

# Advances in Marine Seismic Refraction

## Ongoing development improves visualisation and usability of the data



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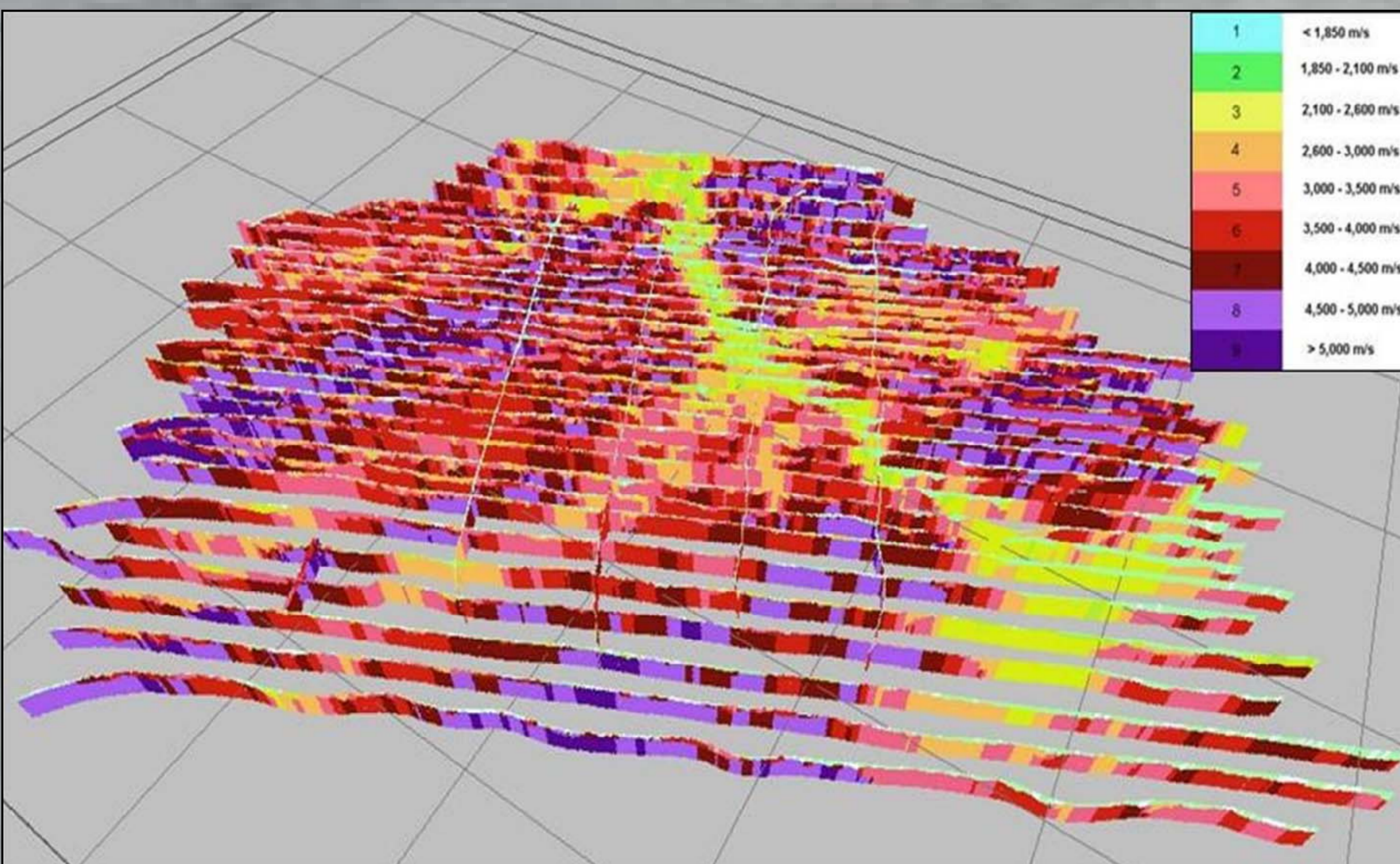
The marine seismic refraction spread was mobilised from Perth to the Panama Canal in 2009

### 3D Perspective Plots

Provided that refraction lines are run at a sufficiently close interval (typically 20 to 75 m apart, depending on the lithological variability), velocity trends in the sub-seabed can be traced between adjacent lines. The profiles (colour-coded in an appropriate way) can then be displayed in a 3D perspective plot, showing the geological structure of the site.

