Geoscientist

The Fellowship magazine of The Geological Society of London | www.geolsoc.org.uk | Volume 22 No 7 | August 2012

INTERNATIONAL DEVELOPMENT
How geology can help

FRACKING REPORT
Regulation & best practice key

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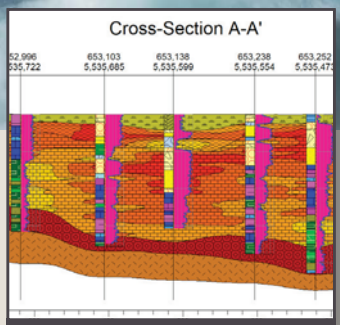

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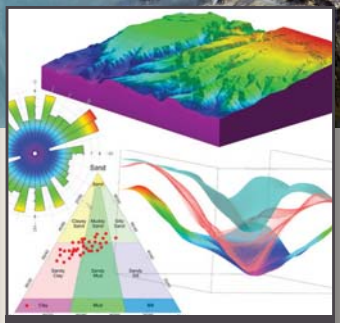

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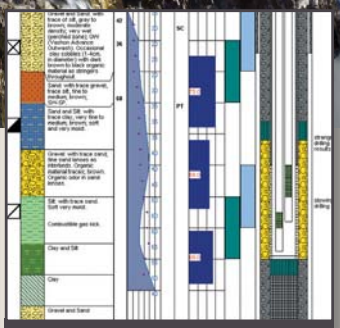

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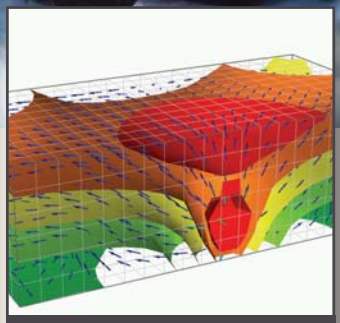

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FEATURES

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FRONTIERS MEETING 2012

Nanogeoscience: a new frontier in science and technology for Earth and environmental systems

10 December 2012

The Geological Society of London, Burlington House, Piccadilly, London

Frontiers Meetings are 1-day meetings focused on short presentations and discussion to explore developments in emerging geoscience areas, followed by an open access discussion forum

Convenors

Vicky Coker (Manchester), Éva Valsami-Jones (Birmingham), David Vaughan (Manchester)

Registration for this meeting is free, but you must pre-register your interest in attending
(Please email Steve Whalley at the address below)

Call for papers

Over recent decades, there have been dramatic developments in techniques for studying nanometer-sized particulate materials that occur naturally, or that can be synthesised in the laboratory or on an industrial scale. Nanomaterials have properties which are distinct from their larger sized compositional equivalents and which are, in some cases, of practical value in fields ranging from technology to medicine. Nanotechnology presents both opportunities and threats, the latter because of the limited knowledge of how industrial nanomaterials behave when released into the natural environment. Nano-particles also play a key role in the natural geochemical cycling of the elements, not least because they have large surface area for the uptake of toxic materials ranging from radioactive species to organic pollutants and inorganic pollutants such as arsenic. Oral presentations are invited on all aspects of nanogeoscience.

Abstract Submission Deadline: 28 September 2012

Please submit abstracts to Steve Whalley at steve.whalley@geolsoc.org.uy

For further information about the meeting, or to submit an abstract, please contact:
Steve Whalley, The Geological Society, Burlington House, Piccadilly, London W1J 0BG
T: 020 7434 9944 F: 020 7494 0579
E: steve.whalley@geolsoc.org.uk W: www.geolsoc.org.uk/frontiers

TIEN SHAN, KAZAKHSTAN. UNDERSTANDING THE RULES OF CONTINENTAL DEFORMATION FROM THE CO-EVOLUTION OF FAULTS AND MOUNTAINS

Front cover: Maxim Petrichuk/ Shutterstock.com

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CANUTE FACTOR

When Richard Feynman was called in to help investigate the 1986 Challenger disaster he famously conducted a simple demonstration to show how cold affected the elasticity of the rubber O-ring seals between sections of the solid rocket boosters, which had failed. However, as he later pointed out, that was only the accident's proximal cause. At root lay an institutional failing - NASA's persistent adjusting of safety envelopes, to help speed up its processes in order to keep to its launch schedule. NASA was confusing what was, with what it believed. This never works because, as Feynman famously put it, 'nature isn't fooled'. Nature doesn't care what we believe.

Well, new research indicates that the coast between North Carolina and Massachusetts is undergoing the world's fastest sea-level rise. The result, published in Nature Climate Change by Asbury Sallenger[1] (USGS, St Petersburg, Florida) and colleagues suggests that sea level between Cape Hatteras and Boston is rising at between three and four times the global average. Barely a fortnight before appeared however the North Carolina Senate tried to ban state agencies from reporting that sea-level rise is accelerating.

The law, approved by the North Carolina Senate on June 12, banned state agency scientists from using exponential extrapolation and insisted they stick to linear instead. International ridicule led to its being rejected a week later; but North Carolina's agencies now have to wait between three and four years for a new, home-grown sea-level study to report before they can say anything.

In true disaster-movie style, local industries and coastal communities fearing loss of investment were behind the political move, citing a single published paper from 2011[2] that suggested, contrary to the vast majority of research, that sea-level rise had slowed since the 1930s.

It is natural, perhaps, for politicians to confuse dreams and reality. Unless they were so deluded, they surely wouldn't want the job in the first place. What is odd about this story is that it reveals how many legislators manage to preserve their delusion despite all the evidence to the contrary that life must by now surely have thrown at them. Imperviousness to evidence is perhaps another way of saying 'conviction politics'.

Sadly, while it may be possible to fool all the people all the time, we forget Feynman's dictum at our peril.

DR TED NIELD EDITOR

REFERENCES

1 ***Hotspot of accelerated sea-level rise on the Atlantic coast of North America***, by Asbury H Sallenger Jr, Kara S Doran & Peter A Howd. Nature Climate Change(June 2012) doi:10.1038/nclimate1597

2 ***Sea-Level Acceleration Based on U.S. Tide Gauges and Extensions of Previous Global-Gauge Analyses*** by J R Houston and R G Dean. Journal of Coastal Research: Volume 27, Issue 3: 409-417. 2011 doi: http://dx.doi.org/10.2112/JCOASTRES-D-10-00157.1

Intuition counts

BY IAIN BARTHOLOMEW

Successful exploration still depends, at the highest level, on a bit of that old black magic, says **Iain Bartholomew***

What makes a successful exploration company? Why are some significantly and consistently more successful than others? And does size matter – does having the resources of a large-cap company contribute to success, or detract from it? As an investor, how do you choose a company to put your money in?

RISK SPREAD

I believe that the root of successful exploration lies in having a good "nose" for oil. The difference between a large-cap company and a small one is just one of scale. Large companies spread their risk between a combination of "near-field" exploration (with a focus on adding short-term value to existing production hubs) and "impact growth" exploration – or, if you like, 'finding the next big thing'. Small caps rarely enjoy the security of a safety net provided by material-producing assets, so their focus is on finding new ones. But for both, the bottom line remains the same - having a good exploration team.

In each case, good basic data and wide-ranging regional studies are crucial. Small-caps can achieve this just as well as large ones, though they may have to be more innovative and resourceful in finding the data they need. The success of any exploration team depends on vast experience and knowledge, and how these are brought to bear.

The understanding of risk and reward in an exploration portfolio is also critical for both small and large cap companies. A larger company will have a different attitude to risk compared with a purely exploration company – after all, we depend on the larger companies for most of our energy supply, and they in turn have to answer to their stakeholders. But having wise and experienced explorers will be what justifies that caution in the short term with new and viable assets in the long term.

