WodCon XXI - 2016

High Resolution Seismics For Determination Of Nautical Depth And Sub-Bottom Features

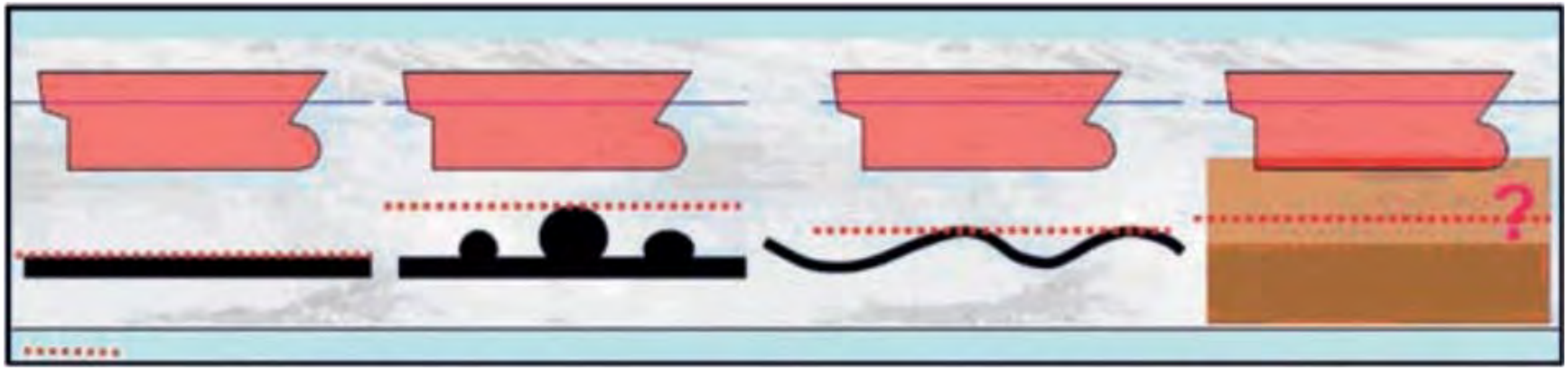
P.J. de Boer

Principle of Nautical Depth

"The level where physical characteristics of the bottom reach a critical limit beyond which contact with a ship's keel causes either damage or unacceptable effects on controllability and manoeuvrability."

(PIANC, 1997)

Principle of Nautical Depth



(PIANC, 1983)

Density

- Most commonly used critical parameter as no other time-efficient survey solution was available
- Unsufficient knowledge about strength of mud

Density

Fluid mud run

Density

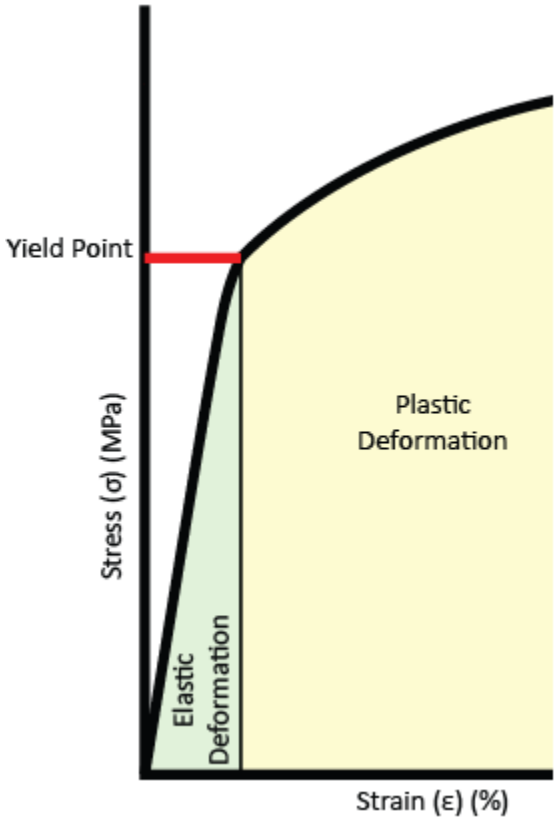
Wet peat: 1120 kg/m3

Yield stress

- Rheological parameter
- Transition point
- Elastic deformation
- Plastic deformation

Yield stress

Yield stress



Principle of Nautical Depth

"The level where physical characteristics of the bottom reach a critical limit …"

(PIANC, 1997)

Principle of Nautical Depth

"The level where yield stress of the bottom reaches a critical limit …"

