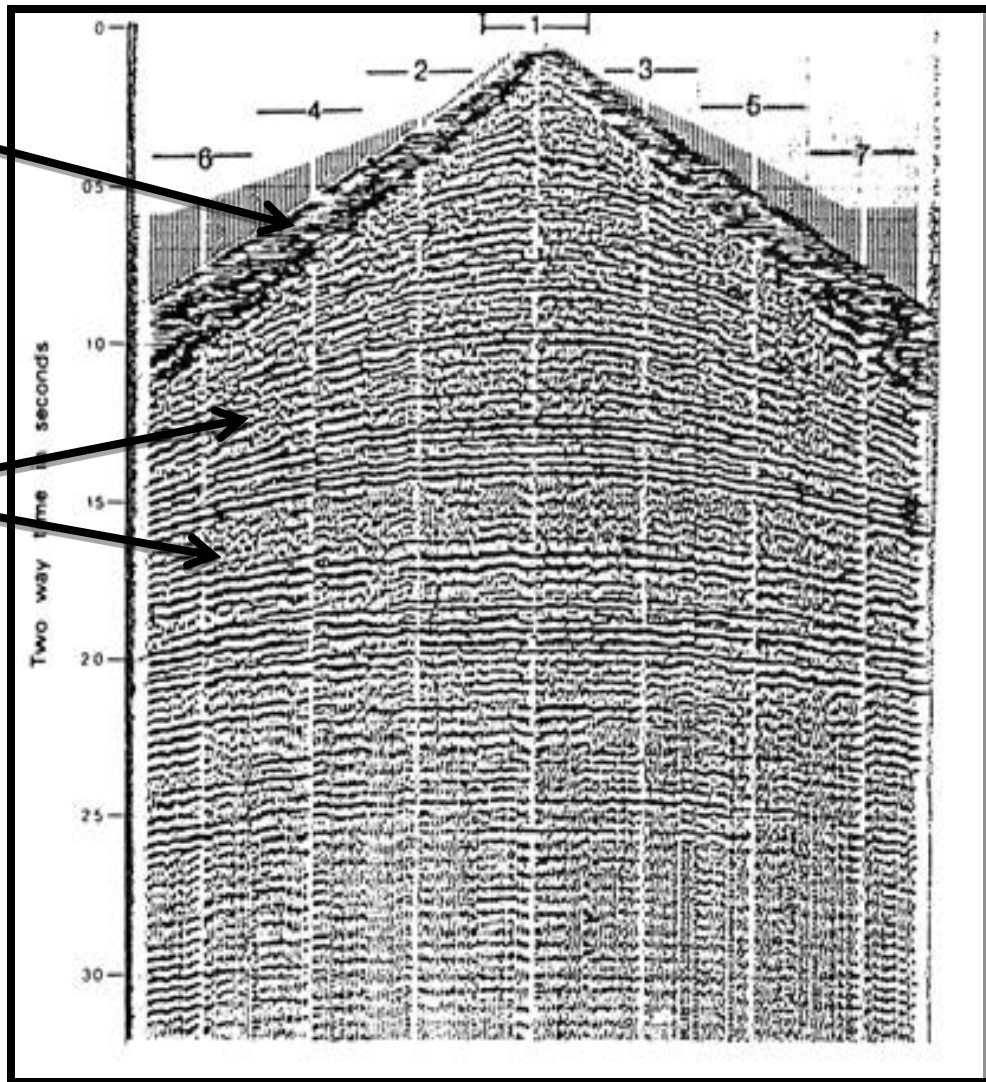
- Typical values
  - ▶ 1–6 engineering studies
  - ▶ 50, 100 or even 1000 in hydrocarbon exploration.



Note: Looks very similar to the shot gather because the shot gather was for a horizontal reflector.

