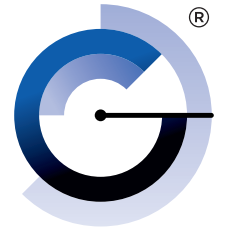


Robertson Geo offers wireline conveyed, slim-hole logging services for geotechnical investigation, hydrogeological projects, environmental studies, mineral evaluation, hydrocarbon exploration and geoscience research worldwide.

No project is too small, no project too large or challenging.



**ROBERTSON
GEO**

SERVICES

Unlocking Your GeoData

Operational Services

Publication No: 006 RGO/25b



Services



Robertson Geo is truly a global operation, the market leader of slim-hole logging instrumentation with comprehensive in-house design and manufacturing facilities and a proven operational logging service of unmatched experience of data acquisition from 1,000's of boreholes, worldwide.

Market sectors serviced include civil engineering infrastructure, nuclear, water, unconventional gas, mining, coal and renewable energy both onshore and offshore.

"No project is too small, no project too large or challenging".



**ROBERTSON
GEO**

SERVICES

Unlocking Your GeoData

Professional and committed service

Robertson Geo and senior personnel are affiliated with major professional organisations including AGS, BDA, BGA, IoM3, EAGE and the Geological Society. With a commitment to continuous Research & Development programmes, often in partnership with leading UK and overseas universities, recent pioneering developments include a slim-line oilfield quad combo logging suite, plus Optical and Acoustic Televiewers establishing new industry standards for high resolution fracture studies.

Service logging operations

Robertson Geo engineers are experienced, highly trained and fully certified for offshore working and can be deployed to any global location.

The complete catalogue of equipment is available on a service basis operated by these field crews. They are capable of prolonged service logging operations with minimum outside support and are expert in data processing and interpretation.

These are very cost effective contracting services in circumstances where projects do not justify purchasing equipment and the necessary back up facilities.

Equipment supply

All Robertson Geo probes are fully tested and calibrated at the Conwy facility prior to dispatch, eliminating testing time on site and ensuring the probes are fully operational prior to downhole use.

Depending on customer needs operational and customised training can be provided; for winch use, probe deployment, logging techniques, data capture and equipment maintenance and troubleshooting.

Equipment rental

Robertson Geo equipment is available to rent with a minimum rental period of 3 days in the USA or 15 days elsewhere. Full systems (including winches) or individual probes can be rented as required with borehole and classroom based training available for rental customers.

In-house processing service can be supplied for rented equipment and all offshore systems come complete with spare probes and surface units together with essential spares to eliminate problems and expensive vessel downtime.

Equipment rental training:
ijones@robertson-geo.com

Technical training and support:
support@robertson-geo.com

Why choose Robertson Geo?

- Safety focused operations performed by skilled, experienced and competent logging personnel
- Logging probes which are tested and calibrated to known industry standards in the Conwy calibration and test well facility
- ISO certified management systems (QMS) for tool design, manufacture, calibration and execution of logging services
- Assistance with preparation of job methodology, procedures and risk assessments
- Experienced operations supervision & support backed by established ISO & QHSE management systems
- Technologies that are 'battle proven' through own use of Robertson Geo logging technologies in service operations
- Expert technical support from in-house Research and Development, Engineering & software groups
- Field proven, high-quality, in-house designed and manufactured logging probes
- Professional, standardised data processing and reporting
- Expertise and experience gained from over 45 years of logging services globally
- Modern fleet of fully equipped logging vehicles for all environments



Wherever you see this icon throughout this digital literature, it allows a live link to more detailed product and interest information.
Viewing a hard copy? Go to: www.rgeo-services.com

Certified Quality Management

Robertson Geo is the only logging services provider with a QMS certified to ISO 9001, comprehensively calibrating all of its logging systems and uniquely using an on-site borehole for testing at its Conwy test well and calibration facility.

Impressive safety record of over 45 years

Safety and Quality Assurance are of prime importance in achieving a valid approach to field investigations and delivery of client requirements. Robertson Geo has demonstrated an impressive safety record of over forty years of logging services, based on the principles outlined in the International Association of Geophysical Contractors Land Geophysical Safety Manual.

These satisfy the requirements for its entire field services department, design, manufacturing and sales activities.



An ongoing commitment to certified quality management

As the world's largest provider of slim-hole logging instrumentation, Robertson Geo designs and manufactures almost all equipment in-house.

Purchasers of equipment include water authorities, mining houses, civil engineering consultants, aid organisations, drilling contractors and oil companies worldwide with logging equipment currently used in over 150 countries.

This expertise, support and experience makes for the offer of first-class services at competitive rates.