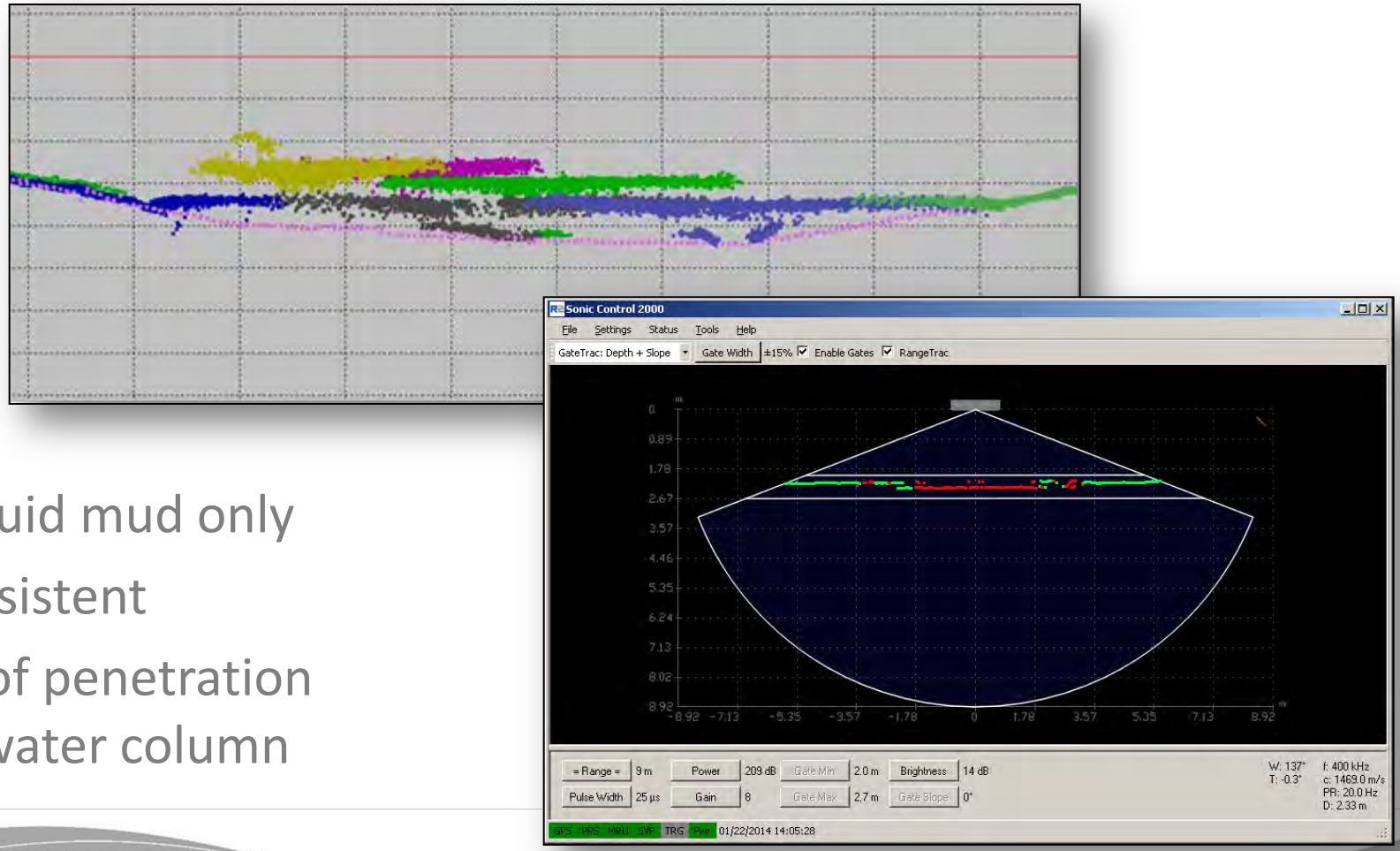
(Modified PIANC, 1997)

Principle of Nautical Depth

"The level where yield stress of the bottom reaches a critical limit …"

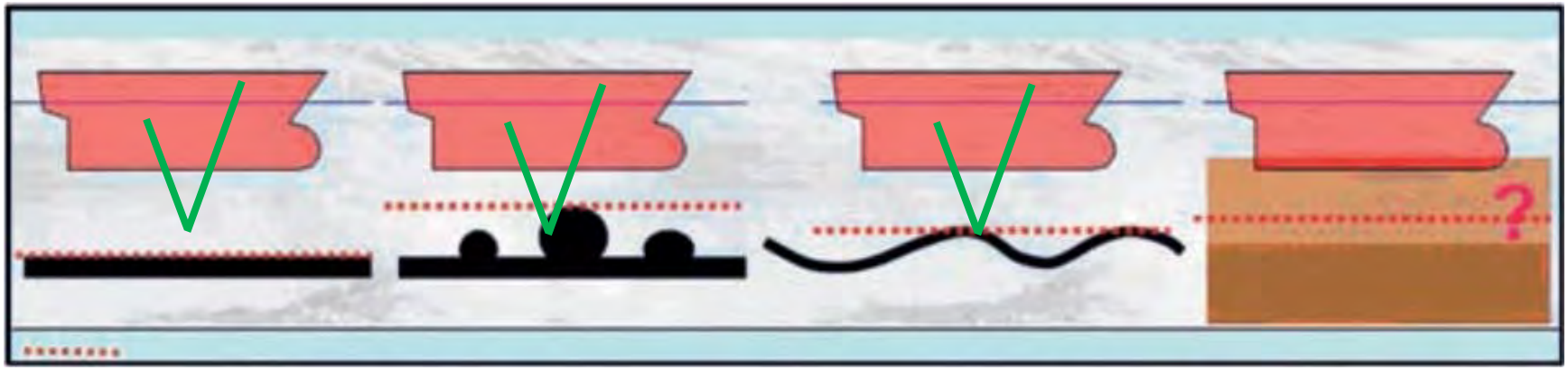
(Modified PIANC, 1997)

