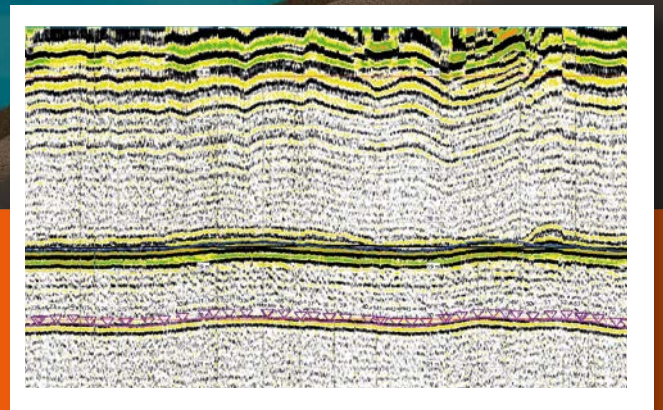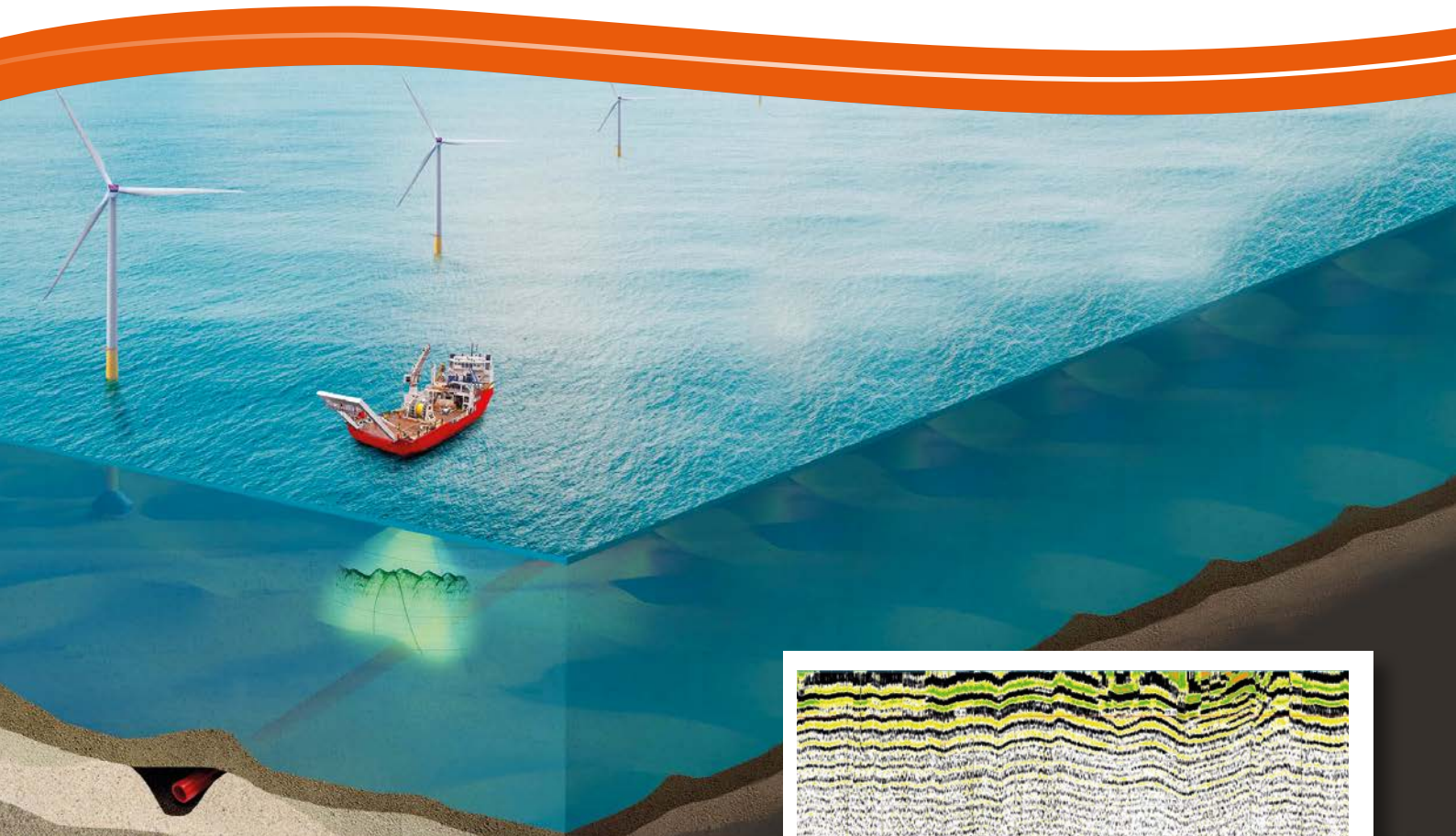# SILAS 3D