In the example below, an old river course (represented by low velocity, mainly "yellow" values), is incised into the faster calcarenite/limestone bedrock which exhibits velocities up to 5,000 m/s.

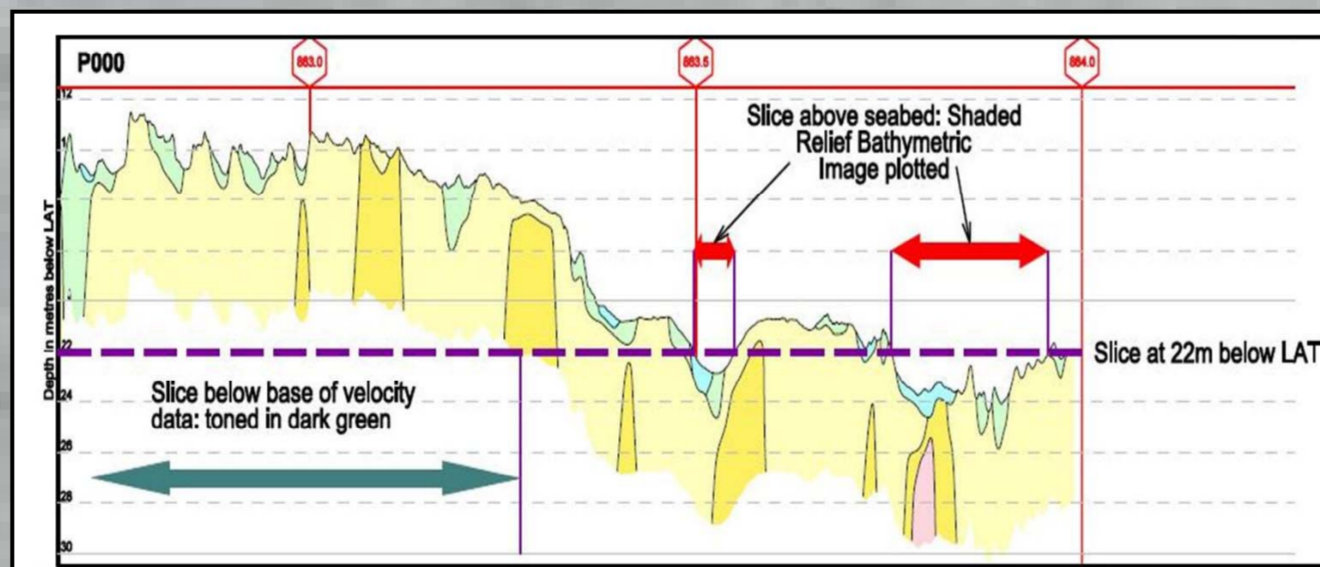
While this sort of display provides a useful qualitative view of the data, quantitative use of the data requires further processing.



