

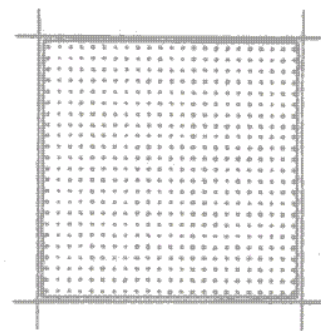
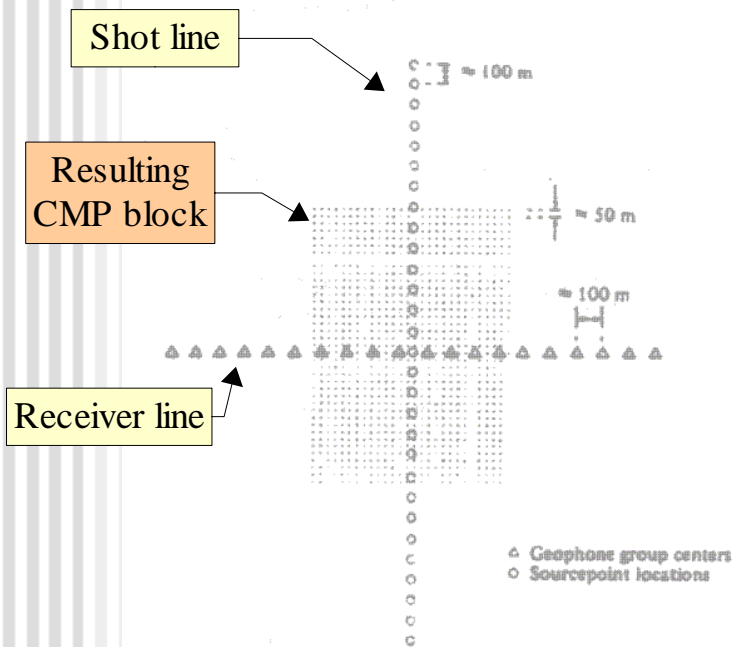
# Reflection seismic Method - 3D

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- 3-D acquisition
  - Land
  - Marine
  - 3-D data processing and display
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- Reading:
    - › Sheriff and Geldart, Chapter 12

# Land 3-D acquisition

- Key considerations:
  - Cost – minimize the number of source points
  - Offset-azimuth uniformity
  - Uniformity and fidelity
  - Reduction of the *acquisition footprint*.
- For comparable data quality, 3-D work usually requires about 1/2 of the fold necessary in 2-D

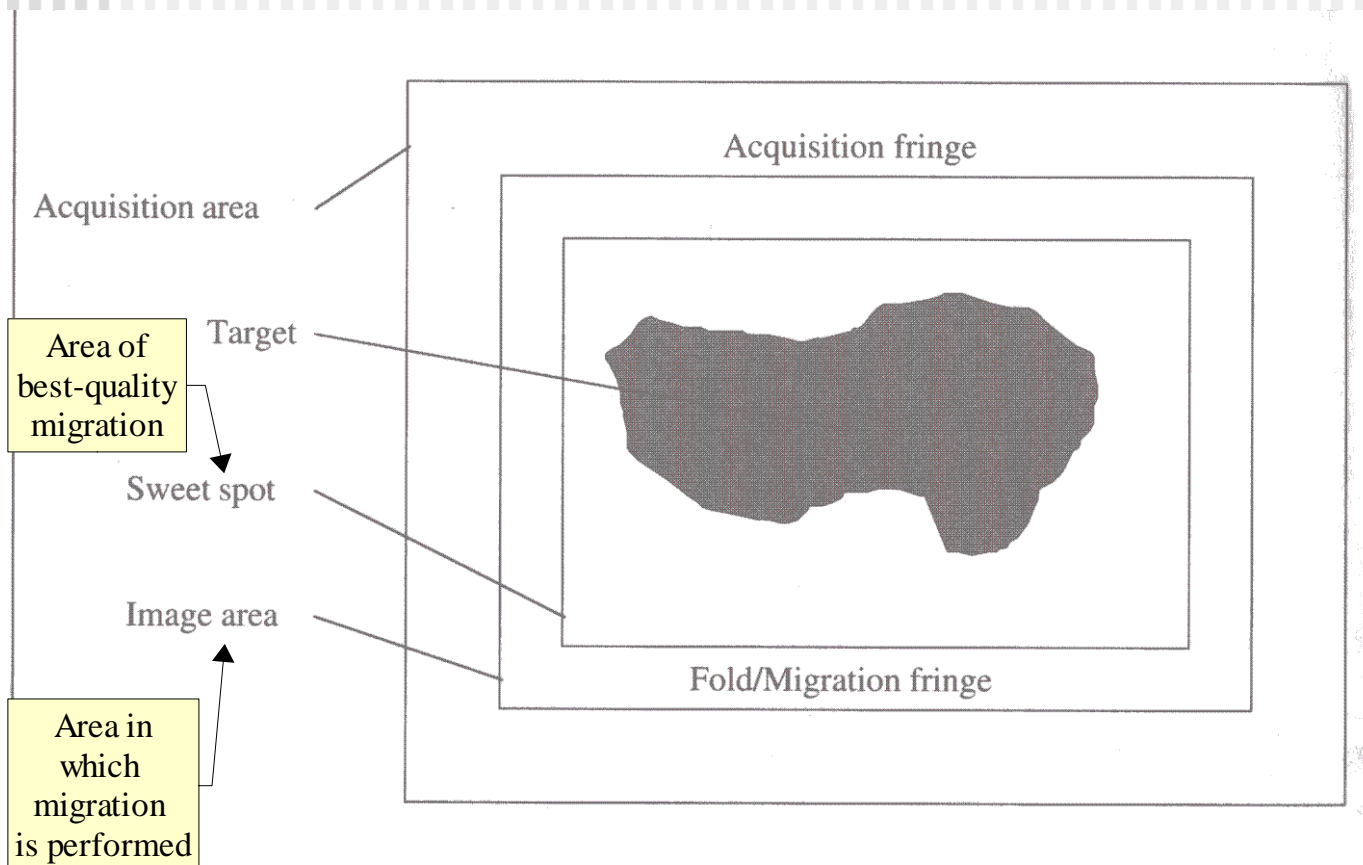


Loop  
(sources and geophones around the perimeter)