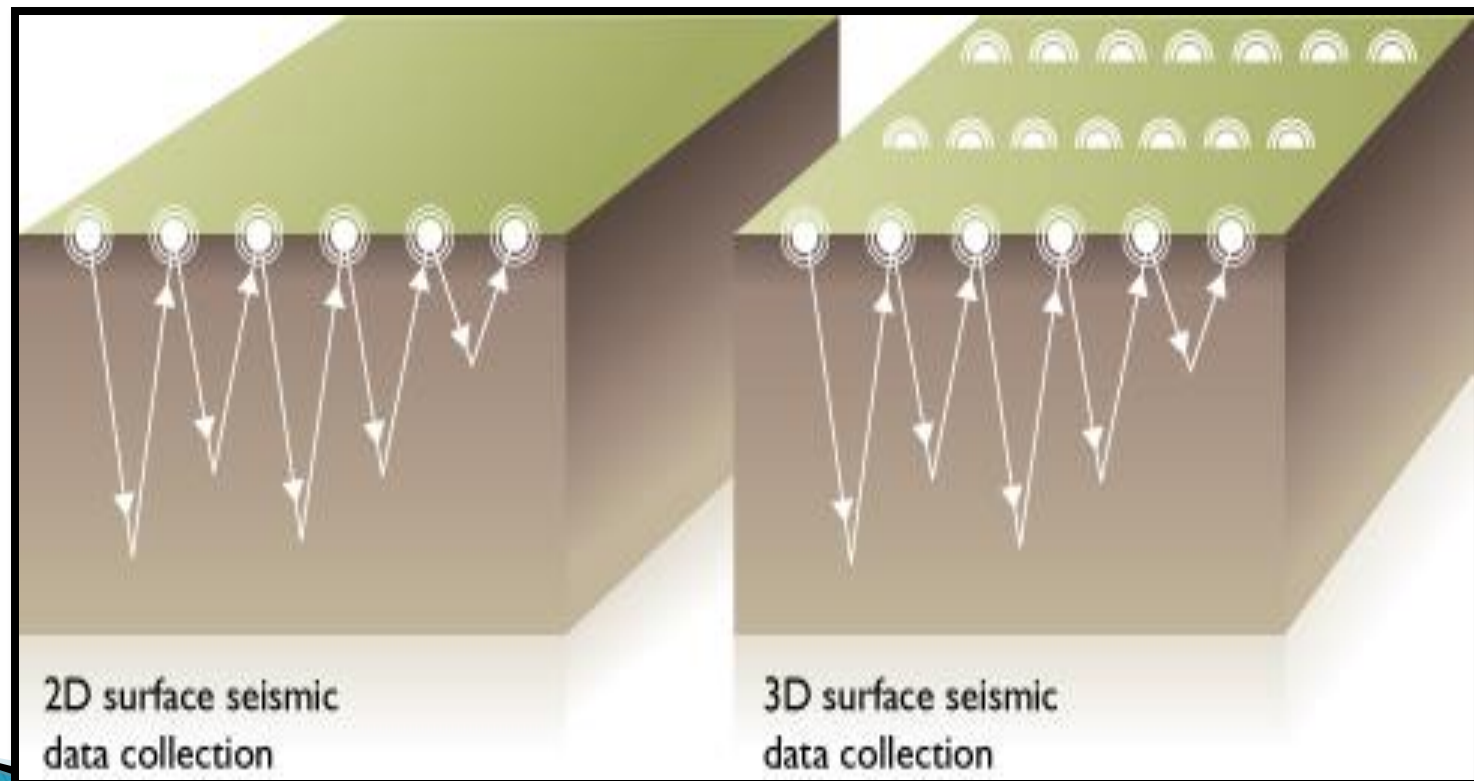
Direct arrival

Reflection hyperbola



