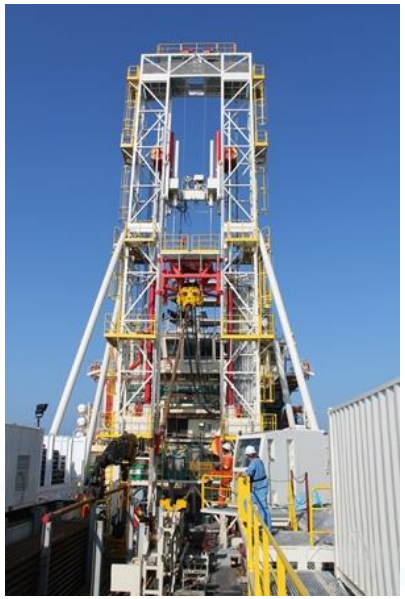
Bluefield Geoservices

Developments in ROV Deployed Seabed Geotechnical Investigation Equipment.

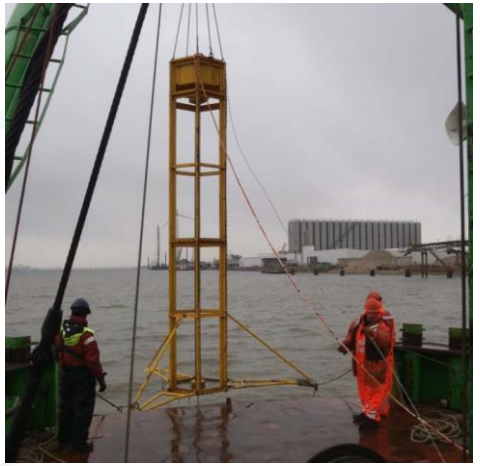
John Buckell
Project Director
January 2020

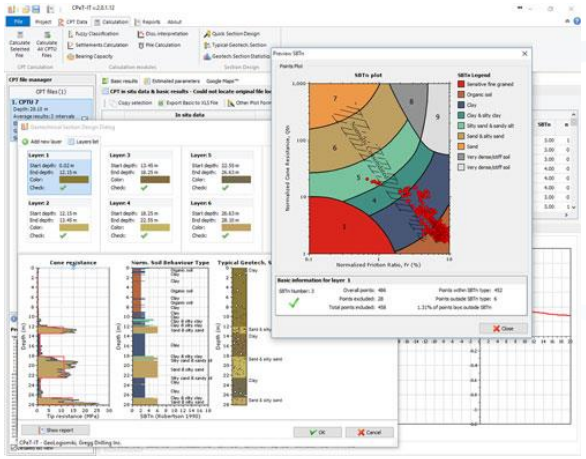
ROV-deployed geotechnical site investigation techniques are becoming increasingly recognised as an effective and efficient method of acquiring data in locations which are inaccessible to conventional geotechnical techniques and to allow precise inspection and positioning of a test location. This includes testing close alongside or underneath existing seabed structures or in extreme environments such as ultradeep-water or deep thermal vents.

Borehole Investigation from Drill Ship



Seabed Geotechnical Investigation





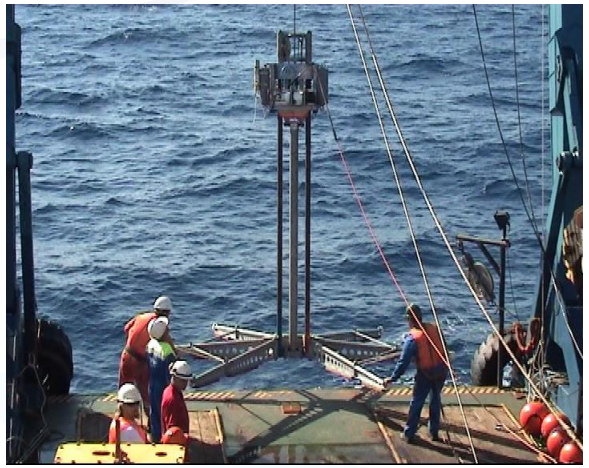


Photo Credits: Geoquip Marine AG, OSIL, Geotech, AP van den Berg

Bluefield Geoservices

ROV based Geotechnical Tooling

Moving tooling from lightweight standalone seabed systems deployed via a vessel crane or A-frame and winch to ROV mounted tools