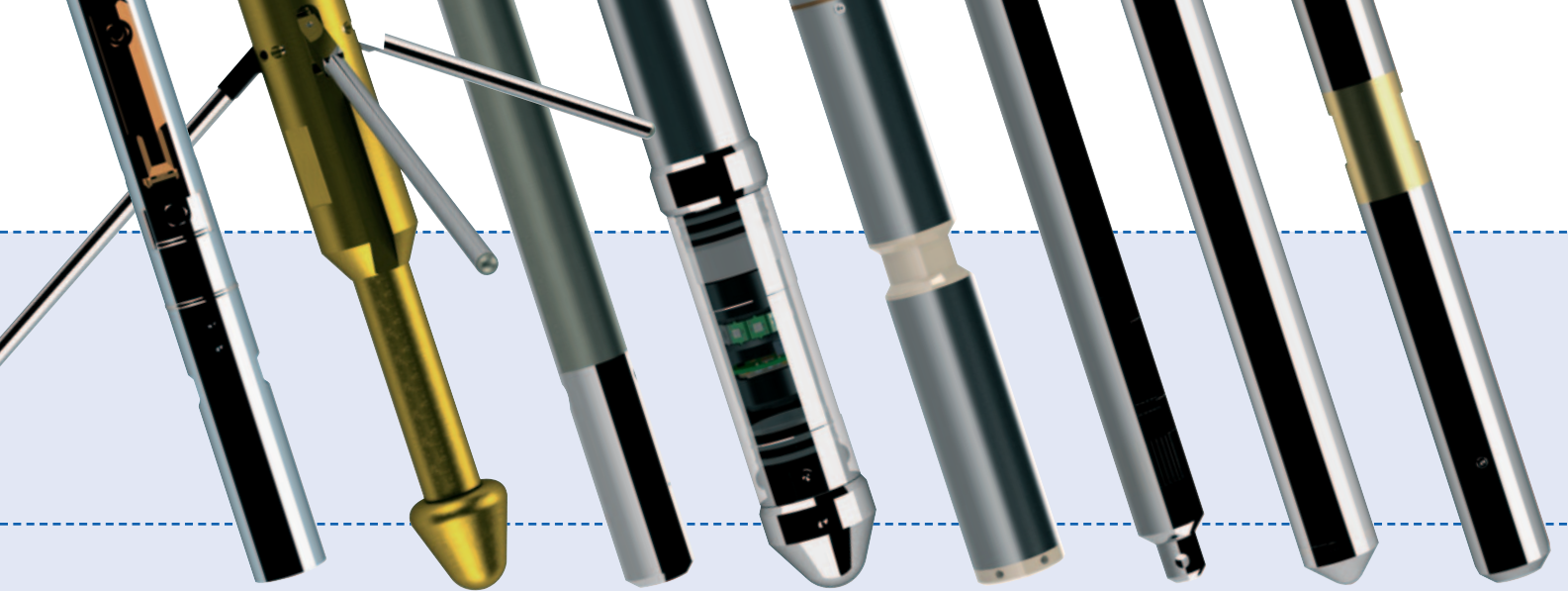
Robertson Geo has an ongoing commitment to certified quality management and our QMS is certified according to ISO 9001 by DNV.

Robertson Geo is the only logging services provider with a QMS certified to ISO 9001, and the only company which comprehensively calibrates all of its logging systems. Established industry references at ELGI Hungary and the DWLBC calibration pits (API) in Adelaide, Australia provide the reference models for nuclear tool calibrations. These two references were used by Robertson Geo to establish calibration benchmarks at the Conwy facility, and to reference the formation response in the Conwy calibration and test well facility.

Once a nuclear tool system (Probe + tool specific source) is calibrated to these recognised Industry standards, they are then run in the Conwy calibration and test well facility to verify that the tool response is within tight tolerances established from data gathered over many years and 1000's of runs. All other non-nuclear tool systems receive the same attention to detail and test well verification prior to deployment.



Only after verification in the test well confirming both tool operational function and measurement calibration are tools accepted for use. Verification reports and calibration records are provided in the end of well reporting package.



Geophysical logging probe overview

High Resolution Optical Televiwer (Hi-OPTV)®:

Provides a continuous very high resolution oriented image of the borehole walls using a conventional light source. A unique optical system based on a fisheye lens allows the probe to survey 360° simultaneously. This information is processed in real time to produce a complete 'unwrapped' image of the borehole oriented to magnetic north.

High Resolution Acoustic Televiwer (HRAT)®:

Provides a continuous high-resolution oriented ultrasound image of the borehole wall. The probe uses a fixed acoustic transducer and a rotating acoustic mirror to scan the borehole walls with a focussed ultrasound beam.

3-Arm Caliper:

Provides a single continuous log of borehole diameter as recorded by three mechanically coupled arms in contact with the borehole wall. A number of sizes are available to suit a range of well diameters. The caliper is a useful first log to determine the borehole conditions before running more costly probes, or those containing radioactive sources.

Borehole Geometry:

Consists of a 4-arm caliper combined with a verticality measurement. The probe can replace the standard 3-arm caliper with advantage where the borehole cross-section departs from circular, and where directional information is required for well completion studies and formation stress analysis.

PS Logger®:

Provides high resolution shear wave and compressional data in rock and soils at depths up to 600m, from measurements within a single borehole.

Electric Log:

The classic water-well combination probe combining shallow, medium and deep penetrating resistivity measurements with Self-Potential (SP).

Focussed Electric (Guardlog):

The focussed resistivity (LL3) measurement provides excellent vertical resolution and a reasonable depth of investigation. The replacement for the classic Electric Log Probe in conditions of low mud resistivity and high formation resistivity.

Dual Focussed Induction:

Provides two simultaneous conductivity logs, corresponding to "medium" and "deep" radii of investigation into the formation. The two depths of penetration are useful in porous, permeable formations where the displacement of formation fluids by drilling mud creates an "invasion zone" with different electrical properties. The 1" focussed induction probe produces a single medium penetration conductivity log. It finds particular application in small diameter dry or plastic lined boreholes used for mineral exploration.

Formation Density:

The Formation Density uses dual shielded detectors to provide a borehole compensated density measurement with good bed-boundary resolution.

