

Geoscientist

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Regional Group
celebrates first decade

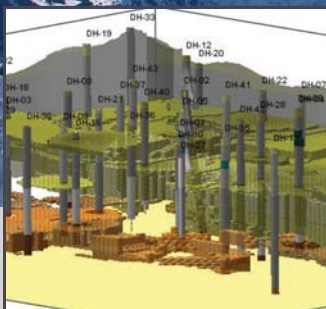
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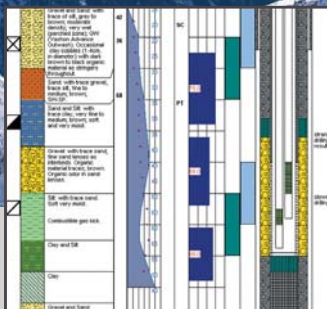


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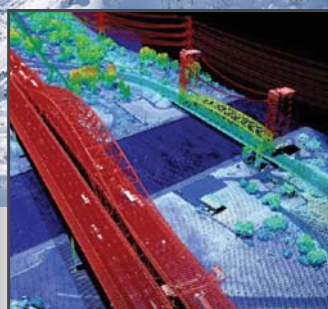


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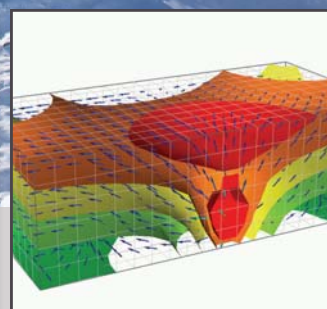


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Lyell Meeting 2012



Thursday, 29 March, 2012

'Big Palaeontology', The Geological Society, London

Large-scale projects, involving multidisciplinary geoscience teams from numerous institutions, are playing an increasingly important role in modern palaeontological research. This meeting will showcase the science being undertaken in these projects across the range of palaeontological disciplines, including key contributions from junior researchers. We will discuss the benefits and logistics of running these large-scale projects including funding, outreach and training opportunities.

Convenors: Drs Jeremy Young (UCL) and Tom Dunkley Jones (University of Birmingham)

Further information

For further information about the conference, please contact:

Ellie Duncanson-Hunter, Conference Office,
The Geological Society, Burlington House,
Piccadilly, London W1J 0BG

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F: 0207 494 0579

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W: www.geolsoc.org.uk/lyell12

Keynote Speakers:

Chris Stringer Ancient Human Occupation of Britain

Henk Brinkhuis IODP Wilkes Land Glacial History

Ken Johnson EU Indonesian Throughflow project

Bridget Wade Tanzanian Drilling Project

Wolfgang Kiessling PBDB – coral biodiversity

Paul Upchurch PBDB – Cretaceous vertebrate biodiversity

Mark Sutton Imaging and Virtual Palaeontology

Richard Twitchett Co-evolution of Life and the Planet

Richard Edmonds Jurassic Coast World Heritage Site

“GLOBAL DEMAND FOR NON-RENEWABLE RESOURCES PUTS NATIONS ON THEIR METTLE”

Front cover image: Carsten Reisinger / Shutterstock.com

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CHINA SYNDROME

For many years, any UK geology student interested in pursuing a career in metal mining has assumed that he or she would have to seek their future in – or under – foreign fields, and expect to burn their boats into the bargain. Not any more.

In October last year, the go-ahead was finally given to a new gold mine in Scotland. This occasioned great media interest – and surprise among people living beyond the villages and farms around Cononish, near Tyndrum (where they have been arguing its pros and cons for decades). Mining company Scotgold Resources now estimates that £50m of gold may eventually be recovered from their banks and braes of the Loch Lomond and Trossachs National Park.

The timing of this is clearly not unrelated to rocketing prices during a time of financial recession. But gold is far from the only metal shooting up in value. At the other end of the UK, at Hemerdon near Plymouth, Wolf Minerals will soon exploit one of the largest tungsten (and tin) resources in the western world. This new mine will provide security of supply for the UK, making it a net exporter by 2014 and directly creating 230 jobs. Metal mining is coming back home.

Both ends of the tungsten market are, as with so many strategic elements, dominated today by China. China dominates production; and not so long ago it flooded the market and prices tumbled. Now, China now consumes much of its output, forcing global prices sky-high. Hemerdon, producing 3000 tonnes per year, will be one of the biggest tungsten mines in the world, and help to restore some balance.

Tungsten is an example of a “strategic metal”, a shortage of which could prove economically and politically sensitive – especially when reserves are concentrated in just one or two countries. In our feature this week, Mark Tyrer (see p.14) explores emerging concerns over the supply of strategic metals and minerals – a concern which industry (and the Society) are attempting to bring to the attention of politicians in meetings and briefing notes (see p8).

Governments need to wake up to this. China enjoys many advantages, including immense mineral wealth; but another is that, uniquely, it is more or less run by engineers and scientists – rather than lawyers and professional politicians. Technocrats make up most of the Chinese politburo, and they are quick to grasp strategic scientific arguments. In a world where increasingly, China keeps all the strategic minerals that it produces for itself, the rest of the world must be on its mettle – and look to its rocks.



DR TED NIELD EDITOR

Dust busters

BY BRIAN MARKER AND HUGH DATSON

Mineral dust can be annoying and even hazardous. **Hugh Datson** and **Brian Marker** think the time is ripe for a UK meeting on monitoring and abating it



Mineral working gives rise to dust from extraction, handling, processing, transport, stripped areas, and waste tips and lagoons (especially in dry conditions). But it can be reduced through careful site, plant and equipment design, management and training. Even in the UK, despite all our planning, regulatory, health & safety constraints, we need to take a holistic approach to dust emissions at and beyond minerals sites.

It is not always obvious where dust comes from. The public may automatically blame a nearby quarry, while farming, roads, other industries or even natural sources as distant as North Africa may be overlooked. Establishing the origin and nature of dust deposits is therefore essential before effective action can be taken.

New best-practice guidance for the minerals industry (produced by AEA Technology for the Minerals Industry Research Organisation) sets out site-based strategies for dust management and control. To compliment this work, an evaluation of the impacts of dust beyond minerals sites is required.

When dust issues arise a number of questions follow. What is the source? What is its composition? How much has been

emitted? How has it been transported and deposited? Does it cause annoyance? Is it potentially hazardous to people, livestock, wildlife or crops? Who, if anyone, is responsible? What, if anything, should be done? Answering these questions demands good monitoring and sampling both at emission and deposition.

Until recently, it has been difficult to secure adequate representative samples. Questions have been raised about the validity of sampling protocols (such as BS1747(5)). Samplers located on site might measure dust that doesn't actually leave the site. Equipment beyond site boundaries might be tampered with. Care is needed in the transport, analysis and interpretation of samples, as well as calibration of data and interpretation. Models of dispersion require good data, at design stage, validation and subsequent practical use. Much work remains to be done on the health and environmental effects of dust emissions.

As understanding improves, it is wise to re-examine the fitness of planning and environmental permit conditions. We feel that the time is right to review the state of the art and would be prepared to organise a meeting if there is sufficient interest from the geological and minerals communities.

More widely, IUGS Commission on Geoscience for Environmental Management has set up a Working Group on Dust (www.iugs-gem.org/dust) to air geological dust issues, not just from mineral working, but more widely. The Group met at the 4th International Medical Geology Conference (Bari, Italy September 2011), has a session at the 34th IGC in Brisbane, Australia in June 2012 and is seeking others at the European Geological Union meeting in Vienna in March 2012.

▶ If you are interested in giving a presentation at or attending a UK meeting on this subject please let either **Brian Marker** (brian@amarker.freeserve.co.uk) or **Hugh Datson** (HughD@dustscan.co.uk) know and steps will be taken to convene a meeting as soon as possible

SOAPBOX

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).

“EVEN IN THE UK, DESPITE ALL OUR PLANNING, REGULATORY, HEALTH & SAFETY CONSTRAINTS, WE NEED TO TAKE A HOLISTIC APPROACH TO DUST EMISSIONS AT AND BEYOND MINERALS SITES”

Brian Marker & Hugh Datson

Cycle pathology

In the ever-intensifying quest to recognise climate-induced stratigraphic cyclicity in sedimentary rocks, false positives may be the norm, says **Simon Vaughan***

SEDIMENTOLOGY

Detecting Milankovitch-band (orbitally-forced) cyclicity in stratigraphic data holds out the tantalising possibility of time calibration. Most of such detections derive from statistical analyses of power spectra; but in a new paper Vaughan, Bailey and Smith¹ demonstrate that many (perhaps the majority) of those in the literature (generated by procedures that have become the standard) are false.

Stratigraphic data suitable for spectral analysis comprise measurements of rock properties taken at regularly-spaced intervals. The key question concerns the nature of the peaks in the 'red noise' power spectra that these data display. Do the peaks represent cycles, or chance fluctuations from the noise? Significance tests are then used to answer the question: "How unlikely is it that a peak in the observed spectrum was generated by the noise?"

“THE MAJORITY OF PUBLISHED REPORTS OF REGULAR MILANKOVITCH-BAND CYCLICITIES AND RESULTANT ASTROCHRONOLOGICAL TIME CALIBRATIONS ARE BASED ON STATISTICALLY UNSOUND DETECTIONS

Simon Vaughan

QUASI-PERIODIC

One problem in the detection of quasi-periodic (M-) forcing in stratigraphic data is the generally unknown relationship between stratal thickness and geological time. The question thus becomes: "Are there any cycles in the data?" Answering this means testing each of perhaps hundreds of frequencies in the spectrum; but despite using the canonical $p < 0.05$



Image: Christopher Jones / Shutterstock.com

threshold for detection, the multiple testing methods commonly used will result in false positives for almost any reasonably-sized dataset. This fact is easily demonstrated with cycle-free synthetic, random data. There are simple methods to correct for the effect of multiple tests, but these are not routinely applied in cyclo-stratigraphic analysis.

The result of the significance test is conditional on the null hypothesis model adopted for the noise in the data series. Apparent 'detections' will arise wherever the noise model differs significantly from the data, whether or not this difference arises as a result of cyclic variations or an undiagnosed mismatch between the noise model and the noise spectrum in the data.

The model most often used in cyclo-stratigraphic work is the autoregressive AR(1), a simple process characterised by only two parameters. It would be surprising if a wide range of different and complex sedimentary systems all generated variations with such simple statistical properties. Vaughan *et al.* demonstrate that real datasets often display power spectra rather different from the simplistic AR(1) case. This data-model mismatch is another source of spurious cycle detections, and goes unnoticed because model checking is not routinely applied in stratigraphic spectral analysis.

Above: Toarcian sands at West Bay, Dorset showing 'cyclic' sedimentation pattern frequently ascribed to orbitally induced climatic fluctuations

Vaughan *et al.* have analysed four well-known datasets for which cyclicities have been claimed, applying model checking and accounting for multiple tests. The cyclicity detections were reproduced in only one case. This suggests that the majority of published reports of regular Milankovitch-band cyclicities (eg in Paleogene, Mesozoic, and older strata), and the resultant astrochronological time calibrations, are based on statistically unsound detections. On a positive note, the more general approaches outlined by Vaughan *et al.* allow for the investigation of a wider range of spectral features than considered by the standard approaches.

