Bridge development in Hong Kong for Robertson Geo Client Waterland Group.

Massive infrastructure project for AECOM Consulting in the USA.

Robertson Geo was contracted to attend two drill sites in United Downs, Cornwall.

ROBERTSON GEO

Unlocking Your GeoData

GeoUnlocked©

GLOBAL GEODATA NEWS

ISSN 2754-7043 | ISSUE 19 | SPRING 2023

Cornwall, UK

Rock fracture analysis deep in a former Cornish (UK) tin mine.

- Page 6

LIFE OF A LOGGING ENGINEER: FIRST AID TRAINING

BACK ON THE ROAD AGAIN

INSIDE:
FOUR PAGE EDITORIAL INSERT

LITHIUM EXPLORATION
in Cornwall Supports the move to a Zero Carbon Future

Bridge development in HONG KONG for Robertson Geo Client WATERLAND GROUP

Robertson Geo Operational Services formed part of the initial phase for bridge development on Lantau Island, Hong Kong. Boreholes: 70m, 32m and 50m were surveyed with the Robertson Geo PS Logger® probe.

The government plans to build two cross-harbour bridges to divert the traffic in the Lantau Link, aiming to open by 2033.

The Highways Department revealed a proposal aiming to develop the project of the Tsing Yi - Lantau Link, which will be extended for approximately 5.2 kilometres long and located on the south side of the current Lantau Link.

The two cross-harbour bridges, which will parallel the Lantau Link, will span the Ma Wan Fairway and the Kap Shui Mun Fairway.

Kyle Owen on location in Hong Kong prior to the Landaur Island logging project - as Senior Logging Engineer Kyle has extensive logging experience often in the most challenging locations.

"All our Engineers' are experienced and highly trained, they are fully certified for offshore working and can be deployed to any worldwide location. The full catalogue of Robertson Geo equipment is available on a service basis operated by these crews. They are expert in advanced data processing and can undertake cost effective and prolonged service logging operations with minimum outside support.

We are using the equipment and back up services only an OEM such as Robertson Geo can provide, geophysical probes are manufactured, tested and calibrated at the Deganwy facility, eliminating on-site test time by being fully operational prior to downhole use."

The bridge crossing Ma Wan Fairway will be constructed on the west side of Tsing Yi, with a 2.3 kilometres length, to connect with Tsing Sha Highway. The other bridge across Kap Shui Mun Fairway will be about one kilometre long, connecting North Lantau Highway, the proposed route 11 (a highway section between Yuen Long and North Lantau) and the proposed Kau Yi Chau Artificial Island.

"The new link will become an alternative for citizens travelling between Lantau and the urban areas as well as enhancing the capability for dealing with traffic incidents," the department noted.

The PS Logger® probe measures P (compression) and S (shear) wave velocities in a single borehole without the need for external energy sources, making it simple and quick to deploy and therefore cost effective, especially when compared to alternative methods. When combined with bulk density values (from a density log or from core sample tests) small strain moduli (Young's, Shear and Bulk) can be calculated using simple formulae.

From unconsolidated soils to the hardest of rocks, (in this case granite and rhyolite) the PS Logger® provides proven results. Simplicity of deployment combined with a minimum of borehole preparation and the ability to obtain high quality velocity data in unconsolidated formations and hard rocks make the PS Logger® the industry choice for Geotechnical and Civil Engineers investigating rock strength.

Main image: From unconsolidated soils to the hardest of rocks, the PS Logger® is the go-to probe with proven results time after time. Lantau Island with Hong Kong central in the background.

Below: The kit and personnel on their way to Lantau Island.

Left: No easy way up to the site location, the logging was deployed using the Robertson Geo Mini Winch, probably the most portable delivery system around.

The Clean Rivers Project is DC Water's ongoing program to reduce combined sewer overflows (CSO's) into the District's waterways - the Anacostia and Potomac Rivers and Rock Creek. The Project is a massive infrastructure and support program designed to capture and clean wastewater during rainfalls before it ever reaches our rivers.

Massive infrastructure project for **AECOM Consulting** in the **USA**

DC Clean Rivers Project (DCCRP) involves the construction of a 12 miles long, 23 ft diameter tunnel with 100+ ft deep shafts, secondary micro tunnels and pump stations to reduce the combined sewer overflow (CSO) by 98 percent. The entire project is divided into 26 tunnel segment sub projects called Divisions (A through Z).

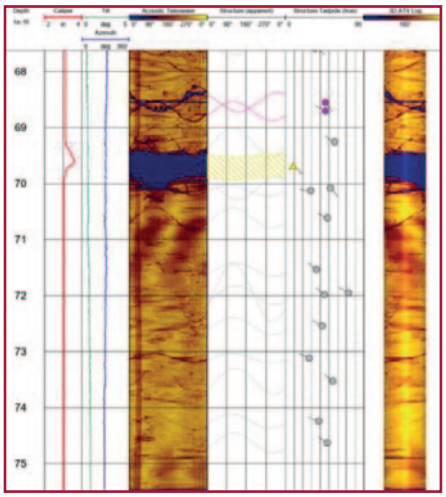
Since 2008, AECOM has supported the project through:

