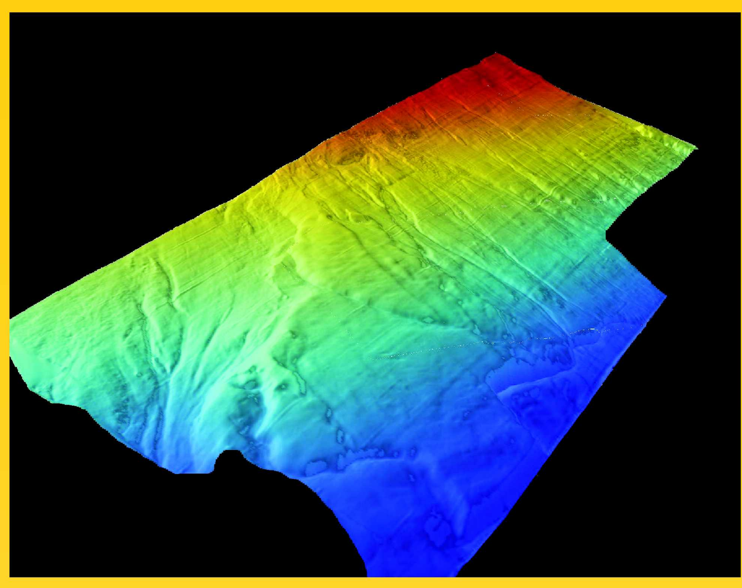
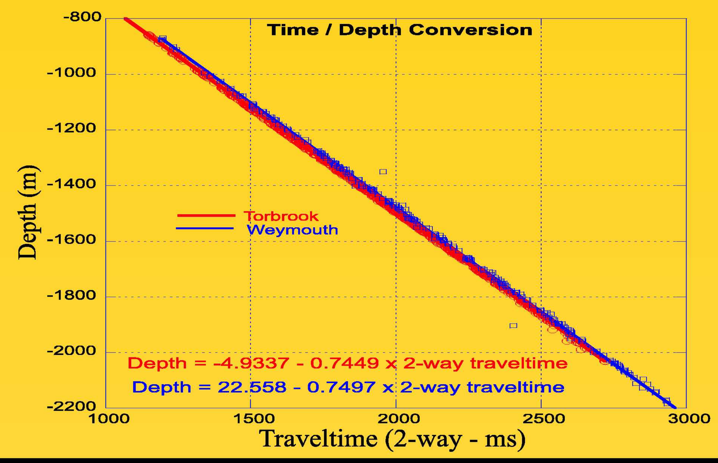
Comparison of 3D seismic reflection and multibeam sonar seafloor surface renders in deep water

