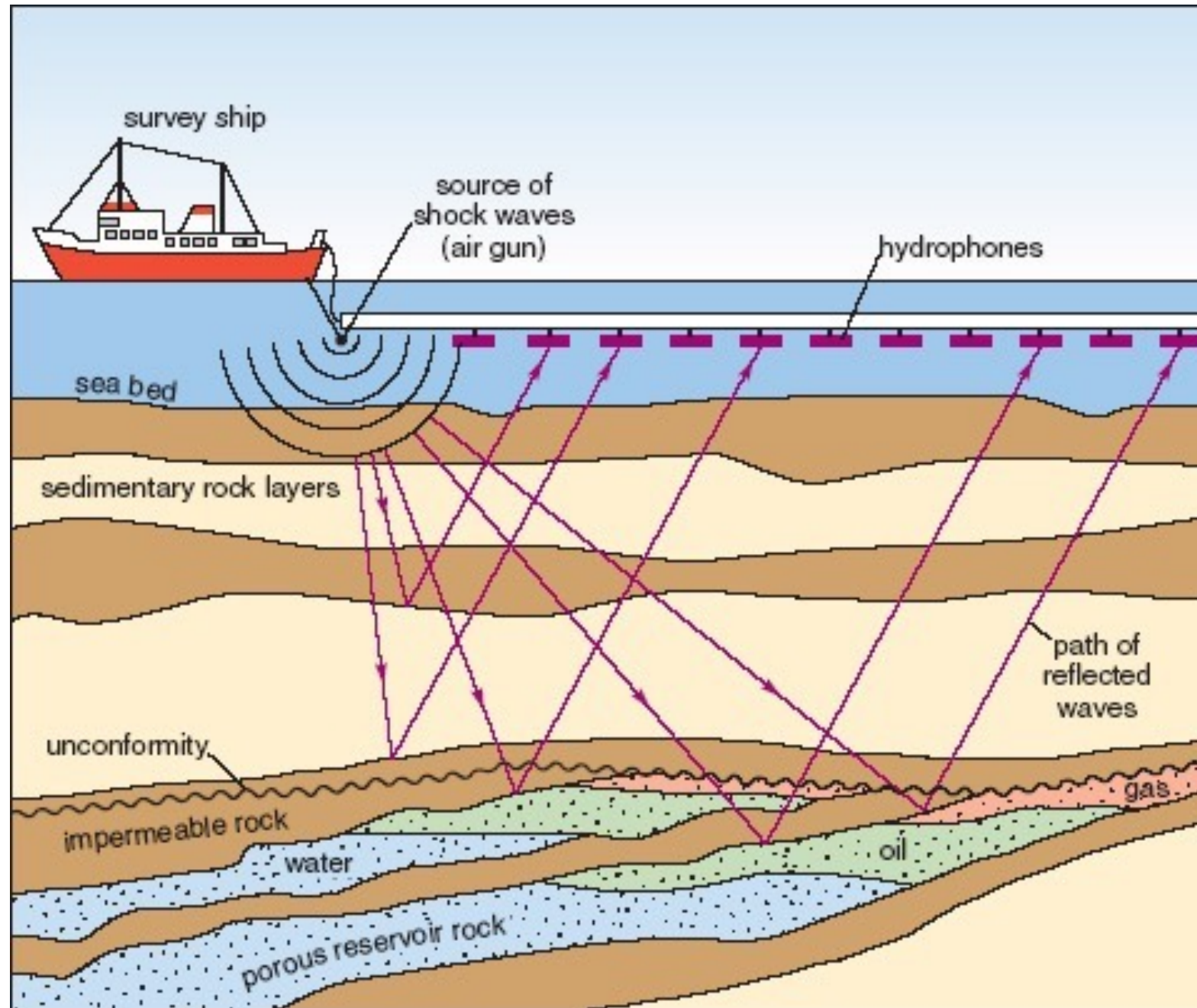


GeoPhyZViZ

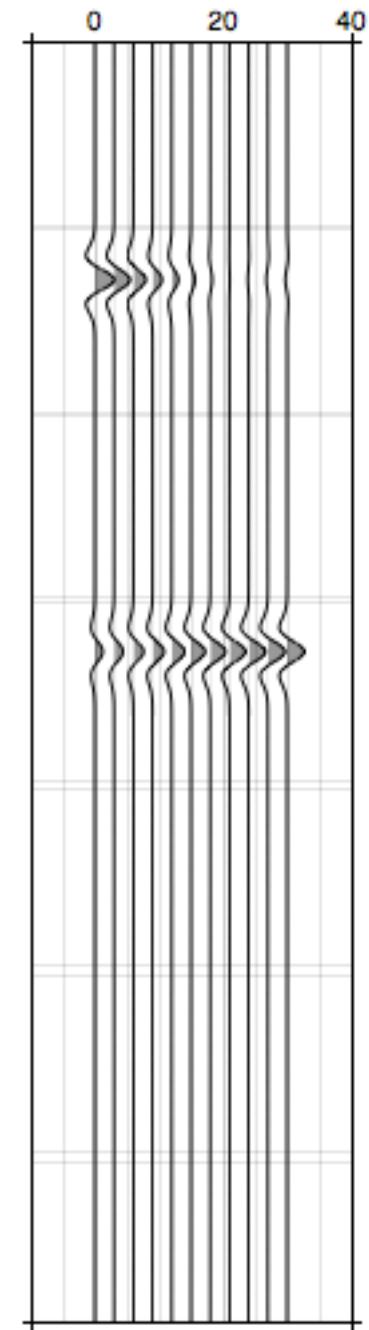