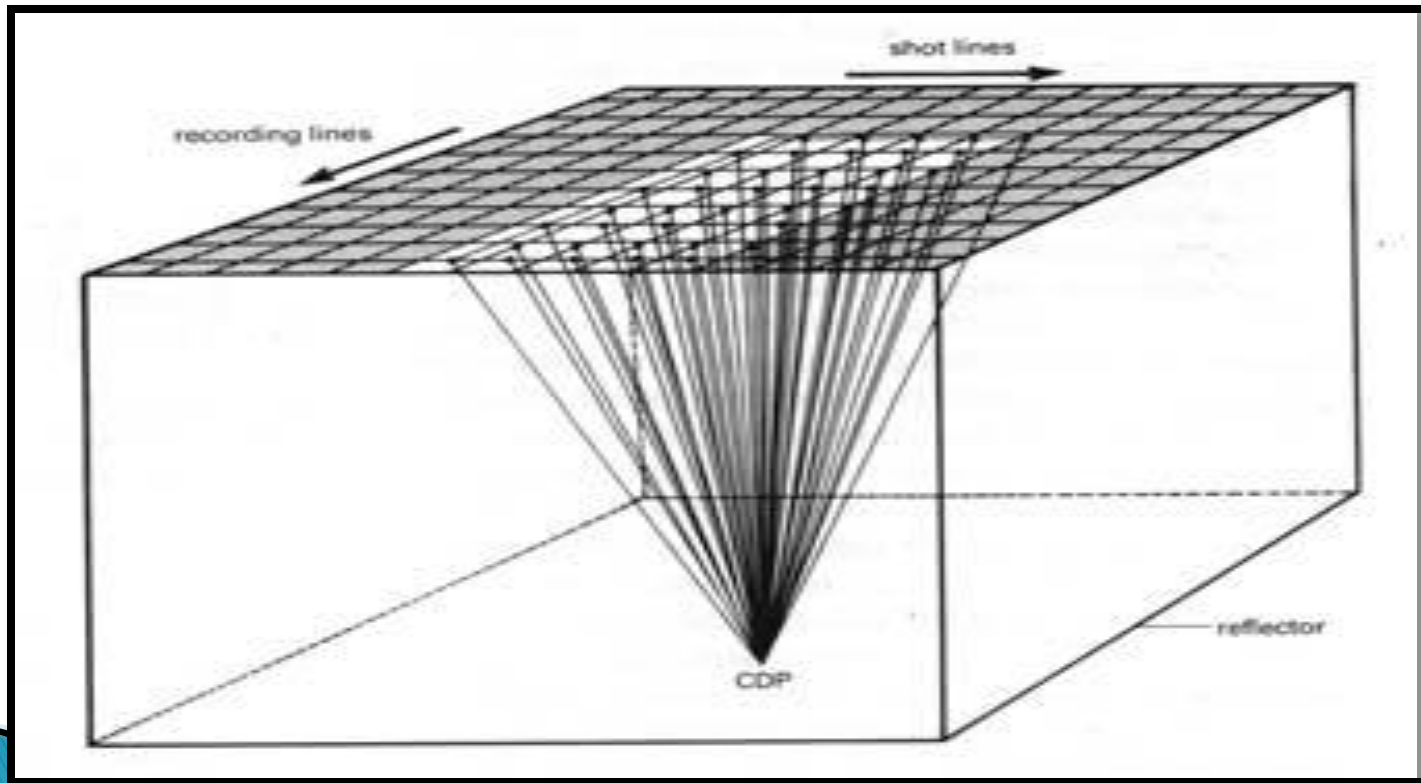
# 3D Seismic Survey

- Collect data on a grid rather than along a line.