Conventional methods: MBES



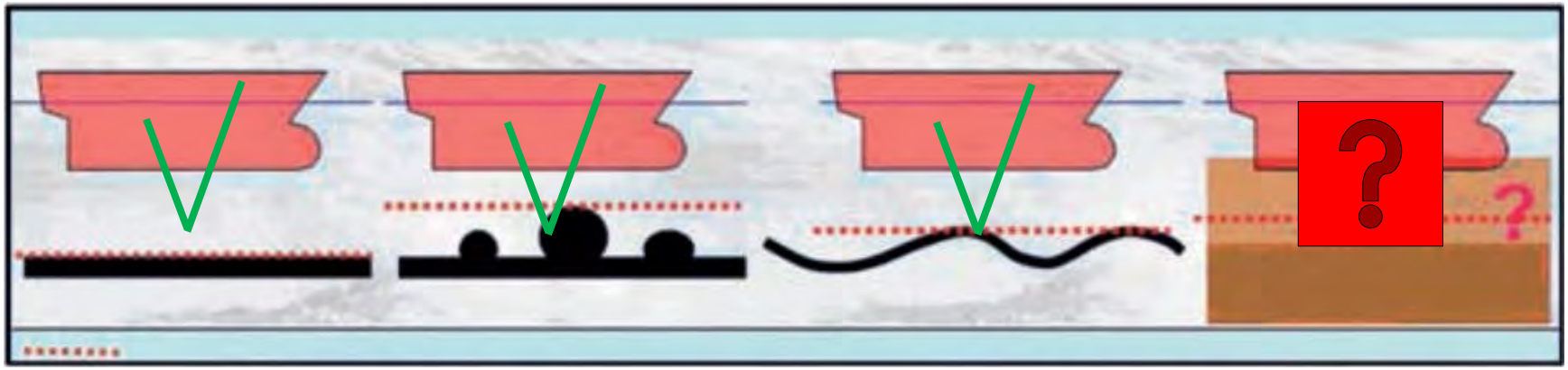
- Top fluid mud only
- Inconsistent
- Lack of penetration silty water column

Principle of Nautical Depth



(PIANC, 1983)

Principle of Nautical Depth



(PIANC, 1983)

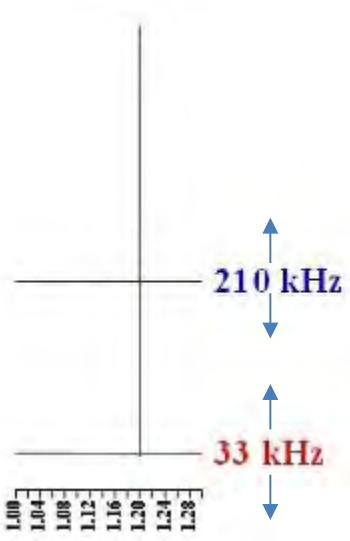
Conventional methods: 210/33kHz

- Auto-digitization of two levels
- No visual feedback
- Change in settings can alter the outcome
- Partial blindness
- Related to density only
- 210 kHz not capable of penetrating water column at post-dredging surveys

Conventional methods: 210/33kHz

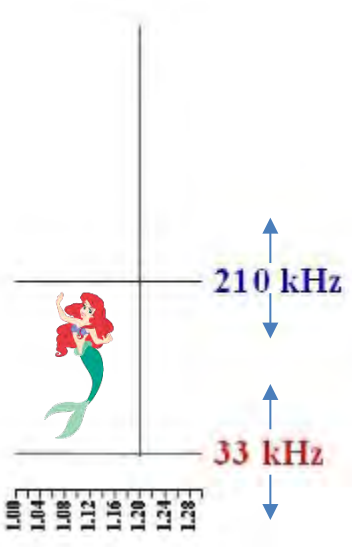
(Modified Druyts et al., 2010)