Impeller Flowmeter:

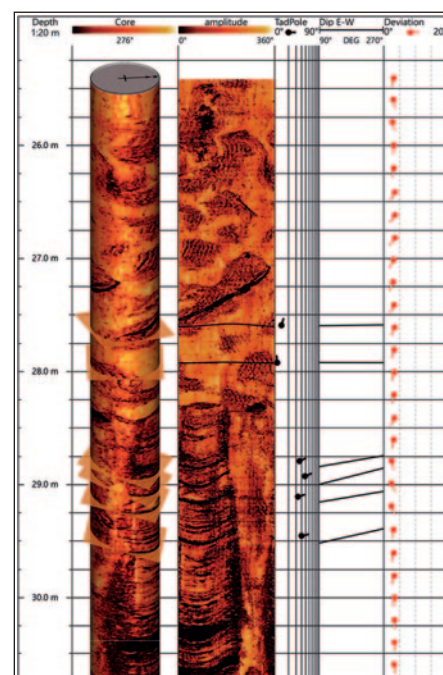
Provides a continuous log of vertical fluid velocity within a borehole. Two sizes of high sensitivity probes satisfy most borehole size requirements and expected flow rates.

Full Waveform Sonic:

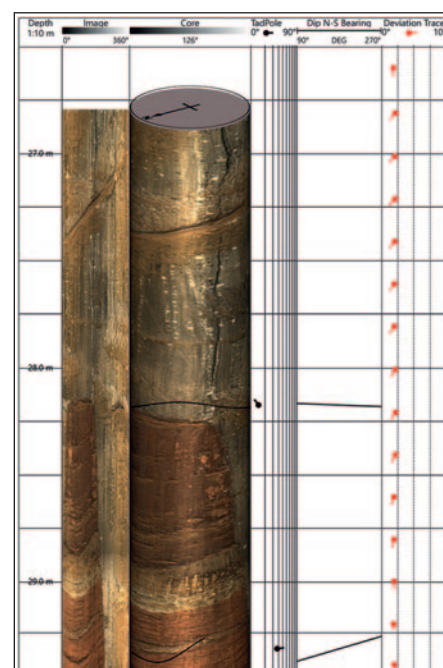
Uses a dual-transmitter dual-receiver array to provide high quality formation acoustic velocity data. Options are available for display of full waveform data and cement bond data (CBL) in cased boreholes.

Temperature Conductivity:

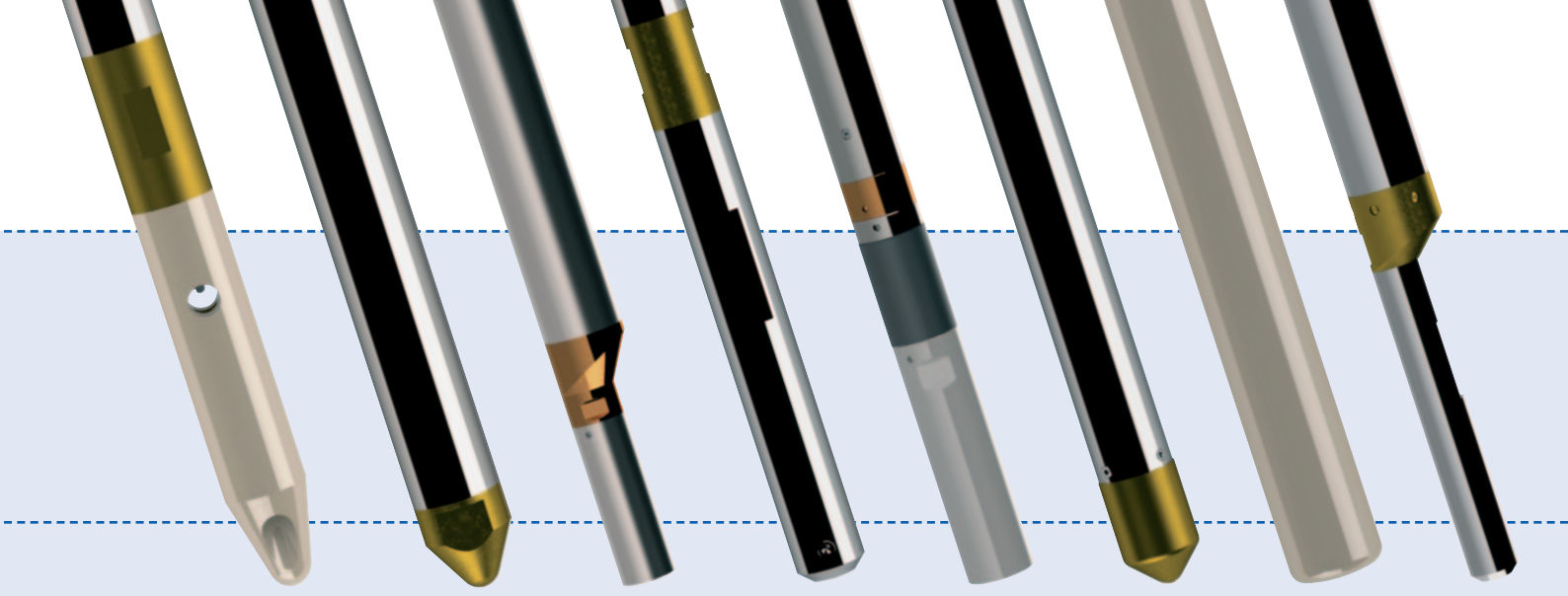
Provides a continuous, depth-based measurement of fluid temperature and conductivity. Both parameters can be output in absolute and in differential forms. A natural gamma detector is included for correlation purposes.



Example of data created by the HRAT® Probe.



Example of data created by the Hi-OPTV® Probe.



NMR:

Nuclear Magnetic Resonance (NMR) technology is rapidly gaining acceptance as the definitive tool for characterising fluid content within formations through a unique set of data.

Heat-Pulse Flowmeter:

Used to detect low vertical flows within a borehole, below the threshold limits of conventional impeller tools. The probe is designed for stationary measurements only. Normal logging practice involves measurements at a series of depths across the zone of interest.