* **Simon Vaughan** Dept. Physics & Astronomy, University of Leicester, Leicester, LE1 7RH, UK E: sav2@leicester.ac.uk

REFERENCE

- 1 Vaughan, S, Bailey R J and Smith D G (2011): Detecting cycles in stratigraphic data: Spectral analysis in the presence of red noise. *Paleoceanography*, 26, PA4211, doi:10.1029/2011PA002195. See also Robin Bailey's recent Soapbox article in *Geoscientist*, "Spare me the cycles". 20.05 June 2011

SOCIETY NEWS

SIR PETER KENT LECTURE 15 MARCH



The Sir Peter Kent Lecture 2012 will be delivered by Andrew Miller MP (left)

Andrew Miller MP to speak on 'Probabilities and Possibilities in Parliament: How a learned society can help improve our decision-making'

The Sir Peter Kent Lecture, the Society's annual flagship lecture on science policy matters, will be given by Andrew Miller MP, Chair of the House of Commons Science and Technology Select Committee. Mr Miller will explore how key decisions are made in Parliament, drawing on his experience of events where Geological Society members have been among key experts called upon to give evidence – including the 2010 volcanic ash cloud, the 2011 Japanese tsunami, and shale gas.

Andrew Miller was educated in Malta, Hampshire and at the London School of Economics, and holds a Diploma in Industrial Relations. He began his career as a geology technician at Portsmouth Polytechnic, where he developed an XRF and XRD laboratory. He then moved into industrial relations and was an official for the MSF Union, representing scientists and engineers. He was elected to Parliament in 1992 where as Labour Member of Parliament for Ellesmere Port and Neston, Mr Miller represents almost 70,000 electors. *Nic Bilham*

▶ A limited number of free tickets are available to Fellows, Friends and others on application. To apply please email policy@geolsoc.org.uk by 1 March.

FUTURE MEETINGS

■ **Council & OGMs:** 1, 2 February (Council Residential); 1 February 2012 (OGM, 1800); 11 April (Council & OGM); 13 June (AGM); 26 September (Council & OGM); 28 November (Council & OGM).

GSL Journal Indexes

At its November 2012 meeting Council discussed the current practice of producing an annual printed index for each of the Society's journals, and made available with the final part. For reasons of budgeting and cost-control the number of pages published in each journal each year is limited. Given that the 'version of record' is now online (and available to all Fellows) and that most searches are via full-text search technologies, Council feels that the pages occupied by the printed index would be more effectively used for the publication of original science. Other societies that publish their own journals (e.g. the Royal Society) have come to the same conclusion and most of our main journal competitors no longer include an index.

▶ Fellows are invited to submit views to **Jonathan Turner** (Chair, Publications Management Committee) via Ted Nield, Editor, *Geoscientist*, before the end of March. E: ted.nield@geolsoc.org.uk

Journal Cancellations

Edmund Nickless writes: In 2010, Council asked a group led by former President Peter Styles to conduct a review¹ of the Society's library collections and services. *Geoscientist* 21.05 (June 2011) published an update on how the review's recommendations were being carried forward.

In line with these, Council agreed to reduce library net costs by £35k in 2012 through new income and savings. The Library Advisory Committee identified journals for cancellation based on criteria agreed by Council (including low usage and high cost-per-usage). Candidates were reviewed by the Information Management Committee and their cancellation has now been approved. They are: *Bulletin d'information des geologues du bassin de Paris*; *Contributions to mineralogy & petrology*; *Coral reefs*; *Geodinamica acta*; *Journal of seismic exploration*; *Mathematical geosciences*; *Near surface geophysics*; *Surveys in geophysics and Palaeontographica Abt. B: Palaeophytologie*.

References: 1. See www.geolsoc.org.uk/libraryreview

REE Exercise

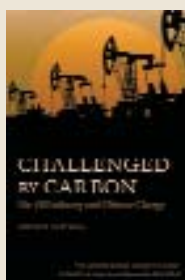
Nic Bilham writes: Rare Earth Elements (REE) have a wide variety of applications, and are increasingly important in the production of low-carbon technologies such as wind turbines, electric traction motors and hybrid vehicles. Demand for REE has increased by more than 50% in the last decade, and is expected to rise further. In 2009, China produced around 97% of global REE. Recent reductions in Chinese export quotas led to increased prices, and have exacerbated concern about future security of supply. While geological scarcity in absolute terms is not likely to be a problem, the technical, financial, environmental and regulatory challenges which must be overcome to establish new REE mines could mean disruptions in supply over the next decade.

Geoscientists will play a vital role in the search for rare earth ore deposits and their extraction, in ensuring that as little damage is done to the environment as possible in extraction, and in addressing questions about security of supply and future demand for REE. We hope that this briefing note will help to inform debate among scientists, policy-makers, potential investors and other industry players.

▶ Download the briefing note at www.geolsoc.org.uk/ree

[LECTURES]

Shell London Lecture Series



Rocks and Climate Change - how we can stop pulling the carbon trigger

Professor Bryan Lovell
(President, Geological Society)
15 February 2012

The message from the rocks is that we should stop pulling the fossil carbon trigger. If we fail to do so, we risk a repetition of a global warming event that took place 55 million years ago. Such a repetition would be fine for Earth, but not so good for us. The message from the rocks presents a particular challenge to the oil and coal industries, to which they can respond by helping us to make the transition to a low-carbon economy. For some years to come we shall generate a great deal of electricity by burning coal, around the globe. The oil industry can store safely underground the carbon dioxide captured from coal-fired power stations, at a price that will be reasonable compared with the alternatives.

■ **Programme** – Afternoon talk: 1430pm 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,
T: +44 (0) 20 7432 0981 E: Naomi.newbold@geolsoc.org.uk

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FROM THE LIBRARY

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Monday-Friday 0930-1730.

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

Rare Book of the Month!



Observations on the geology and zoology of Abyssinia, made during the progress of the British expedition to that country in 1867-68 by W T Blanford. 1870.

Recently restored through the Library's Sponsor a Book Appeal, W T Blanford's *Observations on the geology and zoology of Abyssinia* is an account made during the British Army Expedition to rescue diplomats imprisoned in Magdala (now Amba Mariam, Ethiopia). Charting the voyage out of Bombay harbour (where Blanford was Deputy Superintendent of the Indian Survey) across the Gulf of Aden to the Red Sea, before the long ride inland across sandstone hills and enormous ravines, it is both a visually accurate description of the landscape and an engaging narrative of the thrills and challenges experienced on the journey.

The book is divided into three parts,

with detailed and comprehensive sections on Geology and Zoology, complete with various illustrations of the expansive plateaux, military encampments and some beautifully coloured lithographs of birds (drawn by J G Keulemans). But it is Blanford's Personal Account that is the most interesting, the geologist proving to be a charming narrator: wide-eyed and occasionally gung-ho with excitement, determined in his mission, precise in his descriptions. He revels at the fluke of shooting a hyena by moonlight or the long awaited discovery of some 'oolithic fossils'; but he also notes the dangers of the trip, the loss of hundreds of pack mules, the servant killed by a leopard. Despite this, he writes: 'I have never spent eight months more pleasantly. The country was most interesting, the climate during the greater part of the time perfect, and the fauna and geology had all the attractions of novelty'.

The Library thanks Dr Christopher Toland for his donation, allowing us to conserve this title, which was re-sewn and preserved with its original cloth binding by Aquarius Book Restorers.

► The Library operates a sponsorship scheme to help preserve and restore its rare books. For more information, contact **Michael McKimm** in the library, or go to: www.geolsoc.org.uk/sponsorabook

The Geological Society Club

The Geological Society Club, successor to the body that gave birth to the Society in 1807, meets monthly (except over the field season!) at 18.30 for 19.00 in the Athenaeum Club, Pall Mall. Once a year there is also a special dinner at Burlington House. New diners are always welcome, especially from among younger Fellows. Dinner costs £50 for a four-course meal, including coffee and port. (The Founders' Dinner, in November, has its own price structure.) There is a cash bar for the purchase of aperitifs and wine.

2012: 29 February; 28 March; 11 April (Burlington House); 23 May.

Any Fellow of the Society wishing to dine should contact **Dr Andy Fleet**, Secretary to the Geological Society Dining Club, Department of Mineralogy, The Natural History Museum, Cromwell Road, London SW7 5BD. Email: a.fleet@nhm.ac.uk - from whom further details may be obtained. DR

■ GEOFACETS AVAILABLE IN THE LIBRARY

Elsevier's *Geofacets* search tool is now available for Fellows and Corporate Affiliates to use in the Library. *Geofacets* allows you to search the Lyell Collection as well as Elsevier Earth science journals for map data, using a simple Google Earth interface. Selecting an area of the Earth's surface will bring up a list of all maps, sketch maps and other geographical data for that area from all articles in these collections.

► Find out more: www.geofacets.com

Elections to Council 2012-2013

In the October issue we invited Fellows to nominate new members of Council. Ten nominations have been received for six vacancies. The results of this preliminary ballot will determine the list for the formal vote at the Annual General Meeting on 13 June 2012.

Philip Allen, *Secretary, Science*, is retiring from Council. Council proposes that **Jane Francis**, a current member of Council, should succeed Philip in that role. Council also proposes that **Susan Marriott**, *Vice President*, and **Jonathan Turner**, *Secretary, Publications* remain on Council for a further year to smooth the rotation of Officers.

Below are supporting statements of the candidates for election, together with a table showing the expertise of the present Council (for biographies of the continuing members of Council are at www.geolsoc.org.uk/biographies).

BALLOTING

ONLINE VOTING

Fellows are encouraged to vote online by logging onto the Fellows-only part of the website www.geolsoc.org.uk/vote2012. Please follow the instructions.

POSTAL VOTING

A postal ballot paper is enclosed for those unable to vote online. Fellows should make their mark against the names of up to six candidates. Papers with marks against more than six names will

be invalid.

The ballot paper should be placed in the envelope provided, which should be sealed and returned to reach the Society not later than **31 March 2012**. Unless we are able to determine your eligibility to vote the envelope will not be opened and your vote will be invalid. Please therefore write your full name on the back of the envelope. No other matter should be enclosed.

NOTE: Fellows may only vote only once, either online or by returning the postal ballot.

COUNCIL MEMBERS

	Present Council (2011-2012)	Nominees for new Council (2012-2013)
PRESIDENT	Dr J P B Lovell	Mr D T Shilston
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SECRETARIES	Professor P A Allen (<i>Science</i>) Mrs M P Henton (<i>Professional</i>) Professor A R Lord (<i>Foreign & External Affairs</i>) Dr J P Turner (<i>Publications</i>)	Professor J E Francis (<i>Science</i>) Mrs M P Henton (<i>Professional</i>) Professor A R Lord (<i>Foreign & External Affairs</i>) Dr J P Turner (<i>Publications</i>)
TREASURER	Dr A Law	Dr A Law
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SUPPORTING STATEMENTS FOR COUNCIL NOMINEES**■ NATALYN ALA**

I am dedicated to developing geoscience students and professionals through charterhip and beyond, and

believe that the more challenging the problem, the greater the capacity for learning. I believe the Geological Society, in collaboration with other international institutions, can play an important role in ensuring the environmentally sustainable use of water and energy resources.

I am a Director at Atkins and a practising contaminant hydrogeologist with over 20 years' international experience. I have a BS in Engineering Geology and an MS in Hydrogeology from Texas A&M University. I became a Chartered Geologist in 2000 and am also a Chartered Scientist and a Professional Geologist in California. I serve as a scrutineer for the Society, a member of the Society's degree Accreditation Panel, and am active in other professional organisations. I have provided training courses, lectures and presentations/publications for international conferences and technical journals in groundwater risk assessment and modelling.

My professional and business experience will provide valuable support to the Council. If elected, I would focus my efforts on promoting the Society's collaboration and interaction with international organisations, expanding the Society's influence and technical participation in the contaminated land and hydrogeology professions, and continuing to support the development of geoscience professionals.

