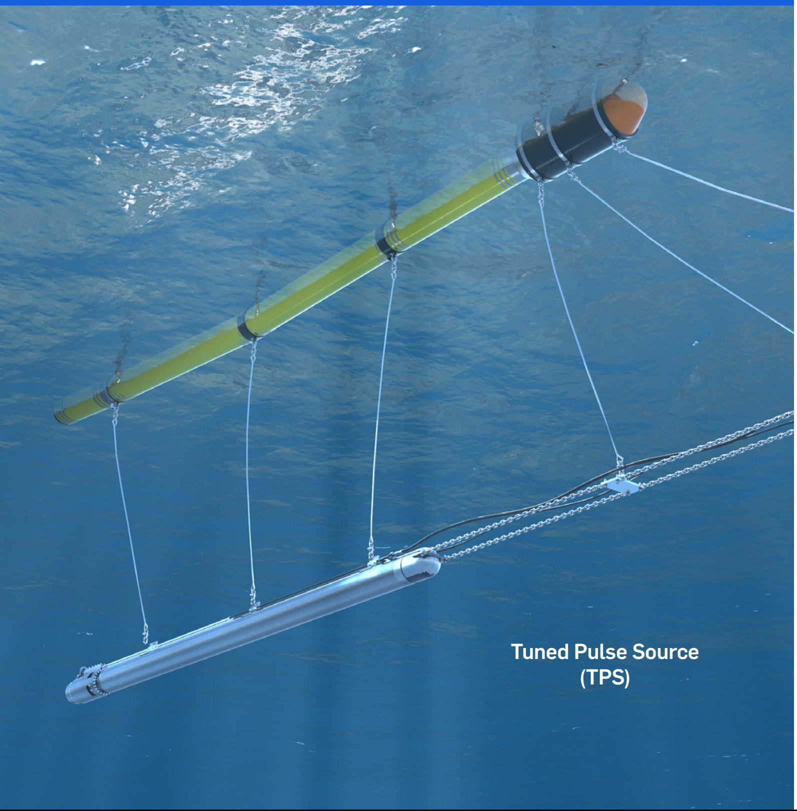
SERCEL
A Viridien Business

# CASE STUDY

## Optimizing broadband seismic OBN source and receiver comparison

## PROJECT SNAPSHOT

This case study from an OBN survey in Southeast Asia evaluates alternative acquisition solutions against conventional OBN configurations.
Two seismic sources and two seabed sensor technologies were deployed side by side under identical conditions, to enable a direct and unbiased performance comparison.
The results show that the Sercel solution delivered **significantly stronger low-frequency content, up to 20 dB improved vector fidelity**, and **lower instrument noise**, enabling **more consistent acquisition and sharper, more reliable broadband imaging**, and confirming **its value for next-generation OBN acquisition**.




## CHALLENGES

- **Ability to image deeper structures**
  Limited low-frequency energy makes it harder to image deeper structures with clarity.
- **Vector fidelity and high levels of noise impacting 3C data quality**
  Conventional sensors struggle to record stable vector data, which affects the accuracy of multi-component measurements.
- **Reliable broadband acquisition**
  Inconsistency in source and receiver performance reduces the effectiveness of FWI model building.

## SOLUTIONS OVERVIEW

To address the project's imaging and operational challenges, the customer selected Sercel for its proven ability to deliver high-quality subsurface imaging and improved productivity.
Sercel's GPR300 is equipped with the QuietSeis 3C MEMS sensor and operates reliably at depths up to 300 m with 60 days on a single battery cycle. The sensor's unmatched digital fidelity and ultra-quiet performance enable the most accurate measurement of seismic signals. TPS is an innovative low-frequency broadband marine seismic source that enhances geophysical clarity by improving low-frequency content while also offering important environmental benefits.
Together, they form a powerful combination for high-quality broadband OBN and shallow water seismic acquisition.

# OUR APPROACH

In this OBN survey, we used two types of sources: an array of Conventional Airguns (CAGs) and the TPS. The data were recorded by co-located OBNs of two types: standard geophones and QuietSeis MEMS sensors.