Good explorationists are more than just bunch of nodding donkeys

INTUITION

So what makes a good explorer – or exploration team? It's a combination of things. Geoscience – and being enthused about geoscience – is the foundation. It is exciting – even someone with vast experience can find something new every day – and intuition plays a large part in that. Exploration companies need to provide an environment with an element of freedom and even nurturing, to bring out the best in their exploration team. But there is no substitute for the basics – a solid understanding of the sub-surface, and immense patience, though it isn't always about processes and procedures. Sometimes success can depend on a random thought – and the courage then to follow your nose to wherever it may lead.

***Iain Bartholomew** is Exploration and Sub-Surface Director for Centrica. He served as Vice President of the Geological Society for six years and spoke recently on this topic at the SPE London Conference (27-28 June) - **www.spelondonconference.com**. Plans for the SPE Second Annual London Conference and Exhibition will be announced shortly

SOAPBOX CALLING!

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

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

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

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

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

> "I BELIEVE THAT THE ROOT OF SUCCESSFUL EXPLORATION LIES IN HAVING A GOOD "NOSE" FOR OIL. THE DIFFERENCE BETWEEN A LARGE-CAP COMPANY AND A SMALL ONE IS JUST ONE OF SCALE"
> **Iain Bartholomew**

INTERNATIONAL CONFERENCE

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History Of Geology Group

ARUP

October 22nd-23rd, 2012

Appreciating Physical Landscapes: Geotourism 1670–1970

The Geological Society, London

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

Lithograph of Kaise-grotte at Bad Bertrich from Dr. August Goldfuss' Naturhistorischer Atlas, 1826

Summary Conference Information

The conference is split between: a

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

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

For further information about the conference please contact:

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

T: 020 7434 9944 F: 020 7494 0579

E: naomi.newbold@geolsoc.org.uk

W: www.geolsoc.org.uk/geotourism12

Conference Organiser:

Tom Hose, *University of Bristol, UK*

gltah@bristol.ac.uk

Follow this event on Twitter #apl12

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William Smith Meeting 2012

Strata and Time:

Probing the Gaps in our Understanding

4–5 September 2012

Burlington House, London, UK

An international conference to explore the relationship between the preserved strata of the rock record and the passage of geological time. Stratigraphic practice can only be as sound as the underlying assumptions relating strata with time. Our focus will be on identifying, evaluating and updating the models that lie behind stratigraphic methods. The scope of the conference will extend from the controls on preservation of strata in the record, through the qualitative and statistical properties of strata, to the implications for analysis, interpretation, modelling and prediction.

Sessions:

- Layers and completeness
- Sediment routing, processes and controls
- Subsurface/seismic methods and prediction
- Stratotypes and missing time

Keynote and Invited Speakers include:

Andrew Miall · Bradford Macurda · Roy Plotnick · John Tipper · Douglas Jerolmack Cedric Griffiths · Philip Allen · Linda Hinnov · Vamsi Ganti

The 2012 William Smith Lecture will be given by Peter Sadler (University of California, Riverside) on *Scaling laws for the aggradation and progradation of the stratigraphic record*

Convenors:

David Smith · Robin Bailey · Peter Burgess · Alastair Fraser

A thematic set of papers will be published in the Journal of the Geological Society

Further information

For further information, including the conference programme, please visit the conference website at www.geolsoc.org.uk/williamsmith12

Enquiries to Naomi Newbold, Conference Office, The Geological Society, Burlington House, Piccadilly, London W1J 0BG

E: naomi.newbold@geolsoc.org.uk

Follow this event on Twitter #wsmith12

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Registration Now Open

East Africa

Petroleum Province of the 21st Century

24-26 October 2012

The Geological Society, Burlington House, Piccadilly, London

Conveners:
Andrei Belopolsky, Premier Oil
John Argent, BG Group
Ian Cloke, Tullow
Niall McCormack, Afren

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East Africa was written off as an oil and gas province for many years. But the exploration campaigns of the last 5 years have changed that perception. Spectacular successes onshore Uganda and offshore Mozambique have attracted attention around the world and made East Africa an exploration hot bed of the second decade of the 21st Century.

Activity continues to pick up speed and is now expanding into neighbouring regions triggering a dramatic change in our geological knowledge of the basins being explored.

This conference will address the regional geological context, specific case studies and discuss the new and emerging exploration plays of East Africa. The meeting will bring together experts from industry, academia, seismic contractors showing the latest data, with keynote speakers from Anadarko, ENI, Tullow, Ophir, Fugro Robertson, BG Group and others.

There will also be a conference Dinner taking place at the Cavendish Hotel in Westminster on the evening of the 24th of October featuring a conference after dinner speaker, Tim O'Hanlon of Tullow Oil.

For further information, abstract submission and registration, please visit the conference website **www.geolsoc.org.uk/eastafrica12**

For further information, abstract submission 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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www.geolsoc.org.uk/petroleum

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Call for Abstracts - Deadline: 17 September 2012

Industrial Structural Geology:

Principles, Techniques and Integration

28 - 30 November 2012

The Geological Society, Burlington House, Piccadilly, London

Convenors:
Frank Richards, Dana Petroleum
Nick Richardson, Dana Petroleum
Steve Rippington, CASP
Woody Wilson, BP

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CALL FOR ABSTRACTS

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

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

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

Confirmed Keynote Speakers:

Joe Cartwright (Cardiff University)
John Cosgrove (Imperial College)
Martin Jackson (AGL, BEG, University of Texas)
Steve Jolley (Shell)
Paul MacKay (Shale Petroleum Ltd)
Dave Sanderson (University of Southampton)
Richard Swarbrick (Ikon Science/Geopressure Technology)
John Underhill (University of Edinburgh)
John Walsh (Fault Analysis Group, UCD)
Nicky White (University of Cambridge)
Graham Yielding (Badleys Geoscience)

For further information and registration, please contact:
Steve Whalley, Event Co-ordinator: +44 (0)20 7432 0980 or email: steve.whalley@geolsoc.org.uk

At the forefront of petroleum geoscience

www.geolsoc.org.uk/petroleum

Regulation is the key to safe fracking

Fracking can be undertaken safely if best practice and effective regulation are enforced, Royal Society and Royal Academy of Engineering's much-anticipated report concludes

SHALE GAS

Hydraulic fracturing can be managed effectively in the UK, as long as operational best practices are implemented and robustly enforced through regulation. That was the conclusion of a review by the Royal Society and the Royal Academy of Engineering published on 29 June.

Professor Robert Mair FREng FRS, Chair of the working group said: "There has been much speculation around the safety of shale gas extraction following examples of poor practice in the US. We found that well integrity is of key importance but the most common areas of concern, such as the causation of earthquakes with any significant impact or fractures reaching and contaminating drinking water, were very low risk."

REGULATION

He went on: "Strong regulation and robust monitoring systems must be put in place and best practice strictly enforced if the Government is to give the go-ahead to further exploration. In particular, we emphasise the need for further development and support of the UK's regulatory system, together with Environmental Risk Assessments for all shale gas operations and more extensive inspections and testing to ensure the integrity of every well."

> THERE HAS BEEN MUCH SPECULATION AROUND THE SAFETY OF SHALE GAS EXTRACTION FOLLOWING EXAMPLES OF POOR PRACTICE IN THE US

The review examined the scientific and engineering evidence relating to the environmental and health and safety risks associated with the onshore extraction of shale gas.

Below: Shale gas production plant in the Appalachians

The group concluded that hydraulic fracturing was an established technology used by the oil and gas industries for many decades in the UK, and that the risks of contamination of aquifers from fractures was very low, provided that shale gas extraction takes place at depths of many hundreds of metres.