Proposer: D J Cragg

Supporters: M Rivett, O Mills

■ MICHAEL ARMITAGE

I am Chairman of SRK Consulting and, after a spell as a mine geologist, have spent the last 20 years as a consulting geologist on exploration and mining

projects worldwide. I completed my degree at the University of Cardiff and my PhD at the University of Bristol and am a Chartered Engineer as well as a Chartered Geologist. I have written several papers on resource estimation and have helped develop international resource reporting codes. For many years I was joint MSc course co-ordinator at Cardiff and until last year was external examiner for an MSc at Imperial. I have been a Fellow since 1993, was a founding member of the Southern Wales Regional Group (Chairman in its formative years). I have acted as scrutineer of charterhip candidates for many years.

I believe the Geological Society is the

Below: Voting open - now is the time for all good men and women to come to the aid of the Society

most active, relevant and appropriate professional body for all UK trained/based geologists in the minerals sector and would like to use my industry, management and academic experience to attract more geologists into membership, and to ensure it continues to represent, encourage and support geologists in all spheres (academic and industrial). I would also like to help improve knowledge of the Society within schools and encourage the teaching of geology at this level.

Proposer: R Bowell

Supporters: P Bridges, P Maliphant

■ ANTONY BROWN

I am a Quaternary geologist with interests in geomorphology, palaeoecology and geoarchaeology. My particular speciality is

fluvial sediments from the Miocene to the present. Currently, I direct the Palaeoenvironmental Laboratory University of Southampton (PLUS) and previously was a Professor at Exeter and Lecturer at Leicester. My work has been in geomorphology and climate change in the East Midlands, fluvial geomorphology and palaeohydrology in East Africa, Romania, Greece and Siberia. Currently, I am extensively involved in the landscape history of Southern Britain; from 1999 – 2003, I was Chair of Devon RIGS (Regionally Important Geological Sites) Group and am a long-standing member of the Ussher Society (Geosciences SW England). I have consulted widely to industry in the UK and overseas, and was appointed Soils and Forensic Palynologist to the United Nations International Criminal Tribunal for the Former Yugoslavia, (Bosnia operation, 1997 – 2003), and have been a member of the Forensic Sciences Advisory Group.

Strengths I would bring to the Council include my commitment to the widest possible promotion of Earth sciences to the Government, NGOs and general public and with my recent involvement in the Anthropocene debate, the views of rank-and-file members can be heard concerning proposals on the geological timescale.

Proposer: P Fookes

Supporters: R Scrivener, J Bennett ►



■ NEIL CHAPMAN



The Society is increasingly responsive to the critical importance of national and global energy policy and associated

environmental and nuclear power issues. I believe that I can help further these aspects of our activities. I have been principally involved in researching and developing the concept of geological disposal of radioactive wastes since the 1970s, acting as adviser to national and international agencies and governments worldwide. I am currently a partner at MCM Consulting in Switzerland, Vice President of the Arius Association for regional and international underground storage, and part-time Research Professor in the Department of Materials Science and Engineering, University of Sheffield. I served as Chairman of the ITC School of Underground Waste Storage and Disposal for eight years. My previous career included 13 years at BGS (latterly, managing the Fluid Processes Research Group) and consultancy work, including 10 years managing Quantisci's Geoscience Group in the UK. I have been a Fellow of the Society since the 1970s and was among the first Chartered Geologists, also serving on the Council of the Institution of Geologists. In 1990 the Society awarded me the William Smith Fund and in 2010 the Institution of Civil Engineers awarded me the James Watt Medal.

Proposer: R S J Sparks

Supporters: J D Mather, W R Alexander

■ JON DAVIDSON



I became part of the UK academic community in 2000 and immediately joined the Geological Society assuming it was the 'right thing to do', as the representative

body of UK geoscientists. But I realised that few of my colleagues are actually members. I want to contribute to the Society by increasing its vibrancy and academic relevance. I think we can do more to support geoscience visibility from primary education onwards, and we can promote employability in geosciences to students and government alike. I can offer experience in developing strategy across allied

bodies such as CHUGD, and an optimism in our capacity to deliver change, as demonstrated in the recent engagement that the Society, united alongside CHUGD and BGS, has had with government.

Currently I am Deputy Head of Science Faculty (Research) at Durham University and serve on the University's Council, which has inducted me into the responsibilities and duties of trustees. I was Chair of the Durham Earth Sciences Department (2002-5) with 17 years' prior research and teaching experience in US universities. I have been a Fellow of the Society for 10 years, and served in the past on the Education Committee (while Chair of VMSG, 2006-9)

Proposer: D A C Manning

Supporters: S A Gibson, D Pyle

■ DAVID JONES



I am a young hydrogeologist, working towards Chartership. I hold a BSc (Hons) in Geology (2004) and MSc in

Hydrogeology (2007), both from Cardiff University.

Since joining Professional Committee last year I have seen good work being done to encourage Fellows to work towards and achieve Chartered status. I am passionate about Chartership and if elected I will work to ensure the Society has the tools in place to provide applicants with the mentoring and guidance needed to reach that goal.

As current Chair of the Southern Wales Regional Group, I want to support the regions. Our regional groups provide a close link to the wider Fellowship and generate many excellent events such as the School Geology Challenge and Early Career Geologist Award. These encourage and support our younger members, and show them that they hold a valued place within the Society.

I have been a STEMNET (Science Technology Engineering Mathematics Network) ambassador since 2009, promoting the geosciences in schools and at careers events across South Wales. I want to continue this work within Council to capture the imagination of Fellows and the wider public about

the contribution geoscientists can make in understanding and addressing environmental challenges.

Proposer: P Maliphant

Supporters: S Neale, M Eynon

■ BRIAN MARKER OBE



Geoscience is fundamental to national wealth, health, safety and environment. We know that, but many administrators,

politicians and members of the public do not. In the 1980s and 1990s, planning guidance was prepared that embedded geosciences in the planning system. But Government is now sweeping that guidance away. I am keen to help the Society respond to that challenge based on long experience in Government service providing advice to non-geologists. An international perspective was added by work for IAEA and IUGS Commissions. Close links with the research community through NERC and EPSRC committees and the Board of the BGS reinforced my strong belief in vigorous research to underpin policy. But outreach is equally important. My interest in wider communication of geoscience developed through work in adult education and more recently editing publications relevant to communication (GS Special Publications 305 and 250). I also participate in Society business through validation of Chartered Geologist applications and the Editorial Board of the QJEGH. This background could be of use to Council in the Society's developing desire to communicate the value of geology at all levels, especially to school students, the general public and non-geological professionals.

Proposer: R E Allington

Supporters: M G Culshaw, L J Donnelly

■ GARY NICHOLS



The Geological Society has been a part of my career as a geoscientist since I joined as an undergraduate student in 1978.

My direct involvement has been through the *Journal* as an editor and as a member of the Specialist Groups Committee as Secretary of BSRG.

The Society has been a venue for research conferences I have attended, including one I co-convened, and I value the Burlington House Library. The Society forms a link between my research interests, through conferences and specialist groups, my publishing activities (I am Special Publications co-editor for SEPM), educational outreach work, in relation to which I am Governor of an FE College, international geoscience teaching through MSc programmes by Distance Learning I have led, industry-based training (I co-ordinate postgraduate programmes based on industry courses) and other aspects of the research-industry interface through my role as Chair of the Board of Directors of CASP. With these diverse geoscience interests, and my position as Senior Lecturer in Sedimentology at Royal Holloway (which I have held for over 20 years with interludes seconded to BAS and 2 years as professor at UNIS in Svalbard) I believe I can make a well-informed contribution to the work of the Society.

Proposer: D J Blundell

Supporters: L E Frostick, J D Mather

■ HOWARD ROSE



After graduation I became a Fellow of the Society early in a long career in industry as a civil engineer always in activities with

geological perspectives. Nearly all of my career has been spent with two of the best known British

geotechnical investigation companies, with engineer and manager responsibilities in, among other things, marine and land ground investigations. This included several years living and working in the Middle East. As well as having an active interest in the Society I am a member of the Institution of Civil Engineers and I serve currently on two of its southern regional committees. I believe a good working relationship between the Society and the Institution has considerable advantages for both and it should be encouraged. If I become a member of Council I shall want to use my industry perspective to promote the Society, and, at the same time, contribute to its organisation affairs.

Proposer: D Norbury

Supporters: J C Woodward, D A Earle

■ BERNIE VINING



I have been a Fellow since 1972 and it has been a privilege to be involved in its many activities over this time, particularly as

President of the Petroleum Group. I have also had the honour of being Technical Chairman of the *Seventh Petroleum Geology Conference* (2009) and as Deputy Chairman in the preceding *Sixth Petroleum Geology Conference* (2003).

I am Chief Geoscientist for Baker Hughes worldwide and Professor of Petroleum Geoscience at Royal Holloway, University of London (RHUL). I have enjoyed over 35 years' petroleum exploration and production experience worldwide, of which 30

were with Exxon. I joined consultancy Gaffney, Cline & Associates in 2005, working for a diverse client-base worldwide.

My current research interests are in carbonates and Neoproterozoic petroleum systems. I am also highly involved in career development initiatives for the geoscience community. I hold a doctorate in geology from King's College, University of London. I am also a member of the AAPG and SPEE; a Chartered Geologist and a European Geologist.

I believe that my energy and enthusiasm, combined with a breadth and depth of industry and academic experience, well positions me to make a contribution to the work of the Society by becoming a member of Council.

Proposer: C M R Fowler

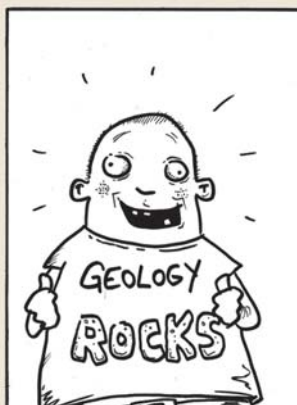
Supporters: D A Waltham, E G Nisbet

BACKGROUND OF CONTINUING MEMBERS OF COUNCIL

Name	Expertise	Sector
Samantha Brough	Environmental Geoscience	Industry
Rob Butler	Structural Geology	Academe
David Cragg	Engineering Geology	Industry
Jane Francis	Palaeoclimatology	Academe
Al Fraser	Petroleum Geology	Academe/Industry
Sally Gibson	Igneous Petrology	Academe
Tricia Henton	Environmental Geology	Government (retired)
Richard Hughes	Information Management	Government
Adam Law	Petroleum Geology	Industry
Richard Lisle	Structural Geology	Academe
Alan Lord	Micropalaeontology	Museum
Paul Maliphant	Engineering Geology	Industry
Susan Marriott	Sedimentology	Academe
David Shilston	Engineering Geology	Industry
Colin Summerhayes	Marine Geology/ Geochemistry	Academe/Government/ Industry
John Tellam	Hydrogeology	Academe
Jonathan Turner	Structural/Petroleum Geology	Industry

STICKS AND STONES

SHOOT THESE PEOPLE 2



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As economies grow and our reliance on technology increases, so too does the world demand for non-renewable resources, in particular, some of the scarcer metals. Since the military reliance on Strategic Metals was identified during the Cold War, developed nations have become very concerned that the world supply of some elements comes from relatively few sources. Foremost among these are the rare earths, but for all of them, high demand and limited alternatives may restrict technological development¹.

The House of Commons Science and Technology Committee's May 2011 report on Strategically Important Metals addressed how the UK should proceed in this economically and technologically significant field – and concluded that scientific input could transform their current scarcity into an opportunity for UK business.

Applications of the rare earth elements² (REE) are diverse, spanning catalysts, electro-optics, semiconductors, magnets and related devices (data storage, power generation, motors etc.). Other critical raw materials include the soft metal Indium, which is used in flat-screen displays and as the dopant in II-VI compound semiconductors, in novel batteries and in photovoltaic devices.

