Geoscientist

The Fellowship magazine of The Geological Society of London | www.geolsoc.org.uk | Volume 22 No 8 | September 2012

HOT TICKET
Engineering geology in hot, dry deserts

TROJAN WEASELS
Where the Trust got lost

[VOICE SQUAD!]
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NZ QUAKES
Christchurch's seismic years

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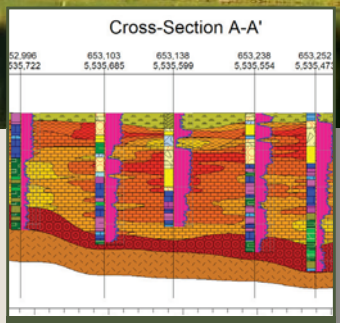

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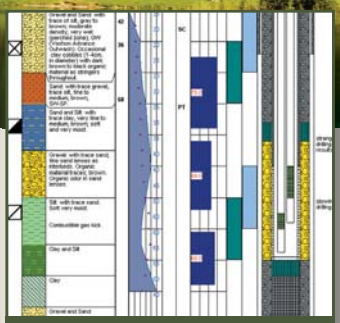

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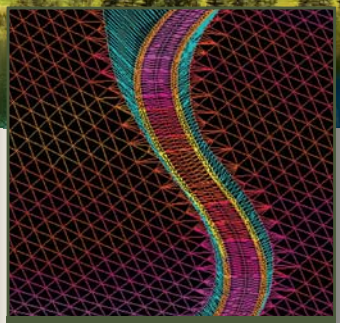

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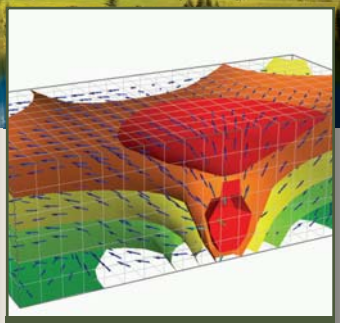

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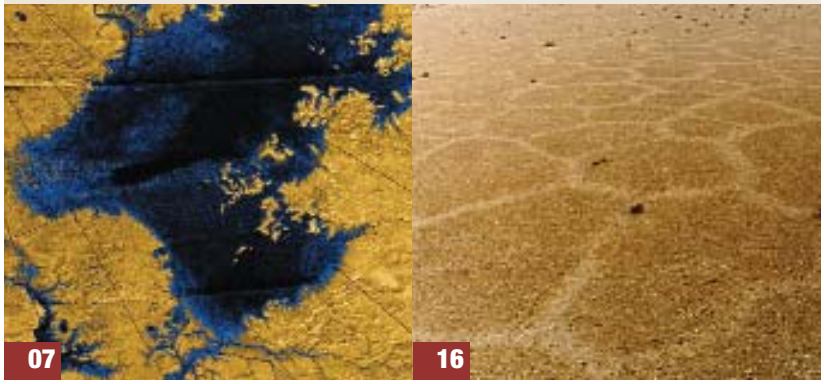

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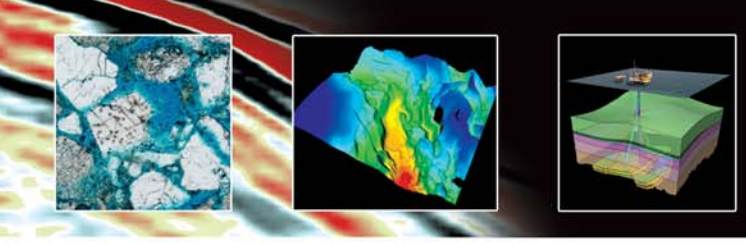

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CALL FOR ABSTRACTS

Structural geology is a crucial element in the Petroleum and Mineral Industries. It provides the framework within which we explore, appraise and develop assets, with a critical influence on their commercial success. Industrial activity provides a wealth of structural data to advance fundamental science, which allows theories to be tested through constantly evolving techniques. Ultimately structural geology is a key pillar in supporting the profitable generation of society's energy and mineral requirements, requiring research funding and offering rewarding careers to future geoscientists.

This conference provides an opportunity to review current best practices in structural geology as well as explore and define the relationships between industry and academic practitioners. In a commercial climate, where declining resources, the environment and safety are all fundamental issues, defining future trends and developments through better collaboration will help prepare us for the challenges that lie ahead.

This three-day conference will combine presentation, discussion and workshop formats. We invite contributions covering all practical aspects of structural geology with a commercial application, including: mapping and fault validation; fault seal, trapping and compartmentalisation; regional geology, including restorations and plate-scale reconstructions; risk, uncertainty and volumetric assessment; geomechanics, fracture prediction and (HPHT) production behaviour; unconventional resources; carbon storage; application of analogues; salt tectonics; data collection, synthesis and integration.

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TROJAN WEASELS

In late July, the National Trust bowed to pressure to rewrite the interpretation boards it had lately installed at the Giant's Causeway, Northern Ireland, which acknowledged the existence – particularly in the Six Counties – of a Young Earth Creationist (YEC) view of its formation. The Trust had come under intense pressure from groups of Christian fundamentalists, and alas made the mistake of bending a little too far backwards in accommodating them.

Scientists must never forget that anyone is free to believe whatever nonsense they like about the world, for their freedom is also our freedom. But that is not to say that we should accept the claims of fundamentalist believers that their version of creation myth has equivalent 'scientific' claim upon reality - and public attention.

It could have been worse. Scientists could take comfort that the panels clearly presented a proper scientific explanation first and relegated YECs to a subsidiary section about myths. The problem arose, however, not because YEC beliefs were *mentioned* (though that was too much for some) but because the Trust did more than nod to the existence of YEC beliefs when it stated: "This debate continues today for some people, who have an understanding of the formation of the earth which is different from that of *current mainstream science*."

The weasel words here are 'current mainstream'. Without those words, the statement is unexceptionable. With them, the YECs attain everything they scheme for – namely, a clear implication that there exists a form of 'science' that supports the ridiculous idea that the world is only 6000 years old. To sow doubt where there is none is all they want.

Max Frisch's classic 1958 play *Biedermann und die Brandstifter* – known in English as *The Fire Raisers* - is a parable about the Weimar Republic's destruction by Nazism. In it, a complacent bourgeois family refuses to think evil of the lodgers in the attic, until it is too late and they find themselves collaborating in burning down their own house. The Trust's careless concession, in two apparently harmless words, was what let the fire-raisers in; for they played right into the hands of those specious casuists whose evil work tricks the ignorant into accepting the trespass of fundamentalism and dogma upon the rightful domain of science.

We would congratulate the Trust on its U-turn, were it not for our belief that it should not have been so naive in the first place.

DR TED NIELD EDITOR

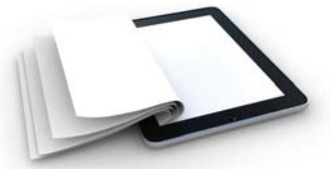
REFERENCES

- Geological Society 2008 Policy Statement "Young Earth Creationism", "Creation Science" and "Intelligent Design": www.geolsoc.org.uk/creationism
- **Moreton, S.** (2009) Facts meet fantasies at the Giant's Causeway. Earth Science Ireland, Issue 6, p. 37-39. On-line: www.habitas.org.uk/es2k/
- **Zalasiewicz**, Jan 2008: Giant's Causeway – myth and reality. *Geoscientist* 18.04, pp14,15 www.geolsoc.org.uk/page3473.html

At last - intelligent publishing!

BY KEITH WESTHEAD

NERC BGS's Intelligent Publications research and development project is transforming the way geological information is presented, as the Survey embraces the digital publishing age, says **Keith Westhead***



Scientific publishing was simpler when we only had paper. In Earth sciences, for example, we had maps, books, reports, pamphlets and journal papers, all very familiar to publishers and readers. Now the world has gone digital, the publishing job has become more complicated - but at the same time, more exciting.

NERC British Geological Survey (BGS) is running an 'Intelligent Publications' research and development project, to look at how it can modernise its published outputs to embrace this rapidly evolving digital era. We are even rethinking the process of scientific writing itself, using a 'wiki' approach similar to Wikipedia but carried out in-house - under the watchful eye of scientific editors. Text that is 'born-digital' like this is easier to break into packages and to use as a resource for future digital publications. It can also be linked 'intelligently' with other information, such as images, databases, maps and even 3D models.

POSSIBILITIES

We are also considering what a new range of digital publications produced by the BGS might look like. Here the problem – but also the opportunity! – is the sheer number of possibilities that digital publishing offers. We have found it best not to think simply in terms of a digital update to our existing series of publications (such as BGS Memoirs) but rather to think of a new, much more flexible range of publications presented in a spectrum of styles and delivered on an array of digital platforms.

For example, we might be able to produce a publication in a *'Discovery'* style for a public audience, delivered using a tablet computer app. Alternatively, we might deliver a more 'in-depth' scientific style for a research audience through a richer, website platform. Moreover, because the publication can be assembled from a range of linked digital elements, it could take any form: for example, an interactive digital map, or 3D model, or a written publication with embedded digital elements. We will be conducting trials of these sorts of publications in the coming year and are keen to receive feedback. The possibilities for revolutionising the way we present our science are very exciting.

BGS is not alone, of course, in tackling this new world of digital publishing. Popular scientific publishers such as *National Geographic* are beginning to provide a mixture of web-based, mobile and printed outputs. Leading journal publishing houses are moving towards interactive, web-based outputs for peer-reviewed papers, such as Elsevier's *'Article of the Future'*.

AUTHORITATIVE

The user can only be the winner in this race to a digital future, as providers of information compete for their attention with a rapidly broadening array of interactive publications. The challenge for publishers will be to remain as islands of authoritative information amid an ever-widening ocean of possibly dodgy digital data!

* **Dr R Keith Westhead** (pictured left) is Head of Knowledge Exchange at the British Geological Survey

SOAPBOX CALLING!

Soapbox is open to contributions from all Fellows. You can always write a letter to the Editor, of course: but perhaps you feel you need more space?

If you can write it entertainingly in **500 words**, the Editor would like to hear from you.

Email your piece, and a self-portrait, to **ted.nield@geolsoc.org.uk**. Copy can only be accepted electronically. No diagrams, tables or other illustrations please.

Pictures should be of print quality – as a rule of thumb, anything over a few hundred kilobytes should do.

Precedence will always be given to more topical contributions. Any one contributor may not appear more often than once per volume (once every 12 months).

> THE CHALLENGE FOR PUBLISHERS WILL BE TO REMAIN AS ISLANDS OF AUTHORITATIVE INFORMATION AMID AN EVER-WIDENING OCEAN OF POSSIBLY DODGY DIGITAL DATA
> **Dr R Keith Westhead**

Rivers of Titan

Findings based on analysis of its river networks suggest the surface of Saturn's largest moon may have undergone a recent transformation, writes **Jennifer Chu**

PLANETARY GEOLOGY

For many years, Titan's thick, methane- and nitrogen-rich atmosphere kept astronomers from seeing what lies beneath. Saturn's largest moon appeared through telescopes as a hazy orange orb, in contrast to the other, heavily cratered moons in the solar system.

In 2004, the Cassini-Huygens spacecraft penetrated Titan's haze, providing scientists with their first detailed pictures of the surface. Radar images revealed an icy terrain carved out over millions of years by rivers of liquid methane.

Very little is known about its geological past. Now researchers at MIT and the University of Tennessee at Knoxville have analysed Titan's river networks and determined that in some regions, rivers have created surprisingly little erosion. Either erosion on Titan is extremely slow, or something may have recently wiped out older landforms.

"It's a surface that should be much more eroded if the river networks have been active for a long time" says Taylor Perron, Assistant Professor of Geology at MIT. "It raises some very interesting questions about what has been happening on Titan in the last billion years."

> "IT'S A SURFACE THAT SHOULD BE MUCH MORE ERODED IF THE RIVER NETWORKS HAVE BEEN ACTIVE FOR A LONG TIME"
> **Taylor Perron**

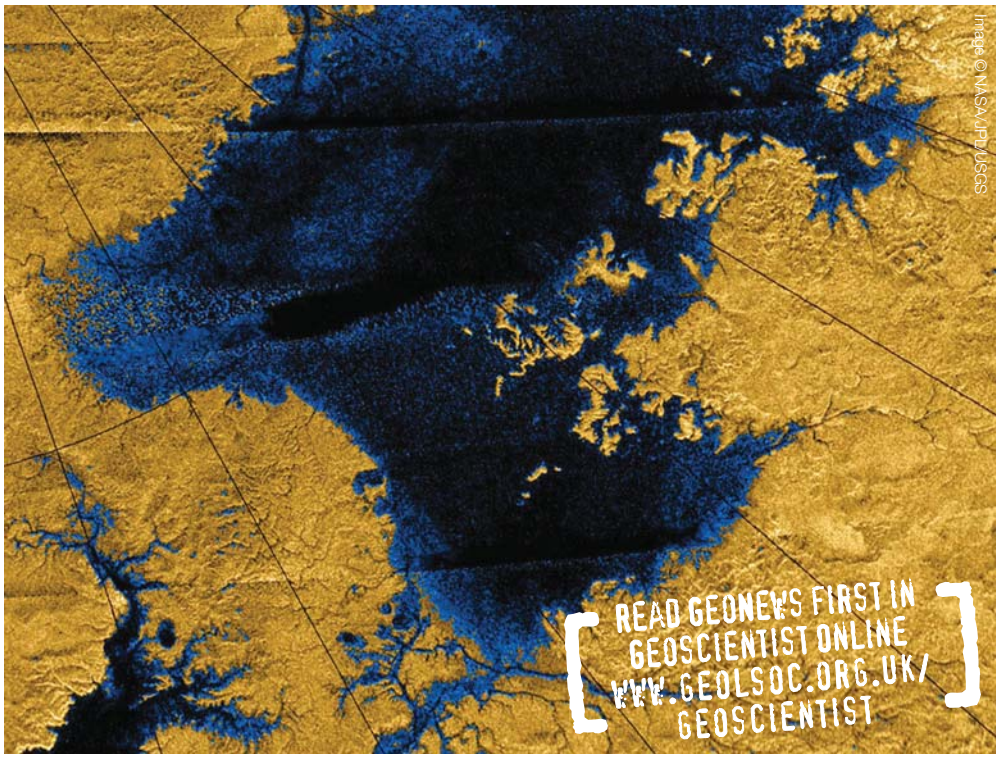
Titan is around four billion years old. But judging by the crater count, one might estimate its surface to be between 100 million and one billion years old. What might explain this low crater count? Perron says the answer may be similar to what happens on Earth.