SEISMICITY

The seismicity induced by hydraulic fracturing, the report said, was likely to be smaller in magnitude than the UK's natural earthquakes, and than those related to coal mining, which are also low by world standards. The report also pointed out that using open ponds for storing wastewater (historically used in US fracking operations) is not permitted in the UK, which possesses numerous treatment facilities. Similarly, procedures for the disposal of naturally occurring radioactive materials (present in the hydraulic fracturing wastewaters) have been developed already. ▶

Image © J.B. Earl & Statoil

The report's authors noted that a particular cause for concern was poor cementation and casing failures, which could potentially lead to leakages and wider environmental contamination. This has happened in some US cases. The review therefore urged that priority be given to ensuring the integrity of every well throughout its lifetime.

EXTRACTION

If shale gas extraction were to be undertaken commercially in the UK, the report said, there should be strengthening of UK regulators, and lead responsibility for regulation of shale gas extraction should be given to a single regulator. The well inspection system should be strengthened to ensure that well designs are considered from an environmental as well as H&S perspective. Appropriate well-integrity tests should be carried out as standard practice, and Environmental Risk Assessments should be carried out for all shale gas operations and submitted to the regulators for scrutiny. Groundwater should be monitored for methane in groundwater before, during and after hydraulic fracturing is carried out, the report urged.

Professor Mair added: "As we made clear at the start, this review is not an exhaustive analysis of all the issues associated with shale gas and we have highlighted a number of issues that we believe merit further consideration, including the climate risks associated with the extraction and subsequent use of shale gas, and the public acceptability of hydraulic fracturing."

Below: Groundwater need not be contaminated by fracking, report concludes

Image: silver-john/Shutterstock.com

REFERENCES

- **Shale gas extraction in the UK: a review of hydraulic fracturing** is available for download at royalsociety.org, and **www.raeng.org.uk**
- See also letter from Professor Peter Styles, **this issue, p.22**

FUNNY OLD WORLD

Above: T Neville George (right) with Sir Edward Battersby Bailey

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Letters to the Editor

Breaking tradition

Sir, Your report on Rowntree's 150th anniversary (June 26) did not mention the origin of the advertising slogan, "Have a break, have a Kit Kat".

Professor Neville George, my uncle, met Rowntree in York at a meeting of the British Association for the Advancement of Science, and recounted the pleasure he and his wife Sadie had from a Kit Kat after a hard-working day. He said that when he took his students on geology field trips they had no time for lunch, but added: "If we need a break we have a Kit Kat". Rowntree called his ad-man and they adopted the slogan. Some 50 years later our grandchildren love to relate this story to their classmates as they crunch their Nestlé Kit Kat.

M. A. DAVIES
Bramcote, Notts

LUCKY BREAK

The great Thomas Neville George FRS (1904-80), distinguished professor and Head of Department at Swansea and Glasgow universities and former President, famous for his work on the Carboniferous Limestone and for a masterly map of his native Gower, has another claim to fame, it emerged in June in a letter to The Times. He was responsible for the advertising slogan "Have a break – have a Kit Kat."

That this snappy piece of English should have come from such a source is all the more surprising, because while George's work was noted for meticulousness it was also famous for a droning, monotonous and enervating written style that positively repelled any sensitive reader's attention. (His wife Sadie is said to have acted as 'literary editor' on all his papers, which some say explains the phenomenon.)

The story goes that George met Sir Joseph Rowntree at a BA meeting and extolled the virtues of the confection as fieldwork rations – stating that: 'if we need a break we have a Kit Kat' Rowntree called his ad man and the rest is history.

Monitor: Dick Selley.
All contributions gratefully received. Please write to the Editor at Burlington House, or email **ted.nield@geolsoc.org.uk** marking your submission "snapper".

SOCIETY NEWS

FEES 2012-13

AGM approves new Fellowship dues, notes Society's attempt to protect those less able to pay. Dawne Riddle reports.

The Society's subscription rates for 2012-13, advertised in the May issue (*Geoscientist* 22.4, p11) were approved by the Annual General Meeting on June 13 without objection. The AGM noted that the distribution of the fee increase – which overall was in line with inflation - protected members who were less likely to be able to afford the raise. For some membership grades, fees will actually be reduced to aid recruitment and retention.

Thus, rates for Junior Candidate and Candidate Fellows will remain unchanged. The 'Concession' rate will be reduced by 26.5% to £68pa, while the rate for full-time postgraduate MSc students will fall by almost £10 to £27.50pa, a reduction of 25.7%. The equivalent rate for full time PhD students will go down by just over £11 to £40pa – a cut of 22.3%.

The highest fee hike of 4.1% will affect Fellows between the ages of 28 and 59. Other age categories will rise by either 3.8 or 3.9%.

Edmund Nickless, Executive Secretary, told *Geoscientist*: "We continue to review our back office processes to improve efficiency and Fellows can help us by using direct debit or continuous credit card payment methods."

For further information about using DD or CCC payment please email: **mike.harris@geolsoc.org.uk**

Pour encourager les autres

Bill Gaskarth (Chartership Officer) announces a new website feature – Scrutineers describe their work for the Society in their own words.

Applications for CGeol continue to stay healthy, and those for CSci are increasing. The Chartership Committee therefore is looking to add to its list of Scrutineers for both of these titles from among existing Chartered Geologists and Scientists who have held the title for four or more years.

The commitment required is for no more than one day a year, to interview candidates normally at a venue in your area. Notes describing the Scrutineering experience have been produced by three of our current Scrutineers, and these are now to be found on the Society's website (link below). Here also you will find the short application form to become a Scrutineer.

Scrutineers under scrutiny: **www.geolsoc.org.uk/scrutineerjobdescriptions**
For further information on becoming a Scrutineer, contact the Chartership Officer **E: chartership@geolsoc.org.uk**; or **T: 07916 138631**

Student bursaries open

The Distinguished Geologists Memorial Trust (DGMT) was set up to help young Fellows at the start of their careers when they are pursuing, or have just attained Chartership (CGeol or CSci). The Trust offers two bursaries per year, of £2000 each, to be used for travel to gain experience and help with career development.

Information about the bursaries and application details can be found on the Society's website under 'Awards, Grants and Bursaries': **www.geolsoc.org.uk/dgmt**

Full book special offer

The Geological Society is pleased to announce that, as we enter the second half of the year, Fellows who have not previously taken advantage of the Full Book Collection can become online subscribers for the remainder of the year for the reduced price of £35 (normal price £62)!

- Features all Special Publications, Memoirs and Engineering Geology Special Publications – including the current and past three calendar years
- Online access immediately on publication.

If you wish to take advantage of this offer, the deadline for receipt of your order is **10 August 2012**. To sign up please contact the Fellowship Department at **membership@geolsoc.org.uk**

Society awards

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

FUTURE MEETINGS

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

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

FROM THE LIBRARY

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

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

Olympic fun & games

Burlington House will remain open during the Olympic Games (27 July – 12 August and 29 August – 9 September). Although staff wish to provide a full service to Fellows, particularly with regard to the Library, there may be disruption to travel which will mean that opening hours may alter at short notice. So that you don't have a wasted journey, please ring the Society before setting out. Fellows are advised to look at **www.tfl.gov.uk/gettingaround/** from where there is a link to London 2012 Games.

VIRTUAL 'HELP YOURSELF BOX'

The Library has a selection of journal issues which are not required due to duplication, defect or damage. A list of these can be found on our website in the section on Library Collections - Serials, under the heading 'Surplus Journals' **www.geolsoc.org.uk/page3358.html**

Here you will find information on how to request them. They are available to both individuals and libraries. Please note that there may be a charge depending on the type of material and the weight, if posted.