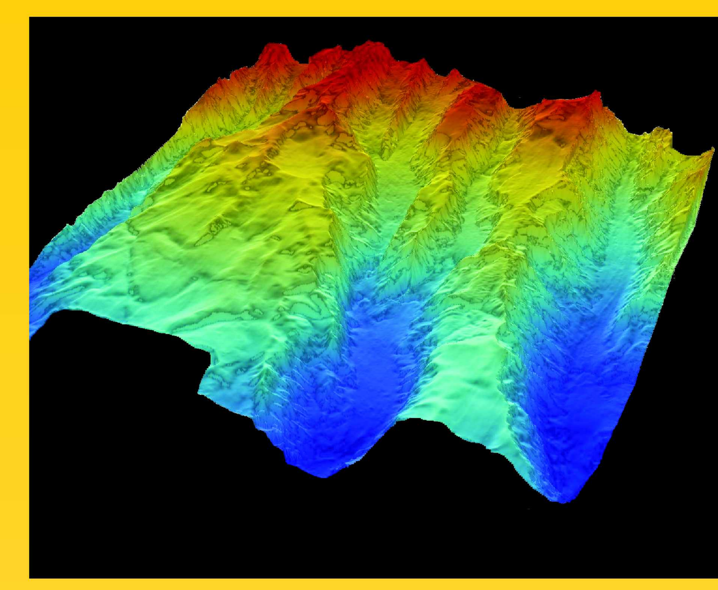
Comparative Case Studies



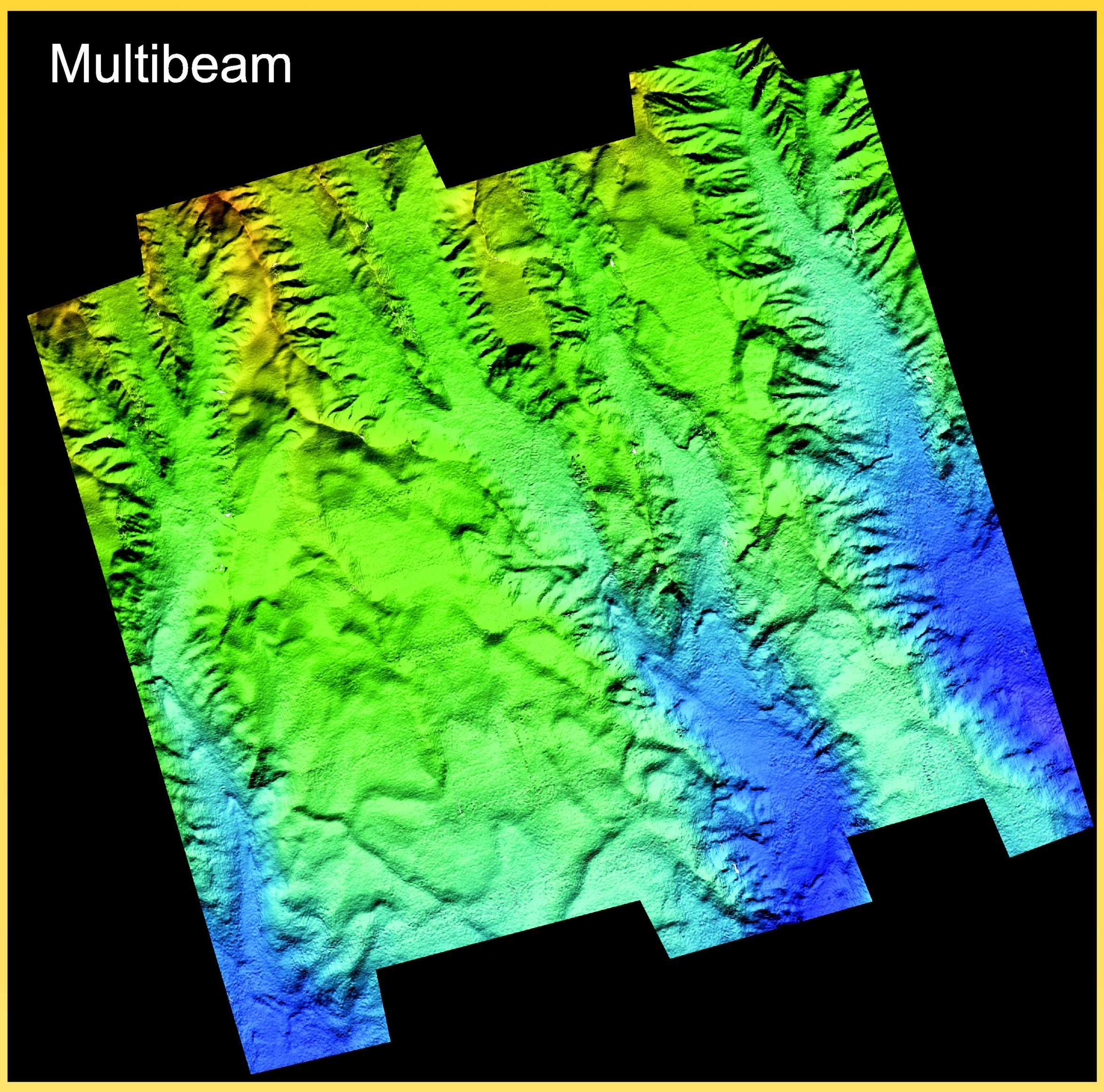
Non-canyon area, 700-2000 m water depth

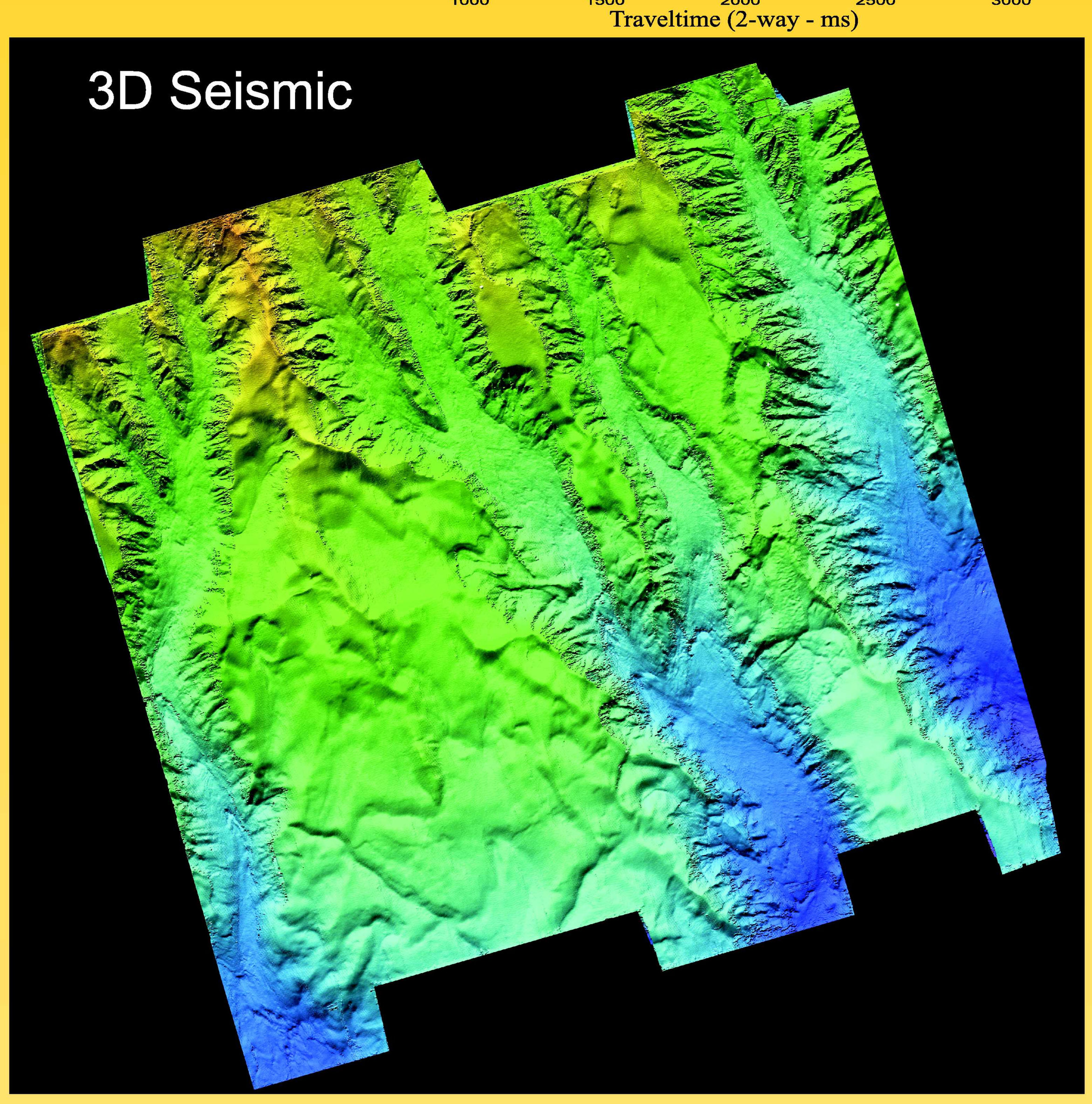
Two areas with overlapping multibeam sonar and 3D seismic reflection data were selected for case study. Multibeam datagrams provide data in depth, based on water column velocity profiles collected during surveying. 3D seismic surfaces have to be "picked" using interpretation software. A meticulous effort was required to pick the seismic seafloor return and provide detailed surface data. These data are in traveltime and had to be converted to depth. Conversions were conducted by regressing 3D seafloor picks against multibeam NADIR (normal incident) data, where they are coincident in geographic position. Surfaces were rendered in identical manners (same grid spacing and gridding algorithms) in order to compare data differences and not artifacts.