"We don't have many impact craters on Earth" Perron says. "One reason is that Earth's continents are always eroding or being covered with sediment. That may be the case on Titan, too."

Images generated by the Cassini spacecraft, similar to aerial photos though with much lower resolution, are flat, depicting terrain from a bird's-eye perspective, and giving no information about elevation or depth. So, going simply on the branching pattern alone, Perron and MIT graduate student Benjamin Black mapped 52 prominent river networks from four regions.

They then compared the images with a model of river network evolution developed by Perron. This depicts the evolution of a river over time, given variables such as the strength of the underlying material and the rate of flow through the channels. The comparison revealed that the moon's rivers most closely resemble the early stages of a typical terrestrial river's evolution.

"They're on the long and spindly side" Black says. "You do see some full and branching networks, and that's tantalising, because if we get more data, it will be interesting to know whether there really are regional differences."



Above: Image from the Cassini mission shows river networks draining into lakes in Titan's north polar region

However, comparing Titan's images with recently renewed landscapes on Earth, including volcanic terrain on the island of Kauai and recently glaciated landscapes in North America, is strongly suggestive. River networks there bear a strong similarity of form to Titan's, suggesting that geologic processes have reshaped the moon's icy surface in the recent past.

"It's a weirdly Earth-like place, even with this exotic combination of materials and temperatures" Perron says. "And so you can still say something definitive about the erosion. It's the same physics."

REFERENCE

1 *Estimating erosional exhumation on Titan from drainage network morphology* Benjamin Alexander Black, J. Taylor Perron, Devon Burr, Sarah A Drummond JOURNAL OF GEOPHYSICAL RESEARCH, doi:10.1029/2012JE004085

SOCIETY NEWS

ELECTION – FELLOWS

The following names are put forward for election to Fellowship at the OGM on 27 June 2012:

ABRAHAM, Scott Antony; **ADAMS**, Christopher James Robert; **ALEXANDER WILLIAM**, Neufeld; **ALYMBEKOV**, Azamat; **AMARASEKERA**, Shirantha; **AMY**, Vincent Peter; **APSEY**, Steven Michael; **ATKINSON**, Daniel Roger; **AVES**, Helena Sophia; **BACIGALUPO**, Joseph Alexander; **BARLOW**, Rachel; **BARMUTA**, Pawel; **BATES**, Christopher David; **BAUR**, Peter; **BEATON**, Benjamin Anthony; **BERENDS**, Lindsey Sarah Christina; **BLOXHAM**, Roseanna Jane; **BONNARDOT**, Marie-Aude ; **BORLAND**, Kyle William; **BOURNE**, Michael John; **BOWLER**, Jonathan Paul; **BUTLER**, Christine; **CARPENTER**, David Kevin; **CASSIDY**, Sarah Louise; **CHAN**, Kwan Yin; **CHANDE**, Shaun; **CHEN**, Bao Xiang; **CLAYTON**, Jonathan; **CONSTABLE**, Rosalie Miranda; **COOPER**, William; **DALE**, Karen Louise; **DAVEY**, Huw; **DICKINSON**, Owen James McLaren; **DOWRICK**, Thomas James; **DYSON**, Andrew; **ELLIS**, Richard William; **EVANS**, Trevor David; **FAWCETT**, Andrew; **FERRIER**, Graham; **FORSYTHE**, Andrew Donald; **GILL**, Tomas; **GILLIGAN**, Edward James; **GREDZINSKI**, Isabella Joy; **GREEN**, David Paul; **GRIST**, Brett James; **GRODNER**, Mark William; **HAND**, Nicolas; **HAUTMANN**, Stefanie; **HERBERT**, Keith James; **HEYS**, Martin; **HICKMAN**, James Patrick; **HIGGINSON**, Jack Alexander; **HORNER**, Thomas Colin; **IBUKUN**, Opeyemi Bolanle; **INTAWONG**, Anongporn; **IRELAND**, Mark Thomas; **JACKSON**, Stephen George; **JOHNSON**, Benjamin Nigel Boyd; **KEAY**, Adam Edward; **KENNEDY**, Freddie; **KENNEDY**, John; **KHIAR**, Mohamed; **KILHAMS**, Ben; **KING**, Owen Morgan; **KWONG**, Hiu Jing; **KYRIAKOU**, Charizanis; **LANE**, Matthew Peter; **LAWRIE**, Helen Amanda; **LEE**, Alexander; **LEUNG**, Kim hung; **MACKAY**, Hugh George; **MACLAREN**, Andrew Hamish; **MACPHIE**, Donald Neil; **MARSHALL**, Adam John; **MARTIN**, Adam; **MCCARTAIN**, Eujay; **MCCRORIE**, Andrew; **MCGILL**, Andrew Thomas; **MELOY**, Anthony Fredric; **MILLS**, William Stephen; **MITCHELL**, George Lawrence Lloyd; **MORRIS**, Peter Elwyn; **MURPHY**, Brian Charles; **MURRAY**, Charlotte; **NAQI**, Mohammad; **NOBLE**, Holly Karen; **NOBLE**, Ross; **NORTH**, Laurence Jotham; **OATES**, Christopher Richard Adrian; **OMARI-MENSAH**, Lawrence; **ONSLOW ,HENRY; PARKER**, Kaye Elizabeth; **PARMASSAR**, Kevin; **PENDLETON**, Ella; **PRISTAVEC**, Christopher; **PUENTE DE LA VEGA**, Gerard Paul; **RADON**, Laura; **REYNOLDS**, Emily Louise; **RHYS-WILLIAMS**, James; **RICE**, Samuel Paul; **RICKARD**, David Terence; **ROBERTS**, William Gaynfur; **ROBINSON**, Gary John; **ROBINSON**, Timothy Michael; **ROSE**, Alexis; **ROWLEY**, Melanie Ann; **SHEPPARD**, Peter; **SMART**, Michael William; **SMITH**, Hudson Stuart; **SOETJIPTO**, Christian Michael; **SOMIARI**, Asitomka Tamunokuro; **SPASH**, Glen Andrew; **SPENCER**, Nicola; **STAVROU**, Anastasios; **STEPHENS**, Ian Nicholas; **STOKES**, Louisa Helen; **STREET**, Andrew; **STRINGER**, Mark James; **SUTTILL**, Hannah Louise; **SWANBOROUGH**, George Charles; **SWINBOURNE**, Graeme; **SYKES**, Benjamin John; **SYMONS**, Jennifer Anne; **TEASDALE**, Christopher James; **THEW**, David James; **THOMAS**, Philip; **THOMAS**, Sharon; **TSO**, Chi Ming; **TURKINGTON**, Iain Thomas; **WALKER**, John Russell Wood; **WALKER**, John Stuart; **WALKER**, Matthew Thomas; **WALLISS**, Caroline Jane; **WHITTINGTON**, Thomas Matthew; **WHITTLESTON**, Rob; **WHYBROW**, Karen Georgina; **WHYTE**, Ewan; **WILLIAMS**, Gareth James; **WITTS**, Duncan Andrew; **WOODCOCK**, Matthew James; **WOOLDRIDGE**, Hannah; **WORRALL**, Christopher Alan; **WRIGHT**, Nicholas John Roseveare; **WU**, Pao Lin Edward; **YU**, Leo Ling Yee; **ZULOAGA**, Ignacio.

FUTURE MEETINGS

Dates for meetings of Council and Ordinary General Meetings until June 2013 shall be as follows:

- **2012:** 26 September, 28 November
- **2013:** 6 February (1500); 10 April

Awards – ours and theirs!

By all means nominate colleagues for Society Awards – but have you thought of nominating them for the awards of other Societies?

Fellows of the Society are invited to submit nominations for the Society's Awards for 2013 to the Awards Committee. Full details of how to make nominations are on the website at **www.geolsoc.org.uk/gsl/awards**. Nominations must be received at the Society no later than Friday 5 October 2012.

But remember, the Society does not have a monopoly on rewarding excellence in Earth science! In fact, to promote international recognition of Fellows of the Society, we encourage you to nominate colleagues for other societies' awards - such as the American Association of Petroleum Geologists, the American Geophysical Union, the European Geosciences Union and the Geological Society of America.

Details on how to do this, and eligibility criteria, can be found at:

- **www.aapg.org/business/honors_awards/**
- **www.egu.eu/awards-medals/general-information.html**
- **www.agu.org/honorsprogram/**
- **www.geosociety.org/awards/aboutAwards.htm**

New visitor arrangements

From September 2012 changes will be introduced for 'visitor' (i.e. non-Fellow/Corporate Affiliate) access to the Library. While an initial appointment will be needed as before, a 'Visitor's Ticket' can now be purchased for daily, weekly, monthly or annual reference use of the Library. Charges will be tiered depending on the reason for using the Library, with rates kept low for students and non-commercial researchers.

For more information, please visit **www.geolsoc.org.uk/use**

'Geofacets' wins award

Jonathan Craig (GSL, Petroleum Group Chair, left), and (right) Friso Veneestra (Elsevier, Director of Market Development – Oil and Gas)

The Society and its partner Elsevier, have won the GetEnergy Education Partnership award 2012. This award traditionally recognises a partnership between an oil/gas company and a university, college or learning provider which shows significant promise.

The Education / Industry Partnership award, determined by over 11,000 individual votes on Getenergy's website, recognises the success of Elsevier and the Geological Society of London's collaboration in developing a new module for Elsevier's Geofacets research tool. The module adds over 48,000 maps sourced from 11 journals from the Geological Society of London's prestigious Lyell Collection.

[LECTURES]

Shell London Lecture Series

Volcanoes and Man

Speaker – Kathy Cashman (Bristol University)

26 September 2012

Interactions between humans and volcanoes are inevitable. Communities in volcanically active areas need a strategy for volcanic risk mitigation. Defining strategies as successful requires a perspective that includes not only modern studies of successes and failures in handling crises, but also evaluation of past cultures, by integrating volcanological studies with archaeological investigations and oral traditions, which encode important geologic observations and place disastrous events within the context of cultural beliefs.

- **Programme** – Afternoon talk: 1430 Tea & Coffee: 1500 Lecture begins: 1600 Event ends.
- **Programme** – Evening talk: 1730 Tea & Coffee: 1800 Lecture begins: 1900 Reception.

FURTHER INFORMATION

Please visit **www.geolsoc.org.uk/shelllondonlectures12**. Entry to each lecture is by ticket only. To obtain a ticket please contact the Society around four weeks before the talk. Due to the popularity of this lecture series, tickets are allocated in a monthly ballot and cannot be guaranteed.

Contact: **Naomi Newbold**, The Geological Society, Burlington House, Piccadilly, London W1J 0BG,
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FROM THE LIBRARY

The library is open to visitors Monday-Friday 0930-1730.

For a list of new acquisitions click the appropriate link from http://www.geolsoc.org.uk/info

Teaching geoscience teachers

The Society will run its successful teacher training programme for non-geologists again this year, *writes Jo Mears, Education & Training Officer.*

Thanks to BP's continued support, we are delighted to be able to announce that the Geoscience Education Academy will be run this year from the evening of Friday 19 October until the morning of Wednesday 24 October, at The Geological Society, Burlington House, London.

The Geoscience Education Academy offers UK teachers who are not geoscientists but have to teach the subject as part of the National Curriculum to understand how to teach geoscience. The course includes with behind-the-scenes visits to the NHM and BP included in the programme.

The GEA is completely free to attend, with all travel/ accommodation costs included/reimbursed.

For a copy of this year's programme and information on how to register, please contact **Joanna Mears E: joanna.mears@geolsoc.org.uk**

Earth Science Week 2012

Following the GSL's success with Earth Science Week last year, the Society will run it again from 15–19 October, *writes Jo Mears.*

ESW 2012 aims to encourage people everywhere to explore the natural world and learn about the geosciences. This year's event will boost awareness of the many exciting geosciences career and job opportunities that exist out there in the world of work.

A number of activities will take place that will not only highlight Earth science, but promote existing events and activities being run by other organisations.

Cooperating with them, we will be running a daily blog, posting online lesson plans, highlighting Earth science careers, organising a free schools/ friends lecture, providing online virtual learning kits, and giving you the chance to compete in some great competitions, plus a heap of regional and school specific activities.

