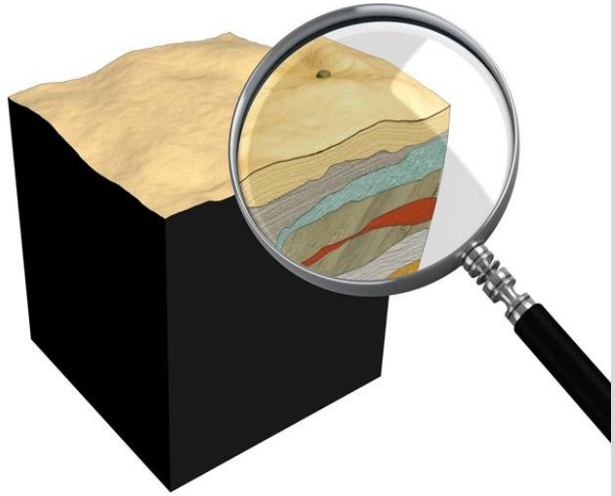


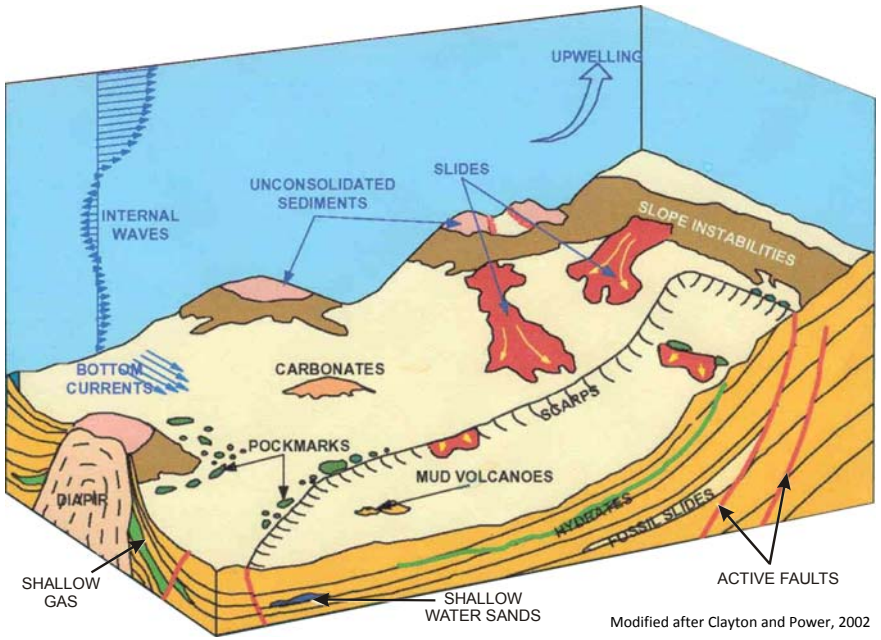
DIG: Diagnostic Integrated Geoscience

Integrating geoscience data to diagnose what is going on with the seabed

Stella Kortekaas and Sam Ingarfield
Fugro AG

Contents

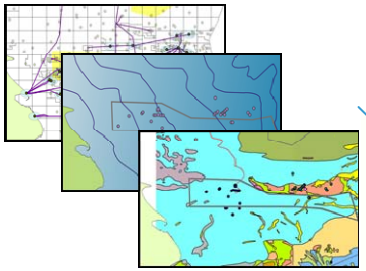
- What is DIG?
- Building a geological model
- Examples
  - Mass transport events
  - Bedforms and sediment mobility



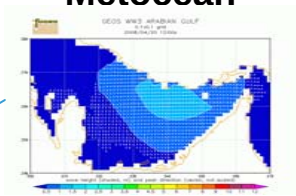
Modified after Clayton and Power, 2002

DIG: Diagnostic Integrated Geosciences

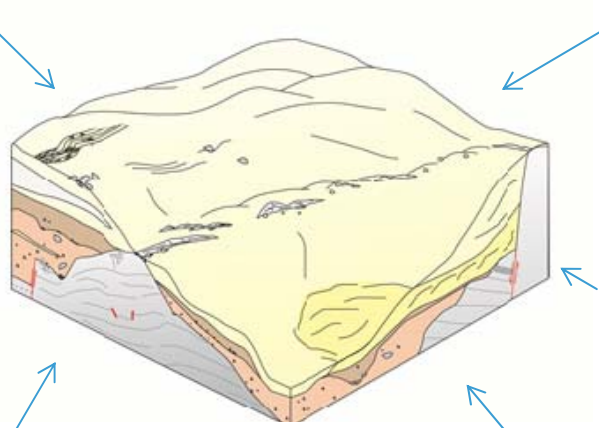
Public Domain



Metocean

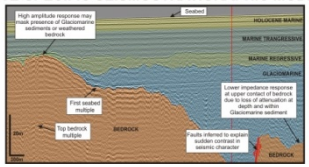


GIS Hosted Ground Model

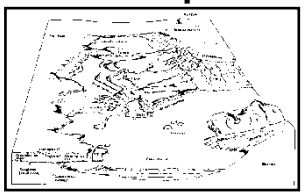


Geophysical Data

SITE-SPECIFIC SEISMOSTRATIGRAPHIC MODEL

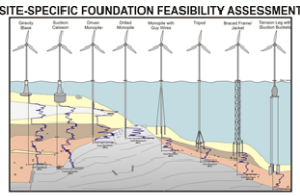


Analogous Sites/ Previous Experience



Geotechnical Data

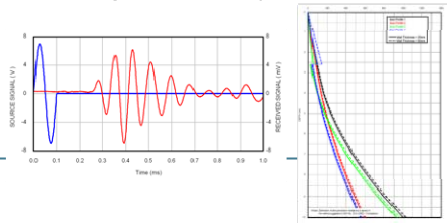
SITE-SPECIFIC FOUNDATION FEASIBILITY ASSESSMENT



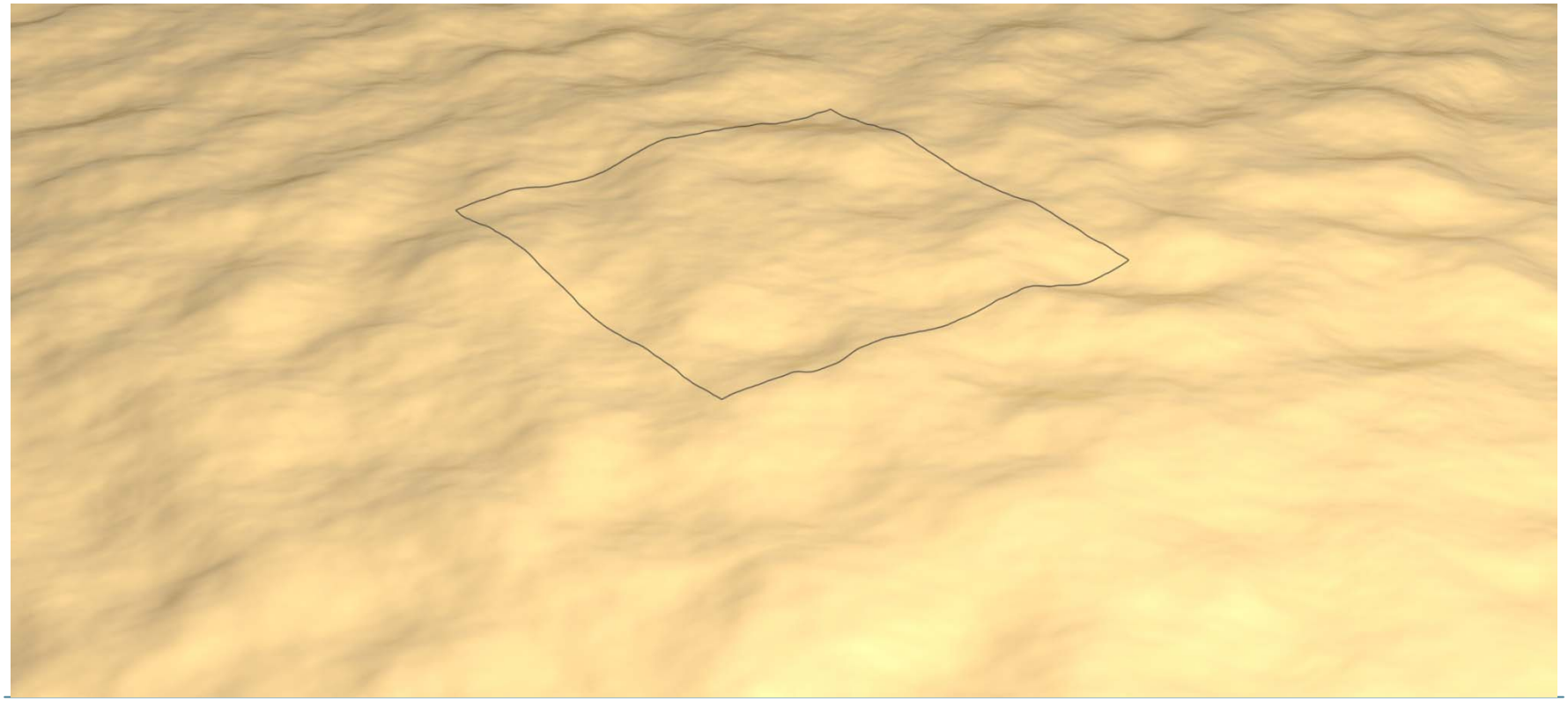
Engineering Analyses
Understanding of Foundation Risk and Cost
Foundation Cost Screening

Integration of multidisciplinary datasets to provide a database which documents the geological evolution of a site