CHINA

The issue has come to a head as the Chinese economy has blossomed. China holds the majority of the known reserves of lanthanide elements and, understandably, would prefer to export high 'added value' products, rather than lower value raw materials. Some estimates³ put China's holdings at >90% of global reserves, and a political decision

to reduce exports from China by 70% has inevitably pushed the price of these metals very high indeed. The British Geological Survey (BGS) produced an informative review⁴ of these metals in 2010 on behalf of Minerals UK, and the Geological Society published a briefing note on the Rare Earth Elements in November 2011.

Rare Earth Elements comprise the lanthanides and the closely related metals scandium and yttrium, with which they are often associated in nature. Although some of them are not especially rare, there are few rich ores and many of those known outside China are in remote locations. To compound this awkward situation, the recycling of these metals is in its infancy.

Lithium is a more abundant element that is also not yet recycled effectively. When I visited the lithium operations of Umicore, in Olen, Belgium, our host asked a simple question: "What have you done with your old mobile phone?" Without exception, the visitors admitted that their old phones were lying in a drawer! Many expensive devices will be stored in this way at the end of their lives - in case they are needed - before they enter the recycling circuit, should such a circuit exist.

In nature, REEs occur in a wide range of minerals, often complex carbonates, phosphates, silicates and arsenates. Despite their name, they are not, in fact, all that 'rare'. Cerium, for example, is about as abundant as copper in the Earth's crust (~68ppm) but, unlike copper, is rarely concentrated into abundant ores. Their similar chemistries mean that the REE metals are notoriously difficult and expensive to separate from each other. At the time of writing the commonest REE, cerium, has a 99% spot price of around £90/kg. Metal prices are further complicated by rapidly evolving markets.

Neodymium is one of the more abundant REE metals, for example, but our ►



1	IA	Hydrogen		2	IIA	
		H 1				
		Atomic Weight = 1.008				
2		Lithium				Beryllium
		Li 3				Be 4
		Atomic Weight = 6.94				Atomic Weight = 9.01
3		Sodium				Magnesium
		Na 11				Mg 12
		Atomic Weight = 22.99				Atomic Weight = 24.31
4		Potassium				Calcium
		K 19				Ca 20
		Atomic Weight = 39.10				Atomic Weight = 40.08
5		Rubidium				Strontium
		Rb 37				Sr 38
		Atomic Weight = 85.47				Atomic Weight = 87.62
6		Cesium				Barium
		Cs 55				Ba 56
		Atomic Weight = 132.91				Atomic Weight = 137.33
7		Francium				Radium
		Fr 87				Ra 88
		Atomic Weight = 223.02				Atomic Weight = 226.03

Rare Earth Elements comprise the lanthanides (see right hand arrow leading from Group 3) and the closely related Group 3 metals scandium (21) and yttrium (39)

STRATEGIC METALS AND MINERALS

Mark Tyrer* asks whether the our growing reliance on Rare Earth Elements constitutes a crisis or an opportunity

► insatiable demand for “supermagnets” keeps its price high - approximately twice that of cerium. The neodymium alloy $\text{Nd}_2\text{Fe}_{14}\text{B}$ has a phenomenal magnetic susceptibility - so much so that a one-gram magnet can lift an object 1000 times its own mass! As a result, much green technology is dependent on these powerful light magnets in motors and generators, for example.

Further affecting the value of neodymium (and samarium) is the unprecedented demand for portable electronic devices, which use these magnetic alloys in their transducers. Interested readers can see price charts updated hourly on the web. A newspaper article⁵ of March 2011 reported that: “At \$72 a kilo, cerium oxide, used in polishing glass and lenses, is now 15 times more expensive than it was a year ago; neodymium has more than trebled in value to \$115 over the same period. Analysts do not expect them to cool off for at least two years”.

CURIOSITIES

It is interesting to consider how we come to be in this situation. Since their discovery in the late 18th Century, REEs remained chemical curiosities for more than 100 years. As industrial applications developed throughout the 20th Century, new discoveries provided commercial sources for these metals from India, Russia, North America, Greenland and ultimately the Monazite mines of South Africa.

Around 30 years ago, the United States was the largest producer (largely from the Mountain Pass Mine, in California) until China flooded the market with low-cost rare earths to supply a rapidly growing demand. This was possible for two main reasons. First, much of the Chinese production comes from the REE-rich tailings of the Bayan Obo iron mine in inner Mongolia, the largest known deposit of both rare earths and of fluorite, occurring as a rift along the edge of the Sino-Korean craton. It is estimated that half the world's known REE reserves are in this one location. The second reason is that China was not restricted by environmental or other legislations, allowing it to undercut other suppliers to the point where commercial competition became futile and production in the rest of the world all but ceased.

An American study⁶ in 2010 assessed the viability of commercial primary production in the rest of the world and concluded that “rare earth deposits in the United States, Canada, Australia and Africa could be mined by 2014” but that

“rebuilding a US rare earth supply chain may take up to 15 years”. Mining operations at Mountain Pass and at Mount Weld (Western Australia) are already getting underway, but it seems likely that for the next decade or so, China will dominate the world supply of these metals. If it chooses to sell them as finished products rather than as raw materials, the rest of the world has two choices: buy them or do without! The latter option appears unlikely; it also seems improbable that alternative technologies will become available over the next few years.

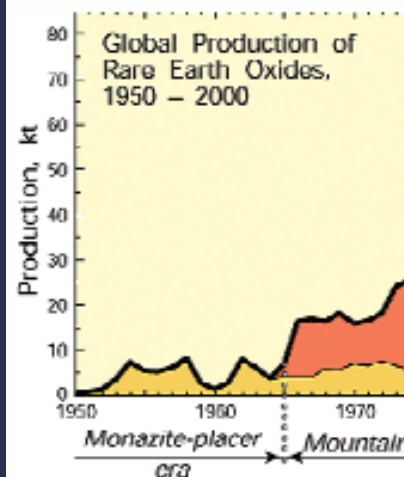
A natural question to ask would be - what is the best strategy for the UK to adopt? This was the basis of the House of Commons Science and Technology Committee's inquiry into Strategically Important Metals. This was launched in November 2010 under the Chairmanship of Andrew Miller MP (the Society's 2012 Sir Peter Kent Lecturer - see p8). The Geological Society presented written and oral evidence to the Committee, which reported on the 17 May 2011. To mark the launch of the report, the Parliamentary and Scientific Committee brought together Andrew Bloodworth (BGs), Hazel Pritchard (University of Cardiff) and Tony Hartwell (Environmental Sustainability KTN) to discuss how the availability of certain elements affects the UK now (and in the future) and involves expert scientific input across the entire supply chain; from exploration and mining to the recycling of materials.

COLLABORATION

The report stresses the need for focused research. Speakers at the May meeting referred to the need for vertically integrated research. Collaboration and developing continuity of ideas throughout the value chain is in its infancy, yet in this case, seems very important indeed. For example, the concerns of the exploration geochemist and the industrial recycler may seem poles apart, yet they are surprisingly close. Both are concerned with similar chemistry and both rely on a sound thermodynamic understanding to reach their goals yet, unless the need for collaboration is recognised, each may remain unaware of the other's work.

The urgency of this issue may foster collaboration and engagement between other ‘links in the chain’, generating new ideas and shared understanding. One important research need is the continued gathering of comprehensive high-quality data. For example, are there sources of strategic metals that have not yet been

The two most abundant REE minerals are both cerium-rich phases: Left and centre: Cerium Monazite (Ce, La, Pr, Nd, Th, Y)PO₄ Right: Bastnäs site (Ce, La)CO₃F



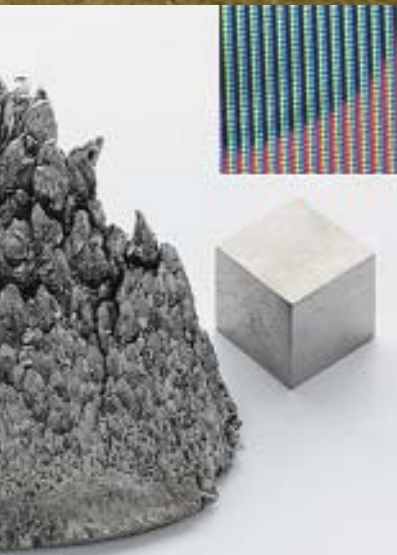
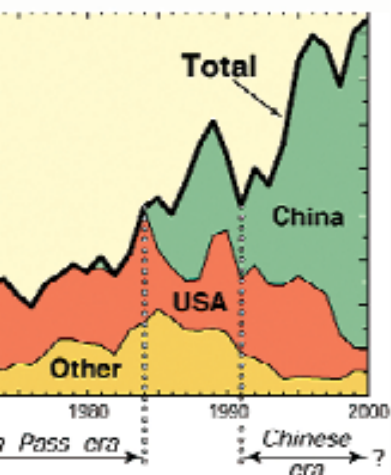
China currently dominates the production of rare earth elements worldwide



Rare Earth Oxides. Clockwise from top centre: praseodymium, cerium, lanthanum, neodymium, samarium, and gadolinium



Yttrium metal in dendritic, massive and machined form. Inset: Yttrium was commonly used as the red phosphor in CRT displays and is now a major component in ‘YBCO’ superconductors (YBa₂Cu₃O₇)



found or adequately exploited? However implausible it seems, much of our own country remains unexplored on a detailed mineralogical and geochemical level. In addition, we know of industrial processes that concentrate some strategic elements (for example in combustion residues) and it seems reasonable to expect others to come to light.

So far, the focus of this and other governments has been on a developing a strategy for the next few years, bridging the period of the Chinese monopoly on global REE supplies. One view is that our demand for strategic metals as raw materials is minimal because Britain's manufacturing base is now so small and because we import finished goods or components. But little consideration seems to have been given to the future. In that medium term, strategic metals in devices will, collectively, reach the critical mass for recycling. Perhaps a better question to ask then is - how do we recycle these elements?

RECYCLE

There are of course, two answers. We can export our waste overseas, where it will be reprocessed and re-imported as new goods, albeit at a price. Alternatively, we have the specialist knowledge and skills in the UK to do it ourselves. Certainly, if native sources are exploited, this will require a technological infrastructure to process the minerals (or industrial residues) which, in turn, opens up opportunities for recycling materials as they become available. It is hoped that someone in government recognises this as an opportunity to be encouraged.

The area needs both research and development. We need research into our natural resources and the technologies needed for their efficient exploitation and re-processing, as well as into the mechanisms acting on the supply chain. How exactly do we get those old phones out of desk drawers? Would a financial incentive similar to a deposit on a returnable drinks bottle help? Research we can do, but development is an area where we as a nation are less successful.

Recent governments seem to feel that market forces will sort things out with minimal intervention from them, but in this case I have my doubts. Although stockpiling and 'rare earth hedge funds' may distort market prices, their contribution to greening the planet seems more questionable. Industry needs an incentive to establish the technology with which these metals will be recycled efficiently and in the UK, we might look to

the Technology Strategy Board to provide a lead.

There is a real opportunity here to shape our own technological futures and the contributions of scientists will be significant. At the Parliamentary and Scientific Committee meeting, one questioner asked the Chairman about scientific understanding in politics and government, specifically how many senior civil servants hold scientific qualifications. To his credit, Andrew Miller turned the question on its head, saying that he hoped debates like this would encourage our brightest young scientists to apply for the Civil Service Fast Track recruitment programme.