Conventional methods: 210/33kHz



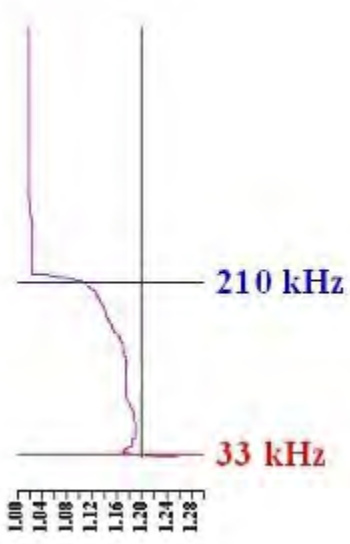
(Modified Druyts et al., 2010)

Conventional methods: 210/33kHz



(Modified Druyts et al., 2010)

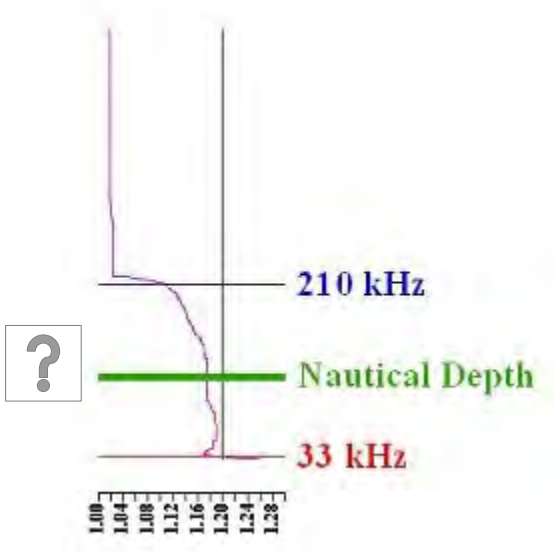
Conventional methods: 210/33kHz



(Modified Druyts et al., 2010)

Conventional methods: 210/33kHz

- Partial blindness
- No yield stress

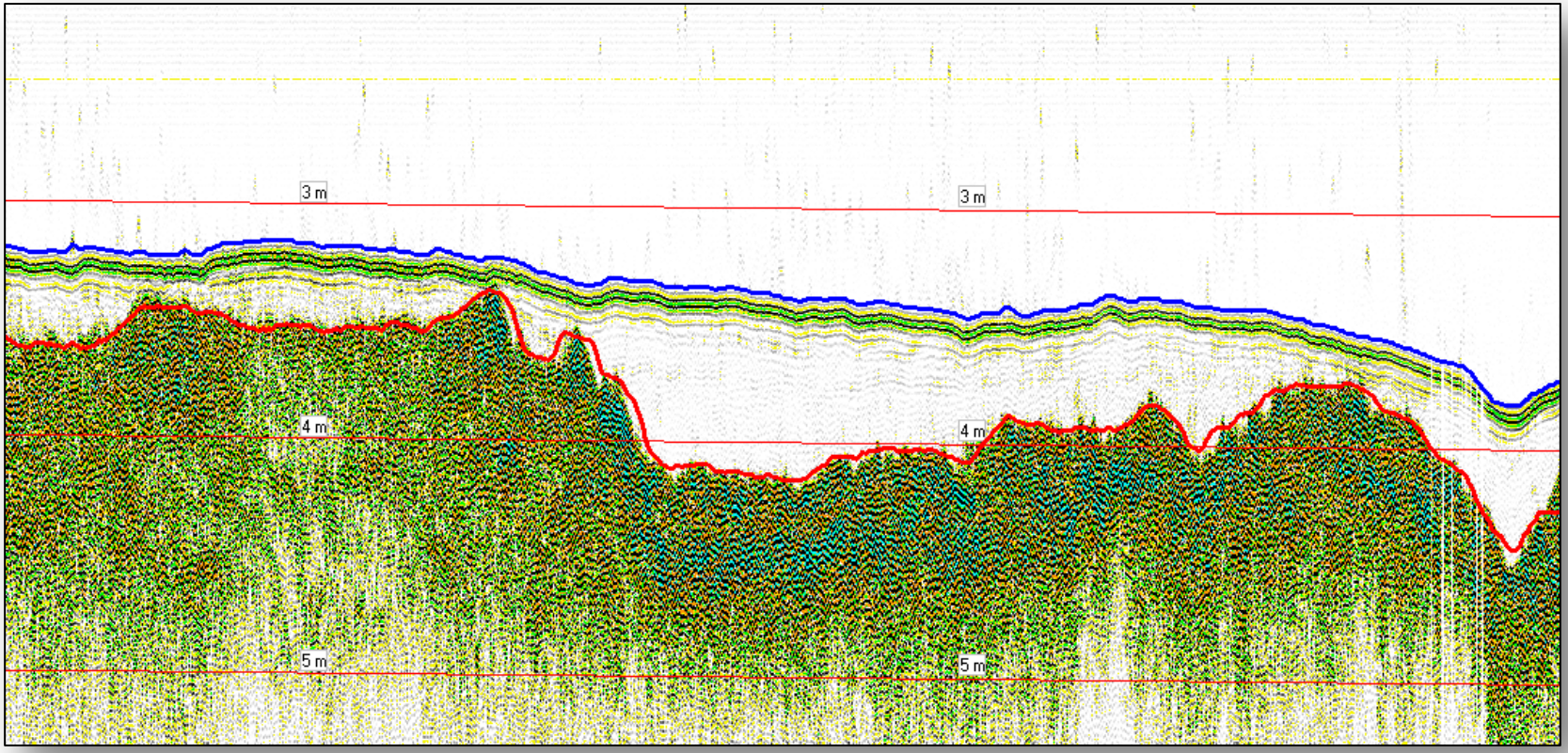


(Modified Druyts et al., 2010)