Land patch acquisition

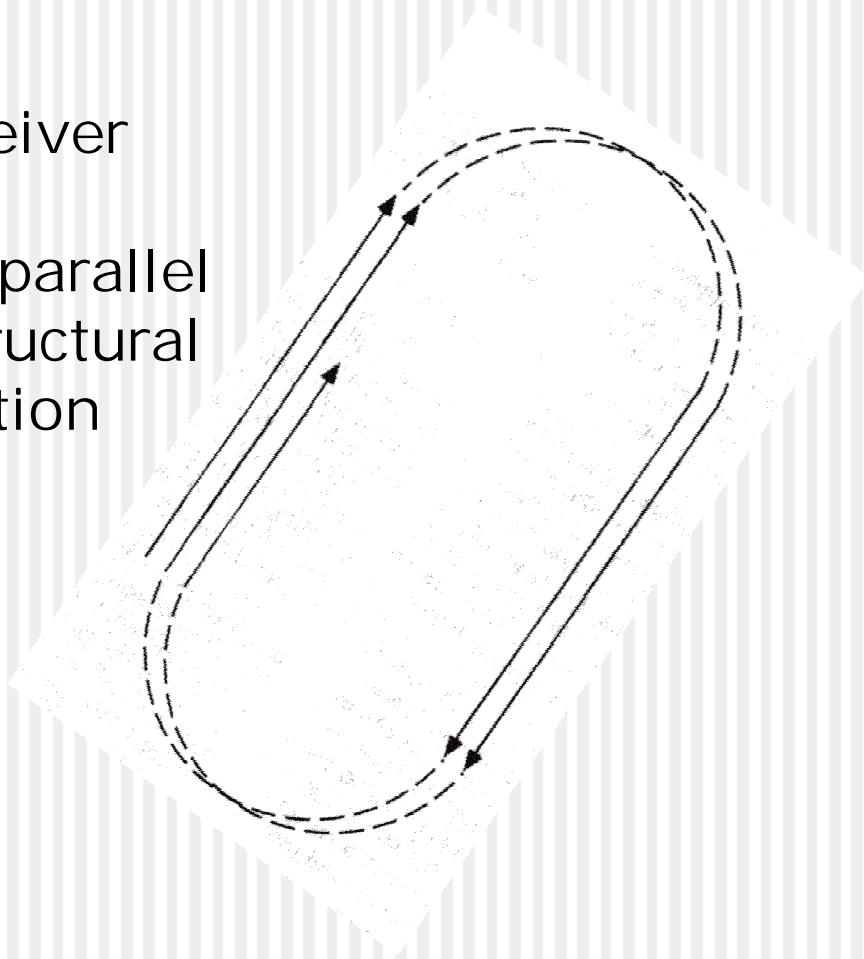
# Acquisition fringe

- In order to ensure uniform coverage of the target area after migration, data must be acquired across a broader area:



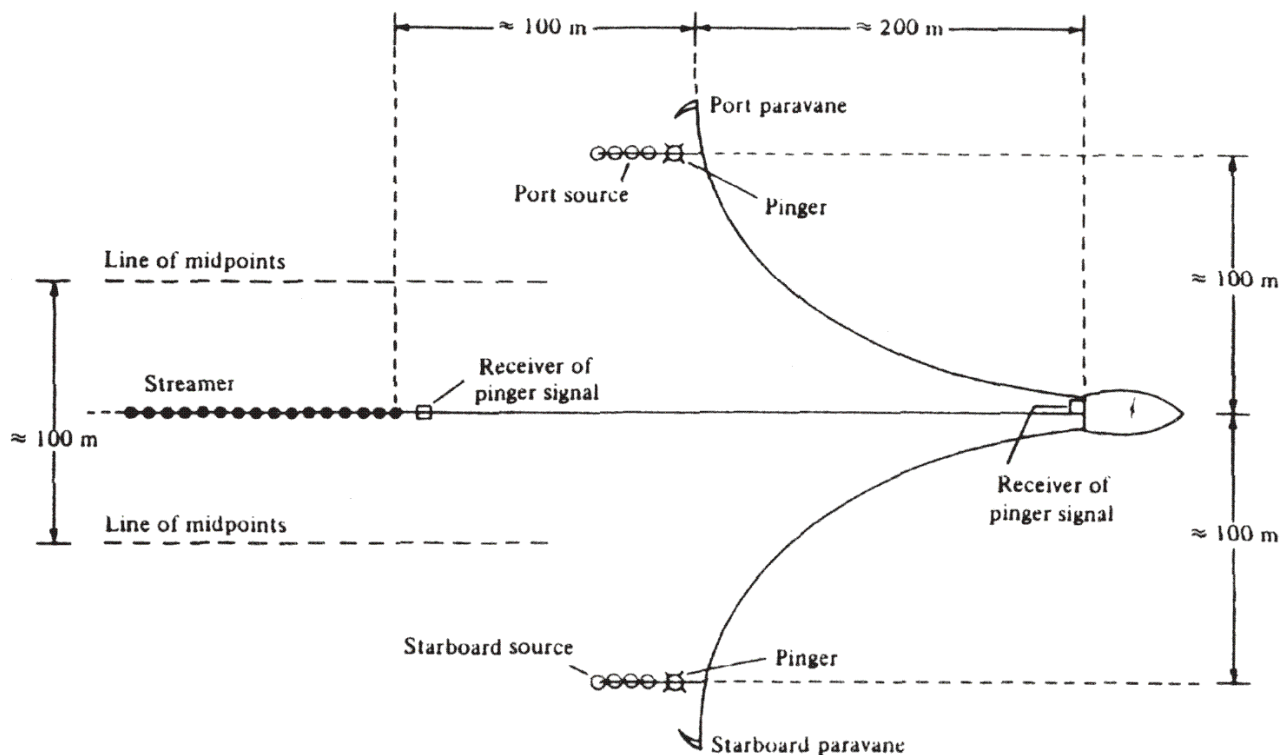
# Marine 3-D acquisition

- Marine 3-D data are generally acquired using a boat towing a hydrophone array (*streamer*) and an array of air guns.
- The boat traverses the area back and forth:
- Shot/receiver lines are oriented parallel to the structural dip direction (why?).



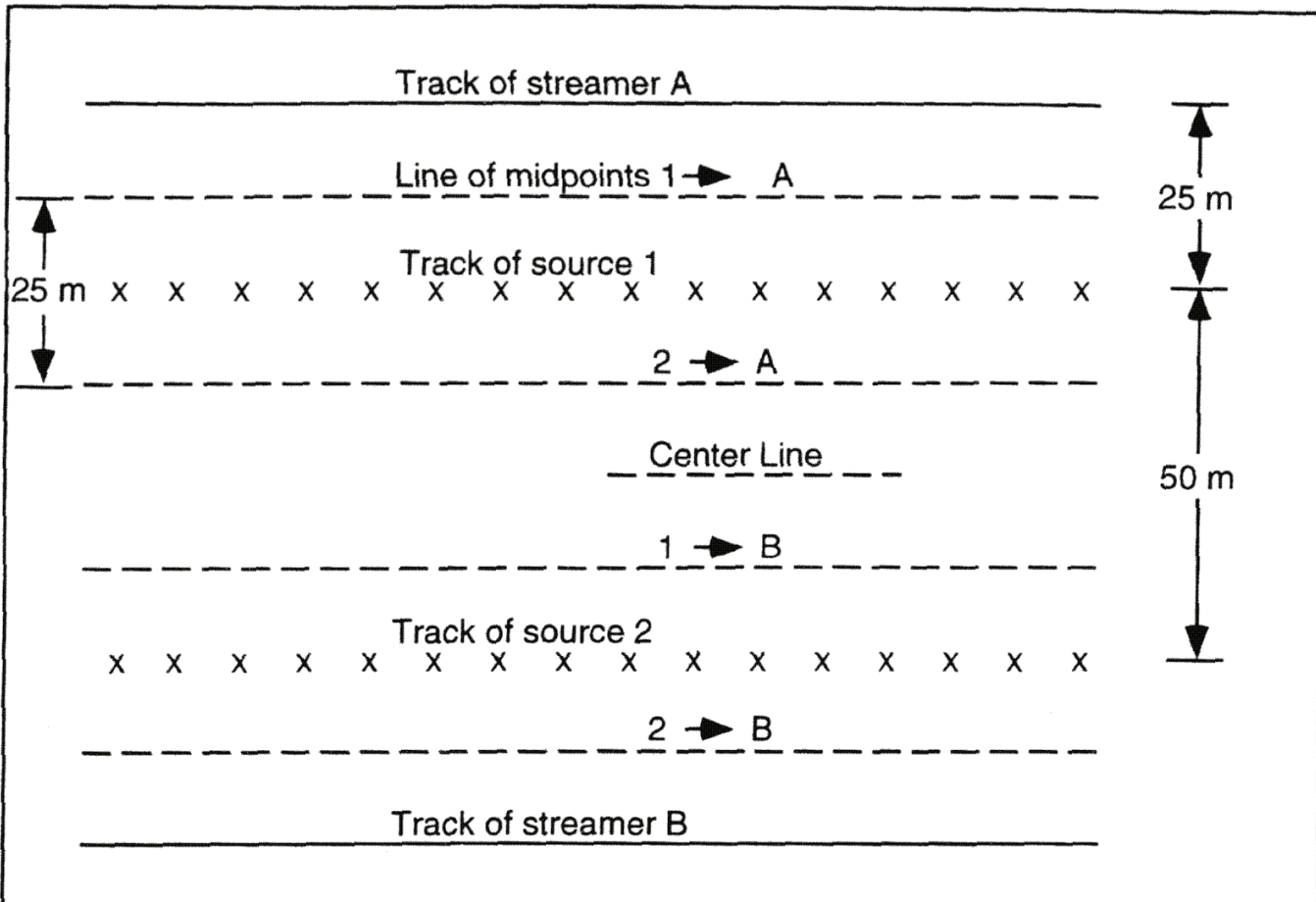
# Marine 3-D acquisition

- To save on the ship costs, several (up to 6) parallel streamers can be towed by one ship.
- Or, two source arrays firing alternately could create two lines of midpoints in one pass:



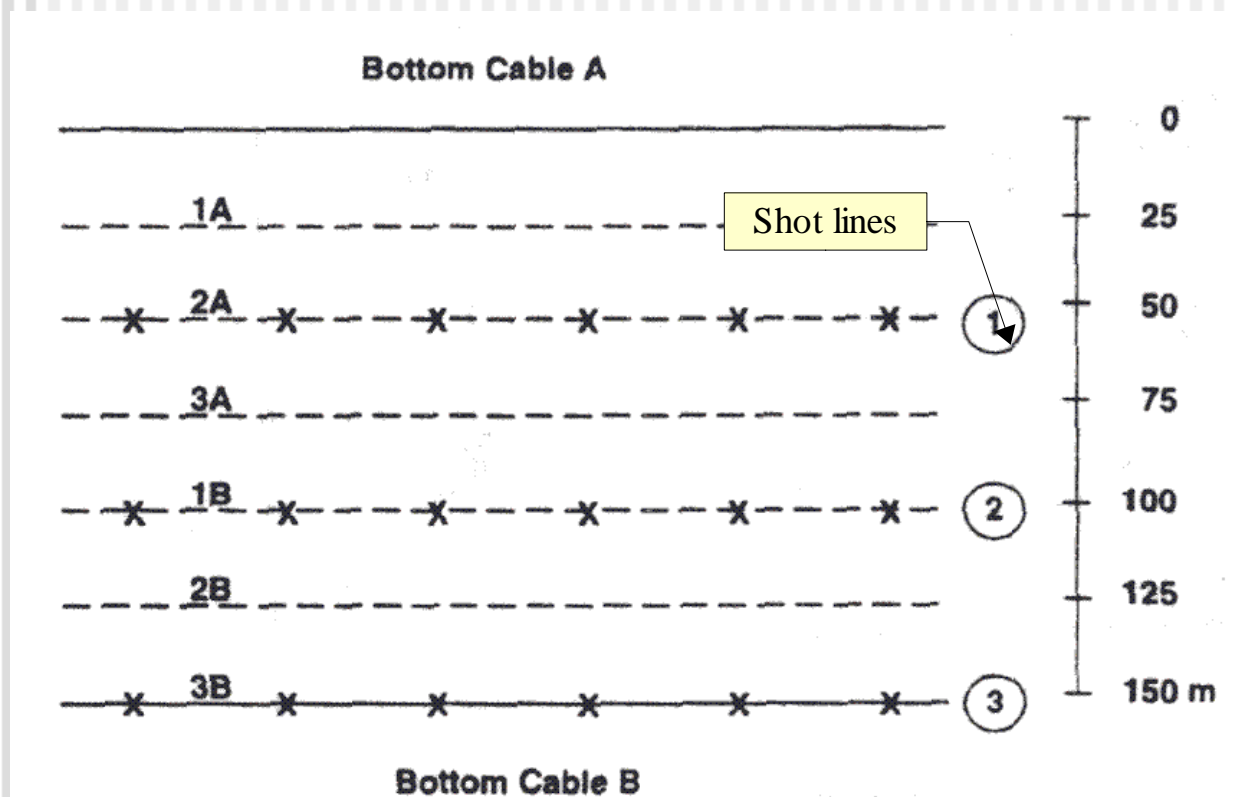
# Marine 3-D acquisition

- Typical geometry with two source arrays and two streamers:



# Marine swath shooting

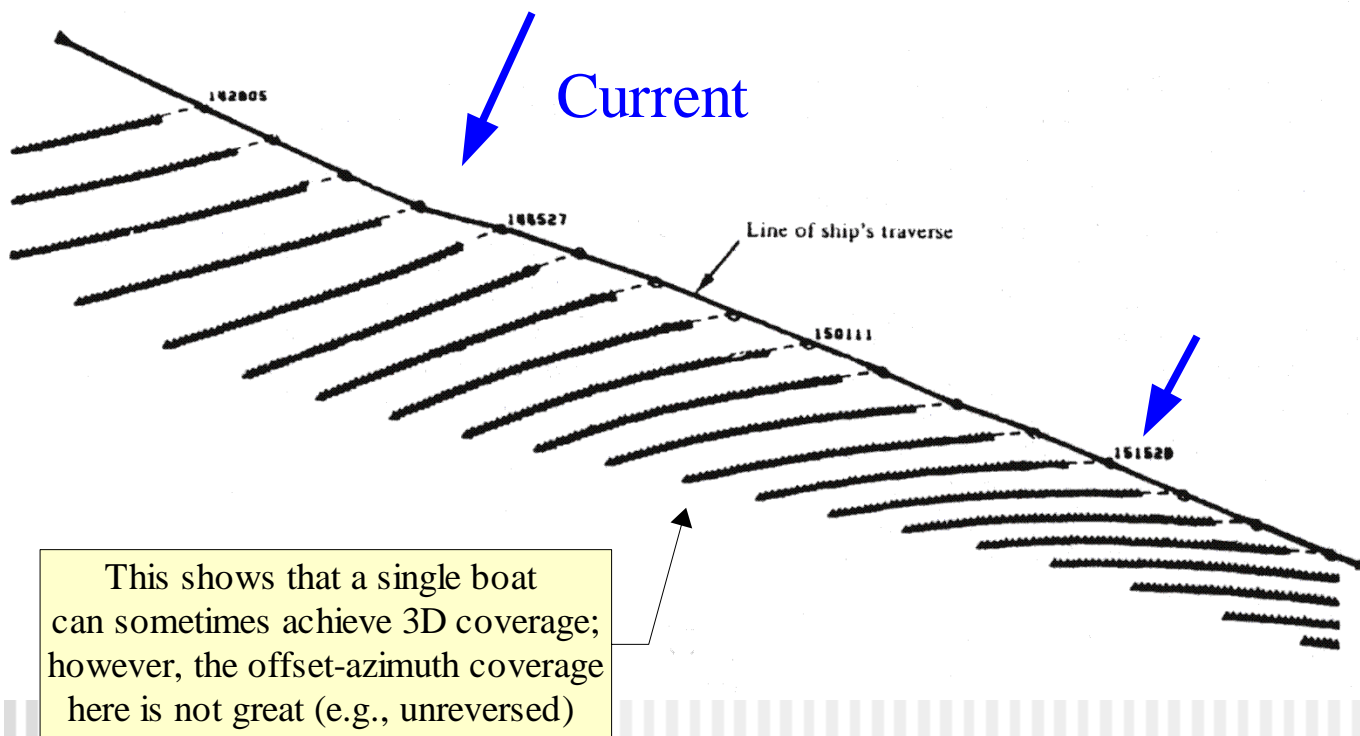
- In shallow water where streamers cannot be towed, bottom hydrophone cables can be deployed in *swaths*.
- A source boat will move along, across, or zigzag between the cables to cover 3D volume.



Note that this particular pattern gives good in-line but poor offset-azimuthal coverage

# Streamer feathering

- Due to cross-current, the streamers and sources often deviate away from the track.
  - This shifts the actual reflection midpoints and creates uneven fold.
- Therefore, *accurate positioning* of all components is critical.





