TERRA DAT
geophysical **innovation**
NEWS
Summer 2006

Over 70 years combined Geoscience experience!

Welcome to the latest edition of the TerraDat newsletter. Now in its 14th year of innovation and provision of specialist geophysical surveys, we are pleased to present a round up of our recent news and developments.

After considerable investment in personnel and technical facilities we now have the UK's largest survey capacity and flexible capability (comprising 13 qualified geophysicists) and a complete suite of state-of-the-art geophysical instrumentation.

Working in such a dynamic and high-tech industry enables us to identify any new opportunities that catch our attention and evolve our capability into new fields.

Recent examples include applied methane gas detection, mobile geochemical analysis of contaminated sites, terrain mapping using advanced photogrammetric techniques and remote imaging of geological and archaeological features.

Seismic bedrock profiling for jetty: Cardiff

Inside this issue:

Ideal geophysics terrain in Kazakstan

... ground solutions through applied geophysical innovation

2005 Open Day

On one of the hottest days of 2005, 40 of our clients attended our first geophysics open day at Chepstow Race Course. The day comprised of a morning of lectures on the background to the various techniques, applied case studies and a 5-minute guide to the procurement of geophysical services.

After an excellent lunch held in an executive suite overlooking the stunning views of the course and the Severn Estuary, live demonstrations of all our equipment were held out on the grass.

For some of the visitors, it was the first time they had seen the latest geophysical equipment up close and personal and many remarked how compact and easily portable they were.

For those who could not make the day and would like to receive Nick Russill's presentation on "recent developments in applied geophysics to engineering and environmental site investigations", please contact simon@terradat.co.uk or call 08707 303050

Geo-Tip

The best time to commission a geophysical survey is at the START of an SI. There is much greater cost/benefit by using the information yielded by the geophysics to direct follow-up invasive sampling programmes. Risks from buried hazards can also be avoided.

Nazi Escape Tunnel Rediscovered

In March 1945, 70 dangerous Nazi prisoners escaped from the high security Island Farm camp at Bridgend in South Wales through a tunnel that was excavated beneath one of the huts and extending under the perimeter fence. Although all of the escapees were eventually rounded up by the Home Guard, locals and the police, it represented the biggest single escape of the Second World War.

The camp is now an overgrown jungle awaiting redevelopment, however the hut where the prisoners slept is preserved, complete with its graphically erotic wall murals designed to distract the guards, as a listed building. TerraDat was approached by a researcher from Hartswood Films and asked whether any techniques existed that would be able to find out if the tunnel still existed. The area was known to comprise Glacial till over Jurassic Limestone and the suspected depth of the tunnel made the choice of method complicated.

News Chronicle

MONDAY, MARCH 12, 1945

70 Nazi prisoners escape

Home Guards and planes in search

SEVENTY German prisoners of war escaped from a camp at Bridgend (Glam.) in the early hours yesterday.

At night 36 were still at large: 34 had been recaptured during the day at various places in the neighbourhood.

There was some shooting, and one prisoner was slightly wounded.

Four stole a car and got into Gloucestershire, where planes were used in the search.

Hundreds of the Home

Ground radar was considered (although the chances of obtaining sufficient depth of investigation through till are limited) along with magnetometry, the latter because anecdotal evidence existed of a crude ventilation system in the tunnel made from a string of baked bean tins, though the suspicion that they would have long ago rusted away proved true when no anomalies could be found. After a few hours of profiling with a variety of ground radar frequencies we were pleasantly surprised to see some characteristic anomalies suggesting the presence of a void at about 2.5 metres below the surface.

A mini-digger was brought in and a test pit over the strongest radar anomaly was excavated. As the hole reached the maximum depth of the excavator we were disappointed to see nothing but sandy overburden (which is why the radar was able to "see" to depth). With the last bucket a small black hole appeared in one corner of the pit which collapsed to reveal the tunnel exactly where the geophysics had indicated.