3D Seismic Sub-Bottom profiler

SILAS 3D

3D Seismic Sub-Bottom profiler

Specifications

Acquisition

Digital high resolution seismic acquisition. Real-time data and live line trace monitoring including real-time output of depth values, including bottom layers. Real time centimetric correction for all directional movements (heave, pitch, roll). Detailed positioning of the center point use of dedicated beam patterns.

Application of real time and off-line Synthetic Aperture Processing and filtering techniques. Recording of all data, including seabed. Real time tracking of seabed in seismic data.

Processing

Silas 3D

Digital seismic processing package that enables the user to identify, analyze and interpret the geological features and objects found in the sea bottom.

With features such as:
- 3D plan view display
  Depth of Burial & Depth of Cover
  Exact measurement and application
  of the
- configuration of system of seismic sources and receivers
- Autodetected seabed detection for all beams
- Import both 2D and 3D data
- Offline check of seismic data with data of auxiliary systems (such as multibeam).

Contact detection

User controlled data determination of observations and related objects (contacts).

Matrix import

Silas module: displays multibeam or gridded data loading in seismic records to check against or match with height data.

Frequency filtering

Silas advanced signal processing modules for S/N enhancement providing a wide range of frequency filters.

GeoTiff mapviewer

Import of geo-tiff data (multibeam, sss, geological map etc) and presentation in plain view.
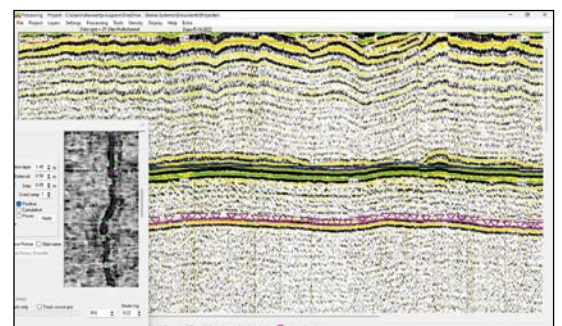
*S3D Results near real time: longitudinal sections*

Silas 3D is a complete data acquisition, processing and interpretation system, that covers a wide range of tasks and shows live line tracking in the helmsman display.