To take part, please contact **Joanna Mears E: joanna.mears@geolsoc.org.uk** or (for further information and a full schedule) visit **W: www.geolsoc.org.uk/earthscienceweek2012**

PICK OF THE CROP

To see what books, maps & serials the Library has acquired, why not register to receive a copy of recent additions to the Geological Society Library, either by post or email? Contact Wendy Cawthorne on **wendy.cawthorne@geolsoc.org.uk**

CHRISTCHURCH QUAKES

Twenty-one months, four earthquakes, 10,510 aftershocks later*, Camilla Gibbons** describes their effect on the city and her work on rockfall remediation

Before September 2010, if you asked any New Zealander where the next big earthquake would be, the answer would have been "Wellington". 'Auckland' would have been the answer for the next volcanic eruptions and of the country's three main cities, Christchurch would have been considered the safest as far as natural disasters were concerned. However Mother Nature has done her best to kick us out of such complacency; and after four major earthquakes and over nine thousand aftershocks (33 greater than magnitude 5.0) one wonders, when will it stop?

New Zealand is located on the 'Pacific Ring of Fire' at the boundary of the Pacific and Australian plates. The Pacific Plate is being subducted below the Australian Plate to the north of New Zealand and under the eastern North Island. The reverse occurs off the west coast in the South of the South Island, where the Australian plate is being subducted below the Pacific Plate. In between lies a large region of strike-slip faulting, including the 600km-long Alpine Fault (dextral strike-slip), which runs up the western side of South Island and moves on average 30m/1000 years. The Alpine Fault was expected to be the culprit in the next 'big one'.

ROCKFALL

Christchurch city itself is built on the Canterbury Plains, 8000 square kilometres of glacio-fluvial gravels overlain with deep alluvial deposits, laid down over the last three million years. The basal greywacke bedrock lies several hundred metres below surface. The southern part of the city lies on the eroded flanks of the extinct Lyttelton Volcano. The hills consist of interbedded dark grey basalt, often with columnar jointing; red/brown ash-dominated layers, and layers of breccia and agglomerate. The columnar basalt is very strong, the ash very weak, the breccia layers variable, and the overall rock mass dilated. With this structure and several unexpected, very large earthquakes, rockfalls were both unpredicted and abundant.

At 04:35 on 4 September 2010, a magnitude 7.1 earthquake hit Darfield, 40km west of Christchurch. I had never felt an earthquake before, and when I moved to New Zealand in early 2008, I wanted to – as long as it was a little one, and not a 7.1! I immediately thought to blame the Alpine Fault, as many did; however, the epicentre actually occurred on the previously unknown Darfield Fault, c. 40km west of the city. This quake measured 9 on the Modified Mercalli Scale ('considerable damage') and had a peak ground acceleration (PGA) of 1.26g. Several buildings were damaged from the shaking and large areas in the northeast of the city were covered in a thick layer of silt from the abundant liquefaction.

Life changed in an instant. It became unusual not to be woken up in the night, as the aftershocks were very regular. As many as 4428 aftershocks occurred in the following five months, 13 of which were of magnitude 5.0 or higher. Reports soon after suggested that the expected decline in the number of quakes was not happening because the Darfield fault had ▶

Boulders blocking the main surface route from the Port to the City (the other route relies on a tunnel under the hills which was closed for several days). Note the bounce marks in the tarmac

not ruptured in the last 16,000 years (minimum estimate) and it would therefore take a long time for the stresses to re-equilibrate. Little did we know that this was just the beginning.

CANCELLED

At 12:51 on 22 February 2011 I was running a bit late, heading to a seminar entitled "seismic strengthening of building foundations". The course was eventually cancelled by the next major earthquake to hit Christchurch, this time a 6.3, centered under the south of the city, with a PGA of 2.2. Again, my immediate thought was 'Alpine Fault' as this one seemed much more violent than September's quake. There was no warning rumble as there so often is (the rumble being the audible vibrations associated with the primary-waves). I was walking along the street one minute and the next I was clinging on to the two strangers as we all tried desperately to stay standing.

I remember looking down at the ground, where I was standing on the tram tracks, and under my feet inch-wide cracks were opening in the pavement, and the tracks buckling up out of the ground. The shaking lasted for a few seconds but it seemed an eternity. I watched a large part of the cathedral fall in the first aftershock at 13:04, before the Central Business District (CBD) was evacuated. It remains so as I write this, a year later in February 2012.

A state of emergency was declared as hundreds of buildings collapsed, 181 people were killed and many injured. Urban Search and Rescue (USAR) teams, Civil Defense personnel, army troops and an endless stream of contractors with diggers, surveyors and engineers flooded into the city to start the rescue and then recovery phases. The state of emergency lasted until April when control was handed back to the City Council.

I walked home to find my house still standing, which was a relief. We had no water or power for a couple of weeks and portaloos on every street corner would become a normal sight for residents over the next few months as the sewer lines were also badly damaged.

BOULDERS

The day after (23 February) I was contacted by USAR to help with geotechnical assessments and inspections. Initially I was responsible for monitoring a large landslide of approximately 1.3ha, where 500mm-

Plate tectonics map of New Zealand and terrain map of the Canterbury and Banks Peninsula area showing the position of Christchurch on the flat plains and the flanks of the Lyttelton Volcano bordering the south of the city

Cliffs at Whitewash Head, Christchurch showing the stratigraphic layering between the basalt, ash and agglomerate layers

Cracking across the road marking the scarp of a 1.3ha landslip. Cracking extends approximately 200m to each side of the photograph

6m³ boulder that had snapped a mature pine tree on its way down the hill as if it were a matchstick. Estimated to be approximately 15 tonnes

Boulder inundation to the rear of a property

Temporary bolts cables and mesh to retain loose boulders

wide cracks had opened up, marking the potential scarp of a large slip threatening the main road that provided the only access to hundreds of houses. This kept me busy for a few days until we had established that it was not creeping and therefore not at a high risk of imminent failure. The monitoring continued and we have since observed that movement is only activated in large seismic events.

A huge number of rockfalls from multiple exposed bluffs tumbled down the hillsides of the Port Hills to the south of the city. Cliffs had collapsed, and outcrops had shed boulders. Roads were blocked by rockfall and many houses had been hit. The initial response by USAR teams had been to evacuate people from houses at imminent risk. Following on from this, over the following months we were able to identify the rockfall source areas and in many cases found further houses at risk requiring the residents to be evacuated.

RESPONSE

Assessing the geotechnical damage and prioritising the emergency work was a huge task. Geotechnical engineers and engineering geologists in the city met every morning before heading out into the field in order to coordinate the day's work. Quickly, an overview of the damage was obtained and we discovered the huge extent over which the rockfall had occurred. The volume was unprecedented because the 'design earthquake' only had a PGA of nearer 0.3g. The February earthquake had a horizontal PGA of 2.2, over twice the force of gravity and around five or six times larger than expected. Consequently, structures had not been designed for such huge shaking; rockfall bunds were filled and overtopped, catch-fences were at worst flattened, at best badly damaged - though many did stop some boulders.

In the months after February, the Port Hills area was divided up and sections assigned to various consulting engineers. Initially we undertook a thorough inspection of the sections. Teams of engineering geologists covered the Port Hills area equipped with cameras, measuring tapes, tablet PCs - and quick wits. Tablet PCs were found to be invaluable as the boulders could be mapped and their various details entered digitally, with accurate GPS locations (obtained via 3G as well as GPS) and the data uploaded in real-time ▶

to the main GIS server. In total 10,000 boulders have now been mapped over the Port Hills area.

In one instance I counted 45 boulders in the garden of a 43m-wide property; another six had gone through the back wall into the rear rooms. In other places boulders had entered through the first floor wall of a house built into the hillside, through the internal floor, out the front wall and ended up wedged into the neighbouring house below. Another landed in someone's bed. Boulders ranged from fist-sized cobbles to large boulders of c. 35 tonnes, although the mean size was around 0.7m^3 – or c. 1.75 tonnes.

REMEDIATION

Many boulders we mapped presented an imminent risk to roads or houses below. Work progressed on prioritising the infrastructural 'lifelines' (main roads, pipelines, substations etc). With the lifeline routes secured albeit temporarily, work could then commence above residential areas to try to get people back home again.

The boulders were stabilised in a variety of ways - from the ideal method of scaling (where safe) using a crow-bar to lever the rocks off and rolling them down. This method was ideal above roads where temporary closures could be implemented and large areas of the hillsides secured quickly. If the boulders were too big to scale, they were blasted into smaller pieces and either scaled or distributed across the slope in stable locations, ie tabular rocks laid flat. Where blasting was not feasible, unstable areas were bolted and tied back. These are temporary works and will have to be re-visited in the long term to increase the robustness of the measures. By June 2011, the remediation of some areas were nearing completion. Unfortunately Mother Nature had another little trick up her sleeve.

HERE WE GO AGAIN

On 13 June at 1300, a magnitude 5.5 struck. The shaking was significant enough for a few things to fall over in the office and for us to head out and do a quick check on the main lifelines - where nothing too major seemed to have occurred, other than a large tension crack in the cliff above the main road. I had just arranged to get half the road closed and the traffic clear before 1400 when a magnitude 6.3 struck, this time with a PGA of 2.13g. This time the epicentre was located on the coast to the east of the city, just a few metres from where I was standing, at the base of a 75m high cliff. A huge collapse occurred, as several thousand cubic metres of rock - 15 horizontal metres of the cliff top - fell down, together with half a house. That was the fastest I ever expect to have to run, in my life.

Hearts across the city sank as a combined groan of "here we go again" went up. Our daily geotechnical morning meetings recommenced (we had dropped them back to twice a week) and we had to re-inspect the whole of the Port Hills area again.

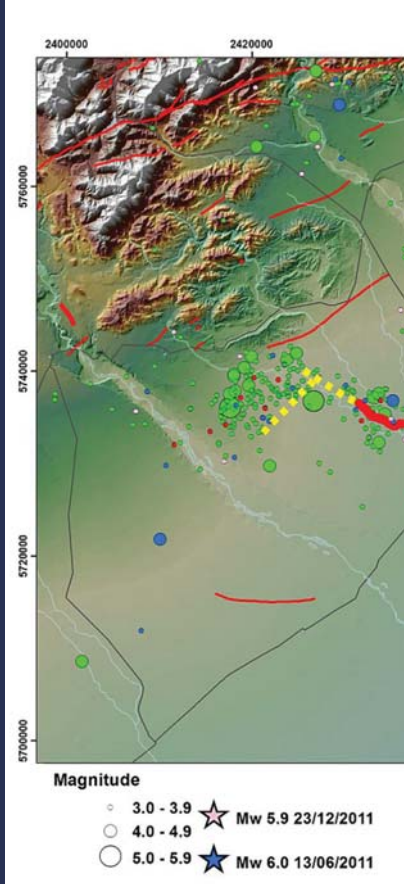
From a rockfall perspective, the June earthquake was more damaging than the February one in the eastern part of the Port Hills. Tens more houses had to be evacuated due to new cracking, generally at cliff-top settings. More rockfall was observed, and some boulders that had not moved previously were now at a high risk of imminent failure. The landslide that I had initially monitored in February moved another 500mm or so, and new cracking opened in new areas leading to a growing concern of new landslides developing.

The June earthquake set us back a long way in our attempts to remediate rockfall in the hills. Following the earthquake all boulders across the hills were re-mapped and evaluated. In some areas where remediation had been completed no further rockfall was observed. This was some much-needed morale-boosting news! Rockfall that did occur was, in places, very directional - in that the June fault-line was oriented approximately north-south. In one valley close to the epicentre, there was very little new rockfall on north-western slopes but over 200 additional boulders on eastern slopes. The predominant shaking was northwards; so on the north-western slopes, boulders were 'pushed' into the hillside while on the south-eastern slopes they were 'pushed' out.

AFTERSHOCKS

In the six months from June to December we experienced only six aftershocks greater than magnitude 5.0, and things calmed down quite quickly. Following the June quake, we started to use ballasted shipping containers as a quick solution to protect roads from rockfall. They have been extensively used in the CBD to provide protection from unstable buildings. As a rockfall measure, they have also proved very effective.