Career change to politics anyone? ■



* **Mark Tyrer** is an independent geochemist, based in Derbyshire and London. He is a Research Manager for MIRO, the Mineral Industry Research Organisation, Visiting Professor of geomaterials at Coventry University and Honorary Research Fellow at Imperial College. © M Tyrer; FBSR to 'Geoscientist' and the 'Geological Society of London' without reservation.

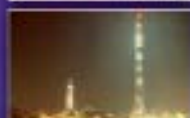
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 - 6 **US Government Accountability Office** (2010) *Rare Earth Materials in the Defense Supply Chain* Washington DC
- The House of Commons Science and Technology Committee report on Strategically Important Metals + Government response: www.parliament.uk/business/committees/committees-a-z/commons-select/science-and-technology-committee/inquiries/strategically-important-metals/
 - The Geological Society's briefing note on Rare Earth Elements: www.geolsoc.org.uk/ree

Water Futures

6-7 March 2012

Imperial College, London,
United Kingdom



Pressure on groundwater use is ever increasing in terms of quantity and quality, particularly from population increases and demographics, new technologies, pollutants and climate change. The interdependency between groundwater behaviour and a broad spectrum of earth system processes of significance to environmental scientists is providing a spotlight on the interface between hydrogeology and the neighbouring Earth System disciplines. This two day conference will launch the Environment Network at the Geological Society. The meeting will feature four board themes which aim to address international and innovative challenges groundwater and the wider Earth System face.

- Groundwater and Energy
- Groundwater and Climate
- Groundwater and Resource Protection
- Resource Development and Societal Challenges

Keynote speakers:

David Henshaw, Colorado School of Mines, USA
(Groundwater and Climate)

Wolfgang Zech, University of Vienna, Austria
(Groundwater and Climate)

David Henshaw, Colorado School of Mines, USA
(Groundwater and Resource Protection)

Jonathan Gbureck, Applied Environment Systems, Austria
(Groundwater and Societal Challenges)

Invited speakers:

Jim Smith, Centre for Ecology and Hydrology, UK
(Groundwater and Societal Challenges)

David Henshaw, Colorado School of Mines, USA
(Groundwater and Societal Challenges)

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(Groundwater and Societal Challenges)

David Henshaw, Colorado School of Mines, USA
(Groundwater and Societal Challenges)

Further information

For further information and to register for this event please contact:

Sara Anders
The Geological Society, Burlington House, Piccadilly, London W1J 8BC
Tel: 020 7432 0945 Fax: 020 7432 0946
E: sara.anders@geolsoc.org.uk W: www.geolsoc.org.uk/joblistings

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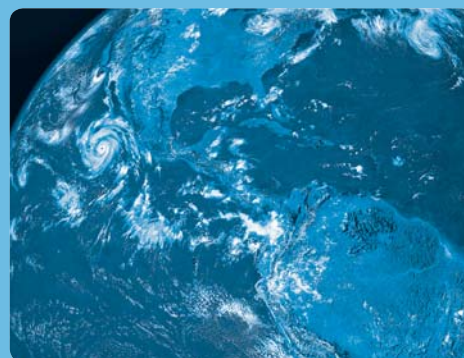
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STABILISING GLANDYFI

Iain Bews* reports on engineering geology and construction at a notorious bottleneck, and investigates the new exposures before they are covered forever

Estuary and mountains combine to create a beautiful setting at Glandyfi, on the Mid-Wales coast. Major civil engineering contractor Carillion is breaking-out the Silurian rocks and stabilising the slope, to realign the A487 trunk road on behalf of the Welsh Government.

The A487 is an important N-S route in Wales, which narrows at Glandyfi, a hamlet on the southern flank of the Dyfi estuary. In the shadow of Snowdonia and eight kilometres SW of Machynlleth, Wales's ancient capital, nightmare tailbacks can occur as lorries and buses try to pass one another. The 1.3km section of narrow road is perched above the Cambrian

Above: Dyfi Estuary showing part of existing A487

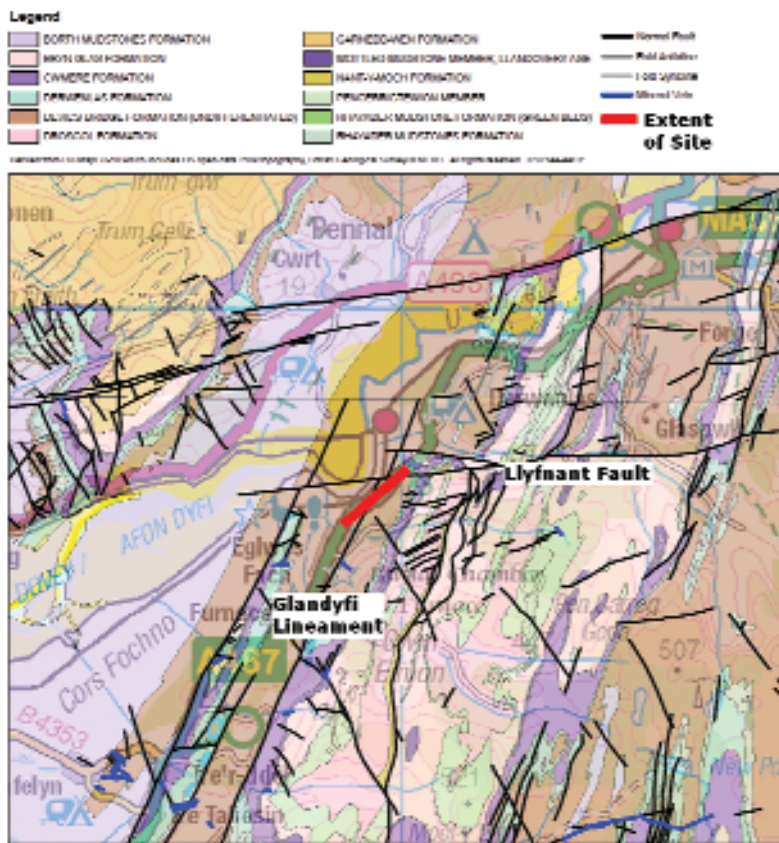
Railway. A steep slope rises to the east, and several residential properties pin the narrow snaking road in its current location. Locals were rewarded for their years of patience when the Welsh Government employed consultants Parsons Brinkerhoff to design an improvement.

Gifford (now as Ramboll, the global engineering and environmental consultancy) is carrying the design forward, as technical advisers to the Welsh Government. Two retained cuttings were included as Contractor-Designed (Design and Build) elements in the Engineering Construction Contract, managed by consultants EC Harris. The £10m contract was awarded to Carillion in

March 2011. Tony Gee was employed by Carillion to design the retained cuttings. Construction started in earnest in April 2011.

EXISTING SLOPES

The slopes that currently confine the road alignment need cutting to allow for widening and straightening work. These slopes typically comprise colluvium above weathered bedrock, with fresh, intact bedrock beneath. Gradients are typically 1 in 5 (but steeper where bedrock is exposed). The colluvium is a granular-cohesive material, the strength and stability of which derive from cohesion of the clay matrix, and a degree of interlock from the included gravels and cobbles. The source material is ►



► weathered bedrock, comprising sandstone, siltstone and mudstone beds of the Silurian Devil's Bridge Formation (DBF) and Borth Mudstones Formation (BMF). The exploitation of structural weaknesses by water and gravity has led to zones of relatively deep weathering, producing clayey gravel with cobbles and occasional boulders.

Late Caledonian (Acadian) folding has created a series of synformal and antiformal axes that trend obliquely to the slope. Through most of the scheme these lead to unfavourable bedding and cleavage orientations that could facilitate wedge and plane failure upon excavation of the new road alignment - an unacceptable risk to the highway as well as a maintenance liability. Two sections therefore require stabilisation: retained cutting RC1 is 15m high and 500m long, and was under construction at time of writing. Retained cutting RC2 is 12m high and 250m long, and was due to commence later in 2011.

The window on the geology exposed to view constantly changes as excavation and construction progress. A recent geological snapshot was observed by Geologists Rhian Kendall from the British Geological Survey, Dr Bob Mathews (Countryside Council for Wales) and Professor Bill Fitches (Central Wales RIGS group) who visited the site during construction of RC1. BGS mapping indicates that the bedrock consists of DBF, a multilayered turbidite sequence. The mudstone-dominated section at the southern end of RC1 closely resembles the partly coeval BMF, which interdigitates with DBF elsewhere in the area; whereas sandstone turbidites become more common in the northern part of RC1.

The primary discontinuity set is the cleavage, which is very well developed, slaty and strongly oblique to bedding (bedding is also strong in sandy layers). Cleavage strikes parallel to the fold axes, and is typically unfavourable for the cutting slope, combining with sub-vertical joints and minor faults, could enable slabs and wedges to slide out. Stereographic analysis was carried out (by Parsons Brinckerhoff) during preliminary design, to inform slope stabilisation requirements.

Burrows and erosional features

Plan of site with BGS overlay



Rock structure exposed, wall construction in background



Rock-wheel at work

such as flute casts are preserved, and lustrous purple manganese oxides coat many bedding surfaces. A fault system is apparent within the sandstone-rich section; in the deformed fault zone the beds rapidly steepen and change in orientation. A 0.6m thick quartz vein, which may be part of an en echelon array, is prominent within the deformation zone. The quartz is strong and hard, as evidenced by damage to the teeth of the rock-wheel during excavation.

Other than a little sphalerite within the quartz vein, we encountered no lead, copper or zinc mineralisation - characteristic of the Central Wales Orefield. The deformation zone is probably associated with the Glandyfi Lineament, a composite structure that here marks a divide in the vergence of Acadian folds and cleavage.

RC2 was not yet excavated at time of writing, but we look forward to the exposures it will provide, particularly as the regionally significant Llyfnant Fault (a transverse normal fault of possible Variscan age) passes through the site. We will again be on the lookout for mineralisation, but sadly our experts have assured us that no gold can be expected here.

RETAINED CUTTINGS

The Contractor-Designed retained cuttings are complex geotechnical structures and subject to Geotechnical Category III checks and approval by the Technical Approval Authority (TAA). The Cat. III checks are being performed by consultant WhiteYoungGreen, and the TAA role is being performed by the Welsh Government. The geotechnical certification procedure is in accordance with HD 22/08 Managing Geotechnical Risk.

Complying with the contract requirements set out in the Welsh Government's Works Information, and with relevant standards, Tony Gee has designed a masonry-faced reinforced concrete wall. In order to prevent slope failure, the design includes a grid of double-corrosion protected and re-stressible rock anchors, using 36mm and 40mm Dywidag bars. Grout encapsulation



Above: Flute casts and burrows on base of cross-laminated turbidite sandstone

within plastic sleeves ensures a 120-year design life. The anchors are spaced at intervals of two metres horizontally and three metres vertically, in up to four horizontal rows. The system has built-in redundancy, so if one anchor fails, the load is safely distributed to the surrounding anchors.

Gee's analysis showed that the maximum stress occurred in the top row; the RC1 top row anchors are 11m long, with 5m bonded length. The bond length was designed to be grouted into moderately strong rock (12MPa Unconfined Compressive Strength), to give design anchor loads of up to 650kPa. Suitability tests were conducted on three trial anchors during the design stage. All installed anchors will be acceptance tested to 135% design load, and locked-off at 110%. The anchors are being drilled, installed and tested by specialist subcontractor CAN Geotechnical.

The anchored face slopes at 12° to the vertical. The slopes are covered by a mesh and sprayed-concrete wall, against which the anchors are stressed. Back-of-wall drains are installed before fixing the mesh.

