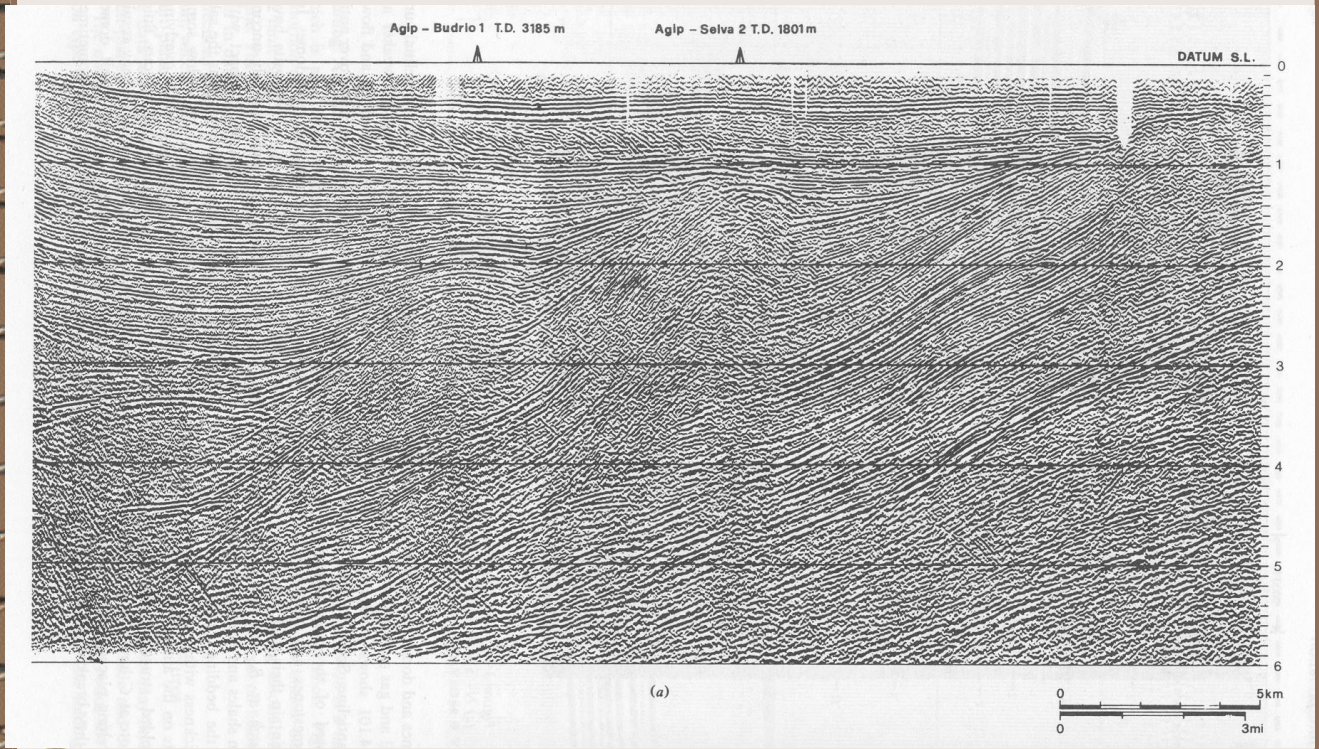
Reflection Seismics: Applications and Case Histories