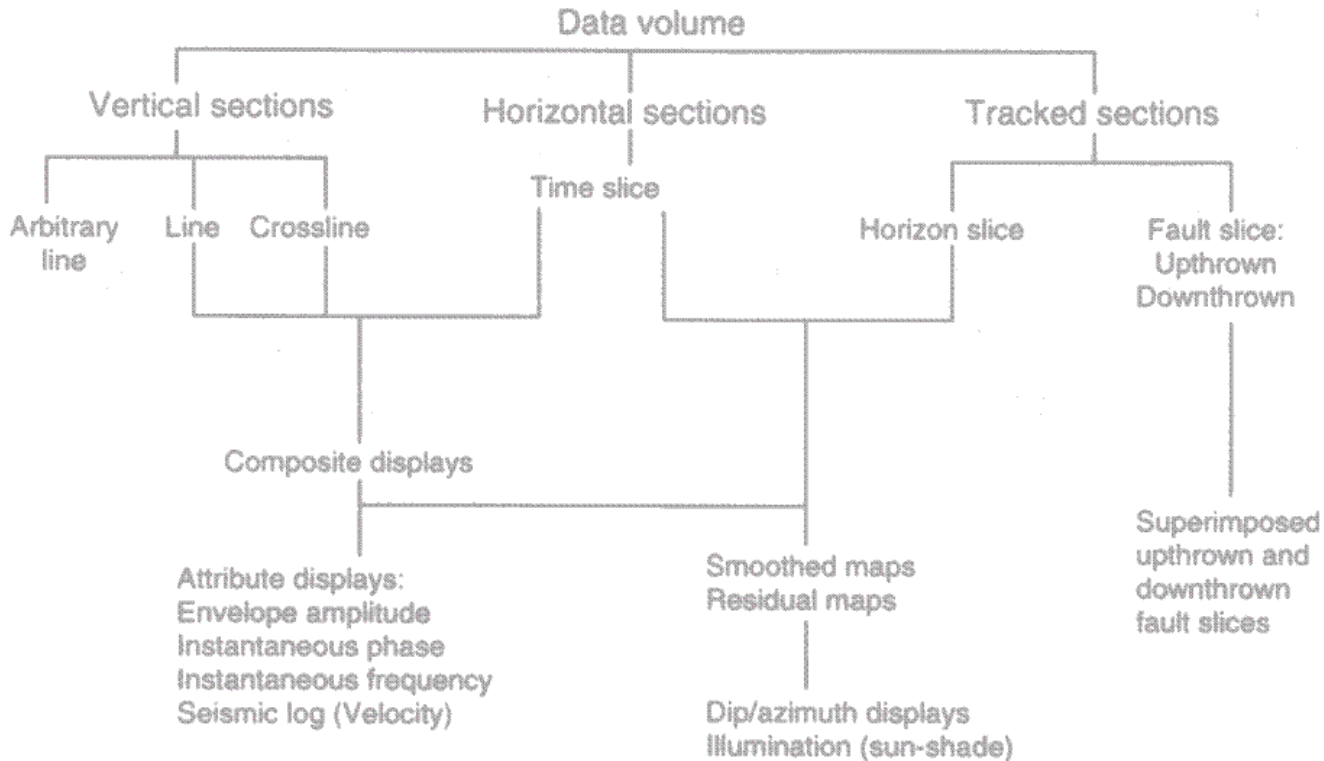
# Positioning

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- GPS and radio trilateration of the ship (to ~10-m accuracy)
  - Sometimes anchored *pingers* are also used to locate the survey within an area.
- *Pingers* (tuned acoustic pulse devices) are used to trilaterate the mutual positions of the ship, sources, and streamers.
- Feathering direction is controlled with compasses installed in the streamer.
- This results in *great redundancy* of navigation data.
  - This redundancy is utilized in data reduction using the ideas of the Generalized Inverse...

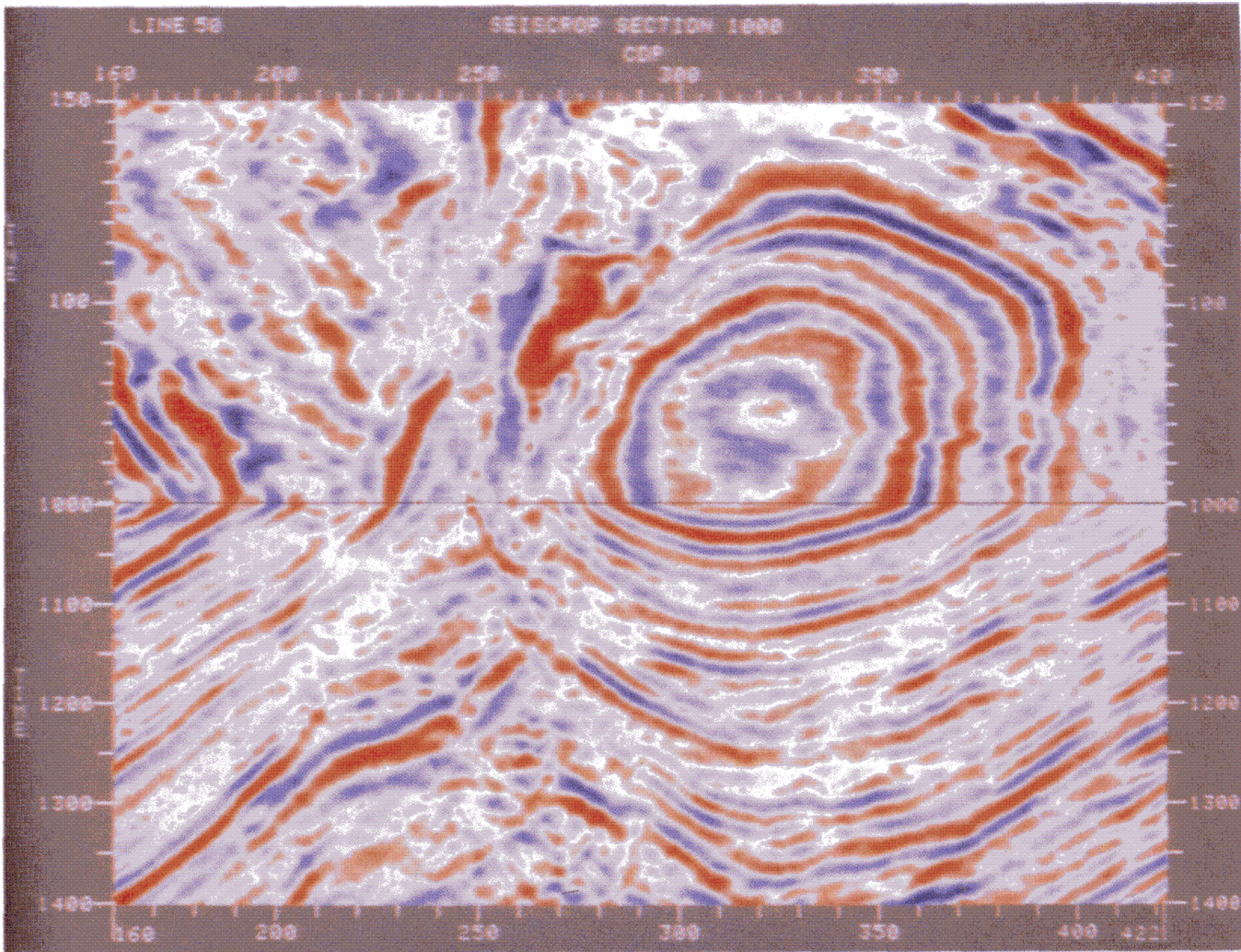
# 3D data displays

- A variety of geometrical types
- Attributes (amplitudes, their gradients, phases, acoustic impedance, porosity, directions, statistics)
- Colour (continuous or discontinuous palettes to highlight gradational character or contrasts)
- Interactive analysis using workstations