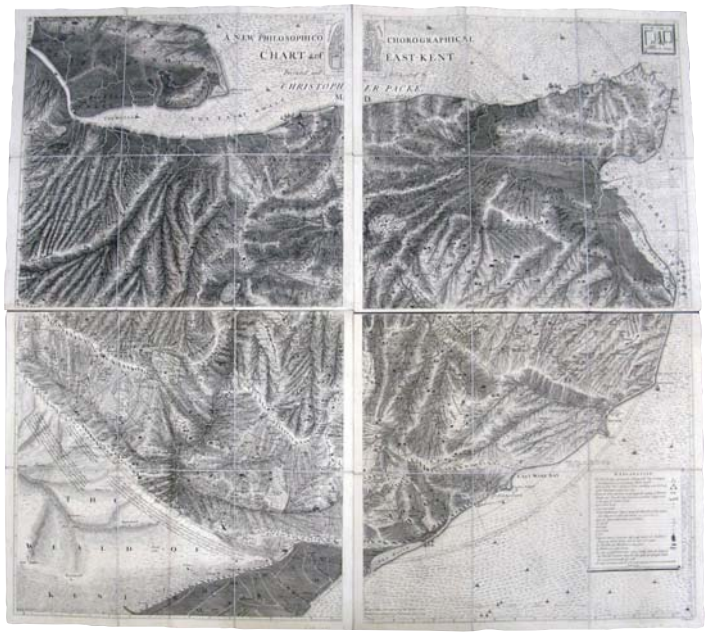
DOCUMENT DELIVERY

Don't forget that the Geological Society Library can usually supply photocopies more cheaply than other providers e.g. British Library & the publishers. Remember - our journals have been bought with your money, and are here to be used!

PICK OF THE CROP

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

Rare map of the month



A new philosophico chorographical chart of East-Kent by Christopher Packe (1743).

This black and white chart (its author, Christopher Packe, 'indignantly refused to call it a map'[1]) is one of the oldest in the Society's collection and was ground-breaking for its time. Originally from St. Albans, Packe (1686 – 1749) settled in Canterbury in 1726 where he was a practising physician until his death. On 'many otherwise tedious journeys' around his Kent practice he became interested in cartography, noting that the structure of the human body, with its 'Systems of Arteries, Veins, or Nerves', could be a microcosm for rivers and valleys of the natural world[2].

Whereas cartographers before him had been concerned with illustrating the shape of the land and points of interest, Packe wanted to show the topography of the region of Kent he knew so well. Using sophisticated methods not previously employed, he single-handedly surveyed the whole area, measuring heights above sea level with a barometer, and in so doing created the first geomorphological map in the world. With a polar co-ordinate system centred on Canterbury (Packe had taken bearings with a theodolite mounted on top of Canterbury Cathedral) the chart shows the country about 15 miles around the city, and is highly detailed, with hills and valleys, rivers and woods, as well as various private estates and all other places of habitation. It is also an early example of geological mapping, for although the areas are not shaded as we would see on a modern map, Packe has included the locations of chalk and gravel pits, shore and cliff line springs, and locations where amber and copperas stone had been found.

References: **1.** Geikie, A. *The Founders of Geology* London: Macmillan and Co., 1905, p 451
2. Jarcho, S. 'Christopher Packe (1686-1749): physician-cartographer of Kent' *Journal of the History of Medicine* and Allied Sciences 33: 1 (1978): 47-52.

Like old maps? Reproduction prints for sale at **www.geolsoc.org.uk/mapsale**

ASIA'S BROKEN FORELAND

Richard Walker* reports from Kazakhstan following a research expedition to relate faults to earthquakes in an attempt to understand continental deformation

Mention 'Kazakhstan' and most people think of a certain moustachioed reporter in a mankini. Geologists however are more likely to associate the country with its vast reserves of oil, gas and minerals. But Kazakhstan is also a land of high mountains, faults, and earthquakes. Active deformation in Kazakhstan is due to the collision of India and Asia, which has generated faulting and mountain-building covering a region stretching from the Himalaya to Siberia, making it one of the main testing-ground for theories of continental tectonics.

A feature of many of the regions in which mountains are forming today - including Kazakhstan - is that they are situated hundreds, or even thousands of kilometres away from plate boundaries. As well as being a hazard to local populations, the very wide distribution of faulting within continents shows that they behave rather differently from oceanic plates, in which relative plate motions are accommodated within very narrow plate-boundary zones. We still do not understand the rules that govern the distribution, in space and time, of major episodes of mountain building; but an essential first step towards understanding these rules, which remains one of the fundamental goals of continental tectonics, is constrain the distribution, rate, and evolution of deformation.

There is a growing, though still rather limited, body of evidence suggesting that active deformation in Kazakhstan, as well as being one of the most northerly deformation zones created by the ongoing collision of India and Asia, is also among the youngest. The apparent youth of mountain-building enables us to learn about the early stages of continental deformation - evidence of which might well be lost in older and more mature ranges, such as the Himalaya and the plateau of Tibet. By studying Kazakhstan's active tectonics, and the ways in which the faulting and mountain-building have evolved, we hope to reach a better understanding of the rules governing continental deformation.

To achieve these overall aims we must measure deformation over a range of timescales, from the rupture of individual earthquakes, through quantified fault slip-rates, averaged over the ten to hundreds of thousand years represented in the landscape, to the total deformation recorded in the bedrock geology.

These scientific factors, combined with clear societal need for research into earthquake hazards in this part of the world, motivated our reconnaissance investigation of geology and geomorphology in southeast Kazakhstan last summer. Over a period of three weeks, we travelled overland across the mountains and basins of southeast Kazakhstan, examining evidence for past earthquakes, active faulting and the building of mountains along the way.

The scientific team consisted of three UK researchers (John Elliott, a postdoctoral researcher from Oxford, Grace Campbell, a PhD student from Cambridge, and myself) and Professor Kanatbek Abdrakhmatov, Director of the Institute of Seismology in the Kyrgyz ▶

Petroglyphs of long-horn sheep, pecked into the desert-varnished surface of a granite boulder exposed on a palaeo-earthquake rupture. The presence of these ancient artworks tells us that the earthquake must have occurred several thousand years ago

Republic National Academy of Sciences, Bishkek. We also enjoyed the services of a driver (Ivan) and a camp manager/cook (Atyr). The Institute of Geophysical Research, National Nuclear Center of the Kazakhstan Republic supported our trip and hosted us in Almaty.

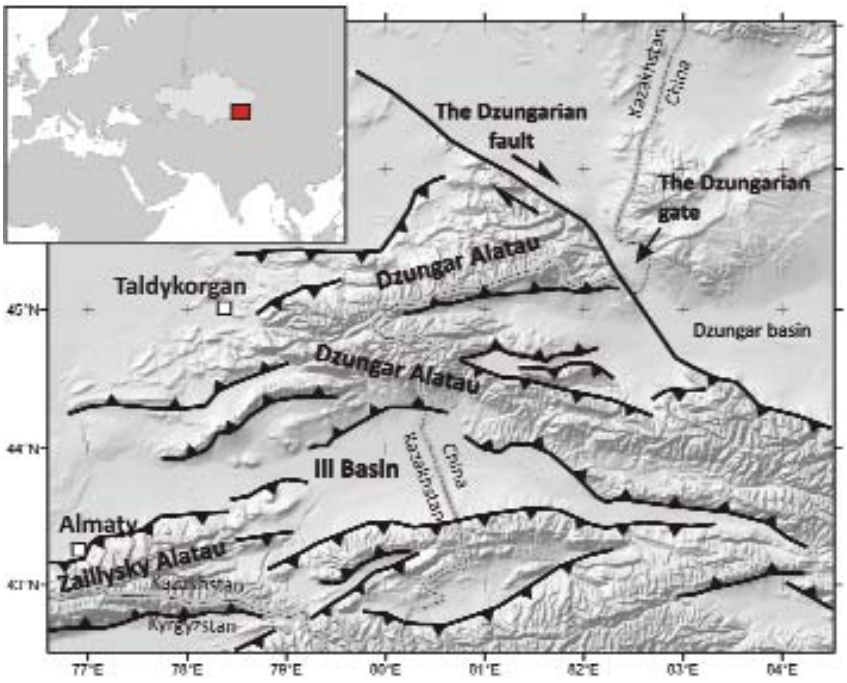
ALMATY EARTHQUAKES

Our fieldwork both began and ended in Almaty, Kazakhstan's capital until 1997, and its largest city - population c. 1.5 million. Almaty nestles at the foot of the snowcapped Zailysky-Alatau mountains, a sub-range of the Tien Shan, which rise to over 4700m and form a dramatic backdrop.

