IsoMetrix

Marine isometric seismic technology

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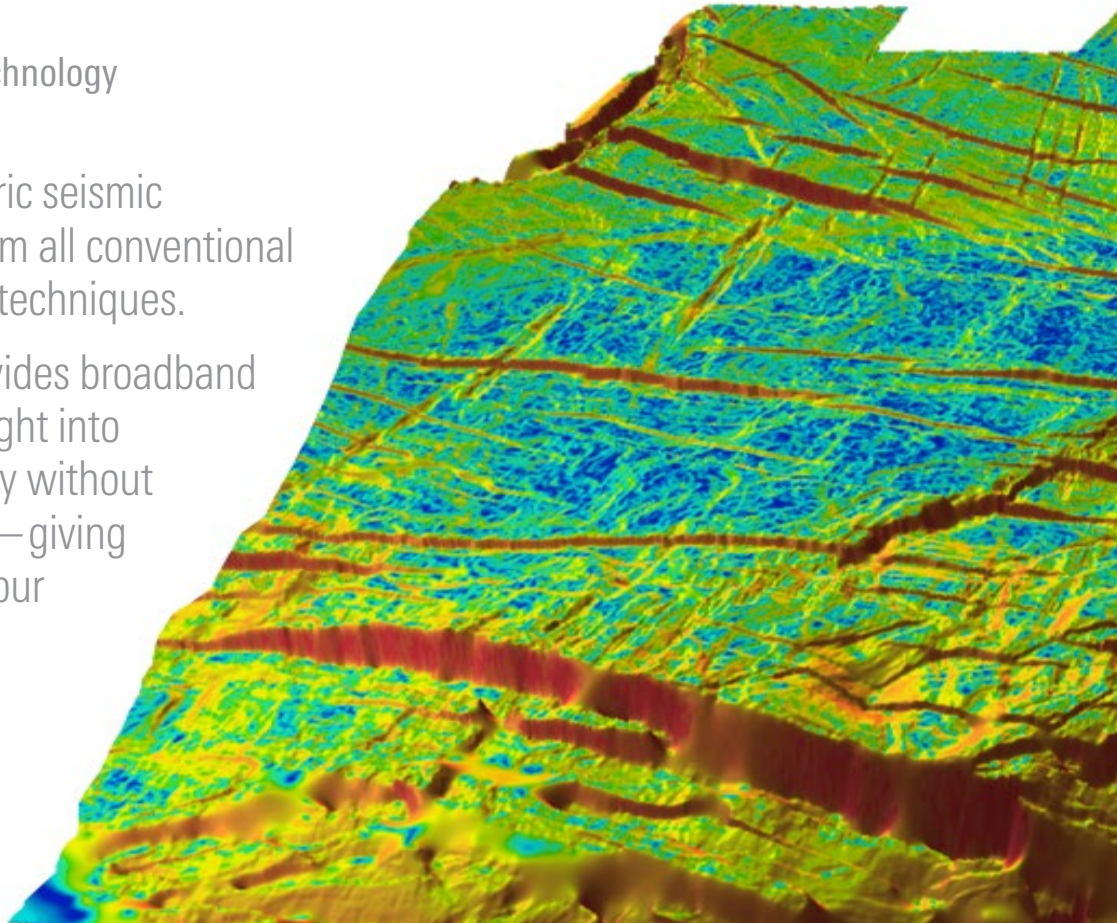
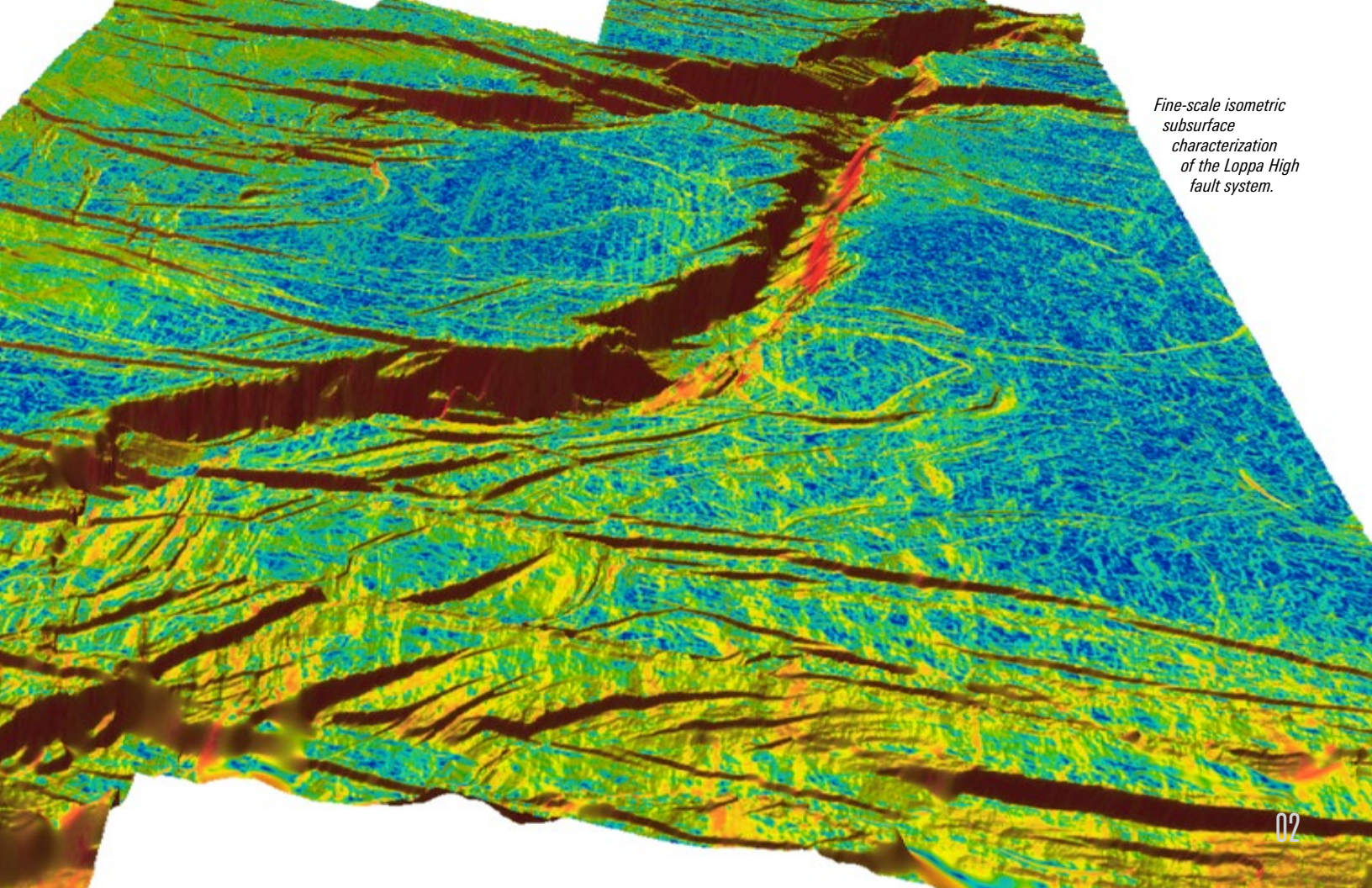
IsoMetrix* marine isometric seismic technology is different from all conventional or broadband acquisition techniques.