Carillion elected to excavate the rock in benches using toothed buckets, peckers and rock wheels, rather than blast. GPS guidance is fitted to the excavator for the final trim, to achieve millimetre-perfect precision, where fracture geometry allows. A cleaner finish is achieved on the lower benches, as the fresher rock encountered at depth is less prone to overbreak.

Working area is extremely

limited where steep rock slopes rise from the existing road, with large slabs (that look ready to slide if disturbed!). Dowels and rock-catch fences are being employed to stabilise these and protect workers and public.

REWARDING

As a civil engineering project with significant geotechnical content in a challenging geological setting, Glandyfi is an interesting and rewarding project. Proven slope stabilisation techniques, clever programming, a strong emphasis on safety, and collaborative working within the project team are being successfully utilised to deliver a well-needed and long-awaited road improvement. I hope that this article has at least scratched the surface of the wealth of geological interest which a project such as Glandyfi can provide. This interest will continue as further exposures are created, and the engineering challenges which they provide are overcome. ■

*** Iain Bews, BSc CGeol FGS** is working for Gifford, part of Ramboll as Client's Geotechnical Supervisor on the A487 Glandyfi Improvement

ACKNOWLEDGEMENTS

Julian Wilson, Contracts Manager, Carillion, for initiating and reviewing this article.

Austin Weltman, Chris Young and Tim Ngai of Tony Gee, who designed the retained cuttings. **Tudor Roberts** of the Welsh Government, for review. **Rhian Kendall**, BGS, for geological expertise. **Dr Bob Mathews**, CCW, for geological expertise and review. **Professor Bill Fitches**, Central Wales RIGS and Geoscience Wales Ltd, for geological expertise and review.

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

THORNTON UNEARTHED

Sir, I enjoyed reading about Richard Thornton's contributions to African geology and Livingstone's Zambezi Expedition. Readers may be interested to know that Thornton's grave in the Shire Valley was 'rediscovered' in the 1960s. By appropriate coincidence this fell to an English geologist carrying out systematic mapping for the Geological Survey of Malawi. I was shown the grave in the early 1970s during a secondment to that Survey from BGS. By that time the grave had been adopted by the Malawian authorities, and a headstone with an explanatory inscription had been erected. Perhaps some reader may know whether it is still being tended?

Peter Bennett

Richard Boak replies: Having already submitted the article about Richard Thornton (*Geoscientist* 21.7 August 2011 p18), I was fortunate enough to be sent to Malawi on a short consultancy contract. On a day off, I managed to visit Thornton's grave, overlooking the Shire River just north of Chikwawa. Although marked on the tourist map of Malawi, the grave is not



easy to find, and I needed considerable help from the locals. I'm pleased to report that it's still in good condition (see photo), beneath a baobab tree, and it was an emotional moment for me.

GEOLOGY'S HOLISTIC PERSPECTIVE

Sir, Emlyn Koster writes (*Geoscientist* 21.9 October 2011 p18) "geology's holistic perspective should become integral to many important societal and scientific issues is long overdue". Is he ignorant, therefore, of the contribution of geologists, and that we are - and have long been - indispensable to the needs of society? Geology's holistic perspective is all around us: it is our economic and social wealth.

The world is currently going through the largest ever increase in societal wealth. Hundreds of millions of people globally (not just Brazil, Russia, India and China) are going through the transformation from poverty to middle class (the so-called \$5000 threshold) with the positive environmental and social implications that this brings. This wonderful economic phenomenon has come about as a

result of a positive feedback loop driven by demand for housing and modern necessities such as refrigerators, air-conditioners, bicycles, telephones, computers and cars. All require metals that are found, evaluated and mined by geologists and engineers.

Central to this world-wide economic transformation is a robust minerals industry. At the epicentre of that industry are geologists, supplying energy minerals, iron for building, copper for electricity collection and distribution, gold as a currency hedge, specialist minerals for modern communication devices and the rare metals critical for next-generation green energy supply.

As the bumper sticker says "if it can't be grown, it has to be mined". Geology already has a critical societal, economic and scientific role.

Julian Vearncombe

ALPHABET SOUP

Sir, In several recent letters, namely John Gahan's 'Volcanoes and innocence' (*Geoscientist* 21.10 November 2011) and associated comments, abbreviations are used without being preceded by the full version of the name. While obvious abbreviations such as BGS might pass muster in this publication, it is surely inexcusable?

Iain A Williamson

Editor writes: Apologies if the alphabet soup of climate change has become a little thick of late. Iain is right; we normally do employ the rule of placing abbreviations in brackets after first use of the full version in any piece. However, in Letters particularly (where space is very tight) we take a judgement about familiarity. Iain cites 'BGS' (British Geological Survey) as an abbreviation that we can reasonably expect our readers to know without explanation, for example. If we were writing for the general public we would not take this view.

The letters to which Iain refers include abbreviations of verbose titles and terms, namely IPCC (Intergovernmental Panel on Climate Change) and AGW (Anthropogenic Global Warming) whose use, even once, may save several lines. We took the view that 'IPCC' ought to be familiar to everyone who keeps up with current affairs. 'AGW' we accept is probably only familiar to those adept in the jargon of climate change, and should indeed have been explained in full.

VOLCANIC GAS

Sir, Your correspondent's assertion that "there is no CO₂ fingerprint that identifies anthropogenic carbon dioxide from that produced by volcanism", is arguably off the mark. Leaving aside that the amount of carbon dioxide accumulated in the atmosphere (the Keeling curve and ice core data) very largely correlates with fossil fuel combustion (calculated from commercial sales) minus ocean absorption (calculated from change in pH), there is another fingerprint clue.

Fossil fuel carbon, unlike volcanic carbon, is depleted in ¹³C, as is carbon from deforestation. Both these sources are anthropogenic. Both these sources are biotic carbon and as such passed through the biosphere's photosynthesis filter that prefers ¹²C (depleting ¹³C). Indeed chapter two of the 2007 IPCC science assessment covers this point (its figure 2.3). Also volcanic carbon is depleted in ¹⁴C whereas carbon from deforestation is not.

Jonathan Cowie

NOTES & CORRECTIONS

■ NOVEMBER COVER



The ammonite on the November cover has been diagnosed as *Coroniceras lyra*, from the L. Sinemurian (Jurassic – pic. Courtesy, Murray Edmunds). We are grateful to him and Prof. John

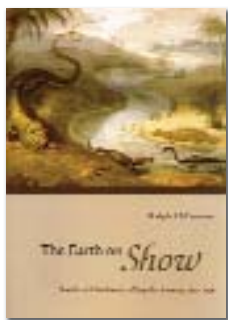
Cope for help in identifying this cropped Agency photo. More on the Society blog entry, 13 Dec 2011: 'All in a whorl'. See front page link.

■ DEC/JAN FEATURE



We got our Nicols in a twist over this picture, which should have been captioned "William Nicol (right) reads to his blind uncle". Thank you for all those who wrote in wondering how a blind man

could have invented the polarising microscope, and remarking upon his striking resemblance to Dr Strangelove.



The Earth on Show

Today's scientists, whether celebrating or complaining about it, often seem to think that 'public outreach' is a new trend. But, as Ralph O'Connor's wonderful study of the early years of geology *The Earth on Show - Fossils and the Poetics of Popular Science, 1802-1856* proves, being able to sell your subject was as important 200 years ago as it is now – perhaps more.

"If men competent to the task disdain to popularize science the task will be attempted by men who are incompetent: popularised it will be", said John Crosse in 1845. Luckily, early 19th Century geologists included in their ranks such men as William Buckland, Charles Lyell and later Hugh Miller – characters more than capable of holding a crowd.

Connor outlines, entertainingly and in meticulous detail, the tools these early champions of geology used, dispelling some popular 'myths' surrounding the science's early years – particularly that geologists were at loggerheads with the religious establishment. Yes, there were 'liberals' and 'literalists', but these were two points on what O'Connor calls a 'spectrum of debate'.

Early geologists won respect by incorporating, not openly challenging, established ideas about Earth's history. To win over a public familiar with the narrative tropes and imagery of the Book of Genesis, Paradise Lost and Childe Harold, it was necessary to draw on these themes rather than dismiss them. Thus, strange new creatures were likened to dragons or biblical monsters, geologists to Byronic heroes and the early Earth to Hell.

"What if there was an ancient, very large sort of octopus, like the kraken of mythology?" asked US geologist Mark McMenamin, in the now notorious GSA press release entitled *Ancient kraken lair discovered*. "A cunning sea monster ... a kraken of such mythological proportions it would have sent Captain Nemo running for dry land."

Amid all the outrage this fanciful release evoked among the strait-laced, no-one remarked on the age-old nature of this

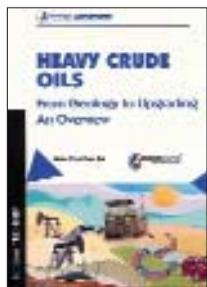
narrative trick. "Imagine an animal of the lizard tribe" writes Gideon Mantell in 1827, "three or four times as large as the largest crocodile...such a creature must have been the *Iguanodon*!"

Wildly speculative, yes; but stories like these bring geology to life for the uninitiated. Though a historical study, *'The Earth on Show'* demands to be taken seriously by today's scientists and science communicators. It is a brilliant reminder of how empathising with your audience is as important as presenting the best factual evidence – a skill which perhaps comes more naturally to the poet.

Reviewed by *Sarah Day*

THE EARTH ON SHOW - FOSSILS AND THE POETICS OF POPULAR SCIENCE, 1802-1856

RALPH O'CONNOR, Published by: Chicago University Press
2008. ISBN: 9780226616681 (cloth) 9780226616704 (e-book). 542pp **List price (cloth): \$47.00**,
<http://press.uchicago.edu/ucp/books/>



Heavy Crude Oils: From Geology to Upgrading

Heavy Crude Oils is a comprehensive review of all aspects of heavy crudes. Part 1 deals with definitions, composition and geological origins. A brief review of the key terms, such as 'heavy', 'extra-heavy', 'bitumen', 'tar sand' and 'oil sand' (the book uses "heavy crudes" for all of them), is followed by a section on the statistical importance of the world's heavy crude resource.

Part 2, the biggest section, details the reservoir habitat and the production methods commonly used to exploit heavy crudes. Oil sand mining is used for completely immobile crudes, where the reservoir is excavated wholesale and the separated sand returned to the ground after processing. Crudes which are to some degree mobile can be produced either "cold" or by heat-treating them.

Part 3 examines the transport of heavy crudes, and the various methods of reducing viscosity. These include heat treatment (I was surprised to learn that it is possible for heat treatment to worsen the rheological properties of crudes),

dilution with solvent, aqueous emulsions, and techniques still in the experimental phase, such as core annular flow. Part 4 looks at upgrading of heavy crudes, focusing on the lowering sulphur and metal contents. The processes of de-asphalting, visbreaking, coking and hydrotreating are described, and their relative merits and de-merits examined. Much of this section was new to me, but it is very clearly written and all the terms and various acronyms are fully explained.

Part 5 tackles the environmental issues that arise out of the very nature of heavy crude production, such as the problems of sand treatment and disposal in bitumen mining; the large amounts of water necessary to generate steam for steam soaking; and the amounts of CO₂ produced by steam generation and by some of the upgrading processes. Part 6 looks at the ongoing technical challenges associated with major heavy oil projects. This section also contains useful summary figures for the costs involved, and a cost comparison with conventional crude production.

The book is very clearly written (written in French, it has been Englished by a native speaker) and would usefully serve any company that is interested in investing in heavy crude exploration and production. Given the amount of untapped heavy crude out there, more and more companies will no doubt be investigating that possibility in the not too distant future. This book is a very good place to start.