Verticality:

Provides accurate, continuous measurements of borehole inclination and direction. These are output directly as log traces or may be processed further to produce tabular and graphical outputs of borehole position, borehole drift and true vertical depth.

Neutron:

Provides a calibrated borehole compensated neutron porosity measurement in mud-filled open holes. It is the probe of choice for quantitative formation fluid studies. A single-detector neutron probe is also available for qualitative porosity logging under most borehole conditions, including through steel or plastic casing and drill-pipe.

Density Gamma:

Offers a convenient alternative to the standard Robertson Geo Formation Density Probe whenever borehole diameter is restricted and qualitative density measurements are acceptable. One common application is in logging through drill pipe when unstable borehole conditions prevent use of unprotected nuclear probes.

Magnetic Susceptibility:

Based on the industry standard Bartington Instruments™ product. It is a low frequency device and is specifically designed for mining applications.

Water/Gas Sampler:

Probes are used to recover discrete samples of well fluid at a particular depth and to return it uncontaminated to the surface.

Spectral Gamma:

Analyses the energy spectrum of gamma radiation from naturally occurring or man-made isotopes in the formation surrounding a borehole. The probe corrects for temperature drift in real-time by matching the acquired spectrum to base spectra of the main natural emitters, potassium, uranium and thorium determined during the tool master calibration. Available outputs are full spectrum (static mode only) and continuous log measurements of elemental concentrations. Borehole corrections are available for casing thickness, borehole diameter, formation density and mud/fluid radioactivity for both centralized and sidewalled tool positions.

Microresistivity:

Provides a focussed pad resistivity measurement with high vertical resolution combined with a caliper and natural gamma.

Water Quality:

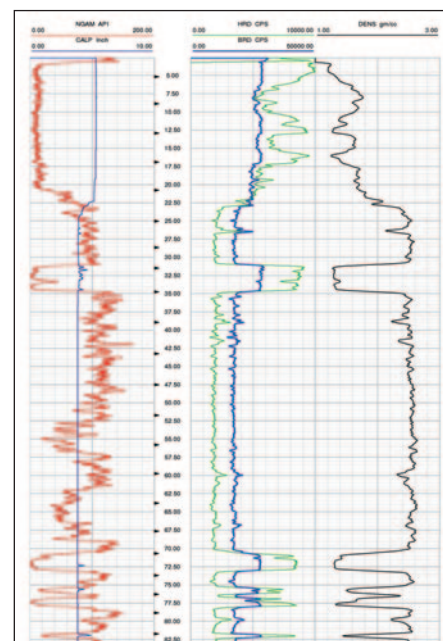
Based on the industry standard Ocean Seven 310™ Borehole probe manufactured by Idronaut Srl. The tool is available in 'saline' and 'fresh-water' versions with different conductivity ranges and available measurements. The probe enables a rapid, continuous profile to be taken of all the selected parameters throughout the borehole either for direct use or as a guide for subsequent sampling.

Gyro:

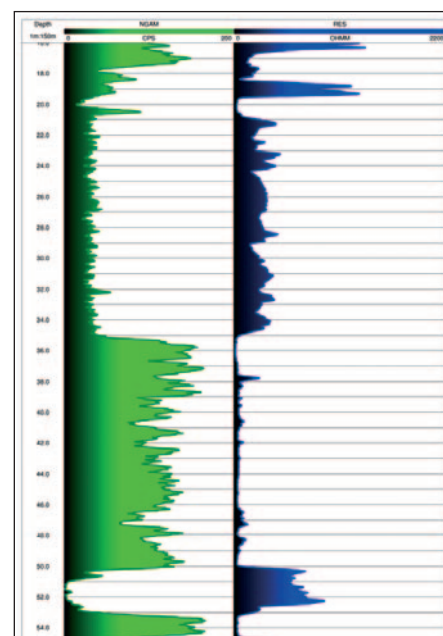
Acquires borehole inclination/azimuth logs in situations where metal casing or magnetic materials around the borehole prevent use of the standard verticality probe. The 3D-magnetometer version also acquires 3D-magnetic data for location of magnetic ore bodies.

4-Arm Dipmeter:

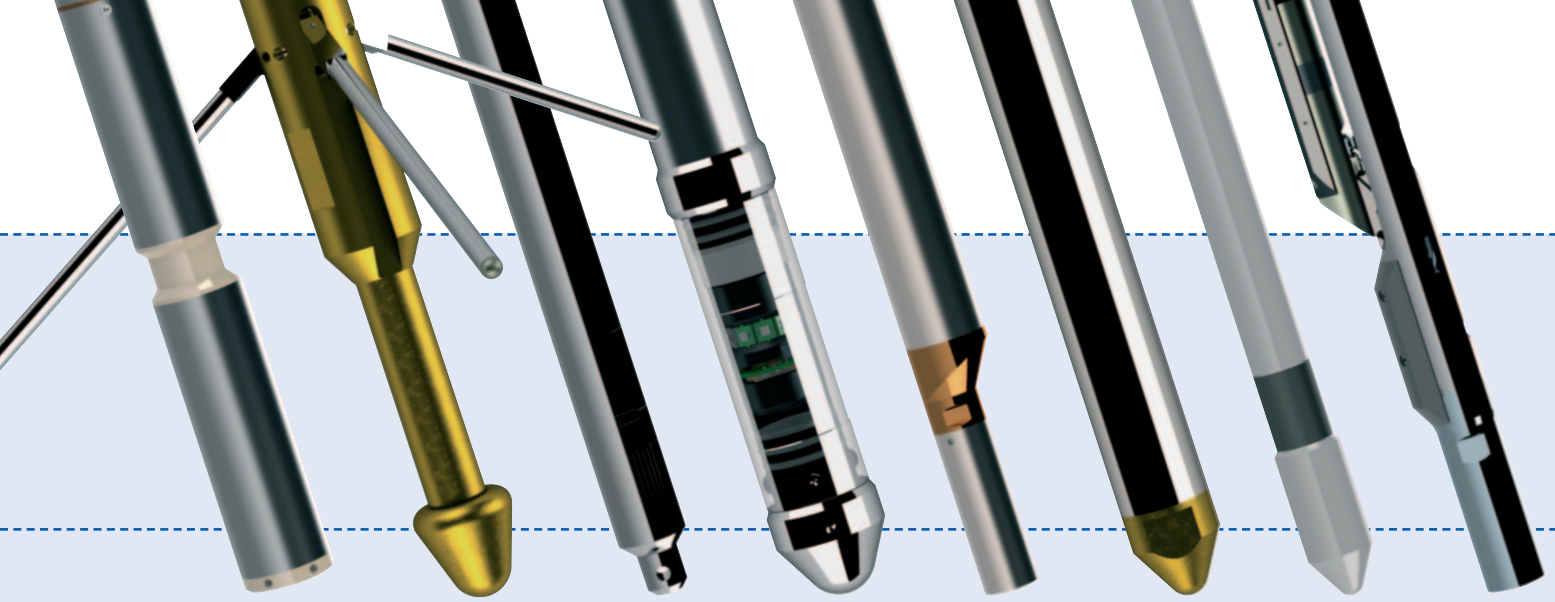
Measures microresistivity and tool orientation data. These can be processed using RG-Dip™ software to determine formation dips.



Example of data created by the Formation Density Probe.



Example of data created by the Focussed Electric (Guardlog) Probe.



Induced Polarisation:

Measures the charge separation or 'chargeability' in porous, water-saturated, mineralised rocks caused by the passage of a low-frequency alternating current. The main cause of induced polarisation is a current- induced electron-transfer reaction between ions of an electrolyte in contact with grains of semi-conducting metallic minerals.

Small Source Density:

Stringent legislation on the transport and handling of radioactive materials increasingly prevents the use of conventional density logging probes. The small source density probe provides calibrated and borehole-compensated density logs at sensible logging speeds using a very low activity ^{60}Co gamma source that may not require a radiation licence in certain territories.

Natural Gamma:

The natural gamma probes measure the activities of naturally occurring or man-made isotopes. The probes are based on scintillation gamma detectors that measure the natural gamma radiation released from potassium and the decay products of uranium and thorium in the borehole.

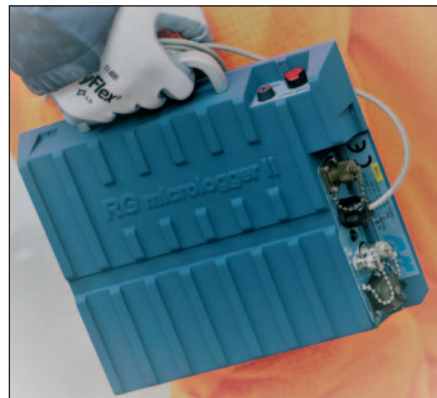
Surface Equipment Overview

Micrologger2:

Surface interface system for handling logging data acquisition, which supports all Robertson Geo probes, including acoustic and imaging tools.

Winlogger:

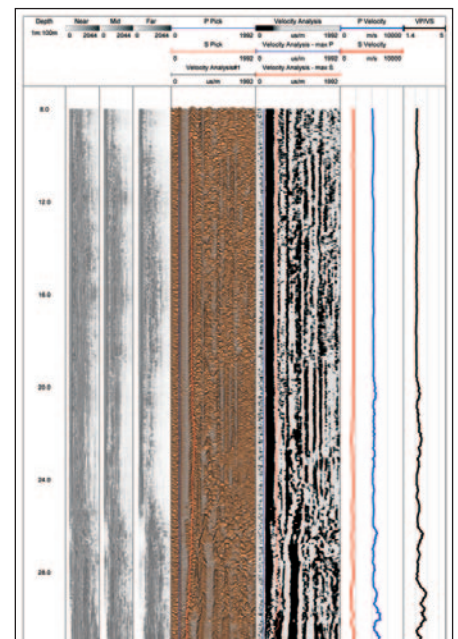
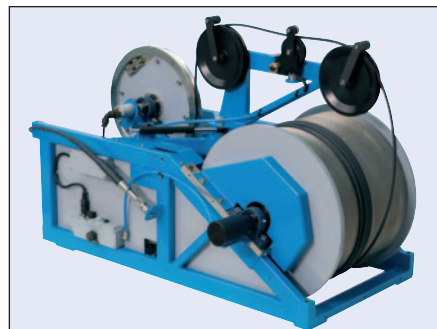
MS Windows based operating system for the Micrologger2, provides field acquisition capability. In-house processing, interpretation and reporting is undertaken.



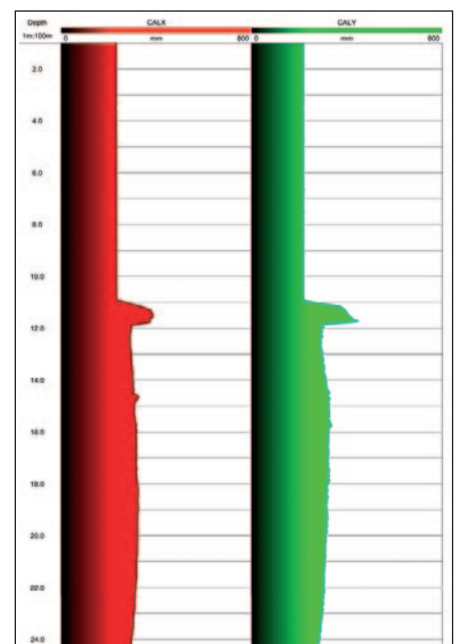
Winches:

Robertson Geo designs and builds its own range of winches of varying capacities for deploying subsurface probes on 4-core or co-axial cable.