Engineering Analysis



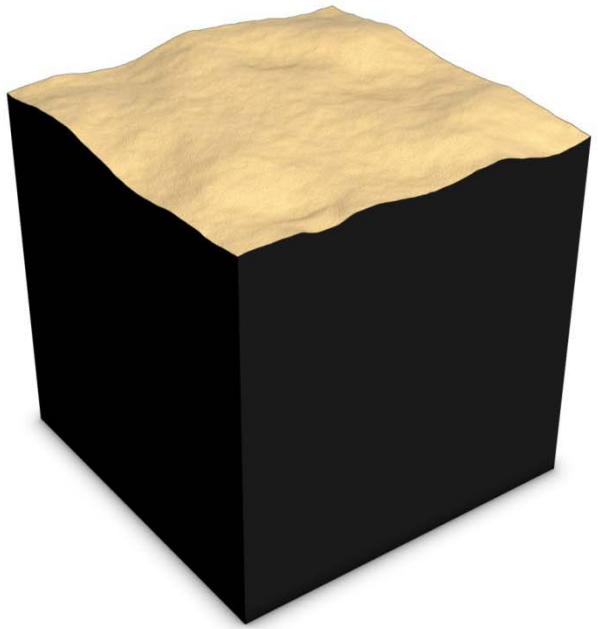
Building a model



Building a model

Start point

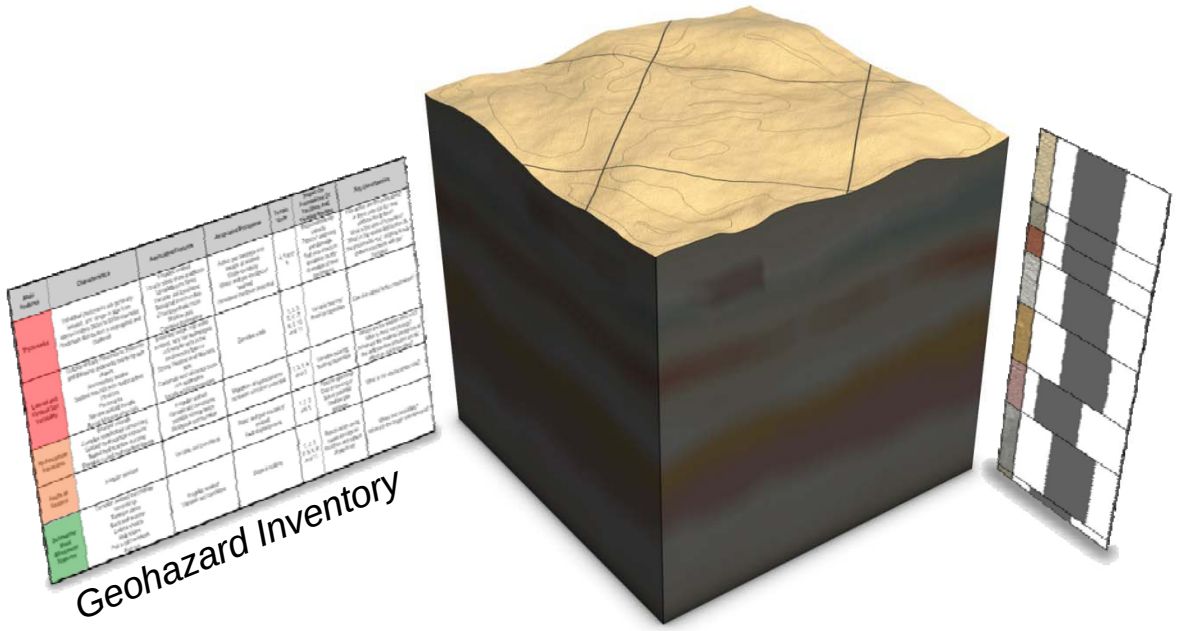
- Bathymetry
- Public domain data
- Regional experience



Building a model

Desk study

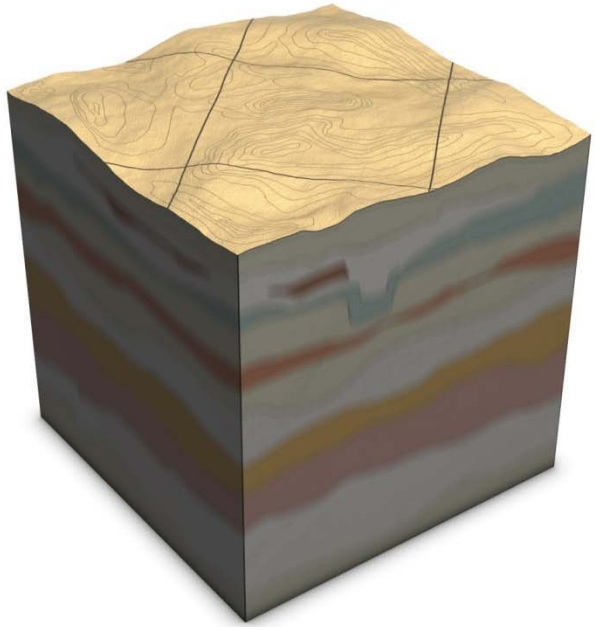
- Predictive stratigraphy
- Design parameter envelopes
- Preliminary risk assessment
- Data acquisition design



Building a model

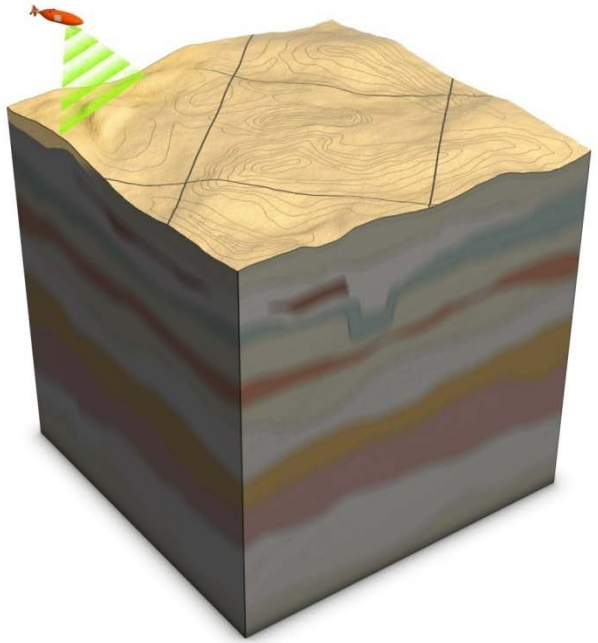
Geophysical survey

- Stratigraphy
- Geological features
- Shallow hazards



Building a model

AUV survey (for deep water)



Building a model

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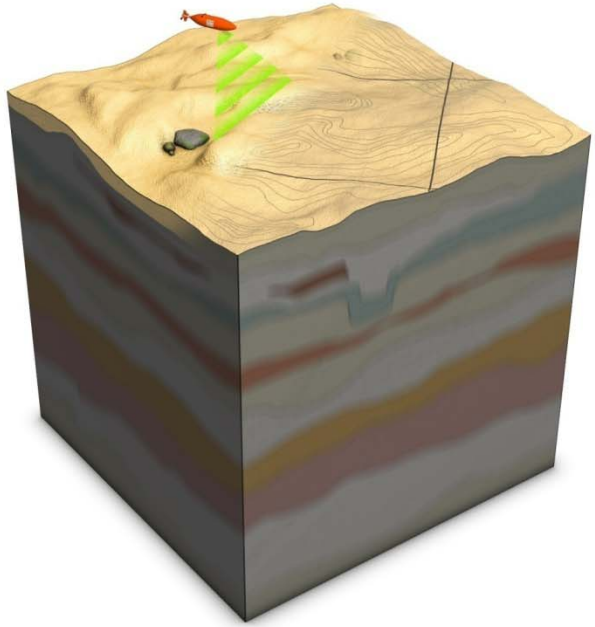

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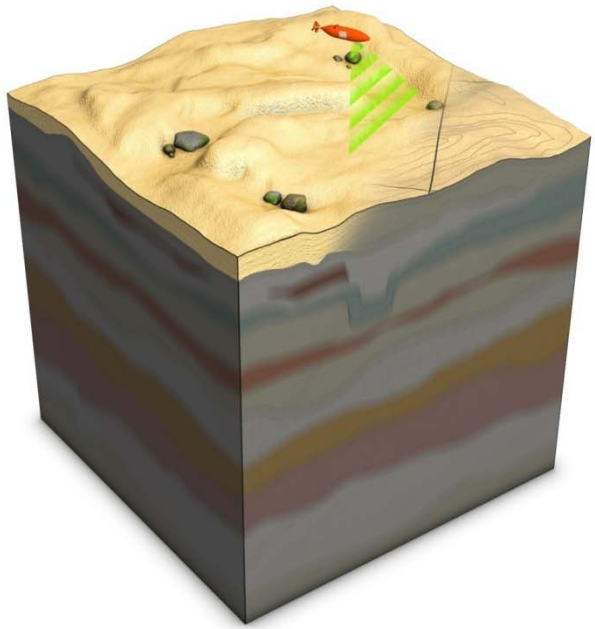
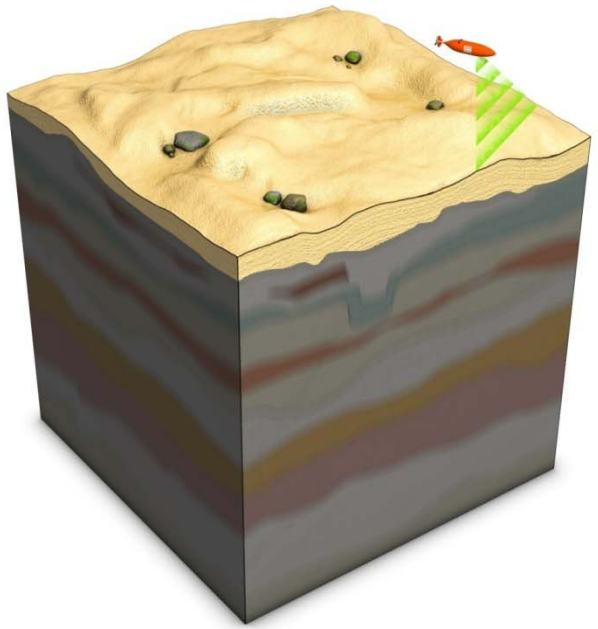


Building a model

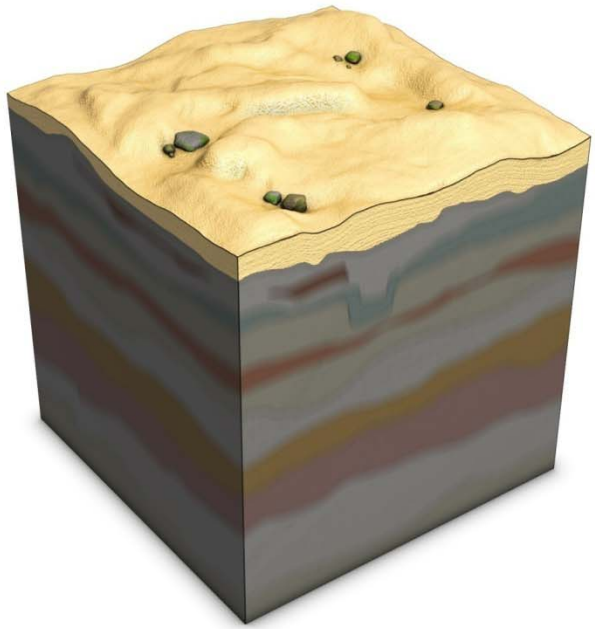
AUV survey (for deep water)



Building a model

AUV survey (for deep water)