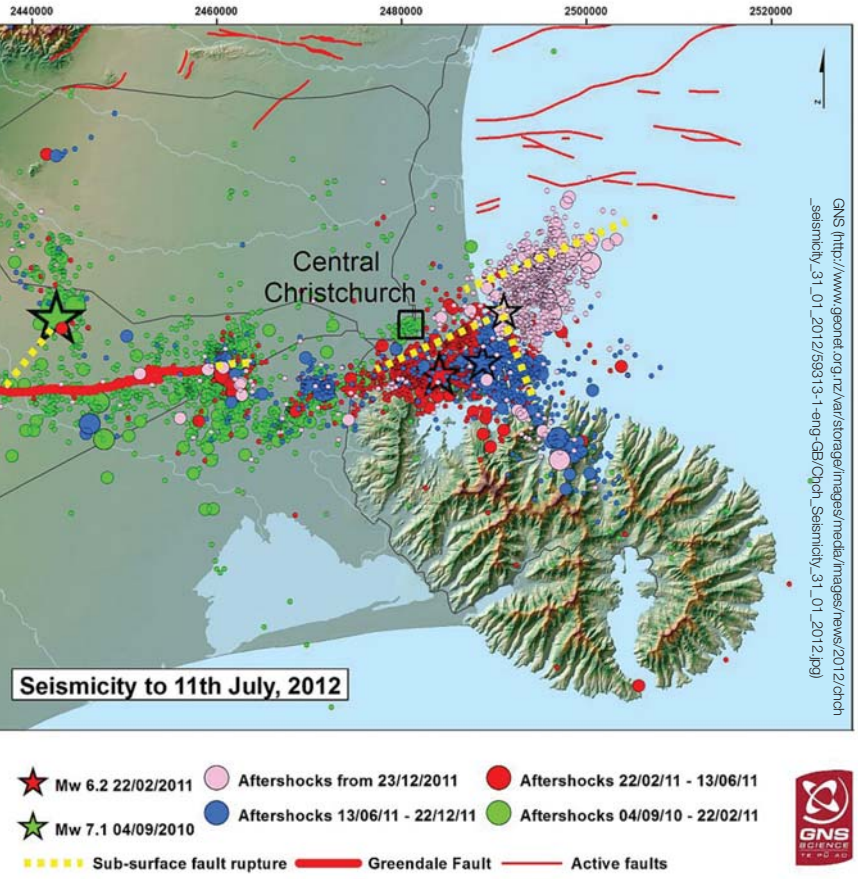
Twenty-eleven had been a hectic year



Mapped summary of the earthquakes and aftershocks

Trace of a 2m^3 boulder through a house and out the other side. Note the bounce mark in the foreground

Peacock's Gallop Cliff after the February earthquake



Approx. 2m^3 boulder that came in through the roof and landed in a bedroom

Peacock's Gallop Cliff after the June earthquake

and we were all looking forward to a well-earned break over Christmas. The office end-of-year barbecue was in full swing on the last Friday before Christmas when it was disrupted by yet another earthquake, this time a magnitude 5.8. I could see the surface waves travelling through the office car park as the whole ground surface took on a movement akin to sea swell. The engineering geologists and structural engineers immediately donned high-viz jackets and boots, turned on flashing lights and headed off to yet again check on the state of the main lifelines.

Half way through inspections, we experienced a magnitude 6.0 with a PGA of 1.0g. This quake was centered on another new fault, this time offshore. Large dust clouds were produced as the cliffs yet again failed. Since then, as of 21 February we have had 654 aftershocks, six of which have had magnitudes greater than 5.0. We were back into a phase of re-assessment of the whole area; however there was little damage in new areas and the temporary works in place were unaffected. The shipping containers retained the debris from the new cliff collapses and new boulders generally fell in high-risk areas already evacuated or cordoned-off. The system is therefore working.

Rockfall is just one effect of the earthquakes. There has also been significant liquefaction with each new aftershock, and several thousand tonnes of silt have been removed from the city. Vast areas of residential land have been written off, while whole suburbs are having to relocate. A huge percentage of buildings in the CBD are currently being demolished (cover picture).

Who knows what is in store for Christchurch? We can only guess but I hope that this is the end of the story - and that I will not be writing 'part two' in another year's time. ■

* As of 4 July 2012

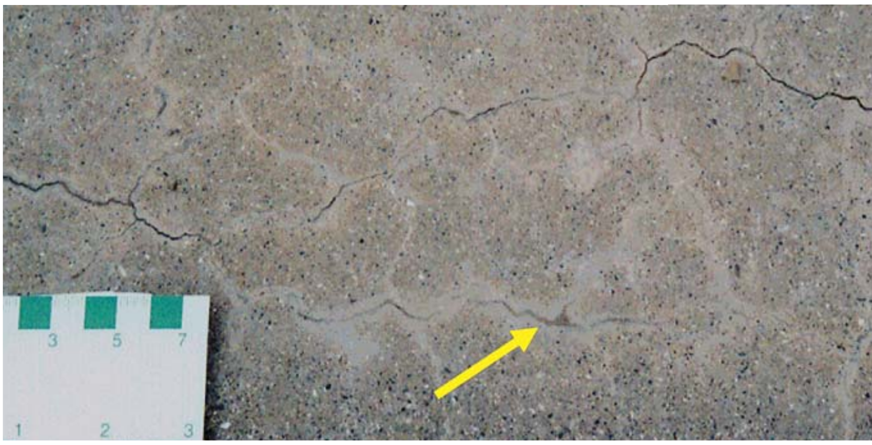
** **Camilla Gibbons** is a Senior Engineering Geologist with Aurecon New Zealand Ltd, living and working in Christchurch. She was made 'New Zealand Young Engineer of the Year' in 2011

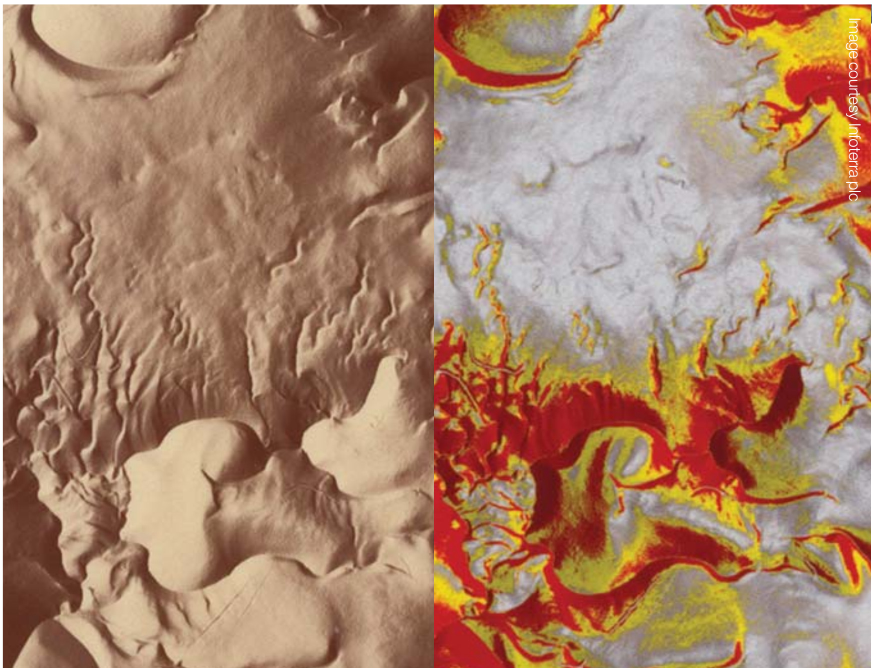
FURTHER READING

- www.geonet.org.nz/canterbury-quakes
- www.christchurchquakemap.co.nz

DESERT SONG

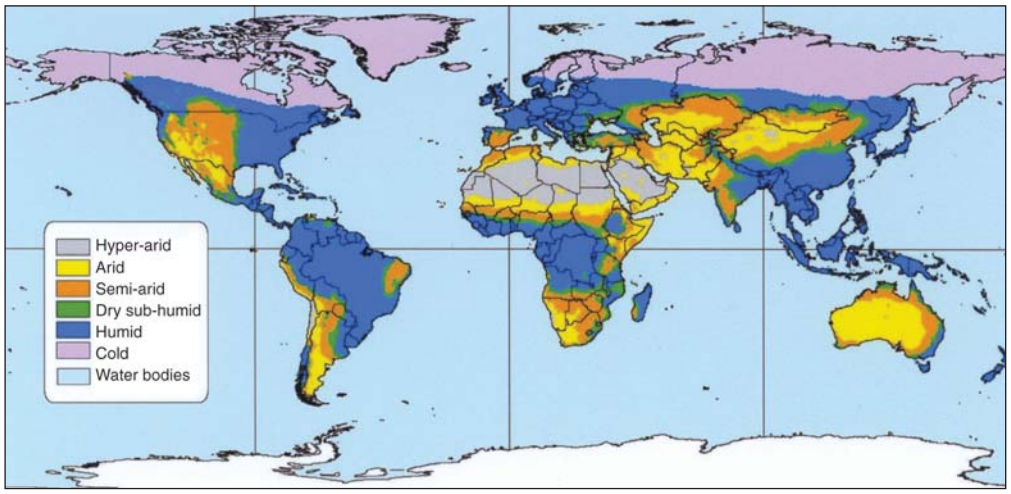
Ian Sims, John H Charman, Mike J Walker & Graham West*
introduce the latest Engineering Group Special Publication





During the last half century, much of the world's most intense development and civil engineering construction has taken place in the geologically hostile conditions found in the hot desert regions. In March this year, the Geological Society published *ZZ'Hot Deserts: Engineering, Geology and Geomorphology'* (Engineering Geology Special Publication No 25), in which hard-earned experiences from a range of engineering and geoscientific disciplines have been brought together in a state-of-the-art handbook.

A plan for this major new instrument for practising civil engineers, geologists and geomorphologists started taking shape 10 years ago, when the Engineering Group formed a steering committee, chaired by Professor Peter Fookes, to consider a handbook on hot deserts to complement the existing guidance on tropical residual soils (Fookes 1997). Peter was the ideal inspiration and guide for this project, having spent more than 30 years helping to explain and understand the challenges of construction in hot desert regions (Charman 2008) and having completed, as Chairman, the final volume in the trilogy of working party reports on geomaterials in construction (Reeves *et al.* 2006, Sims 2006).



Above: Desert areas of the world

Left (clockwise from top): Sand deposition on a road surface and measures to control sand movement

Typical map cracking of concrete caused by alkali-silica reaction

Example of using LiDAR-generated Digital Elevation Model (DEM) for sand dune morphology and trafficability assessment (left: artificial sun-shading, right: slope steepness, with red indicating >20°)

Aerial view of sabkha lagoons, Abu Dhabi

WORKING PARTY

The Working Party first met in late 2003, under the Chairmanship of John Charman, who led a multidisciplinary team of desert specialists drawn variously from engineering and geoscience backgrounds and representing commercial, consultancy and academic activities (see online version). An invaluable aspect of the report's compilation was a thorough process of regular peer review as the chapters took shape. The Working Party had regular face-to-face meetings for five years, where issues were thrashed out and chapter drafts openly discussed and improved. Therefore the whole Working Party is jointly responsible for every chapter in this handbook.

Along the way, the Working Party received help from many acknowledged correspondents and benefited from a dedicated session at the International Association for Engineering Geology Congress in Nottingham in 2006. Once the report/book had been compiled and edited, Professor Sir Ronald Cooke, a renowned geomorphological pioneer in desert regions honoured the Working Party with a Foreword, concluding: *"This comprehensive, state-of-the-science review successfully brings together the experience gained over recent years of many engineering geomorphologists and geologists into one volume. It integrates knowledge of the landforms and the processes that have worked on them over time with studies of the nature and behaviour of materials, appropriate techniques of analysis, and guidelines for the choice of engineering designs, construction methods and materials. It should be an essential guide to all who seek to develop land in hot deserts."*

When we reached the end of our main 'face-to-face' compilation period in 2008, prior to the lengthy process of detailed editing, the Working Party unanimously agreed to dedicate the volume to Peter Fookes. As well as being timely recognition of his tireless support for the Engineering Group and many of its members individually, this was also appropriate because of his unrivalled contribution to the partnership between geologists and engineers in understanding, confronting and ultimately solving the many challenges facing successful construction in hot desert regions.

The handbook can be used as a reference work, aided by a detailed index, an extensive specialised glossary distilled from the various chapters, and extensive reference lists supporting each chapter. However, it can equally be used as a textbook, for work, education or – we hope - just for pleasure! To these ends, following a scene-setting introductory first chapter, the report is structured into three main themes: Geological and geomorphological background (Chapters 2 to 4), Investigation and testing (5 to 7) and Engineering behaviour (8 to 10): (See online for more detail). All chapters are copiously illustrated, including many images and diagrams in colour, courtesy of generous sponsorship from Arup, Fugro and Fugro-Suhaimi.

Professor David Nash leads off in Chapter 2 with a geographical overview, including the distribution of hot deserts, causes of aridity, controls over diversity, and discussion of past and future changes. This review is complemented by an extensive account of desert processes and the landforms they create in Chapter 3, from Professor Jim Griffiths and his team. Processes are presented in four categories: weathering and duricrust formation; wind, sand and dust; fluvial; and subsurface water, salts and aggressive ground. ▶

Example investigation of a sand & gravel deposit: showing the gypcrust surface, exhibiting 'tension polygons'

A section through the tension crack filled with gypsum-rich sand

Loose aeolian sand leading to poor 'trafficability' for off-road vehicles

EARTH SYSTEMS

An important theme of the report was to review, update and apply the existing desert ground models, including those pioneered by Fookes & Knill in 1969 and still widely used. In Chapter 4, after a review of desert models and hazards, an 'Earth Systems' geomodel is proposed, based upon desk study and mapping data, which can be used to devise site-specific models, for further refinement by actual ground investigation. This new scheme is supported by nearly 40 superb colour images. This section of the report could well be used as a field guide to the identification of desert landforms and features.

Three chapters on investigation and testing seek to avoid being a mini 'site and ground investigation' textbook, and aim instead to provide particular information and guidance that will be relevant to work in hot desert regions. In Chapter 5, Dr Martin Stokes and his team explain the distinct characteristics and classification of hot desert soils and rocks, including their relationship to the desert model, and propose a scheme based on an extension to the respected Atkinson recommendations.

In Chapter 6, David Shilston explains the adaptation of desk study and phased field evaluation techniques to hot desert conditions, especially relating such investigations to the conceptual ground model. A section on remote sensing is provided by specialist corresponding co-author, Dr Richard Teeuw. All this is helpfully supported by examples of some new techniques and short case histories. Finally, Roger Epps in Chapter 7 describes the application of detailed ground investigation and testing methods to hot desert locations and materials, again including actual examples and case studies, plus a very useful appendix, giving guidance on the ways in which standard tests and/or their interpretations can be affected by hot desert conditions.