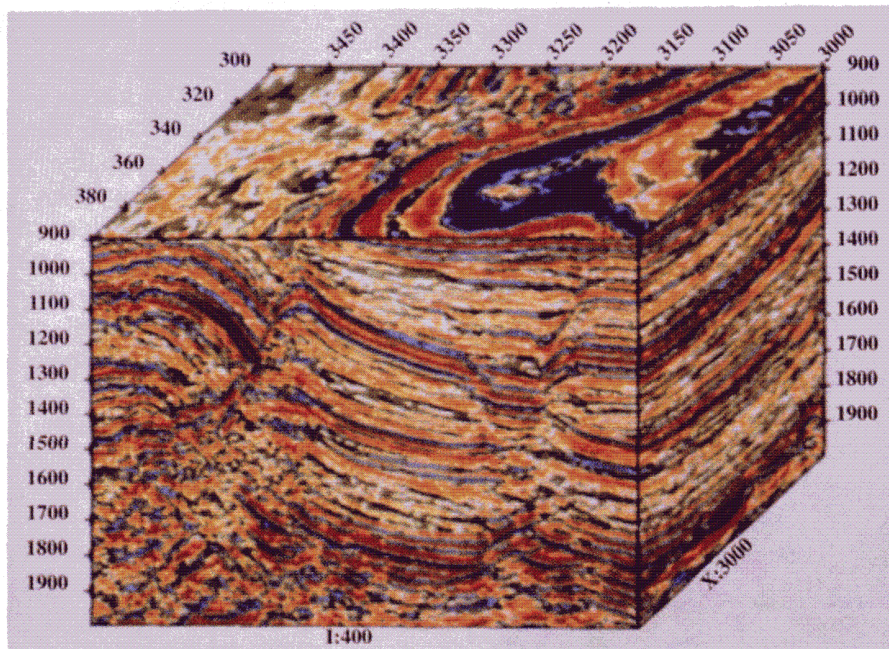


# 3D displays (Sheriff and Geldart, plate 7)

GEOL483.3

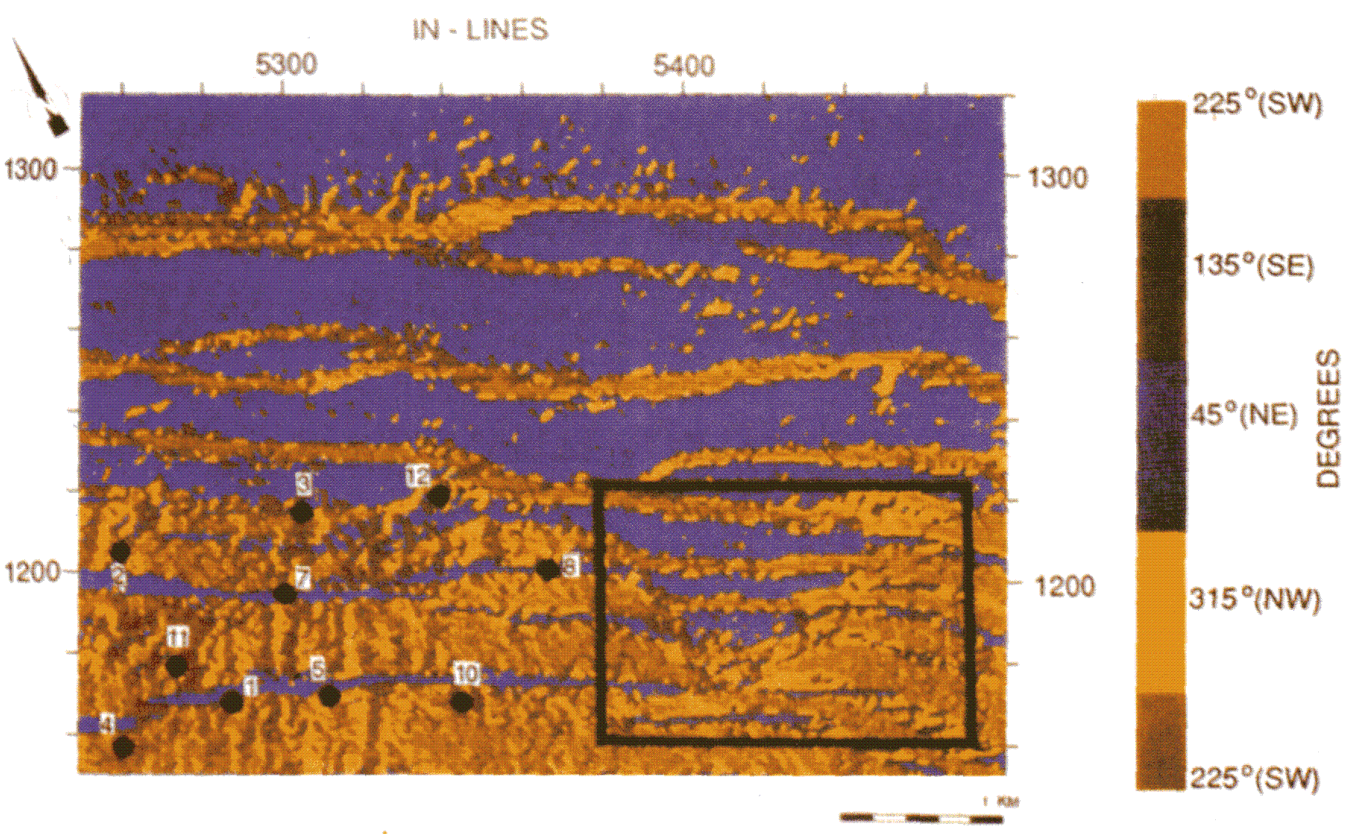
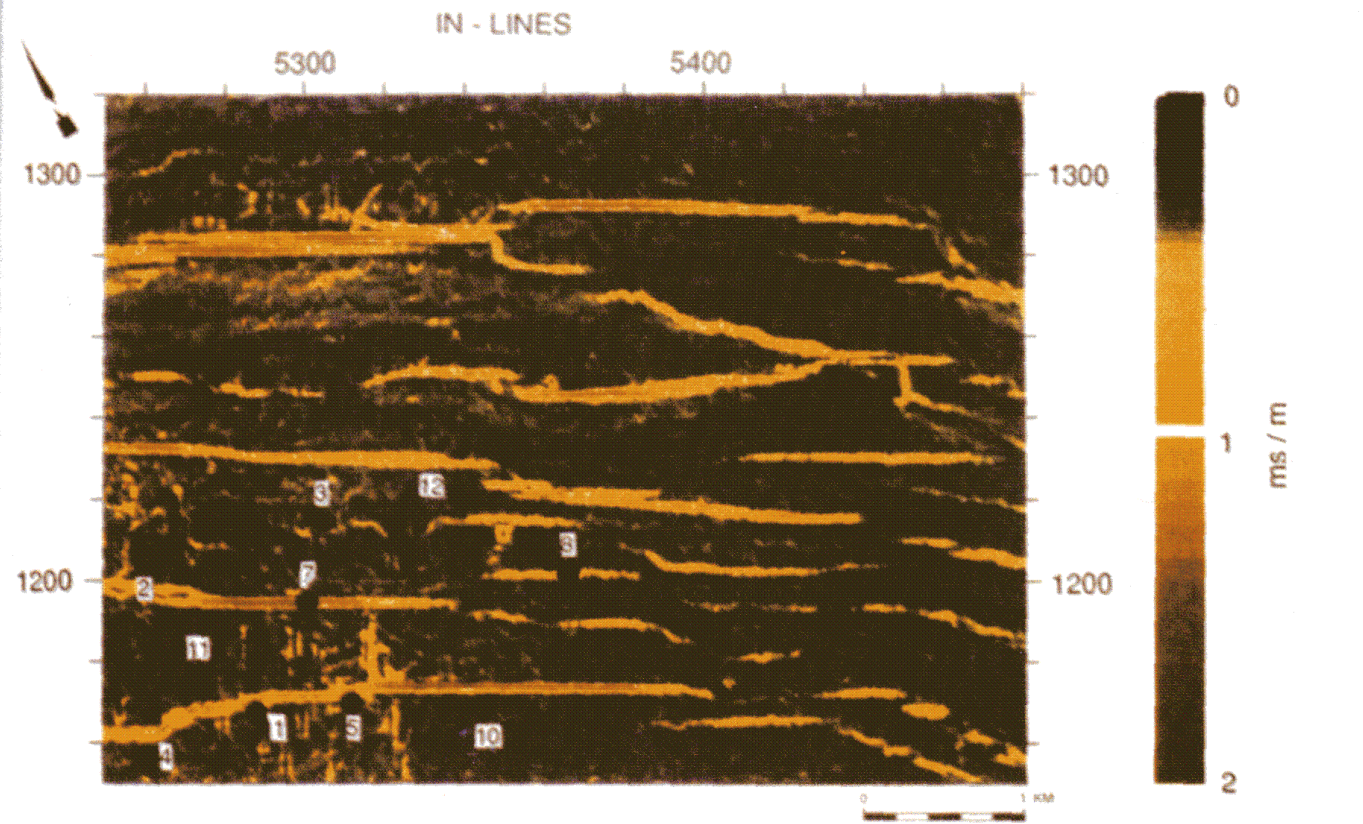