- Shallow data quality improvements
- Design geotechnical SI

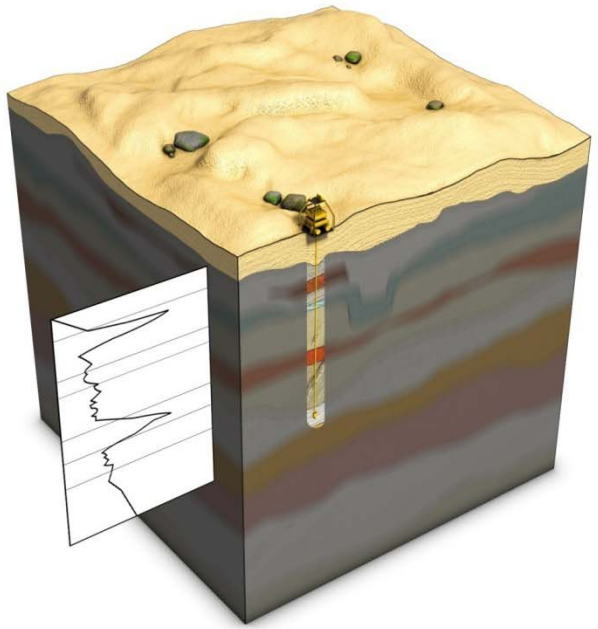


Building a model

Insitu testing (CPT)

Building a model

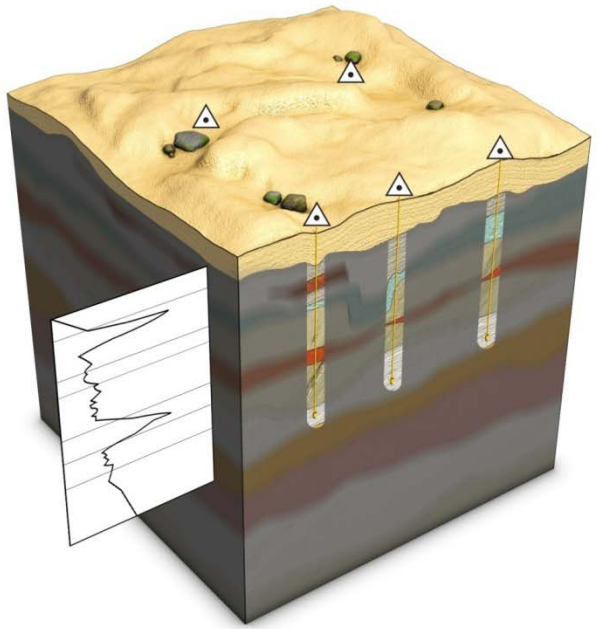
Insitu testing (CPT)



Building a model

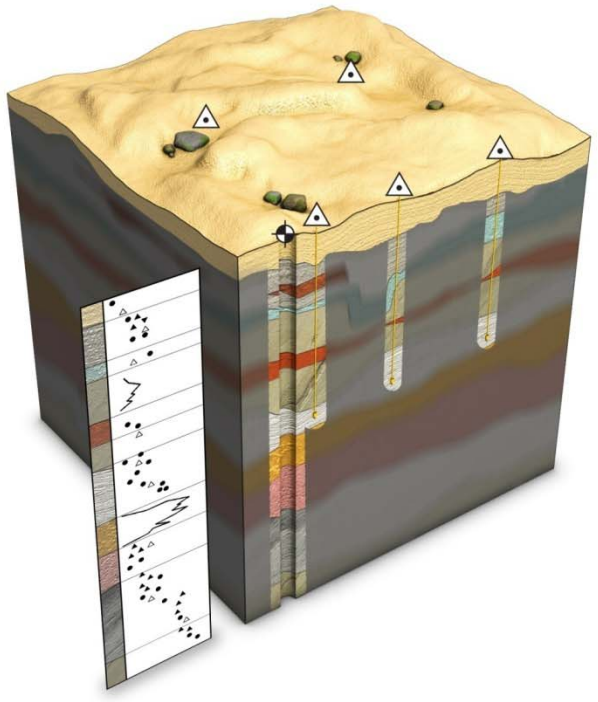
Insitu testing (CPT)

- Strength characteristics
- Pore pressure



Building a model

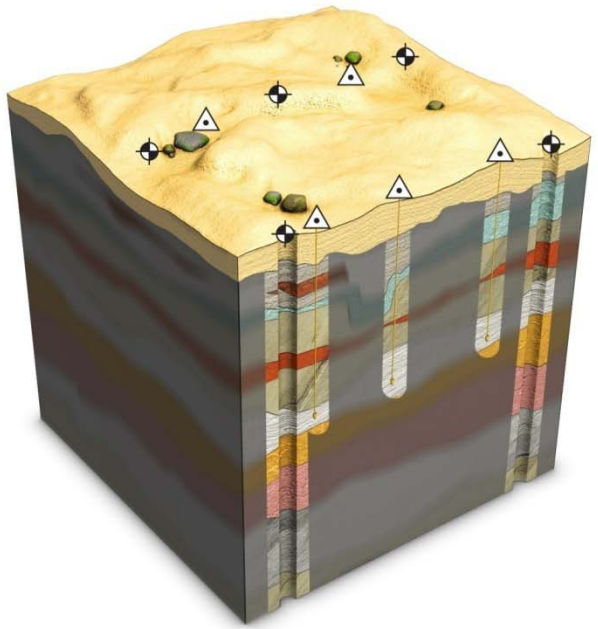
Borehole drilling and sampling



Building a model

Borehole drilling and sampling

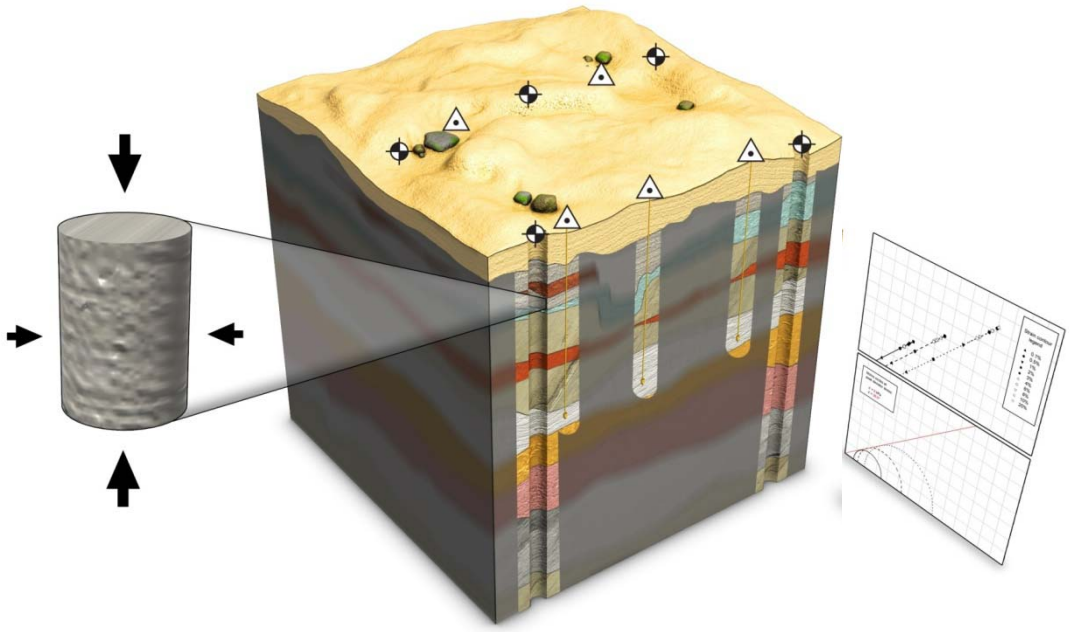
- Soil sampling
- Insitu testing



Building a model

Lab testing and analyses

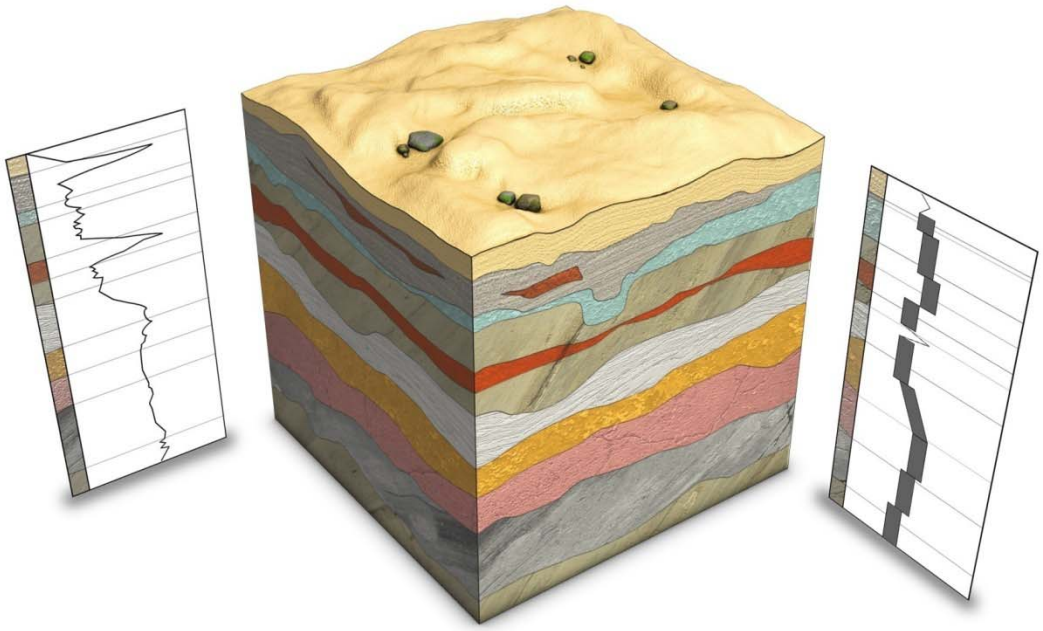
- Classification
- Strength characteristics
- Dynamic response



