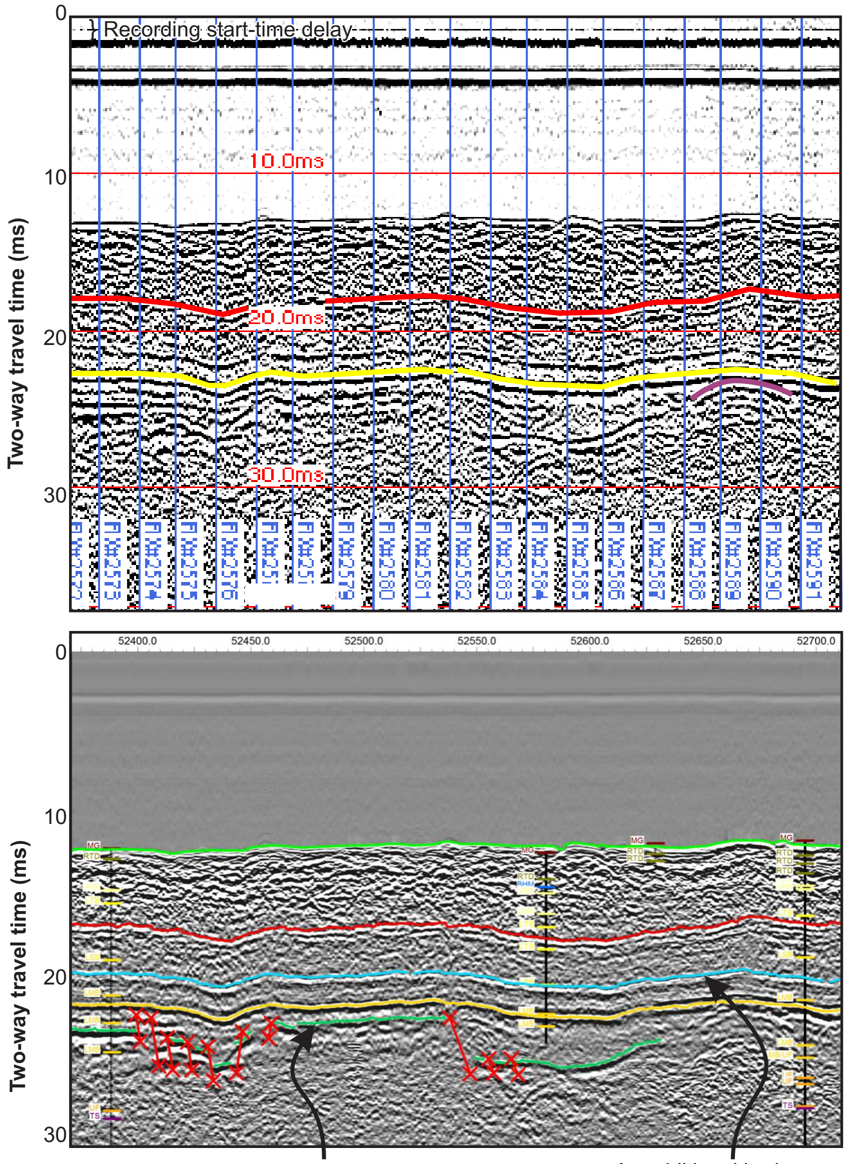
High-resolution single-channel seismic interpretation

In over-water surveys for engineering applications, single-channel Sub-Bottom Profiling data (*e.g.* Pinger, Boomer or Sparker) are acquired. The results are commonly displayed as black and white graphics and the horizons traced onto the sections by eye by the interpreter. However, the original reflection seismic data often contain much more information than is normally interpreted using these simple 2D methods. Digital seismic data files can be processed to reduce the effect of noise and to enhance the data quality, and loaded subsequently into specialist interpretation software. This can significantly improve interpretation compared with manual horizon picking based on minimally-processed data.



A faulted horizon, coloured green, with fault locations indicated by red lines, can be seen much more clearly here.

An additional horizon, coloured cyan, has been identified.