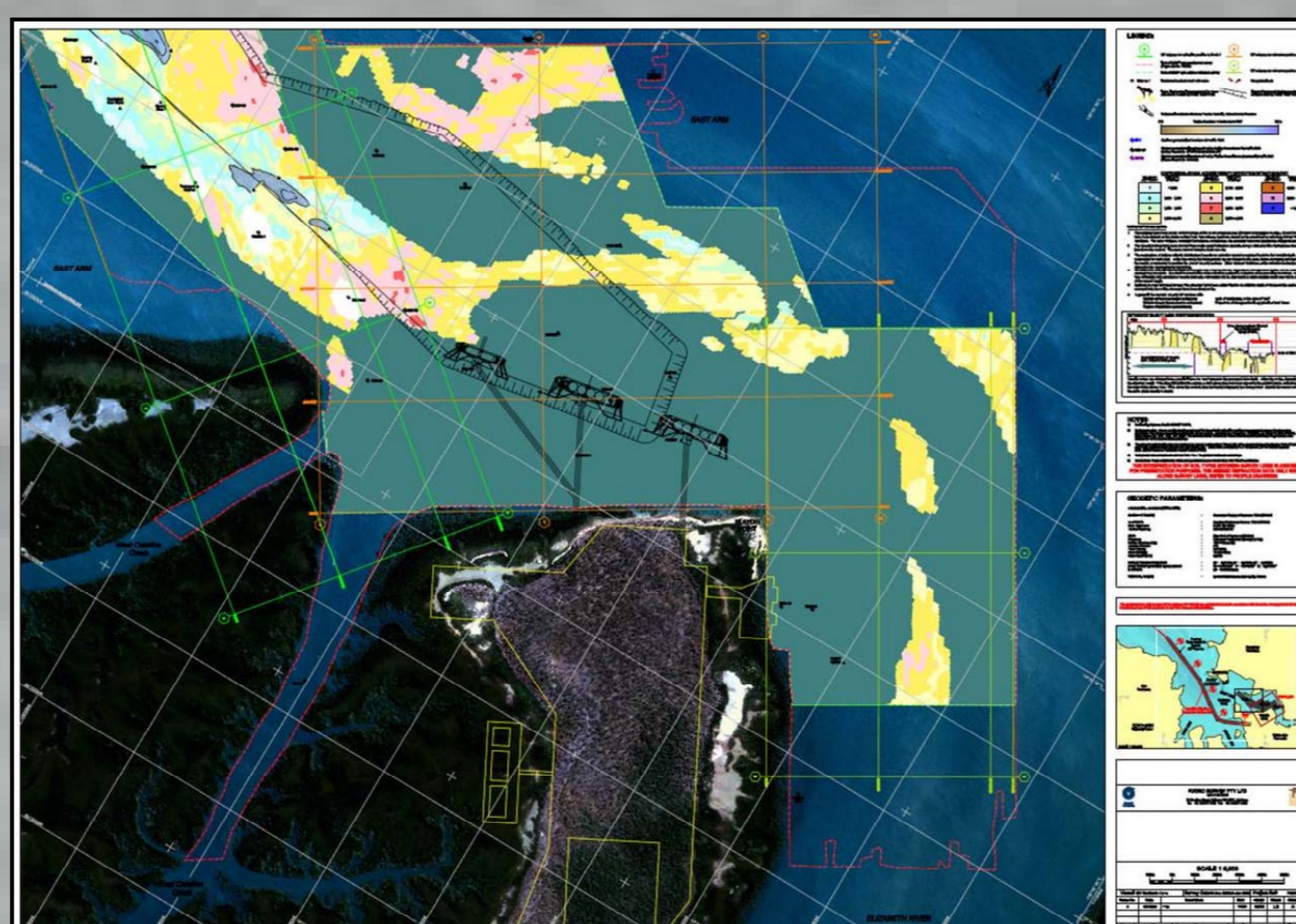
### Horizontal ('Velocity') Slices

Values are obtained if the slice level (for example, 22m below datum as shown below), intersects the presumed data depth below the seabed (this is a function of the prevailing velocity regime and the streamer length, but will normally be in the range of 4 m to 10 m beneath the seabed). If the slice cuts above the seabed, normally the bathymetric image is plotted; if the slice is below the velocity information, the area is toned as a uniform colour.

After the velocities have been extracted from each survey line, the set of values (for that level) is gridded and contoured. The procedure is then repeated for the other required levels, to build up a complete set of velocity slices. Slices will generally be computed at 1 m vertical spacing.