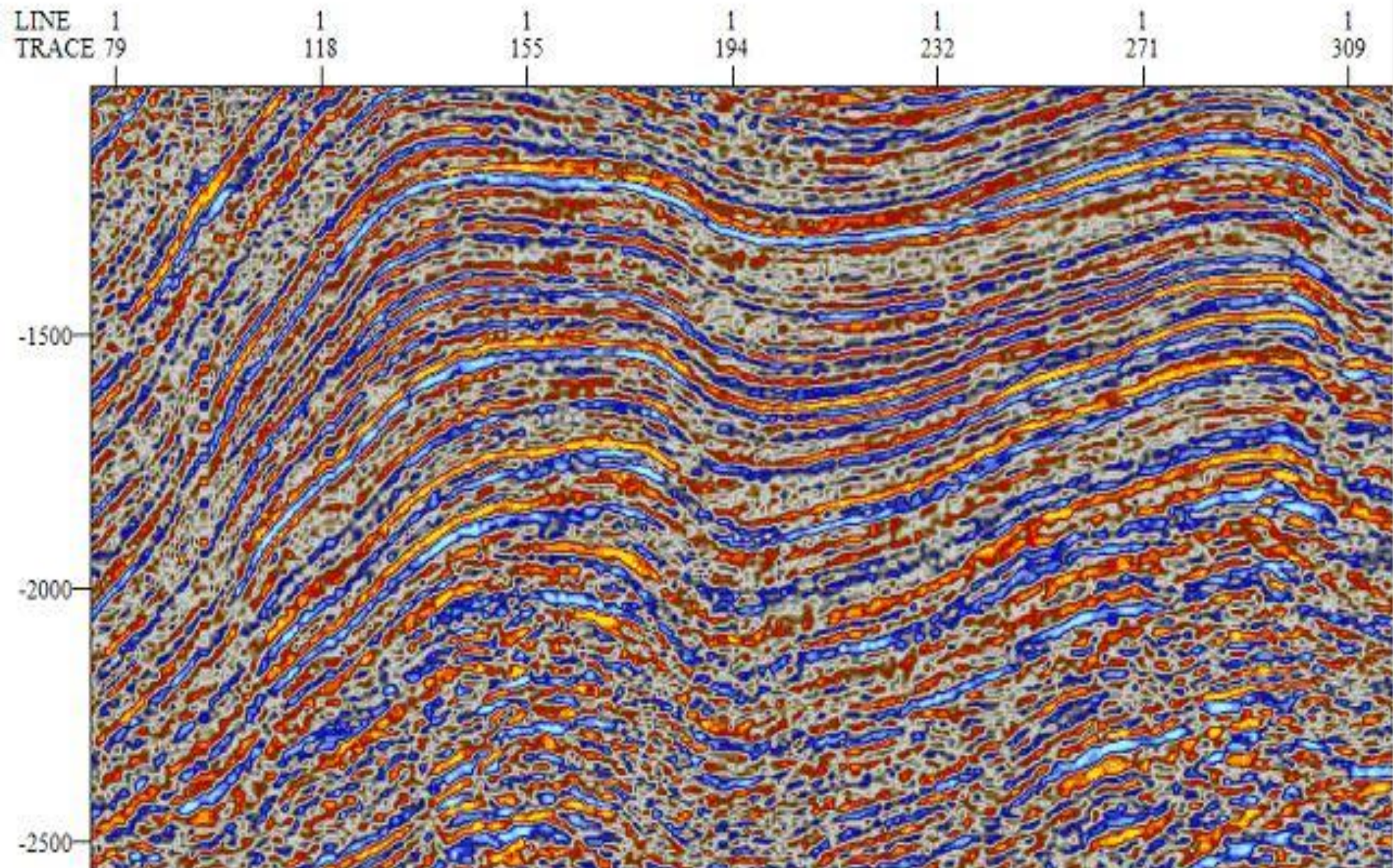


# 3D Seismic Survey

- 3D survey produces a data cube rather than a line.