## SOURCE COMPARISON

The sources were deployed from the same vessel. The CAGs were deployed in a staggered flip-flop configuration, with each array consisting of two sub-arrays and spaced 50 m apart between the port and the starboard. The port array was 16.67 m ahead of the starboard array. The TPS was deployed in the middle, behind the vessel. Each CAG array was fired twice for each TPS shot, resulting in four CAG shots for every TPS shot. There were 25 m along the sail line between CAG shots and 100 m between TPS shots. The staggered flip-flop pattern was designed to produce a square shot carpet. The sail line separation was 100 m, resulting in a woven carpet of 50 x 50 m CAG shots and 100 x 100 m TPS shots.

### Fourier Transform

Fig.1 shows the geometry, continuous common receiver gather data, and phase rings. Phase rings were produced by Fourier transforming the data, calculating the phase as the arctangent of the real and imaginary components, and then extracting frequency slices. The phase rings show that the TPS has a much stronger low-frequency signal compared to the CAG.

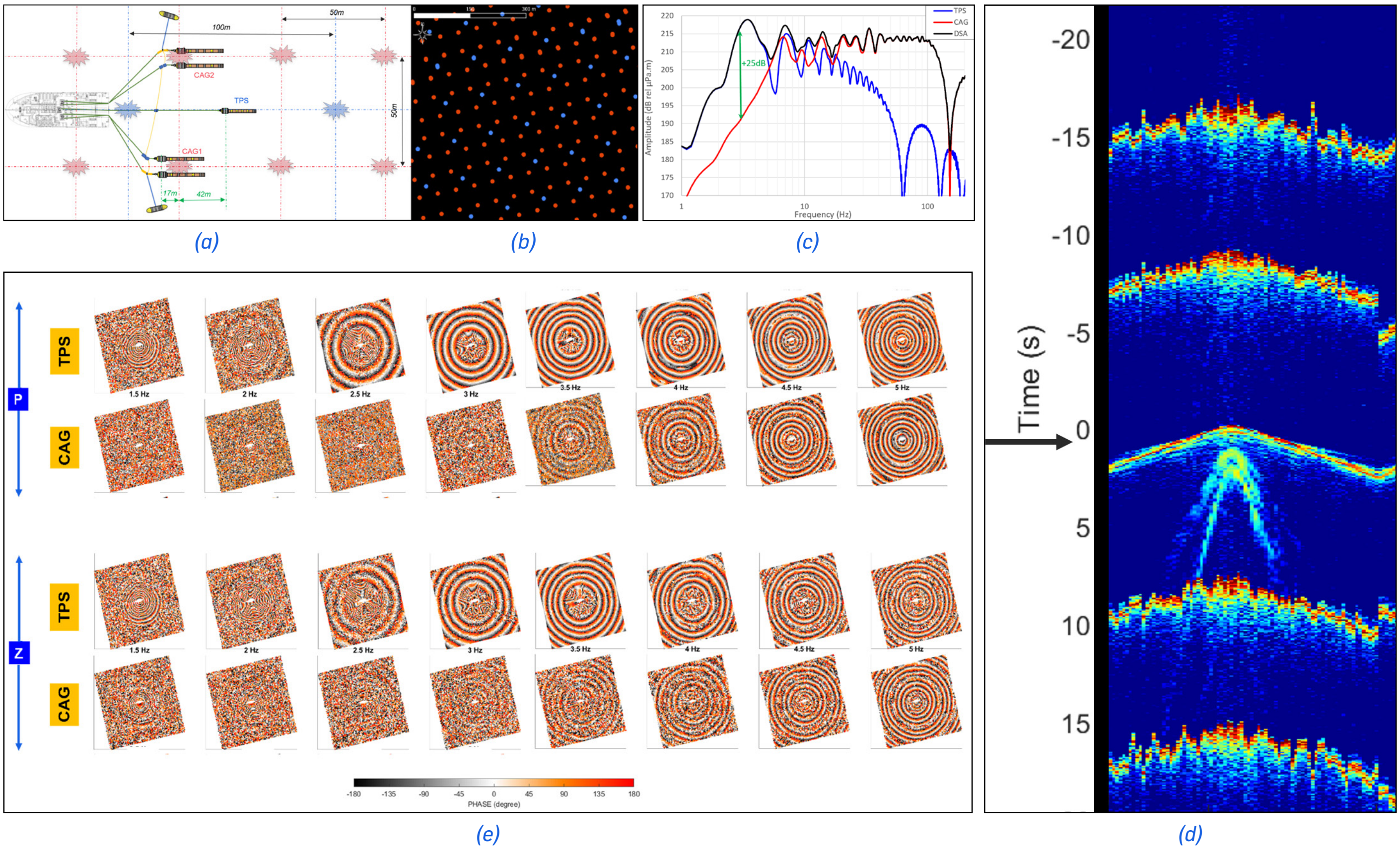



*Fig.1. (a) Source boat configuration. (b) Woven shot carpet. (c) Spectra. (d) Blended data chunked on the TPS. Note the saturation overdrive (darker than red) affecting the airguns more than the TPS. (e) Phase rings show better low-frequency signal from TPS than from conventional airguns.*