- *Borehole Geophysical Logging of 40+ borings including High Resolution Optical Televiewer®, High Resolution Acoustic Televiewer®, and 3-Arm Caliper*
- *Downhole and crosshole seismic surveys for design investigations at multiple tunnel shafts*
- *Seismic refraction, reflection and MASW surveys to support terrestrial tunnel alignment and design investigations*
- *Marine seismic reflection, bathymetric and magnetic surveys to support river tunnel alignment and design investigations*
- *MASW survey to delineate paleochannel along cut and cover tunnel alignment*
- *Bathymetric, side scan sonar, and marine magnetometer at combined sewer outfalls*
- *Utility avoidance and subsurface obstructions surveys including electromagnetic, magnetic and ground penetrating radar surveys at geotechnical boring locations for terrestrial and river borings*
- *Pre-constructions surveys at structures adjacent to planned tunneling, open cut and shaft construction sites*

AECOM Utilizing Robertson Geo Micrologger 2, Mini Winch, High Resolution Acoustic Televiewer® and 3-Arm Caliper probes.

- *Pressure meter testing in terrestrial and river borings*
- *Unexploded ordnance (UXO) and munitions and explosives of concern (MEC) avoidance surveys (electromagnetic and magnetic surveys) at designated boring locations*
- *MASW and horizontal to vertical spectral ratio (HVSR) surveys to assess subsurface conditions at planned facilities in complex urban environments*

AECOM utilized of a Robertson Geo Micrologger 2 data logger, Mini Winch, High Resolution Acoustic Televiewer® and 3-Arm Caliper logging probes to acquire borehole geophysical data in 40+ boreholes. The data, one portion of the project's larger geophysical and geotechnical program helped to characterize site geologic conditions.

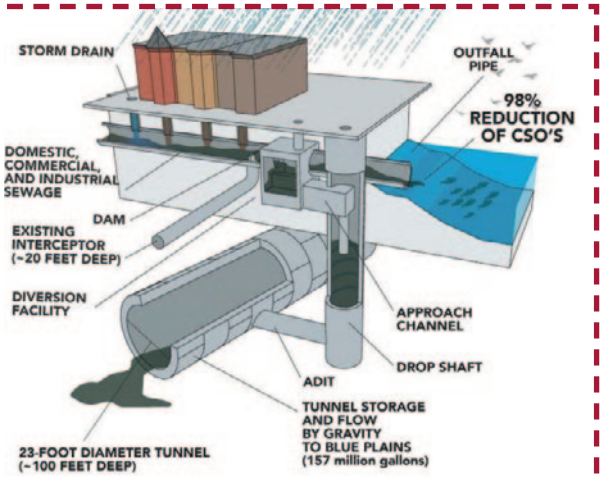


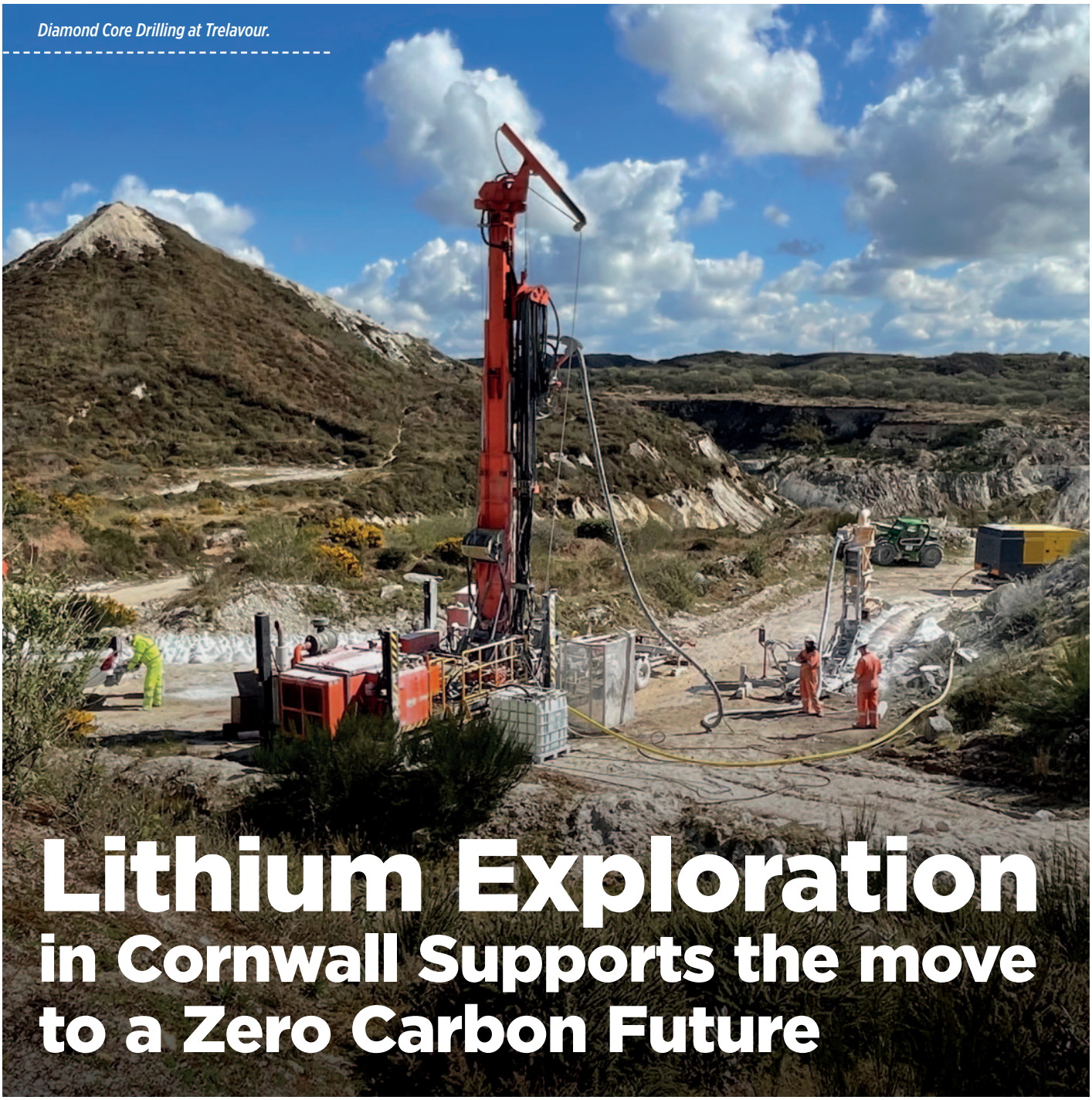
Sample Caliper and HRAT® Data acquired by AECOM Utilizing the Robertson Geologging System.

