Semi-automatic interpretation of the Earth's interior

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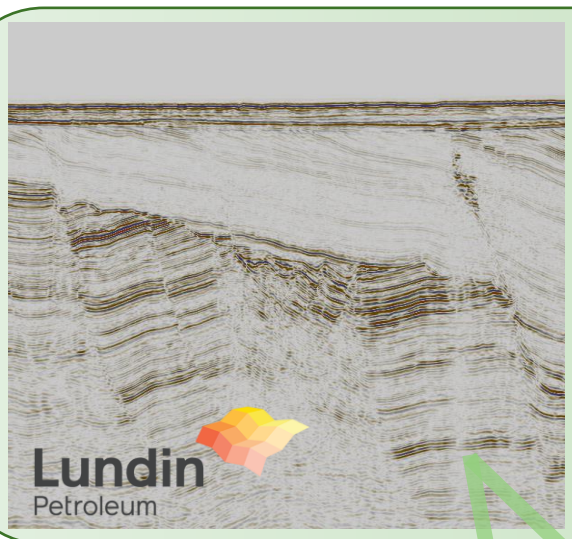
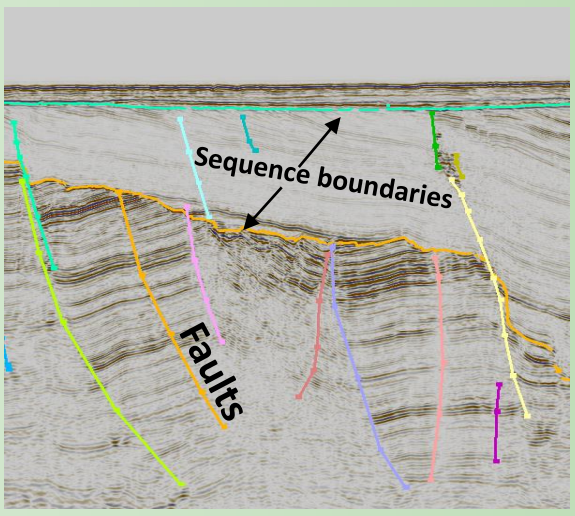
Abstract:

Different geophysical imaging techniques can be used to investigate the Earth's interior. The most common method is reflection seismology, which produces ***seismic data*** (seismic images)***.*** *Each reflector in the seismic data represents a change in seismic velocity, typically due to sharp contrasts in the rock type or density. Seismic data is today interpreted manually to give an understanding of the subsurface. This is time-consuming and often user-biased. With this PhD research, we want to investigate how the process can be automated by exploiting image processing techniques and eventually machine learning.*

1.SEISMIC DATA AND CONVENTIONAL INTERPRETATION



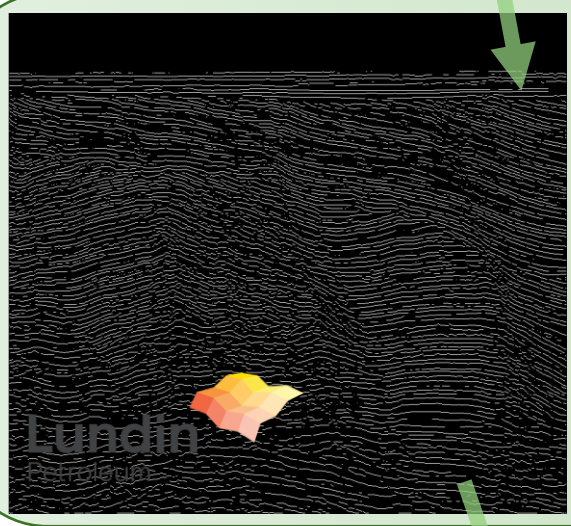


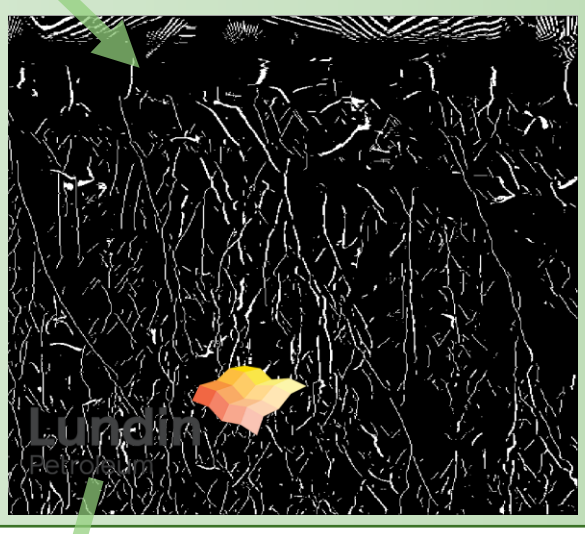
Conventional seismic interpretation is based on manual tracking of:

- **SEQUENCE BOUNDARIES:** Boundaries between seismic sequences; successions of relatively conformable reflectors.