(a)



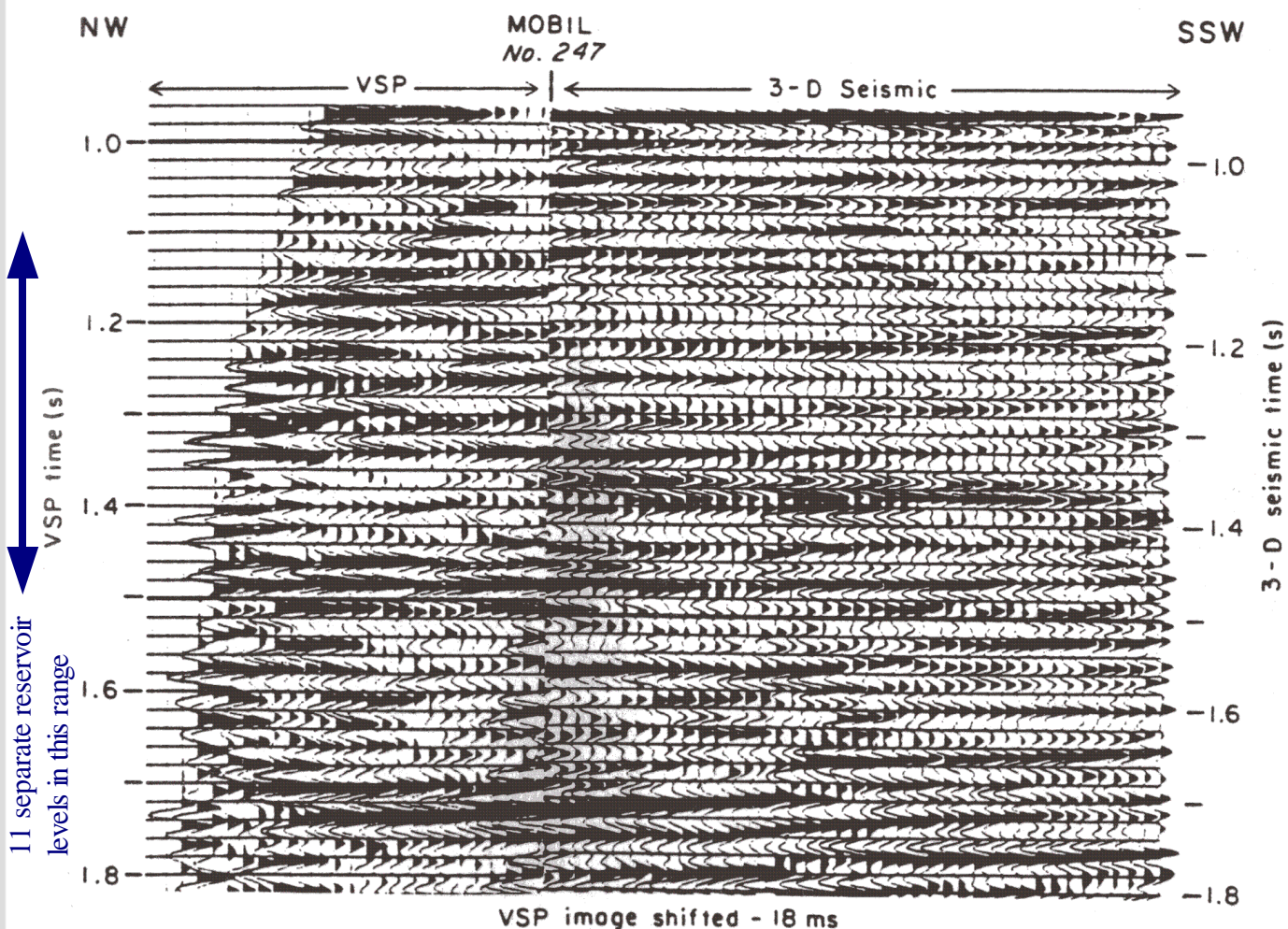
(b)

Directional attributes (Sheriff and Geldart, plate 6)