Beautiful as they are, the proximity to the Zailysky-Alatau range has a significant, continuing and, sometimes, literal impact on the development of Almaty. The city was almost totally destroyed by major earthquakes in 1889 and 1911 leaving only rare examples of the original wooden architecture preserved, with the most outstanding example being the 19th Century Zenkov cathedral. The record of destructive earthquakes in Almaty is a stark reminder of the hazard posed in Kazakhstan - a hazard perhaps not fully highlighted by the instrumental records of the last few decades, and one that becomes more acute as urban regions expand.

Surface ruptures from the 1911 earthquake were mapped at the time, and show that the causative fault ran along the southern margin of the Zailysky range, across the border in Kyrgyzstan. In Asia's arid interior, surface effects of faulting degrade very slowly, and the 1911 ruptures are still fresh and can easily be traced in the field. It is likely that the surface ruptures from other large historic - and even prehistoric - earthquakes are still preserved in the landscape. If we can locate them, we can add significantly to the understanding of past, and also future, earthquake hazard in the region. A case in point is provided by the destructive 1889 Almaty earthquake. Its location is not known in any detail, but its ruptures are probably still visible, waiting to be discovered, somewhere in the mountains.

One aim of our project is to identify active structures posing a hazard to the populations of Almaty and other cities along the foot of the sub-ranges of the Tien Shan. To identify active faults that are capable of rupturing in the future, we look for their effects on landscape. As the interval between earthquakes on any fault might be several thousands of years, we

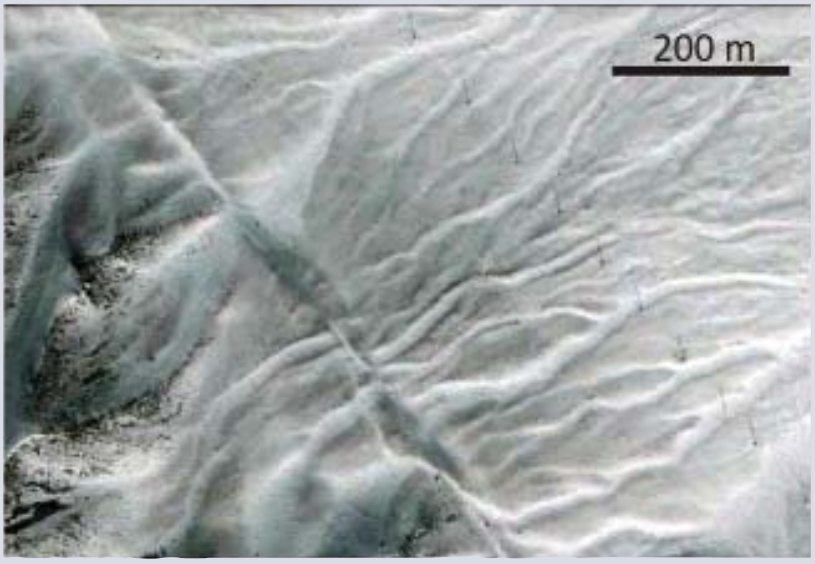


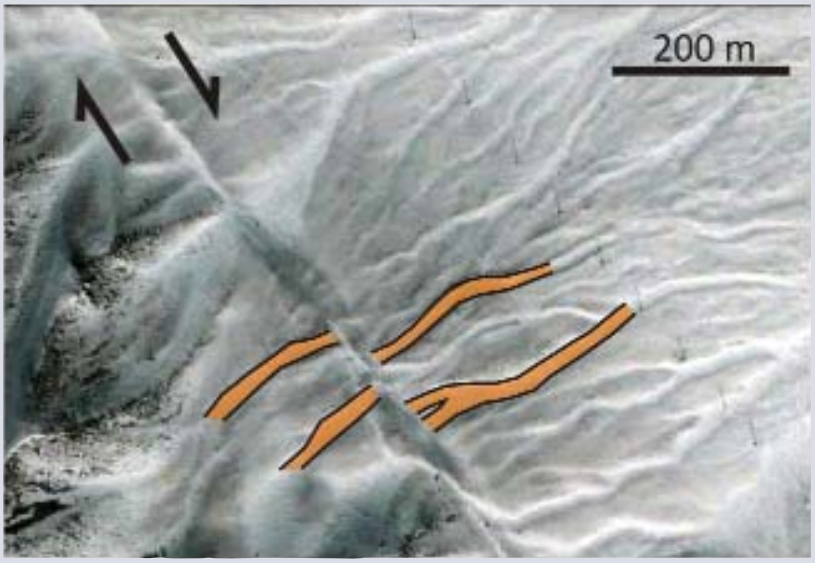
Active faulting in southeast Kazakhstan and its surroundings. The topography is dominated by the Zailisky and Dzungar Alatau ranges, which are bounded by active faults, and which are separated by wide desert basins

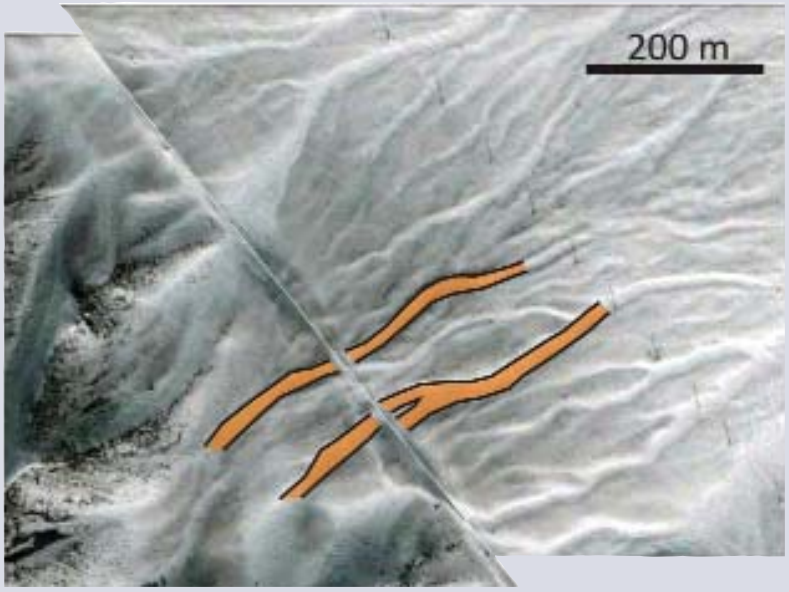
The Dzungarian right-lateral strike-slip fault. The fault cuts across and displaces alluvial fan deposits from the lower-left to upper-right of the image. Note the apparent right-lateral deflection of drainage in the centre of the image

One of the few buildings to have survived the 1911 earthquake in Almaty

Group photo by the Dzungarian fault. L-R: Ivan (driver), Atyr (cook), Richard (Oxford University), Kanatbek (Institute of Seismology, NAS), John (Oxford University), Grace (Cambridge University)







Hi-res satellite image (Google Earth) showing right-lateral displacement of abandoned alluvial fan surface by multiple earthquakes

Top image: un-annotated image. The Dzungarian fault cuts across top-left to bottom-middle. A slight component of uplift to the west has produced topography, which has led to the development of eastward-draining rivers and alluvial fan surfaces

Central image: two old drainage channels on the abandoned fan highlighted.