IsoMetrix technology provides broadband data in 3D for greater insight into real geology and efficiency without compromising on quality—giving you control to maximize your seismic investment.





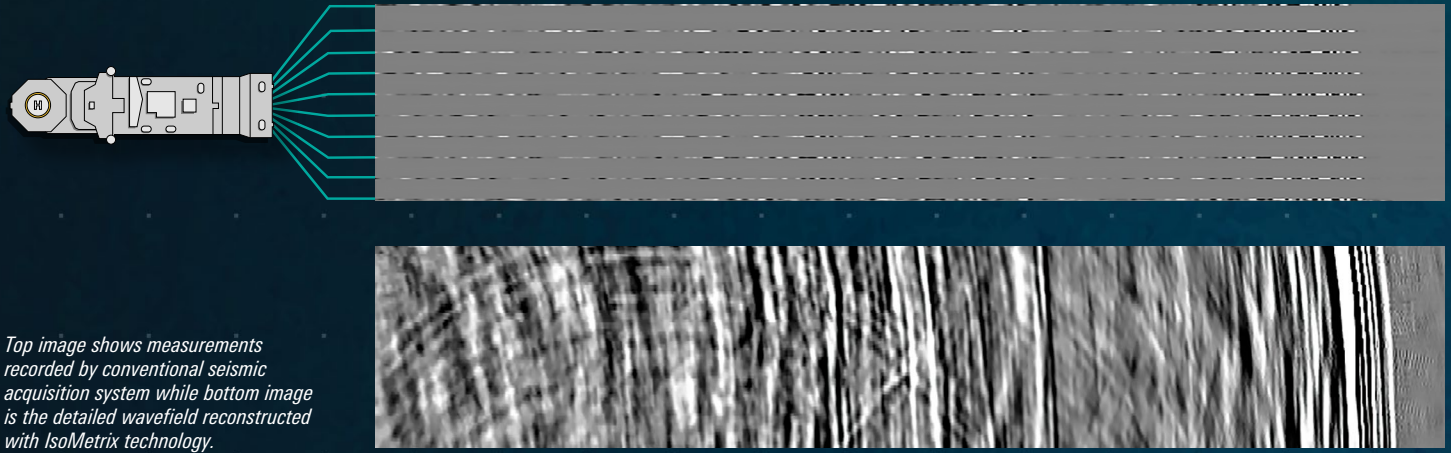
Fine-scale isometric subsurface characterization of the Loppa High fault system.

Reading between the lines

IsoMetrix technology records additional measurements to build a more detailed picture of the seismic wavefield in all directions, filling the gaps between cables associated with conventional towed-streamer acquisition technology.

What does this mean?

Fine-scale resolution of the wavefield in all directions translates directly to fine-scale resolution of the subsurface in all directions, enabling a more accurate representation of the geology for subsequent interpretation and a new level of insight from seabed to reservoir.



Top image shows measurements recorded by conventional seismic acquisition system while bottom image is the detailed wavefield reconstructed with IsoMetrix technology.

Images courtesy of IPA

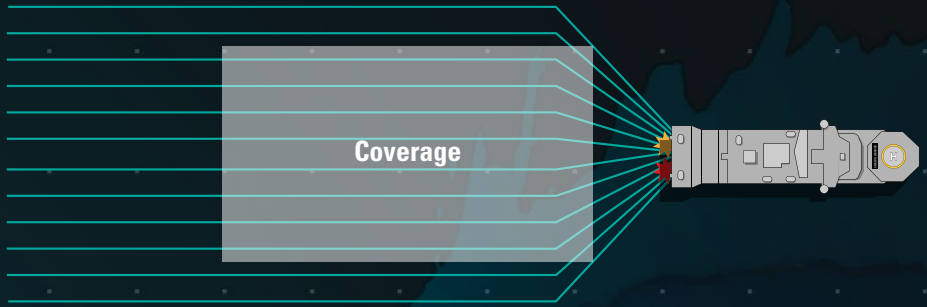
"Dip or Strike? – Complementing Geophysical Sampling Requirements and Acquisition Efficiency for Towed Streamer Marine Seismic," IPA Annual Convention, Jakarta, 2016

Increasing subsurface coverage without compromising data integrity

IsoMetrix technology relaxes the sampling constraints that limit conventional acquisition technologies, enabling more efficient (and safer) acquisition configurations for a wide variety of objectives.

Advanced approaches to survey design, such as shooting strike rather than dip, can be a more efficient option in areas of strong currents or strict border regimes.

Conventional



IsoMetrix Technology

Wider tow streamers and sources

40%
more efficient

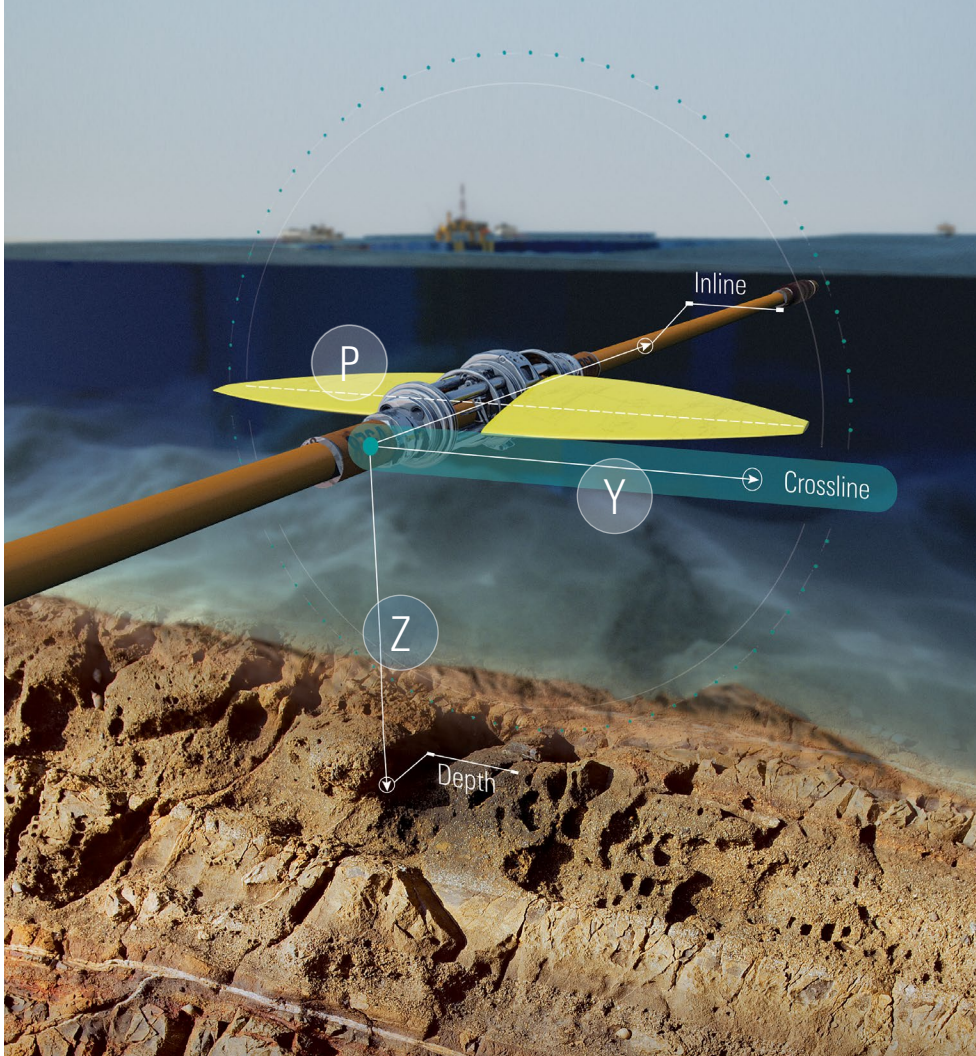
Wider streamer placement, fewer streamers in the water

Multimeasurement streamers

At the heart of IsoMetrix technology is a revolutionary seismic streamer. This combines standard hydrophone (P) measurements with two accelerometer sensors recording the seismic pressure gradient in the vertical (Z) and crossline (Y) directions.