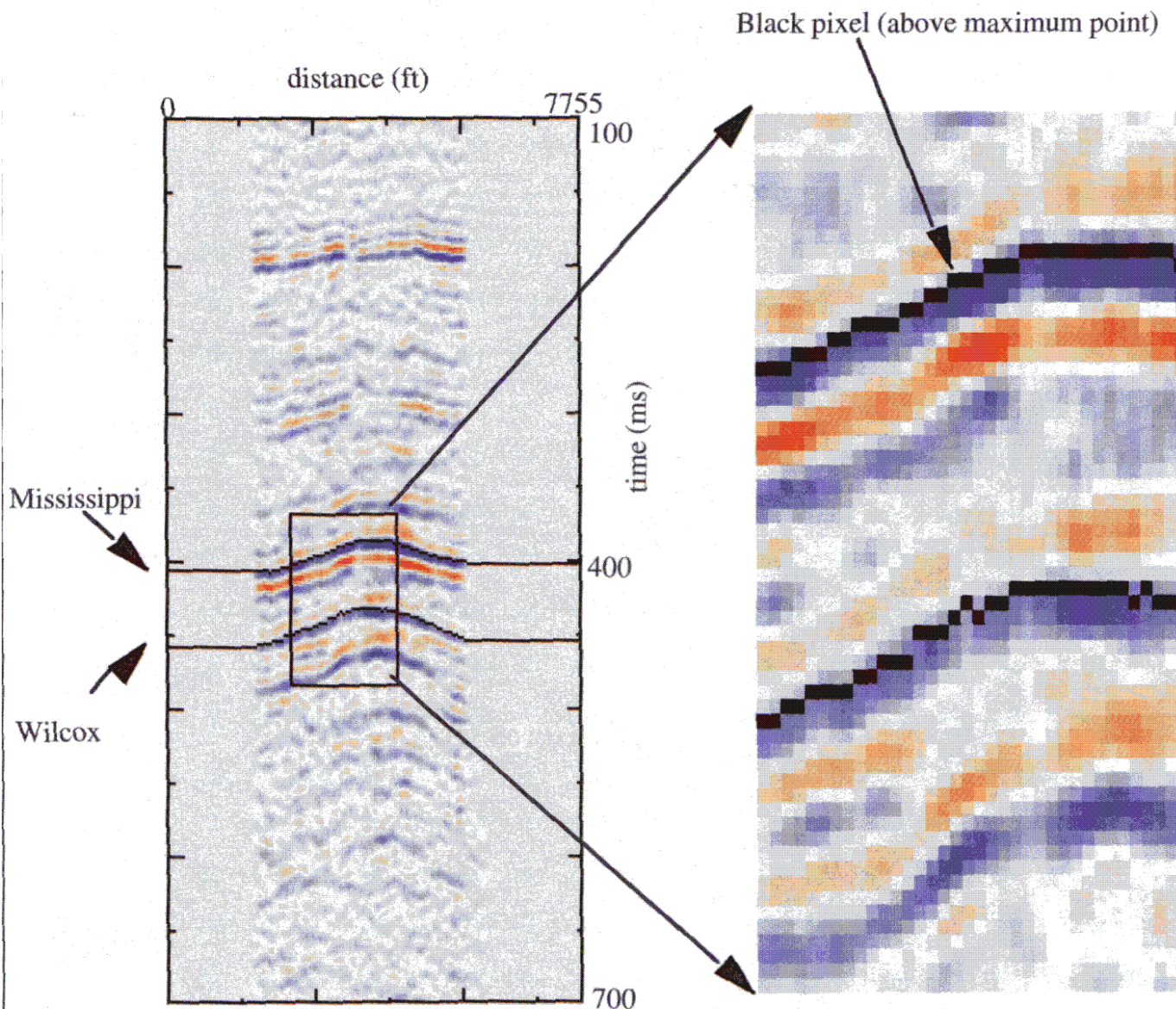
# 3D horizon tracking

- Manual ("point" or "stream") tracking
  - Good for consistent interpretation
- Automatic
  - Relies on a *zero-phase wavelet* (tracking the maximum amplitude)
  - Preferable for accurate amplitude analysis
- To identify correct reflection events, data are compared to borehole logs, synthetics, and VSPs



# 3D horizon autotracking

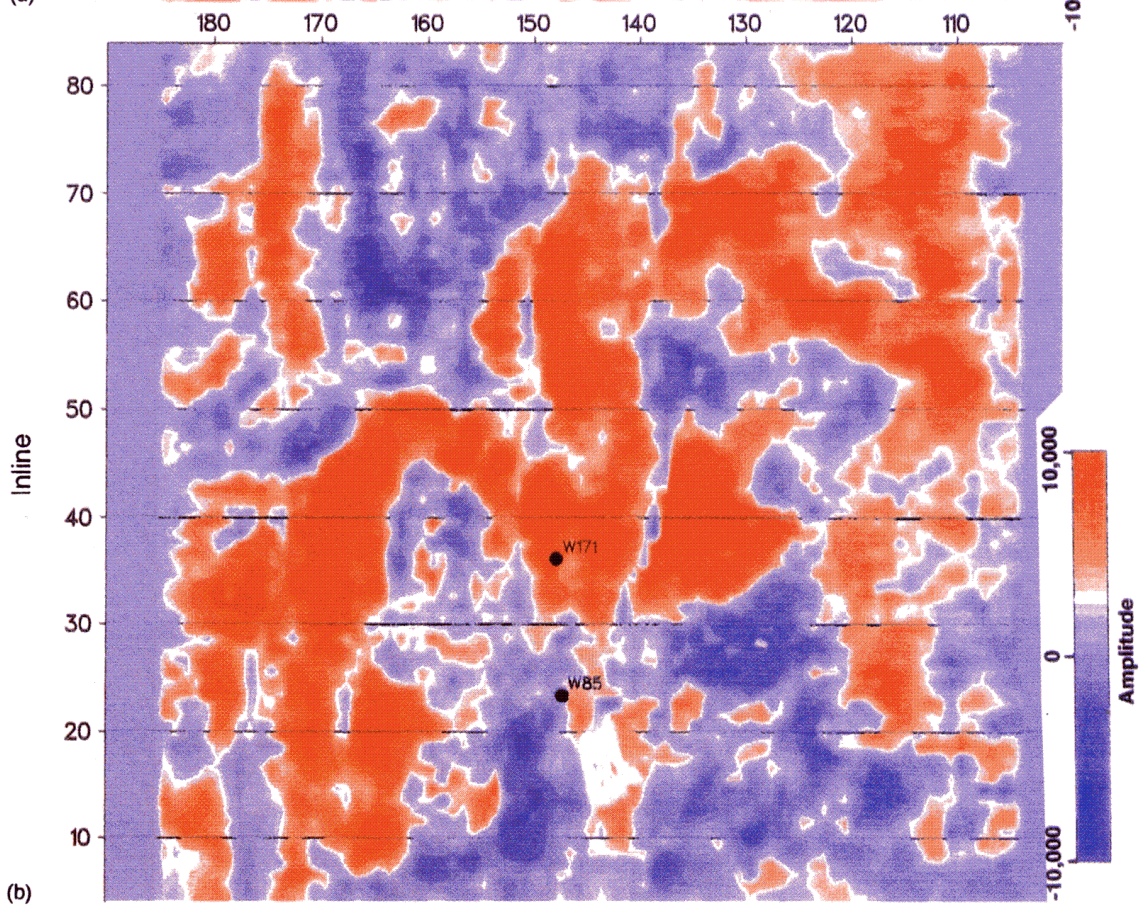
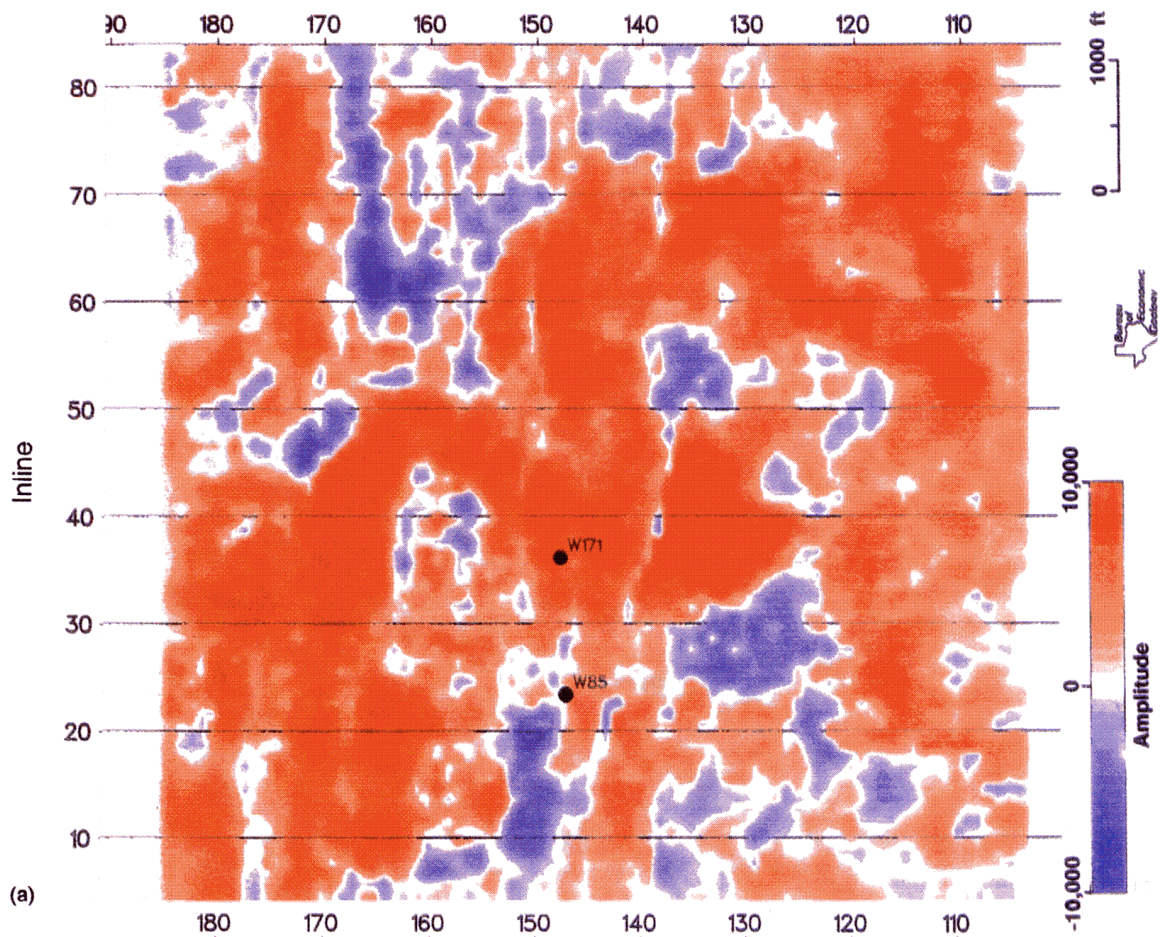
3D Auto-tracking (Cross line 71)