- **FAULTS:** Discontinuities in the Earth resulting from displacement and brittle fractures in rock volumes.

2.ATTRIBUTE DATA



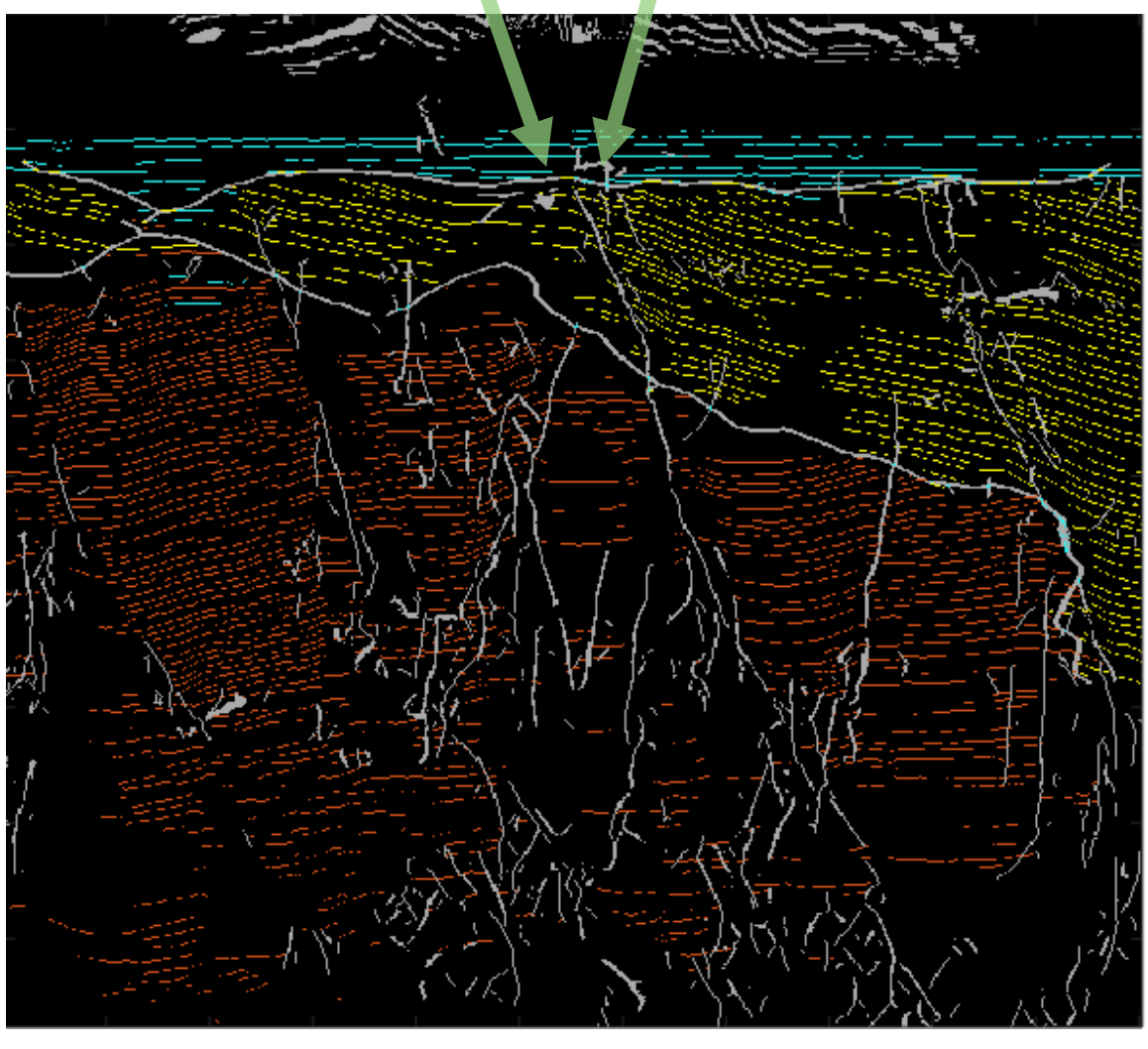


Attribute data display quantities derived from the original seismic data, here converted to binary data.

1) REFLECTOR ATTRIBUTE DATA
tracked quantities along reflectors.

2) FAULT ATTRIBUTE DATA
tracked incoherent events (discontinuities).

All the detected individual reflectors and faults are assumed to be binary objects with a set of properties.



3.SEMI-AUTOMATIC INTERPRETATION

Image processing functions are exploited to semi-automatic interpret the attribute data.

- **FAULTS** are filtered so that smaller faults and noise are removed
- **REFLECTORS** are classified and grouped into sequences (blue, yellow and red), separated by sequence boundaries in transition zones
- **MODEL:** The processed fault and reflector data is combined to give a model of the Earth's interior, obtained without manual tracking.

4. MACHINE LEARNING

The proposed interpretation relies on user-interaction (to set parameters etc.) and is considered *semi*-automatic. The idea for further work is that machine learning can help make the interpretative process fully automated