Dual-sensor measurements (PZ) enable receiver deghosting, providing deeper insight into the Earth's complexity.

Only IsoMetrix technology combines the three PZY measurements to perform true 3D deghosting and reconstruction of the seismic wavefield between the streamers. This steps toward a new definition of broadband seismic—with broad spatial bandwidth in all three dimensions.



The three measurements of IsoMetrix technology allow for full 3D deghosting and dealiasing. Dense wavefield reconstruction provides the only truly broadband product in all three directions—vertically, along the streamer, and crossline between the streamers.

Core offerings

Choose between three IsoMetrix technology deliverables, depending on the objectives and constraints of a particular survey. Each option makes full use of the three measurements in the IsoMetrix technology streamer.

Broadband At Cable delivers a 3D deghosted dataset with the same volume as conventional acquisition, making it an ideal option for large-scale exploration surveys. However, you retain the option to revisit the densely sampled IsoGrid* isometric marine seismic reconstruction for more targeted, high-resolution processing.

IsoGrid Reconstruction

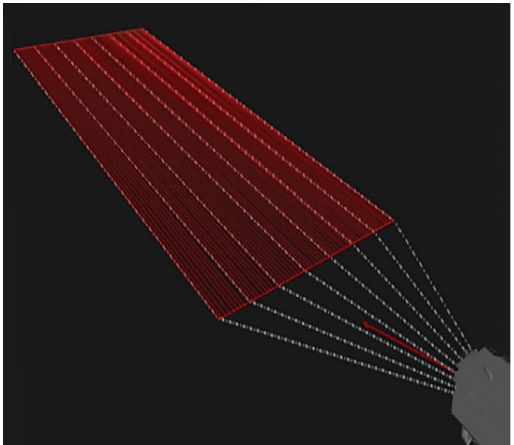
- Wavefield reconstruction using PZY
- Nominal 6.25–m carpet of virtual streamers

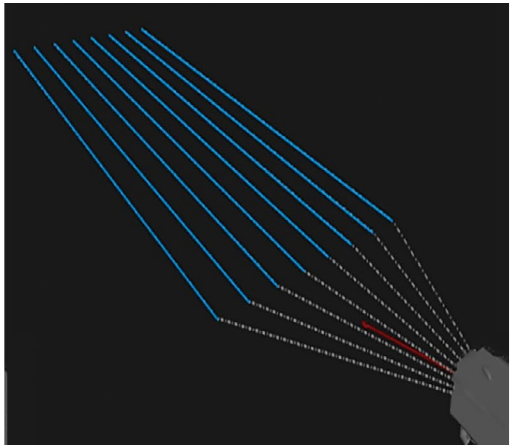
Broadband At Cable

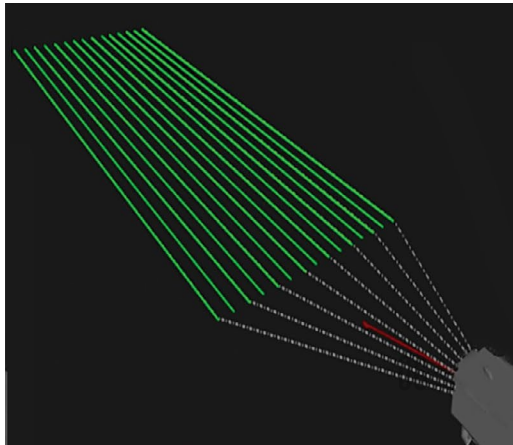
- Spatially resampled to original locations
- Conventional data volume for reprocessing
- Geophysical benefits maintained

Broadband Between Cables

- Same benefits as Broadband At Cable
- Option to output at your desired target geometry