Reviewed by *Pete Webb*,
Petrus Consulting, High Peak, Derbyshire

HEAVY CRUDE OILS: FROM GEOLOGY TO UPGRADING – AN OVERVIEW

ALAIN-YVES HUC (ed.) Published by: Editions Technip
Publication date: 2010 ISBN: 978-2-7108-0890-9.
439pp. **List price: \$US115.00; €100.00**,
www.editionstechnip.com

REVIEWS: COPIES AVAILABLE

Interested parties should contact the Reviews Editor, Dr. Martin Degg 01244 513173; m.degg@chester.ac.uk, only. Reviewers are invited to keep texts. *Review titles are not available to order from the Geological Society Publishing House unless otherwise stated.*

■ **Modelling Uncertainty in the Earth Sciences** Caers, J (2011), Wiley-Blackwell

■ **Basic Geological Mapping (5th Ed)** Lisle, R J, Brabham, P & Barnes, J (2011), Wiley-Blackwell

PEOPLE

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

CAROUSEL

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

MARCIAN D BLEAHU



Marcian D Bleahu (former Director of the Geological Institute of Romania) was awarded the

Percival Allen Medal of the Association of European Geological Societies (AEGS) at MAEGS-17, held in Belgrade last year. The Percival Allen Award was created to reward Earth scientists who have contributed greatly to fostering international relations in their science.

ANDREW HURST



Andrew Hurst (Professor of Petroleum Geology, University of Aberdeen) has been

awarded the AAPG Grover E Murray Memorial Distinguished Educator Award, 'in recognition of distinguished and outstanding contributions to geological education'. Hurst received the award jointly with Professor Howard Johnson, Shell Professor of Petroleum Geology, Imperial College, London.

NEAL MARRIOTT



Neal Marriott (currently GSL Director of Publishing) will assume the new role

of Director of Publishing, Library and Information Services from 1 January 2012 and have overarching responsibility for managing both Publishing House and Library. The post has been created to ensure optimal sharing of skills and experience across these

Glossop Award and Medal, 2011

Members of the Engineering Group gave an enthusiastic reception to the 12th Glossop Lecture and the winner of the Glossop Award



Eddie Bromhead



Emma Slack and Sophie Gibb

Adler deWind writes: The Royal Geographical Society's lecture theatre was packed on November 23 last year to hear Eddie Bromhead (Professor of Geotechnical Engineering, Kingston University London) deliver the 2011 Glossop Lecture entitled 'Reflections on the residual strength of clays with special reference to bedding-controlled landslides.' The lecture was preceded by a presentation from the 2011 Glossop Award

winner, Sophie Gibb (Key GeoSolutions Ltd.) on 'Application of presplit blasting to final faces in hard rock quarries.'

PRESENTATION

The Award and Medal were presented to Ms Gibb and Prof Bromhead by Emma Slack, Rudolph Glossop's younger daughter. Ms Gibb was presented with a copy of the recently published book *Rudolph Glossop and the Rise of Geotechnology*, by Ronald

Williams, as reviewed by Ian Sims in the previous issue. She also received a cheque and certificate.

The evening was presided over by David Entwisle (BGS), Chair of the Engineering Group, who announced at the meeting that Prof. Bromhead will take over Editorship of the *Quarterly Journal of Engineering Geology and Hydrogeology* (QJEGH) in 2013, in succession to Mike Winter.

departments and to support implementation of Library Review recommendations. Sheila Meredith's successor, to be recruited in the first half of 2012 (following a review of library management requirements) will report to Neal.

SOSPETER MUHONGO



Sospeter Muhongo, University of Dar Es Salaam and Editor-in-Chief of the *Journal of African*

Earth Sciences (and Honorary Fellow of the Society) has been decorated with the *Ordre des Palmes Académiques*, a French Order of Chivalry for academics, cultural and educational figures. Originally a decoration founded by Emperor Napoléon (Established in 1808 by Napoleon) to honour eminent members of the University of Paris, it was established as an order in 1955 by President René Coty.

TED NIELD



Ted Nield, Editor, *Geoscientist*, has been commissioned by Granta Books to write his third book for them. Provisionally titled *Beyond the Vale – a personal journey through time's lost landscape*, the book will combine personal memoir with the history of our use of Earth materials, and warn that the vanishing of Britain's quarries, mines and spoil heaps has divorced us from our planet's past.



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.

Hong Kong visit

President-elect David Shilston and Chartership Officer Bill Gaskarth visit Hong Kong's Regional Group.

The HKRG held its 10th Anniversary in November and invited President-elect David Shilston as guest speaker at its celebration dinner on Friday 18 at the Hong Kong Football Club (see below/right/left). The occasion presented an opportunity for the Society to develop contacts with companies and geologists in Hong Kong and with Hong Kong University, and hence Chartership

Officer Bill Gaskarth accompanied David on his visit.

Meetings were held, with geologists in the Hong Kong Government's Geotechnical Engineering Office, Arup, Jacobs, AECOM and Atkins, to promote the Society's proposal for accrediting Company Training Schemes. This met with considerable interest, and it is likely that applications will be received soon. (At the time of writing once course had already been submitted, by Gammon Construction).

Below: Hong Kong foodies. Back: Ken Ho (Geotechnical Office CEDD), Celia Choy (Secretary HKRG) Front: David Shilston, Paul Cheung (HKRG Chairman), Bill Gaskarth at the 10th Anniversary Dinner



A star rises in the East

Ian Jack (Hong Kong Regional Group) writes: HKRG can look back on the last 10 years with pride, having arranged numerous meetings, fieldtrips and conferences; maintained professional standards; promoted the role of geoscientists; liaised with related professional bodies; and facilitated mentoring and scrutineering for chartered geologist candidates in Hong Kong.

We hope that the next decade will be even more successful as

we build on this legacy, maintaining our busy programme and undertaking new initiatives. The HKRG is therefore always eager to hear from geoscientists interested in sharing their experiences and ideas.

All Committee members contributed to the dinner's success, but special thanks go to Philippa Halton and Celia Choy. Thanks also go to David and Bill for taking the time out from their busy schedules to visit us in Hong Kong.

IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Allen, Anthony William*	Friedman, Gerald M*\$	Oates, Francis *
Collie, Michael*	Hepworth, Barrie*	Price, Ivor C*
Cruickshank, Arthur	Humphreys, Adrian *	Uko, Suzuki*
Edwards, Wilfrid Thomas*	Kwolek, Julian Kenneth*	Young, Roger Andrew*

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.

Accreditation HK-style

Training Scheme Accreditation is being developed as a partnership between the Society and participating companies to address the need for structured training and mentoring for early career geologists and help them develop the necessary competences required for Chartership (more information on www.geolsoc.org.uk). Around 60 young geologists took part in a series of company meetings and one arranged by the HKRG. They left no doubt as to Hong Kong's interest in Chartership, and the HKRG has an important role to play in fostering this. The Society presently has some 12 scrutineers

on the list in Hong Kong, and at a meeting arranged with CGeols and at the dinner produced a further nine recruits (as well as further enquiries about Accreditation).

We also visited Hong Kong University, where Professors Lung Chan and Andrew Malone described how the geology degree is being changed from three to four years. The present degree boasts an accredited pathway, and we hope that in the new structure most, if not all, students will graduate with an accredited degree. All in all this was a most fruitful visit, and our thanks are to Paul Cheung and his HKRG committee. BG



Graduates and students of HKU Earth Sciences with Prof Lung Chan and Prof Min Sun

PEOPLE...

Bath discoveries

The recent *Bath Discoveries Conference*, celebrating the Petroleum Group's 30th birthday, was attended by 165 people in the magnificent surroundings of Bath's Pump and Meeting Rooms. The conference, entitled *Major*

Discoveries of the 21st Century 'Standing on the Shoulders of Giants', presented an impressive array of 22 talks over two and a half days. A longer account by Mike Bowman can be found in the online version of this issue.



DISTANT THUNDER

With St Valentine's Day in mind, geologist and science writer Nina Morgan*, contemplates true love



Antony and Cleopatra, Napoleon and Josephine, Paris and Helen of Troy. These are just a few of the passionate love affairs that have literally, it seems, changed the course of history. But what about the influence of true love on the development of geology? The pivotal role played in the 19th Century by intelligent and loving sisters and wives in assisting the researches of their brothers and husbands is now increasingly recognised and acknowledged. But important though these contributions are, one could argue that they essentially filled in details related to the understanding of geology – albeit often very important ones. But in one case, at least, the love of a good woman did have a profound effect on the course of geological history.

According to his biographer,

Archibald Geikie, Roderick Murchison "had entered the [military] service with high hopes of distinction, but by a series of unfortunate circumstances and through no fault of his own, he had been grievously disappointed". The end of Napoleonic Wars dashed Murchison's hopes of distinguishing himself in active service, and when he returned to England from France in 1815, Murchison was at a very loose end.

But in early summer of that year, things began to look up. Murchison was introduced to

Portrait of Sir Roderick Impey Murchison 1st Bt., by Stephen Pearce



Charlotte Hugonin, described by the mathematician, Mary Somerville, as "an amiable and accomplished woman, with solid acquirements which few ladies at that time possessed [and] had taken to the study of geology". After what must have been a whirlwind romance, the pair were married at the end of August.

Marriage marked a real turning-point in Murchison's life. "From this time he came under the influence of a thoughtful, cultivated, and affectionate woman" Geikie records. "Quietly and imperceptibly that influence grew, leading him with true womanly tact into a sphere of exertion where his uncommon powers might find full scope". According to Somerville, it was soon after his marriage that Murchison "began that career which has rendered him the first geologist of our country".

One of Murchison's greatest achievements was his delineation and definition of the Silurian system in Wales. But when it became obvious that some of the strata defined by Murchison as lower Silurian were equivalent to strata defined by the Reverend Adam Sedgwick as Upper Cambrian, geological

warfare erupted. The result was a protracted dispute which was only solved after several decades by the adoption of a new system – the Ordovician. It's pure speculation, of course – but if Murchison had never met Charlotte, would the Ordovician ever have come into existence?

► ACKNOWLEDGEMENT

Sources for this vignette include the DNB entry for Roderick Murchison; the DNB entry for Charlotte Murchison; *Life of Sir Roderick I. Murchison Based on his Journals and Letters by Archibald Geikie, John Murray, 1875; and Personal Recollections from Early Life to Old Age of Mary Somerville with selections from her Correspondence by her daughter, Martha Somerville, John Murray, 1874.*

► 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, where the programme and abstracts from the Conference on Geological Collectors and Collecting are available as a pdf file free to download.

* Nina Morgan is based in Oxford.