Advantages

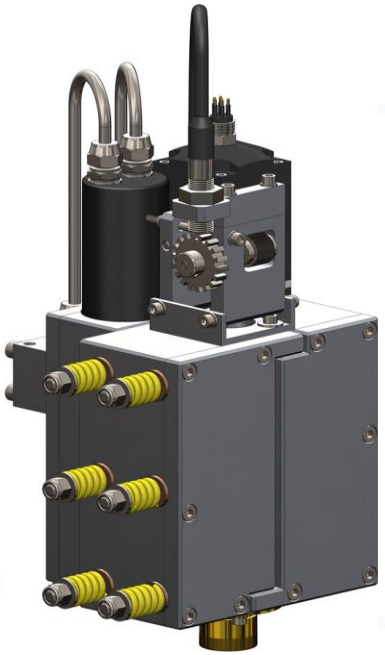
- Mobilisation onto existing in-field vessels / vessels of opportunity
- Mobilisation of lifting and umbilical arrangement not required as using existing ROV onboard
- Safer approach to existing infrastructure on the seabed via an instrumented ROV used to operating in proximity
- Rapid accurate positioning
- In conjunction with visual seabed survey

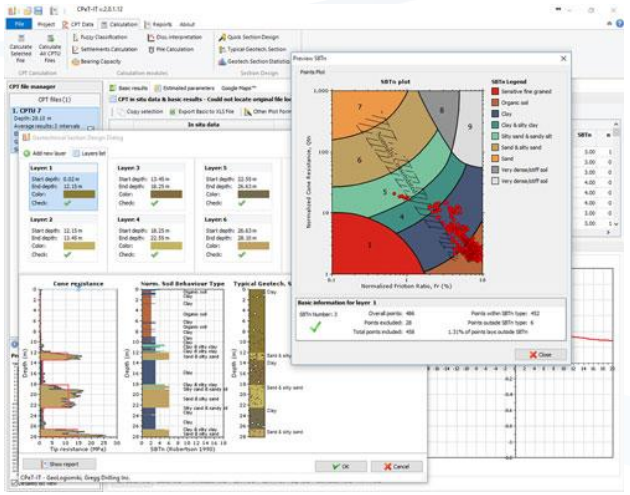
Disadvantages

- Limited by the available reaction from the ROV system or geotechnical skid
- Requires careful pre-mobilisation planning to ensure compatibility

ROV based Cone Penetration Testing

- The ROVcone system has been designed to meet the requirements for a lightweight unit delivering 10 kN push force and suitable for deployment on any work class ROV, trenching machine, or similar subsea vehicle.
- The system can be used for *in situ* testing (CPT and T-Bar) and push sampling in uncemented soils. It is ideal for route surveys, subsea developments, drill cuttings surveys, decommissioning surveys, and for locations which may be problematic for non-ROV conveyed systems to access.
- Uniquely, the system can be operated with wire-free (acoustic) real-time communications.





Bluefield Geoservices

ROV based Sampling

- Push and piston sampling up to 2m in length
- Dependant on the reaction and clearance available from the ROV system
- Multiple samples taken via ROV manipulator inserted samplers
- Environmental sampling
- Targeted sampling
- Class 1 sample in soft soils possible

ROV based Coring

- Cores up to 3m possible from a 200HP+ ROV
- Simple or fully controlled coring options
- ROV skid mounted systems provide rapid mobilisation
- Fully integrated drills provide full drilling parameters via the ROV and a data acquisition system.