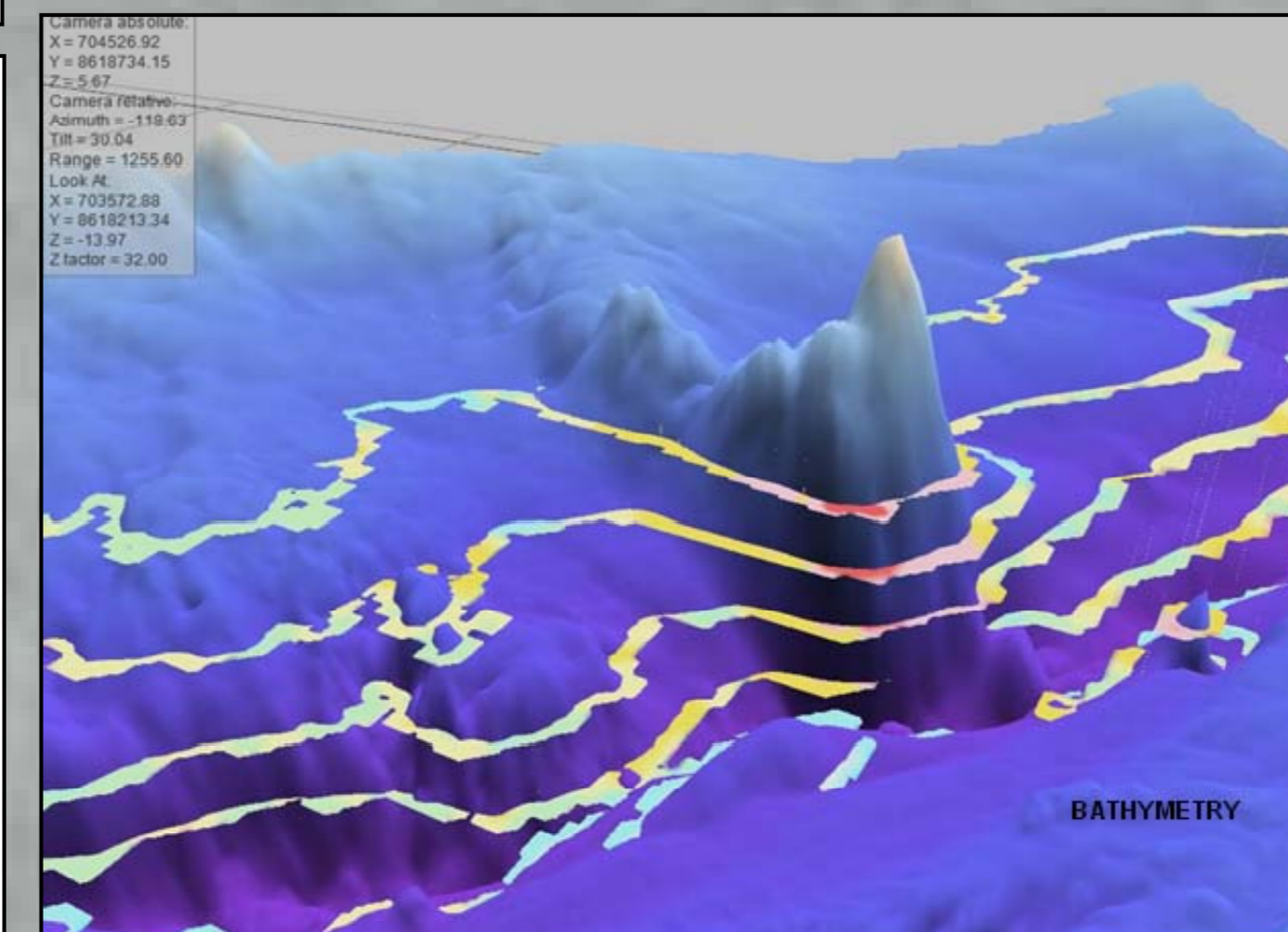