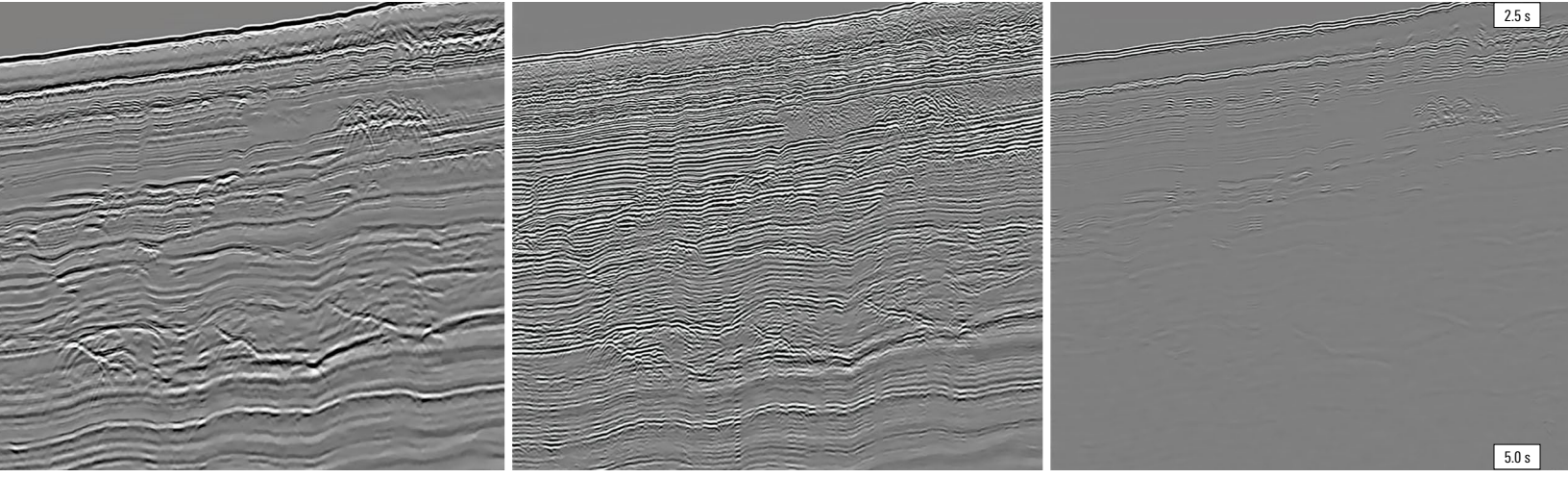






Multimeasurement signal quality

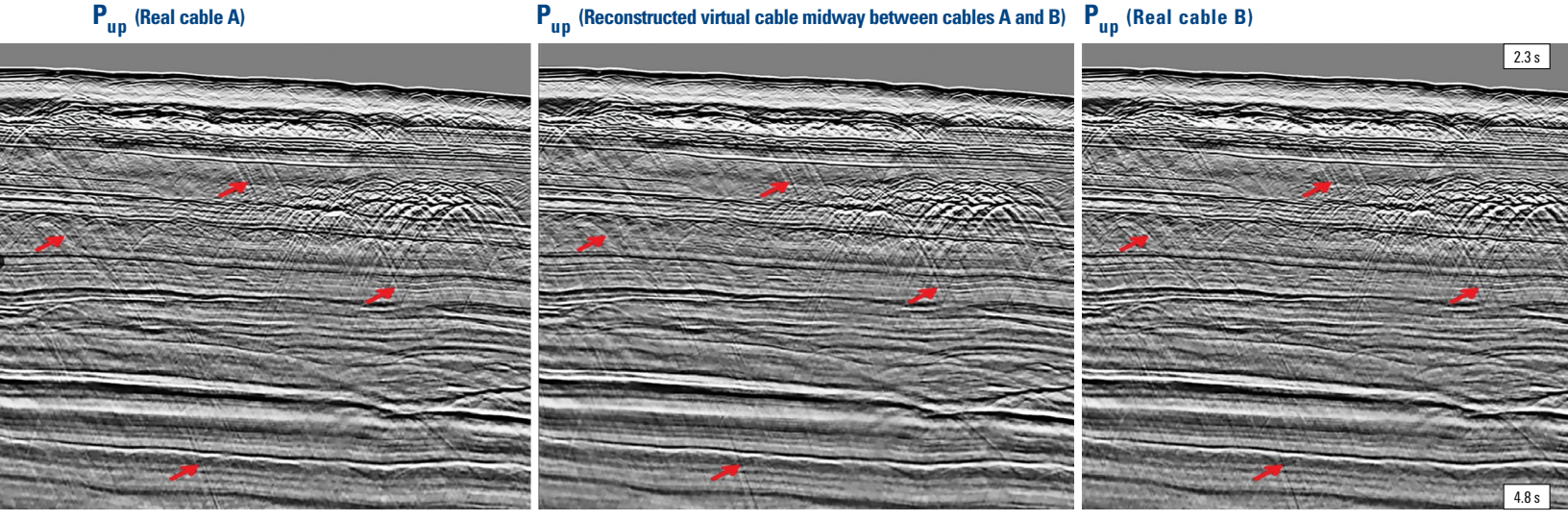
Hydrophone P | **Accelerometer Z** | **Accelerometer Y**



Good signal-to-noise separation for all three measurements is a key step in delivering high-quality IsoMetrix technology 3D broadband data. The panels show P, Z, and Y stacks prepared for input to the 3D deghosting step. The Y stack, in particular, shows clean signal content from seafloor to deep in the section, even though the water depth exceeds 2 km. This demonstrates the complexity of wave propagation and the need to handle full 3D effects in the deghosting process.

This data quality is achieved by powerful data preconditioning and noise attenuation enabled by densely spaced sensors coupled with single-sensor digital processing. This is performed in real time in the acquisition system, producing high-quality field data ready for subsequent processing.

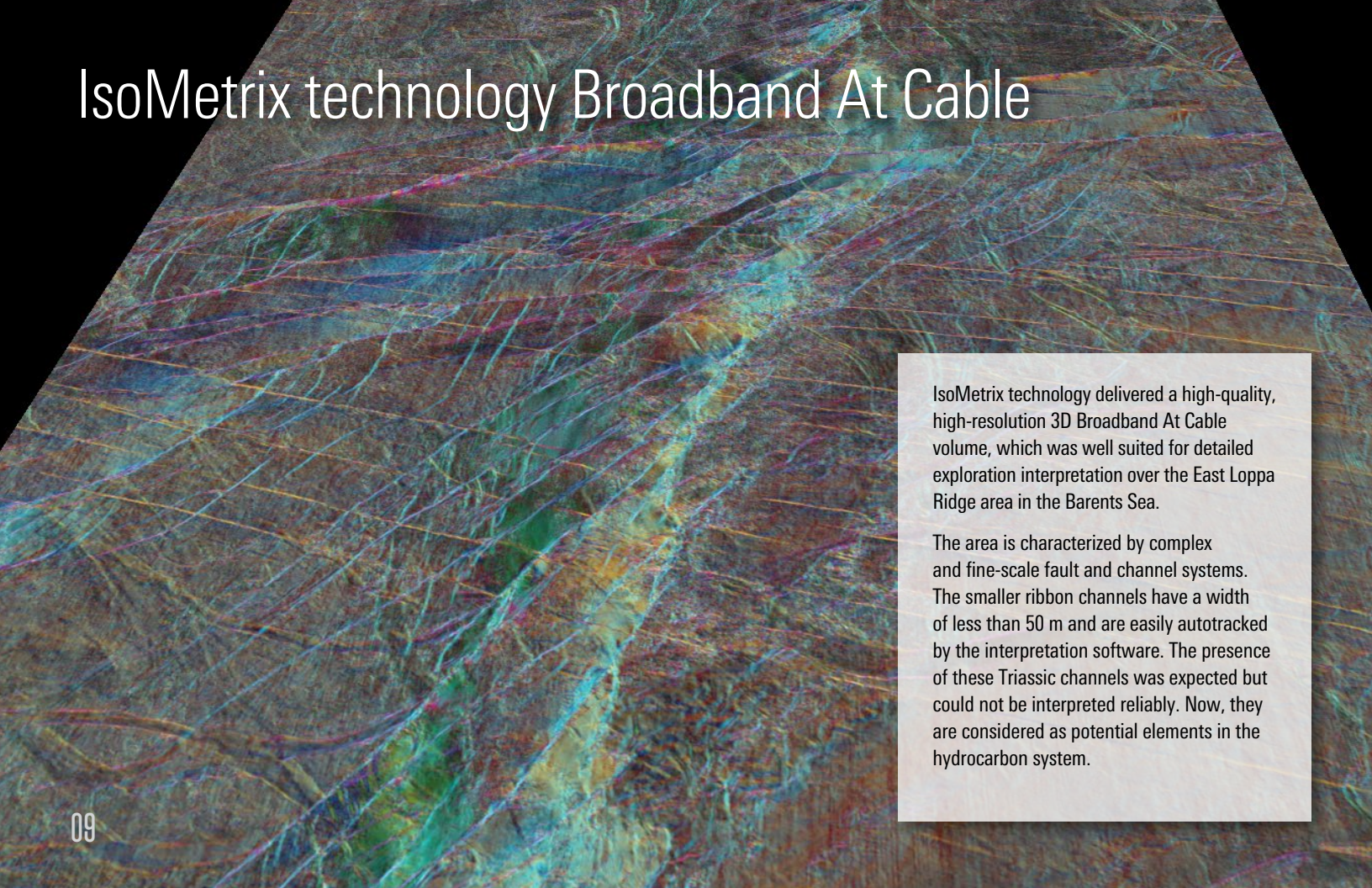
Wavefield reconstruction



The quality of these measurements enables joint interpolation and 3D deghosting. This example from frontier deepwater exploration offshore East Africa shows the upgoing seismic wavefield (P_{up}) is successfully reconstructed at two neighboring real cables, as well as at a virtual cable midway between the two.

