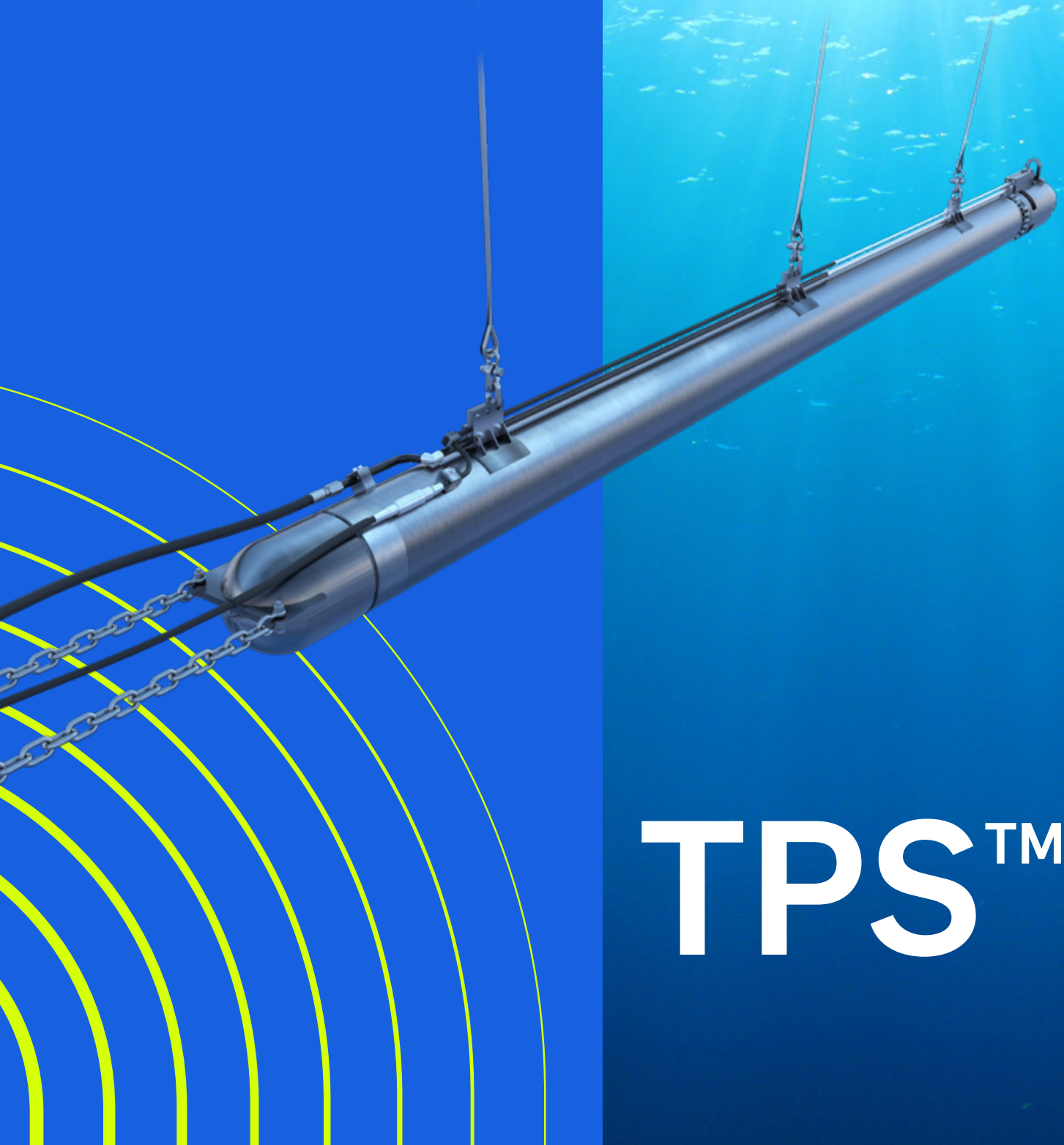




SERCEL

A Viridien Business



TPS™

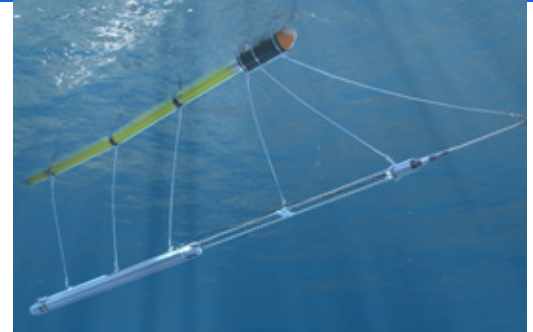
INNOVATIVE LOW FREQUENCY BROADBAND
MARINE SEISMIC SOURCE