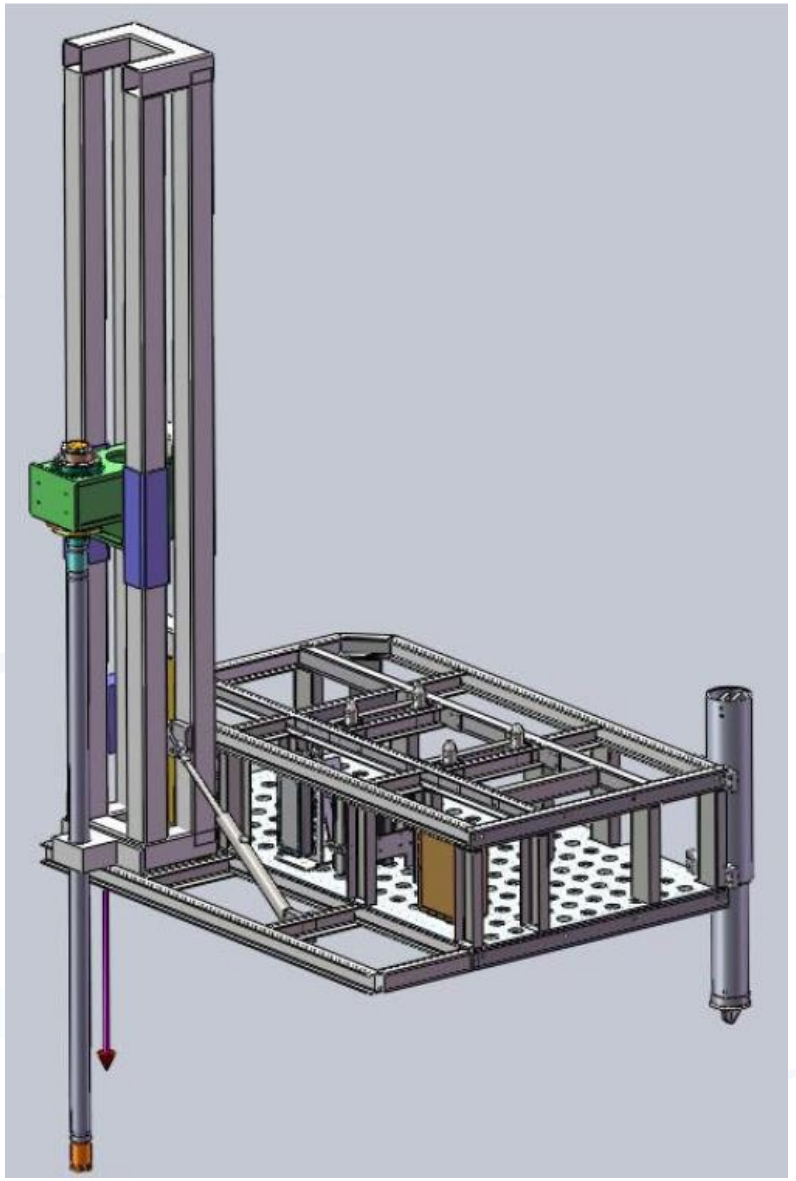


Photo Credits: Cellula Systems Inc., Furmanite Ltd.