The SILAS S3D system is a passive cable detection system which uses an acoustical pinger source. The sound source consists of an array of transducers which are mounted in a frame over the side of a vessel, on a ROV or depressor. This sound source in turn is connected to a transceiver which actually sends the signal Reception of the signal is executed by an array of hydrophones mounted on a frame. The signals sent by the transducer array are not in all directions the same due to the fact that the transducer array geometry has an elongated shape. The axis through the array of the transducers is located parallel to the vessel sailing direction and results in the largest beam angles perpendicular to the sailing direction. Pipeline and cable contacts are detected by sailing longitudinal lines over and parallel to the object. The beam pattern of the Silas 3D cable detection system is approximately elliptical. The system combines high penetration with ultra-high resolution, allowing for detailed interpretation and object detection.
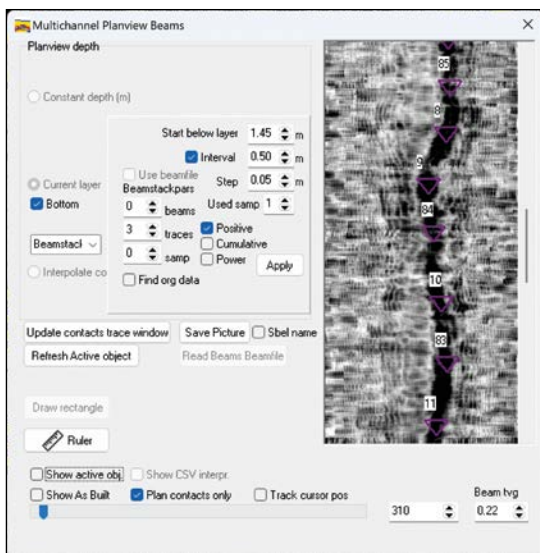
Silas 3D Helmsman display detection
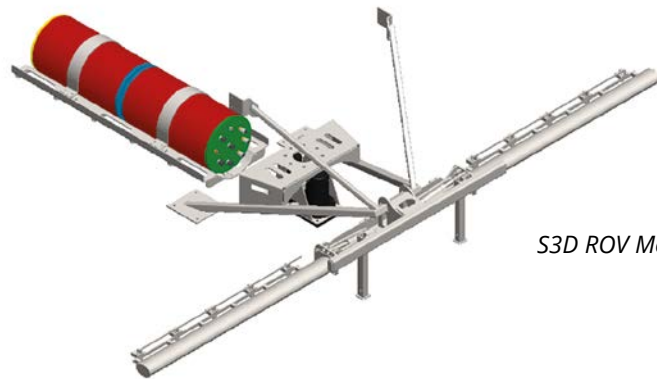
S3D ROV Mount

Key features

• Live line tracking helmsman display
• Vessel & ROV mountable
• Records all raw S3D seismics
• Realtime and near real time processing options

PROPERTY	VALUE
Proven technology	Track record of > 1350km
	Details available upon request
Frequency	3.5 – 7 kHz (kilohertz)
SPL Powerlevel (2 transducers at 3.5 kHz, measured at 3.5m below transducers) *3	190.01 dB re 1 microPa, 0 degrees*1
SPL Powerlevel (4 transducers at 3.5 kHz, measured at 3.5m below transducers) *3	193.83 dB re 1 microPa, 0 degrees*1
Pulse length	Variable, generally 0.5 milliseconds at 3.5 kHz
Output Power	2 Kilowatt
Ecological impact	Approved system
Details available upon request	
Hydrophone array	High sensitivity broadband hydrophone array with signal recording for reprocessing with alternative array length. Active array length can be chosen in field based on distance to seabed.
Number of hydrophones	14
Pingrate	5 – 10 pings / second
Maximum height of transducers above seabed	7.0 meter
Maximum waterdepth	200 meter for ROV-mounted application
	Shallower for Pole- and Armmounted applications, depending on physical length of mounting
Maximum penetration in seabed	> 4.0 meter depending on seabed composition *2
Accuracy	0.05 to 0.10 meter
Beamwidth	8.0 meter
Soft-start procedure	Yes, required*4
Survey speed	Preferred speed 1 – 2 knots, affected by mounting application
Detection capability longlines / crosslines	Yes / Yes
Seismic seabed detection	Yes
Integrated verification with multibeam data	Yes, optional
Integrated magnetometer data	Yes, optional
Matched filtering	Yes
Synthetic Aperture Processing	Yes
Motion correction (heave, roll, pitch)	Yes
Realtime tracking of cable/pipeline	Yes
Realtime top of contact picking	Yes, output of preliminary contact list possible
Max. acceptable heave	0.5 meter for polemounted application
	Higher for ROV- or Armmounted applications, affected by vessel specifications
Width of array	3.8 meter
Approximate weight of mandatory wet components (excl. frame) in 2-transducer configuration	55 kg ROV-Application
	Heavier for Pole- and Armmounted applications

Table 1: System properties for Pole, Arm & ROV-mounted application of Silas3D system.