The tunnel was still in perfect condition and a tribute to the ingenuity of the prisoners who had used all manner of stolen and salvaged items to shore up the roof. The whole story, including footage from inside the tunnel was told in "The Great Welsh Escape" and shown on Channel 4.

More information on this story can be found at www.islandfarm.fsnet.co.uk

NEW WEBSITES LAUNCHED

TerraDat is pleased to formally announce the launch of two new websites. We have increased the amount of technical content and improved the navigation so that it will become even more of a popular resource for clients or academics looking for applied geophysical case studies. This can be found at www.terradat.com

The second website at www.terrageomatics.com is specific to our new imaging / mapping capability and includes an easy to read guide to photogrammetric modelling and many impressive case studies.

Keep an eye on the news page for latest electronic versions of e-Newsletters, upcoming events and new publications.

CARDIFF BUSINESS CLUB

We are pleased to have assisted local enterprise as a sponsor for the 2005-06 season of Cardiff Business Club by hosting their website. The Club was founded in 1912 and has hosted numerous eminent speakers including Sir Tim Rice, Sir, Richard Attenborough, Piers Morgan and the Duke of Westminster at the St David's Hotel in Cardiff Bay.

The final meeting was in honour of Professor Lord Robert Winston who gave an insightful talk about the public's trust in advances in science, ranging from biochemistry through to sustainable energy. This was particularly relevant in the light of the British Government's renewed commitment to nuclear energy - a sector of industry

Overseas Update

Our portfolio of overseas projects is increasing, the highlight of 2005 being a geophysical characterisation of rock properties in KAZAKSTAN which was completed by Mark Harwood and Richard Bowen.

The AUSTRALIA office continues to further awareness of the benefits of geophysical mapping of brownfield sites.

Anna is making the most of her return to ITALY and is promoting the services of "TerraDat Italia", specifically for evaluating rock strength for building foundation studies using innovative shear wave seismic methods.

Director, Nick Russill has identified potential markets for imaging work in the context of volcanoes in ICELAND. He also had a very positive response at the first Water Middle East exhibition in Bahrain, promoting the benefits of geophysics for rapidly locating aquifers for water supply.

Discussing groundwater geophysics in Bahrain

New Appointment: *Simon Hughes*

Simon became TerraDat's new Operations Manager in March 2005 and is your first port of call for quotes or enquiries as well as overseeing survey logistics. He returned to Cardiff after 10 years in Mexico and New York City. He completed his Ph.D. in volcanology at Cardiff University in 1995 and went on to do a Post-Doc at National University of Mexico, and research at the State University of New York, Buffalo, USA. His research interests are in pyroclastic rocks and the application of geophysical techniques to mapping and monitoring active volcanoes. *Contact: simon@terradat.com*

Equipment Update

Recent additions to our inventory include: GEM2 Electromagnetic instrument (a significant improvement over the EM31), a second Geonics EM61 for metal detection,and a millimetre accurate RTK GPS system. Hydrocarbon mapping is achieved with a new Ecoprobe V gas sensor.

Our downhole / crosshole seismic capability has been enhanced with the purchase of an in-hole shear wave source and clamping geophones.

Geo-Tip

The value of a TERRADAT survey can be significantly increased if time / budget is allowed for re-evaluation of the results in the light of follow-up ground truthing.

This will enable our scientists to clarify any points in the data and extend the interpretation in the light of any new data.

NEW Photogrammetric Imaging Services

TerraDat has periodically undertaken projects to generate digital terrain models (DTMs) using stereo photographic imagery for large mineral exploration projects using specialist consultants. Photogrammetry is the generation of spatially-correct georeferenced models (e.g. CAD DXF or TIN files) from a pair of photographs. Acquisition of the new PI-3000 software provides us with an in-house ability to produce sub-centimetre accuracy datasets from pairs of photos taken with any digital camera within the timeframe of a few hours.