## KX-KY DOMAIN ANALYSIS

Further analyses were performed in the kx-ky domain which helps to isolate true seismic energy from noise. In this domain we expect to see a circle whose radius corresponds to the propagation of sound in water (1,500 m/s). Everything inside the circle represents seismic signal, while everything outside corresponds to instrument and environmental noise.

| Parameters | |
|---|---|
| Water velocity | 1,500 m/s |
| Delta x | 100 m |
| Delta y | 100 m |
| Frequency | 1.5 Hz |

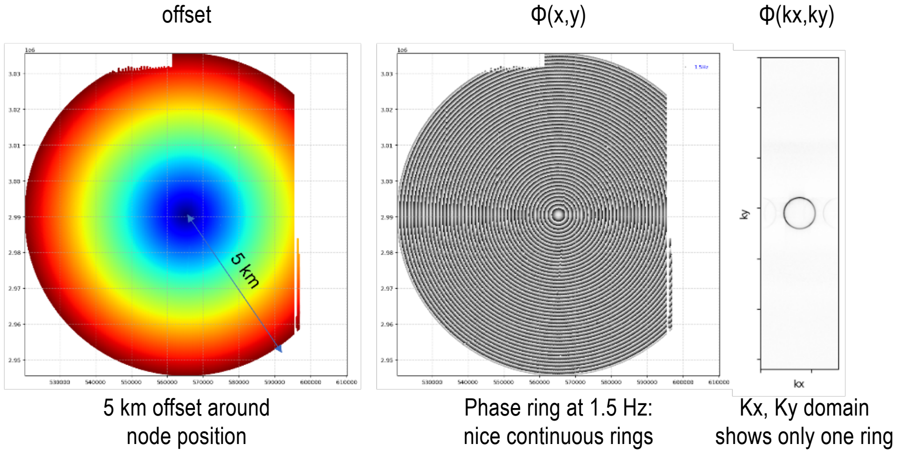



*Fig.2. A simulation example at 1.5 Hz with a 5 km offset around the OBN location.*

The figures below clearly indicate that the TPS produced a stronger and more coherent low-frequency signal footprint, while the conventional airguns showed more scattered noise. These results confirm the TPS advantage in delivering broadband low-frequency content critical for deepwater imaging.