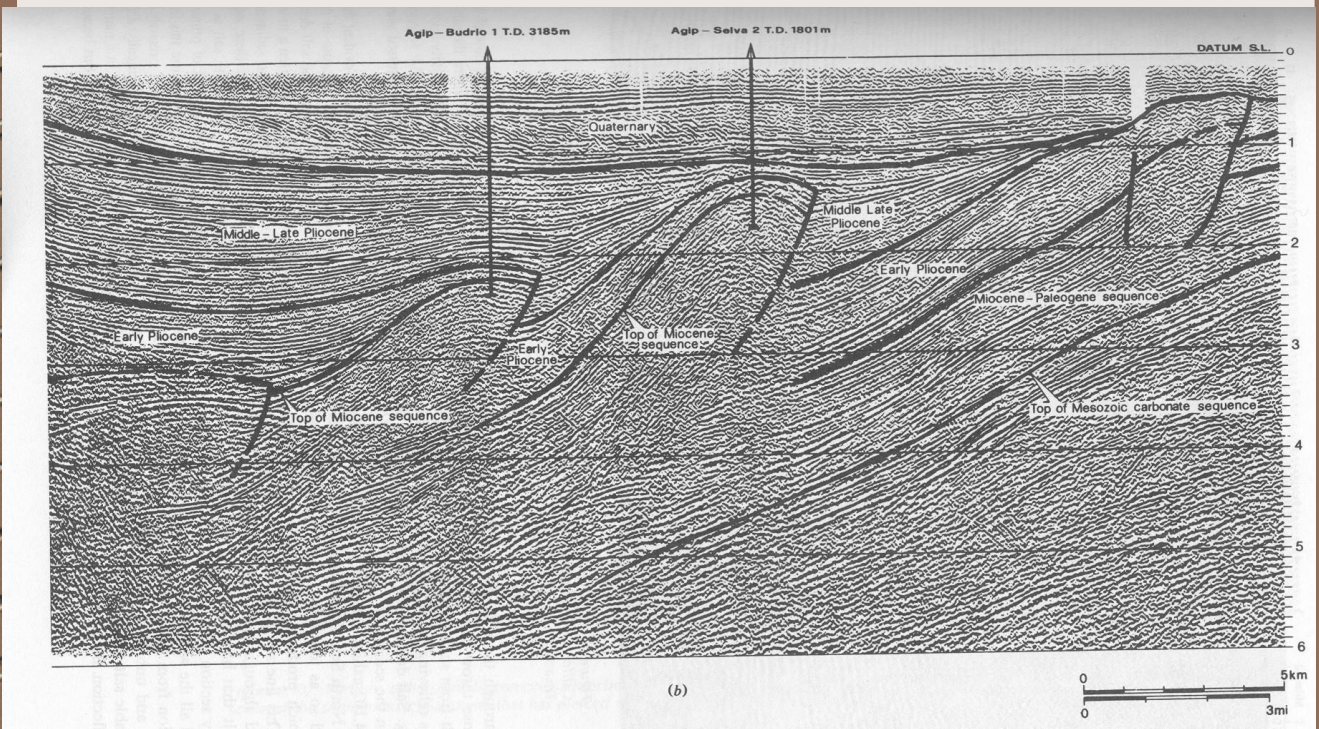
- Structural interpretation
- High-resolution seismic profiling on land
- Multiples
- Interpretation pitfalls