Building a model

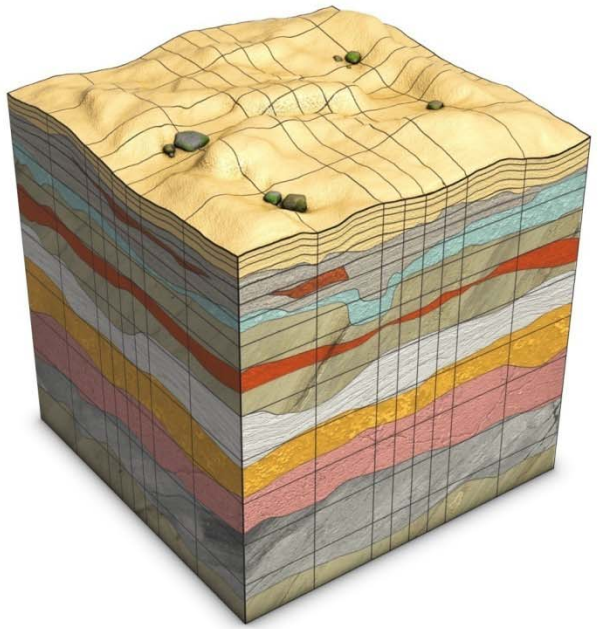
Data integration

Maximising value of datasets



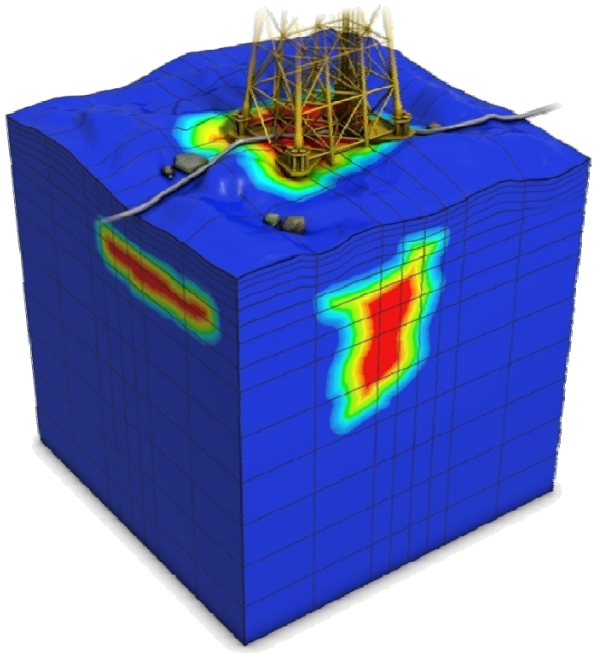
Building a model

Engineering ground model



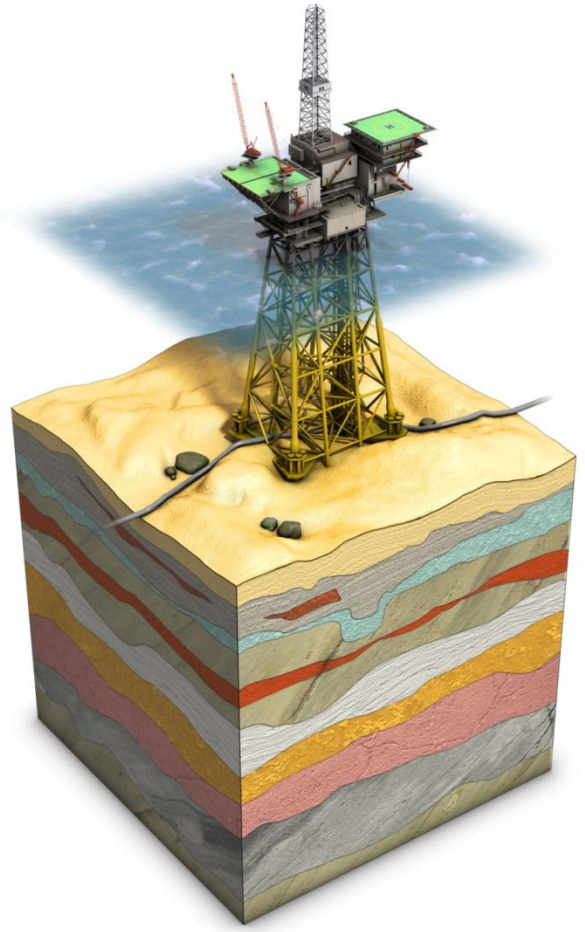
Building a model

Engineering analysis and design



Building a model

Optimised design, location, installation and operation



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  - Bedforms and sediment mobility

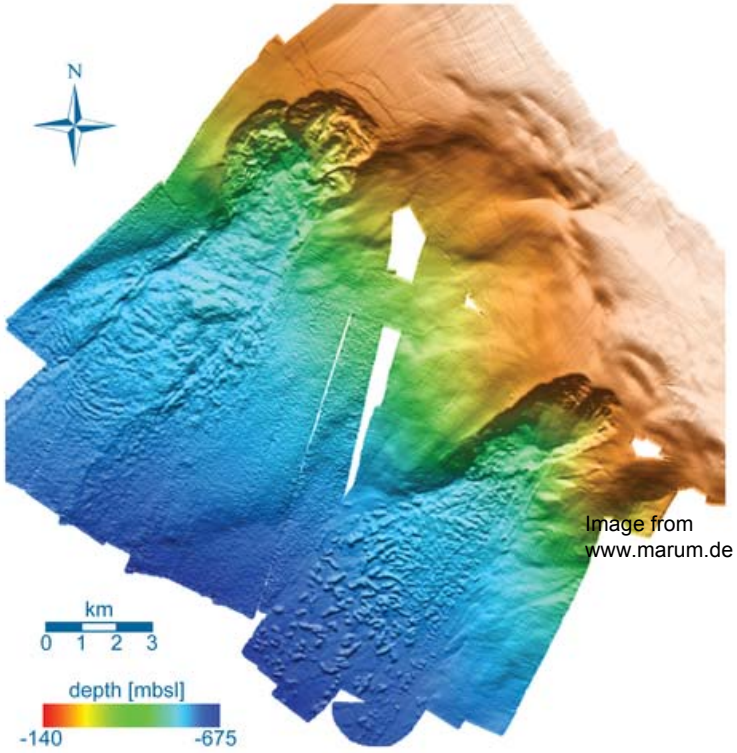
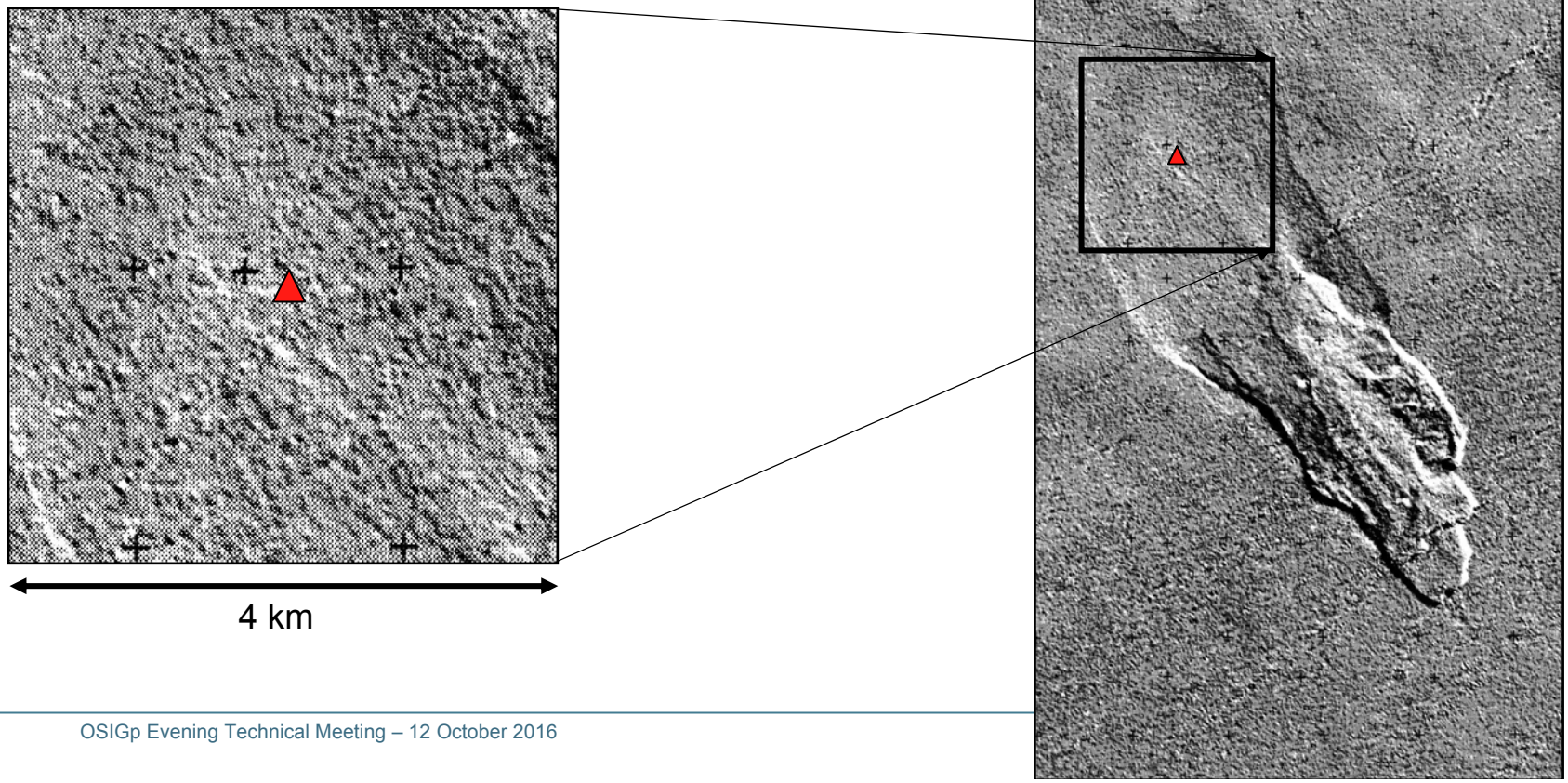