TPS™ (TUNED PULSE SOURCE)

A UNIQUE LOW-FREQUENCY ALTERNATIVE TO AIRGUNS

TPS is Sercel's response to a market need for an enhanced low-frequency source that produces a broader bandwidth and reduced environmental impact. TPS provides geophysical clarity by enhancing the quality and value of seismic data and enabling effective imaging of the most complex geologies. It has been successfully deployed in commercial marine acquisition operations.



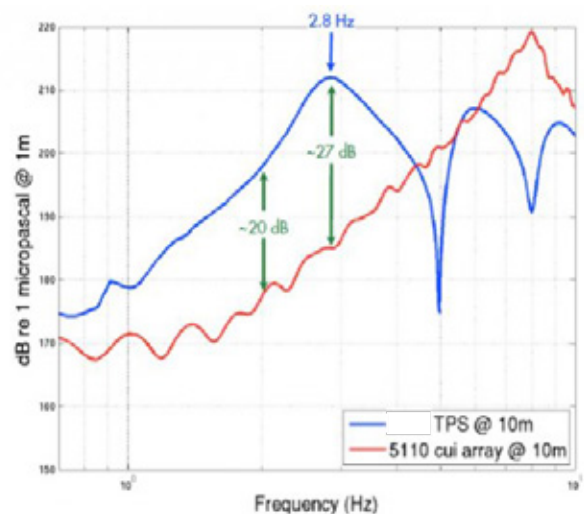
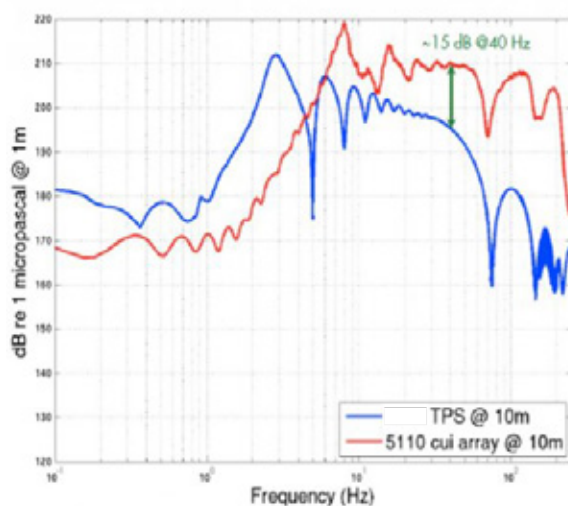
INDUSTRY CHALLENGES

Complex geologies, such as sub-salt, intra-basalt, and chalks, contain some of the most attractive E&P opportunities. In contrast, poor seismic signal penetration in these areas leads modern model algorithms like FWI to perform inefficiently, resulting in cycle skipping. Cycle skipping causes velocity models to generate seismic images that do not accurately depict the subsurface, which impacts prospect identification, well placement, and project life cycles. There is also an increasing need to reduce high-frequency noise to minimize the environmental impact of active seismic surveys.

- **Unrivalled low frequency content <3Hz** – enables effective imaging of complex geologies and deep targets.
- **Improved signal-to-noise ratio** – leading to superior data quality and optimized seismic acquisition.
- **More efficient model building** – eliminates cycle skipping in FWI.
- **Environmentally friendly** – minimized high-frequency content and reduced exclusion zones for marine fauna protection.
- **Simplified operations** – easier deployment and retrieval reduce HSE risks and ensure marine regulatory compliance.

OUR SOLUTION

Sercel's new source, TPS, is the best in class in respect of its very low-frequency content. It is unique in that it can generate the highest amplitude signal at frequencies of less than 3 Hz, which are critical for developing velocity models for complex geologies, deep targets, and very long offsets. TPS is also one of the most environmentally friendly source options in the industry today due to its reduced high-frequency emissions. Our source is available for proprietary and multi-client operations.