Height of search window :	6
Starting crossline # :	1
Starting coordinates (x,y) :	(40,150) for Mississippi
	(41,176) for Wilcox

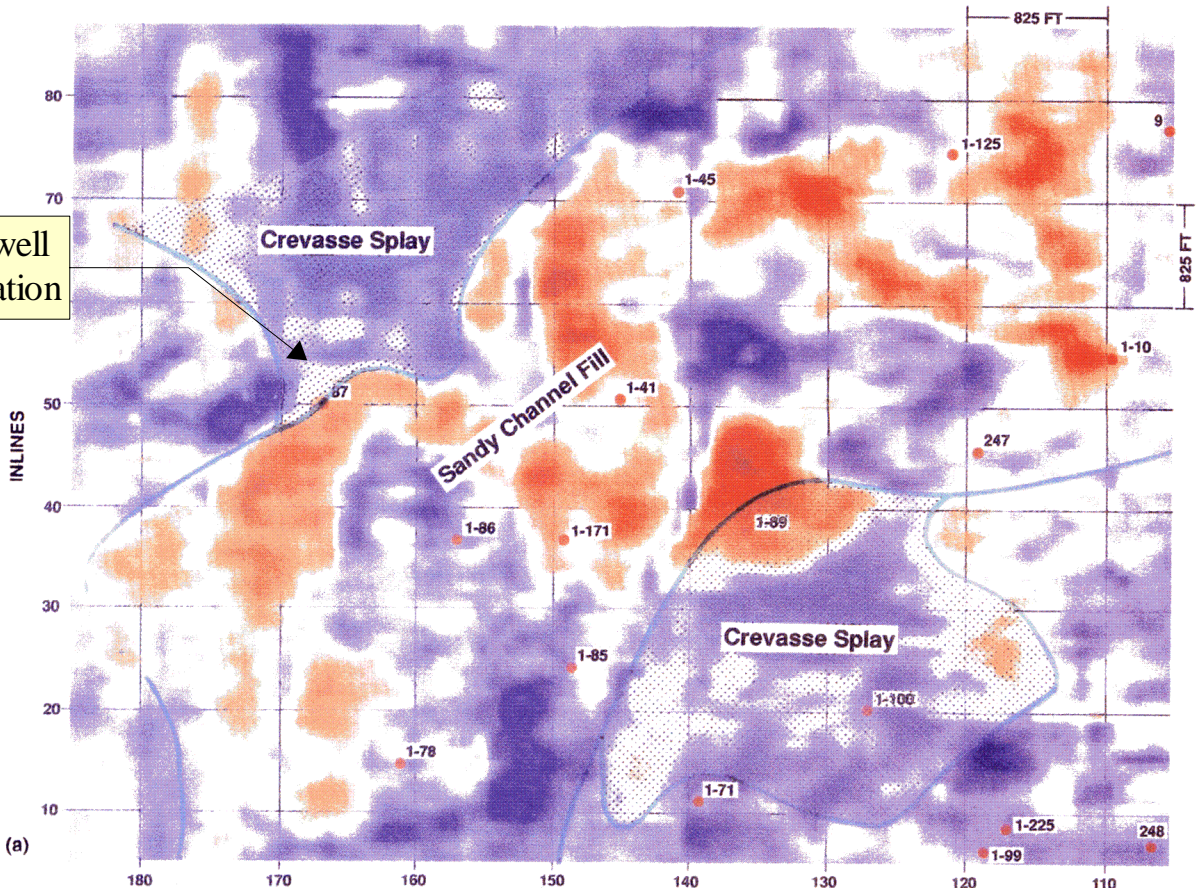
*From Liner, 1999*

# Horizon slice (Sheriff and Geldart, plate 15)

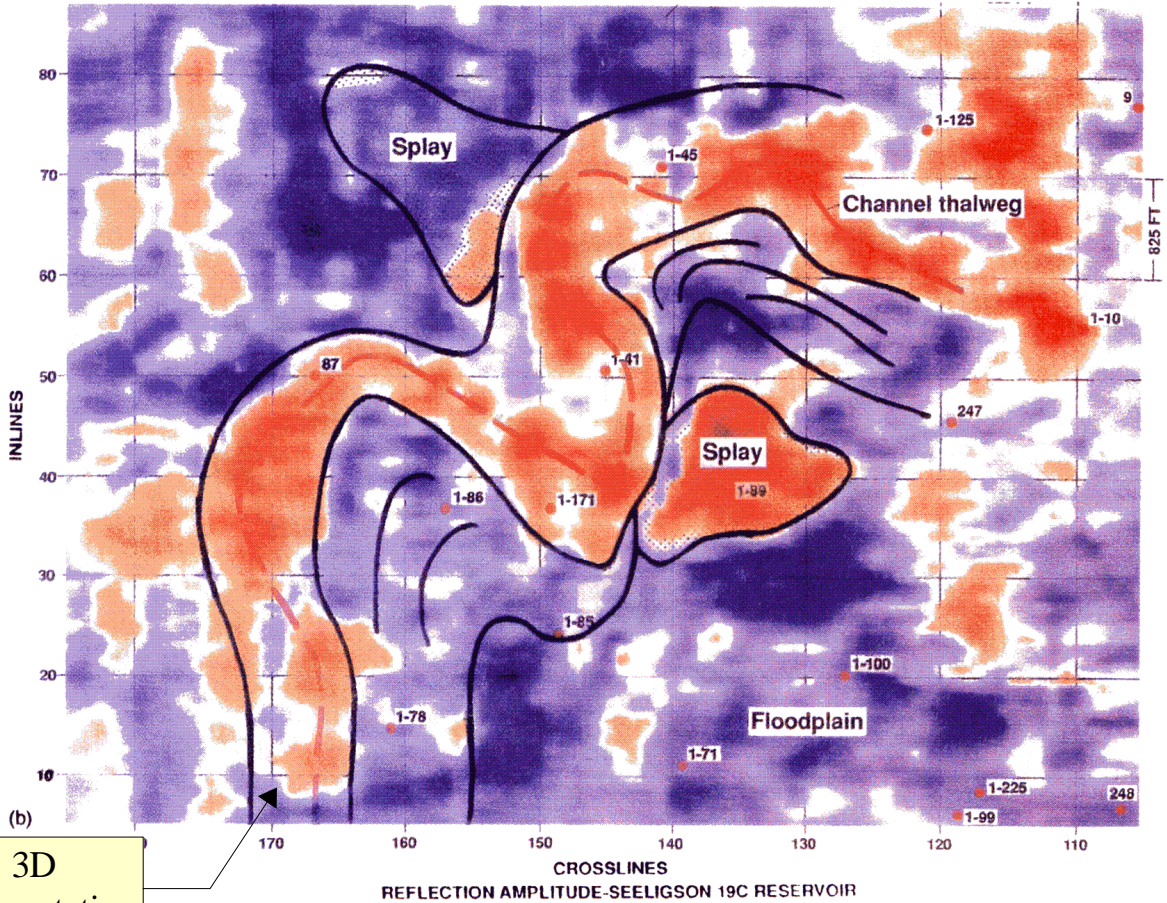


Horizon slice (Sheriff and Geldart, plate 16)

2D and well interpretation



3D interpretation



REFLECTION AMPLITUDE-SEELIGSON 19C RESERVOIR