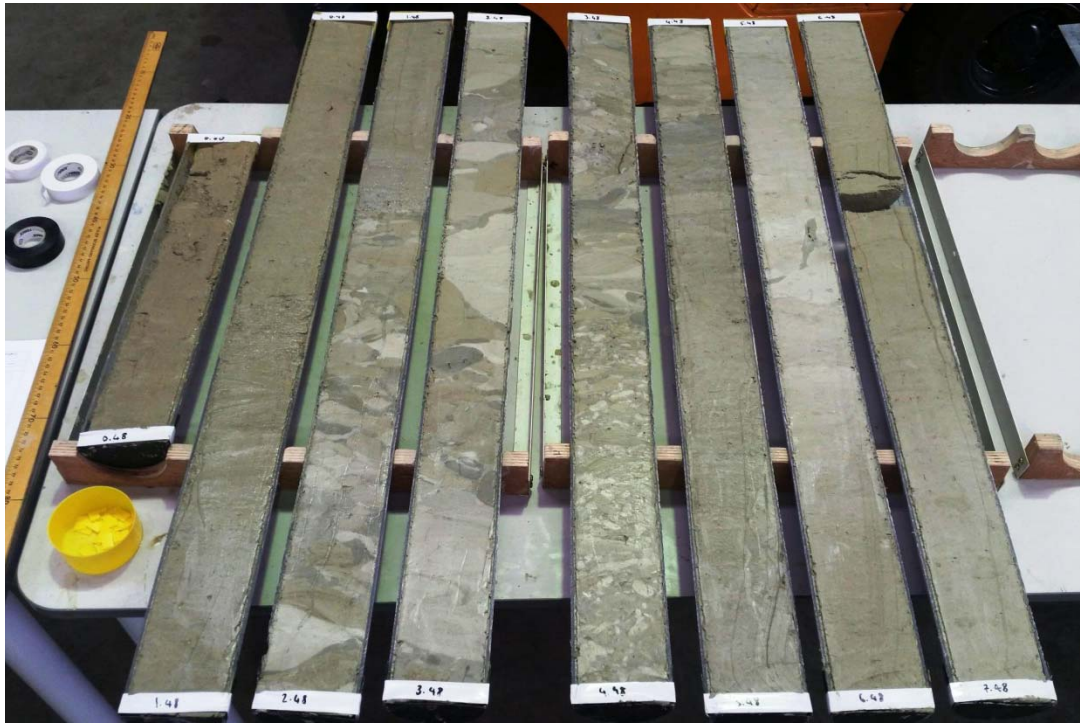
Image from www.marum.de

Example: Mass transport events

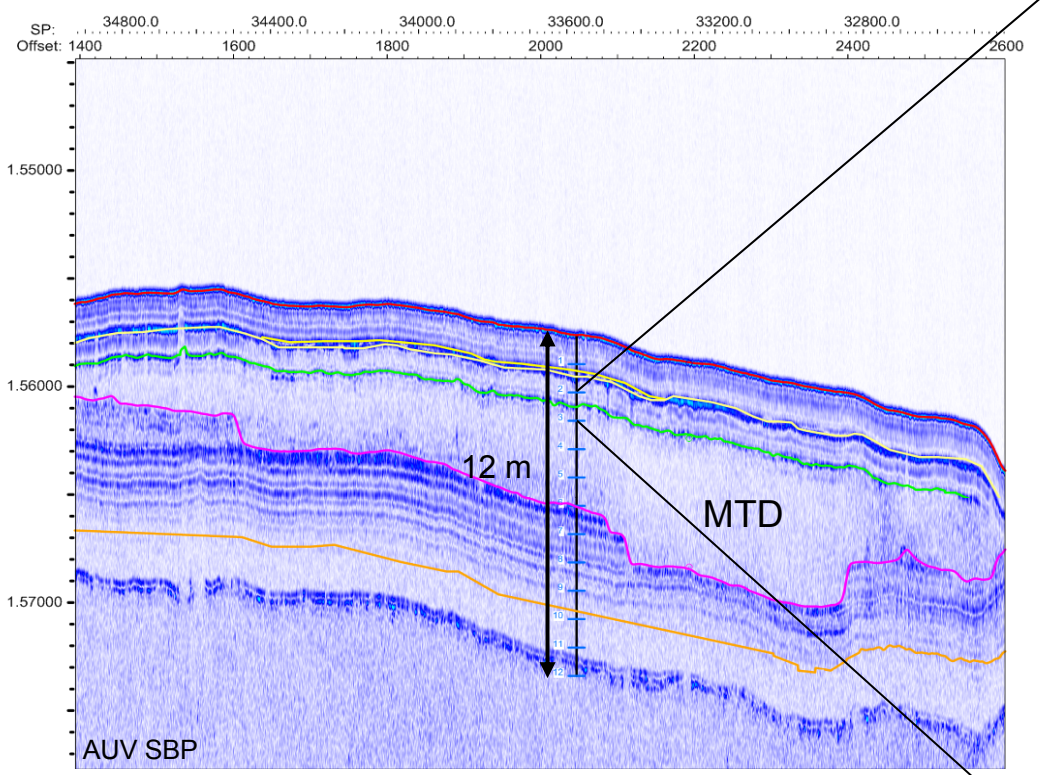


Example: Mass transport events

- How did it happen?
- When?
- Trigger?
- Could this happen again?
- How often?
- Deposition/erosion?
- Distance of run out?
- Velocity?



Example: Mass transport events



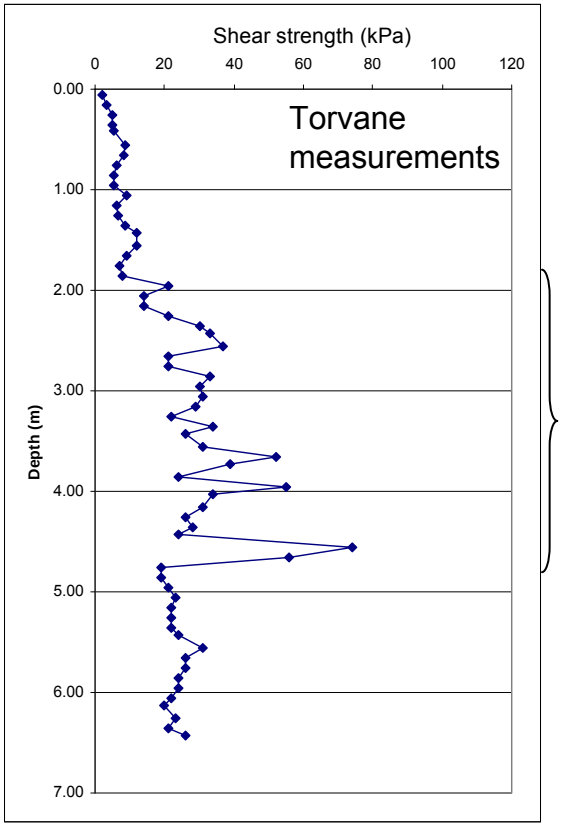
Hemipelagic sediment

Turbidite

^{14}C age date

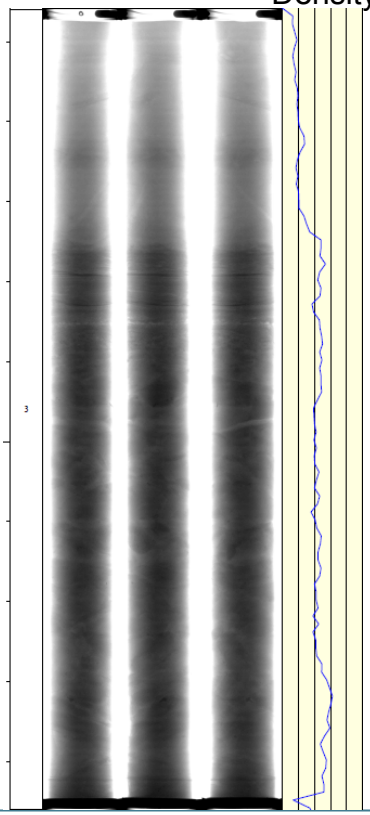
Debris flow deposit

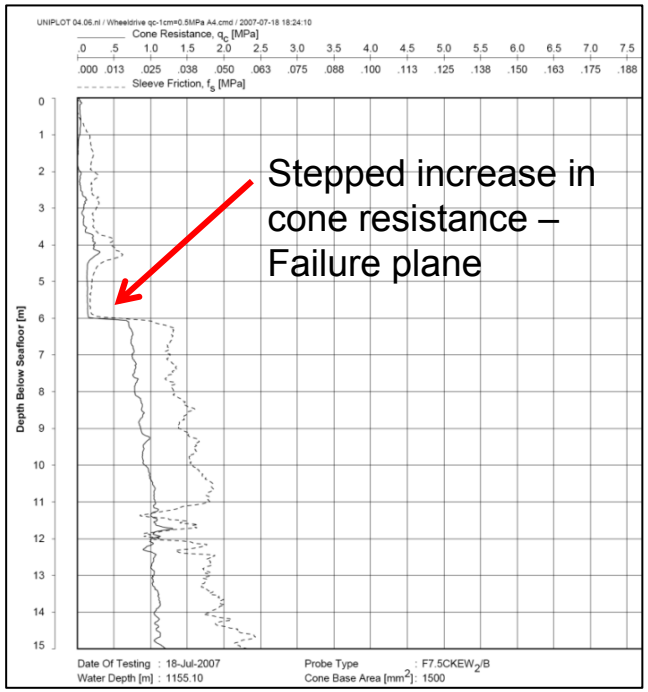
Example: Mass transport events



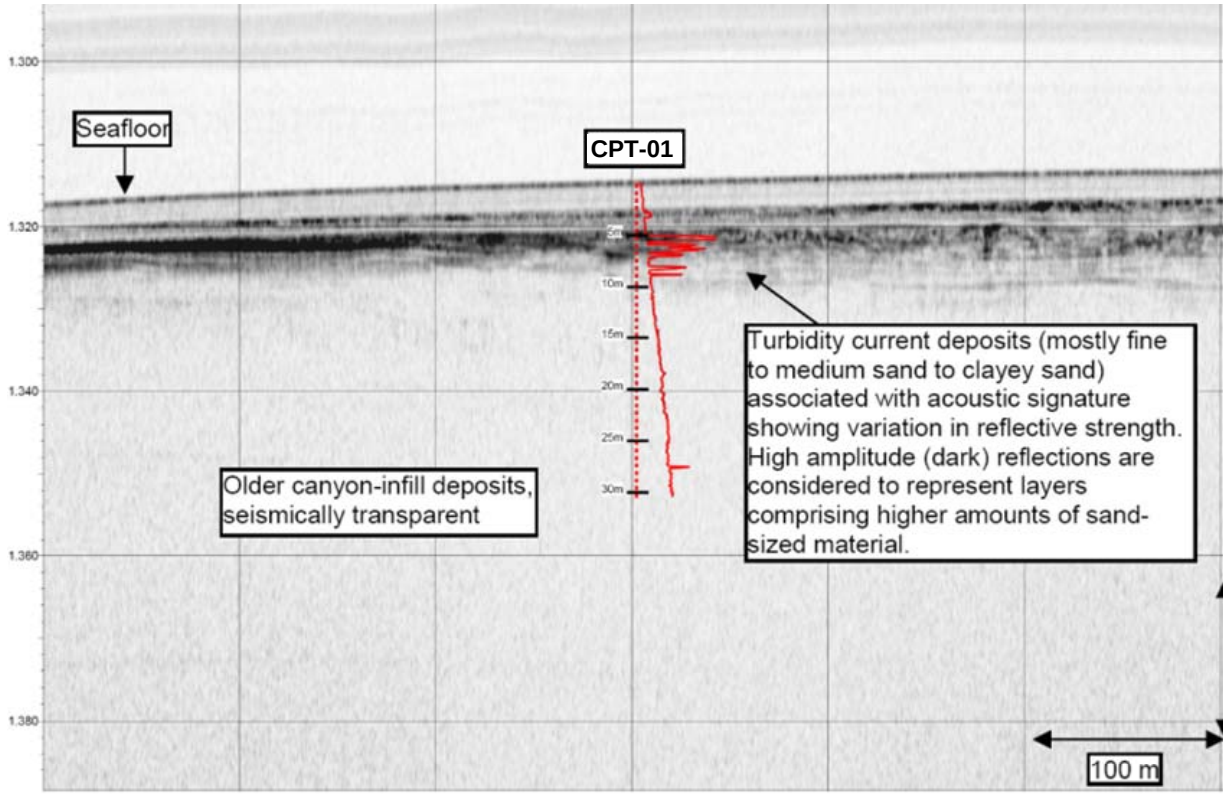
Debris flow different clasts –varying shear strength