The Yield Stress Method

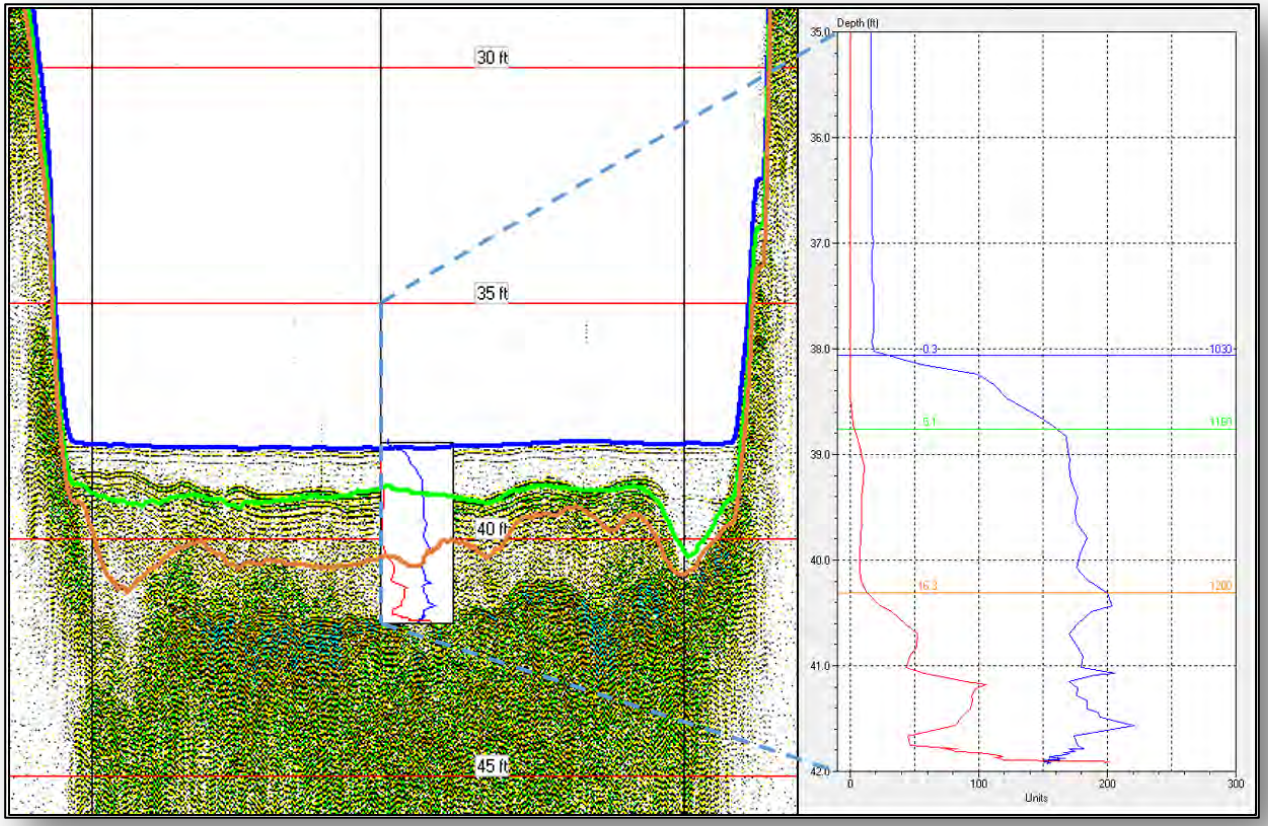
- High resolution seismic profiling to acquire full signal
- Probe measurement capable of detecting both density as yield stress