- Reading:
  - Reynolds, Section 6.6
  - Telford *et al*., Section 4.10

Structural interpretation

Folds and faults

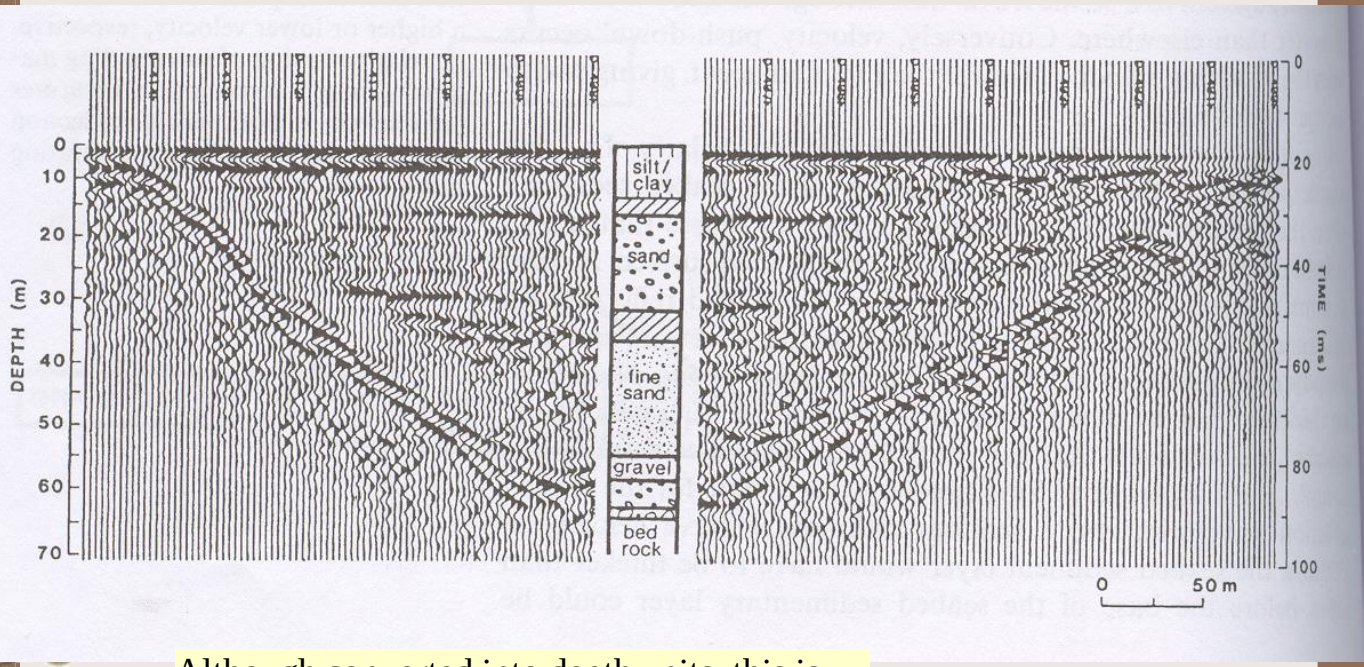




High-Resolution seismics on land

Pullan and Hunter (1990)

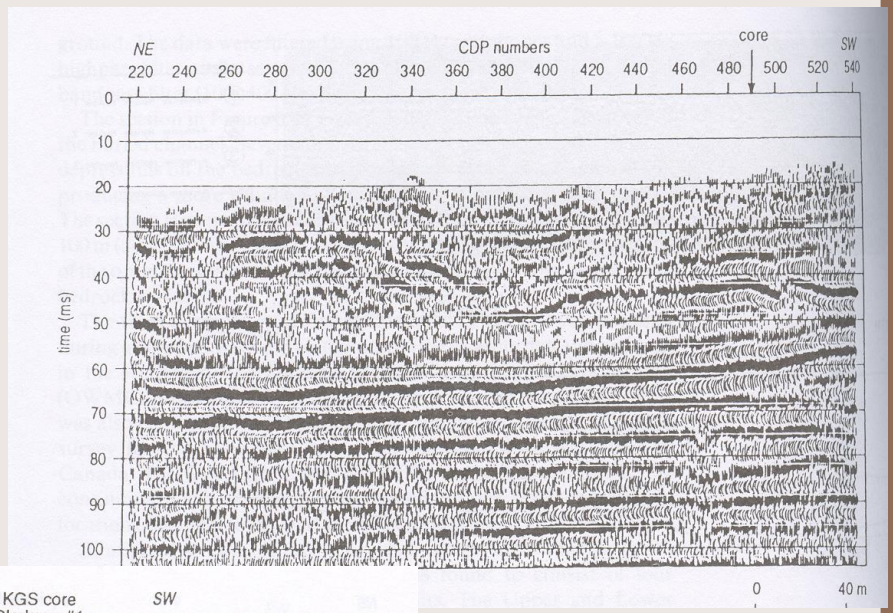
- Buried rock valley in Dryden, ON;
  - Groundwater at only 1m depth;
  - Source fired into finely-grained water-saturated sediments
    - this is ideal for high-res reflection profiling
- In-hole shotgun source
- 100-Hz geophones;
- Recording at a single ('optimum') 15-m offset
  - so no NMO or stacking required!
  - only gain (AGC) and bandpass filtering (240-800 Hz) used