Exploration of seismic attributes

Seismic acquisition

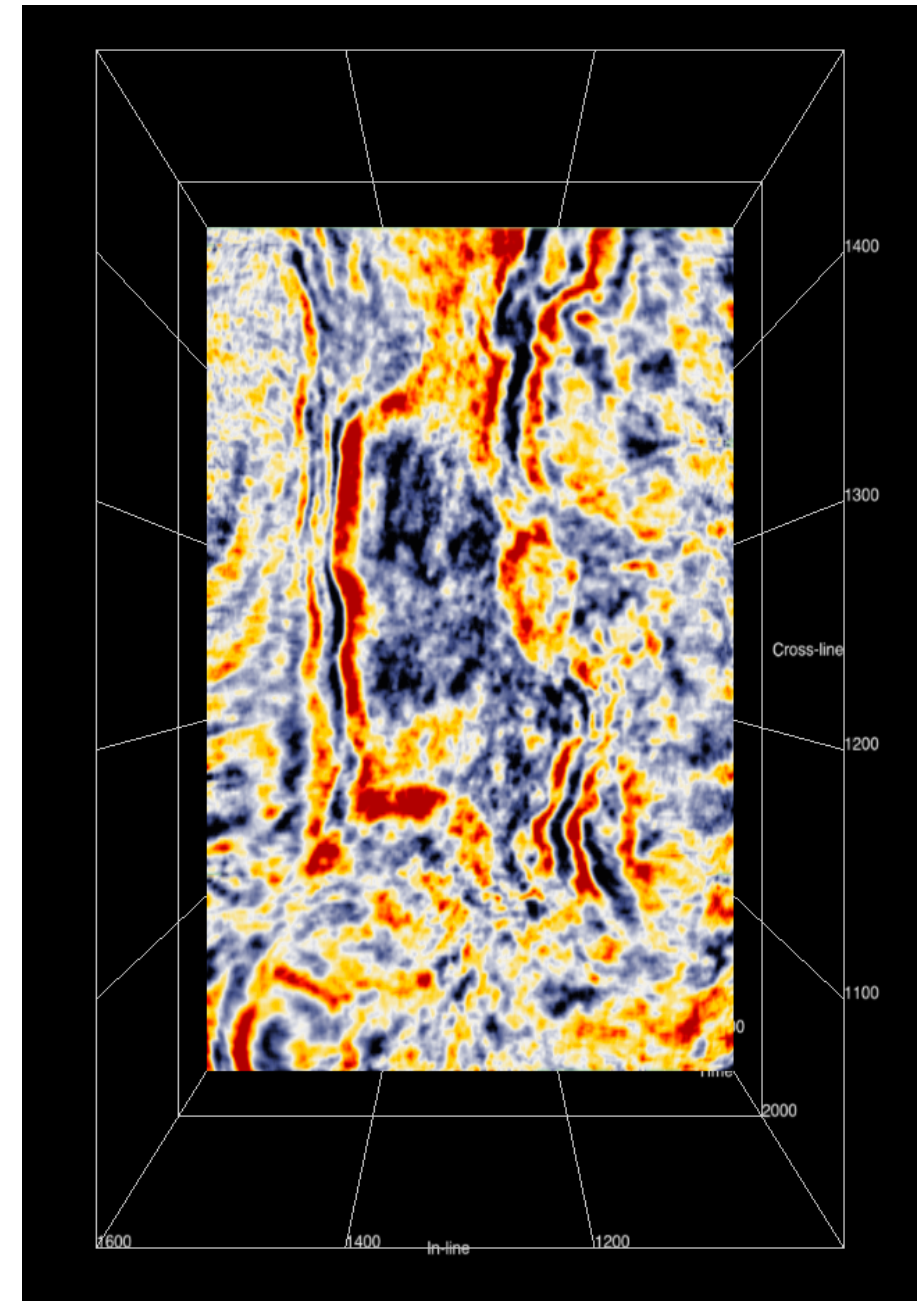
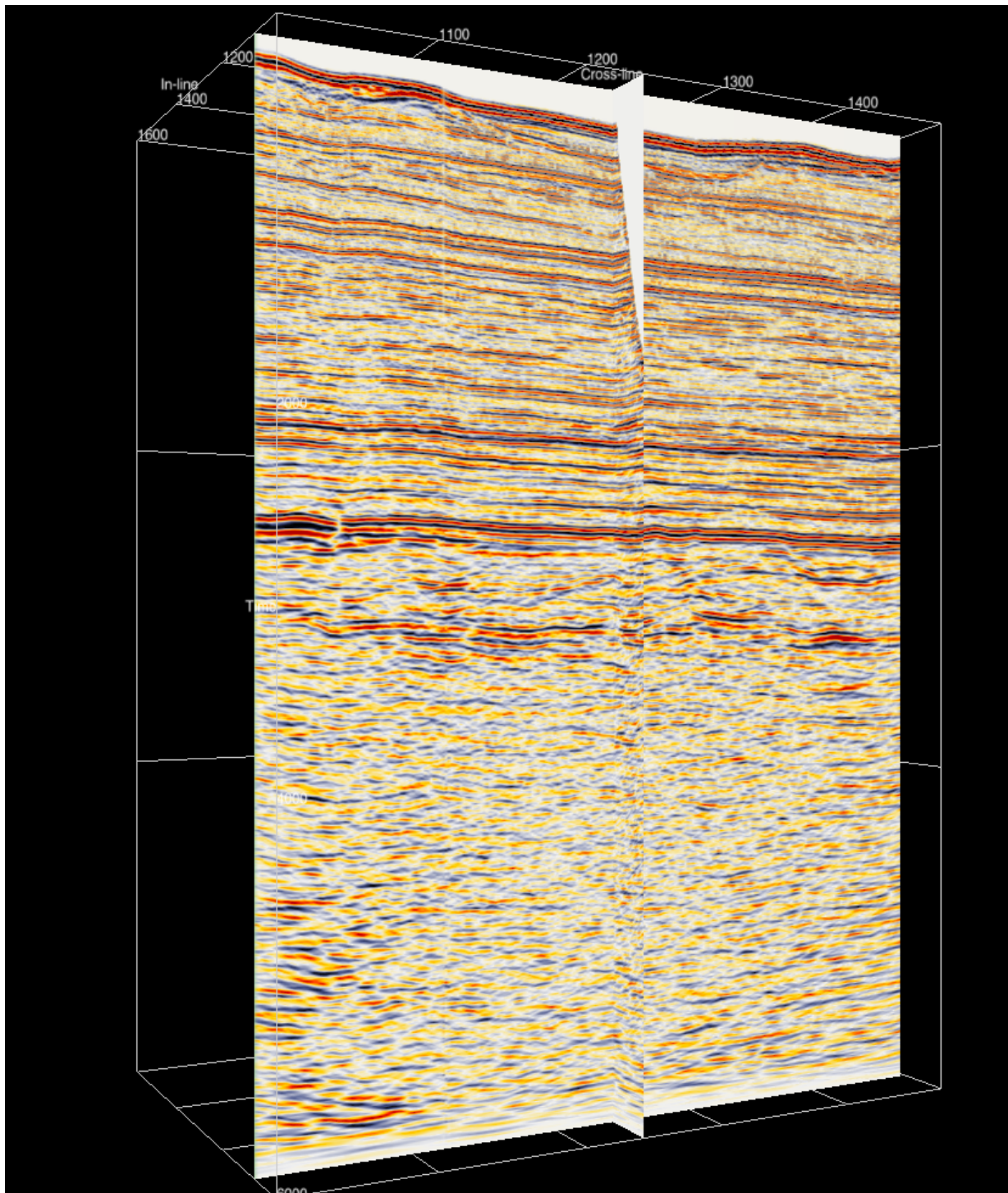


