



# Marine Seismic Refraction

## OVERVIEW

**SISMOCEAN** is a survey company which provides the offshore industry (oil and gas, harbour development, dredging, reclamation area, etc.) with quantitative geophysics services.

**Marine Seismic Refraction** is a well known technique used by SISMOCEAN. This technique measures in-situ compressional wave velocities (P-Waves) using the refraction properties. This is a “direct” measurement method.

**Marine Seismic Refraction (MSR)** produces profiles where the layers defined by the P-Wave velocities are positioned in function of the depth of interface between the differential layers (in meters).

**Refraction profiling** has outstanding properties :

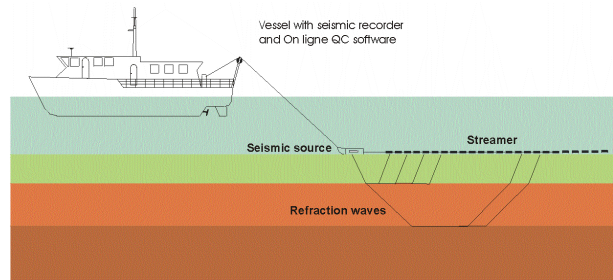
- Layers geometry well defined in terms of P-wave velocity and thickness (or depth position).
- Continuous acquisition along a route
- Borehole positioning optimization using the refraction results.
- Perfectly adapted to very shallow water surveys (investigation depth larger than water depth),

## MSR METHOD

MSR relies upon proper records and analysis of refraction waves. The waves generated by the seismic source (air-gun), travel in the sediment and are refracted by the different layers (Snell and Descartes laws).

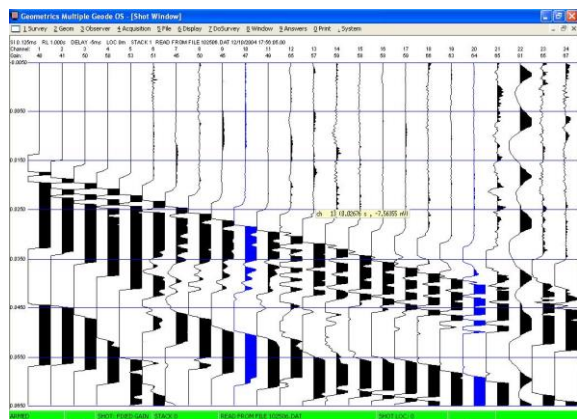
A multichannel streamer is dragged onto the water bottom and records the refraction waves. Using the same equipment and the same record it is possible to combine refraction and marine surface wave processing (see MSWP booklet).

Our software for on-line data QC visualizes the receivers and the seismic signal recorded. The picked of the first arrivals give access to the P wave velocities of the soil and the position of the different layers. In function of the streamer length used, the nominal penetration can reach 20-25 meters.

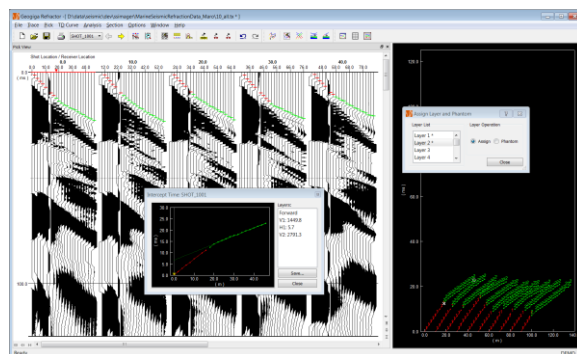


Acquisition set-up for Marine Seismic refraction

## QC on line



On-line QC of the marine seismic refraction acquisition



First arrival picked and “dromo” visualization



# Marine Seismic Refraction

## Applications

Marine Seismic Refraction Survey has many applications including:

- Pipeline/cable route surveys
- Burial assessment
- Pre-dredge geotechnical surveys
- Reclamation quality control
- Calibration of superficial geophysical data
- Shallow foundation design, Suction anchors
- Site investigations
- Seabed templates
- Bedrock mapping
- Optimisation of sampling and geotechnical testing locations (CPT, coring, miniCPT, ...)

## Key Features

- Non-destructive tool.
- The seismic layers are defined by their P-Waves velocities and thickness computed (in meters).
- Soil conditions estimated over several hundreds of km.
- The depth penetrations do not depend of the water depth.
- Quick and reliable method

## System description

### Underwater equipment

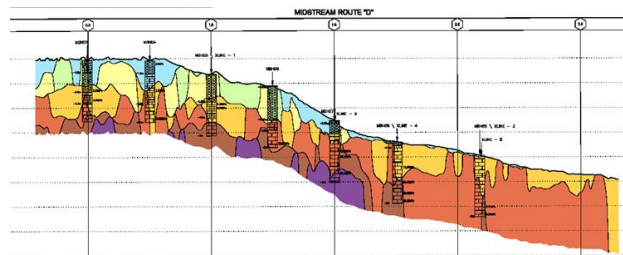
- From 24 channels up to 48 channels streamers
- Receivers spacing adapted in function of the need.
- Marine seismic source, Umbilical,...

### On board equipment

- Seismic recorder
- On-line in-house QC software
- On-line in-house surface wave data processing software

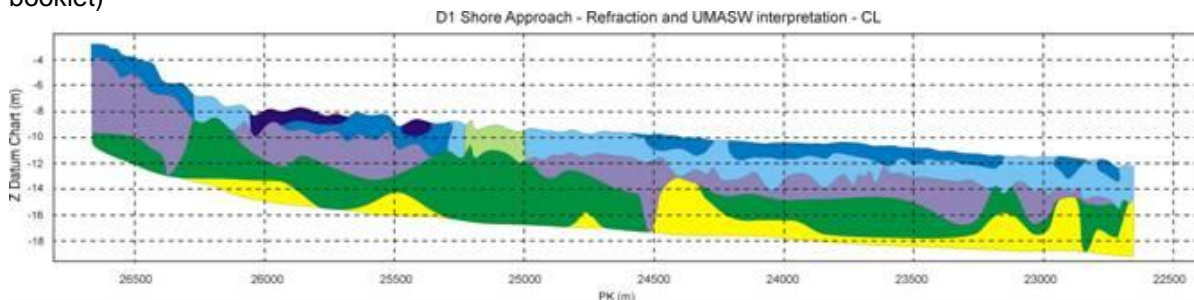
## System features

- Water depth range 0-50m.
- Penetration range from 0 to 20-25 m.
- Continuous P wave velocity profile along the route
- Estimated accuracy at 10% of actual values
- Shallow water operations do not limit penetration range
- Land version available



MSR and boreholes results

In function of the soil condition, the same equipment and the same data acquired can be used for the refraction and surface wave interpretation. (see example here below and MSWP booklet)



Units	P wave velocity (m/s)	S wave velocity (m/s)	Description (assumption)
#1	1500 – 1600	< 80	Recent deposit – silt, sand
#2	1500 – 1600	80 – 140	Recent deposit – sand and gravel
#3	1500 – 1600	140 – 220	Recent deposit – sand and gravel
#4	1500 – 1600	220 – 330	Outcrop of weathered moraine
#5	1800 – 2100	180 – 220	Weathered moraine
#6	1800 – 2100	220 – 330	Weathered moraine
#7	> 2100	>330	Lightly weathered moraine