The workflow for creating a model for a typical geological section is: 1. Field image acquisition (1 hour); 2. Register images in software and pick a minimum of 6 pass points (20 minutes); 3. Calculation of the orthorectified images and defining model polygons (15 minutes); 4. surface modeling to produce 3D output (ascii xyz, vrml, TIN, dxf etc.).

Recent applications include:

- Quarry face mapping (see image)
- Aggregate stockpile volumetric estimations
- Geological exposure mapping for cutting
- 3D model of heritage buildings for conservation work
- Recording of archaeological excavations
- Building elevation surveys for architects
- Volcanic eruption prediction

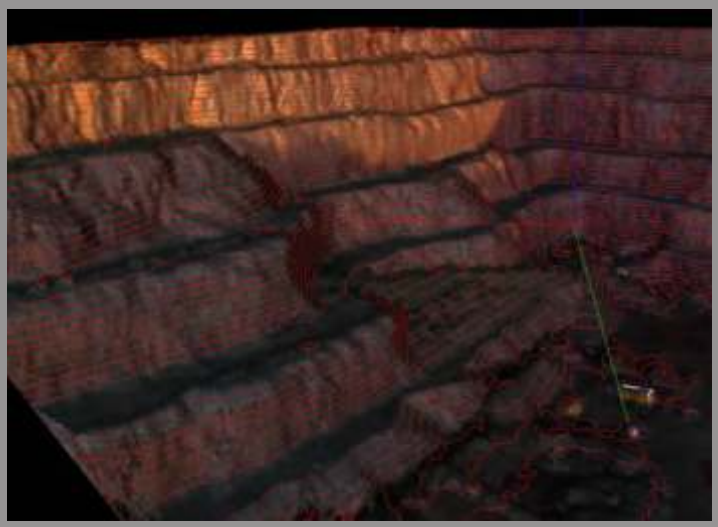


photo-draped 3D surface model of quarry derived from stereo photography

The quality of the final solution from the above process is a direct function of starting with good quality images - ideally from elevated vantage points. Driven by a brief from several UK Police Forces, we have come up with various solutions including: a 50ft telescopic mast with remote controlled digital SLR; a compact 8 megapixel camera remotely mounted and controlled on a kite; a gyro-stabilised helicopter with onboard high quality video making it ideal for inspection work.

The combination of our newly-acquired imaging hardware solutions, pioneering software and established expertise as map makers means we are ideally positioned to offer a full range of solutions ranging from simple acquisition of aerial photographs through to generation of ortho-photos and DTMs. The PI-3000 software is also available for sale through TerraDat as an authorised reseller and includes onsite training / online support.

For more information, visit www.terrageomatics.com

Why desk studies aren't always reliable
A GEM2 to locate abandoned gas holders

TerraDat were recently commissioned to undertake a geophysical survey to locate the position of contaminated gas holder bases situated under a TESCO car park. As part of the conditions for expansion of the superstore, an environmental clean-up of any contamination associated with former industrial activity was required.

Previous intrusive investigations had been unable to establish the exact size and location of the buried structures, but a desk study established that two gas holders were present within the survey area. One holder was believed to be completely removed and filled with clean material, while the second left intact and heavily contaminated.

In order to establish the position and condition of these gas holders, Santus Ltd, contacted TerraDat for a rapid non-invasive survey with minimal impact on daily activities at TESCO.

Using our newly-acquired GEM-2 system, an electromagnetic survey was carried out to exploit the conductivity and metal content contrast between gas holders and the surrounding subsurface materials. A follow-up magnetic survey was then conducted using a Geometrics G-858G with the aim of identifying iron supports present within the base of the holders.