Seismic traces

- Energy reflection interfaces are recorded by receivers at the surface



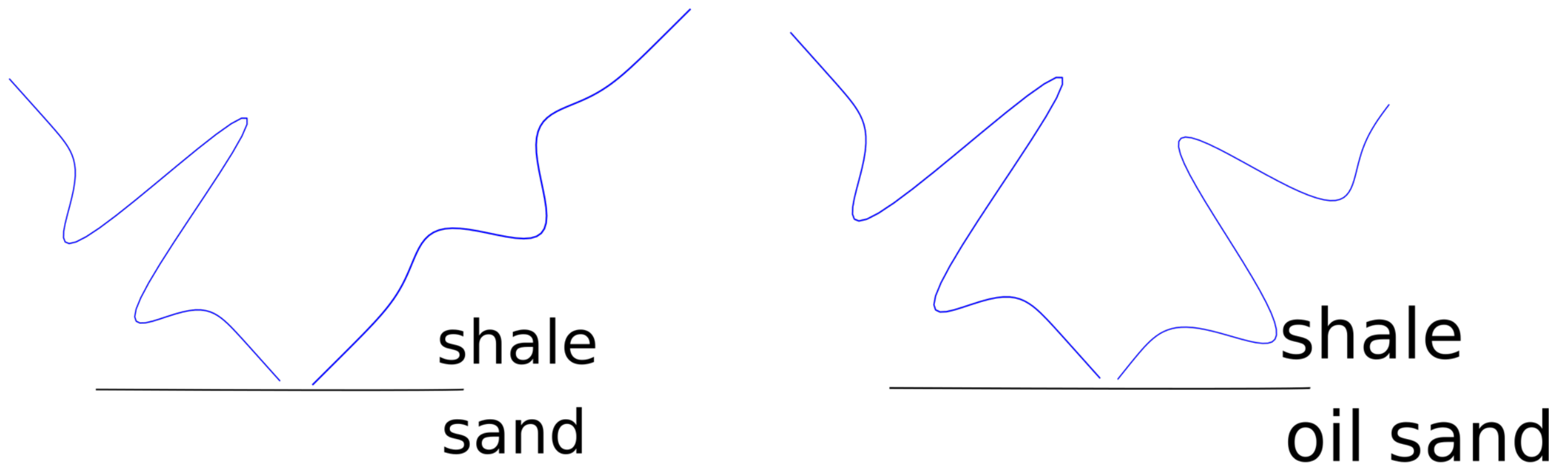
Seismic data



Seismic analysis

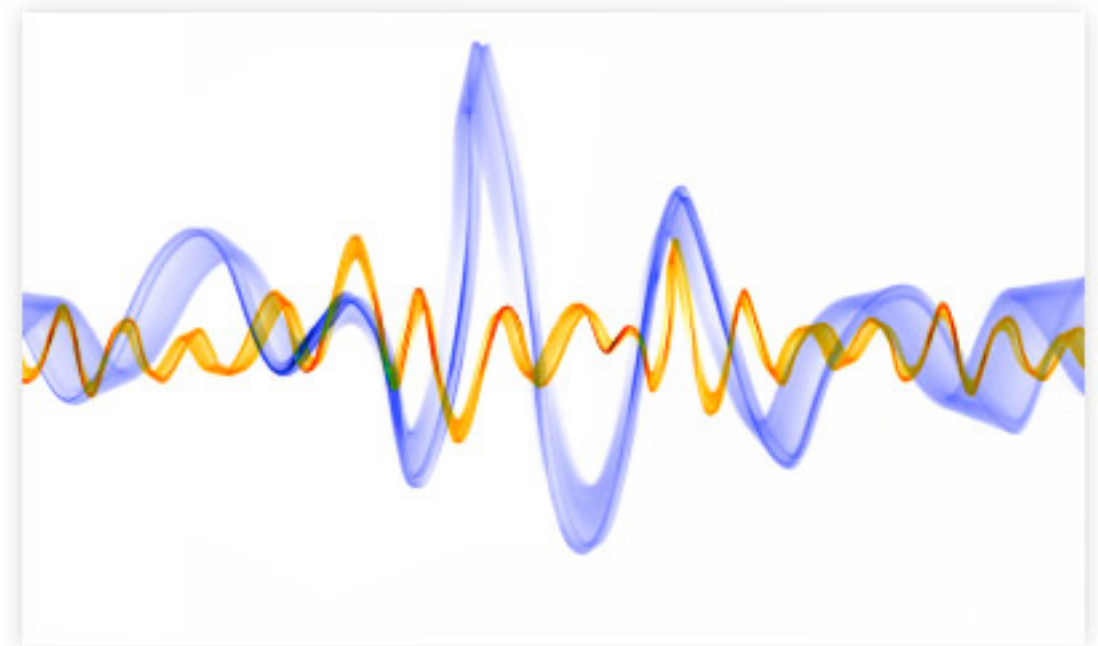
Reflected wavelet is a function of the rock properties at the reflection interface.