GEOPHYSICAL BENEFITS

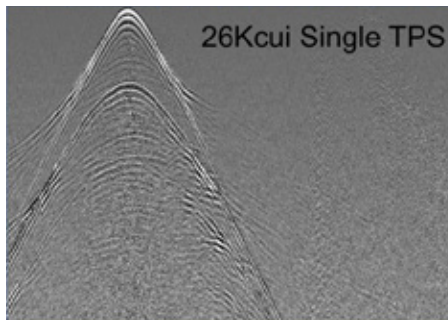
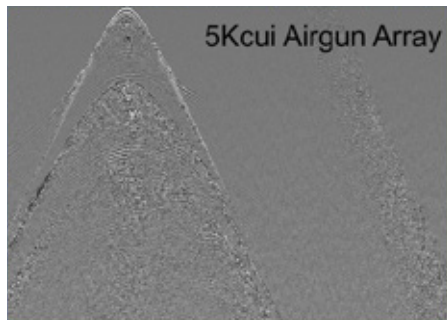
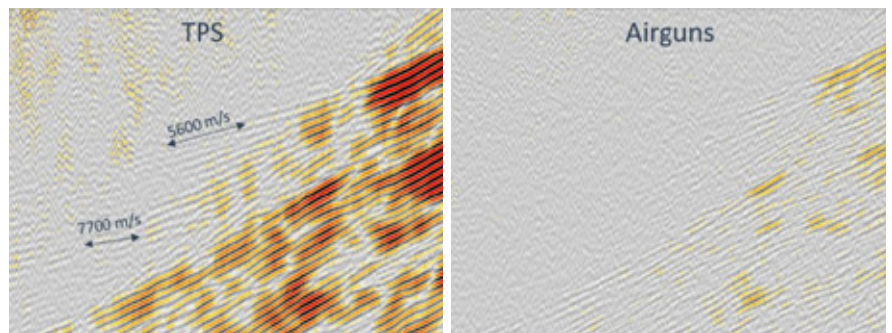
IMAGING DEEP TARGETS AND COMPLEX GEOLOGIES

Increased low frequency content

TPS generates a signal that contains an additional octave and a half beyond that of conventional sources.

The low-frequency content allows for deeper and more efficient seismic wave penetration, making the TPS significantly superior for imaging targets under complex overburden such as sub-salt and sub-basalt.

Low frequency signal enables building blocky reservoir models with less need for well logs. Broader band data improves resolution by reducing interference resulting from wavelet side-lobes.

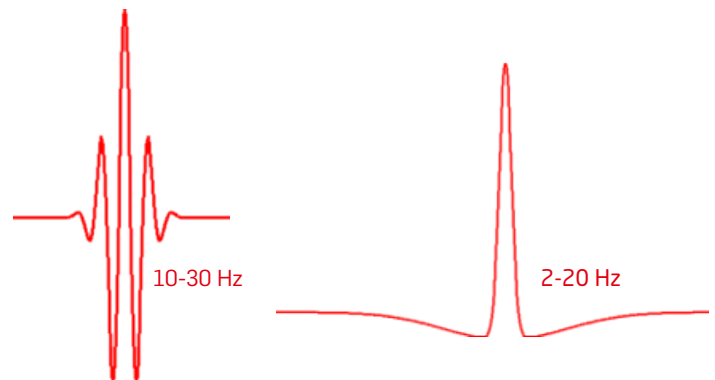


Common receiver gathers comparing data from an array of airguns whose total volume was 5110 cubic inches (left) to a single 26.5 thousand cubic inch TPS (right). Only spherical spreading gain was applied to the data.

The TPS is designed to optimize air release in order to generate the most efficient bubble with good broad-band emissions. By enhancing the signal-to-noise ratio in the low-frequency part of the seismic spectrum, TPS enables clearer detection of subsurface structures at longer offsets.

Velocity model building

TPS also enables the construction of velocity models with full waveform inversion (FWI) and the mitigation of local minima in fitting models to data (also known as cycle skips). FWI encompasses a range of methods that leverage the full waveform to create accurate velocity models. These methods incorporate reflections, refractions, primaries, multiples, body waves, and surface waves. The primary goal of FWI is to estimate the earth model that best fits the data, with a focus on minimizing misfit and maximizing stack power.