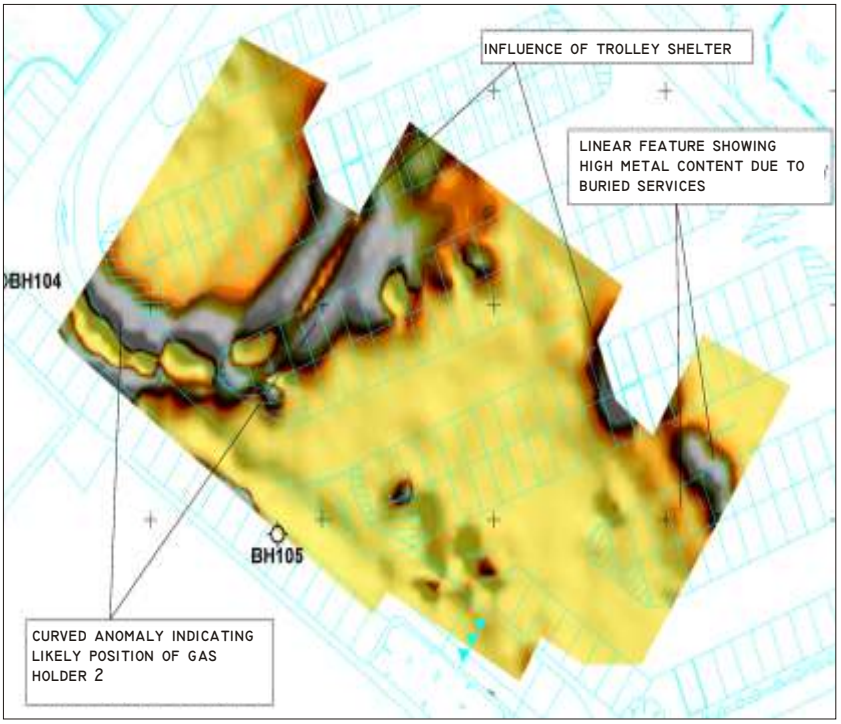
Both surveys were positioned using one of the first handheld dual-constellation differential GPS systems in the UK (Topcon GMS2) giving real-time sub-foot positional accuracy.

Based on the geophysical results, we were able to prove the position of one of the gas holders that was previously thought to have been completely removed.

The geophysics therefore shows that historical records are not always reliable and our technology can provide a useful tool for optimally characterizing the subsurface.

A spokesman for the Client said:

"The geophysical results were very useful and greatly increased our understanding of the site. We were impressed at how rapidly TerraDat acquired the data and produced working results."



TerraChem Surveys

We are now supplementing our geophysical services with a selection of geochemical services using state of the art portable instrumentation, purchased with the help of grant funding secured by the Welsh Development Agency Environmental Goods & Services programme. These services provide rapid, high quality onsite analysis for many industry sectors and include:

Soil Vapour Surveys

Our soil vapour surveys detect vapours associated with hydrocarbon contamination, and are ideally suited to mapping contamination caused by diesel and petrol spills or landfill gas leaks. The system can detect gas concentrations as low as <0.1ppm methane and carbon dioxide. Other applications include, pipe line leak detection, measurement of bio-remediation processes, contaminant plume migration and surface methane emissions.

Heavy Metals Analysis

This service provides a high resolution geochemical mapping of heavy metals in soil, detectable metals include Pb, As, Cr, Cd, Hg and Sb. Other applications of this service includes, profiling core samples, screening soils, time integrated monitoring of remediation projects, mineral exploration, positive material identification, metal concentrations in paints, plastics, alloys and printed circuit boards.

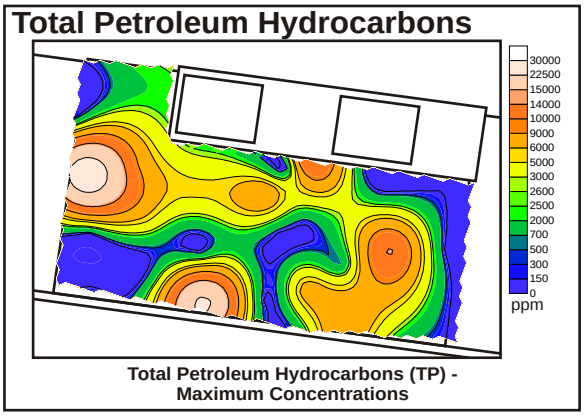
Radiological Surveys

The survey comprises a fully weatherproof dGPS integrated gamma ray scintillometer for mapping areas where radiological contamination is suspected

Water Analysis

Chemical analysis of water samples (e.g. groundwater, leachate, surface waters). All pollutant types can be analysed, including metals, non-metals, organic/inorganic compounds to extremely high standards, even at low concentrations (<1ppm).