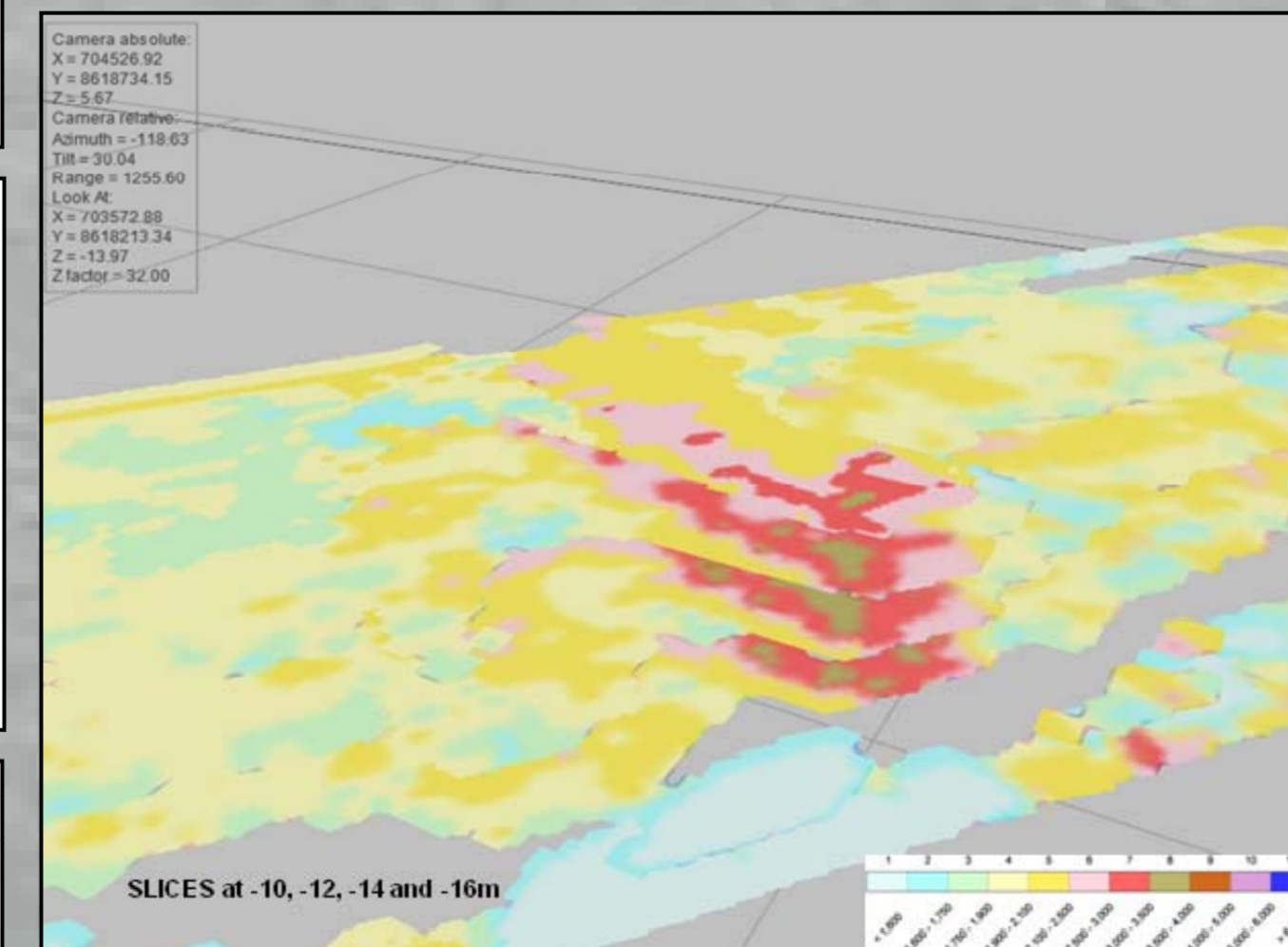