Figure 1: *(Top)* A Boomer seismic section displayed as a standard tiff, with manually interpreted horizon surfaces. *(Bottom)* The same section, digitally processed and re-displayed with boreholes. Reflections are picked with the aid of horizon-tracking software.

Interpretation

In the oil industry, seismic reflection data processing and interpretation are carried out at a much higher level than is standard for near-surface engineering surveys. RIL has developed bespoke iterative methods by which such higher-level analysis can be carried out on single-and multi-channel seismic reflection data from engineering surveys.

RIL seismic interpretation is carried out in a 3D interpretation environment that can incorporate seismic, bathy-metric, side-scan sonar, borehole, geotiff, GIS and/or CAD data into a fully geo-referenced data volume.

Interpretation is carried out primarily through direct correlation between seismic sections and borehole data. Horizons can be picked on all lines with the aid of semi-automated picking routines, then tied across the survey volume. Mis-tie analysis can be performed to remove residual vertical offsets between seismic lines before interpolation of final faulted reflector surfaces.

Fault planes can be picked and tied between lines to identify fault trends. Borehole logs can be projected directly onto elevation-corrected, depth-converted seismic sections. Key marker elevation surfaces can be generated directly from borehole log data, converted to time surfaces if required, and projected through the seismic volume to aid seismic interpretation. Pick locations, interpolated surfaces and faults can be exported in a variety of formats. A comparison between a manually-interpreted 2D graphical seismic section and the same section in RIL's 3D interpretation environment is shown in Figure 1. Examples showing fault picks and projected marker surfaces are shown in Figure 2.