CONSTRUCTION

The final three chapters give guidance on the application of the

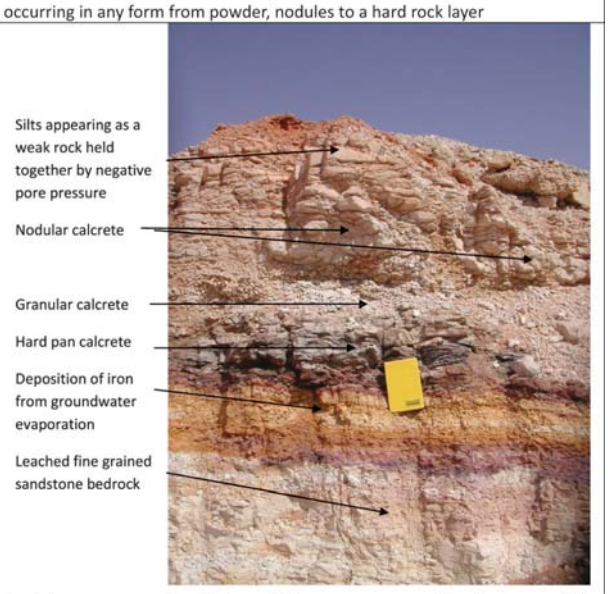
earlier-defined characteristics and models to actual engineering behaviour and applications. Professor Matthew Coop, in Chapter 8, explains the ways in which desert soils can respond to construction activity, including mechanical properties, moisture and saturation issues, variously collapsible, expansive or salt-bearing soils and cemented soils. In Chapter 9, Dr Alan Poole leads on a wide-ranging and well illustrated assessment of construction materials in deserts, including rock, stone and armourstone, aggregates, road-making materials, concrete and mortar, traditional materials including bricks, recycled materials and water. Details are often provided separately in text-boxes, such as an account of alkali-aggregate reaction.

Philip Dauncey completes the final part of this theme (Chapter 10), by considering engineering design and construction in hot deserts. Major types of construction are addressed in turn, including earthworks, foundations, roads and pipelines, coastal development (dredging, reclamation & shore protection), concrete structures and traditional construction, such as adobe. This chapter also addresses some of the practical effects of - and responses to - key desert hazards to construction, including flooding and erosion, groundwater changes as a consequence of development, and wind-blown sand.

We believe that this long-awaited handbook has achieved its objectives and should act as a helpful guide and authoritative reference. At some stage, as with previous reports of this type, it is probable that a new Working Party will be formed to revise, amend and improve sections in which understanding has advanced and, above all, add new experience and newly developed techniques. The Engineering Group therefore welcomes any feedback! ■

Right: Sections of the new SP can be used as a field guide to desert landforms and features

Below: Cover of the new Handbook

Landform: name and descriptions	**Duricrust:** Calcrete – predominantly calcium carbonate enriched soil horizon occurring in any form from powder, nodules to a hard rock layer
Image/plan: Trial pit in central Sahara (Photo J S Griffiths)	
Form/topography	Can form a near surface hard rock layer up to many 10s of metres thick overlying a softer layer of weathered soil/rock. Removal of overlying soil through water and wind erosion leads to the calcrete being exposed at the surface
Processes	Displacive and/or replacive introduction of vadose or phreatic carbonates within a weathering profile in areas subject to high rates of evapotranspiration
Potential Resources	Most forms of duricrust are potential sources of aggregate but may need blasting and/or ripping and crushing, or ripping and screening without crushing. Provides random or select borrow material
Nature of hazards	Continuous duricrust horizons are likely to need ripping or possibly blasting for excavation. Underlying horizons can be significantly weaker creating an inverted bearing capacity profile that can be difficult to manage in areas where significant earthworks are involved. Gypsum contamination may be possible
Special SI features	Need to ensure borehole sampling system can deal with the strong duricrust overlying a weaker leached layer; deposit may be locally very variable which needs to be identified in the SI; aggregate suitability tests, including sulphate content

A meeting on *Hot Deserts: Engineering, Geology and Geomorphology* will be held on Thursday 4 October 2012, 10.30-16.45, Burlington House. Fee: £80 for GS members. See website calendar

* **Ian Sims** Secretary, Hot Deserts Working Party (HDWP), & Director, RSK Environment Ltd: **isims@rsk.co.uk; John H Charman** Chairman, HDWP, & Consultant: **geojohn@sky.com; Mike J Walker** Editor, HDWP & Consultant: **mj.walker@tiscali.co.uk; Graham West** Engineering Group Representative, HDWP

FURTHER READING

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- **Charman, J H** 2008: Peter George Fookes: father of modern British engineering geology? *Quarterly Journal of Engineering Geology and Hydrogeology*, 41, 201-216
- **Fookes, P G** (ed) 1997: *Tropical Residual Soils: a Geological Society Engineering Group Working Party Revised Report*, Professional Handbook, Geological Society, London
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- **Walker, M J** (ed) 2012: Hot deserts: *Engineering, Geology and Geomorphology - Engineering Group Working Party Report*, Engineering Geology Special Publication No 25, Geological Society, London 424pp

READERS' LETTERS

Geoscientist welcomes readers' letters. These are published as promptly as possible in *Geoscientist Online* and a selection printed each month. Please submit your letter (300 words or fewer, by email only please) to **ted.nield@geolsoc.org.uk**. Letters will be edited. For references cited in these letters, please see the full versions at **www.geolsoc.org.uk/letters**

WAGER AND EVEREST

Image: © David Evison / Shutterstock.com

Sir, Geoff Glasby's letter 'Worth a Wager' (*Geoscientist* 22.06 July) raises the question of Wager's exploits on Everest in 1933. I have already this year (in *Geology Today*) discussed the fact that all of L R Wager's mountaineering exploits were undertaken as a University of Reading employee, as was his classic Skaergaard work.

Recently I have been privileged to talk with David (E A) Vincent (who succeeded Wager in the Oxford Chair) about the Reading Department of Geology during the 1930s. David was an undergraduate at Reading 1936-39 and read Geology as a subsidiary to Chemistry. Wager's daughter Jane Hargreaves in 1991 compiled a privately published biography of her father (*L R Wager - A life* 1904-1965, Oxford, 141pp). She writes (p27): 'Professor Hawkins and the University had great foresight and generosity in granting leave of absence amounting to about five years in the 10 years that LRW was at Reading'.

Chapter seven is devoted to the 1933 Mount Everest Expedition and quotes extensively from Wager's diary. It records that on May 27 he was at Camp Four and on the following day Wyn Harris, Bill Mclean, Jack Longland and Wager climbed up to Camp Five along with 12 porters. On May 29 the porters, Harris, Longland and Wager climbed the steep rocks of the 'yellow band' and then dug a platform at 27,200 ft for a tent. Wager and Harris stayed while the others descended to Camp Five.

On May 30, the day of the summit attempt, the steep or overhanging 'grey limestone band' frustrated their progress and finally 'a little couloir of powder snow stopped us and decided us that we should turn back' at some 28,100 ft. On the return, Harris picked up Mallory's ice axe, which had been found on the ascent, and Wager independently climbed a ridge to gain a view of the SE face. Arriving back at their overnight camp Frank Smythe and Eric Shipton were waiting. All four descended to Camp Five. The following day they reached Camp Four and were welcomed by Jack Longland and others. Later Shipton and Smythe failed to get any further towards the summit.

Peter Worsley

Sir, I was interested to read Geoff Glasby's letter (*Geoscientist* 22.06 July) about the altitude reached by members of the 1933 Everest expedition. On their summit bid Lawrence Wager was accompanied by Percy Wyn Harris and, attempting to outflank the Second Step, reached a height of around 28,100 ft before turning back because of unstable snow conditions (rather than a holdless rock slab). Frank Smythe, climbing solo, reached the same point the following day. Dr Glasby is correct about my father Jack Longland; his high point was Camp VI at around 27,400 ft.

Incidentally, Lawrence Wager was invited to my wedding in 1968 and, having just embarked on a research project into two-layered gabbro intrusions on the Isle of Mull, I was greatly looking forward to meeting him. Unfortunately he died from a heart attack that morning.

Nick Longland

Sir, During the 1933 expedition, Harris, Wager and Smythe reached a height of c. 28,100 ft on the North Face from Camp Six at 27,400 ft. Longland had a crucial role in charge of the porters and returned with them down to Camp Five under atrocious storm conditions which, without his leadership, could have resulted in loss of life.

Harris and Wager made the first summit attempt on 30 May. They reached their highest point at 12.30 pm with Harris leading and Wager in support "precariously balanced on a slab affording no belays" and Wager "could not possibly hold him should the snow slip away". They retreated to Camp Five but carried out further exploration of ridge and North Face alternative routes, including Wager reaching the main ridge. Did this afford him the opportunity to collect the samples mentioned by Glasby and thus achieve a record for high altitude sample collection?

Meanwhile the second summit party, Smythe and Shipton were confined to Camp Six by blizzard conditions on 31 May. Conditions improved the following day but Shipton was taken ill, leaving Smythe to continue alone, reaching the same point as Harris and Wager two days earlier.

Shipton, of course, took part in several later Everest expeditions and led the reconnaissance from the South side of Everest that identified the route successfully climbed by Hilary and Tensing in 1953.

He also led the 1957 Imperial College Karakoram Expedition, of which I was proud to be a member.

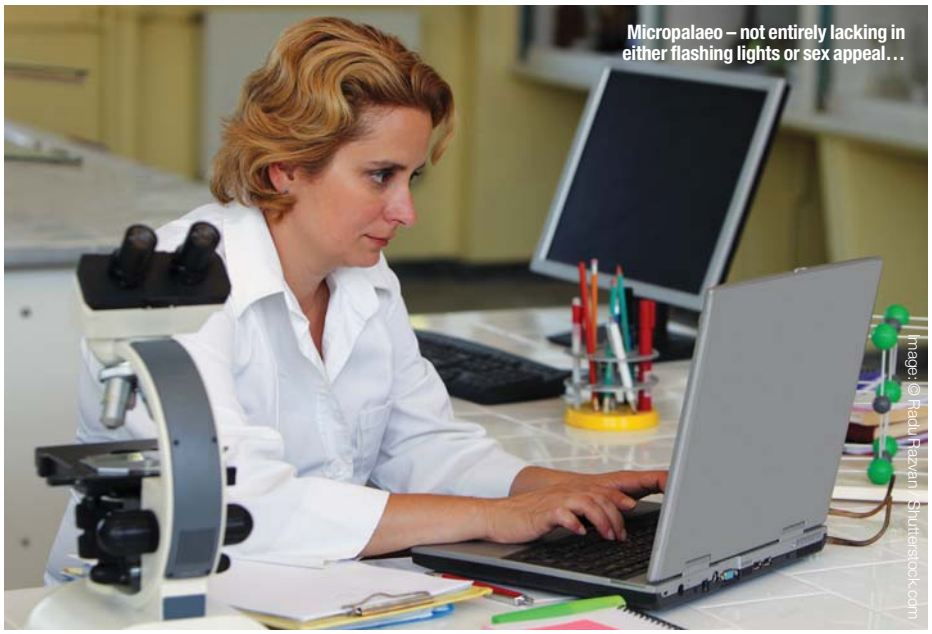
Roger Cratchley

MICROPALAEO WOE

Sir, I was dismayed by Cornelia Kohler's letter (*Geoscientist* 22.06 July) claiming that industrial biostratigraphy has failed to enter the 21st Century and needs to be 'reinvented'.

It is true that industrial biostratigraphy may lack flashing lights and sex appeal, but it remains an essential discipline in subsurface analysis and interpretation. Cornelia's views are precisely those that persuaded bureaucrats to axe the excellent MSc courses at Aberystwyth, UCL and Sheffield. The resulting shortage of well trained, experienced biostratigraphers is currently causing problems to those who recognise the value of this discipline.

Robin Dyer



Micropalaeo – not entirely lacking in either flashing lights or sex appeal…

Image: © Radu Razvan Shutterstock.com

Sir, As a biostratigrapher with 35 years' experience I found the letter by Cornelia Kohler (*Geoscientist* 22.06 July) ill-informed and patronising. The picture she paints of a failing discipline locked in the past could not be further from the truth.

The groups of fossils we use have changed (from ammonites to dinocysts for example); a greater understanding of taxonomy, and novel ways of characterising assemblages, have greatly improved stratigraphic resolution. Biostratigraphy has contributed greatly to our understanding of sequence stratigraphy, and demand is growing, as any overworked biostratigrapher will tell you. New techniques supplant old, but biostratigraphy has not stood still. For example, 'biosteering' is a relatively new technique which has revolutionised applied biostratigraphy and now keeps large numbers of us busy.

All industrial biostratigraphers worth their salt use sophisticated computer-based methods of recording and manipulating their data, and for integration with other geological disciplines. Indeed my own company has prospered for 20 years providing state-of-the-art software for this very purpose.

John Athersuch

Sir, As a semi-retired industrial micropalaeontologist I was annoyed by the rather dismissive comments by Cornelia Kohler. Micropalaeo in the oil industry is not in decline; it is required more than ever in increasingly complex oil plays.

Wellsite micropalaeo, the 'sharp end' of the business, requires a high degree of skill and experience to perform in an often crowded and noisy environment in 'real time', pressured by demands for information by the wellsite geologist and continually being interrupted in order to process the next sample. None of this can be replaced by new technology.

This job requires rather special people, but they need training - the key missing factor, as others have pointed out. This takes time. Years of experience are needed to sit confidently in the hot seat as the drill bit heads into the unknown.