Density





Example: Turbidity currents



Sharp base

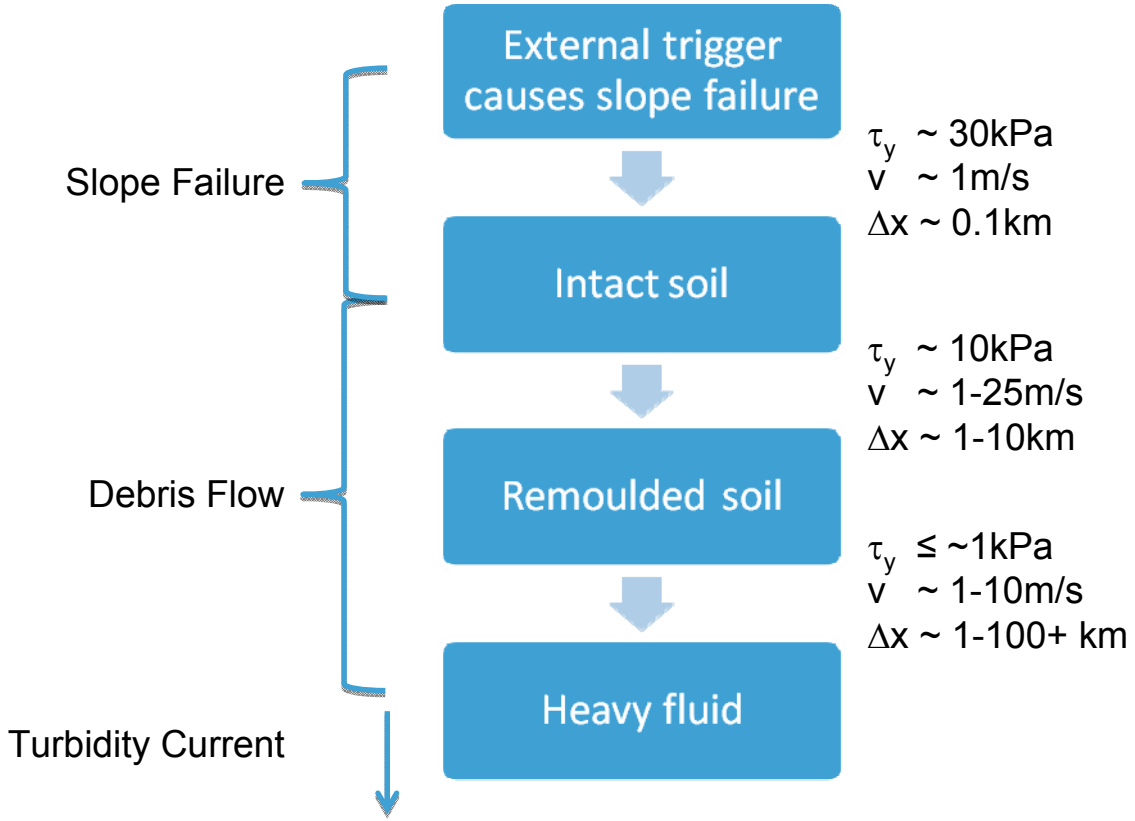
Burrow

Background clay sediments between turbidites

Normal grading

Bioturbated upper contact

Numerical Modelling - Background

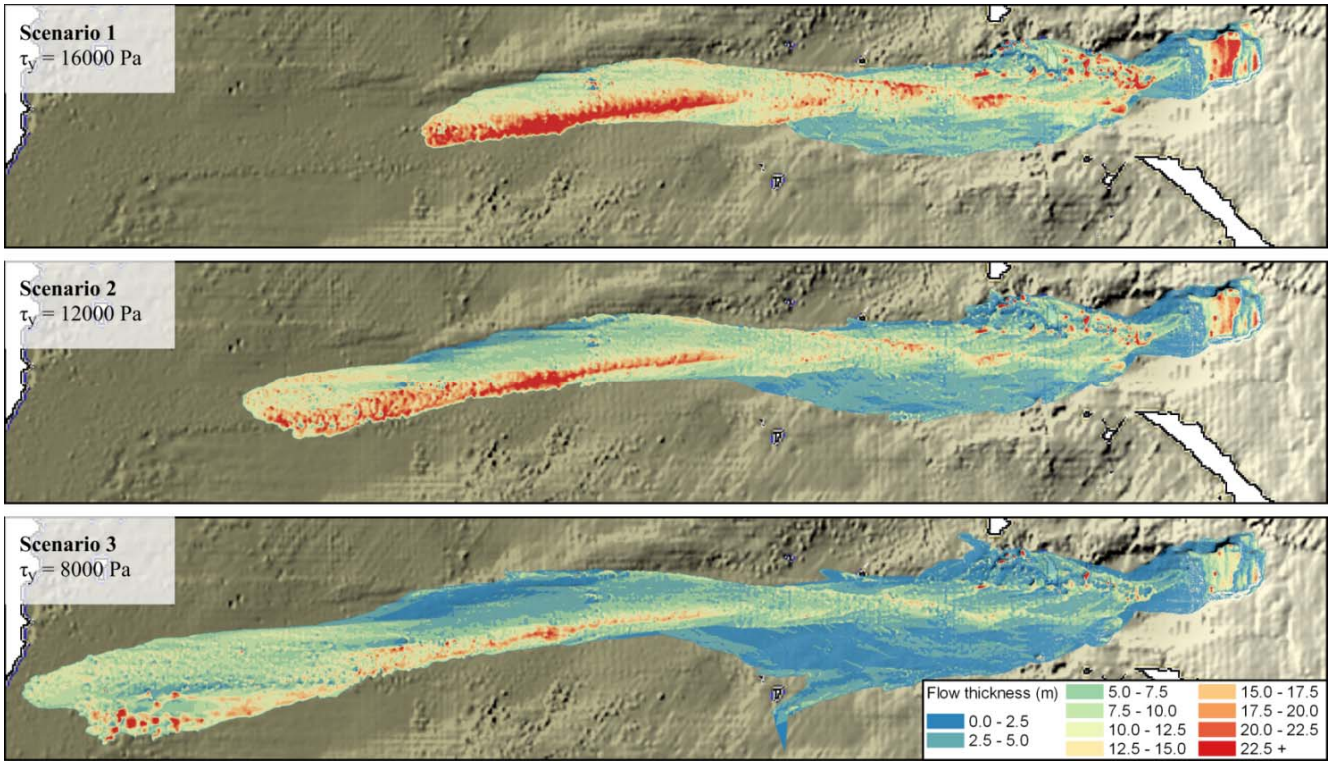


Numerical Modelling - Background

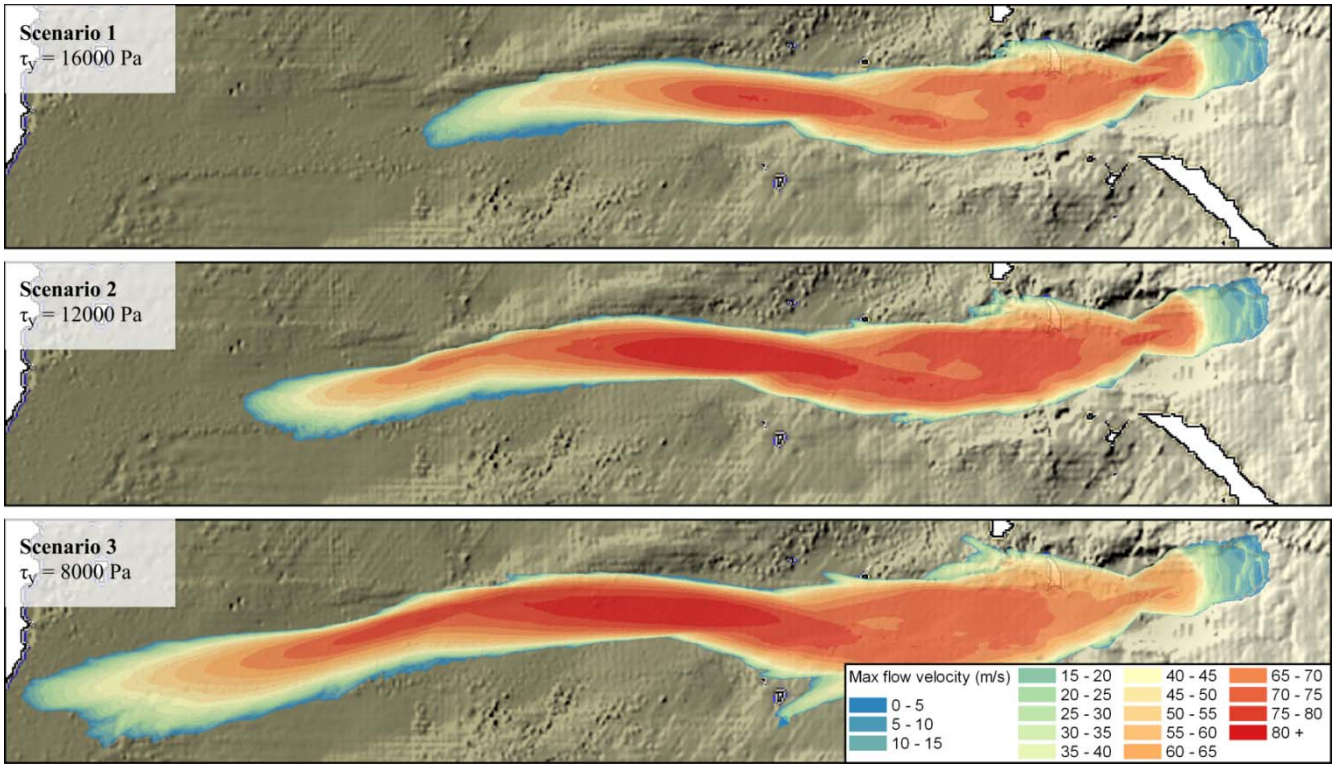
- Heavy sediment density flows and turbidity currents pose risks to seabed infrastructure.
- Accurate modelling key in assessing these risks.
- Technology at Fugro to model both heavy debris flows and turbidity currents, within a fluid mechanics framework (ie, the soil is considered as a non-newtonian fluid).
- Sponsoring cutting edge research focused on modelling the transition between debris flows and turbidity currents.