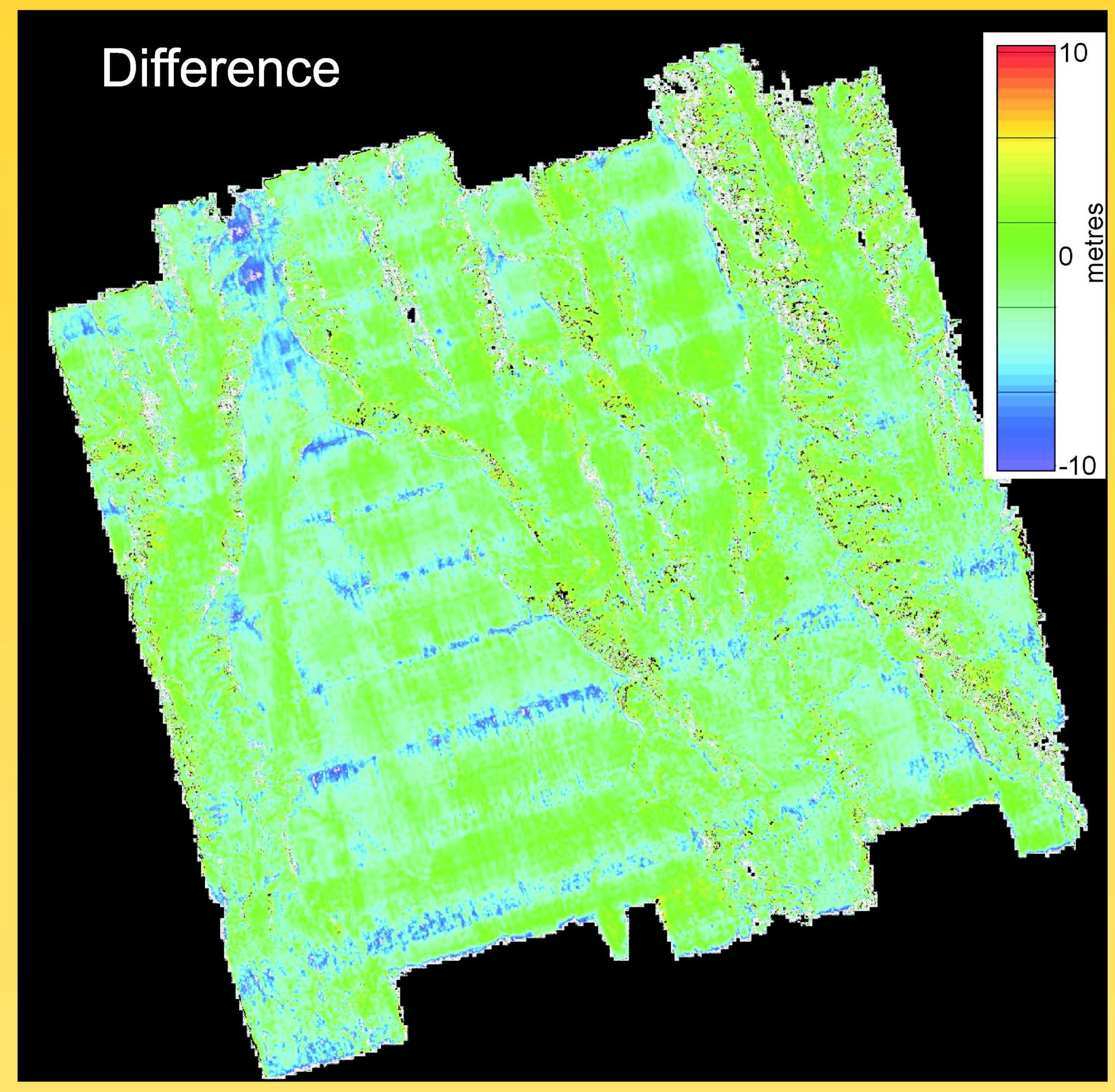


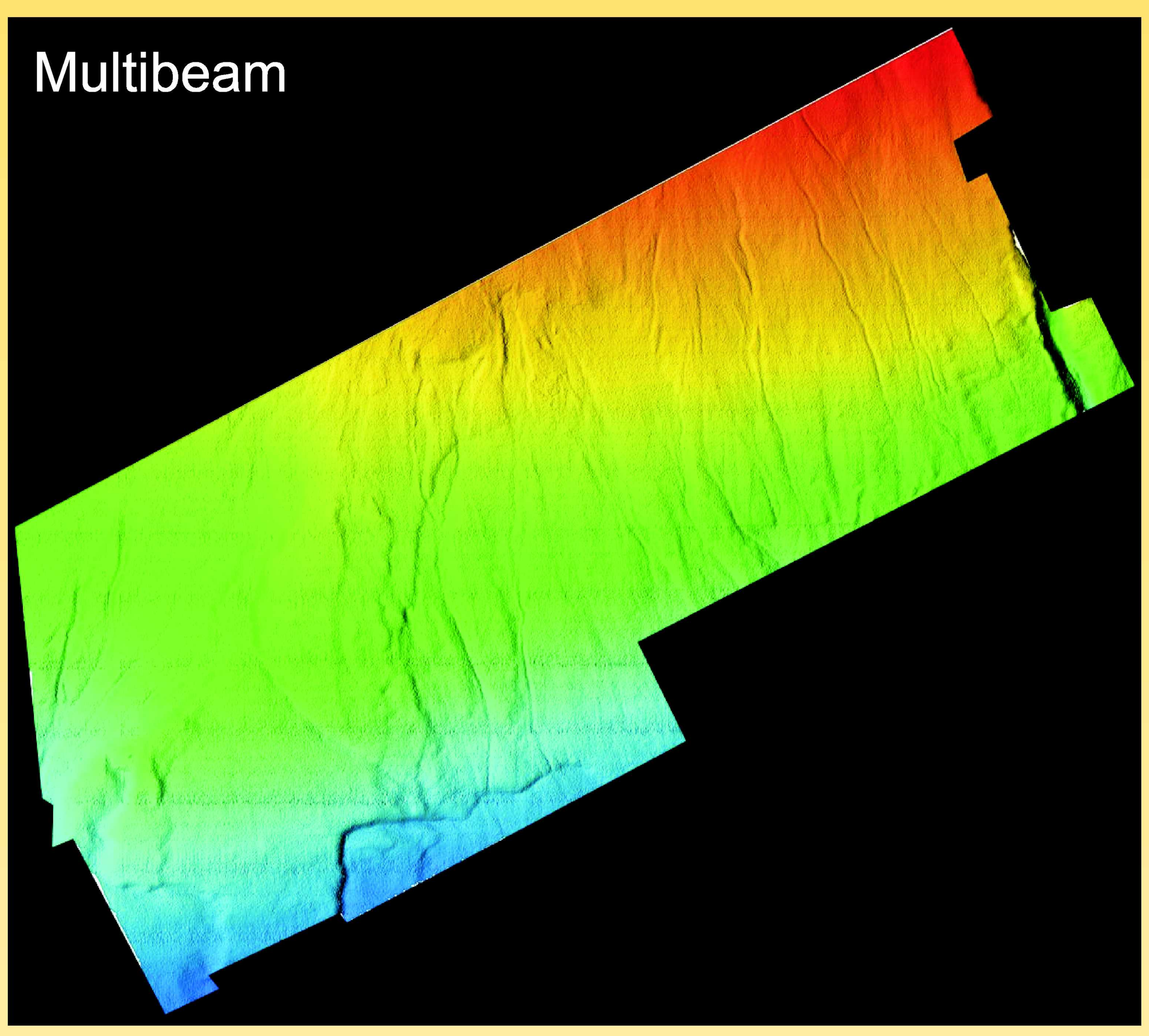


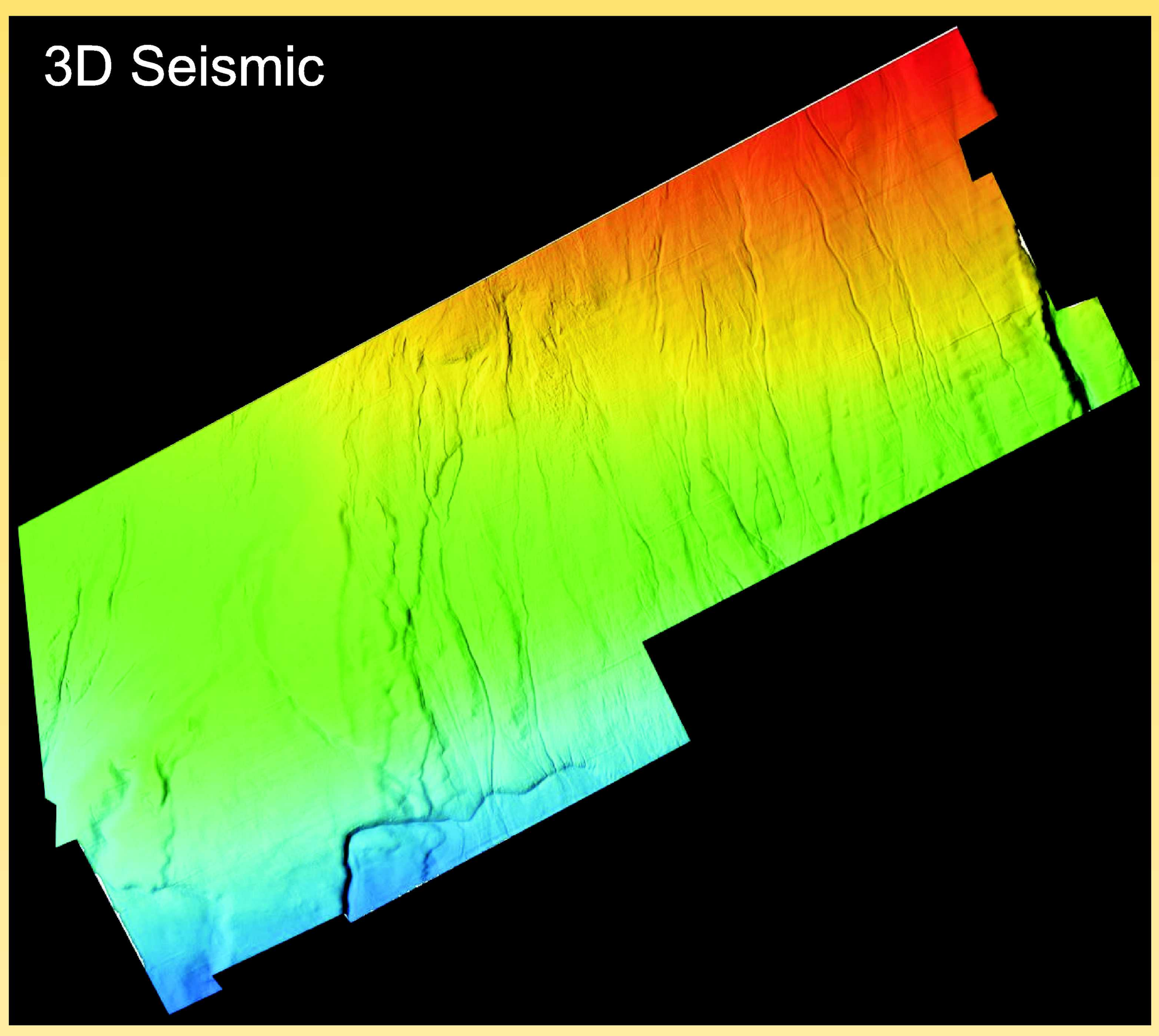
Canyon area, 1000-2500 m water depth

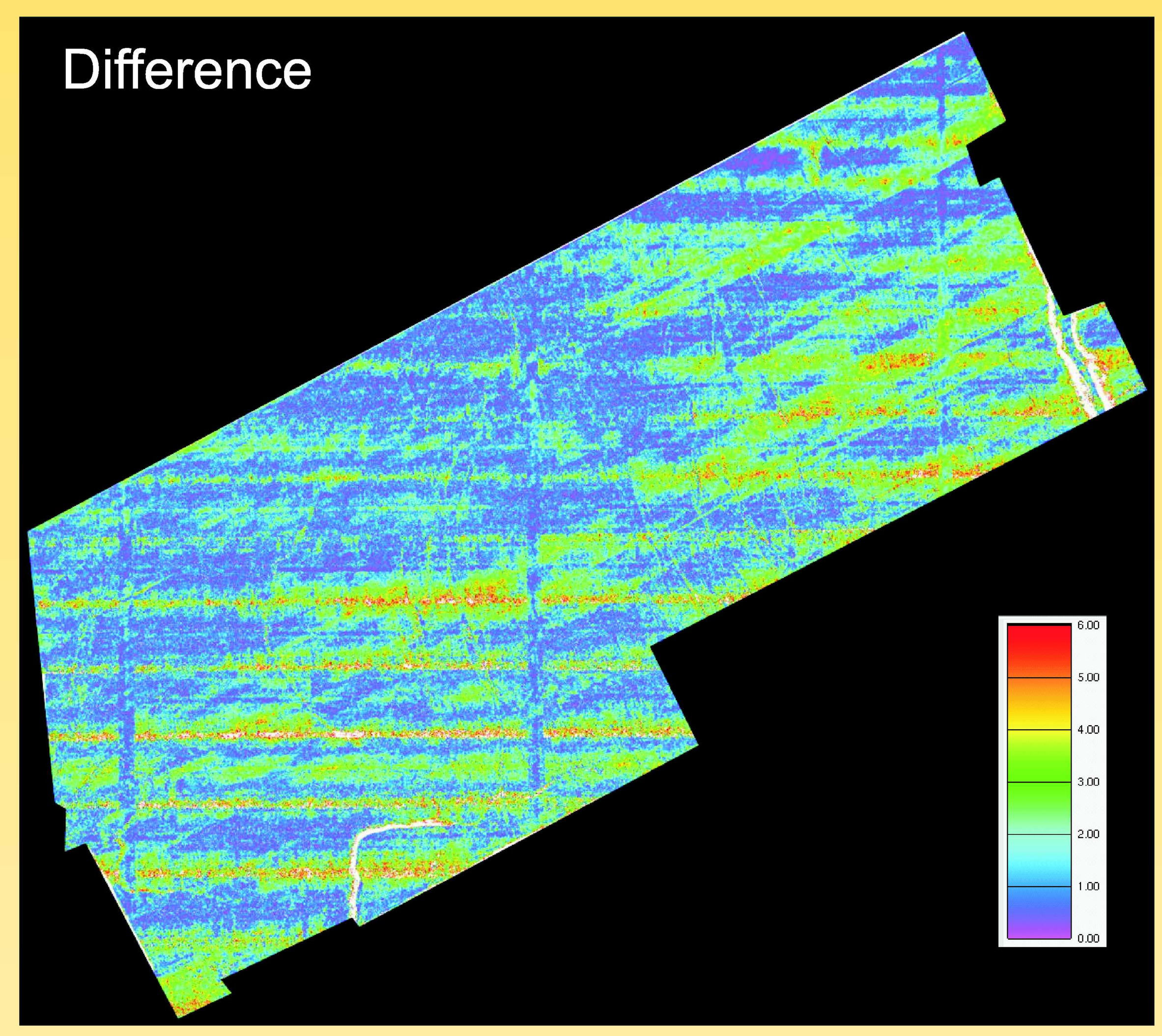




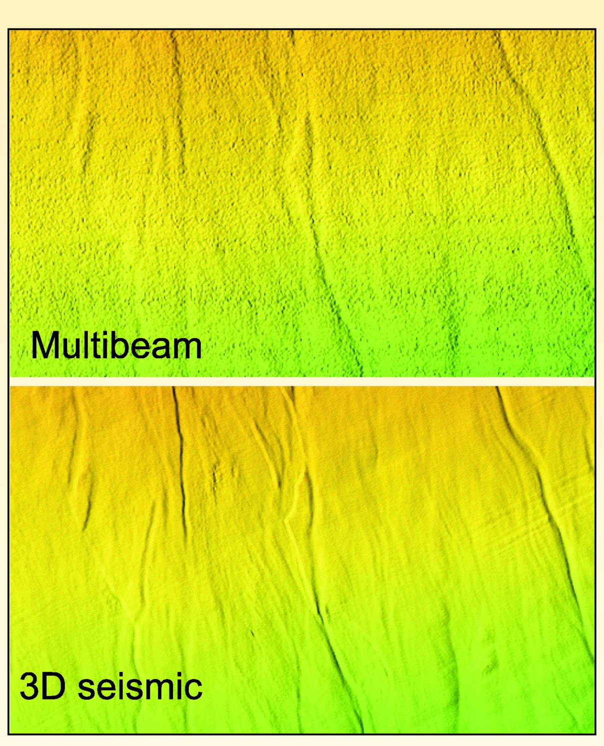




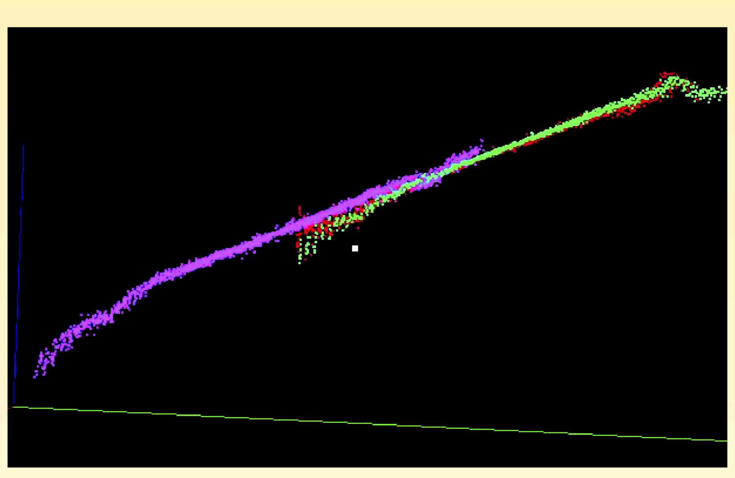




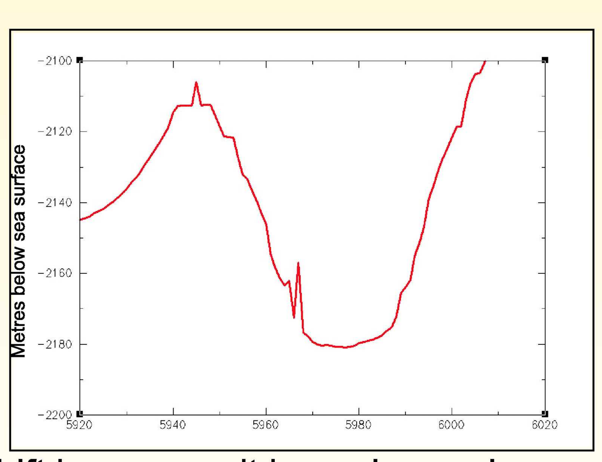
The panels above show multibeam and 3D seismic seafloor surface renders of the two case-study areas. Difference maps, subtracting the multibeam surface from the 3D seismic surface, highlight several artifacts. 1) The higher data density of 3D data sets support rendering at higher resolution, hence cleaner looking images. 2) Multibeam refraction errors on the order of 10 m are noted in along track differences. These errors result from inappropriate multibeam raypath corrections due to inadequate water column velocity models. 3) The largest differences are along the steep canyon walls. Automatic horizon picking software used on the 3D seismic data sets is largely incapable of accurately following the steep terrain of the canyon walls. Significant manual effort is required to pick the seafloor return in this case. Auto-detection of the seafloor in the multibeam acquisition software is much better designed to follow this steep terrain. 4) Minor along track offsets are apparent in the 3D seismic data sets, possibly a function of inaccurate static corrections during seismic processing.