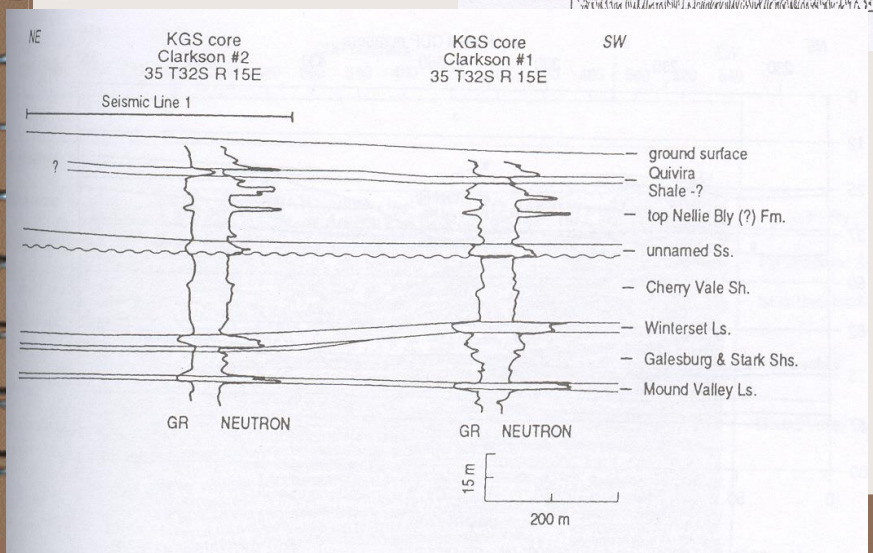


Although converted into depth units, this is still a *time section*! So, geometry of bedrock walls is not accurate...

High-Resolution seismics on land
Miller et al., (1995)

- Study of achievable vertical spatial resolution
- Similar source and recording system as in the previous example
- Note the difference in resolution due to shooting *in an unsaturated zone*