Water Depth
-700
-1775
-2850
-3925
-5000

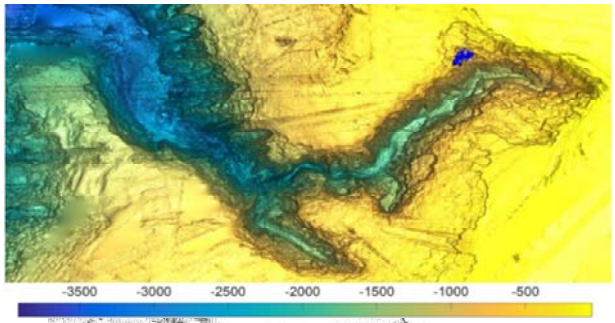
Hypothetical debris flow – Australian continental shelf



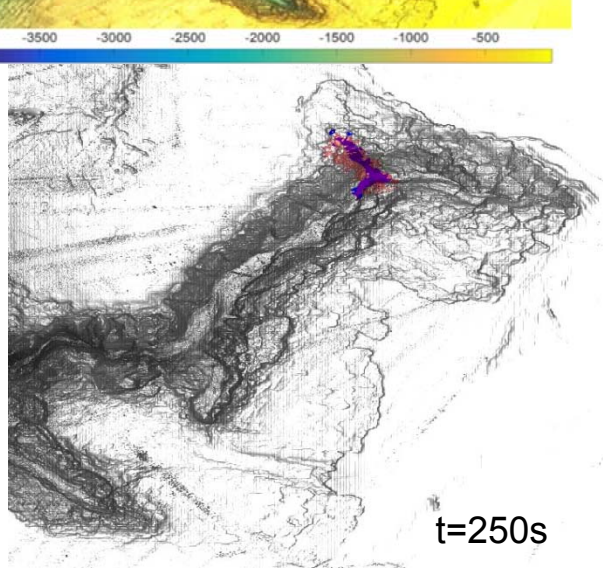
Hypothetical debris flow – Australian continental shelf

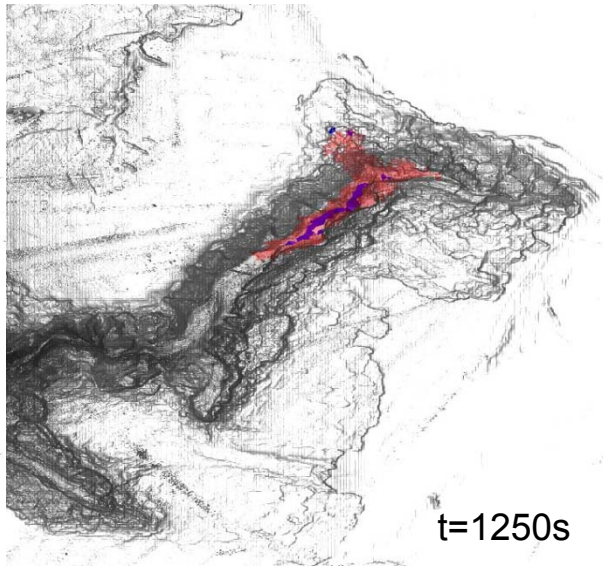


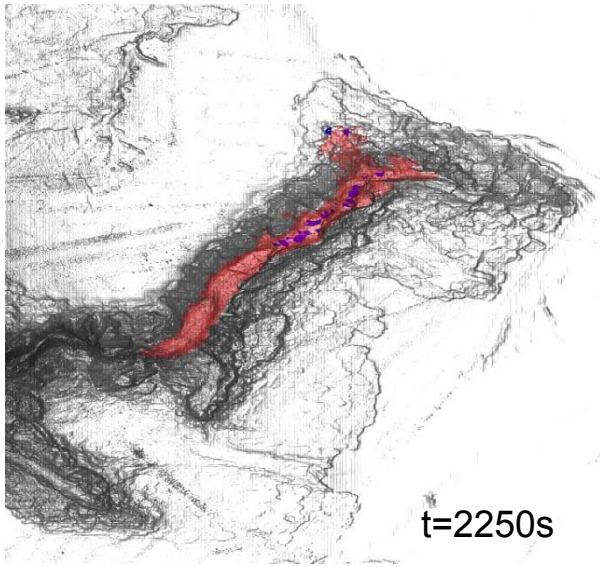
Hypothetical ‘Two-layer’ Simulation



- Hypothetical flow in Perth Canyon
- Transition between debris flow and turbidity current well captured by model







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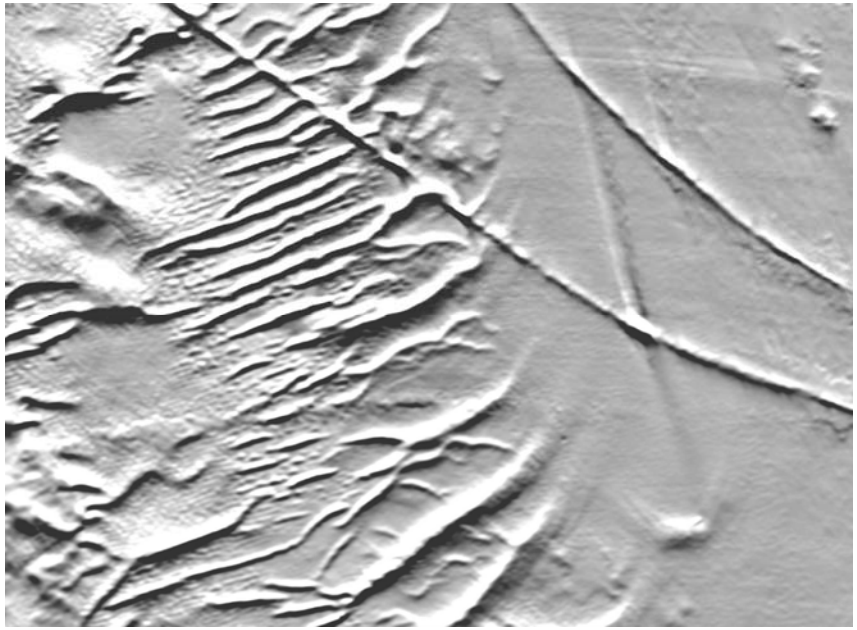
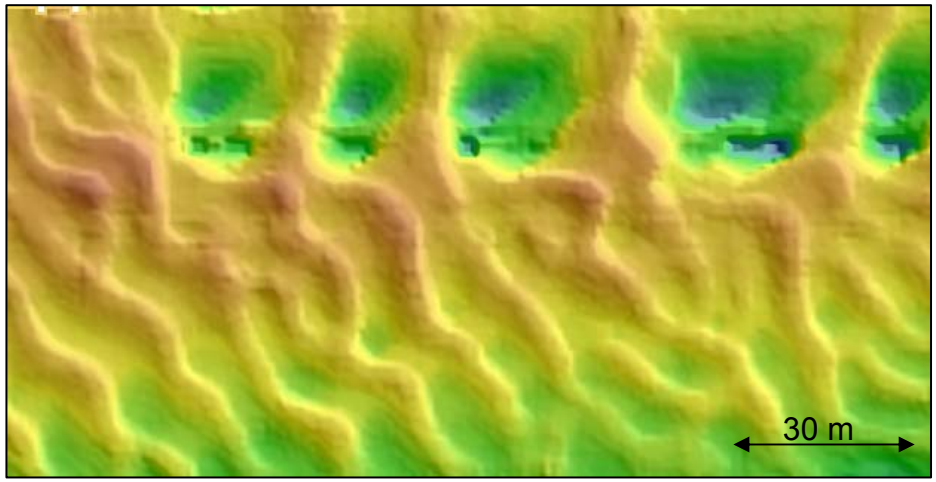


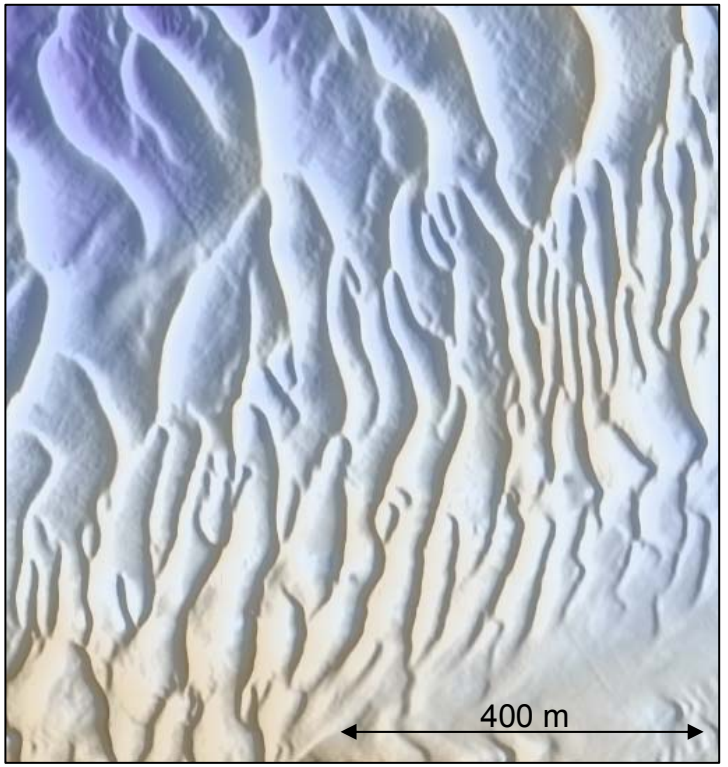
Example: Bedform mobility

-Are they mobile?