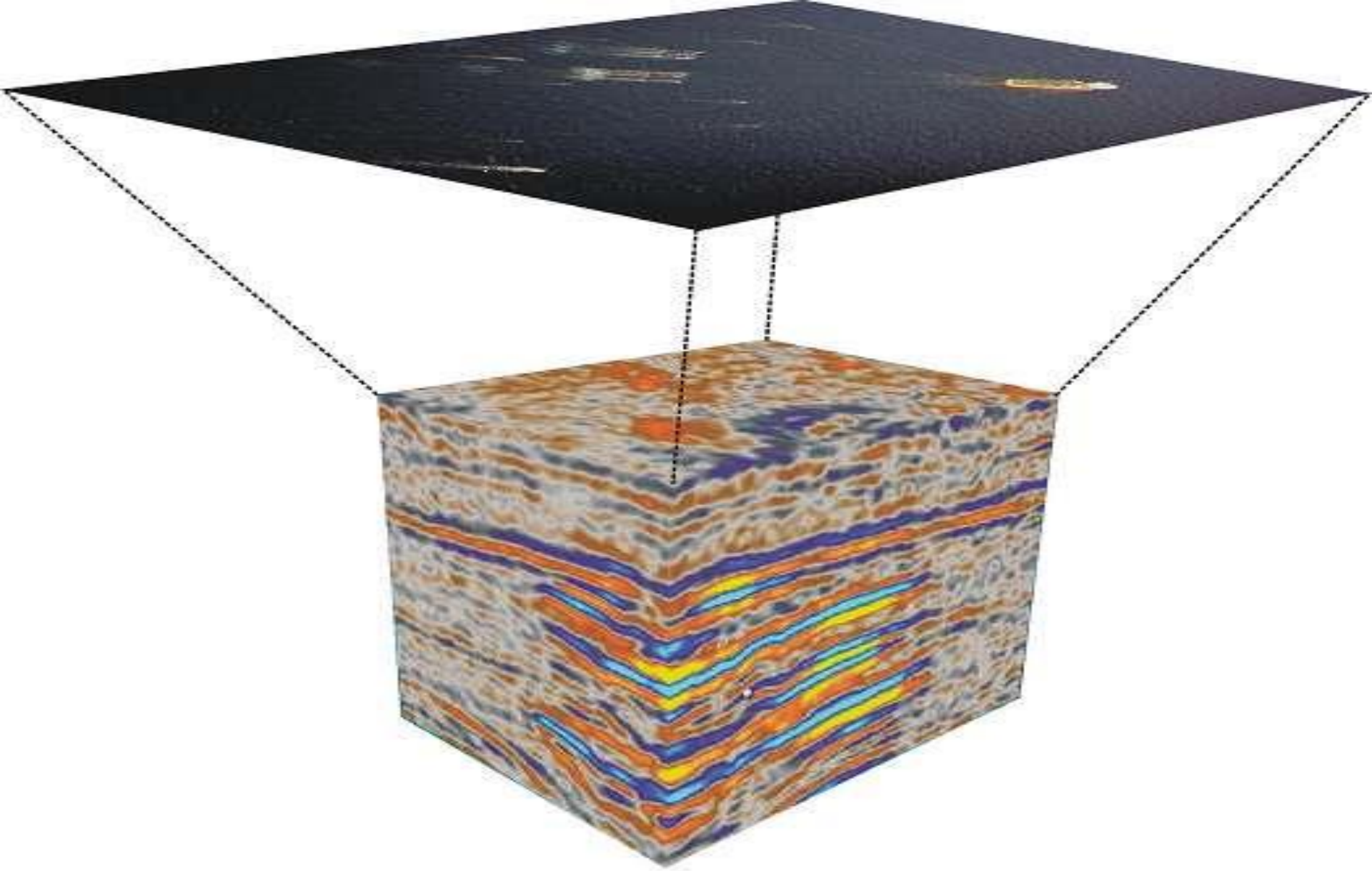






2D- seismic section





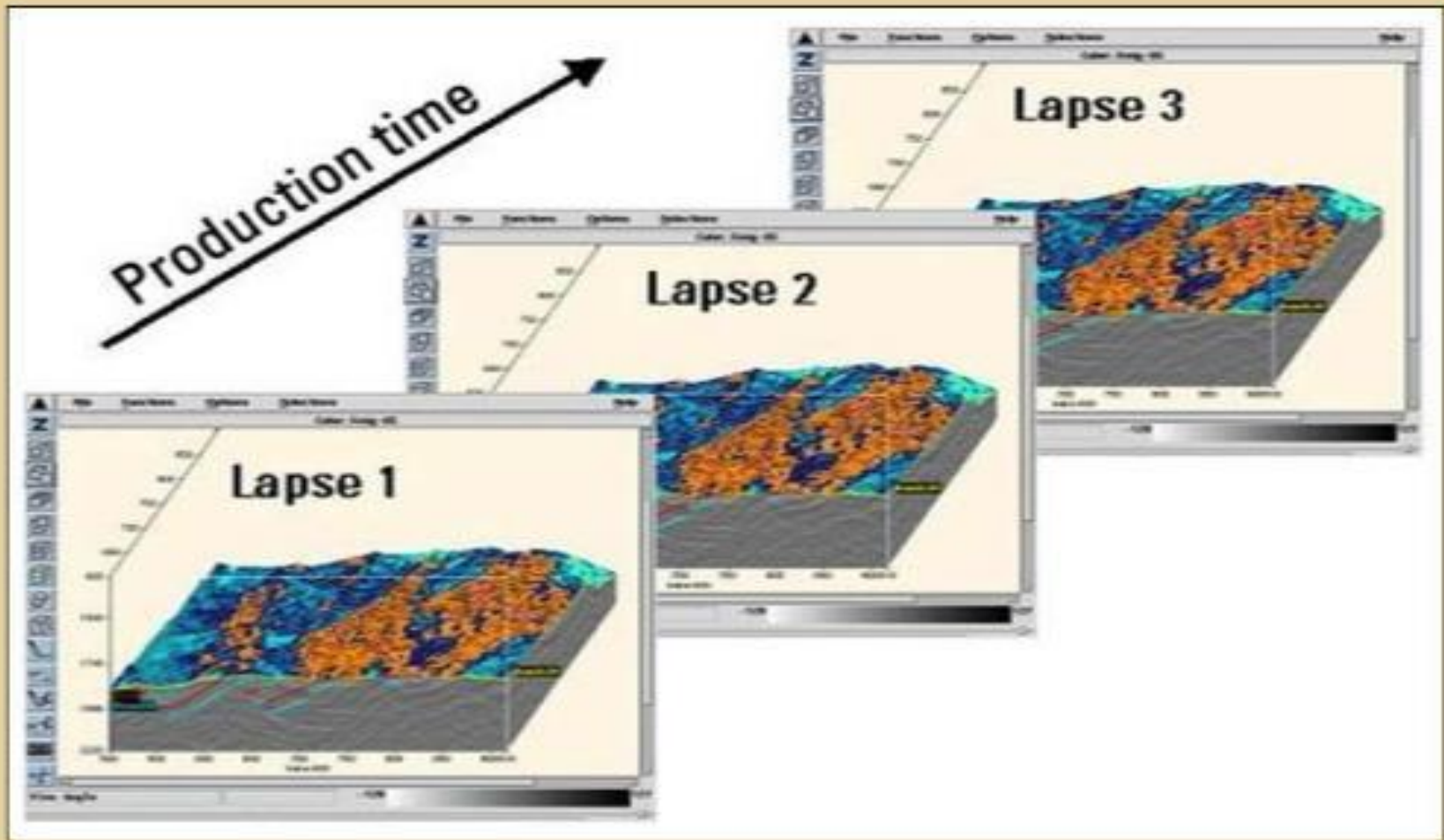
## 3D-Seismic section

10/17/2020



# 4D– Seismic survey

- 4D seismic (Time–lapse ) involves comparing the results of 3D seismic surveys repeated at considerable time intervals (e.g. before a field starts producing versus various post–production stages).
- Time is the fourth dimension.



## 4D- Seismic survey

# 4D– Seismic survey

- Strong differences seen between the survey results are attributed to fluid changes and/or changes in reservoir pressures.
- The arrow points to a producing part of the hydrocarbons reservoir.
- These hydrocarbons depleted with the producing time.

# Textbook

Alsadi, H.N. (2017) Seismic Hydrocarbon Exploration: 2D and 3D Techniques. Springer International Publishing, Switzerland, 331 p.

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