Below is an example of a velocity slice at a single level (18 m below LAT). The green-toned regions represent areas below the effective depth of penetration of the refraction system.

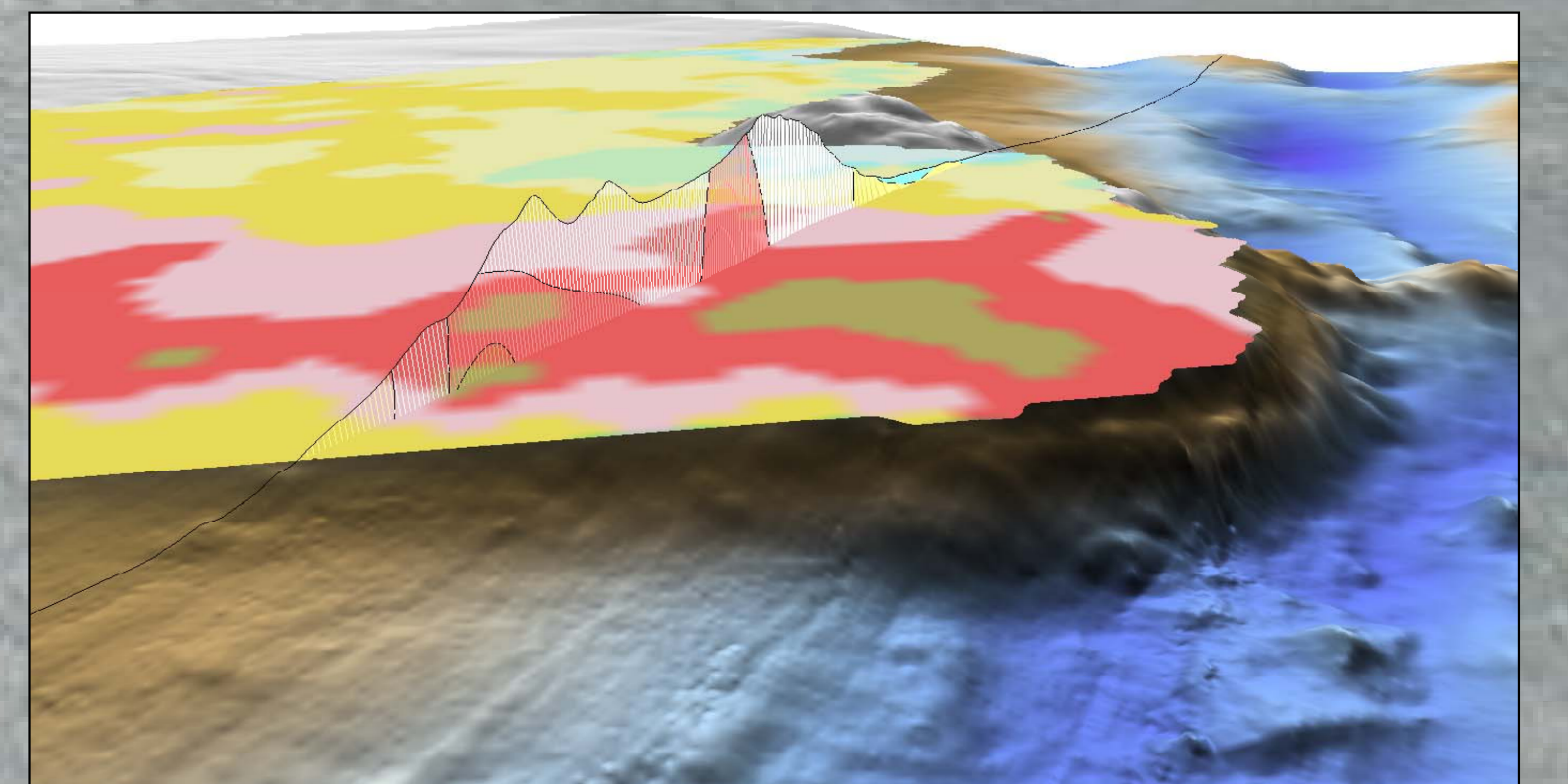


Slices can be presented as individual charts for each level (the above example), or displayed in a stacked, perspective format (right).

The example on the right (top) presents multi-level slices illustrating a vertical variation in velocities. The higher values (red and brown tones) represent a hard, erosionally resistant band which has formed a seabed ridge. Its morphology is illustrated by the swath bathymetry (bottom).



Example (below) of a bathymetric DTM with a velocity slice and example intersecting velocity profile.



### Other Presentations

In addition to the horizontal slices, the levels below datum of the various velocity categories can be read off the profiles and used to create plans of threshold velocities (as shown in the example below). Volumes of material within particular ranges can then be computed.

Following appropriate geotechnical sampling, the velocity categories can be correlated with parameters such as Unconfined Compressive Strength (UCS), Point Load Index (PL), Rock Quality Designation (RQD), Fracture Index (FI) and CPT Cone Resistance. Provided the relationships are established in the prevailing geology, the average engineering properties between the boreholes can then be interpolated with confidence.