How the System Works

dc clean RIVERS PROJECT
RESTORING OUR RIVERS
PROTECTING OUR DISTRICT

The Clean Rivers project is installing "diversion facilities" at strategic locations to capture untreated sewage from wet weather events and divert it to the new 157-million-gallon tunnel system and conveyed to the Blue Plains Advanced Wastewater Treatment Plant. Diversion facility components include a Diversion Chamber to intercept flow from the existing sewers, an Approach Channel to direct the flow and create a vortex, a Drop Shaft to drop the flow approximately 100 ft and an Adit to connect to the main tunnel system. The entire system works by gravity. During dry weather conditions, the existing sewer system uses its existing Dam and Interceptor system to deliver flow to Blue Plains for treatment.





Diamond Core Drilling at Trelavour.

Lithium Exploration in Cornwall Supports the move to a Zero Carbon Future

The importance of lithium-based battery technology in the worldwide move toward zero emissions and greener energy cannot be overstated. Cornwall, in SW England, has a long mining tradition based around copper and tin but also has reserves of lithium.

Cornish Lithium are amongst a group of companies now seeking to extract lithium in the region, establishing a UK based strategic supply. Exploration and evaluation of these resources is currently underway both from hard rock and geothermal waters. Robertson Geo Operational Services (RGS) have strong credentials in the renewable energy sector with over 15 years of experience providing vital geophysical data for offshore wind farm (OWF) developments. With considerable experience also in deep mining applications RGS has been engaged by Cornish Lithium since 2022 to collect geophysical exploration data.

The Demand for Lithium

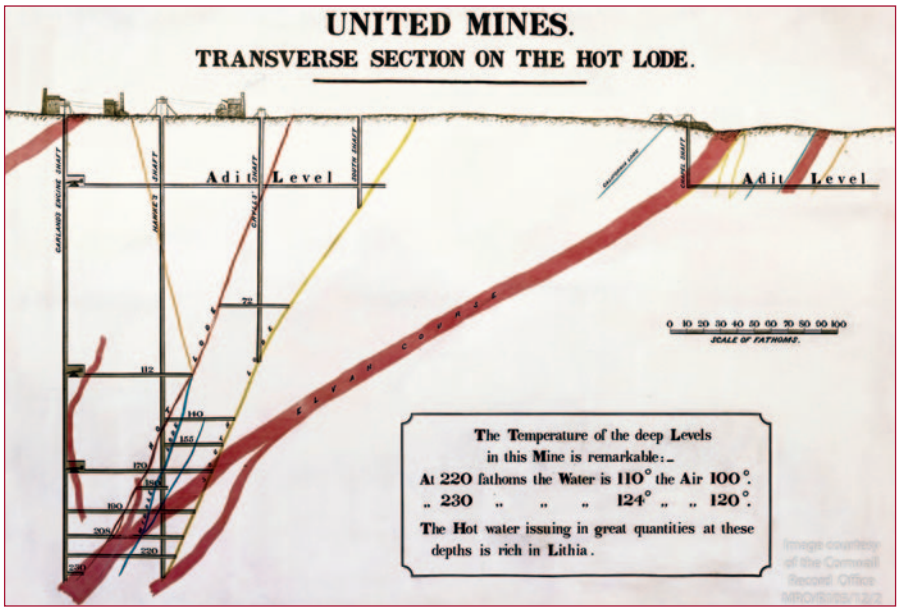
From worldwide production in 2021 of just over 0.5 million tonnes lithium carbonate equivalent (LCE) the demand is projected to rise to around 3 million tonnes (LCE) by 2030, as the world produces more electric vehicles (EV) and batteries.

The EV revolution is for the foreseeable future dependent upon a continuous supply of lithium for batteries, which has driven prices to new heights. Faster charging, improvements in vehicle range and increased safety continue to drive development. Aggressive government targets for zero emission vehicles and renewable energy have been accepted for the UK, Europe, and many other countries. The UK intends to end the sale of new petrol and diesel vehicles by 2030 with all new cars and vans to be fully zero emission by 2035. The European Union has decreed that by 2035 all new cars sold in the EU will be battery electric.