*1   0 degrees; in downwards direction
*2   Penetration of 4.0m has been proved, higher penetration levels could be possible
*3   Power levels at 3.5, 5 and 7 kHz are comparable
*4   A soft-start procedure is required:
       - Ping rate is gradually ramped up in the timespan of 5 minutes from
         1 to 10 pings / second (in steps of 1/10th of the maximum)
       - Simultaneously, the power is ramped up from 0 to maximum power level
         in steps of 1/10th of the maximum

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Silas

## Seismic acquisition and processing software suite

Silas is a complete data acquisition, processing and interpretation software suite, that covers a wide range of tasks.

The Silas software package has been developed to allow you to obtain the best quality data and easy access to multiple data types to best evaluate the subsurface conditions. It is compatible with multiple sources and can process the full-wave signal from sub-bottom profilers, boomers, sparkers, parametric and chirp systems. The system covers the range from deep penetration to ultra-high resolution. Whether you look for general sub-surface geology, cables, pipelines and other objects or fluid mud surveys. For sub bottom classification and interpretation the Silas Software Suite can easily integrate borehole and map data into the data set, providing the information that is sought allowing for detailed interpretation.
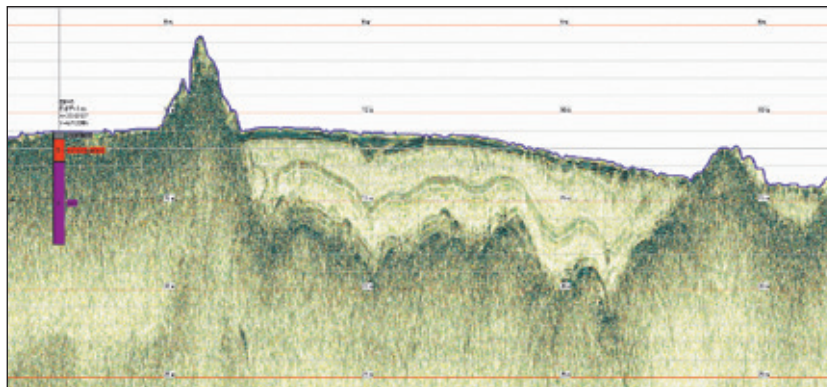
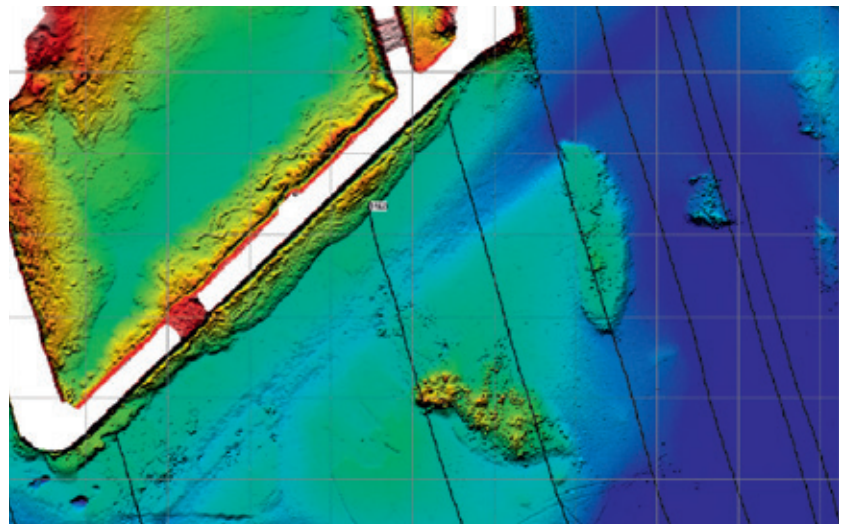*Silas recording with integrated borehole data.*
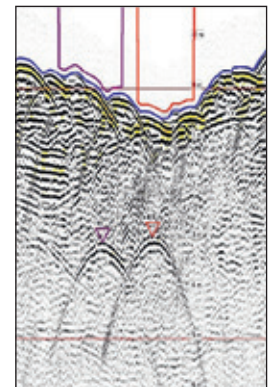
Pipeline detections with Silas Object detection.