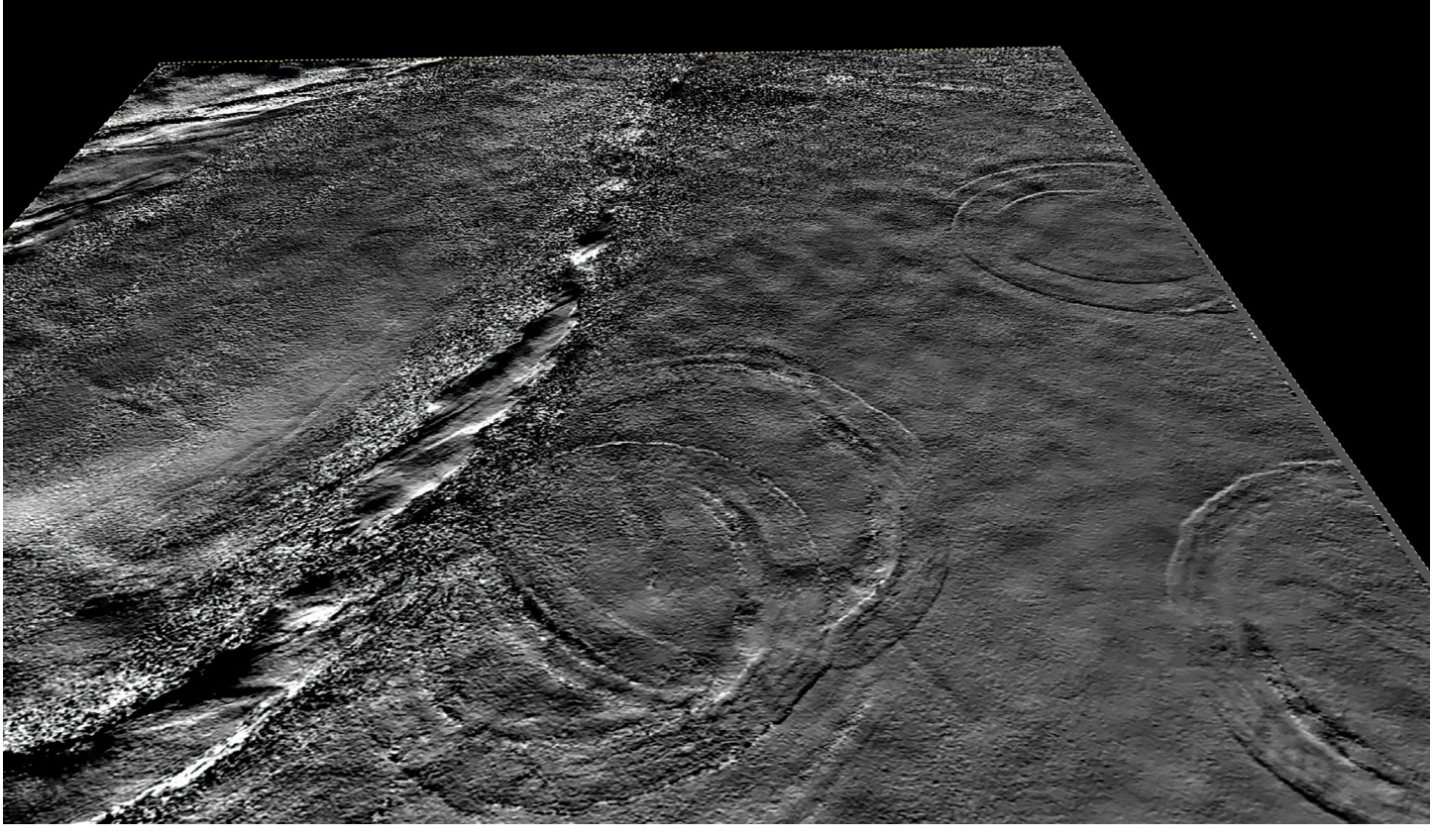
These sections already display the characteristics of high-quality broadband data, even before source deghosting and debubble are applied. Complex events such as diffractions (see arrows) are correctly captured at the virtual cable midway between real cables A and B, despite the 100-m actual cable separation, demonstrating the ability for IsoMetrix technology to accurately interpolate in the shot domain early in the processing flow.

IsoMetrix technology Broadband At Cable



IsoMetrix technology delivered a high-quality, high-resolution 3D Broadband At Cable volume, which was well suited for detailed exploration interpretation over the East Loppa Ridge area in the Barents Sea.

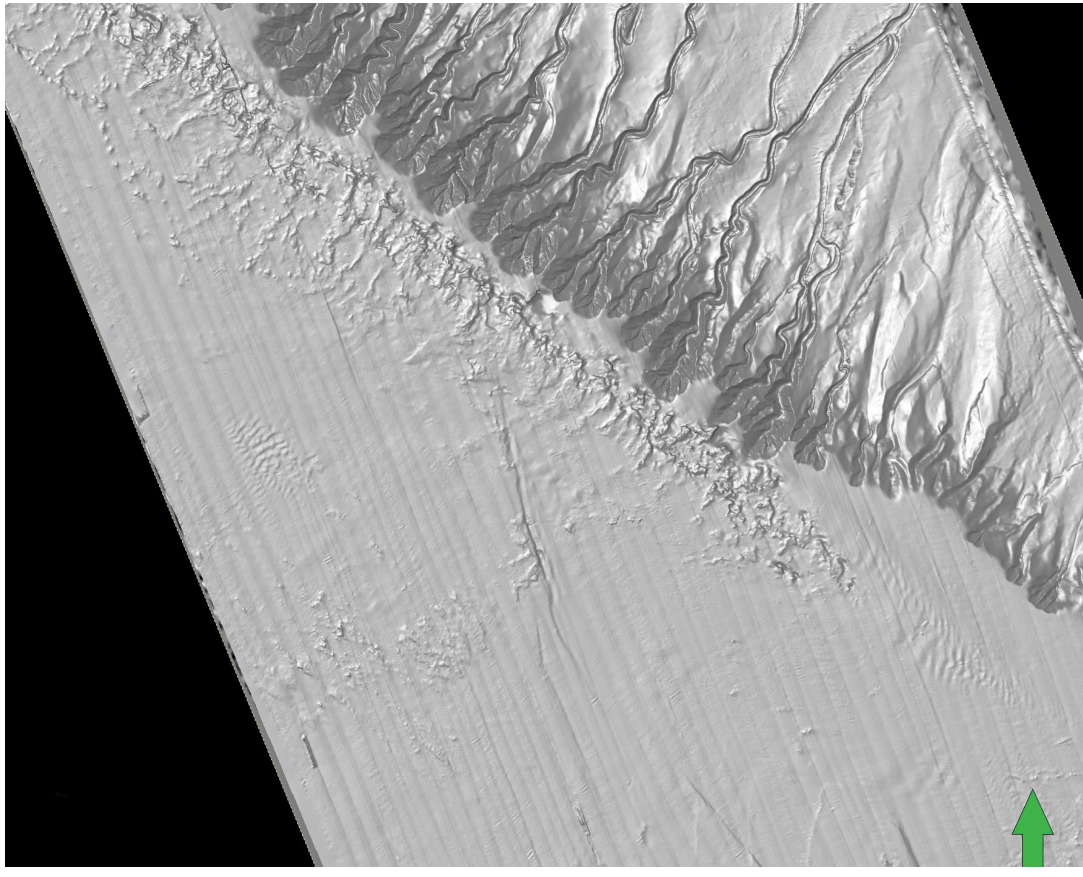
The area is characterized by complex and fine-scale fault and channel systems. The smaller ribbon channels have a width of less than 50 m and are easily autotracked by the interpretation software. The presence of these Triassic channels was expected but could not be interpreted reliably. Now, they are considered as potential elements in the hydrocarbon system.