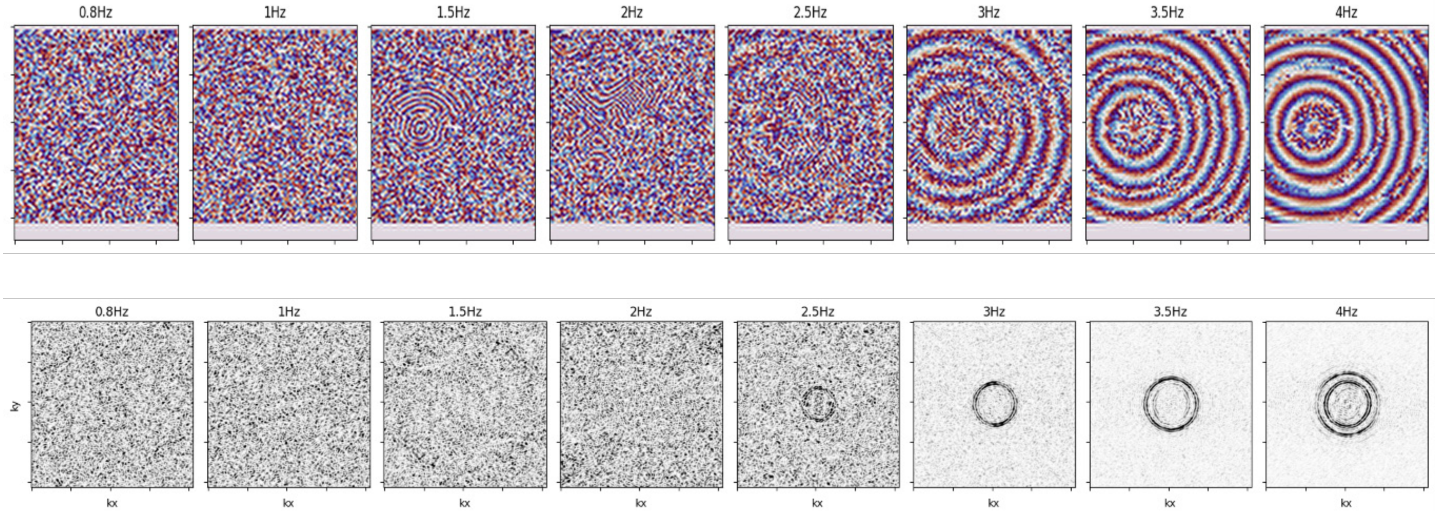



*Fig.3. Phase rings X,Y and KX,KY plots. conventional airguns. (bin=100x100)*

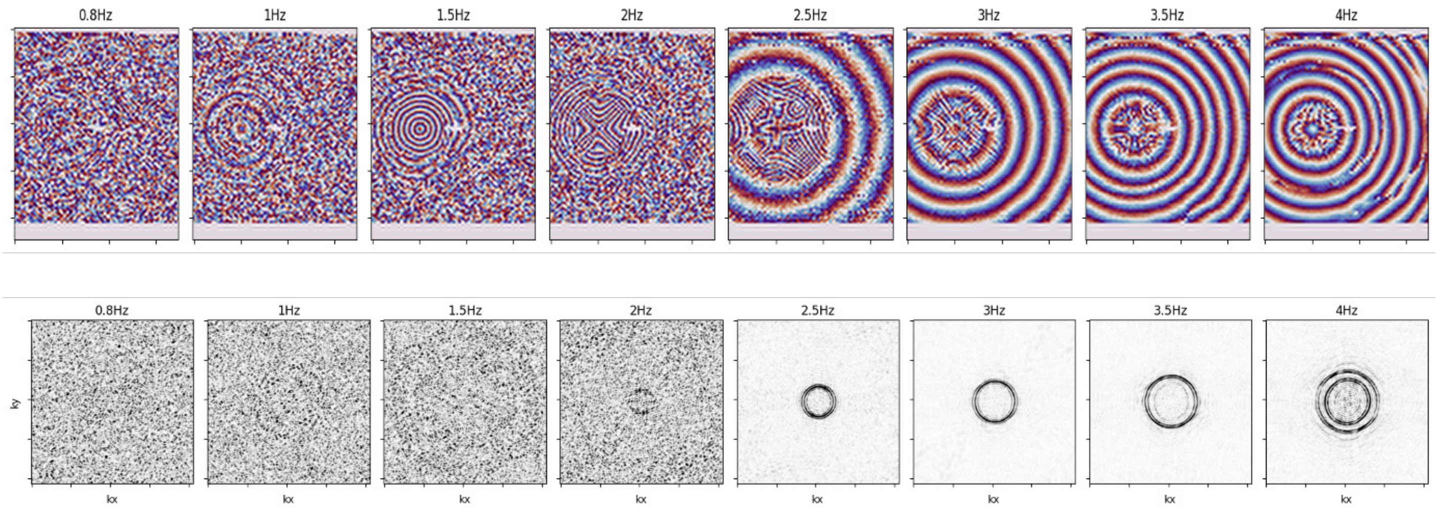



*Fig.4. Phase rings X,Y and KX,KY plots. TPS. (bin=100x100)*

## RECEIVER COMPARISON

We used the transverse component of the direct arrival as an attribute indicative of vector fidelity. The direct arrival wave traveling through the water was radial. Direct arrival energy recorded on the transverse component was an indication of vector infidelity that might be due to spurious sensor response to waves arriving from an orthogonal direction to the sensor, residual tilt that was not recorded accurately, or components that were not exactly orthogonal.

Fig.5 shows the results of the transverse component analysis. The time window was narrow on the direct arrivals. Only the direct arrivals traveling through water were purely radial. Surface waves and refractions can come from the side and contain non-radial waves. A low-cut filter was used to attenuate surface waves. The QuietSeis MEMS sensors had much less energy on the transverse component.