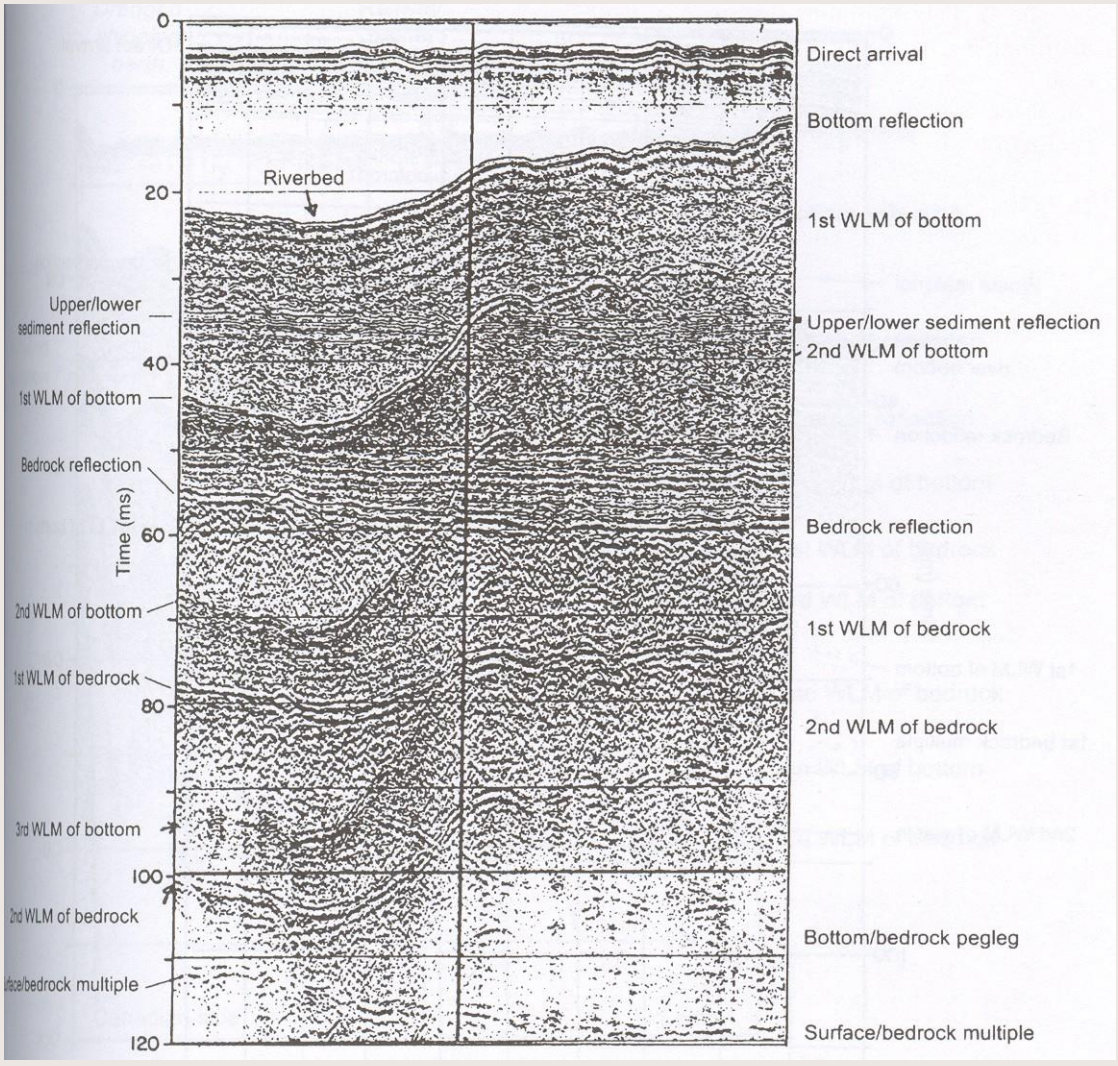




Multiples

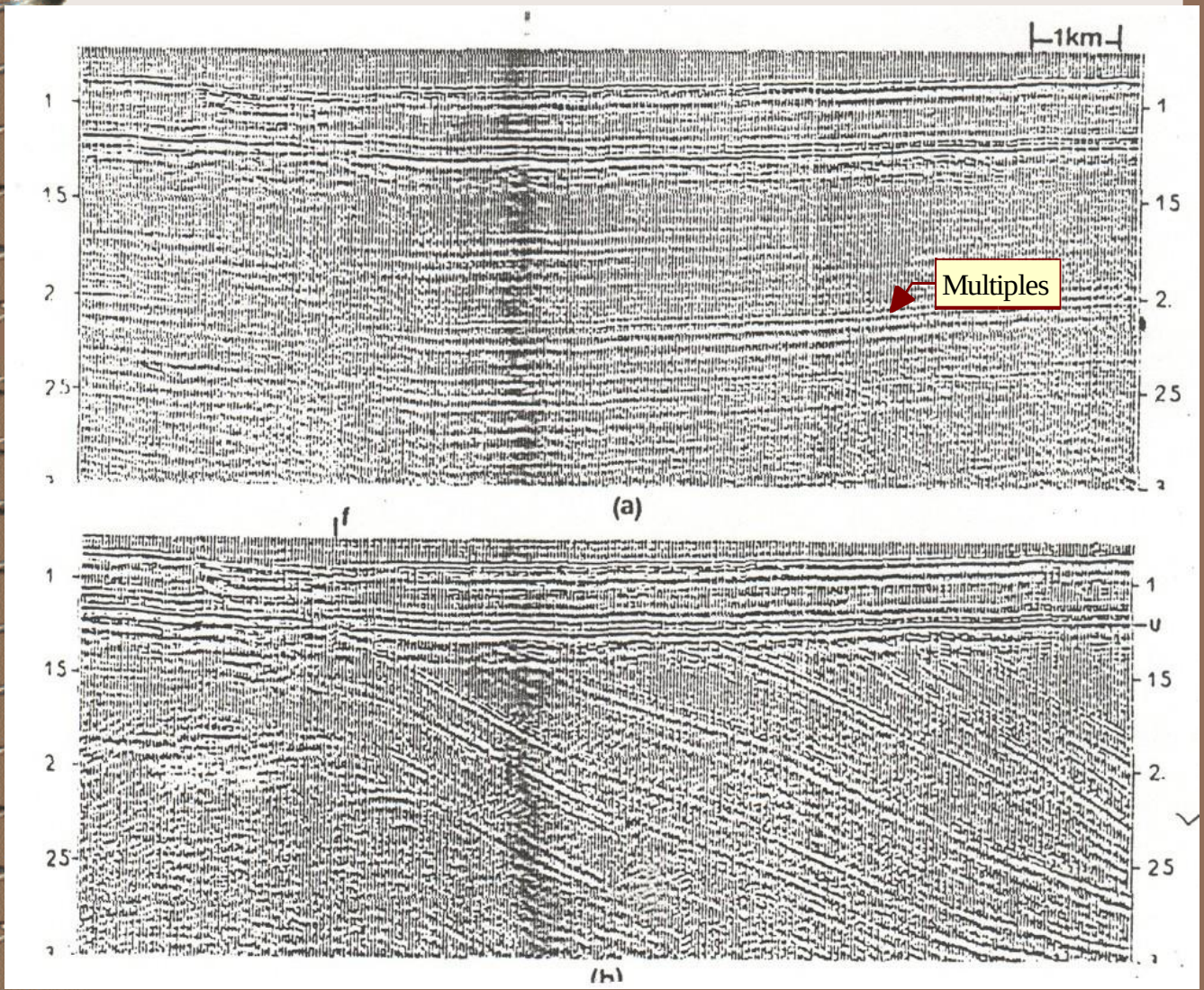
(multiple reflections)
Saint Clair River, *McGee*, 1990

- Multiple upward and downward reflections from strong impedance contrasts:
  - *e.g.*, surface, bedrock, water bottom
- Usually suppressed by *velocity filtering* before stacking



