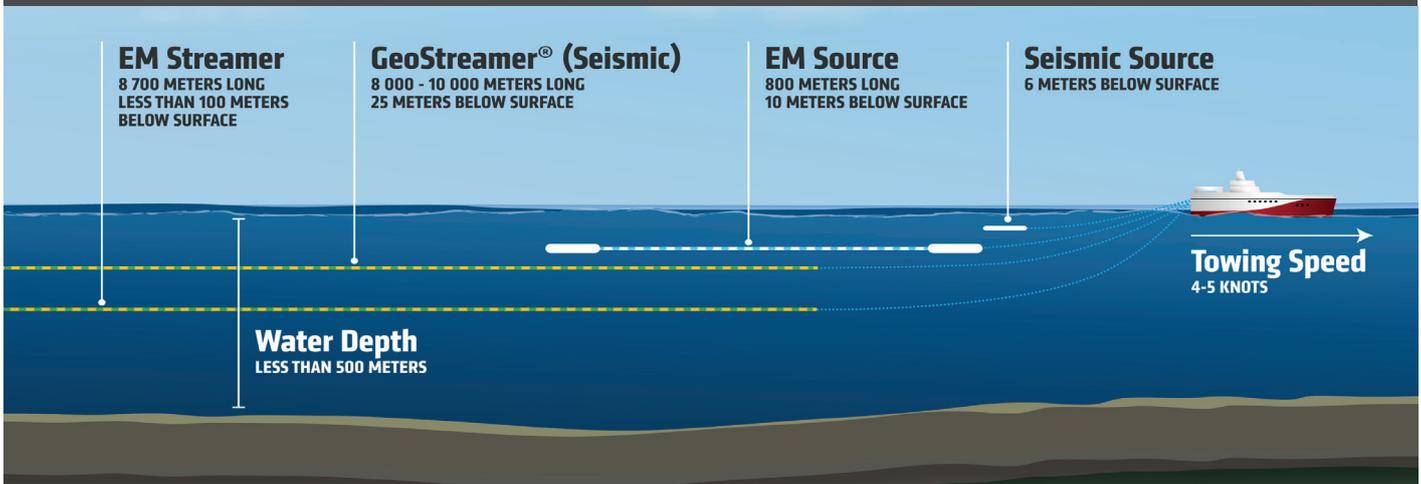


TechNote

Towed Streamer EM



Towed Streamer EM – Survey Design and Acquisition

Towed Streamer EM delivers high density 3D CSEM data with exceptional acquisition efficiency. Daily acquisition rates in the order of 140 sq. km are frequently achieved with the current record at over 200 sq. km in a single day. PGS acquires 2D GeoStreamer® data simultaneously with EM data, or 3D EM data over existing or planned 3D seismic.

Survey Design

To improve understanding of a basin or a large area of frontier acreage consideration should be given to a simultaneous 2D GeoStreamer® and Towed Streamer EM regional survey. With line spacing in the order of a few to tens of kilometres, a grid which can be tied to appropriate wells delivers 2.5D resistivity sections collocated with 2D broadband seismic data. This is in contrast to PGS' typical line spacing of 1km for exploration 3D CSEM surveys, this line spacing provides an ideal balance between efficient acquisition of a 3D survey and the required lateral sensitivity

to enable 3D CSEM inversion. The minimum line length required for accurate inversion results and to understand the background resistivity in relation to that of the target is in the order of 25 km, with a full streamer length run in and run out.

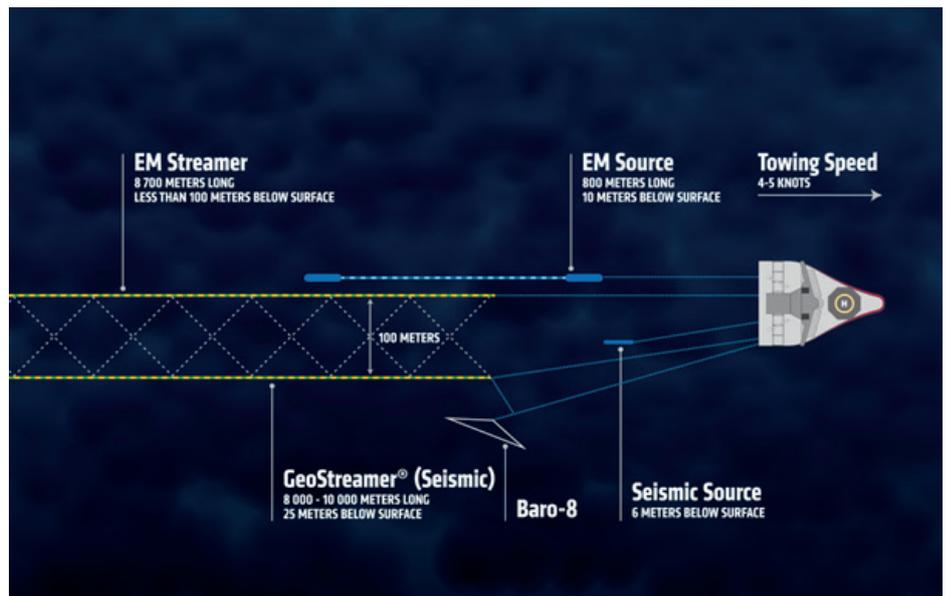
EM Data Acquisition

The EM streamer is deployed at a depth of between 25 and 100 meters depending on water depth in the survey area. This ensures that the signal to noise ratio is optimised while enabling the vessel to maintain acquisition speeds of 4 to 5 knots, so operational efficiency