- Mini Winch  • 1000m/2000m Winch 
- 500m Winch  • 2000m Marine Winch 
- 600m Winch  • 3000m Winch 



Example of data created by the Full Waveform Triple Sonic Probe.



Example of data created by the Borehole Geometry Probe.



RGeo-eye®:

A slimline full colour downward view camera, operating on a 4-core or coaxial cable at a high transmission rate and is fully compatible with existing Robertson Geo winches and surface systems.

No-one has more UK and International experience

Over the top and from a bogie - Logging at the Harry Potter viaduct

The camera deployed was an Aries Industries BT 9000 series with a bottom and rotatable side facing camera, together with a powerful integrated light source. Due to the known access issues two different surface systems were mobilised for the operation to ensure success. 



Not much room to work in

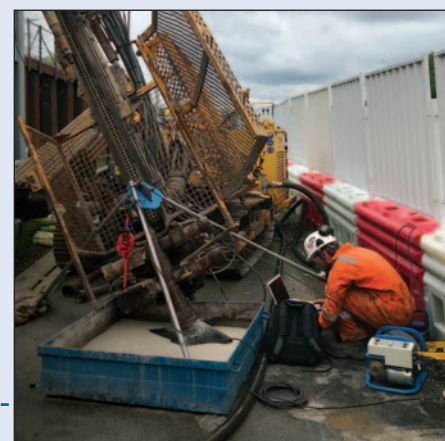
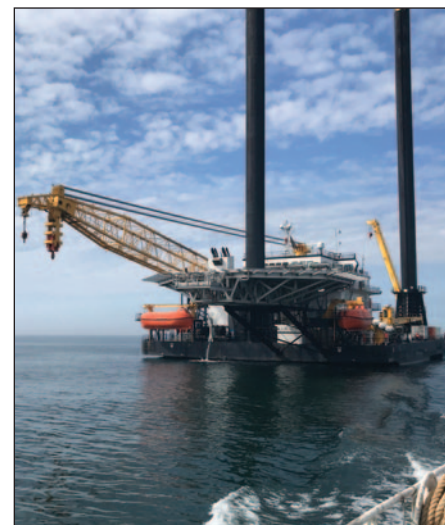
The M25 is one of Europe's busiest motorways, it would not have been practical to close it and drill boreholes in the traffic lanes. Instead, in order to investigate the ground conditions underneath the live carriageway, the client drilled 30° angled holes from a service layby into which Optical and Acoustic Televiewers and a Caliper probe with natural gamma were applied to acquire the data for the ground characterisation. 

Case Histories

Go to our case history archive on the dedicated site:
www.rgeo-services.com/case-histories/

Three new Danish offshore wind farms by 2030

As part of the preliminary geotechnical surveys, Robertson Geo conducted PS Logger® operations on four 70m boreholes over a two-week period. The geology encountered was mainly moderate to stiff clay with some dense sands, predominately producing excellent data from the PS Logger® with both the compression and shear waves being well defined. 





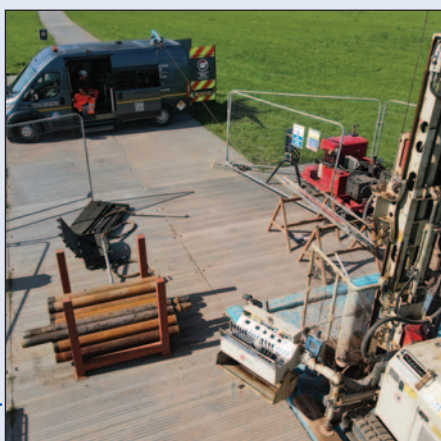
GeoUnlocked®

Or visit our GeoUnlocked® magazine archive:

www.robertson-geo.com/geounlocked/

Televiewer and Caliper Gamma Survey at the busy A38 near Derby

One of the fleet of 4x4 logging vehicles was deployed and data collated from Optical Televiewer, Acoustic Televiewer and 3-Arm Caliper (natural gamma) sub surface probes. Prior to the logging operation a risk assessment was produced and a client induction with special emphasis on traffic management was held. 



Elia Mog 2 Offshore Wind power - Ostend Belgium

As part of the preliminary geotechnical surveys, Robertson Geo conducted PS Logger® operations on three 80m boreholes over a seven-week period. The geology encountered was moderately stiff clay for all depths surveyed. 