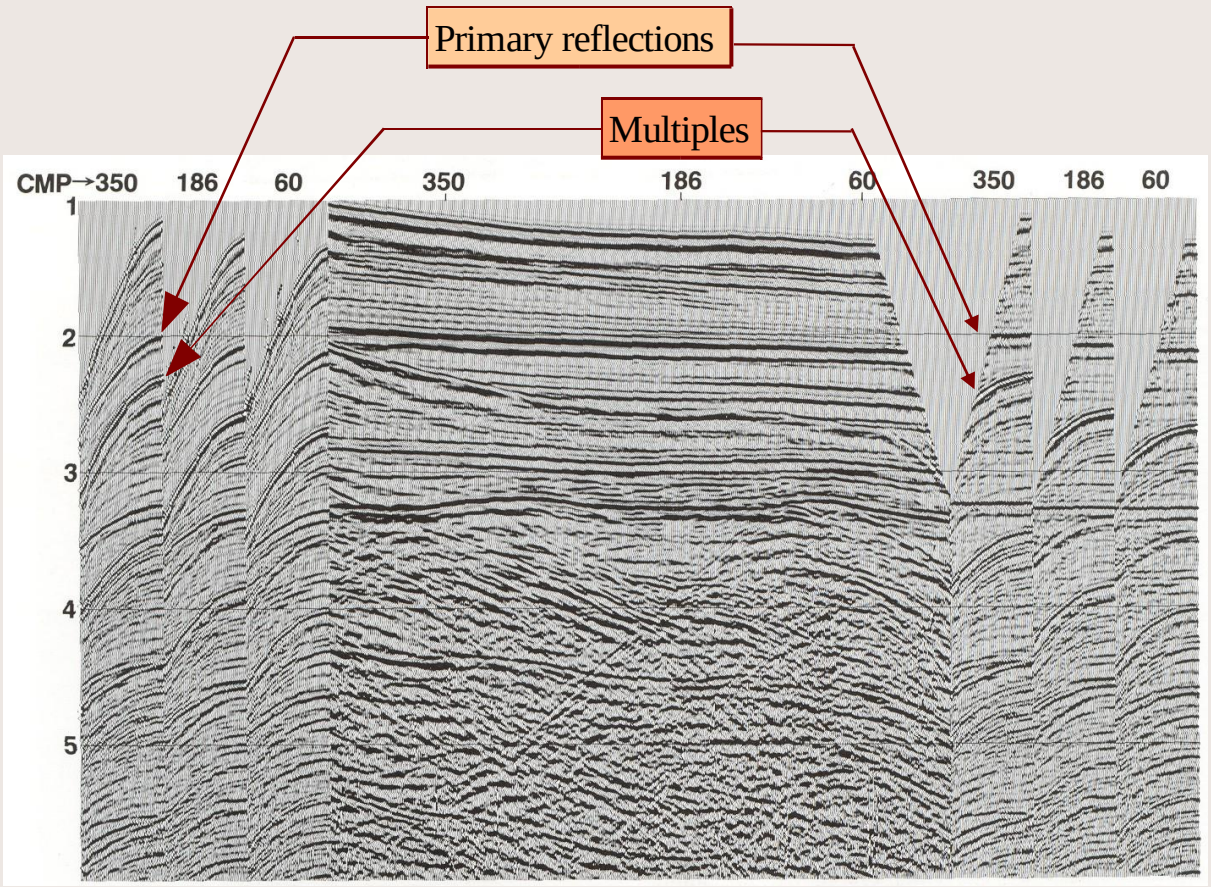
Importance of velocity analysis and suppression of multiples
(an example of a *misinterpretation*)

- These are two images of *the same line*
  - Low stacking velocities (treating multiples as true reflections) in the *upper plot* result in an erroneous interpretation.