$$W_{ref} = f(\theta, \phi, \rho, \dots, \psi)W_{in}$$

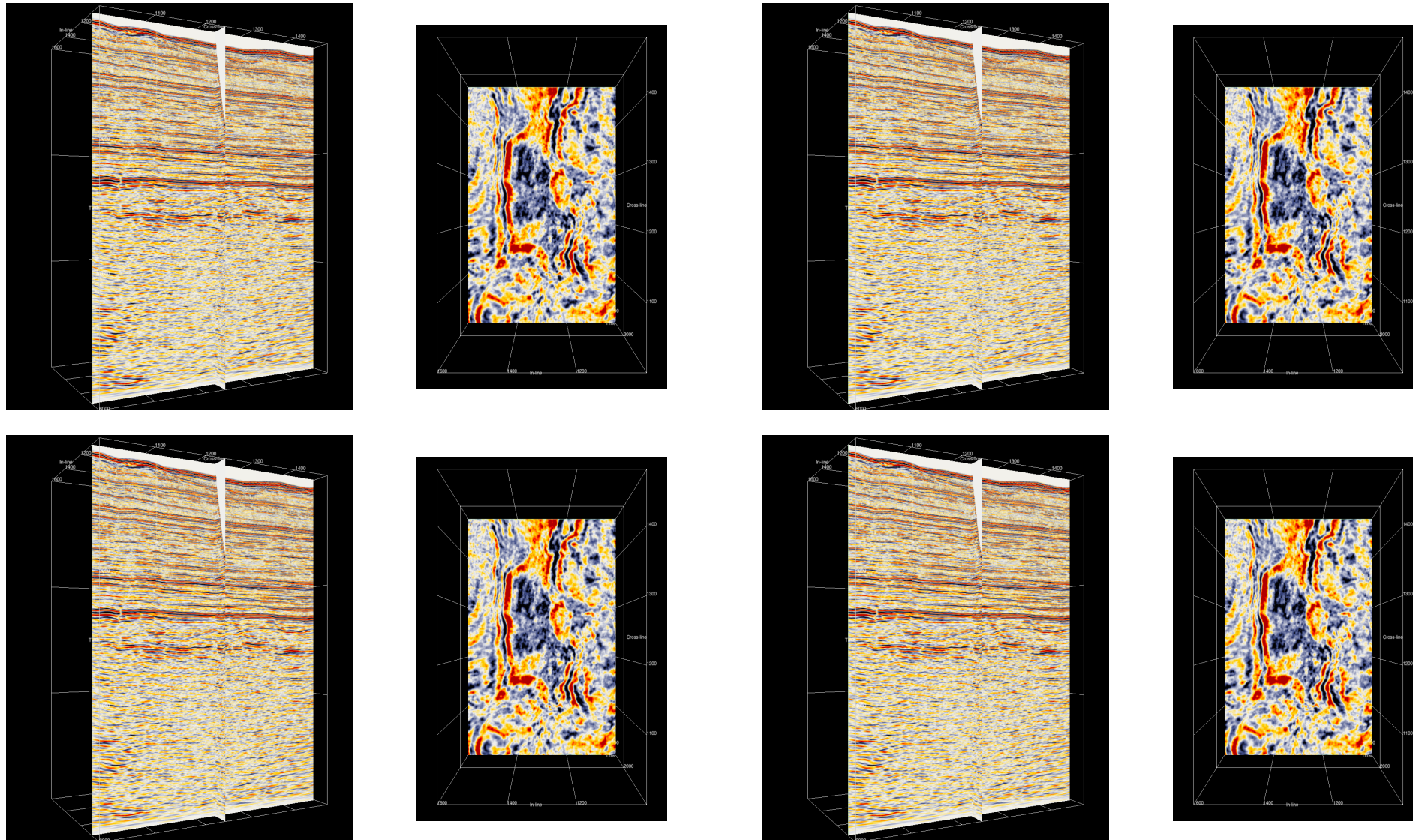


Signal analysis

- In reality, the transfer function is unknown
- Loose empirical relationships based on signal analysis
- Decompose the signal into “attributes”
- Close ties to black magic