Deliverables

- Nautical Depth
- Site investigation / Layer detection
- Object / Cable / Pipeline detection

Key features

- Import of profiles for accurate seismic interpretation
- Ultrahigh resolution (combination with USB-A/D)
- Seg Y Import - Export

Mapview of Silas profiles with multibeam bathymetry.

Specifications

Acquisition
Digital high resolution seismic acquisition.
Supports USB-A/D card and UDP inputs/outputs.
Real-time data and single trace monitoring, including real-time output of depth values of bottom track and a bottomlayer: hard bottom or iso-density level (requires calibration).
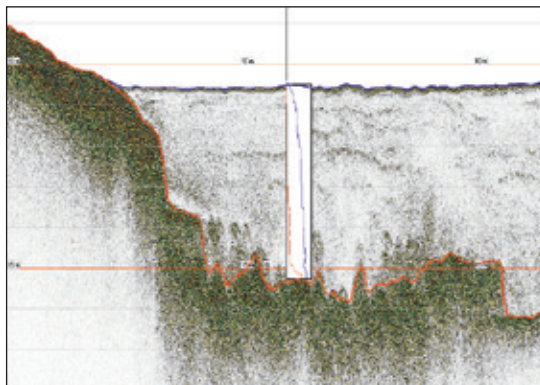
Processing

Silas Density Pro License
Digital seismic processing package that enables the user to identify, analysis and interpret the geological features found in the sea bottom.

With features such as:
- Layer tracing
- Position and tide corrections
- Navigation view
- Cross-points
- Batch filtering
- Signal correction
- Borehole import/export
- Density calibration of seismic data for nautical depth management
- Fluid mud migration studies
- Predictive multiple reduction
- Seismic parameter assessment
- Sub-bottom classification module

Automated contact detection
Contact recognition based on two quantifiable parameters which enable a more objective classification of detected contacts.

SEG Y import / export
Silas module: reads and stores seismic data in various SEG Y-formats.

Matrix import
Silas module: displays multibeam or gridded data loading in seismic records to check against or match with height data.

Frequency filtering
Silas advanced signal processing modules for S/N enhancement providing a wide range of frequency filters.

Deconvolution
Silas advanced signal processing modules for S/N enhancement providing spiking deconvolution tools.

Horizontal stacking and multiple suppression
Silas advanced signal processing modules for S/N enhancement by suppression and enhancement techniques.

Density calibration and calculation
Tool to match acoustic data with in-situ density profiles. Calculation of synthetic density profile per trace. Tool required for real time density mapping.

Overlay borehole and geotechnical data
Import and overlay of borehole data (BH, CPT, chemical tests, density, etc.) on seismic records.

Subbottom material classification
Signal analysis and matching to material properties of subbottom layers: Impedance, absorption and velocity module.

GeoTiff mapviewer
Import of geotiff data (multibeam, sss, geological map etc) and presentation in plain view.

Density (red) and yield stress (blue) profiles in a fluid mud layer recorded by the RheoTune, implemented in Silas.