Another interesting feature appears in this time slice. At first glance, the circular features appear to be processing artifacts. However, further inspection indicates that they correspond with throws of a conical fault system. These features demonstrate the ability of IsoMetrix technology in successfully resolving geologic features with a full 360° of azimuth, independent of the acquisition direction.

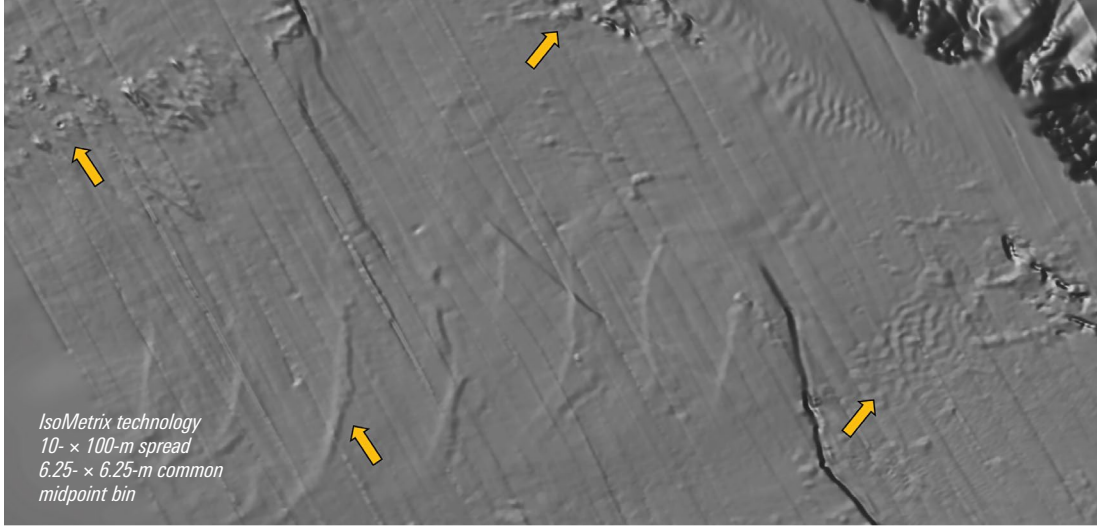
High-resolution IsoGrid reconstruction imaging

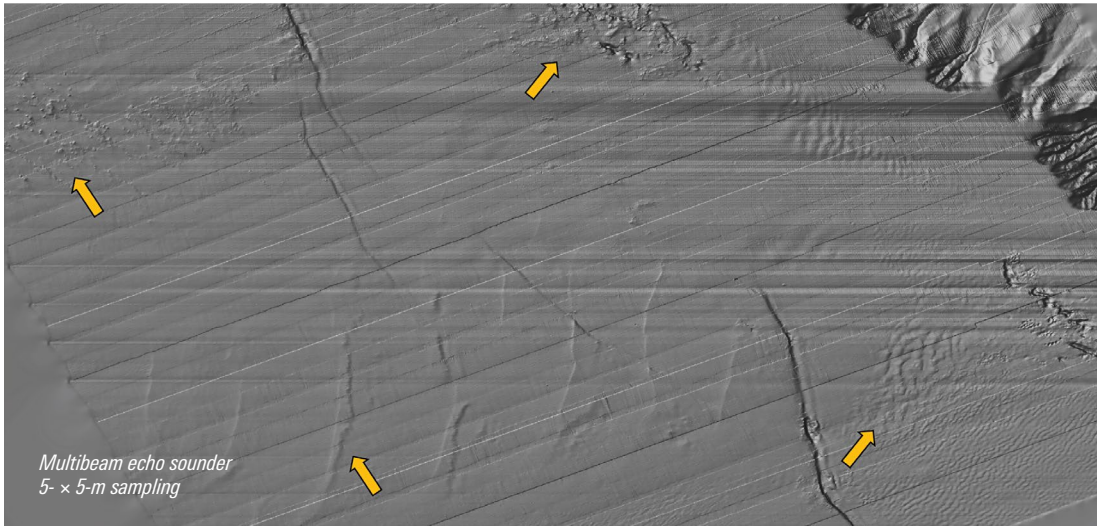
An IsoMetrix technology survey was acquired offshore Malaysia in water depths ranging from 80 m to more than 1,000 m. This high-resolution image of the seafloor was obtained using a 10- × 100-m streamer spread, which is more typical of exploration surveys. Fine-scale details in the rugose seafloor are captured, even when orientated parallel to the acquisition direction and with a scale less than the 100-m streamer separation.



Images courtesy of IPA
"Dip or Strike? – Complementing Geophysical Sampling Requirements and Acquisition Efficiency for Towed Streamer Marine Seismic,"
IPA Annual Convention, Jakarta, 2016

The lower image shows a portion of a high-resolution seafloor image that was acquired with a 5- × 5-m density. Extracting the same horizon from the IsoMetrix technology data reveals corresponding details. IsoMetrix technology was not designed to replace a dedicated shallow hazard technology, although it is encouraging that this type of resolution is achievable even with a 100-m cable spacing more often used for exploration surveys.





Images courtesy of IPA
"Dip or Strike? – Complementing Geophysical Sampling Requirements and Acquisition Efficiency for Towed Streamer Marine Seismic,"
IPA Annual Convention, Jakarta, 2016

Advanced velocity model building and imaging

IsoMetrix technology was combined with full-waveform inversion (FWI) to generate an accurate velocity model of the overburden and to reduce uncertainty in reservoir sand definition over the Mariner field in the North Sea.

The FWI updates benefited from low-frequency signal provided by the deep, flat tow of IsoMetrix technology acquisition. Compared with a legacy depth migration model, FWI captured high-resolution detail defining the various small-scale channels across the area as well as high- and low-velocity heterogeneities in the deeper section.