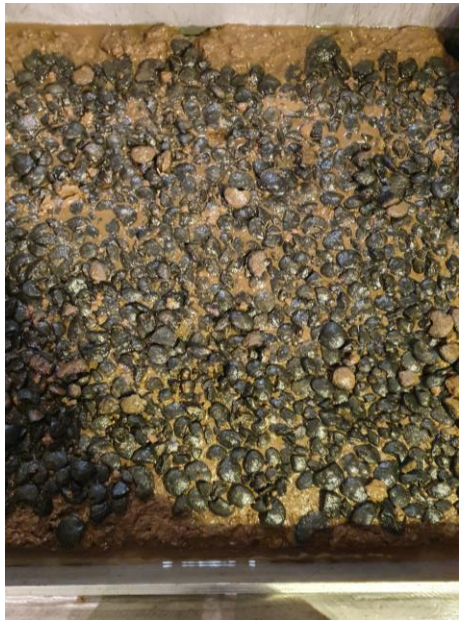
Bluefield Geoservices

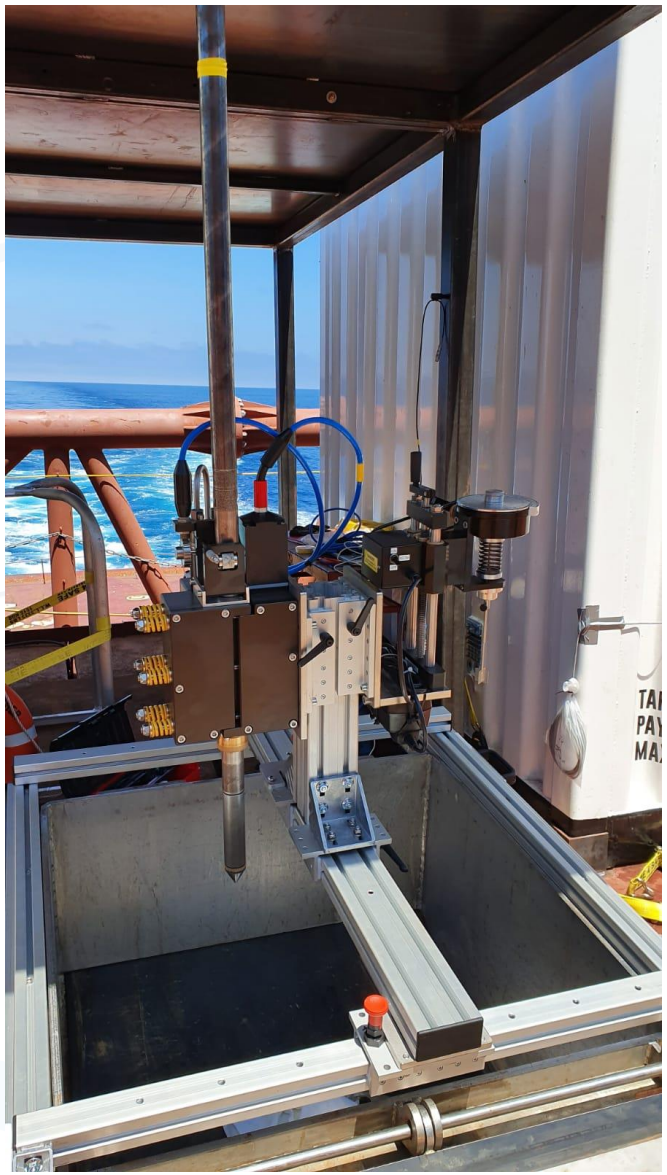
Applications

- Deep Water Mining including nodule survey and seafloor massive sulphide deposits
- Oil and Gas
  - In-field site investigation including inside the 500m zone
  - Operating from directly from rigs
  - Flow lines
  - Pipeline
- Seep Surveys
- Military investigations
- Oceanography
- Cable route survey
  - CPT conducted in real-time with line survey (visual) work

Deep Water Operations

- Current deep water testing normally requires samples to be recovered to deck for testing
- Depressurisation of the sample can lead to changes in the measured soil parameters
- Increased availability of ultra-deepwater ROVs eases the access requirements as only the tool needs development
- Pressure compensated CPT cones now in the commercial market





Bluefield Geoservices

Industry development projects

- RIGGS Joint Industry Project

ROV / Subsea Drilling

“Seabed Drilling is the use of remote robotic technology to conduct geological or geotechnical investigations from equipment located on the seafloor”

There is a market opportunity for ROV based seabed drilling over conventional surface drill ships

- Several systems now on the market
- There is great variability in seafloor drill design.
  - Variability in mode of operations: fix rod vs. wireline

The main benefits and differentiators associated with seabed drilling compared to conventional surface drill ships are:

Publications

- Technical papers presented in ISFOG 2011, highlight the effectiveness and efficiency of seabed drilling technology compared to surface drilling (Ref Osbourne, Yetginer & Tjelta (2011), Yetginer, Halliday & Tjelta (2011)).

HSE Benefits

- Reduced tool handling – reduced HSE hazards*
- Shallow gas – elimination of venting source to deck
- Precision use of drilling mud and loss to environment*

Improved Efficiency

- Reduced launch and recovery times for drilling equipment*
- Reduced tool run times for sampling and in situ testing
- Less weather sensitive, can utilise shorter weather windows*

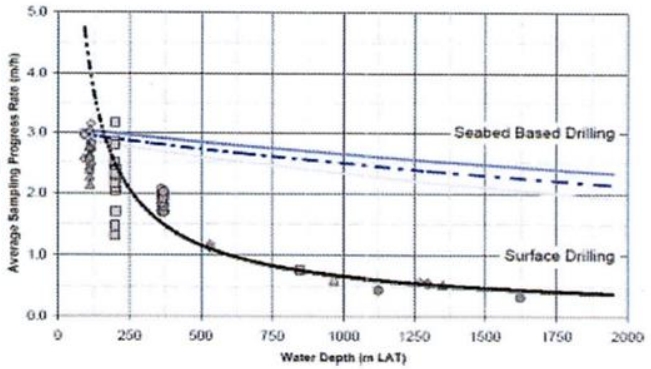


Figure 2. Sampling Progress Rate with Water Depth – Comparison for a 40 m borehole.

