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
Reflection surveying

- Shot gathers

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(a) detectors central shot detectors

(b) end shot detectors
Surface waves

"Ground roll"

I.e. noise

Direct Arrival

Reflection

Hyperbola
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
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.
3D-Seismic section
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

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