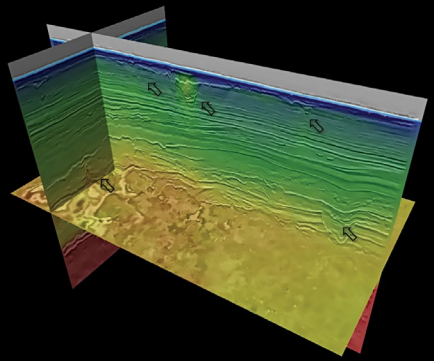
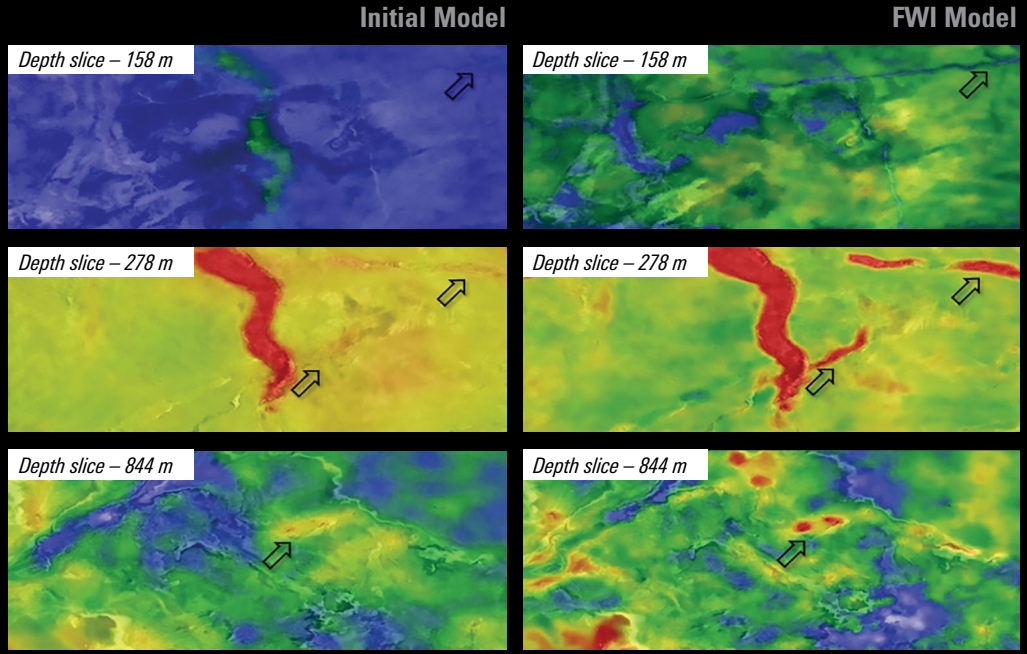
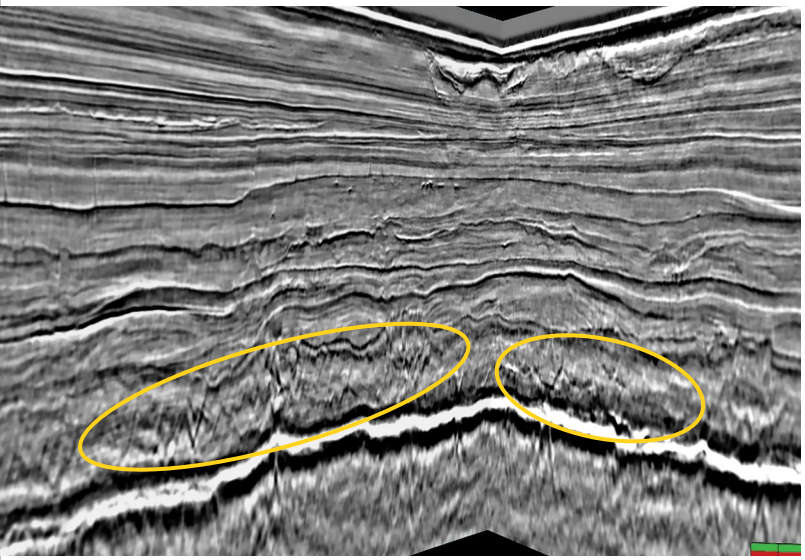


Image courtesy of Schlumberger, Ltd.
Published in Oilfield Review, *May 2016.*

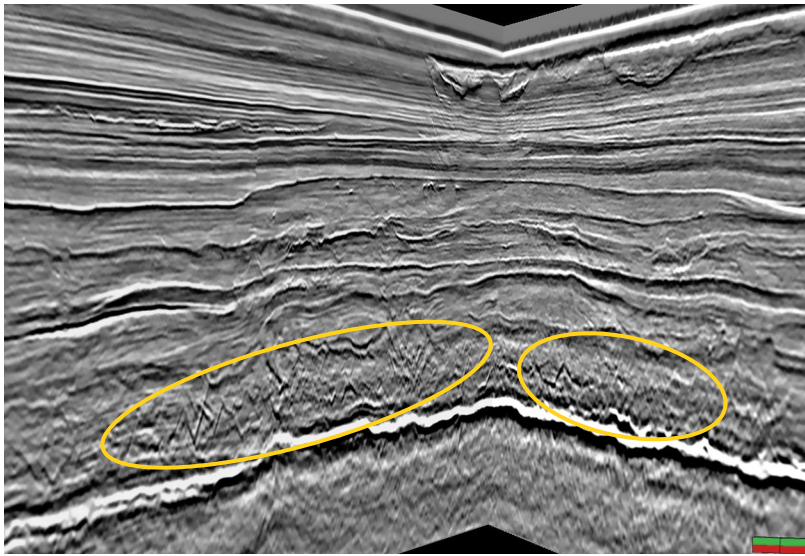


The FWI velocity model was combined with a high-frequency 100-Hz reverse time migration (RTM), enabling migration direct from the native shot domain. This is compared with an equivalent image derived using Kirchhoff depth migration and a legacy tomography model after regularizing in the offset domain. Note that both images used the same IsoMetrix technology data as input.

The highlighted areas demonstrate further improvement in discrimination of the target injectites from the background shales, helping build confidence in the reservoir model.



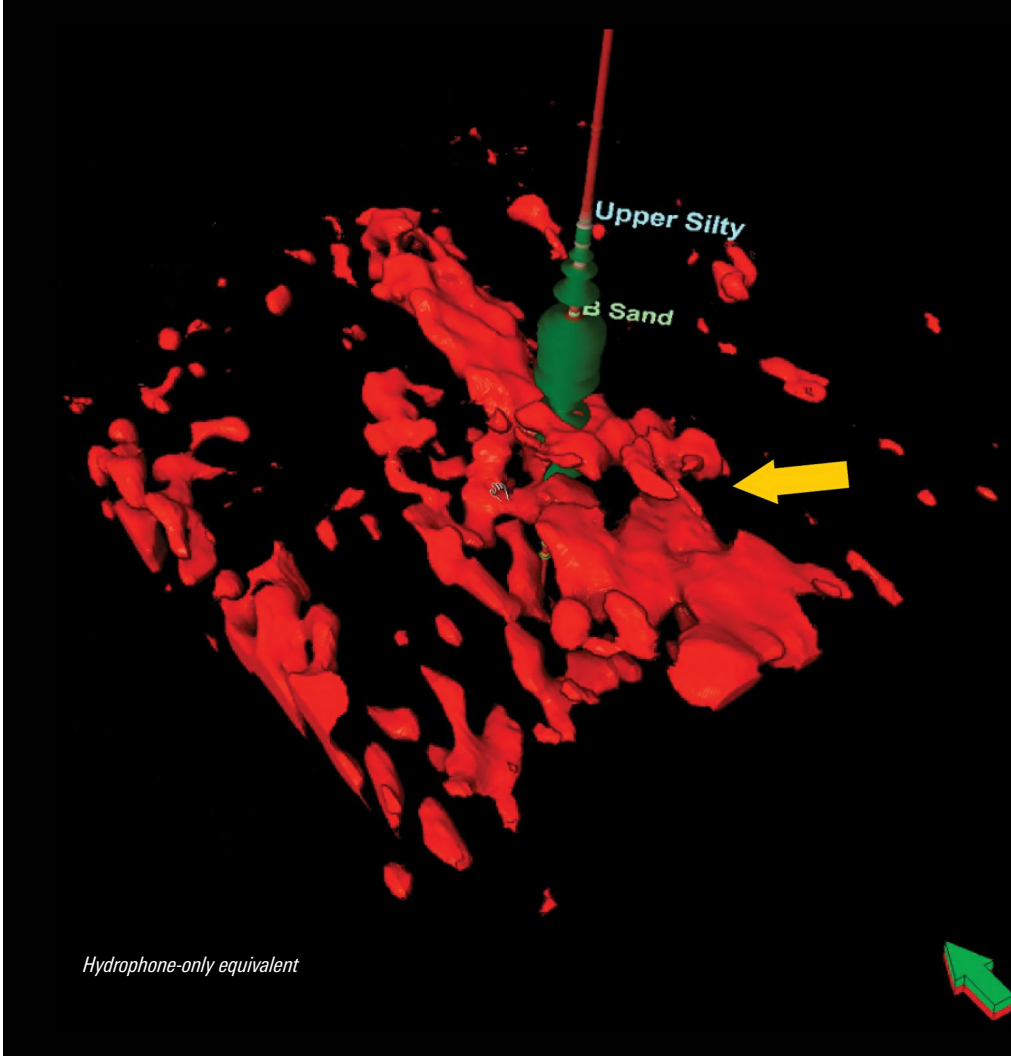
Legacy model with Kirchhoff depth migration.