Lower image: drainage channels realigned across the fault by restoring c.50m of right-lateral slip. Determining the age of these channels, or the fan deposits in which they formed, can help determine average slip-rate

cannot always find ruptures from individual events; but we can identify active faults by the presence of steep scarps developed in young sediments if the fault reaches to the Earth's surface or, if the tip of the fault is buried (so-called 'blind' faulting), by broad surface warping and folding.

DESERT HOLES

Identifying and mapping active faults is one step towards understanding the tectonic role of the structure, and quantifying the hazard they pose. But we must also determine the average rate at which faults slip. Measurement of fault slip-rate indicates how important the fault is in regional tectonics, and, when combined with constraints on the likely amount of slip during individual earthquakes, provides an estimate of the interval between earthquakes along the fault.

Our first target for detailed fieldwork and slip-rate measurement was located at the Dzungarian gate; a wide pass through the Tien Shan that presently forms the railway border-crossing between Kazakhstan and China. It has long been an important route for the movement of people and goods - and lots of strong winds! It has even been suggested that the home of the god Boreas - north wind of the ancient Greeks - originated from travellers' stories of the Dzungarian gate.

The region owes its name to the Dzungars: a Mongolian people who formed the left wing of Genghis Khan's army (Dzungar means left-hand in Mongolian) and the gate exists because of the Dzungarian Fault, a major active right-lateral fault that cuts obliquely through the Tien Shan. It is one of the clearest examples within a sequence of such faults that propagate northwards from the Tien Shan. The role of these large strike-slip faults is not clear. One of the objectives of our trip was to look for evidence of ancient earthquake ruptures and to determine the average rate of slip of the Dzungarian fault in order to understand its role in accommodating India-Eurasia shortening.

To measure fault slip-rates we try to date landscape features that have been displaced by measurable amounts. Abandoned alluvial fans are one of the most common types of landform used in such studies. Changes in environment (e.g., amount of precipitation and sediment supply) cause rivers to go through repeated cycles of sediment deposition in fans at the mountain range- ▶

fronts, followed by entrenchment of the river channels into the fan surfaces. Once a fan surface has been abandoned it will passively record any subsequent displacement on active faults cutting through it. An example of cumulative fault movement recorded in the displacement of a fan surface crossing the Dzungarian fault is shown in the photo. In this example, the surface of the fan appears to have been displaced by about 50m. To determine an average slip-rate, we now just need to determine when the surface was abandoned.

Unfortunately, finding material that allows us to determine the age of alluvial fan deposits is not always so easy. Because natural exposures through the sediments are rare, the first stage in obtaining ages is usually to dig holes in the fan surfaces. We may find charcoal or other organic matter that can be radiocarbon-dated, but such material is rare given the arid conditions.

Instead, we typically use either cosmogenic isotope exposure dating or optically-stimulated luminescence (OSL) dating. Exposure dating provides the length of time that sediment has been exposed to cosmic radiation at or near the Earth's surface; luminescence dating tells us the length of time since burial of near-surface sediment. These two techniques provide age constraints up to >100,000 years and are independent of one another. For our initial studies in Kazakhstan we are using OSL to provide burial ages of sand and loess deposited within alluvial units. We are now waiting for the analysis to be completed but, once they are, we hope to gain a much-improved idea of the role of the Dzungarian fault in the deformation of Asia.

PETROGLYPHS

In addition to performing a few detailed studies of major active faults, we also aimed to perform a reconnaissance study of active faulting across as wide a region as possible in the three weeks available. Leaving the Dzungarian Gate we travelled west and south through the Dzungar-Alatau mountain range, looking for evidence of fault activity and earthquake history. Our reconnaissance through the Dzungar-Alatau culminated at the southern border fault of the range, where high glacial peaks up to 4300m high tower over the desert basin of the Ili river - a truly impressive sight. Our reason for approaching the southern margin of the Dzungar-Alatau was to collect samples of the bedrock from the base of deep valleys carved into the mountains. The history of cooling preserved within these rocks will constrain the history of exhumation, from which we can infer the history of mountain building.

We then drove west, back towards Almaty, examining active faults along the way. Our journey took us through landscapes ranging from desert, through semi-arid steppe, across alpine meadows, to high glacial peaks. Throughout this journey, we were struck by the wide distribution and large number of faults present in this part of Kazakhstan. Most of the faults we examined showed evidence for slip in the recent geological past, and in a few rare cases we found evidence preserved in the landscape for slip in individual earthquakes.

The preservation of ruptures from earthquakes that occurred hundreds or even thousands of years ago is a peculiar feature of faults in cold and relatively arid regions. We have had considerable success in extending the earthquake record over the past thousand years or so during our visits to Mongolia in recent years and are confident that we can do the same in Kazakhstan.

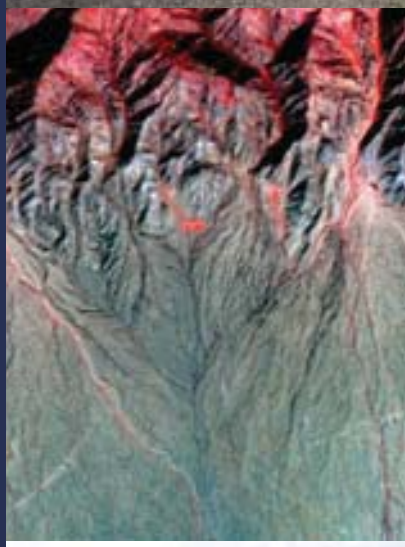
For example, in the basin of the Ili river we found - in addition to large numbers of mosquitoes - a rather novel means of dating one of the potential palaeo-earthquake ruptures discovered during our fieldwork. The dating method is provided by prehistoric petroglyphs etched into the surface of granite boulders exposed along the scarp. As the earthquake scarp must predate the drawings, it suggests that it occurred several thousand years ago. Should a similar earthquake recur in the near future, it would probably have a very destructive effect on nearby population centres.

INCEPTION

Returning to Almaty after three weeks of camping we had a day to relax, see the sights, and take our first shower in three weeks! Our final day in Kazakhstan was spent at the National Seismic Center, where we presented a slideshow of our findings and passed an enjoyable day talking with the research scientists there. We could then begin to assimilate our observations and impressions over a cold beer and a plate of hot shashlik.