SILAS: solves partial blindness

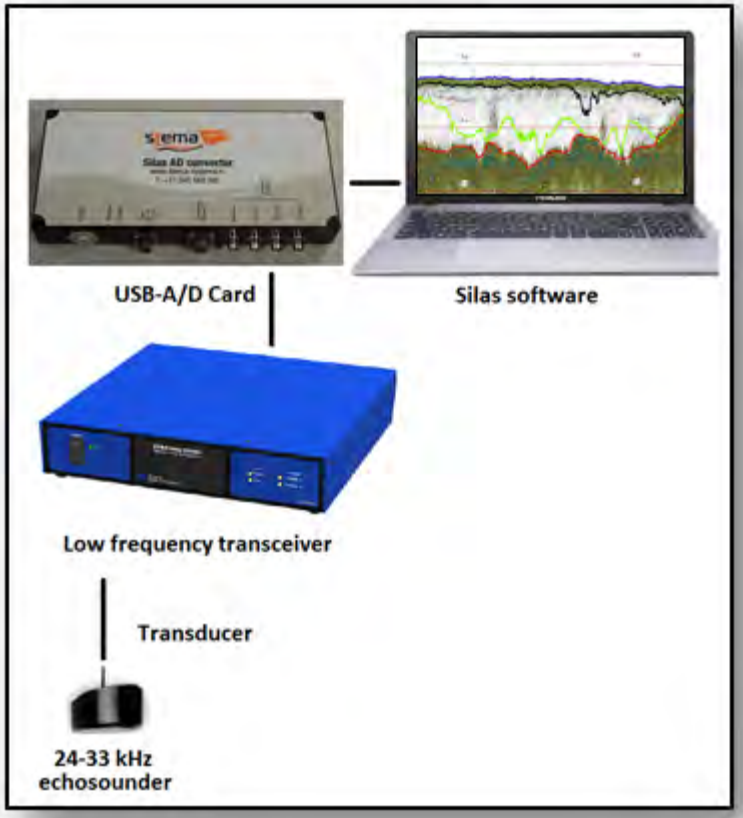


Full signal with one frequency only

SILAS: solves partial blindness

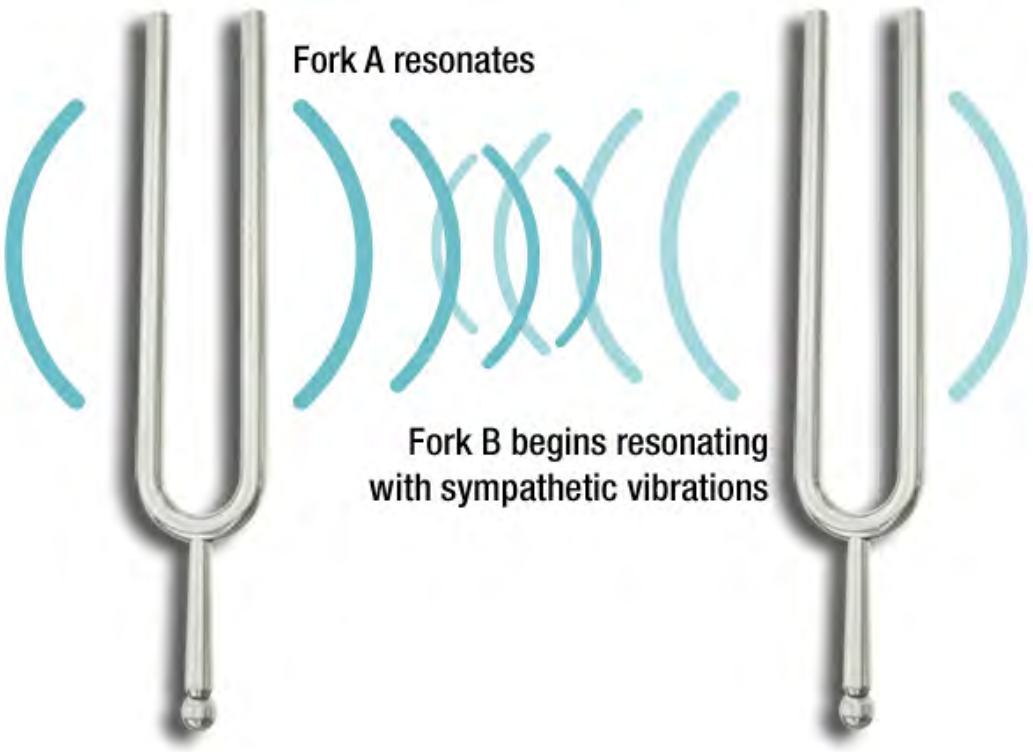


SILAS: solves partial blindness

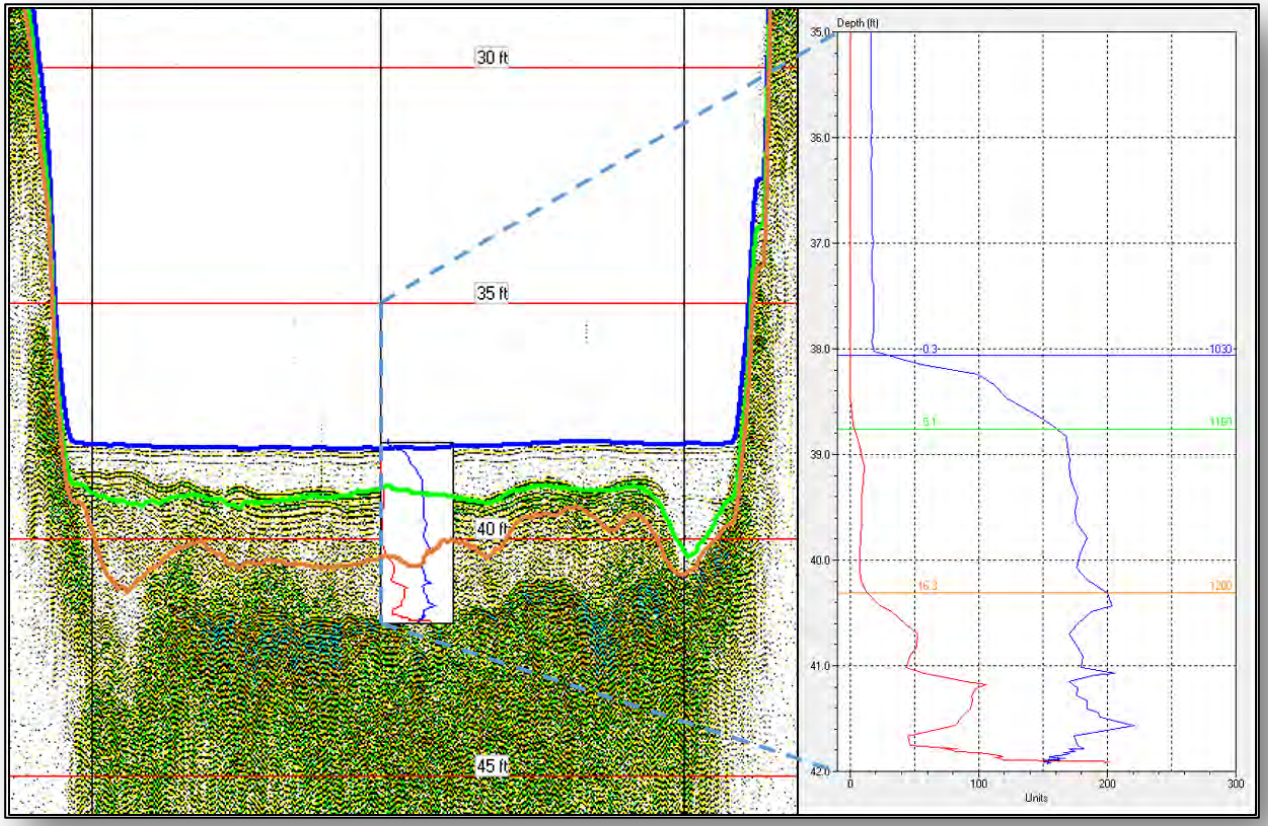


RheoTune: density & yield stress

RheoTune: density & yield stress



The Yield Stress Method



Benefits of method

- Complete high resolution seismic profile
- Full penetration of siltated water column
- Measuring both density and yield stress
- Time-efficient operation with high accuracy