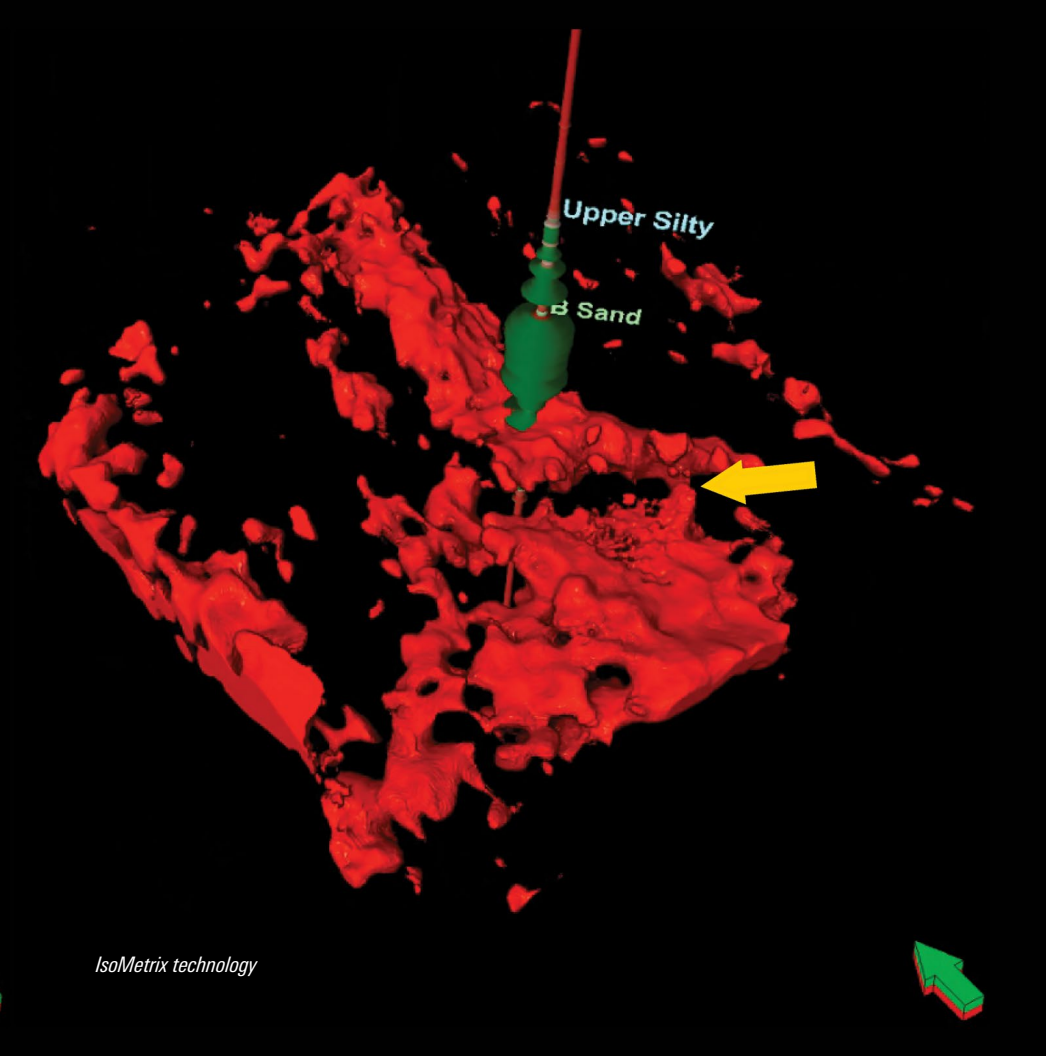


FWI model with 100-Hz RTM migration.

Detailed reservoir characterization

Sometimes it is the smallest detail that is the most important. This example shows geobodies extracted from a prestack inversion cube from two datasets in the vicinity of the Bruce field in the North Sea.





IsoMetrix technology

The IsoMetrix technology volume clearly delineates a small east–west–oriented fault that separates the reservoir interval into two compartments. The comparison dataset was generated using only the hydrophone measurements from the same IsoMetrix technology data, creating a conventional system equivalent.

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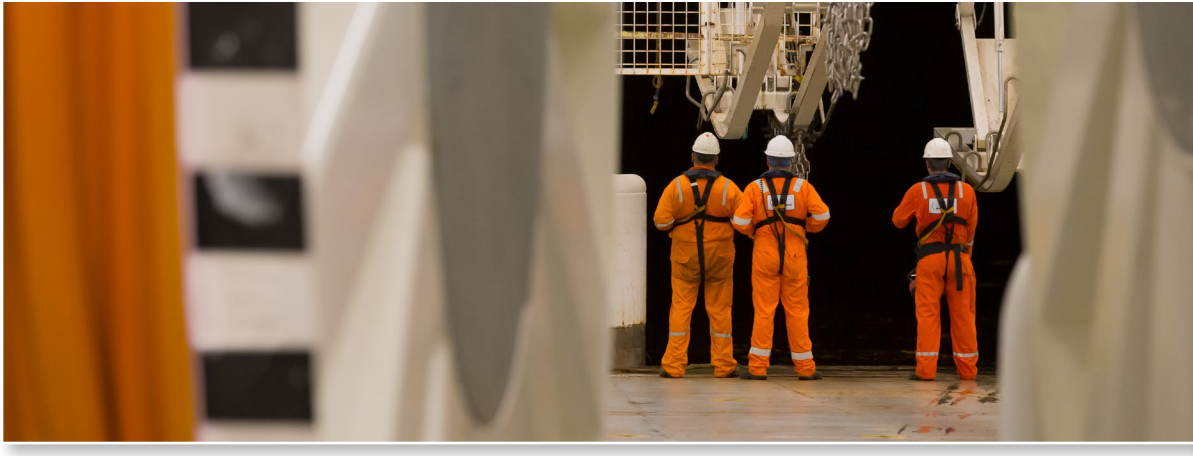

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