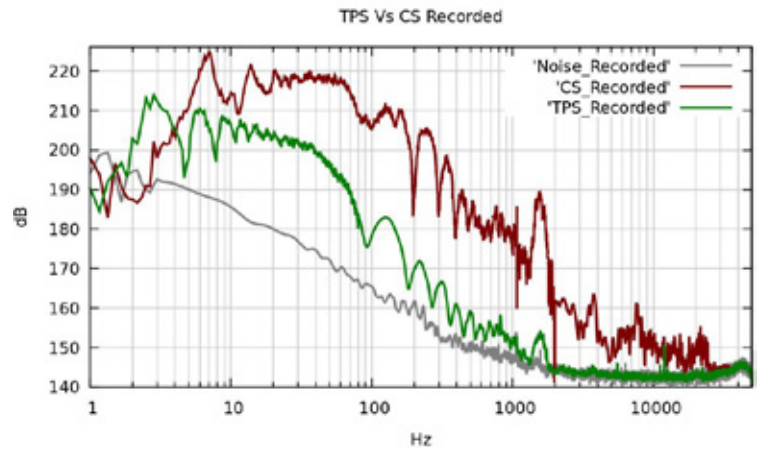


ENVIRONMENTAL BENEFITS

MINIMIZED HIGH-FREQUENCY CONTENT

The higher frequencies of acoustic noise generated by marine seismic sources may interfere with the communication range of marine mammals. TPS significantly reduces these high-frequency emissions, which minimizes potential wildlife disturbance.

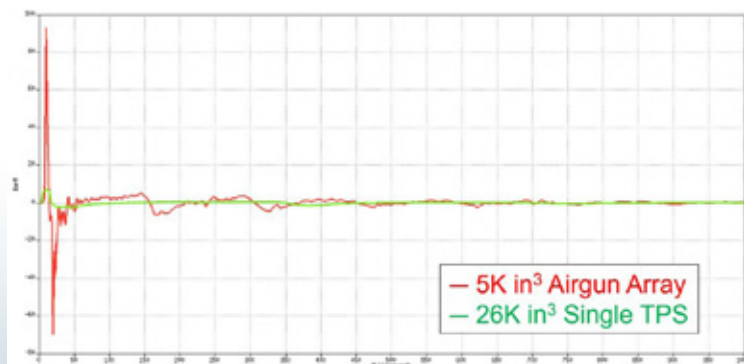
In the time domain, TPS's maximal Sound Pressure Level is lower, the rise time of the main peak is longer, and the maximal slope is lower.



Data shown is from an OBN with 10 microsecond sampling interval hence the Nyquist frequency is 50 kHz. Note that the TPS does not emit waves above 1500 Hz while the Airguns' upper limit is 25 kHz.

REDUCED EXCLUSION ZONES

We claim that TPS can support a significantly smaller exclusion zone than a conventional source array. Most of the energy generated by our source is infrasound and has no effect on marine mammals or persons on board vessels.



Note that the zero-to-peak sound pressure level of the air-gun array at 92 Bar-Meter is 13 times (22 dB) higher than the TPS at 7 Bar-Meter.



OPERATIONAL BENEFITS

SIMPLIFYING OPERATIONS

Easier deployment and retrieval

TPS arrays contain fewer components, all of which are located under a single float, allowing for easier deployment and retrieval, improved source steering and positioning control, and reduced shot-to-shot variations caused by sub-arrays drifting cross-line. In addition, the design of TPS enables improved cross-line sampling and has increased tolerance to bad weather.

TPS has been deployed and tested using both rigid and flexible floats, with quick and easy integration into existing float designs. The deployment of a dual TPS took one-sixth the time it took to deploy a dual conventional source from the same vessel.

Improved Safety

Auto-fire is a major risk in marine pneumatic sources when draining the air. Unlike conventional sources, the TPS has a safe method that includes a check valve. The check valve ensures that the pressure in the operating chamber is very low and keeps the TPS closed so that it does not auto fire when the air is being drained at sea.



VALUE ADDED SERVICES

TPS is offered to customers as a service solution through which our experts will provide 24/7 support during the three phases of a project:

- **Pre-survey**, including source modeling for survey design and optimization, full system design and integration, exclusion zone evaluation for permitting, and support for risk management.
- **During the survey**: technical personnel onboard, turnkey solutions including maintenance and repairs, support for acoustic source data monitoring and analysis.
- **Post-survey**: NFH and sensor data processing for deterministic signatures.

GETTING THE MOST VALUE OUT OF YOUR BROADBAND SOURCE

TrueBroadband

Delivering effective broadband data requires the right hardware, software, field implementation, and advanced acquisition scenarios to extend bandwidth and preserve signal quality. Over the last decade, Sercel has made significant advances in equipment design to achieve this goal and meet the expectations of both seismic contractors and data end-users. Our experts work closely with each customer to develop a solution for optimal survey performance.

#TrueBroadband 

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