DIARY OF MEETINGS FEBRUARY 2012

Meeting	Date	Venue and details
Theme evening: Geochemistry East Midlands Regional	Tbc	Venue: University of Nottingham. Evening meeting. Talks: Field based geochemistry (speaker Anna Whittaker) and GBASE (speaker Tbc). Contact: David Boon E: dboon@bgs.ac.uk
Söderströmstunneln: geotechnical challenges for an innovative immersed tunnel in Stockholm Engineering Group	8 February	Venue: Burlington House. Time: 1730 for 1800. Speakers: Johannes Glückert, Tilo Spahn and Ralf Astalosch (Zublin GroundEngineering). Contact: Alexandra Boorer, Coffey Geotechnics Ltd, Atlantic House, Simonsway Manchester M35 0AW T: +44 (0)161 499 6800 E: alex_boorer@coffey.com
Rocks and Climate Change: How we can stop pulling the carbon trigger? Geological Society Shell	15 February	Venue: Burlington House 1500 and 1800. Speaker: Bryan Lovell (President, Geological Society of London). A Shell London Lecture. See p9 for details.
Wine, Whisky and Beer: The Role of Geology South Wales Regional	18 February	Venue: Room 1.25, School of Earth & Ocean Sciences, Main Building, Cardiff University, CF10 3AT. Time: 1030 for 1100. Speaker: Alex Maltman. Contact: Maria Clarkson E: swales.rg@geolsoc.org.uk
Forensic Geology Central Scotland Regional	21 February	Venue: David Livingstone Centre, Glasgow. Time: tbc. Speaker: Dr Laurance Donnelly. Contact: Caroline Lasham E: caroline.lasham@woodmac.com
A Geological Journey through Wine-Franconia, Bavaria. <i>Eine geologische Reise durch Weinfranken</i>	23 February	An Evening Lecture & Social Event. Venue: The Kenn Centre, Kenn, Near Exeter, EX6 7UE. Speaker: Gordon Neighbour. Time: tbc Contact: Dani Pullen E: swrg@geolsoc.org.uk
The Geomicrobiology of the Nuclear Fuel Cycle North West Regional	23 February	Venue: University of Manchester. Time: 1830. Speaker: Prof. Jon Lloyd (Professor of Geomicrobiology, University of Manchester). Contact: Chris Berryman T: 01925 291111 E: geologicalsociety.northwest@gmail.com

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OBITUARY



IAN STUART EDWARD CARMICHAEL 1930-2011

Pioneer of quantitative microanalysis and chemical thermodynamics in igneous petrology

Ian Carmichael, larger-than-life petrologist who introduced quantitative microanalysis and chemical thermodynamics into igneous petrology, died in Berkeley, California on 26 August 2011.

Ian did his BA in Cambridge where he came under the influence of C E Tilley. Since Tilley did not, apparently, want him as a PhD student he moved to Imperial College where he began research under supervision of George P L Walker. His thesis (1958) focused on Thingmuli, a Tertiary volcano in eastern Iceland. Ian used his field and petrographic skills to address one of the most contentious issues in Earth science at the time, namely the origin of silicic magma, and whether it could form solely by crystal

fractionation of basalt, or whether assimilation of older continental crust was required. The problem went to the very heart of crustal evolution, and his was a classic demonstration of the evolution of basalt to rhyolite.

MICROPROBE

On completion of his thesis, Ian became a lecturer at Imperial College. He developed his research on the crystallisation paths of feldspars in silicic magmas and became close friends with William S MacKenzie, who was following similar ideas experimentally in Manchester. In 1963, Ian took a six-month leave at the University of Chicago, where one of the first electron microprobes was being demonstrated. He quickly realised that this instrument would revolutionise petrology

and therefore asked to extend his leave to collect more data. When his request was refused Ian resigned, finding himself aged 34, with a wife and three young children, in Chicago, in the dead of winter, without a job. Before long he was invited to the University of California, Berkeley to give a lecture and this turned into a tenured position as an Associate Professor.

In 1964, when the study of magmatic rocks was largely descriptive, Ian Carmichael was asking detailed questions about whether the crystals in erupted lavas could be used quantitatively to determine the temperatures, pressures, dissolved water concentrations, and oxidation states of the magmatic liquids from which they crystallised. The answers necessitated, firstly, detailed microanalysis of crystals and matrix and secondly a thermodynamic approach to crystal-melt equilibrium. The latter was hindered by the lack of information on the thermodynamic properties of magmatic liquids under in situ high-temperature conditions.

Nevertheless, Ian and his students came up with innovative ways of estimating and extrapolating these properties, which gave him some bones to support his thermodynamic approach. Soon thereafter (1971) he discovered a moth-balled calorimeter in the Materials Science department and he and his students began to measure the properties of silicate liquids, including their compressibilities from sound

speed measurements, and their heat contents up to 1700°C. One of the best-known fruits of this work is the MELTS computer program of one of Ian's students, Mark Ghiorso. Despite, however, his emphasis on microanalysis and experiment Ian's research was always field-orientated and he maintained an active field programme into his 70s.

Ian became Department Chairman in Berkeley, a position he held on two separate occasions. He also spent 15 years as Associate Dean and Associate Provost at UC Berkeley, at the same time serving as Editor-in-Chief of Contributions to Mineralogy and Petrology. In 1986 he was invited to review my department at Northwestern University at a time when we feared closure. Once Ian and Karl Turekian (Yale) had reported and browbeaten the Dean, the University reprieved us, delivered a pat-on-the-back and awarded us an extra faculty position.

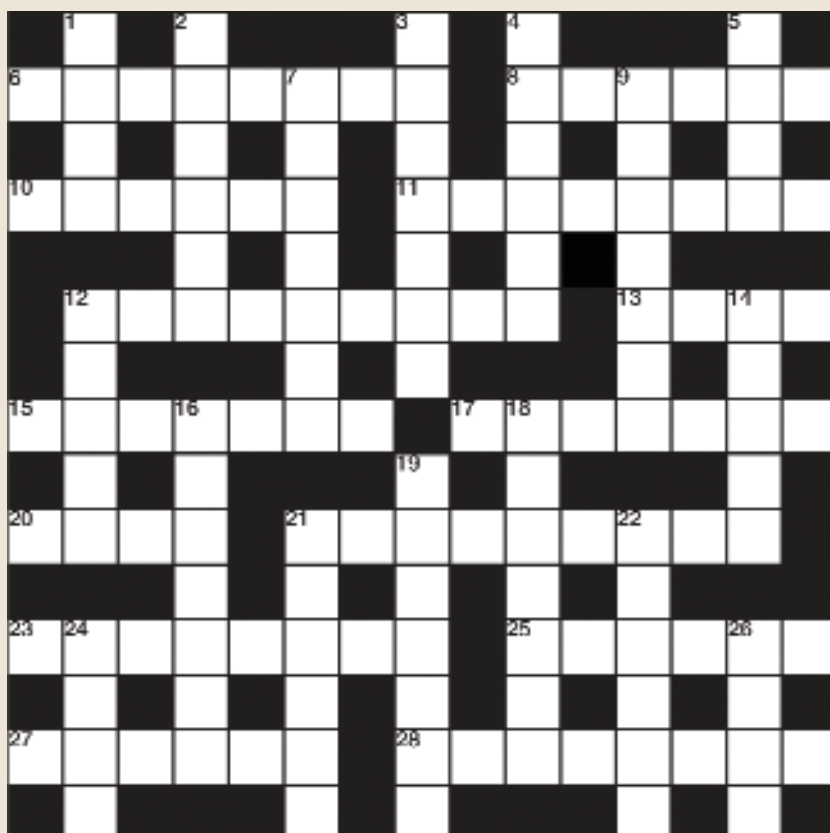
Ian was a Fellow of the Royal Society. His contributions were also recognised by the Bowen Award (AGU), the Day Medal (GSA), the Murchison Medal (GSL), the Schlumberger Medal (Min. Soc., GB), and the Roebling Medal (Min. Soc. Am.).

► By **Bernard Wood**

► For a longer version – see online. Follow 'Obituaries' link, bottom right, *Geoscientist* front page



CROSSWORD NO. 154 SET BY PLATYPUS



ACROSS

- 6** High-silica muscovite (8)
8 UN educational and cultural agency headquartered in Paris (1,1,1,1,1,1)
10 Coarsely foliated high-grade metamorphic rock (6)
11 Fine-grained muscovite (8)
12 Side-to-side shearing action (9)
13 Swirling, reverse current formed when fluid passes an obstruction (4)
15 Riverine (7)
17 Boulder stranded far from home (7)
20 African rift triangle (4)
21 Scientist who studies the living world (9)
23 Lustrous grey metalloid toxin, found chiefly in the mineral stibnite (8)
25 With same chemical formula but different molecular structure (6)
27 Water nymph, both in biology and myth (6)
28 Instrument for measuring electrical resistance (8)

DOWN

- 1** Become reduced in thickness, as from Girvan to Moffat (4)
2 Cut down into its bed as a result of rejuvenation (6)
3 Earthquake-related (7)
4 Berber nomad of the Sahara (6)
5 Rabbit or hare's short, erect tail (4)
7 Largest Class of Arthropoda (7)
9 Assorted waste products of living things, Latinly (7)
12 Type of stereo net where equal angles on a sphere surface project as equal distances (5)
14 Superficial deposits (5)
16 Patina applied to boulders by millennia of desert dew (7)
18 Transition metal discovered by William Wollaston, but too hard for striking a medal (7)
19 Many angled two-dimensional figure (7)
21 Marine seismic source, producing waves in the 1000 - 10,000 Hz band (6)
22 Smoothed by the application of heat and steam (6)
24 Tenth antediluvian patriarch (4)
26 Biblical paradise (4)

WIN A SPECIAL PUBLICATION

The winner of the November Crossword puzzle prize draw was Helen Jackson of Hungerford.

All correct solutions will be placed in the draw, and the winner's name printed in the April issue. The Editor's decision is final and no correspondence will be entered into. **Closing date - February 27.**

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

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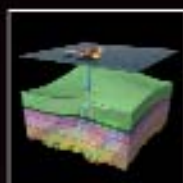
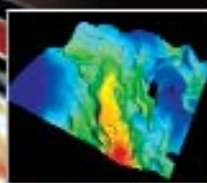
SOLUTIONS NOVEMBER

ACROSS:

6 Zeolites **8** Yawing **10** Zooids **11** Evolving
12 Premature **13** Rule **15** Clinker **17** Cheddar
20 OPEC **21** Allotropy **23** Mimicked **25** Phloem
27 Bowels **28** Nutation

DOWN:

1 Zero **2** Alpine **3** Osseous **4** Zygote **5** Onan
7 Testate **9** Wavered **12** Polyp **14** Loamy
16 Nacrite **18** Hotspot **19** Sliding **21** Arkose
22 Oblate **24** Iron **26** Eyot



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New Abstract Deadline 29 February 2012

There has been a quiet revolution in the precision with which geochronologists and biostratigraphers are able to date and correlate rock sequences. Recent advances in radiometric ITDMS U-Pb dating of zircons and computer-based methods of quantitative biostratigraphy now make it possible to produce sub-100 k.y. resolution as far into deep time as the Palaeozoic. Orbital cyclicity has been demonstrated in the Cenozoic and Mesozoic and has been suggested for Palaeozoic successions, allowing age calibration using the 40 400Ky cycles. This conference will bring together chronostratigraphy specialists, biostratigraphers and applied geologists to explore new synergies to bring the 'new dating' into ever wider applied and practical uses.

Keynotes:

Bruce Levell, Chief Scientist Geology, Shell
Felix Gradstein, Museum of Natural History, Blindern, Norway
Thijs Vandenbrouke, Université Lille 1 - Sciences et Technologies, France
Peter Sadler, University of California, Riverside
Andy Gale, University of Portsmouth

Conference fees:

£150 for fellows of the Geological Society, £250 for non-fellows, and £50 for students

For further information and registration, please contact:

Steve Whalley, Event Co-ordinator: +44 (0)20 7432 0980 or email: steve.whalley@geolsoc.org.uk



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Strata and Time: Probing the Gaps in our Understanding

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Call for papers:

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- Accumulation of the record: rates and gaps
- The biostratigraphic record: accumulation and quantification
- Subsurface stratigraphy: contributions from well and seismic data
- The architecture of the record: statistical and modelling approaches

Abstracts of up to 250 words should be sent to ellie.duncanson-hunter@geolsoc.org.uk by 30 April 2012.

The 2012 William Smith Lecture will be given by Professor Peter Sadler (University of California, Riverside).

Convenors:

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Further information

For further information about the conference, please contact:

Ellie Duncanson-Hunter, Conference Office, The Geological Society, Burlington House, Piccadilly, London W1J 0BG

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