Wind turbines face the challenge of wind that changes speed continuously and lithium-ion batteries are commonly used to stabilize these energy surges. RGS started OWF work when turbine sizes were typically 2MW and now turbines with outputs up to 15MW are being deployed. This increased scale also brings with it the need for larger lithium-based batteries. Many renewable energy sources produce intermittent power profiles and there is a drive toward larger-scale storage systems to smooth out quiet periods, including battery-based systems. The EU needs to build 30 GW of OWF a year under its new energy and climate security targets and the UK target is to increase OWF generation from 15GW to 50GW by 2030, with aggressive targets also in many countries worldwide.

History and Uses of Lithium

Although known about for decades and named in 1817 by Johan August Arfvedson, it was not until 1855 that the German chemist Robert Bunsen and the British chemist Augustus Matthiessen obtained it in bulk by the electrolysis of molten lithium chloride. Lithium was first discovered in Cornwall in 1864 when hot saline water from United Mines was analysed by Professor Miller of Kings College London. Prior to the development of commercial lithium-based batteries, lithium has been used for glass and ceramic production, alloys, greases and medicines with this demand continuing to this day. Lithium makes up about 7% of the weight of a lithium-ion battery and is the ideal metal for batteries given its high electrode potential and low atomic mass, giving batteries a high charge and power-to-weight ratio. Lithium consumption has increased by around fourfold since 2010 with most of the additional requirement being for batteries, up from 23% of total consumption in 2010 to 74% in 2021. Automotive usage already dominates overall lithium demand and will soon account for 50% of total consumption alone as around 10kg is required for a single EV battery. Lithium demand for consumer electronics and grid storage systems for solar and wind applications also continues to grow.



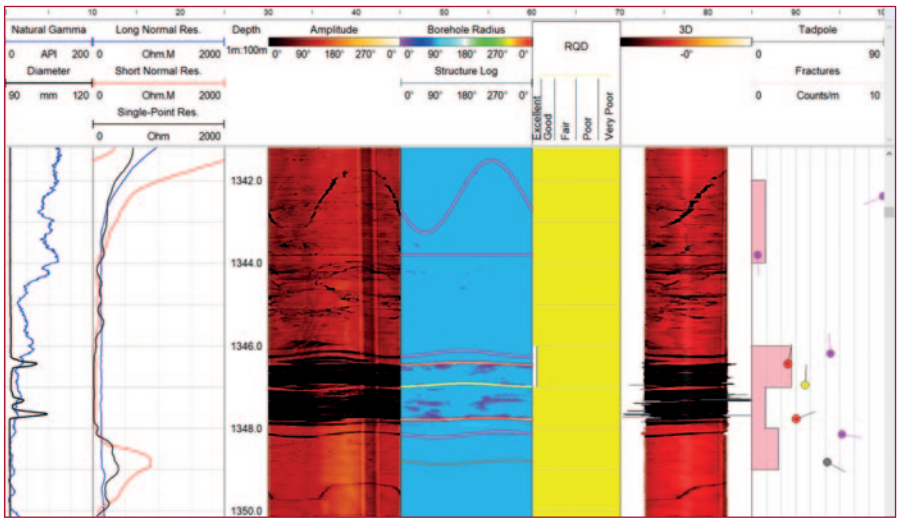
Lithium Discovery in Geothermal Waters at United Downs in 1864.

Lithium Resources and Extraction

Lithium is too reactive to occur as the metal in nature but is found combined in small amounts in nearly all igneous rocks and in the waters of many mineral springs. Spodumene, petalite, lepidolite, and amblygonite are among the more important minerals containing lithium. There are a fairly large number of both lithium mineral and brine deposits but only comparatively few of them are capable of being processed to produce battery grade lithium compounds. As of 2021, it was estimated that the world had 88 million tonnes of lithium resources of which one-quarter of that, 22 million tonnes, is feasibly extractable. Australia, Chile and China produce around 88% of lithium currently and have large proven reserves. However, Bolivia, Chile and Argentina hold around 50% of the world's identified lithium resources, with Bolivia's largely untapped. In the UK there are several areas known to contain lithium with extraction projects in Cornwall and NE England at the most advanced stages. In Cornwall, lithium can be found in hard rock deposits and due to its high solubility is also contained in geothermal waters emanating from these source rocks. These geothermal waters form an important part of Cornish Lithium's plans for extraction.

Where conditions allow, brine may be concentrated by sunlight evaporation, such as in Chile, then the concentrate is treated with sodium carbonate to yield lithium carbonate. Lithium may also be extracted from geothermal waters by new Direct Lithium Extraction (DLE) technologies which work at ambient temperatures and have a low environmental impact as the water produced can be utilised once the lithium is extracted as opposed to it being evaporated to the atmosphere. Heat energy from geothermal waters can also used to decarbonise industrial and domestic heating, which further reduces the carbon footprint of lithium extraction from geothermal waters. For hard rock lithium extraction there are different techniques employed, with a common method producing concentrate from spodumene by heating and cooling the ore then crushing and reheating with sulphuric acid before sodium carbonate is added to produce lithium carbonate. Other more

Televiewer Composite Log - United Downs.