On-site for huge rail project Manchester, England

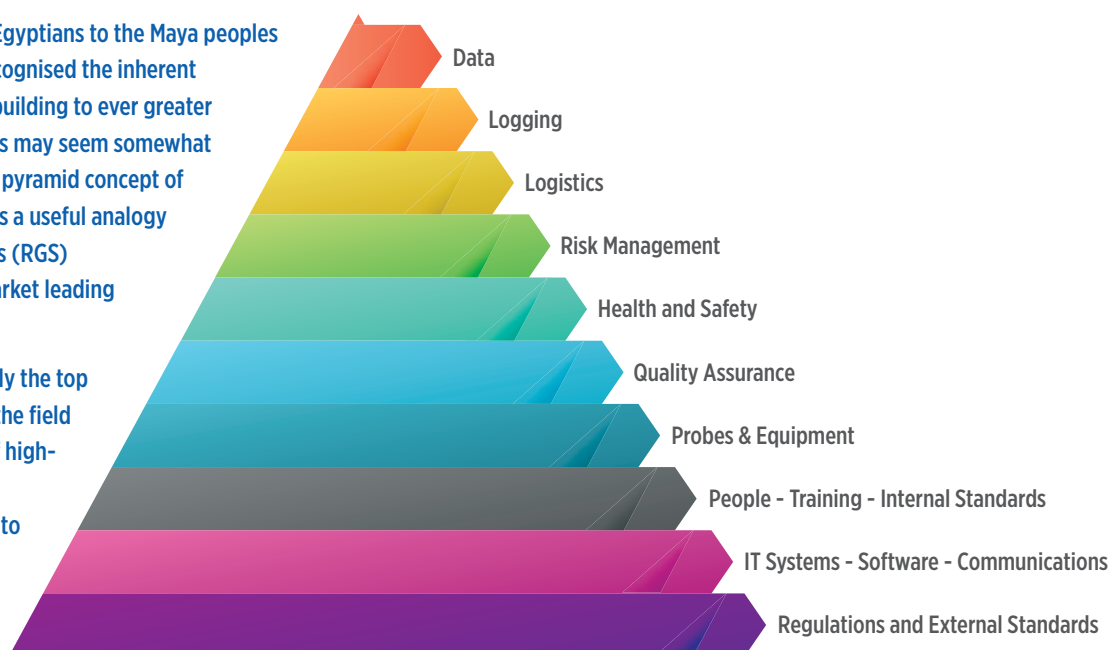
“Wherever we need to go...” Using a tracked metal access to the rural borehole drilling site, one of the fleet of service logging vehicles deployed on site. Robertson Geo Services teams arrive fully equipped with subsurface tools and surface deployment and data acquisition equipment. 

On Solid Foundations

The Pyramid of Support for every logging job

Ancient civilisations, from the Egyptians to the Maya peoples and geographically beyond, recognised the inherent strength of the pyramid when building to ever greater heights. While their motivations may seem somewhat bizarre to modern cultures, the pyramid concept of building on solid bases provides a useful analogy for how Robertson Geo Services (RGS) approaches the provision of market leading logging operations.

Clients of RGS experience mainly the top of the pyramid which includes the field operations and the provision of high-quality data. Here we highlight some of the systems necessary to underpin what may appear to be a relatively simple service provision.



Regulations and External Standards

Over the years RGS has seen an ever-increasing adoption of the regulations and standards that apply to the conduct of logging operations. As designers, developers and manufacturers of all its own equipment Robertson Geo continue to meet similarly stringent standards to compete in the worldwide marketplace.

RGS work in accordance with many standards including "D5753 – 18 Standard Guide for Planning and Conducting Geotechnical Borehole Geophysical Logging" from ASTM International, UK Specification for Ground Investigation 2nd Edition from ICE Publishing and BS 5930:2015+A1:2020 Code of practice for ground investigations from The British Standards Institution. These standards provide specific guidance for the practice of geophysical logging in a geotechnical environment.

Radioactive sources are used for collecting density and porosity data, vital for hydrogeologists and civil engineers. Due to the sensitive nature of and potentially harmful effects from both gamma rays and neutrons it is necessary to comply with a multitude of nuclear regulations relating to storage, maintenance, operation and road transport from authorities including Public Health England, Natural Resources Wales, Office for Nuclear Regulation, Department of Transport and both police and fire services.

IT Systems, Software and Communications

To successfully control a multifaceted logging operation there is a corresponding need for sophisticated IT systems. Multiple platforms, cloud-based services and remote working capability all put demands on bandwidth in the office, at home and in the field. The software required to make this all run

efficiently is provided not only from company wide distributed systems like Office 365 and SAP Business One, but also from in-house developed software and standalone packages for security and internal admin.

The volume of geophysical data and their associated presentations keeps increasing and careful management is required to keep everything organised and backed up.

The advent of smart phones has been a boon to the logging industry allowing peer to peer communications in most locations. These devices now form an integral part of how data is transferred quickly from the field.

People, Training and Internal Standards

Geophysical logging in the field often requires engineers to work long hours in difficult conditions with a high level of responsibility. Staff recruitment takes account of this, whereby engineers are selected for technical prowess, willingness to learn, hands-on and communication skills and the ability to work well in a team.

In-house training is provided in relation to geophysical principles, specific probes, equipment use and maintenance plus the software necessary to run the systems and process the data. External training is a continuous process that covers such diverse areas as offshore safety, workplace safety, driving, radiation safety and first aid.

Internal standards have been drawn up and are maintained, as requirements change, in order to present clients with a consistency of deliverables.

Probes and Equipment

Robertson Geo manufactures almost all the geophysical equipment that RGS uses which allows

for an unparalleled level of backup for the provision of services. This backup includes spare probes, the ability to call off additional equipment from stock and a fast track for repairs. This facility has been key for RGS to almost eliminate down time for clients, due to geophysical problems.

A modern fleet of customised logging vehicles including transit style and 4x4 vehicles, together with portable and offshore configurations means that RGS can undertake depths of borehole to 2000m in almost any environment.

Quality Assurance

Robertson Geo is an accredited ISO9001:2015 company. All business processes are documented, from customer enquiry through contractual agreement, planning and execution to data delivery and billing. Internal and external audits ensure that systems are adhered to and processes are updated where necessary.

All data collected from Robertson Geo probes is backed up by a comprehensive four tier validation system, comprising precision (repeatability), accuracy (calibration), conformance (borehole test) and real-world support. In addition to a conformance guarantee a unique system for full life cycle history for each probe is maintained which includes an audit trail for all data collected, probe/job allocations, maintenance history and calibration dates.