All our services are undertaken with an accepted method by the Environment Agency, which involves sample verification (usually 10%) at an independent laboratory. More information relating to these services can be downloaded from our website.



Total Petroleum Hydrocarbons (TP) - Maximum Concentrations

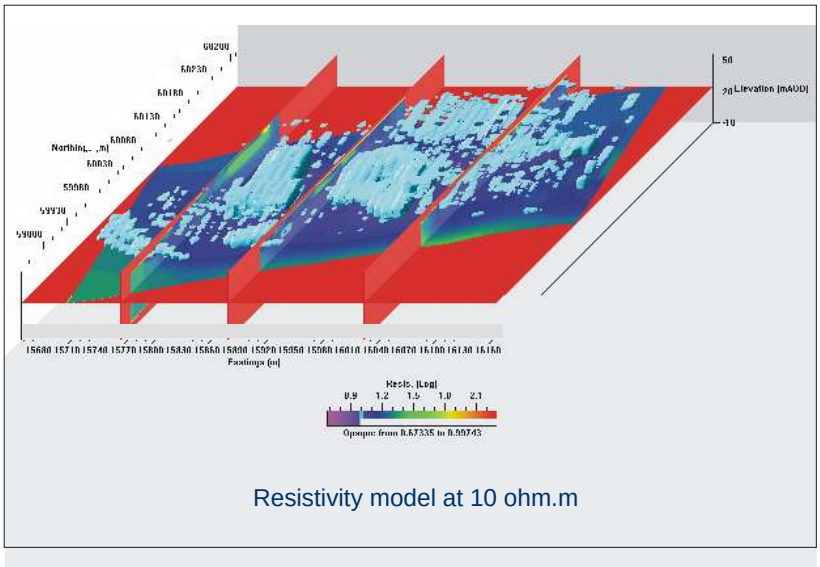
Imaging the internal structure of landfills in 3-D

One of our most commonly used and effective techniques is resistivity imaging (sometimes known as tomography or MRT). This technique uses multi-electrode arrays to generate 2-dimensional cross sections of the subsurface, identifying different geological or hydrological horizons by virtue of their characteristic geo-electrical properties. For example, it is an ideal technique to use along the length of a proposed roadway to look for limestone cavities where they are often infilled with low resistivity clay that contrasts strongly with the surrounding resistive rock.

Traditionally, these types of surveys are carried out in 2-dimensions (depth vs distance along the surface), however a sufficiently dense dataset of close-spaced parallel lines can be inverted in 3-dimensions. TerraDat recently carried out what can be considered the largest 3-D resistivity survey of a landfill site with the aim of identifying perched leachate bodies within the waste mass. Areas of dry waste could be used for effective recirculation of the leachate and make the most of the absorbative capacity of the landfill thus reducing operating costs and potential environmental breakouts.

In conjunction with Meng Heng Loke the World expert in resistivity modeling, a detailed model was derived and exported into the LSS software for "virtual reality" analysis.

We are presently researching this technique for the use in long term monitoring of slope stability in post-glacial terrains.