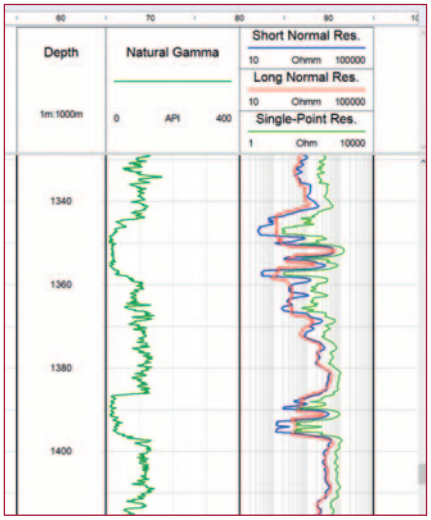


environmentally friendly techniques may be used in Cornwall including low energy consumption hydro-metallurgical processes, such as the Lepidico processing technology Cornish Lithium plans to use, which employs low cost, conventional reagents along with using industry standard equipment.

Lithium Batteries Toward the Future

Lithium-ion technology, with its unsurpassed ability to produce a nominal 3.7V from a single cell, currently dominates the battery market for electric vehicles and devices such as mobile phones and portable computers. There is a tremendous development investment into the battery components to improve the efficiency, lifespan and charge times for these batteries as well as reduce their dependence on metals. The four key components of a lithium-ion battery are: anode, cathode, separator and electrolyte. For the anode, graphite has been the anode material of choice since its commercialization in 1991 due to its low cost, high abundance, non-toxicity and structural stability. Research to produce an industrial anode material that is superior to commercial graphite continues using intercalation, conversion, and alloying-type anode materials. The most commercially successful cathode is lithium cobalt oxide (LCO) used in many current Lithium-ion batteries. EV car manufacturers may use lithium iron phosphate (LFP), nickel cobalt aluminium (NCA), nickel cobalt manganese (NCM) for cathodic materials with other materials under development. For electrolytes, most commercial lithium-ion batteries currently use non-aqueous solutions based on lithium hexafluorophosphate salt which is dissolved in a mixture of organic carbonates. The separator allows for the transport of ions while providing electrical insulation between the anode and cathode and lithium-ion batteries typically use separators made from polyolefin based materials with a semi-crystalline structure. The developments in lithium-ion battery components will continue to improve the performance of these batteries and whilst research into non lithium batteries continues, for the foreseeable future the batteries in electric vehicles, laptops, mobile phones and other devices will be based on lithium-ion technology.

Resistivity - Natural Gamma Log - United Downs.



Cornish Lithium

Company Profile: Cornish Lithium

Cornish Lithium is a highly innovative mineral exploration and development company focused on the environmentally responsible extraction of lithium from geothermal waters and hard rock in the historic mining district of Cornwall.

The Company has secured agreements with the owners of mineral rights over a large area of the County and is using modern technology to re-evaluate the region for its potential to produce lithium and other vital decarbonising metals in a low carbon and low impact manner. A secure domestic supply of such metals is considered vital to the industrial strategy of the UK as it moves towards Net Zero 2050, renewable energy and the production of electric vehicles.

Trelavour Hard Rock Project

The flagship Trelavour hard rock project is located near St Dennis in central Cornwall. The project is situated in an existing kaolin (china clay) pit at Trelavour Downs, near the TreLith processing site, a former china clay processing facility which benefits from excellent logistics and existing infrastructure, including power, rail, road and access to port facilities. There is potential to use these as the project develops, which could have both economic and environmental benefits.

Resource drilling in 2021 led to the publication of a maiden JORC-compliant Inferred Resource of 51.7 million tonnes at a grade of 0.24% lithium oxide equating to over 300,000 tonnes of contained Lithium Carbonate Equivalent. Based on the resource estimate, extensive metallurgical test work and engineering studies, Cornish Lithium completed a scoping study in 2022 with the following highlights:

- *20-year mine life with average production of 7,800 tpa of lithium hydroxide*
- *Post-tax NPV (8%) of US$318.6 million and IRR of 24.4%*
- *Initial capital expenditure of US$243.8 million*
- *Payback within 3.8 years from first production*

The Company holds an exclusive licence with Lepidico for use of their low carbon processing technology across the St Austell region. Importantly this technology enables extraction of other valuable by products, including caesium and rubidium – technology metals that are currently exclusively produced in China. Battery-grade lithium hydroxide has been successfully produced from a bulk sample of Trelavour material, and work is now underway to build a demonstration-scale processing plant at the nearby TreLith processing facility. Environmental surveys and studies have commenced to support the project's Feasibility Study together with a drilling programme designed to expand the Trelavour Mineral Resource and allow conversion from Inferred to a Measured and Indicated classification under the JORC Code. Detailed engineering of a demonstration plant is underway and construction at the TreLith site will commence shortly. This will validate the process flow sheet and will advance progress the Company's plans to be in production in 2026.

Lithium in Geothermal Waters

Lithium-enriched groundwaters circulate naturally beneath Cornwall, within permeable geological features, which can be found across the county. These waters can be accessed by drilling boreholes to depths of between 1-2km and then pumping the water to surface. Once at surface, the lithium can be efficiently extracted using Direct Lithium Extraction technology, and the heat energy of the waters can also be utilised to provide a low carbon heat source for local industry or housing.

Cornish Lithium has drilled three research boreholes to date, two at United Downs and one at Twelveheads, allowing the team to test several permeable geological structures and to identify potentially commercial lithium concentrations with minimal levels of deleterious elements. A test facility has been established at United Downs, for processing test work, evaluation of other co-products and resource estimation.