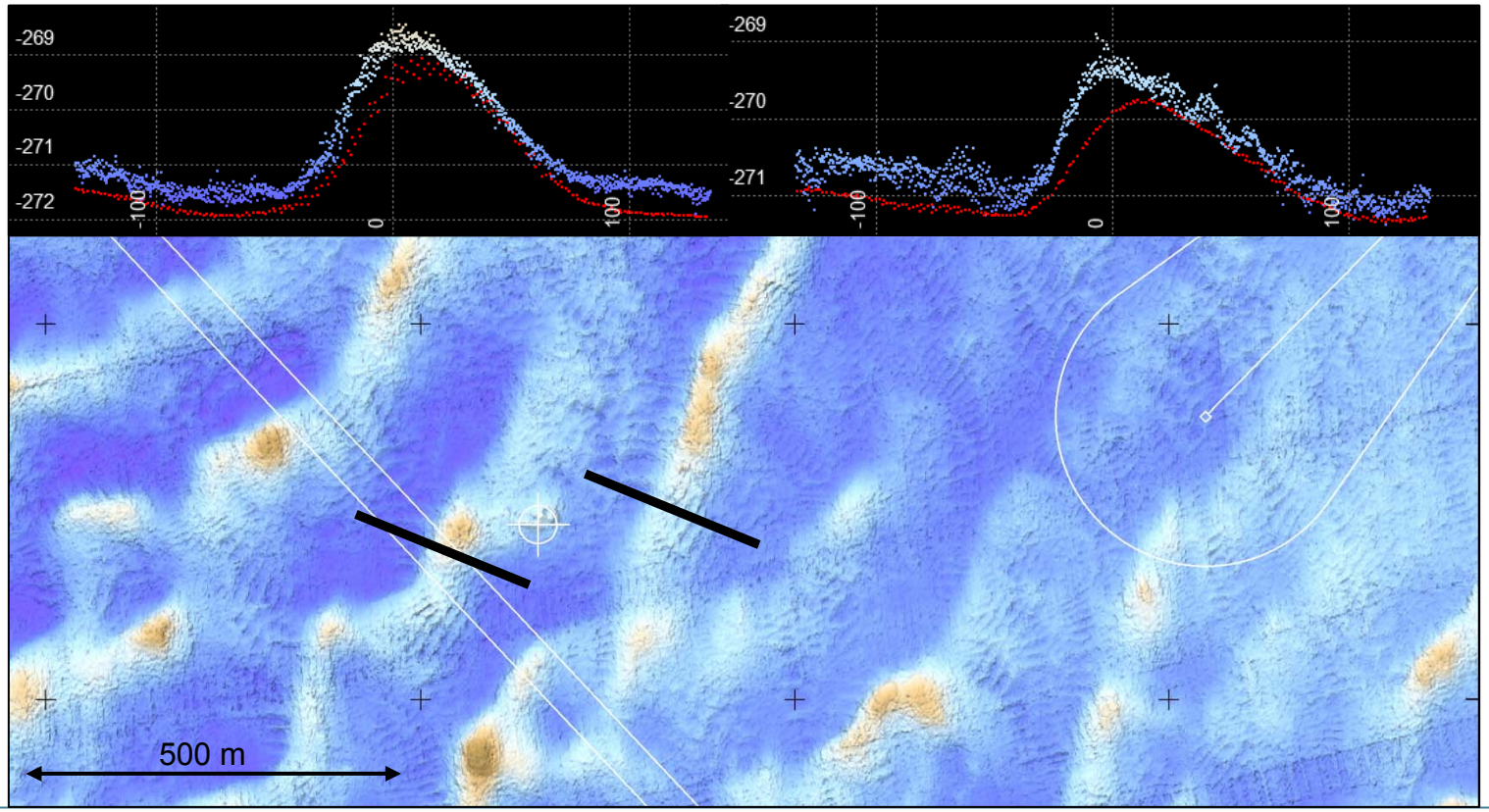
-Rate of mobility?

-Effect on structures?

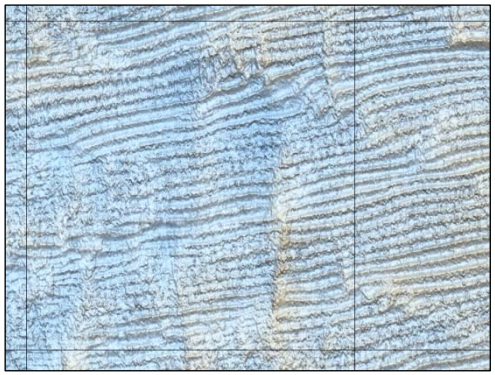


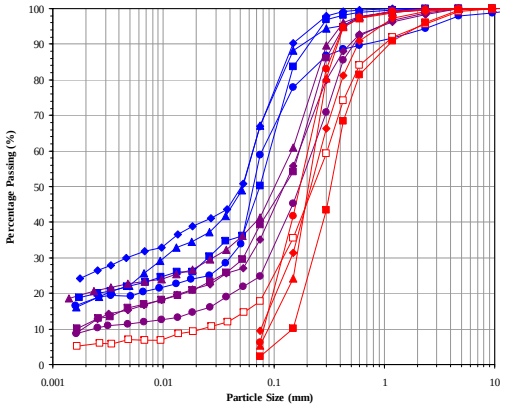


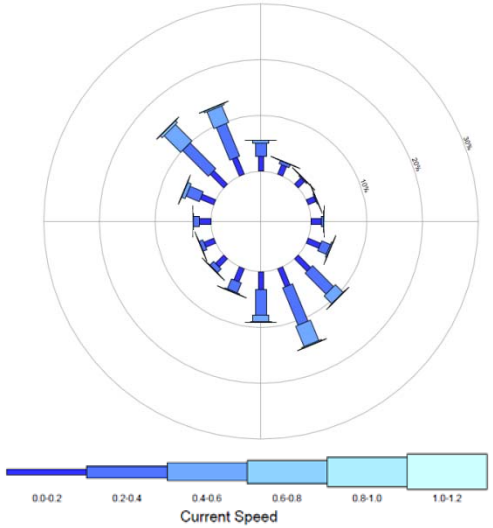
Example: Bedform mobility



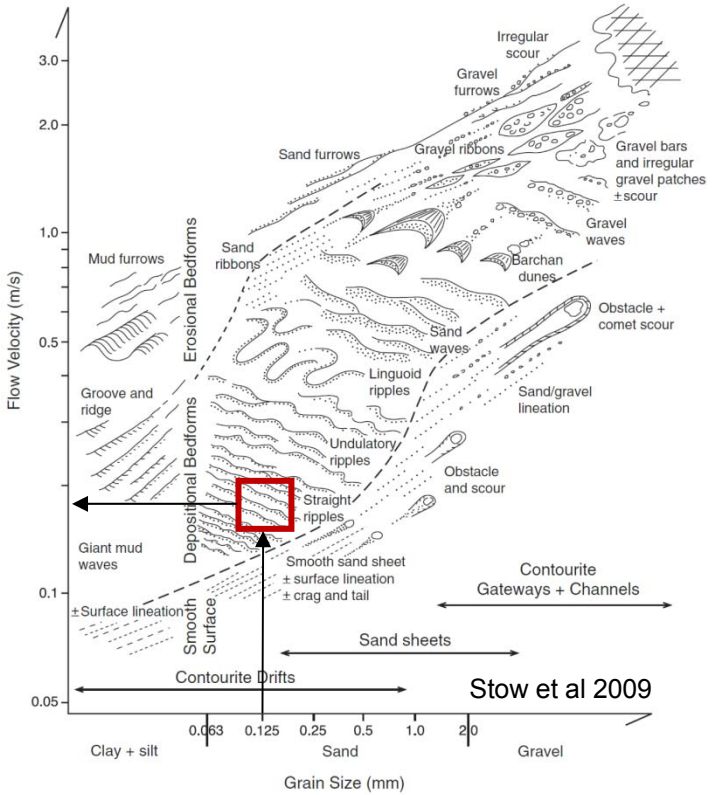
Example: Bedform mobility



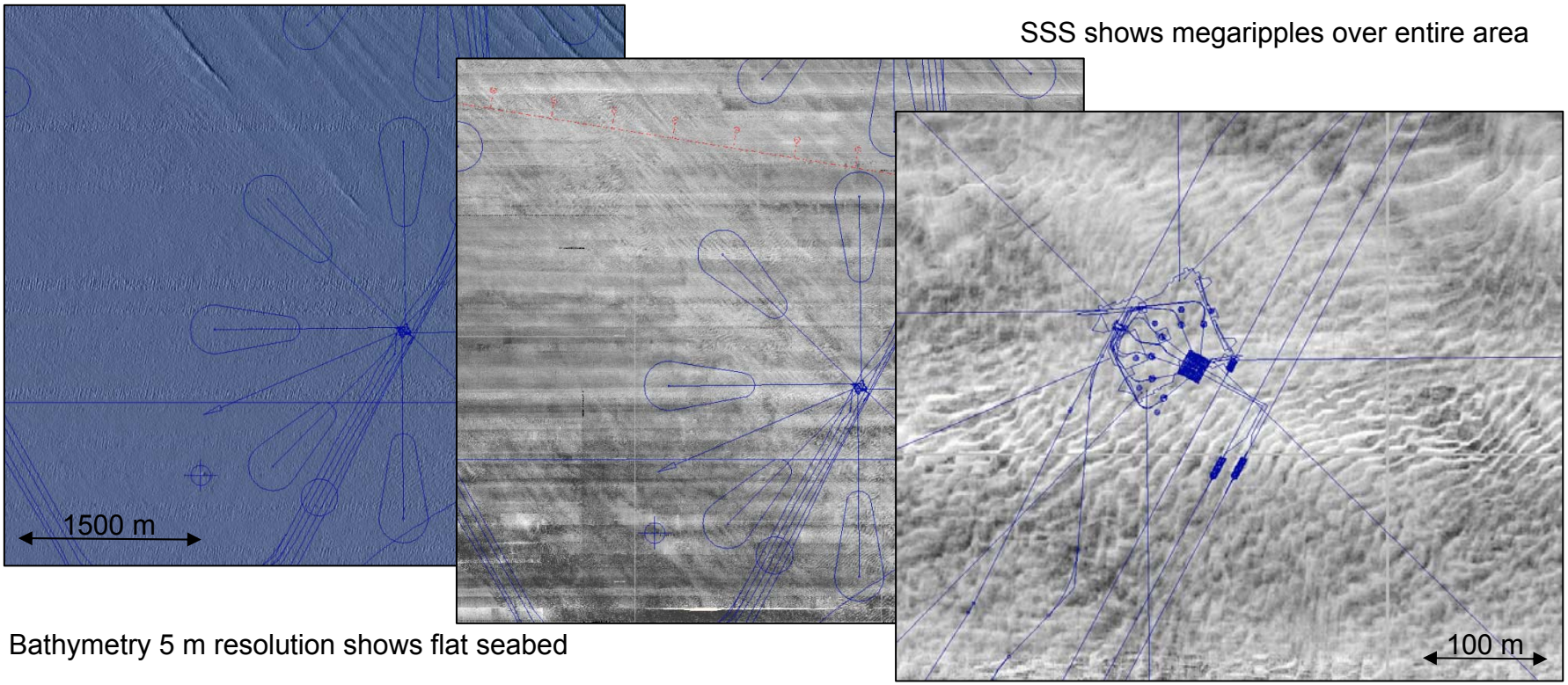




In deep water bedform shape and size are mainly dependent on grainsize and current velocity



Example: Bedform mobility



SSS shows megaripples over entire area

Bathymetry 5 m resolution shows flat seabed

Summary

The DIG approach:

Integrating different datasets (geological, geotechnical, geophysical and metocean) to create a geological model / engineering ground model

- Maximises value of datasets
- Enables us to diagnose the seabed

The geological model will form the basis for further risk assessment, engineering and mitigation

Thank you