Attenuation of multiples

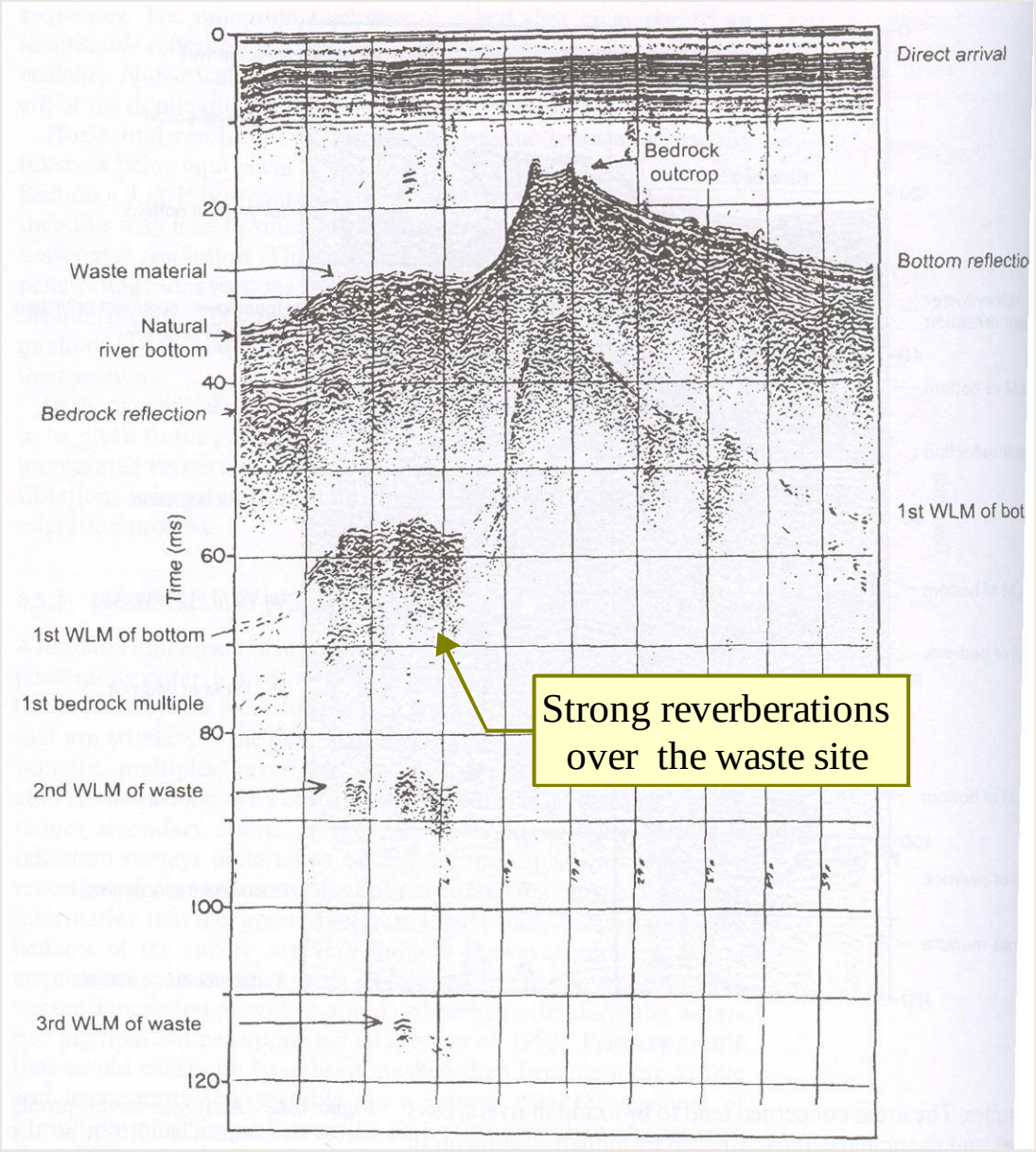
- Multiples are separable from their primary reflections in *time-velocity* domain
  - Using NMO;
  - Using velocity ('*f-k*' or '*τ-p*') filtering.



The use of multiples

(*McGee*, 1990)

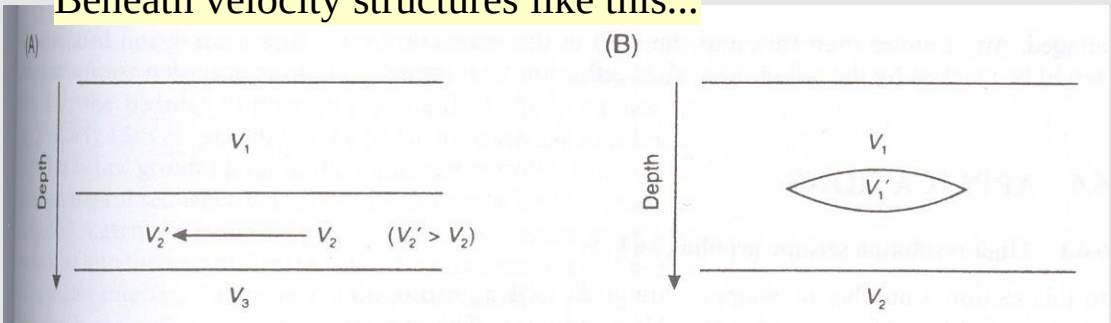
- Strong multipes may indicate areas of anomalous reflectivity



Interpretation pitfalls
in reflection sections

- CMP Reflection processing results in *time* sections that have to be converted into *depth*
  - Knowledge of overburden *velocity* is critical.

Beneath velocity structures like this...



...horizontal reflectors may look like this.