Additional boreholes are planned in 2023, with the intention of selecting a site to build a demonstration-scale project in the future where lithium will be produced by Cornish Lithium, and the low-carbon geothermal heat will be utilised by an industrial partner. This demonstration-scale plant will be key to proving Cornish Lithium's strategy of developing multiple low impact production sites across Cornwall producing 500-1,000 tonnes per annum of LCE making Cornish geothermal waters a scalable opportunity for a domestic source of lithium.

Case Study: Lithium Brine Extraction in Cornwall

Cornish Lithium

Background

Between 2017 and 2019, Cornish Lithium collated data from a wealth of Cornish mining archives and consulted Cornish miners, gaining knowledge of their experience from working in the mines. The data collected was used to create a 3D model of the subsurface.

This exploration work identified United Downs as the most prospective site to test Cornish Lithium's concept that lithium-enriched geothermal waters circulate within permeable faults (as noticed by Professor Miller in 1864) and can be accessed via boreholes and pumped to the surface. The Company began drilling in November 2019, completing two diamond boreholes to approximately 1 km each. Cornish Lithium used a bespoke sampling method, which isolated individual permeable structures at depth and proved that they contained lithium-enriched geothermal waters.

Since the proof-of-concept drilling at United Downs, Cornish Lithium has established United Downs as its Geothermal Waters Test Facility where it is undertaking test work to establish the most effective processing technologies for the extraction of lithium from Cornish geothermal waters. Cornish Lithium has also recently completed an approximately 2000m exploration borehole for lithium enriched geothermal waters near Twelveheads. The Company will drill further exploration sites across Cornwall to demonstrate the countywide potential of lithium enriched geothermal waters with a view to developing multiple sites across Cornwall.

Drilling and Coring

To date Cornish Lithium's exploration boreholes have been drilled using a standard mineral exploration technique, diamond coring. Diamond coring allows a cylinder of rock core to be collected over the length of the borehole. This type of sample allows the geologists to identify permeable zones within the rock, indicating where the geothermal waters are likely to be flowing naturally underground. Once identified, the geological structures are isolated using a Standard Wireline inflatable Packer Tool (SWiPS), and sampled using a submersible borehole pump, to test the chemistry of the waters.

Geophysical Testing

Cornish Lithium contracted Robertson Geo Operational Services (RGS) to undertake wireline logging of the Company's most recent 2,000m borehole. The main aims of the geophysical logging were to identify the location and orientation of open fractures, indicate areas of flow, define the temperature profile within the borehole and to correlate the geophysical properties of the rock to the core samples.

It is expected that the gamma and resistivity logs will build up a picture of the geophysical properties for the different metamorphic rocks, intrusive sheets, veins, permeable geological structures and the granitic basement. Cornish Lithium plans to use this data to accurately correlate the logged geology from the core samples to the geophysical properties. This data will become critical if the Company moves away from coring drilling techniques in the future. When using destructive drilling techniques, the geological resolution and understanding is greatly reduced when compared to coring methods. If a good understanding of the geophysical properties for the typical lithologies is collated now, gamma and resistivity logs can be used in the future to better understand the downhole geology within boreholes drilled using other techniques.

The fluid temperature, conductivity and impeller flow logs are used to indicate the location and nature of the permeable structures within the borehole. The geothermal waters are typically warm in temperature and are highly conductive relative to background meteoric water. It is expected that ingressing geothermal waters will create positive conductivity and temperature anomalies, and the flow paths will be recorded by the impellers. The temperature log is also expected to be used in conjunction with external heat flow measurements on the core, to identify the heat potential of the borehole for future industrial or domestic heating applications.

The High Resolution Acoustic Televiewer® (Hi-OPTV®) and High Resolution Optical Televiewer® (HRAT®) logs give structural information to the joints, fractures and structures within the borehole. It is expected that this information will be vital in fracture network and resource modelling of the area.

Geophysical Data Collection and Quality Control

RGS mobilised to site with their custom logging vehicle with capability to depths beyond 2000m, together with two experienced engineers. A risk assessment for the operations was provided in advance and site inductions and a point of work risk assessment (POWRA) were conducted on site to ensure safety.

A high temperature rated probe suite was deployed due to anticipated high borehole temperatures at depth. The temperature conductivity probe was run first as a downlog to record an undisturbed temperature profile. Next the Hi-OPTV® televiewer was run, again as downlog, to provide the clearest borehole image. The 3-arm caliper, HRAT®, focussed electric and electric log probes were then all run as conventional uplogs. The impeller flowmeter was run as three uplogs and downlogs to enable calculation of flows within the borehole. For quality control, all probes were supplied with a mandatory valid conformance certificate ensuring accurate calibration and continual monitoring of the logs in real time was performed by the engineers.

Processing of the data was by the field engineers and additionally QC checked by our in-house geophysicist back at base. Individual logs were processed and for the televiewers features were picked, classified and analysed statistically. The data was then presented as a composite log, a fluid log and a televiewer log including borehole deviation. The final data was presented visually in PDF format and digitally as LAS and CSV files.