Industrial micropalaeontologists do vital, unsung work. There just aren't enough of them. As a consultancy director said when we met by chance recently: "If you wanted to return to work, Chris, I could get you a job tomorrow".

Chris King

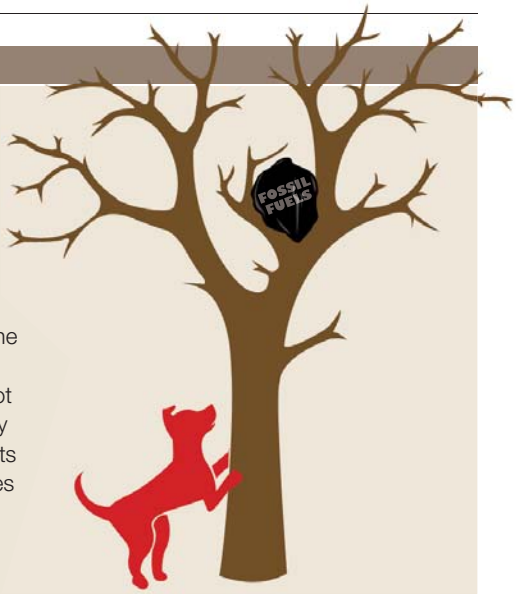
FRACKING UP THE WRONG TREE

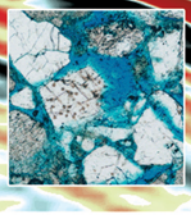
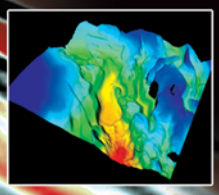
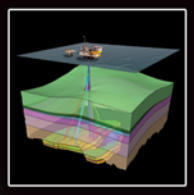
Sir, With reference to the recent letter by Prof. Styles (*Geoscientist* 22.07, August), I am afraid that if anyone thinks hydraulic fracturing ('fracking') is the answer, then they are asking the wrong question. I was unable to attend the recent public meeting at Burlington House but have now viewed it online. I do not see how the Society can admit (November 2010) that anthropogenic climate disruption is a real problem and yet fail to point out that burning all the Earth's fossil fuels simply because we can, will make it much more expensive to mitigate.

If burning fossil fuels is causing the Earth's climate to change, continuing to do it when we do not have to would not only be unwise - it would be illogical. Albert Einstein's definition of insanity was... "doing the same thing over and over again and expecting different results". Therefore, pursuing fracking would appear to be more than indicative of collective hypnosis or hysteria - it would appear to be insane.

I appreciate that government must initiate the phase-out of fossil fuels (as promised at the G20 Summit in Pittsburgh in 2009) but, is it not incumbent upon the Society to be intellectually coherent and consistent in the public statements that it makes? Just because we *can* frack does not mean that we should. In short, being in a hole, is it not time we stopped drilling?

Martin Lack



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Operations Geology Workshop

Friday 5 October 2012

Kings College Conference Centre, University of Aberdeen

Convenors:

Stuart Archer
University of Aberdeen

Nick Birch
Talisman

Chris Clarke
Talisman

Graham Dudley
BP

Mark Kingsley
ConocoPhillips

Peter Redpath
HRH

Tim Stephen
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Peter Williams
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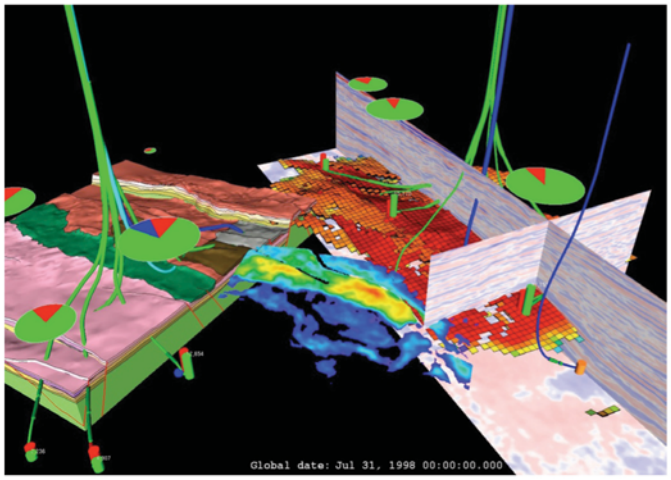

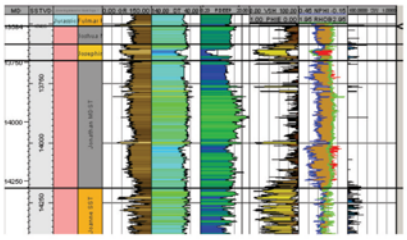

Operations geology is a critical function in the continuing wealth and health of the hydrocarbon industry. This conference aims to highlight the importance of the discipline of operations geology in the industry today. The conference will provide an opportunity to share best practices through case studies and in doing so will demonstrate the central role that the operations geologist plays as an integrating link between drilling engineers and geoscientists. The conference will promote operations geology as a viable long term career path and demonstrate its value to the industry.

- **NEW AND EMERGING TECHNOLOGIES** - including remote operations, geosteering techniques, visualisation and integration tools
- **TRADITIONAL DATA AND ANALYSES** - maximising value from conventional data such as mud logging, drilling and real-time data
- **OVERBURDEN GEOHAZARDS** - shallow gas, pore pressure, geomechanics and wellbore stability
- **PLANNING, PROCESS AND PEOPLE** - optimisation of the well planning process and how to ensure integration between functions during execution

Conference Sponsors:

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For further information and registration, please visit the conference website www.geolsoc.org.uk/gsl/groups/specialist/petroleum/operations12 or contact: Laura Hayward, Events Administration Assistant: +44 (0)20 7432 0983 or email: laura.hayward@geolsoc.org.uk

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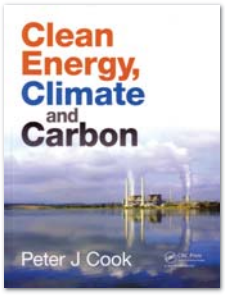


Clean Energy, Climate and Carbon

Peter Cook aims at the general reader as he explains why carbon capture and storage (CCS) is an essential part of the transition we must now make towards a low-carbon economy. He hits the target with clear text and fine coloured illustrations, quite decently proof-read (although that's 'Socolow' in Figures 5.7 and 5.8!). Cook tells us that his initial intention was to focus entirely on one technology, CCS. Then he decided that CCS needed to be put into context.

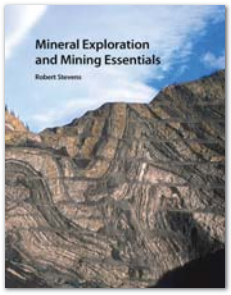
Our journey begins steadily, as this framework is set in the early chapters. We start with carbon dioxide and climate change. (Here more could have been made of the evidence from the geological record: you might consider taking the GSL 2010 statement out of your rucksack at this point.) Cook then reviews clearly our dumping of carbon dioxide into the atmosphere, the technological options for decreasing those emissions, and the mix of technologies required to achieve that reduction.

Cook has warned us that his "largely impersonal approach" will begin to break down in his final chapter: there are signs of things to come when the price of carbon erupts into a sober early discussion of the use of fossil fuels. The duty of setting the context has been honourably discharged by the end of Chapter 5. We now get stuck into CCS itself, nicely done in separate chapters on capture, transport and storage. Our journey picks up speed as we head towards the promised unleashing of Cook's unbridled opinions on the risks, costs and politics of CCS. Good punches landed include: "There are no technology 'show stoppers' for CCS" and "There needs to be a clear and strong policy directly linking a carbon price to clean energy development, otherwise there is no real carbon policy, just another speculative market."

I was fortunate enough to see at first hand something of the pioneering work on CCS that took place in BGS during Cook's Directorship in the 1990s, at a time when my academic and industry colleagues were showing little interest in the subject. Since then Professor Cook has led the Otway Project in Australia, an important step forward in developing CCS. These two notable achievements underpin the authority with which he speaks to us in this welcome book.

Reviewed by ***Bryan Lovell***

CLEAN ENERGY, CLIMATE AND CARBON
PETER COOK, Published by CSIRO Publishing 2011.
Pbk. ISBN: 9780643094857 232pp
List price: AU$ 39.95,
www.publish.csiro.au/pid/6467.htm



Mineral Exploration and Mining Essentials

The mining business is extremely complex and involves a wide variety of geological professionals working alongside others with technical skills. An overview of the industry, explaining concepts and bringing an appreciation of how its various parts link up, has long been needed.

This book has the wide-ranging ambition to fill this gap, and it does it admirably. Developed from course materials developed by the author to inform the business and investment sector, it should find a wider audience among the general public, where there is little understanding of the need for resources and what their development entails. It should also prove invaluable for students contemplating a career in the minerals industry, who may have studied the occurrence and formation of mineral deposits and exploration techniques, but perhaps not the rationale behind mining as a business, and its wider context.

The structure of the book is well thought-out, nine chapters following the 'Mining Life Sequence', following Exploration through Mining to Closure and Reclamation. Readers with a special expertise in any field may well find that to them the corresponding chapter lacks 'full technical coverage'; but this is to be expected and does not detract from the book.

The introductory chapter is followed by one on basic geology. Following this the Mineral Deposits chapter introduces 10 major types of ore deposit, covering precious and base metals, diamonds and uranium. Particularly useful here is the information on the distribution, range of size, shape, grade and tonnage, and mining techniques for each type. The next chapter, on Exploration Techniques, introduces aspects of economics, as well as a clear description of the main techniques.
The concepts of Reserves and Resources are clearly explained in the next chapter and here also is a very good explanation as to how decisions are made over the uncertainty of size and grade of a deposit and the probability of success (becoming a mine). The environmental impact of mining, sustainability and reclamation of sites are explained in the penultimate chapter. The final chapter provides suggested questions to ask when evaluating companies, together with a discussion on how to interpret company press releases.

This is a well written and illustrated overview of the mining business.
A particular strength lies in linking financial, technical and environmental aspects, giving the reader a clear picture of how and why things are done the way they are. Anyone reading it will have gained a very good introduction to the business and will be able to enter into informed debate on aspects of an industry which underpins our everyday life.

Reviewed by ***Bill Gaskarth***

MINERAL EXPLORATION AND MINING ESSENTIALS
ROBERT STEVENS, Published by: Pakawau GeoManagement Inc., 2010
ISBN 978-0-9867221-0-3 (pbk) 322pp.
List price: CA$99.95, www.miningessentials.com

REVIEWS: COPIES AVAILABLE

We have received the following books. Please contact **ted.nield@geolsoc.org.uk** if you would like to supply a review. You will be invited to keep the review copy. See Geoscientist Online for an up-to-date version of this list.

- **Applications of Palaeontology - techniques and case studies,** by Robert Wynn Jones. Cambridge University Press.
- **Ichnology - organism-substrate interactions in space & time,** by Luis Buatois and M Gabriela Mangano. Cambridge University Press.
- **Theory of Reflectance and Emittance Spectroscopy,** (2nd Edn) by Bruce Hapke. Cambridge University Press.
- **Astrobiology - a brief introduction,** (2nd Edn) by Kevin W Plaxco and Michael Gross. Johns Hopkins University Press.

PEOPLE

Geoscientists in the news and on the move in the UK, Europe and worldwide

CAROUSEL

All fellows of the Society are entitled to entires in this column. Please email ted.nield@geolsoc.org.uk, quoting your Fellowship number.

JANE PLANT

Jane Plant CBE, one of the world's leading geochemists, chief scientist of the British Geological Survey 2000-05, and Anglo American Professor of Geochemistry at Imperial College, London, has been elected a Fellow of the Royal Academy of Engineering.

GALEN WHITE

Galen White, of Resource Industry Consultants CSA Global, has been appointed Managing Director of UK operations. Galen, a geologist with more than 16 years' experience in the international exploration and mining industry, has been with the company since 2008 in a Principal Consultant role. He replaces Malcolm Titley, who remains with CSA Global as a Director and Principal Consultant, but who will focus on client activities and business development in Africa and Canada.

IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Chappell, Bruce *
Chapman, W T *
Dawson-Grove, Glascott Eyre
Hooper, Peter L *
King, Bruce *
Middleton, John *
MacLean, Ronald G *
Williams, Colin L *

In the interests of recording its Fellows' work for posterity, the Society publishes obituaries online, and in *Geoscientist*. The most recent additions to the list are shown in bold. Fellows for whom no obituarist has yet been commissioned are marked with an asterisk (*). The symbol § indicates that biographical material has been lodged with the Society.

If you would like to contribute an obituary, please email **ted.nield@geolsoc.org.uk** to be commissioned. You can read the guidance for authors at **www.geolsoc.org.uk/obituaries**. To save yourself unnecessary work, please do not write anything until you have received a commissioning letter.

Deceased Fellows for whom no obituary is forthcoming have their names and dates recorded in a Roll of Honour at **www.geolsoc.org.uk/obituaries**.

Online First

Publish-ahead-of-print system

Online First is a feature offered through the Geological Society's electronic content platform, the Lyell Collection. It enables Special Publication articles to appear online soon after they have been accepted for publication and ahead of the printed volume.

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Sponsor-a-Fish!

The Geological Society's Library needs your help with a new project to conserve and digitise one of the most important collections housed in the Geological Society's Archive: the fossil fish portfolio of Louis Agassiz (1807-1873).