In deep water, the higher data density of the 3D seismic support higher resolution surface rendering and consequently cleaner looking imagery.

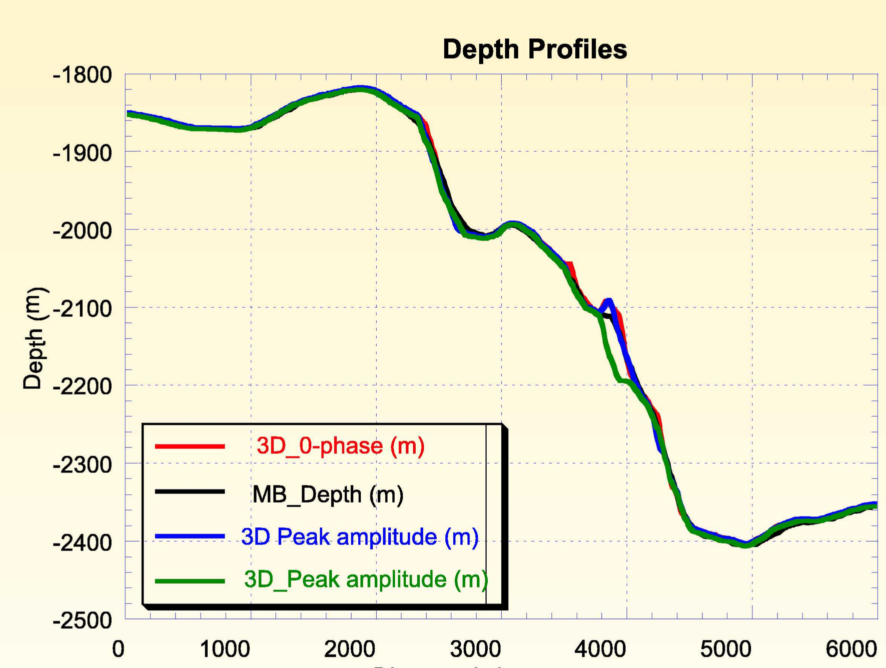


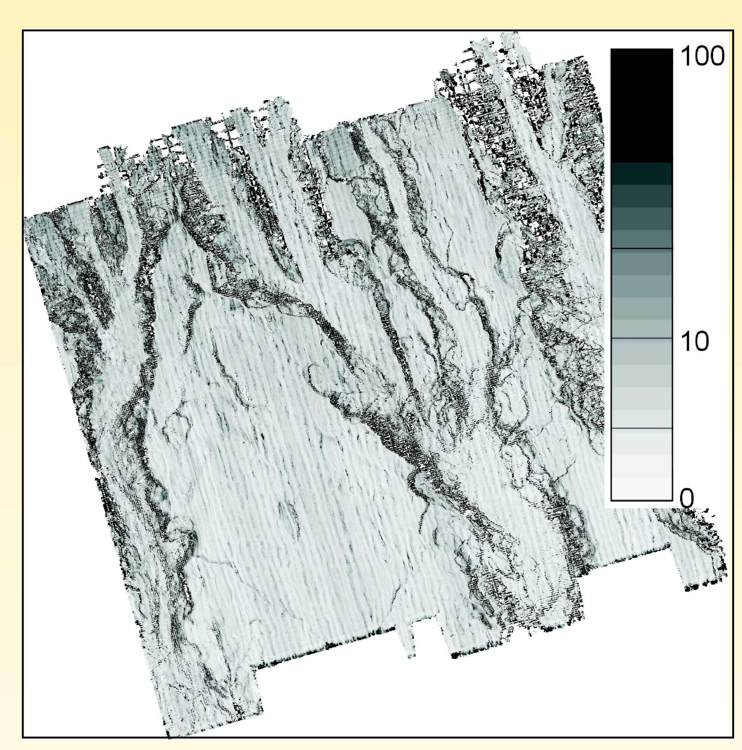
Multibeam refraction errors appear as "frowns" and "smiles", as demonstrated in these overlapping swaths.



Phase shift jumps result in peaks as shown above. These are a source of error in 3D seismic resulting from autopicker miss-picks and in multibeam data from detection errors. Correcting these miss-picks is time consuming but cleaning (detecting and removing) can be automated.

Differences of tens to hundreds of metres are noted on the steep canyon walls. These errors result from autopicker inability to follow steep terrain. Intense manual picking can minimize these errors.





Along track errors in the 3D seismic data sets are demonstrated by the NNW-SSE lineations above. This surface is a difference map between the zero and peak positive phases of the seafloor arrival in the 3D seismic data set. These artifacts are only 1.5 m high, and are unexplained. They possibly result from a processing error, such as an inappropriate static correction.

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