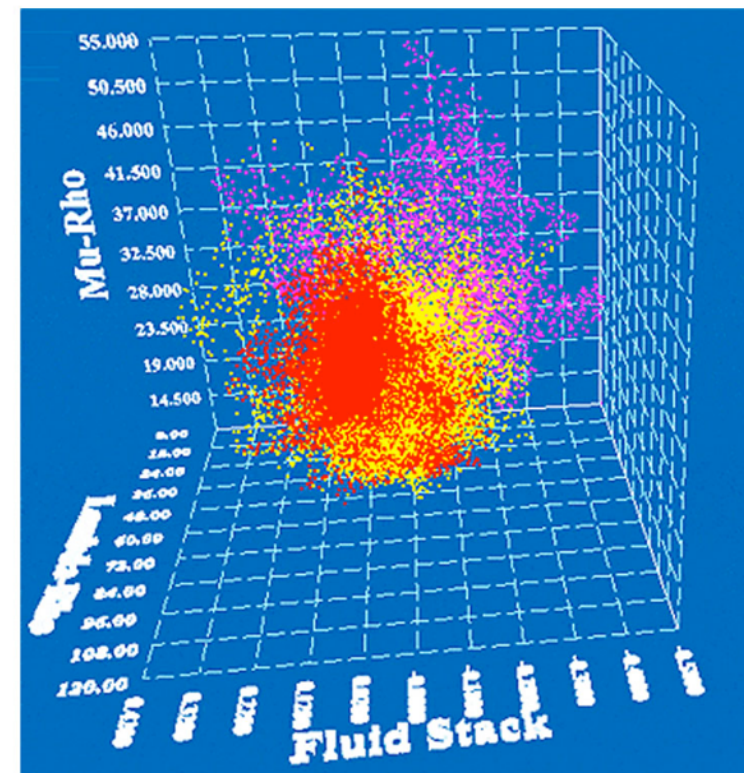
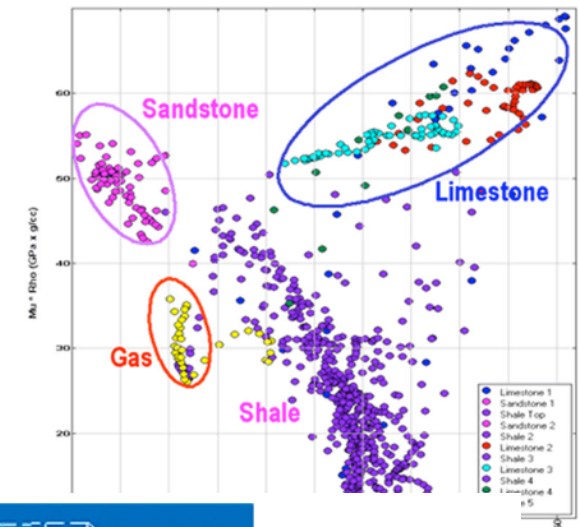
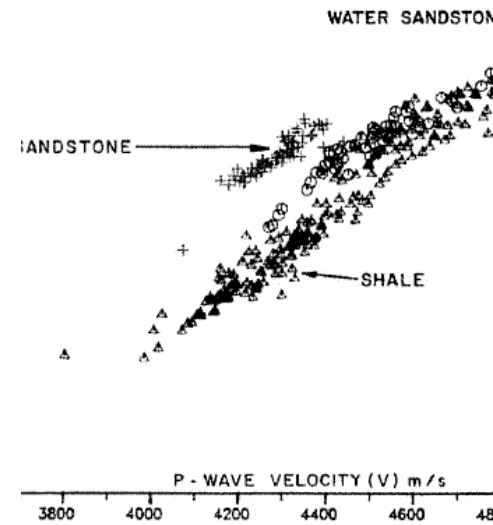
Seismic attributes



Every attribute creates another data volume
increases the dimensionality

Attribute analysis

- Crossplots: Looking for relationships between attributes
- Most reflections have similar properties, forming background trends
- Reflections from resource reservoirs are outliers