Agassiz gained international recognition as the leading figure on fossil ichthyology after the publication of the five volume Recherches sur les Poissons Fossiles, lavishly illustrated with 400 lithographic plates of fish (1833-1843). In 1836 he was awarded the Geological Society's Wollaston Medal.

Comprising nearly 2,000 watercolours and drawings, these images of fossil fish, dating from the 1830s-1860s, were copied from private and public collections around Europe, principally by the German artist Joseph Dinkel. For many years the drawings were kept in a trunk in the Museum and later in different places around the Society. We would now like to make them accessible to future generations of researchers by conserving and digitising the entire collection.

How you can help

If you would like to help the Library and Archive in this project, a small contribution of £20 will allow us to carefully clean, conserve and digitise one fish. The names of all sponsors will be included in a roll of honour in the Archive and on our website. If you would like to make a more substantial contribution please contact us to discuss the options.

To make a donation or for more information: www.geolsoc.org.uk/sponsorafish

HELP YOUR OBITUARIST

The Society operates a scheme for Fellows to deposit biographical material. The object is to assist obituarists by providing contacts, dates and other information, and thus ensure that Fellows' lives are accorded appropriate and accurate commemoration. Please send your CV and a photograph to Ted Nield at the Society.

DISTANT THUNDER

Rock addicts

Geologist and science writer Nina Morgan discusses the geological obsession with possession

Collecting is a basic human trait that goes back a very long time. The urge to collect geological specimens seems to have evolved very early in human history - collections of Upper Cretaceous flint sea urchins have been found in association with prehistoric graves (*Geoscientist* 22.5 June 2012 pp14-19). Although collecting is a relatively harmless activity that can potentially enhance to store of human knowledge, it can lead to serious obsessions - not to mention storage problems. Just ask the mother of any geology student, as she struggles to prevent her offspring's growing rock/fossil/mineral/map collection from taking over the family home, and then, once the degree has been awarded, is faced with the even more difficult task engineering its removal.

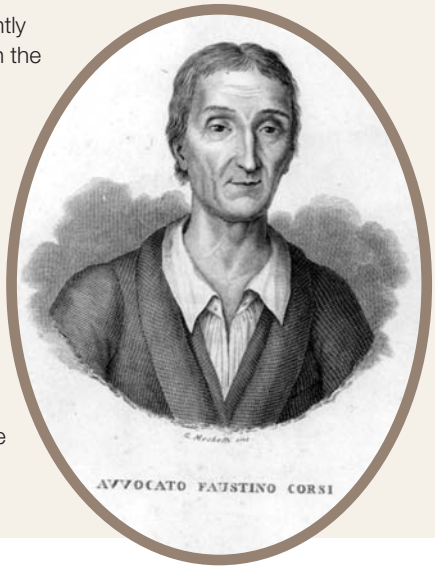
MARBLES

With that in mind, spare some sympathy for Mrs Corsi, wife of the Roman lawyer, Faustino Corsi. Corsi caught the collecting bug in the first quarter of the 19th Century. His obsession started innocently enough, with an interest in the antique and decorative marbles used in by the ancient Romans. But enthusiasm took over, and his collecting activities extended to obtaining samples of decorative stones used in Italian buildings from medieval to his own times.

Then he went on to add samples of decorative stones from sites as far afield as Derbyshire and America. By around 1826 Corsi's collection, described by William Buckland, first Reader in Geology at Oxford University, as "…quite unique in its kind, and such as is never likely to be made by any other individual…" included nearly 1000 large (approximately 15x7x4 cm) uniformly cut and polished specimens, all carefully numbered and arranged in geological order and accompanied by a comprehensive printed catalogue.

Then, suddenly, it seems Corsi deemed his collection was complete, and decided to sell. The specimens, along with all the available copies of the catalogue were bought by Stephen Jarrett, a wealthy Oxford undergraduate in 1827 for more than £1000. Jarrett donated the lot to Oxford University, where it is now housed at the Oxford University Museum of Natural History.

As for Corsi's motives for selling, one can only guess. But it's interesting to speculate that Mrs Corsi might have had a hand in influencing his decision. Imagine what it must have been like living in a second floor city centre apartment with an obsessive collector and his vast collection of stone samples. And to top it off, the sheer weight of the collection must certainly have posed a structural risk to an old building located in seismically active Italy.



Corsi's collection, in Oxford University Museum today

ACKNOWLEDGEMENT

This vignette was inspired by a talk given by Monica Price of the Oxford University Museum to celebrate the launch of a website documenting the Corsi Collection (see: **www.oum.ox.ac.uk/corsi**) which includes high resolution images and descriptions of all the samples as well as a copy and modern translation of Corsi's catalogue. Other sources include The Corsi Collection in Oxford, by Lisa Cooke and Monica T. Price, in *Asmosia 5: Interdisciplinary Studies on Ancient Stone*, Hermann, J.J. Jr, Herz, N and Newman, R eds, Archetype Publications, London, 2002 ISBN: I-873132-085, and *Decorative Stone: The complete sourcebook* by Monica T Price, Thames and Hudson, London, 2007, ISBN 9780500513415, and abstracts by Monica Price and Stuart Baldwin included in the abstracts for the talks and posters presented at the Conference on Geological Collectors and Collecting, April 2011 available free to download as a pdf file from **www.geolsoc.org/hogg** .

If the past is the key to your present interests, why not join the History of Geology Group (HOGG)? For more information and to read the latest HOGG newsletter, visit: **www.geolsoc.org.uk/hogg**

* **Nina Morgan** is a geologist and science writer based near Oxford

OBITUARY

STEVEN JAMES O'CONNOR 1951-2012

Petroleum geologist who worked on successful plays all over the world and was a renowned trainer and consultant

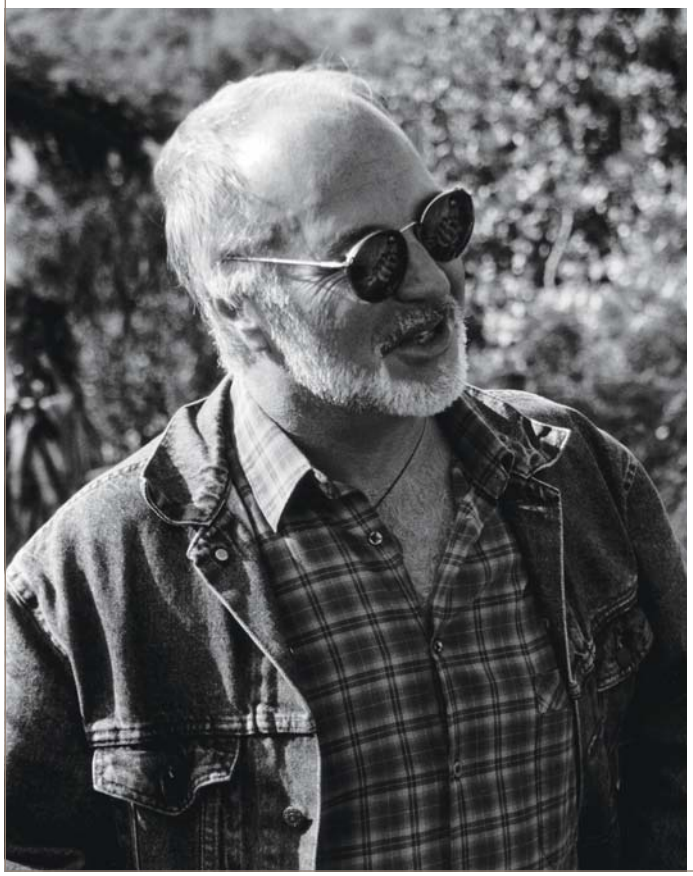
Steve O'Connor was a geologist in the petroleum industry for 35 years. He was a fellow of the Geological Society of London from 1979 and became a Chartered Geologist in 1992. He represented the society as a scrutineer for New Zealand applicants for Chartered status. He was a member of the American Association of Petroleum Geologists where he was a Certified Petroleum Geologist (1988).

Steve graduated from Leicester University with a 2:1 in Geology in 1974. In 1975 he joined the petroleum industry in Libya where he worked as a mudlogger for two years subsequently joining Conoco and the Oasis partnership working the Gialo Field. After a brief spell with Conoco in London Steve moved to the UAE in 1979 and would stay until 1983 working first for Conoco on the SW Feteh Field and then Amoco, drilling 14 successful wells on the giant Sajaa Field and drilling the South Juweiza discovery.

HOUSTON

May 1983 saw a move to Houston where he led an exploration team that made two gas discoveries in the Oman thrust system. From 1985 to 1993 Steve worked in London for Amoco. He led teams that worked most of the North Sea basins and that resulted in five New Field discoveries. He represented Amoco on the UKOOA sponsored revision of North Sea stratigraphy and became a recognised industry expert in the interpretation of pressure data, giving courses on the subject.

In 1994 Steve and the family emigrated to New Zealand and Steve took the position of Exploration Manager with Fletcher Challenge Energy where he stayed until 1999 overseeing the drilling of four discoveries. From 1999 to 2012 Steve was the Managing Director of Diligenz, a small geoscience consultancy providing high quality technical services to the New Zealand petroleum industry. Throughout his career Steve was driven by the desire for technical excellence and was the author or co-author of a diverse collection of 15 papers.



GUITARIST

Steve married Cheryl at the British Consulate in Tripoli in 1977. They have two loving children, a son Liam (29 years) and a daughter Kerry (27 years). Steve's enthusiasm for petroleum geology was eclipsed only by his love for music. He was an accomplished guitarist. He entertained expats in Libya and the UAE and could often be found with singer Cheryl entertaining the crowds at the Blues and Jazz festivals of New Zealand where they gained critical acclaim. Steve wrote the music for Cheryl's lyrics and they published four albums together.

> "STEVE'S ENTHUSIASM FOR PETROLEUM GEOLOGY WAS ECLIPSED ONLY BY HIS LOVE FOR MUSIC"

Steve fought cancer for nearly a year. He underwent surgery to remove a brain tumour in August of 2011 but sadly the condition returned early this year and was found to be inoperable.

Steven James O'Connor was born in Great Yarmouth on 15 May 1951. He passed away peacefully in his sleep in New Plymouth, NZ on 2 April 2012 with his loving wife Cheryl, his son Liam and daughter Kerry by his side. He leaves behind many friends in the oil and gas and music communities where he will be sadly missed.

By **Robin Crawford**

Editor writes: An extended version of this obituary is available online

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ENDORSED TRAINING/CPD

Course	Date	Venue and details
Geology of the Western European Alps	28 August - 9 September	The trip will involve the exploration of the tectono-thermal evolution of the Alpine orogeny including studies of high-grade metamorphism, deformation mechanisms, uplift and exhumation processes revealed in the Alpine molasse and Mesozoic palaeontology. **Fee:** £2500. GSL Fellows receive a 10% discount. Please mention when registering.
Structural Modelling and Analysis Using MOVE	25-27 September	This Midland Valley Exploration course, in Glasgow, is an introduction to the Move software suite and covers the geological theory behind Move. 10% discount for FGS; please mention when registering. **W:** www.mve.com/training/training.html or **E:** Sarah Davenport (events@mve.com).
Geotechnical and Geo-environmental Geophysics	27 September	Edinburgh. FUGRO. Free. Theory and application of the latest geophysical survey methods for engineering and environmental purposes. Free. **E:** s.poulter@fes.co.uk with contact details and indicating which course(s) you wish to attend. **W:** www.fes.co.uk
Cone Penetration Testing	28 September	Edinburgh. Free. Introductory course and technology update on Cone Penetration Testing theory and application. See website for other dates. Will also run on 14 December (Wallingford), 19 October (Nottingham), and 23 November (Exeter). **Contact:** Steve Poulter **E:** s.poulter@fes.co.uk **W:** www.fes.co.uk
Lapworth's Logs	n/a	'Lapworth's Logs' are a series of e-courses involving practical exercises of increasing complexity. 'Lapworth's Logs' provide training in applied geology for civil engineers, engineering geologists, environmental engineers, hydrogeologists, and anyone interested in ground modelling. **Contact:** info@lapworthslogs.com. Lapworth's Logs is produced by Michael de Freitas and Andrew Thompson. Price dependent on number of users/duration of licence.