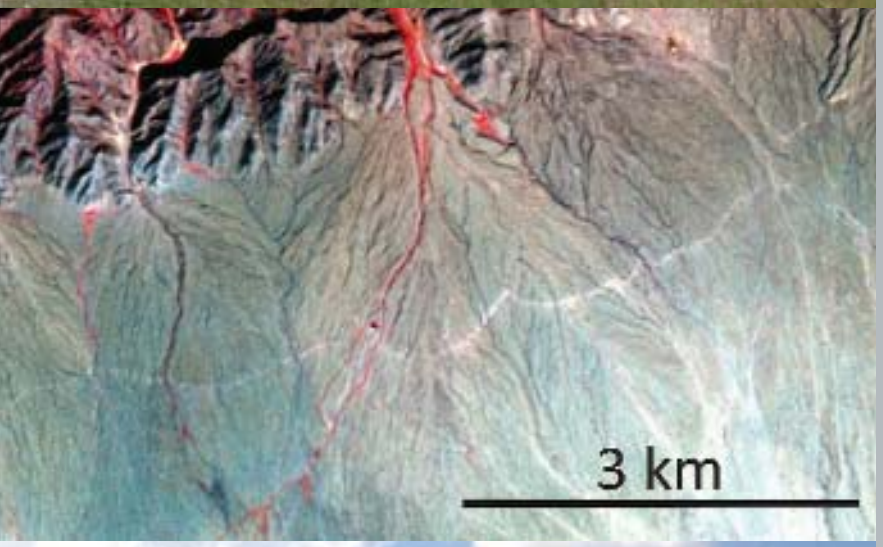
The overall aim of our research in Kazakhstan and wider parts of central Asia is to learn about the processes of continental deformation through studying examples of active mountain ranges. My own interest in central Asia's

View towards the high glacial peaks of the Dzungar Alatau mountains. These mountains are a sub-range of the Tien Shan, with peaks reaching 4300m, and are being uplifted along active reverse faults at their margins



ASTER satellite image of the N. edge of the Ili Basin. Rivers exiting the mountains at the N. edge of the image deposit sediment in a series of alluvial fans at the mountain-range front. The light-coloured line cutting across the image from top-right to bottom-left is the rupture of a prehistoric earthquake

A field photograph of the rupture scarp (looking N)



active tectonics began in 2004, when I made my first visit to the Altay Mountains of western Mongolia. This visit, with Professor Amgalan Bayasgalan of the Mongolian University of Science and Technology in Ulaan Baatar, laid the foundations for a research programme into central Asian tectonics that continuesto this day and has formed the basis of doctoral research by three students - Ed Nissen, Laura Gregory, and Grace Campbell.

Several geodynamic scenarios have been put forward to explain the evolution of deformation in Asia, with the initiation of progressively younger deformation northwards through the zone. For example, stresses introduced by the rapid rise of the Tibetan plateau - itself postulated to result from detachment of the mantle lithosphere beneath Tibet - may explain the widening of the deformation zone. Other leading hypotheses include attributing the deformation to changes to the stress field in Asia caused by rifting at the Pacific margin, or to a simple widening of the deformation zone through time.

The key to resolving the kinematic development of continental deformation within Asia, and from that, the dynamics of continental deformation, lies in providing timing constraints for the initiation of mountain-building and for its subsequent spatial evolution - constraints that do not exist for many of the active ranges of central Asia, including the Tien Shan, Dzungar Alatau, and Altay of Kazakhstan and Mongolia. Our 2011 fieldwork was a mixture of regional reconnaissance and focused local study; but having seen the evidence of numerous active faults first-hand, we see that Kazakhstan does indeed offer a new frontier for the study of continental deformation and we look forward to continuing our investigations there this season. ■

* **Dr Richard Walker** is a Royal Society University Research Fellow at the Department of Earth Sciences, Oxford University. Much of his career to date has been spent on the study of continental deformation and earthquakes in central Asia: particularly in Iran, Mongolia, and now Kazakhstan. This 2011 fieldwork was partly supported by the **Mike Coward Fund of the Geological Society of London**. To apply for research funding, visit **www.geolsoc.org.uk/grants**

ACKNOWLEDGEMENTS

I gratefully acknowledge the support of the Royal Society, Geological Society of London, Percy Sladen Fund of the Linnean Society, Gilchrist Educational Trust, and the Earth and Space Foundation

GEOLOGY FOR GLOBAL DEVELOPMENT

Geoscience has a crucial role to play in international development and the fight against severe poverty among the world's most vulnerable, says **Joel Gill***

Image courtesy Bruce Malamud, King's College London

Understanding groundwater can enable us to bring clean water to communities who previously had to walk several kilometres to fetch it. A thorough knowledge of natural hazards (earthquakes, volcanic eruptions, landslides) informs and improves disaster risk reduction. Engineering geology, agrogeology, sustainable extraction of natural resources, medical and contaminant geology, and climate change research all have the potential to assist development.

Many young geologists today are eager to get involved in this important work, applying geoscientific understanding for the benefit of the developing world. But while organisations exist for professional/later-career geoscientists in this area, there is a gap when it comes to opportunities for younger geoscientists.

Young geoscientists need the opportunity to learn more about how their skills can be used within development; the opportunity to gain experience, and develop the key skills essential to this kind of work. Skills such as cross-cultural communication and assessing vulnerability and resilience are not covered in traditional geoscience courses, though they are crucial in effective development. Moreover, even though a geoscience student may not plan to pursue a career in the development sector, gaining international experience and developing a broader range of skills will nevertheless improve his or her effectiveness, reputation and employability in our truly global discipline.

FILLING THE GAP

The organisation Geology for Global Development (GfGD), established in 2011, is working to fill this gap between interest and opportunities. The organisation aims to:

- Inspire and inform individuals (students, the public, policy-makers and politicians) about how geoscience can be applied to global development
- Engage young geoscientists in key discussions between Non-Governmental Organisations (NGOs), governments and academia
- Support individuals in developing skills, acquiring opportunities and gaining experience
- Equip charities and organisations by communicating relevant geoscience simply and effectively.

Left (clockwise from top): Tanzania - Protected water sources close to the local community can bring major benefits to both health and education

Zambia – Assessment of sewage entering the water close to agricultural areas

United Kingdom - World Walks for Water event 2011, Former Secretary of State for International Development, Douglas Alexander, shows his support

Tanzania - Effective communication across cultures is important in many projects

Right: Tanzania - Developing 'soft skills' is essential to understanding the reasons behind the failure of a water system

These core objectives will be pursued mainly through university groups. They give students with an interest in development work the opportunity to pursue their interest through seminars and discussion groups and by contributing to our wider work. At the time of writing groups run by one or two student ambassadors have been established at Cambridge, Leeds, and Leicester universities, and UCL. Three students who were keen to become involved right from the start were Laura Rose Wilson (LRW, University of Leicester), Claire Fyson (CF) and Tim Middleton (TM), both recently graduated from Cambridge.

Laura Rose Wilson said: "While studying geology I have found many students interested in using their geological knowledge to aid global development. However most find it a challenge to gain experience and therefore careers in this sector. On many occasions this is due to lack of funding, but another dominant factor is the lack of practical opportunities in developing countries, unlike the copious opportunities in industry and exploration."

Claire Fyson says: "The GfGD University Group in Cambridge is an excellent forum for students to share and discuss ideas about development that are rarely covered in undergraduate geoscience courses. Our seminars have covered topics from earthquake education in Central Asia to the importance of hydrogeologists in post-tsunami disaster recovery work. In the future we hope to help members gain invaluable experience through placements with NGOs and other development organisations."

Tim Middleton says: "GfGD can cultivate a generation of geoscientists who are aware of the huge power they have to help those around them. We can arrange seminars, post blogs and use social media to attract attention to what we are doing. We can complete internships, volunteer abroad and pursue academic courses with a development-related focus. We can also write advisory documents for charities, petition policy-makers and engage in debates. The crucial thing is to do it with enthusiasm and professionalism. We have an important message to spread and it's paramount that we take it seriously."

NATIONAL PROGRAMME

University groups provide the springboard for students to get involved in GfGD's national programme such as the GfGD blog, and developing resources for NGOs and universities. The opportunity to write for the blog, with around 4000 hits a month across the world, will help students to engage with the challenge of science communication in a development context.