Broken workflow

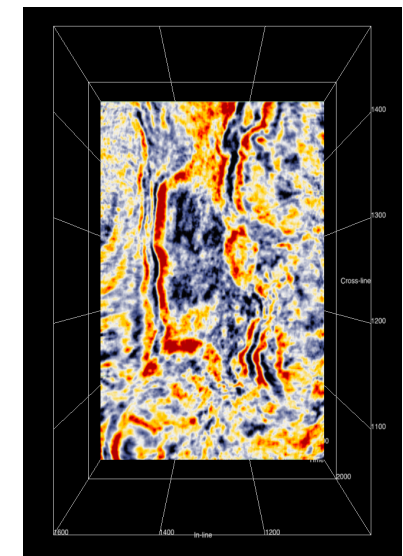
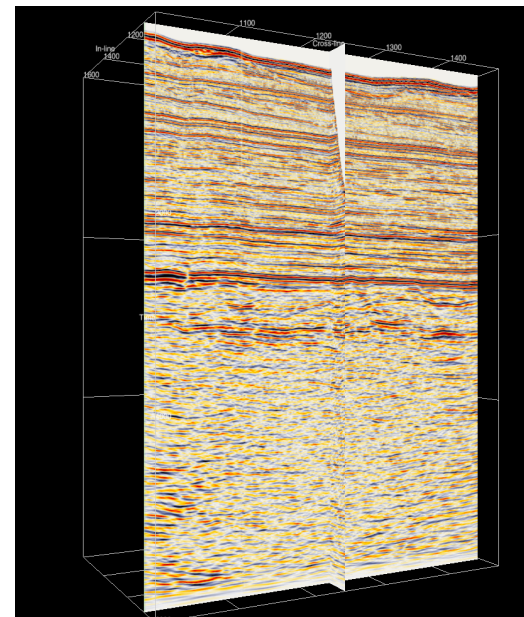
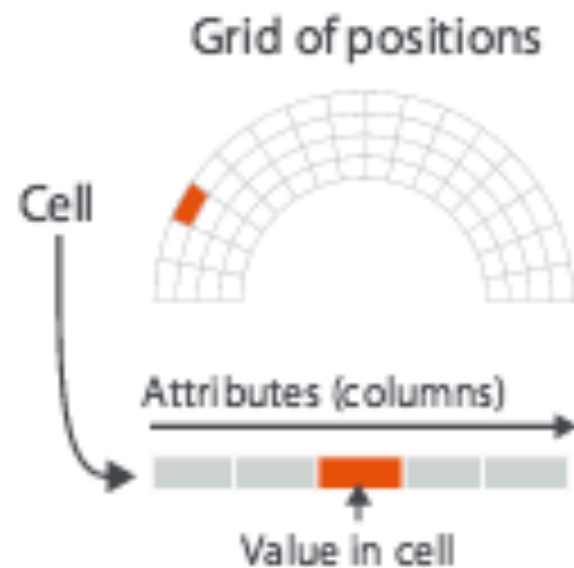
- Sometimes done using excel spreadsheets
- Using multiple software packages to hack an analysis result together
- Large information space, need interactivity to do efficient analysis
- Need linked displays in the same tool

[https://
geophyzviz.appspot.com
/](https://geophyzviz.appspot.com/)

What?

Seismic data is a **field** where each cell contains a **position** (lat, lon, depth) and **attributes** (amplitude, similarity, coherence, phase, etc..)

→ Fields (Continuous)



Why?