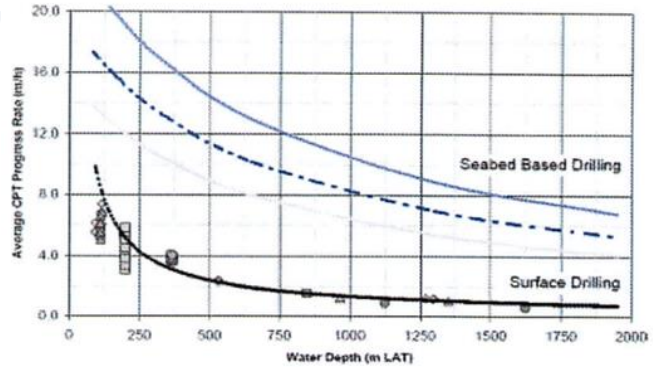


Figure 3. CPT Progress Rate with Water Depth – Comparison for a 40 m borehole.

Bluefield Geoservices

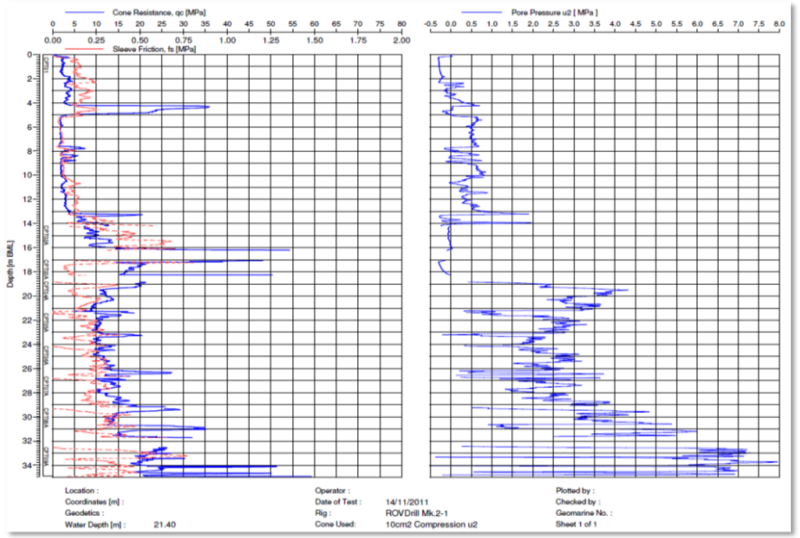
Differentiators of Subsea Drilling

Improved Sample and Data Quality

- Accurate detection of mudline & significant improvement in borehole depth control*
- Reduced levels of sample disturbance
- Increased accuracy of *in situ* test results

Increased Flexibility of Operation

- Subsea operations can take place closer to subsea assets
- Can traverse between drill locations without recovery to deck (subject to BH design)*
- Operation in high seabed currents – up to 8knots*
- Can work in minimal visibility – worked through highest recorded tidal surge on Humber*
- Most drills can be deployed from vessels of opportunity worldwide



Bluefield Geoservices

Limitations of Subsea Drilling

Sample Quality

- Hard to assess sample recovery prior to system recovery to deck
- Hard to assess sample quality prior to recovery to deck
- If drilling process has poor control, then complete borehole sample data can be compromised

Operations

- Operators learn a new method and technique of operation
- Hard to assess sample quality prior to recovery to deck
- Mobilisation depends on system but some simple, some involved.

IHC SWORD

- Sonic Wireline Operated Remote seabed-Drill
- Designed to operate in waters up to 3000m
- 3 adjustable legs for uneven, sloping seabed and various seabed stiffness; stability assured
- Drilling depth of up to 120m below seabed
- Sampling by push, piston-push or sonic core-drill
- Real-time monitoring of Cone Penetration Test (CPT), Shear Vane, T-Bar, Seismic CPT
- Wireline technique for all tools
- Interchangeable carousels that carries drill string and stores sample barrels

Summary

- High quality data and samples
- Effective use of existing assets
- Access to remote locations
- Safer controlled access to sensitive structures
- Rapid mobilisation and ability to fit into an existing campaign without additional vessels onsite
- High accuracy of positioning
- Integration into existing ROV survey programme
- Increase in production rates through controlled in water transits

Thank You

For more information please contact john.buckell@bluefieldtech.com or visit www.bluefieldgeo.com