Benefits of result

- Using nautical depth principle guarantees safety
- Cost-efficient harbour management (e.g pro-active targeted dredging)
- Better understanding of harbour dynamics

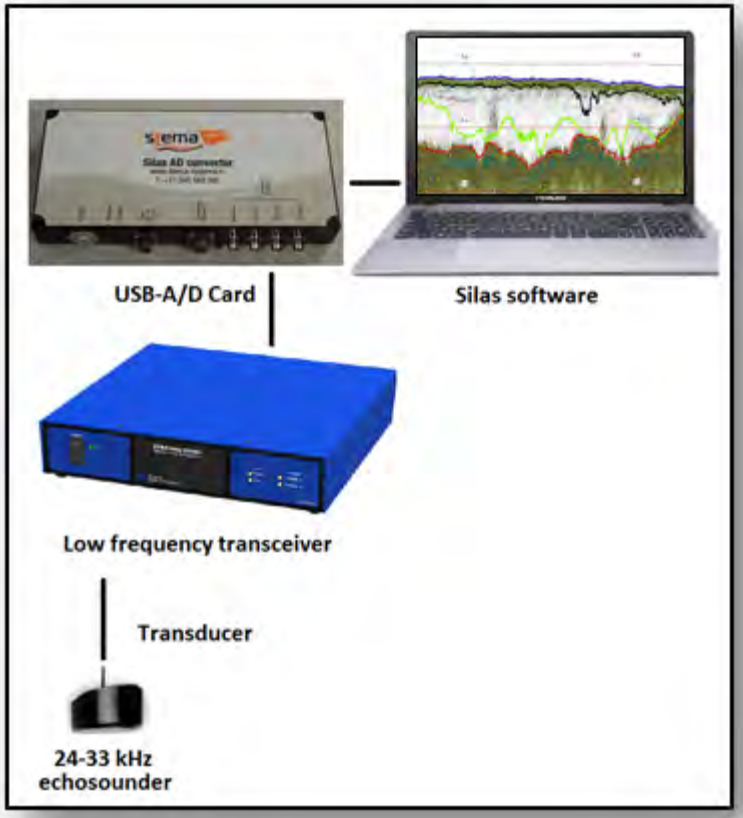
Additional possibilities of SILAS

- Integration of geophysical data:
  - Boreholes
  - Cone Penetration Tests (CPT)
  - Ground Penetrating Radar (GPR)
  - SEG-Y data
- Integration of hydrographical data:
  - Multibeam
  - Magnetometer
  - Side Scan Sonar
- Advanced filter techniques
- Sub-bottom cable & pipeline detection