Initial Findings

The initial results confirmed that all prospective geological structures for lithium enriched geothermal waters were successfully identified by Cornish Lithium's geologists from the core, and that the correct intervals were sampled. Had prospective structures been missed, the geophysical data would have identified these. The televiewer data successfully identified the orientation of the geological structures throughout the borehole. This allowed structural data to be attributed to the target structures, and for Cornish Lithium's geological models to be updated accordingly. This will significantly enhance the future exploration at the site.

Ongoing Work

In the future, the results of the geophysical logging will be used to help define a geothermal lithium resource within Cornwall. This may be in the form of resource modelling, fracture network analysis and production borehole design. This work will be vital as Cornish Lithium works towards executing its strategy of having multiple low impact lithium production sites across Cornwall.

Geophysical Probes Used in Geothermal Lithium Exploration

Probe	Output	Data Usage
High Resolution Optical Televiewer® High Resolution Acoustic Televiewer®	Unwrapped, oriented borehole image	Fractures and bedding/core orientation Specifically, looking for the orientation of permeable target structures
3-Arm Caliper Gamma	Diameter, natural gamma	Assessment of borehole stability and location of void space
Resistivity	Formation resistivity	Assessment of lithologies in conjunction with gamma
Temperature/Conductivity	Fluid temperature and conductivity	Geothermal and brine profiles (identifies areas of inflowing geothermal waters)
Flowmeter	Flow rates	Flow potentials

Robertson Geo was contracted to attend two drill sites in United Downs, Cornwall for Cornish Lithium, a British mineral exploration company with an objective to extract lithium from brines pumped from the subsurface. Metals such as lithium are key enablers in the transition to clean energy given their role in power storage batteries making such metals vital components of the future UK economy.

CORNISH LITHIUM
United Downs, Cornwall

Boreholes, 1.6km deep and 800m deep at two drill sites were logged to determine the viability of extracting lithium brine from these two wells. These waters would be warm, a feature that would aid the lithium extraction and enable the process to maintain a low carbon footprint.

Lithium brine from geothermal waters is significantly hotter than that from a shallower depth, which means there is also potential for the geothermal waters to be used to produce heat for domestic or industrial use.

To be able to achieve the temperatures expected during the survey, Robertson Geo needed to deploy probes from the extended temperature range suite. The complete suite of probes comprised High Resolution Acoustic Televiewer®, High Resolution Optical Televiewer®, 3-Armed Caliper Gamma, Temperature Conductivity, Focussed Electric Resistivity (Guard Log) and a high-resolution Flowmeter.

The conductivity probe was run first as a top-down log to preserve the thermohaline column within the hole therefore minimizing mixing by the probe. This was followed by the televiewers and caliper. These tools allow Robertson Geo engineers and Cornish Lithium to identify any major or minor fractures and cavities where brine could ingress, aiding Cornish Lithium to identify potential pumping zones. The combination of data from the full suite of probes allowed Cornish Lithium to confirm target structures and to update their geological models accordingly.

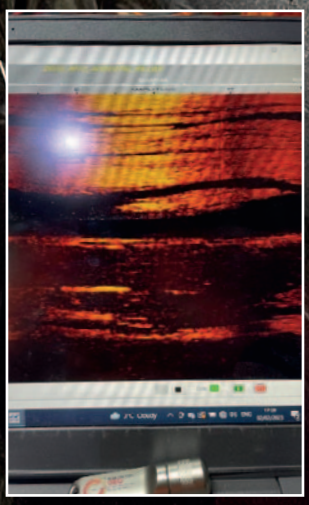
FEASIBILITY STUDY at former TIN MINE

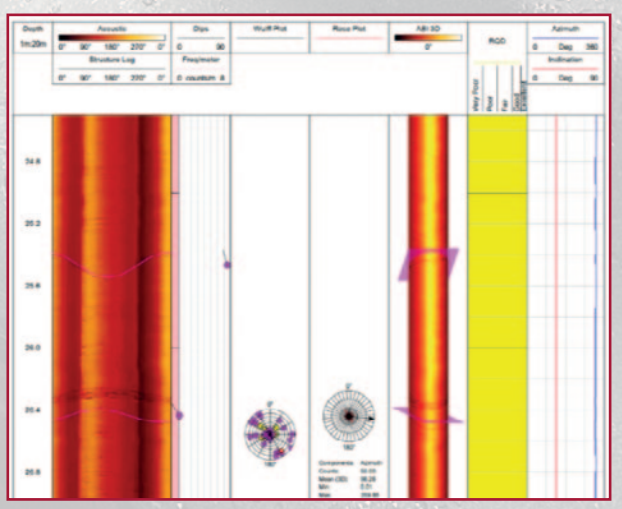
Robertson Geo Operational Services conducted a rock fracture analysis to assist an ongoing feasibility study with the hopes of reviving a former Cornish tin mine.

Multiple boreholes across the site have been logged, reaffirming earlier fracture orientations, recorded when the mine was operational some two decades ago. The setups have provided unique challenges with vertical depths exceeding 1,000 meters, hole inclinations (up to 60°), wedge deflections and narrow internal hole diameters.

Televiewers consisting of the High Resolution Optical Televiewer® and High Resolution Acoustic Televiewer® have captured excellent continuous logs of orientated, high resolution unwrapped images of the local geology and fractures therein. By "picking" and classifying fractures from the image, Robertson Geo software has been able to generate strike and dip azimuths, providing stereonets (Rose and Wulff plots) to display the main fracture orientations in the boreholes.