3D iso-surface of model resistivities at 10 ohm.m
(i.e. low resistivity = leachate saturated zone)

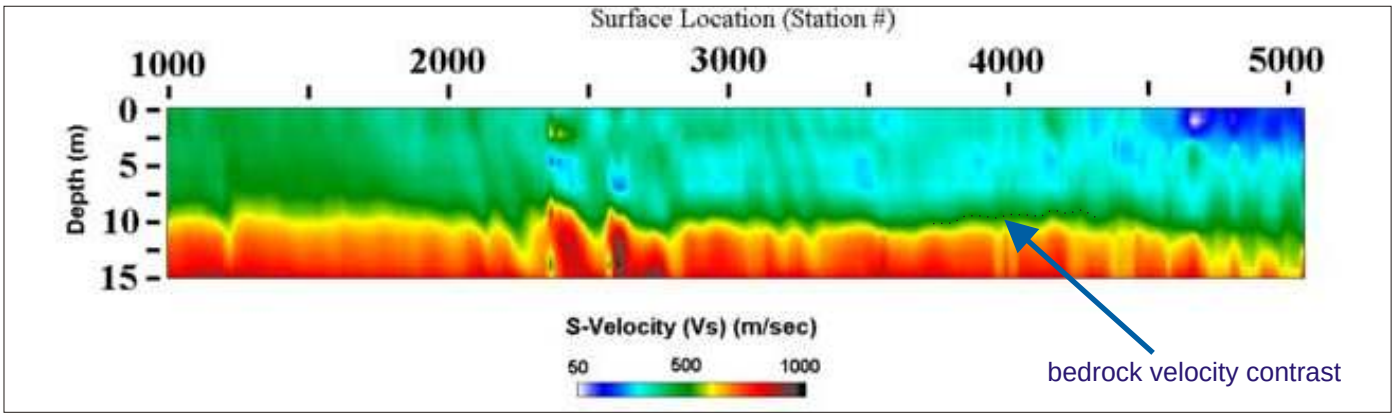
Generation of Shear-Wave Velocity (Vs) Profile through 3 Automated Steps

TerraDat now has the facility to process seismic data acquired as an implementation of the multichannel analysis of surface waves (MASW) method. By analyzing the fundamental-mode Rayleigh waves, we can produce shear wave velocity profiles (1-D and 2-D) applicable for both engineering and geophysical projects that need a stiffness evaluation or anomaly detection of ground materials shallower than usually 30 m.

The entire procedure requires a skilled approach, but represents a very cost effective means of deriving engineering moduli for our clients. The process consists of three steps:

1. Acquisition of standard multi-channel seismic data.
2. Extraction of dispersion curves--dispersion of the fundamental-mode Rayleigh wave is extracted from the seismic data.
3. Inversion for shear-wave velocity (Vs) profiles--extracted dispersion curves are inverted for the Vs profiles each of which depicts the Vs variation with depth at a particular surface location.

This technique is particularly popular in regions where earthquake risk assessment is of particular concern for the design of building foundations and anywhere that soil stiffness information is required.



2-D section of model s-wave velocity indicating the top of bedrock and providing information on sediment stiffness variations

The World's First Imaging Theodolite Launched

In 1995 Nick Russill and Rob McDonald sought a solution to the problem of mobile computing in harsh environments - in other words, a computer that would work in the classic British weather. Their solution developed into our sister company Terralogic which was #4 in the official list of Wales's fastest growing companies in 2004 and continues to supply surveyors, military and public services around the World with bespoke rugged computer products.

In 2006, we were approved by leading instrument manufacturer Topcon Positioning Systems to become an authorised dealer for their imaging products. This includes the state of the art PI-3000 photogrammetry software and also the revolutionary GPT-7000i imaging total station.

The GPT-7000i has several world firsts including:

- reflectorless capability making it ideal for geological or building structural mapping
- a built in CCD digital camera that records a wide angle and zoom view of the crosshairs effectively making a perfect digital notebook
- built in laser pointer to assist targeting (ideal for use in mines or dark places)
- colour TFT screen and Windows CE
- ability to import files directly into the PI-3000 photogrammetry software
- optional remote display solution for use in inaccessible places

We are able to offer TerraDat customers a 15% discount and free onsite training session on the current price of £ 11,000 + VAT on this instrument.

For more information visit www.terrageomatics.com

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Free Geophysics Seminar!
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