KEY BENEFITS

- More data, less cost
- High density large-scale regional surveys
- 1 survey for the entire lifecycle of the project – multiple applications (from exploration to RC)
- 1 vessel – 2 independent complementary datasets

is maintained. The length of the EM streamer is configurable depending on the aims of a specific survey, during standard acquisition it is 8 700 m long. Typically this provides an offset range of between 1 500 and 8 000 m when it comes to selecting data for inversion. With 72 receivers of between 200 to 1 100 m between receiver pair electrodes in the EM streamer this broad range of offsets enables target driven data selection for inversion. This benefit is amplified by the range of frequencies from 0.1 to 10 Hz, but this sweep can be optimised for specific targets. Towed streamer EM surveys are generally optimised for efficient acquisition; the high density data acquired enables improved resolution and more reliable sub-surface imaging.

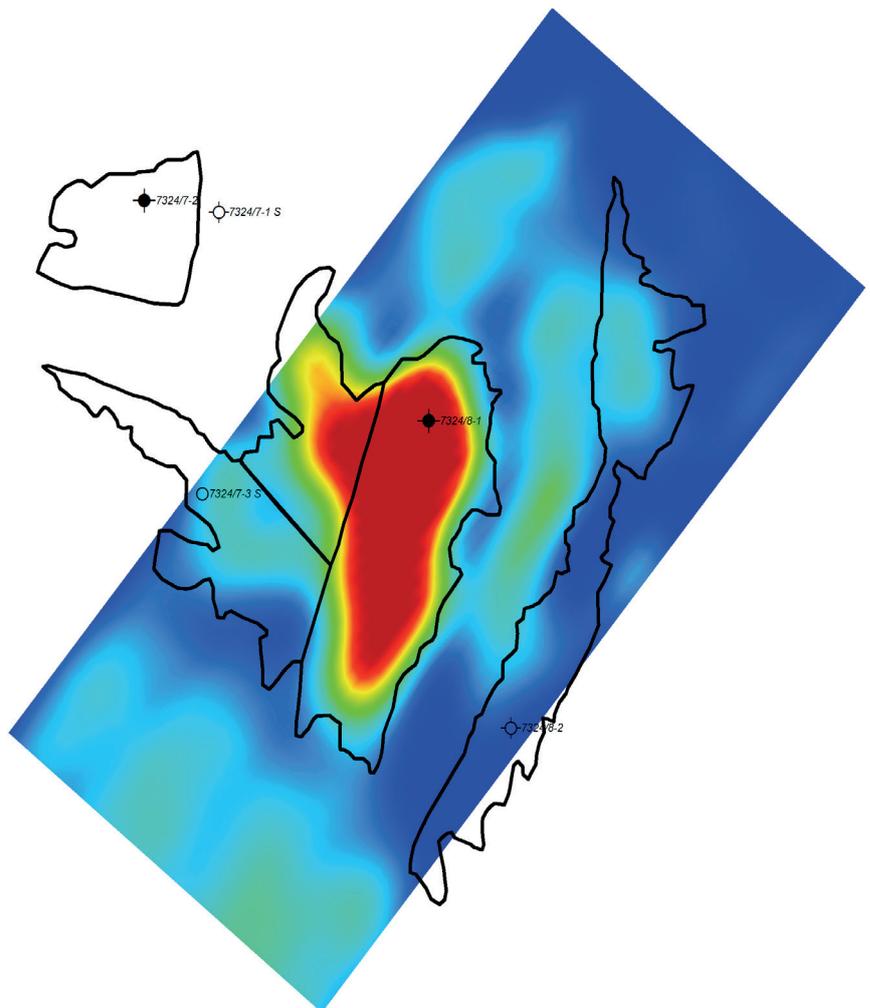


Plan view of towing setup for simultaneous acquisition of 2D GeoStreamer and EM data using a single vessel

Resistivity in Context

Interpreting resistivity information with structural data from seismic is key to forming a more accurate understanding of the sub-surface. But when we consider resistivity in context it isn't just in relation to seismic data, rather there is context within the resistivity data itself. To enable identification of areas of potentially interesting anomalous resistivity it is important to understand the underlying background trends. The high daily acquisition rates achievable using Towed Streamer EM acquisition provides cost effective imaging of a significant area, ensuring reliable interpretation.

High density data, rich in both frequencies and offsets enables a wider range of application of CSEM data compared to traditional methods. Frontier exploration and prospect derisking on a large scale remain valuable applications, but Towed Streamer EM offers value in field delineation, reservoir characterization and drilling hazard identification, providing value throughout the exploration life cycle.



Reservoir scale application – Depth slice of 3D resistivity volume at 700 m, Wisting, Barents Sea