Additional possibilities of SILAS

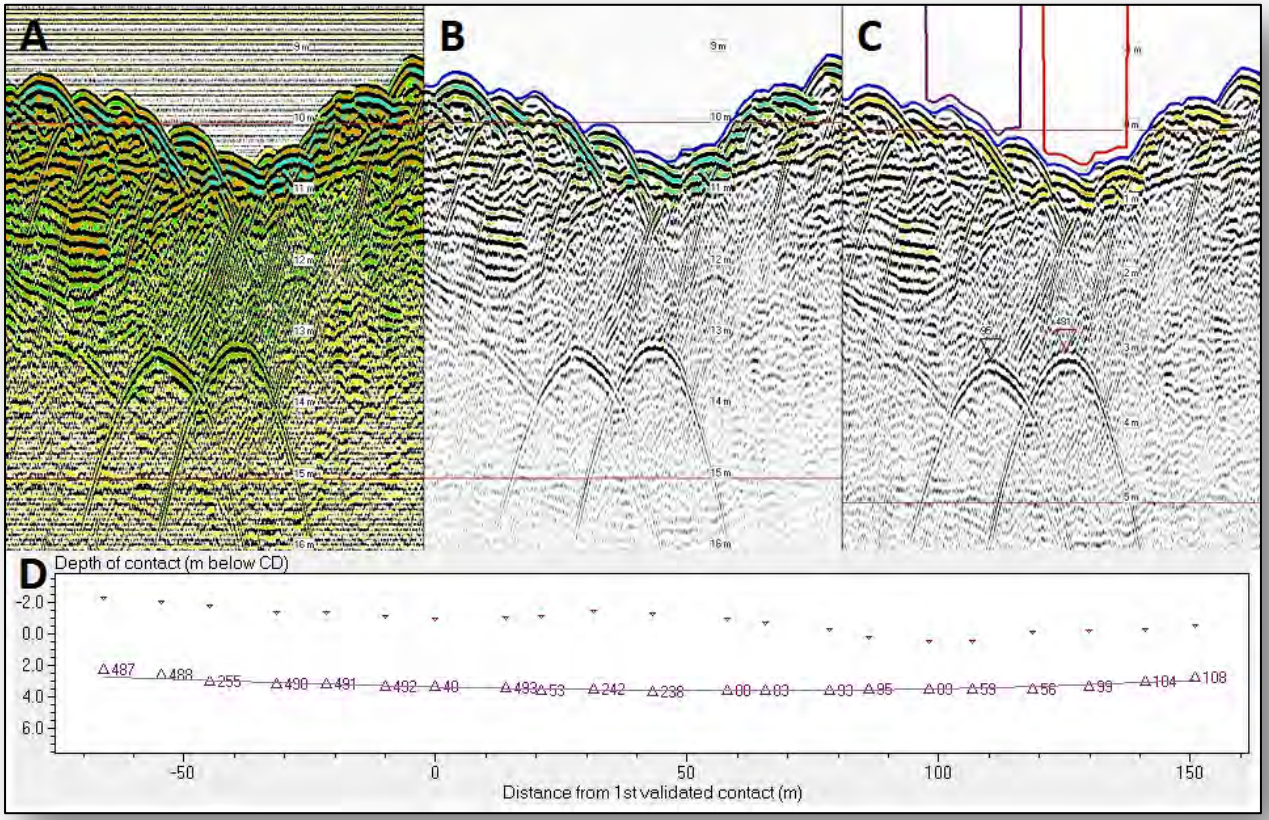
- Integration of geophysical data:
  - Boreholes
  - Cone Penetration Tests (CPT)
  - Ground Penetrating Radar (GPR)
  - SEG-Y data
- Integration of hydrographical data:
  - Multibeam
  - Magnetometer
  - Side Scan Sonar
- Advanced filter techniques
- Sub-bottom cable & pipeline detection

Similar set-up



Similar set-up

Cable & pipeline detection



Summary

- Yield stress measurement required to define nautical depth
- Hybrid method of high resolution seismics calibrated with point measurements for yield stress and density results in a time-efficient operation
- Similar setup can provide numerous solutions

Please visit booth #18

- For more information:
  - stema-systems.com
  - fluidmud.com
  - geo-matching.com/rental

Stema Systems

@StemaHQ