The latest visit to site was to an underground borehole and required 4-by-4 access. The Optical Televiewer was requested, however the image returned to surface was insufficient for purpose. Further investigation revealed the cause was a hydrocarbon source rock which obscured the camera lens. Fortunately our Acoustic Televiewer, which instead relies on ultrasound, was not affected and generated an excellent image (see below).





LIFE OF A LOGGING ENGINEER:

First Aid Training

Being a logging engineer requires many additional skills and training outside of wireline logging that are just as important to ensure that any project is also completed safely.

In the past year alone, Robertson Geo projects have seen our engineers work underground in mine shafts, remote woodland, aboard drilling vessels, cliff edges, quarries, alongside busy motorways and in city centres. Robertson Geo engineers will work across a range of weather conditions and environments, so being able to look after themselves, their engineer partners and other contractors on-site is essential to all parties on that particular project.

The aim of first aid is to provide basic medical care to someone experiencing a sudden injury or illness. This follows the principle of the "3 P's": ***to Preserve life, to Prevent worsening and to Promote recovery***.

Over the years, as the Robertson Geo Operational Services team has expanded with more engineers, we have worked closely with the Snowdon Mountain Rescue to complete the REC Outdoor First Aid Level 2 Programme. This 2-day course covers a broad range of topics.

Day 1 involves: the principles of first aid and checking for vital signs, accident procedure following the DR CABCDE (*Danger, Response, Catastrophic Bleeding, Airways, Breathing, Circulation, Discovery, Emotional support*) steps and follow up second survey, head injuries, proper CPR techniques for all age categories and shocks and big bleeds.

Day 2 involves: Fractures, dislocations, and soft tissue injuries – recognitions and treatment of each kind. Treatment of hypothermia and hyperthermia and understanding the differences between each. Finally, we covered common minor injuries and how to recognise and treat any medical conditions.

Throughout the day much of this theory was then put into practice with testing scenarios that were pre-planned by the instructor. Each participant would have to use what they had learnt to make the correct diagnosis and administer the proper treatment to the 'patient', making sure that any wounds or injuries have been cleaned and appropriately dressed and using any relevant survival gear to make sure they are comfortable whilst help arrives or they are safely evacuated from the site.

BACK ON THE ROAD AGAIN

At Robertson Geo we have always had good representation at the most important Geophysical based exhibitions and conferences worldwide.

This year restarts our program of attendance at the following exhibitions:

EAGE Annual 84th Conference & Exhibition
Vienna, Austria
5th - 8th June 2023 | Booth: 6100

Geotechnica 2023
Warwickshire, UK
5th - 6th July 2023 | Booth: D

Reuters Events US Offshore Wind 2023
Boston, US
11th July - 12th July 2023 | Booth: 211

Near Surface Geoscience 2023
Edinburgh, UK
3rd - 7th September 2023
Booth: 19

Mining & Metals Central Asia
Almaty, Kazakhstan
20th - 22nd September 2023
Booth: 9-21

48th Annual Conference on Deep Foundations
Seattle, Washington, US
31st October - 3rd November 2023
Booth: 504

Groundwater Week 2023
Las Vegas, US
5th - 7th December 2023
Booth: 1506

Watch our events page at www.robertson-geo.com/upcoming-events/ and as always - new and established clients alike - *"we're looking forward to seeing you"*. Our direct marketing messages allow you to follow an easy enrolment procedure if you are coming.

PREMIUM geophysical operational **SERVICES**

EXPERIENCE FROM **1000'S** OF **BOREHOLES GLOBALLY**

PROVEN *subsurface data*

ROBERTSON GEO SERVICES

Unlocking Your GeoData



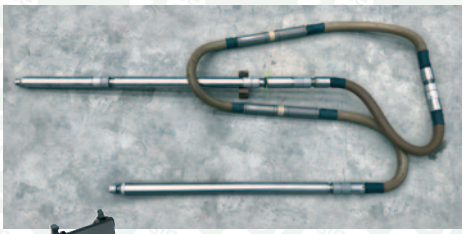

No project is too small, no project too large or challenging.

www.rgeo-services.com

www.pslogger.com

PSLogger® since 79

A registered Robertson Geo trademark product of over 40 years use, development, sales and manufacture. Routinely deployed for major civil engineering and offshore projects, the PS Logger® is the Industry reference go-to probe for determination of soil and rock strength.




ROBERTSON GEO

Unlocking Your GeoData

ROBERTSON GEO

Unlocking Your GeoData

SAFETY IS KEY ©

Robertson Geologging Ltd.
Deganwy, Conwy, LL31 9PX,
United Kingdom
T: +44 (0) 1492 582 323
Sales & Corporate
E: growlands@robertson-geo.com
Operational Services
E: ijones@robertson-geo.com

Robertson Geologging (USA) Inc.
1809 N. Helm Ave., Suite 4,
Fresno, CA 93727, USA
T: +1 (559) 456 1711
E: sstroud@robertson-geo.com

Robertson Geologging (Asia) Inc.
Flat 21A, Village Tower, 7 Village Road,
Happy Valley, Hong Kong
T: +852 650 33486
E: steveparry@robertson-geo.com

www.robertson-geo.com

TÜV SÜD ISO 9001 Certified Quality Management System www.tuv-sud.com/ms-cert