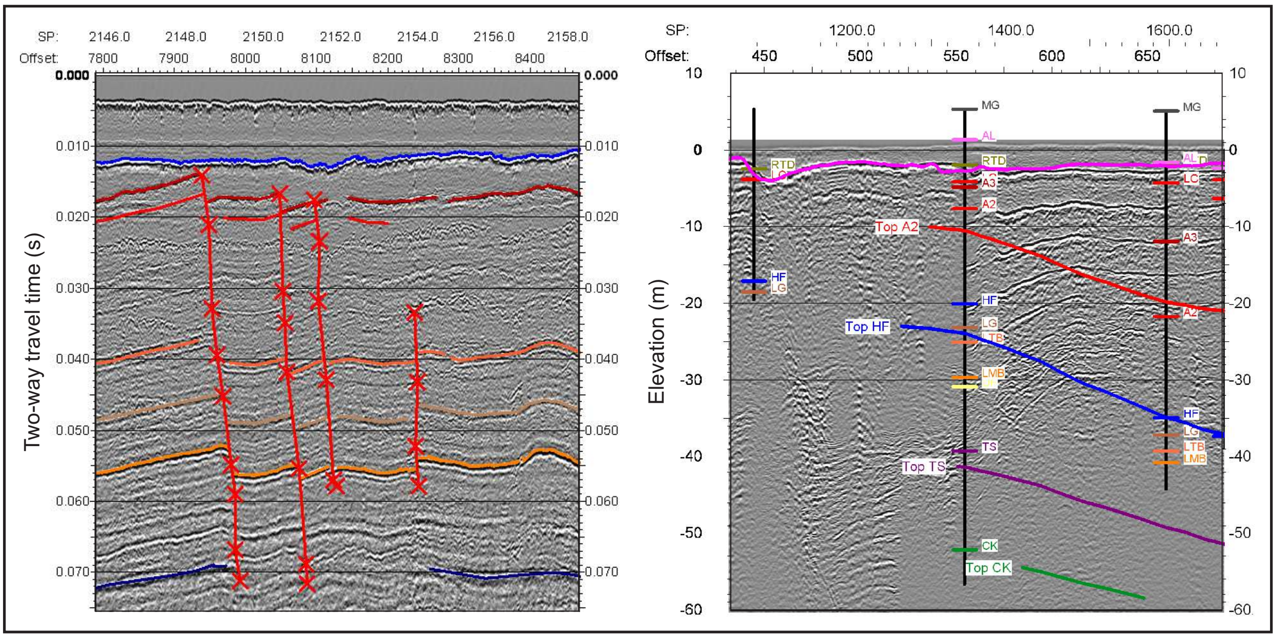
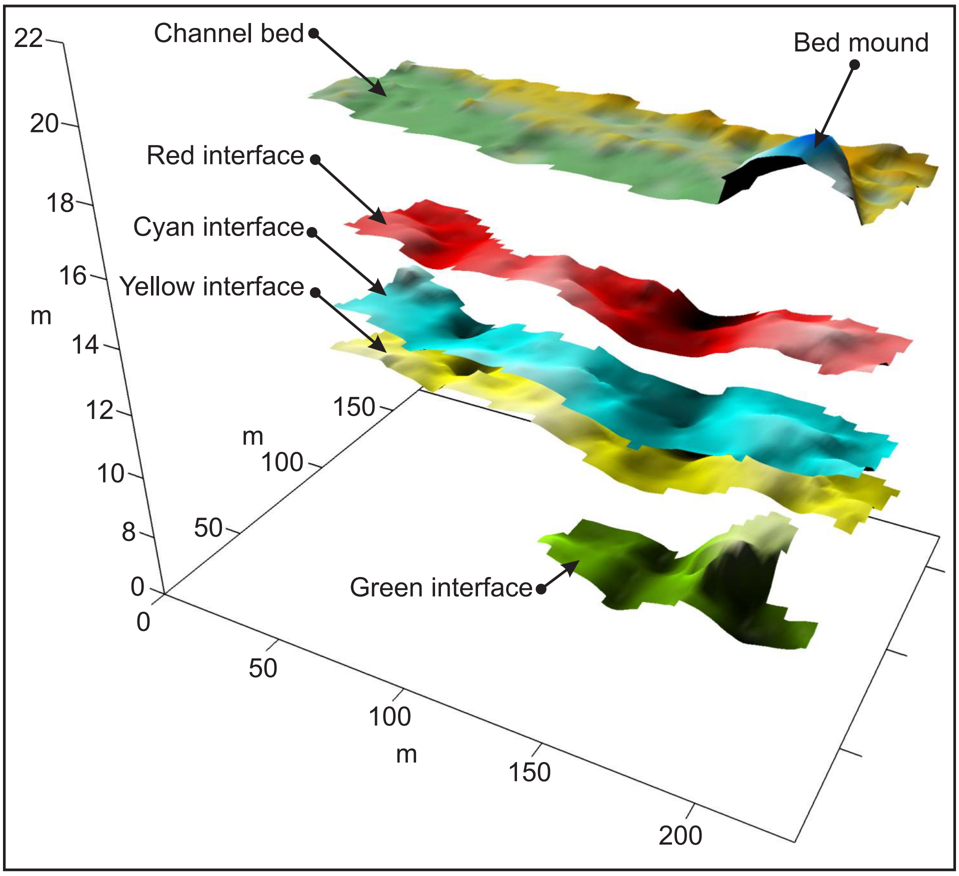


Figure 2: *(Left)* Detail of a seismic time section with fault and horizon picks. *(Right)* Borehole logs are projected onto depth-converted seismic data. The intersections with the seismic line of the bathymetry (magenta) and of key marker surfaces interpolated from borehole data are also shown. All boreholes, key marker surfaces and seismic sections are displayed at their correct elevations.

Analysis and visualisation

Through a combination of 3D visualisations and picked 2D time sections, a much more complete model of how different horizons are related to each other can be interpreted than by observing 2D seismic sections alone, improving the final site stratigraphy model. An example visualisation is shown in Figure 3.



RIL's GIS capability means that multiple data types can be incorporated into a GIS database for further spatial analysis, such as the extraction of seabed attributes in a buffer zone around a proposed sea-bed foundation. Possible outputs range from a spreadsheet of elevations of selected interfaces or a series of GIS shape-files to interactive 2D pdf maps or 3D pdf visualisations.

Figure 3:
An example 3D perspective projection of the surfaces in identified in Figure 1. Seismic picks for each interface were interpolated onto a regular grid and are displayed as 3D relief-shaded surfaces.