Health and Safety

Constant attention to all health and safety matters is required to ensure that staff work safely. Robertson Geo has its own customised health and safety system which is regularly updated and checked by external auditors. This provides a framework for a modern, inclusive system allowing for feedback and remedial action where required and which meets the

requirements of all applicable standards such as the Health and Safety at Work Act 1974.

Training records are kept up to date for each engineer and refresher training is provided at designated routine intervals covering more than twenty specific safety topics. Staff health is continually monitored by providing regular medicals. All engineers carry radiation dosimeters as part of a controlled radiation management programme.

PPE requirements also constantly change over time and the latest equipment is provided for all staff.

Risk Management

Assessment and mitigation of risk now forms an integral part of all logging operations. Wherever possible, risks are eliminated at source and when this is not possible control measures are put in place such as additional training or PPE or by a revision to procedures.

Risk assessments are in place for head office operations, the storage, operation and transport of radioactive sources and most recently for Covid 19.

For every job a specific set of RAMS (risk and method statements) is prepared and sent to the client prior to mobilisation. An on-site point of work risk assessment (POWRA) is also conducted to account for further specific local risks.

Engineers also undertake inductions at all sites so that site specific hazards can be explained, and site rules are understood.

Logistics

Due to the nature of borehole logging, whereby logging often commences as soon as possible after drilling finishes, it is necessary to be able to respond to client needs at short notice. While planning in advance is necessary, all plans are subject to last minute changes in this fast-moving industry.

For land-based jobs the ability to deploy a variety of vehicles and systems to cope with the expected terrain is vital. The extensive use of mud mats has allowed for larger 2WD vehicles to be deployed which can speed up operations in many cases. For locations inaccessible to vehicles portable or marine equipment can be deployed.

For offshore work, on windfarms for instance, it is often necessary to ship the equipment separately from the engineer. RGS can rely on the expertise of our shipping department who have experience arranging shipments to over 140 countries. Recent restrictions due to Brexit and Covid 19 have served to increase the administrative overhead and travel restrictions and quarantine rules for engineers have to be constantly monitored.

Logging

After dealing with all the above RGS can get to do some logging!

By deploying only two-man crews for all land work (initially as a result of risk assessment) RGS have increased the efficiency of operations to the point where customer satisfaction responses are almost all positive. Simple things like arriving on time, at the right place, with all necessary equipment and spares and working long hours have served to mostly eliminate client downtime attributable to RGS.

RGS engineers are all experienced and fully trained and have the ability to solve problems on site and in the unlikely event that external support is required this is only a mobile phone call away.

All data collected is always QC checked both during logging and by replay at the end of the log to ensure integrity. This is vital if the borehole is to be filled in immediately following logging.

Offshore, RGS usually operate with a single engineer. This is due to the time between logging operations and often from pressure on berth availability on the vessel.

Data

Finally, the most important part, the data. This is what RGS is paid to collect.

For clients everything that goes before is essentially a prelude, providing the work has been planned and conducted safely with efficiency and integrity.

Following the field QC checks the data is ready for processing, usually back at base but sometimes in the field, when offshore for example. Depending on availability, the data will be processed by the engineers or by an RGOS geophysicist back at base. In all cases, the processed data will then go through a final QC check by the geophysicist to ensure that it conforms, meets client requirements and is consistent with any previous submissions. Normally data turnaround time is within 24 hours.

For larger, more complex projects a comprehensive final report will be required. The RGS geophysicist will prepare this and it will comprise a factual report and a fully consistent set of data.

For client peace of mind and for our own internal QC analyses, RGS will maintain a copy of all the data in our database in perpetuity.

References:

D5753 – 18 Standard Guide for Planning and Conducting Geotechnical Borehole Geophysical Logging ©ASTM International.

UK Specification for Ground Investigation 2nd Edition ©ICE Publishing.

BS 5930:2015+A1:2020 Code of practice for ground investigations ©The British Standards Institution 2020.

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“Clients of Robertson Geo Services experience mainly the top of the pyramid which includes the field operations and the provision of high-quality data.

No one takes more care with the fulfilment of your objectives and the procedures necessary to ensure we at all times offer the best time and cost-effective services package for your project.”

Fleet of Services vehicles

“

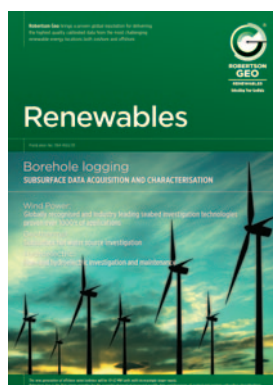
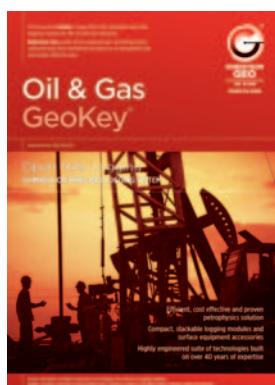
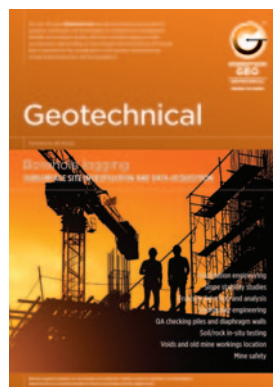
We have a fleet of customised vehicles, ready to go and fully equipped for onsite data acquisition and subsurface deployment capability.

Together with the portability of Robertson Geo equipment there are few locations that our logging engineers can't reach, irrespective of how challenging the circumstances.”



Part of the fleet of logging vehicles on the move.

Our complete range of brochures:



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GEO**

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