

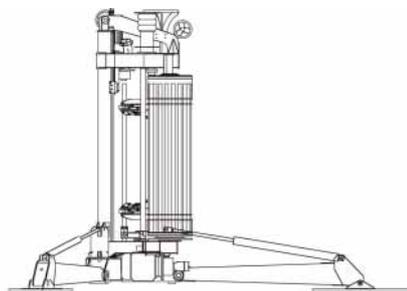
The PROD Technology

PROD, the **P**ortable **R**emotely **O**perated **D**rill is a fully self contained, remotely operated sea floor drilling system. PROD operates on the seabed and is powered and controlled from a ship via an umbilical.

In the same hole, PROD can switch between diamond bit rotary drilling, piston sediment sampling and in situ CPT testing at the dictate of the seabed geology or the clients' data requirements.

Once PROD has landed on the seabed, the drill is isolated from the influence of ship movement. PROD provides sample and data quality that are superior to ship-mounted heave compensated drilling equipment or seabed CPT frames. PROD's data acquisition capability exceeds existing in situ testing equipment that lack capacity to penetrate past 20m or drill through obstructions.

Two rotary magazines hold PROD's core barrels, CPT barrels and casing. The magazines can carry 260m of tools, allowing a practical penetration capability of plus 100m depending on sampling type. Tools, core barrels or casing are delivered between the drill head and the magazines by a pair of robot arms. All drill related operations are hydraulically driven. Drill tools handling the core are placed into the magazines following each run and are removed from PROD when PROD is retrieved to the ship.



Drill attitude is monitored and corrected as required during operations to ensure that PROD remains vertical. The depth of the drill bit with respect to the drill platform is monitored accurately to within 2mm throughout the operation. The position of the PROD frame can be measured to an accuracy of 25mm relative to the mudline.

Ancillary features include pan and tilt cameras for visual inspection of all drill operations; an altimeter, compass; tilt sensors

and thrusters for position and heading control during landing, recovery or repositioning. All drill operations and performance criteria are monitored and stored in real time, and drilling data is readily available to clients in digital format.

Portable

PROD fits into a standard open-top 20' shipping container. Modified containers provide control, power management and workshop facilities. The full system, including winch, is transported in four 20' containers.

Unloading of the containers and installation on the vessel is handled by the PROD operating crew and takes an average of 3 days from arrival dockside.

PROD's portability allows for cost-effective mobilisation and offers the opportunity to use ships already in the mission location vicinity or under charter by clients.



Remotely Operated

PROD's functions are controlled by an operator on the ship via computers. Drilling actions such as advancing casing, make up of drill string, wash boring, rotary drilling,





piston sediment sampling and testing are precisely controlled by robotic actuators. Computer screens show all drill parameters in real time, including bit weight, rotation speed, torque, elevator position, penetration rate, water pressure and flow rate, and current hole depth. Clients are provided with a digital log of drilling parameters which, once the geotechnical characteristics have been established, can be used as an indexing tool for material strength down the drill hole.

Drill

In the same hole, PROD can switch between diamond bit rotary drilling, piston sediment sampling and in situ CPT testing at the dictate of the seabed geology or the clients' data requirements. Amongst other things, this allows CPT data to be gathered in sediments below hard obstructions that would defeat typical seabed CPT systems.

Rock Coring

Rock coring is performed using standard diamond drill bit rotary coring equipment. Core barrels are 2.25m long, B size triple tube producing samples that are 35mm in diameter. Each rock barrel is fitted with a drill bit that is used for a single run. This ensures that there is minimum disruption of progress if any particular drill bit becomes blocked during coring.

Sediment Sampling

Sediment coring is performed using Benthic Geotech's patented piston tube sampling system. This system exploits ambient hydrostatic pressures to overcome friction as sediment enters the barrel. Samples are taken in 2.75m long sections. Coring is precise and of high quality, as penetration is immediately arrested once frictional forces overcome the hydraulic tether and inhibit further sediment entering the core barrel. A proprietary finger & sock type catcher system is used to retain the complete soil



sample during extraction from the hole and subsequent storage on the magazine. All recovered core is retained in transparent plastic liners, which are end capped, waxed and stored in vibration proof storage boxes after PROD is recovered to the vessel.

Casing

PROD carries casing on each deployment sufficient for 50m. Casing is advanced in a similar procedure to standard drilling and allows CPT testing and sediment sampling to be conducted at greater penetrations in a variety of soil types that would prohibit advancement using standard-style seabed systems.

In Situ Testing

PROD carries a standard 10cm² piezocone penetrometer (CPT). The CPT can operate at water depths up to 2,000m, and can penetrate to depths greater than 50 m below the mudline. The system provides real time data log records of cone tip pressure, friction and pore water pressure. In addition, the CPT probes carry non volatile onboard 18-bit backup memory, allowing full verification and enhanced resolution of the acoustically transmitted real time data.

The PROD CPT system consists of a 1m long standard 36mm diameter probe and push rod assembly, attached to a customised PROD drill rod. For the purpose of enabling tool redundancy and to extend operating capability, multiple CPT probes can be deployed in conjunction with sampling tools.





Key Specifications

Height (excluding main sheave wheel)	5.8m
Deck footprint (vertical, legs raised)	2.3m x 2.3m
Weight in air	Approximately 10 tonnes
Weight in water	Approximately 6 tonnes
Drill stowed for shipping	1 x 20' shipping container
Maximum operating depth below sea level	2,000m
Maximum sampling penetration depth	125m
Maximum casing depth	50m
Drill tool size	B
Piston Sampler core diameter	44mm
Piston Sampler core length	2.75m
Rotary Diamond Drill core diameter	35mm
Rotary Diamond Drill core length	2.25 m
Maximum push thrust	6 tonnes + suction pressure
Rotary coring power	75 kW (100 hp)
CPT seabed penetration	>50 m
CPT diameter x length	36 mm x 1,000 mm, followed by drill rods
CPT data transmission	Acoustic transmission from probe via drill string to fibre optics in umbilical
CPT performance specifications	Resolution 0.04-0.05% F.S., Stability < 0.05% F.S./10 deg. C Non-linearity qc <0.1%; fs, u < 0.5% F.S., Overload 25%

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