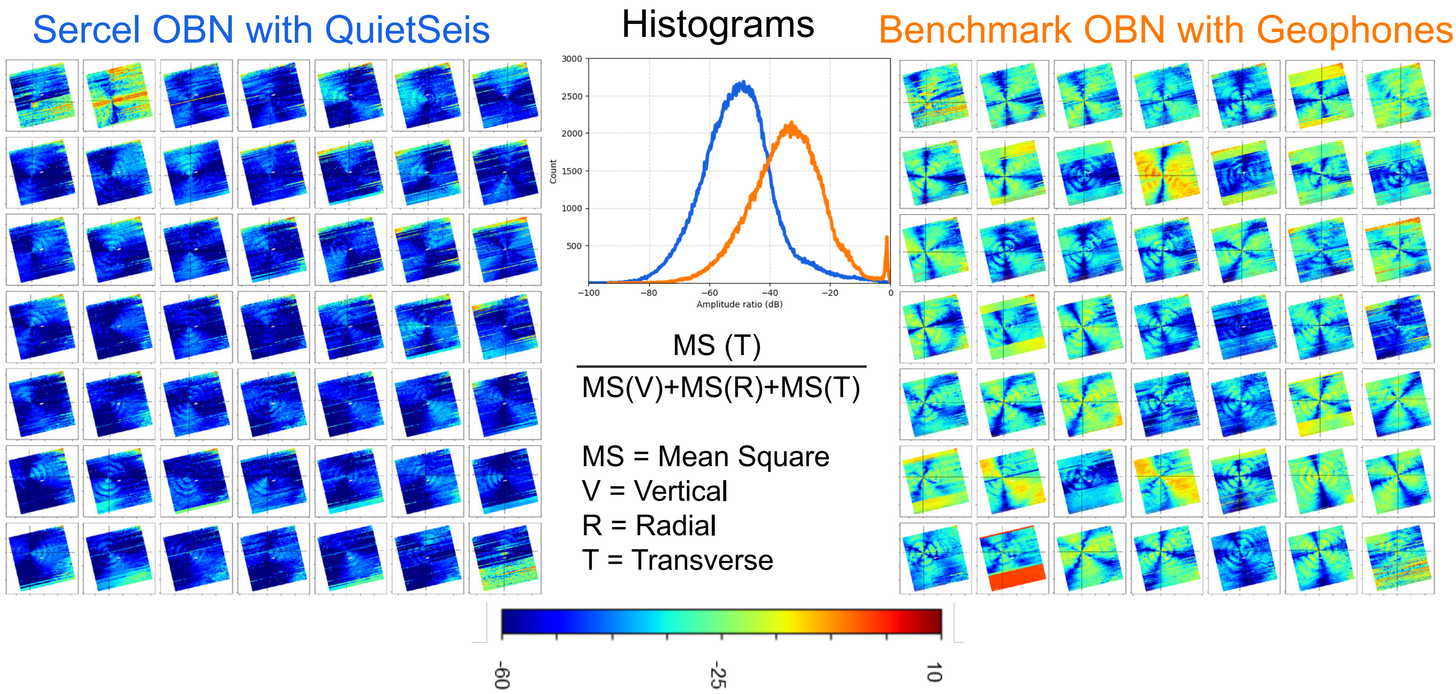



*Fig.5. Maps of the ratio between the mean square amplitude of the transverse component of the direct arrival and the mean square amplitude of all three components. (a) Sercel GPR nodes with QuietSeis MEMS. (b) Benchmark OBNs with geophones (c) Histograms with QuietSeis in blue and geophones in orange. There is a 20 dB lateral difference between the peaks of the histograms.*

## RESULTS

This case study clearly demonstrates that QuietSeis MEMS GPR300 nodes, together with the TPS, deliver excellent low-frequency performance and unmatched vector fidelity compared to standard geophone OBNs and airguns.

For operators seeking to get the most out of their broadband seismic data, this combination offers the best OBN acquisition solution on the market today.

- **Stronger low-frequency content from TPS**
- **Up to 20 dB better vector fidelity from QuietSeis MEMS**
- **Lower instrument noise for consistent, repeatable results**
- **Sharper, more reliable broadband imaging**
- **A proven solution for high-quality next generation OBN acquisition**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