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RheoTune

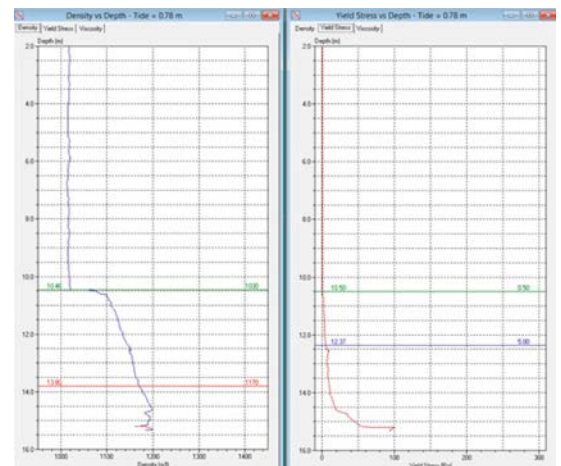## Density and yield stress measurement

The RheoTune is a versatile system that provides both density as well as yield stress profiles of fluid mud simultaneously.

The fact that the RheoTune is **pre-calibrated** makes it easy and quick to deploy, enabling **swift and accurate data acquisition**. Running proprietary software for both acquisition and processing results in a detailed almost real time display of the profile that can be imported into sub–bottom profiling processing suites enabling a full and comprehensive picture of the fluid mud and its characteristics.

To increase productivity further an automated electrical winch with slipring or manual light weight winch is available. The Tune system is optimized to integrate with the Silas Processing Software.

Stema RheoTune in action. Both density and yield stress are measured in-situ without the need of field calibration.

RheoTune software displaying both density (left) and yield stress (right).
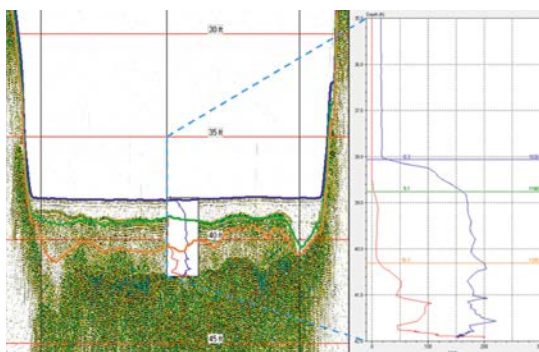
Density and yield stress results of RheoTune plotted in a Silas record.

Deliverables
• Properties of fluid mud
• Yield stress profile
• Density profiles
• Nautical depth

Key features
• Constant accurate results
• Easy to deploy and operate
• Pre-calibrated

Specifications

System
RheoTune

Output parameters
Density, Yield stress, Viscosity
Dry solids, Temperature, Depth (P)
Material classification

Density

Accuracy	< 1% of density (Newtonian fluid)
Resolution	1 g/L
Range	800 – 1500 g/L (semi fluid materials with Bingham yield stress < 1 kPa)
	1500 – 1800 g/L (with adapted calibration in semi fluid materials)

The design of RheoTune is kept simple and robust.

Yield stress (Bingham)

Accuracy	Ca. 5% of Yield stress
Resolution	1 Pa
Range	0 – 500 Pa

Viscosity

Accuracy	Depending on site calibration*
Resolution	1 Pa s
Range	0 – 600 Pa s

* Viscosity is derived from density based on a roto visco laboratory test for site specific material.

Temperature

Accuracy	2% FS
Resolution	1 °C
Range	0 – 60 °C

Depth

Accuracy	0.25% of depth
Resolution	0.01 m
Range	0 – 60 m

Housing

Probe	Stainless steel (IP68, 250 m) Fork
Control box	Plastic box (IP65)

Dimensions

Probe	75 cm with Ø15 cm
Transport case	80 x 58 x 48 cm

Weight

Probe	15 kg (+9 kg weight optional)
Transport	35 kg (excl extra weight)