Actions and targets

- Discover **outliers, trends, features**



- Need to **identify** and **compare** anomalies

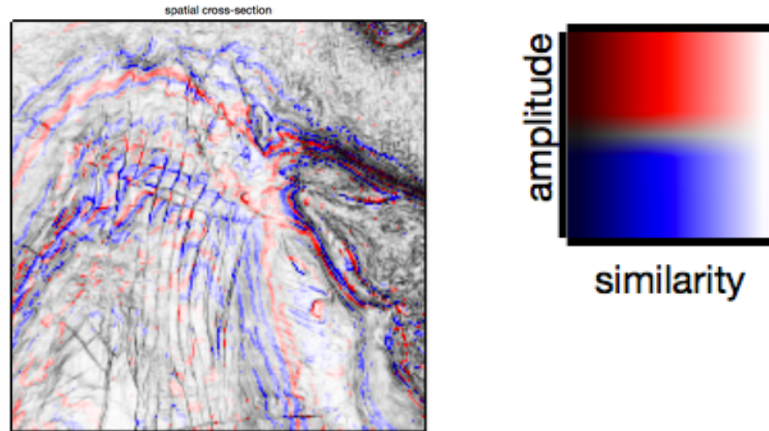


- Relate to **spatial data**

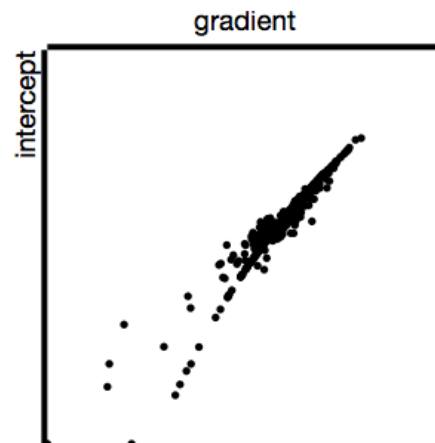


How - encode

- Field data as a heatmap, using the **colour channels** to **encode** two attributes



- Attributes as scatter plots, which uses point marks to **encode** attributes via the **spatial channel**

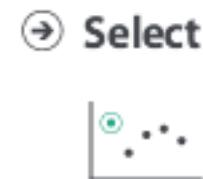


How - manipulate

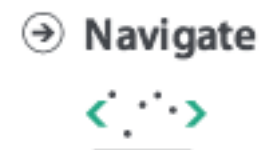
- Look for how clusters move through attribute space using **change** animations



- **Select** outliers using brushes

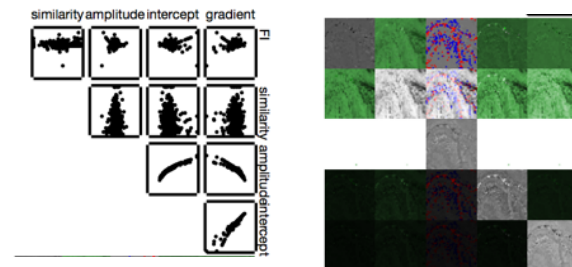


- **Navigate** views by clicking on summary plots

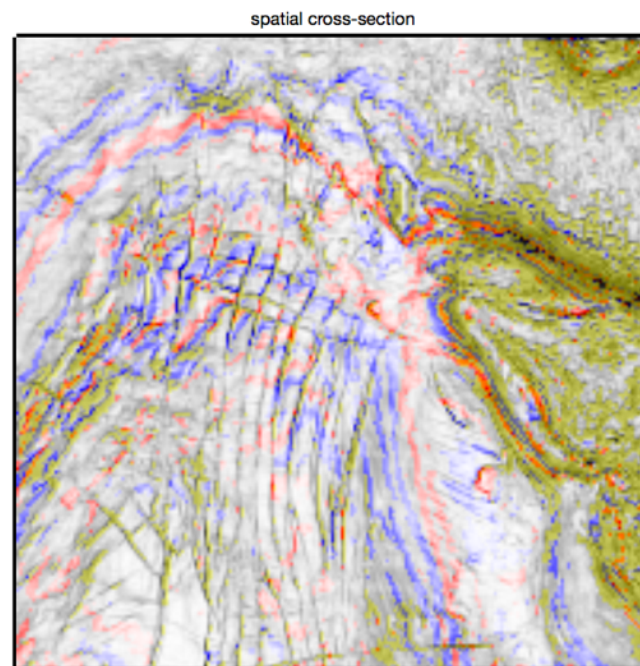


How - facet

- Small multiples to **summarize** and **juxtapose** the data



- **Superimpose** the selected anomalies on the spatial plot



[https://
geophyzviz.appspot.com
/](https://geophyzviz.appspot.com/)

Epilogue

- Optimize colour maps
- Use on larger real datasets
- How does d3 scale for massive scatter plots?
- Will interpreters find it useful?

Reference

Visualization Analysis and Design, Tamara Munzner (A K Peters Visualization Series, CRC Press, 2014)

<http://www.capefarewell.com/climate-science/the-science/seismic-profiling.html>

Successful AVO and Cross-plotting, Satinder Chopra, CSEG workshop
<http://cseg.ca/technical/view/successful-avo-and-cross-plotting>

http://wiki.seg.org/wiki/AVO_equations

<http://www.allaboutcircuits.com/technical-articles/an-introduction-to-digital-signal-processing/>