DIARY OF MEETINGS SEPTEMBER 2012

Meeting	Date	Venue and details
William Smith Meeting 2012 Strata and Time: Probing the gaps in our understanding Geological Society	4-5 September	International conference to explore the relationship between the preserved strata of the rock record and the passage of time. See Website for details and registration. **Office contact:** Naomi Newbold **T:** 020 7434 9944 **F:** 020 7494 0579 **E:** naomi.newbold@geolsoc.org.uk
Young Geoscientist Papers Competition South East Regional	11 September	See Website for details. **Venue:** Bell Inn, Godstone, 1800 for 1830. **Contact:** Jon Race **E:** jrace@southerntesting.co.uk
The Geology and Mining of Ballclays in the Bovey Basin South West Regional	12 September	**Venue:** The Dolphin Hotel, Bovey Tracey, Devon TQ13 9AL. 1830 for 1900. **Speaker:** Andrew Deeming
Geological Model of HS2 Engineering Group	13 September	**Venue:** Burlington House. Evening meeting. **Speaker:** John Perry. See Website. **Contact:** John Perry **E:** John.Perry@atkinsglobal.com
The Geology of the Isle of Wight from the Waverly Paddle Steamer Solent Regional Group	See website	Field trip. For details see website. **Leader:** Andy Gale. **Contact:** Karen Allso (Secretary) **E:** karen.allso@ramboll.co.uk
Petroleum Geology East Midlands	See website	Venue: TBC. Evening meeting. **Speaker:** Dorothy Satterfield. **Contact:** David Boon **E:** dboon@bgs.ac.uk
Fermor 2012 - The Neoproterozoic Era; Evolution, Glaciation and Oxygenation Geological Society	19-21 September	**Venue:** Burlington House. See website for details and registration. **Office contact:** Naomi Newbold **T:** 020 7434 9944 **F:** 020 7494 0579 **E:** naomi.newbold@geolsoc.org.uk
Volcanoes and Man Geological Society Shell UK	26 September	**Venue:** Burlington House. **Time:** 1500 and 1800. **Office contact:** Naomi Newbold **T:** 020 7434 9944 **F:** 020 7494 0579 **E:** naomi.newbold@geolsoc.org.uk

OBITUARY

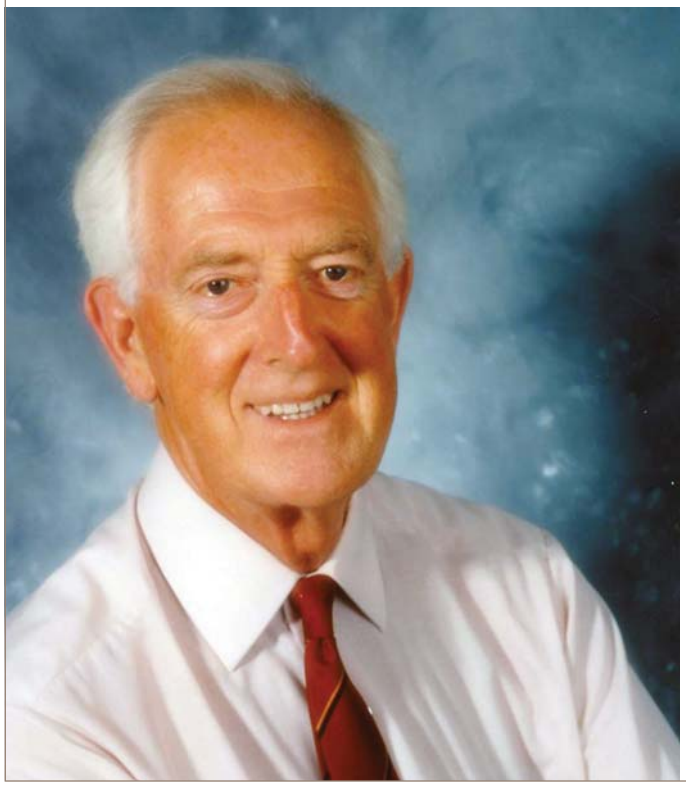
PETER GRAHAM HARRIS 1924-2012

Former Professor at Leeds noted for his mantle research, and as an outstanding Head of Department in Perth

Professor Peter Graham Harris of Leeds University and later of the Geology Department in The University of Western Australia (UWA) passed away peacefully in Perth on 25 February, leaving daughters Clare and Emma. Sadly, his wife Tessa had recently predeceased him.

Peter was born in New Zealand in 1924, entered the Victoria University College in Wellington, and gained his PhD at Leeds in 1953, becoming Professor of Earth Sciences from 1971-75. Some of his earliest work was on Tristan da Cunha, the main island of a group east of the Mid Atlantic Ridge opposite South Africa. When eruptions in October 1961 forced the evacuation of residents, the Royal Society sent him with a colleague to reconnoitre and check on the stability of the area. Party field work and extensive laboratory studies followed.

> HE ANTICIPATED THE SWING TO GENDER BALANCE IN SCIENCE, AND IS KINDLY REMEMBERED AS A RESULT BY MANY FORMER STUDENTS



KIMBERLITES

Peter later produced a stream of individual and joint papers about Tristan da Cunha, mantle rocks, Recent volcanism, the composition and genesis of magmas, the origin of kimberlites, the evolution of the Earth and related topics. These were published mainly between 1962 and 1975.

In 1975, he was appointed Professor of Geology at UWA. His background differed from those of most local staff, and his presence proved stimulating. He guided the research of others rather than continuing with his own, and managed the Department with energy and foresight. He felt that Departmental research on artesian water was slight for an arid region, and supervised some research students himself.

In 1982 diamonds were discovered at Argyle, Western Australia, and the Fourth International Kimberlite Conference was held in Perth in August 1986. Many local geologists were inexperienced in diamond exploration, and Peter helped organise an introductory two-day seminar in 1984 attended by 175 participants.

Senior University student groups at the time were overwhelmingly male. Female lecturers were few, and women were rare in geological surveys and mining companies. Female students, aware of their poor employment prospects, often did not persist. Thus, in a continent depending significantly on its complex geology, the science itself lacked the contribution of many potential researchers. Peter encouraged talented female students to remain, and tried to get finance and positions for them. He anticipated the swing to gender balance in science, and is kindly remembered as a result by many former students.

CONVERSATIONALIST

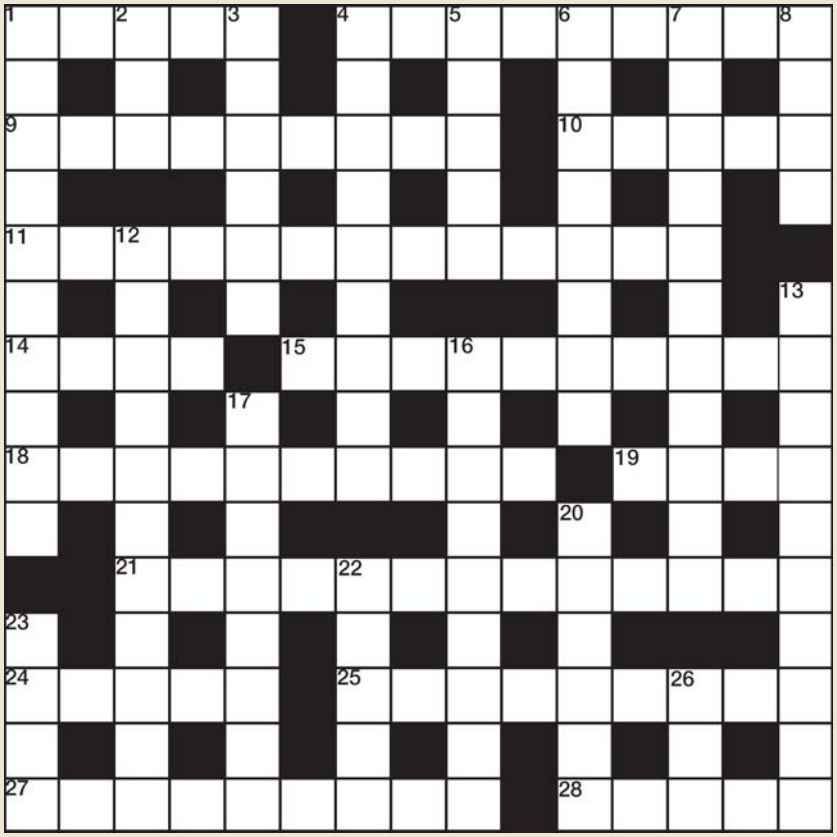
Peter was tall but quietly spoken, with a friendly approach. If as Head of Department he differed with another staff member, he generally managed to confine their differences while getting his way. He was made Dean of the Faculty of Science from 1985-87, and a member of the Academic Council and Deputy Chairman of the Academic Board.

Peter's background in the archaeology and history of the Maoris, and the early civilisations of the world with their use of minerals and rocks, was extensive. He was a fascinating conversationalist in these areas.

His even-handedness with staff, and sound judgement, helped him guide the diverse Department as a cohesive group. Scientific Departments are complex, and Peter's appointment was timely and singularly effective.

By John Glover

CROSSWORD NO. 161 SET BY PLATYPUS



ACROSS

1 Equipotential surface of the gravitational field of the Earth (5)

4 Impermanent, like a desert stream (9)

9 Cancelled out (9)

10 Offer counter argument (5)

11 Mixing by freezing (13)

14 Temporal equivalent of 'Upper' (4)

15 Portentous pronouncements (10)

18 Cave-dweller (10)

19 Only meat to occur with shales (4)

21 Pertaining to development of the egg and foetus (13)

24 Orientation seen in the geomagnetic dipole, for example, roughly speaking (5)

25 To pass judgement on, or censure (9)

27 Navy recruiting team of yore (5,4)

28 In between odds (5)

DOWN

1 When the twin plane changes the crystal orientiation to resemble a knee joint (10)

2 Petroleum (3)

3 Piles of wind-blown snow (6)

4 Departed old shores for new (9)

5 Genus of simple freshwater multicellular animal named for the multi-headed Lernaean (5)

6 Facies around the edge of a basin of deposition (8)

7 Acid messenger (11)

8 Ancient stringed fretted instrument of the Renaissance, descended from the near eastern Aoud (4)

12 Rare, massive granular or earthy version of cerian fluorite (11)

13 The happy condition of serving a worthy purpose (10)

16 Praising highly (9)

17 Small spheres (8)

20 Set aflame (6)

22 Nevadan mountain and long mooted nuclear repository, now cancelled (5)

23 Portable light (4)

26 The culprit in 11a (3)

WIN A SPECIAL PUBLICATION

The winner of the July Crossword puzzle prize draw was Catherine Isherwood of Stirling.

All correct solutions will be placed in the draw, and the winner's name printed in the November issue. The Editor's decision is final and no correspondence will be entered into. **Closing date - September 21**.

The competition is open to all Fellows, Candidate Fellows and Friends of the Geological Society who are not current Society employees, officers or trustees. This exclusion does not apply to officers of joint associations, specialist or regional groups.

Please return your completed crossword to Burlington House, marking your envelope "Crossword". Do not enclose any other matter with your solution. Overseas Fellows are encouraged to scan the signed form and email it as a PDF to **ted.nield@geolsoc.org.uk**

Name .....

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Membership number .....

Address for correspondence .....

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Postcode .....

SOLUTIONS JULY

ACROSS:
6 Bertrand **8** Ashlar **10** Ostler **11** Sapropel **12** Disasters **13** Lake **15** Systole **17** Alembic **20** Isle **21** Hexagonal **23** Mindanao **25** Ingots **27** Speech **28** Elements

DOWN:
1 Lens **2** Stalls **3** Odyssey **4** Pampas **5** Jade **7** Aerosol **9** Hoodlum **12** Dryas **14** Krill **16** Treadle **18** Lignite **19** Exposed **21** Honshu **22** Nugget **24** Imps **26** Tutu

INTERNATIONAL CONFERENCE

The Geological Society
serving science & profession

History Of Geology Group

ARUP

BSHS THE BRITISH SOCIETY FOR THE HISTORY OF SCIENCE

October 22nd-23rd, 2012

Appreciating Physical Landscapes: Geotourism 1670–1970

The Geological Society, London

Geotourism's burgeoning literature has tended to focus on descriptions and case studies of modern interpretative and promotional provision in protected areas and geoparks. The significant historical antecedents of modern geotourism in Britain and Europe are comparatively neglected in the literature. Whilst these antecedents can be traced back to the elite 17th century travellers who ventured into wild landscapes and visited caves and mines, early modern geotourism, with many of the features of its present-day provision, can be recognised if not so named from the opening of the 19th century. This latter period more than coincided with the emergence of modern scientific geology and the beginnings of excursion tourism; the organised publication of regional geology guide-books and geology field excursions followed from the first quarter of the nineteenth century. The conference's timeframe opens with the early reportage of elite travellers and the publication of the first travellers' guide-books and closes at the cusp of modern landscape and geoconservation measures, such as national parks, areas of outstanding natural beauty, national nature reserves, and the emergence of environmental interpretation and modern countryside leisure as forerunners to modern geopark provision.

Lithograph of Käse-grottee at Bad Bertrich from Dr. August Goldfuss' Naturhistoricher Atlas, 1826

Summary Conference Information

The conference is split between: a

Paper Reading Day (22nd October) with 2 Keynote speakers, 12 paper presentations, and a poster session. Registration (including Abstracts Volume, refreshments and wine reception); costs from £45-£65

Field-Excursion (23rd October) to the Isle of Thanet (including rail fare, guide, snack luncheon, and afternoon tea); cost is £45

For further information about the conference please contact:

Conference Office, The Geological Society, Burlington House, Piccadilly, London, W1J 0BG

T: 020 7434 9944 F: 020 7494 0579

E: naomi.newbold@geolsoc.org.uk

W: www.geolsoc.org.uk/geotourism12

Conference Organiser:

Tom Hose, *University of Bristol, UK*

gltah@bristol.ac.uk

Follow this event on Twitter #apl12

The Geological Society

serving science & profession

Careers Day 2012

Wednesday 7 November 2012

British Geological Survey, Nottingham

The Geological Society

Careers Day is the essential meeting place for geoscience students and the geoscience industry, where university undergraduates and postgraduates will have the chance to find out about the latest career options and talk to industry leaders about how they might gain entry into that sector.

The day will run from 10am – 4pm and will include presentations on careers, a CV writing workshop, an interview techniques workshop and an exhibition fair. The day will end with a beer reception.

Registration

This event is free to attend and covers all delegate material, lunch and a beer at the reception, but you must register for the event and the workshops must be pre-booked.

Contact Information

Naomi Newbold

Tel: 0207 432 0981

Email: naomi.newbold@geolsoc.org.uk

Web: www.geolsoc.org.uk/careersday12

Photograph: P Bucktrout (British Antarctic Survey)