Power

Input	110 / 220 V AC, 35W

Output

Type	UDP and Ethernet standard
Update rate	20 Hz

EBP System

Ultra-high resolution sub-bottom profiling

The EBP system has been developed to yield optimal results in the 3 – 33 kHz sub bottom acquisition range.
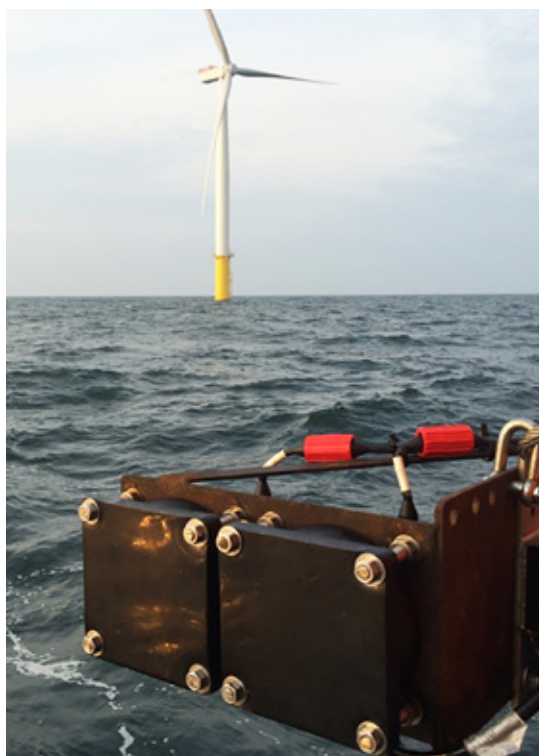
It offers the choice of transducers dependant on requirement and processes this via its unique USB-A/D configuration to ensure the highest resolution of your data. With the full digitalization of the signal the system enables full and quick import of the acquired data into the Silas Software Suite, ensuring the high-resolution transmission of data for full processing.

Data acquisition/processing

Data acquisition is done with the Silas Acquisition software. The software displays real time profile and trace data, receives position data, tide data,

Stema EBP sub-bottom profiler system

and start/stop signals from the survey software and can record heave from an external source. The acquisition software records in a proprietary format that can be processed and/or converted to SEG-Y using the Silas Processing software. More details on the Silas data sheet.

Deliverables

• Ultra-high resolution sub-bottom profiling
• Cable detection
• Fluid mud detection

Example of transducers used with EBP system to detect export and infield cables.

Specifications

Frequency
High band: 100 kHz - 1 MHz
Low band: 3.5 kHz - 50 kHz

Power
Output High band: 900 W RMS at 200 kHz.
Output Low band: 2 RMS.

Input
110 or 220 V AC - 24 V DC, 120 W

Interfaces
4xRS232
Ethernet interface

Output
• Raw seismic wiggle
  (user select sampling rate)
• Digitized depth levels
  (echo-sounder pre-sets)
• Real-time density level
  (requires calibration)

Transducer options
• 3 – 7 kHz
• 10 – 14 kHz
• 24 / 33 kHz
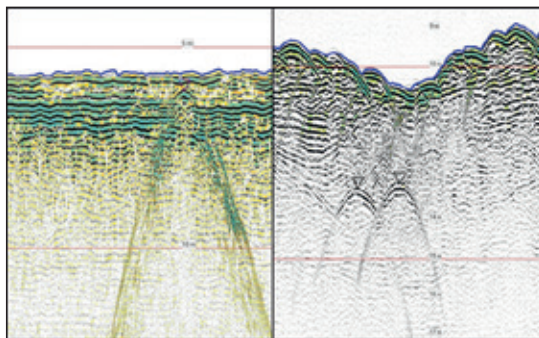
Vertical resolution
• Depends on frequency and
  cycle selected
• 24 kHz 1 cycle < 10 cm
• 4 kHz 1 cycle < 40 cm

Penetration
• Depends on soil type and frequency
• 24 kHz: clay / mud, typical 5 m
• 4 kHz: clay / mud, typical 10 – 20 m
• 4 kHz: sand, typical 5 m

Peripheral equipment options
• Boomer
• Sparker
• Bubblegun

Example of Silas sections with detected cable (left) and detected pipelines (right).

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