GfGD have also initiated an 'advocacy programme', promoting the positive role that geoscience can play in society and lobbying for the better use of geoscience within government development policy. GfGD took part in the 'World Walks ▶

Image courtesy Sarah Hey, University of Leicester

for Water' event at Westminster in 2011, in which MPs came together to show their support for international water programmes. We hope that this advocacy will continue through continued attendance at such high-profile events, through scrutinising major legislation and lobbying Parliament to consider geoscience within development.

FUTURE PLANS

Where does Geology for Global Development go from here? Plans begin with expanding and developing our GfGD University Groups. As these multiply, so must GfGD's capacity to support their development; and so a National Committee comprising students and recent graduates will be established. A UK-based conference, aimed at gathering members from across our various university groups, is also on the agenda.

Another of our aims is to establish UK-based summer placements through our relationships with NGOs – so putting geoscientists at the heart of the development sector. Such opportunities will help students cement their understanding of how development works from both policy and practitioner perspectives. Students will have the chance to consider if and how geoscience is used within this work, and so look for ways to improve its understanding among development practitioners.

Above left: **Solomon Islands – University of Leicester Students working closely with the Geological Survey in a knowledge exchange program**

Above right: **Tanzania – Surveying for shallow groundwater in the Kagera Region**

The development of an overseas placement scheme will give students and recent graduates the chance to spend time working in less developed countries, fostering both soft and technical skills, and gaining important experience for career development. Placements will involve close collaboration with host country universities, governments and charitable organisations. This emphasis on strengthening technical capacity brings real benefit to host countries from the dialogue, skill sharing and knowledge exchange that is thereby fostered.

Finally, as always with an initiative such as this, there is the challenge of fundraising. The programme proposed by GfGD is ambitious, and many future initiatives will involve securing serious financial backing. We expect that university groups will play a role through organising fundraising events; and as well as making applications to grant-making bodies, we intend to establish opportunities for private sector sponsorship.

By getting involved in the activities of GfGD we hope that many students will begin to engage with the question of how to work effectively in other cultures, making projects more sustainable and reducing vulnerability through the improved communication of geoscience. There are many individuals and groups within the geosciences that have worked to share their knowledge and skills with those less fortunate - a far from straightforward task. What has been lacking so far, however, is a forum for young people - students and recent graduates - to get involved, and develop skills and experience. Geology for Global Development has an ambitious plan to help fill that gap - and in so doing, join the fight against global poverty. ■

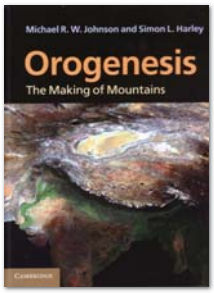
* **Joel Gill** is the Founder and Director of Geology for Global Development (GfGD), and a first year PhD student in the Environmental Monitoring and Modelling Research Group at King's College London. For further information you can contact him via e-mail (**joel@gfgd.org**)

FURTHER INFORMATION

Find out more by visiting the GfGD website (**www.gfgd.org**), Facebook (**www.facebook.com/gfgd.org**), or Twitter (**@Geo_Dev**)

ACKNOWLEDGEMENTS

My thanks go to **Laura Rose Wilson** (University of Leicester), **Claire Fyson** and **Tim Middleton** (University of Cambridge), for their contributions to the content and review. **Dr Bruce D. Malamud** (King's College London) and **Sarah Hey** (University of Leicester) provided images. Finally, many thanks to **Professor Mike Petterson** (University of Leicester) for helping to initiate this article



Orogenesis; the Making of Mountains

Mountains are striking features, and readers of any book on orogenies begin with considerable expectations - a daunting prospect for authors. Mike Johnson and Simon Harley have produced a book that provides an overview of orogenic research and an introduction to the physico-chemical properties of mountain belts. Both are leading authorities in their fields and their excellent understanding of the issues involved comes though in the clearly-structured text.

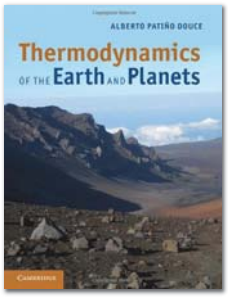
Orogenic belts, old and new, are difficult to write about because much of the fascination lies in the differences between them. The authors start with plate tectonics, driving mechanisms, physical and chemical principles of deformation, isostasy and geochronology, before getting into orogenic belts through large-scale features such as thrusts and faults. I was keenest to know what an orogenic belt was geologically, what orogenic belts' key features are, and how might I recognise an old one that is now eroded. However, there is inevitably insufficient space to convey a reasonable understanding of the topics listed above, and to me they therefore required setting in context – something that could only come from knowing a little more about orogenic belts and the issues involved in orogenic research. These only emerge later in the book.

There are many good things in this book; but my sense is that it will appeal most to readers who already know a fair amount about orogenies, and want to be brought up to date. Those classic detailed Alpine cross-sections can be off-putting to new students, and many chapters rely on reproductions of diagrams already in the literature. I think an opportunity has been lost by not developing new figures that would be accessible to students and non-specialists. These would need colour; and bundling colour plates at the back of a book now looks a little dated.

I am sure the publishers would defend this on cost grounds; but many modern books have overcome that. I enjoyed the text, but was too often left wondering about the diagrams that might have accompanied it. In the end I wanted more guidance about what the big topics are, and what I should be thinking about as research into orogenies develops. The topics are contemporary; high precision geochronology is increasingly challenging current thermal models for orogenic systems; mountains influence climate, and there is a wide-ranging final chapter on secular change in orogeny. Those prepared to dig will be well rewarded, and despite my reservations, this book deserves to be widely read.

Reviewed by ***Chris Hawkesworth****, University of St Andrews*

OROGENESIS; THE MAKING OF MOUNTAINS
MICHAEL RW JOHNSON AND SIMON L HARLEY, Published by Cambridge University Press 2012
ISBN: 9780521765565 (hbk) 398pp
List price: £45.00, www.cambridge.org



Thermodynamics of the Earth and Planets

Planetary bodies derive their energy externally from solar electromagnetic radiation and internally from gravitational and nuclear binding energy. Dissipation of these energy sources produces heat that is stored within various reservoirs on or within the planet. Transfer processes make this heat available to drive the wide range of planetary processes that we observe in the Solar System. The author's thesis is that a planetary body may be considered as a combination of heat reservoirs and heat engines and thus planetary processes are best understood in thermodynamic terms.

This book provides a rigorous introduction to thermodynamics, together with the related topics of heat and mass transfer, for a reader with some background in physical sciences and mathematics. The material is presented in a clear, user-friendly style that makes liberal use of worked examples integrated with the text. These worked examples are drawn from planetary bodies right across the Solar System in order to show the general applicability of the methods developed. End of chapter exercises are provided, together with a full set of solutions that can be downloaded from the book's website. A particular strength of the book is the way in which the author links the macroscopic thermodynamic concepts to the "microscopic world"; for example changes in gas specific-heat capacity with temperature are interpreted in terms of the partition of internal energy between the translational, rotational and vibrational degrees of freedom of a molecule.

This is a superb publication, with many insightful explanations of planetary processes. It is very well produced in a clear type and with excellent illustrations, a detailed table of contents and a comprehensive index. James Hutton, who viewed the Earth as a heat engine "capable of fusing together sedimentary rocks, causing upheavals in strata and creating mountains", would surely have relished this book.

Reviewed by ***Duncan Woodcock***

THERMODYNAMICS OF THE EARTH AND PLANETS
ALBERTO PATINO DOUCE, Published by: Cambridge University Press, 2011. ISBN: 9780521896214 (hbk). 709pp
List price: £50.00,
www.cambridge.org/patino_douce

REVIEWS: COPIES AVAILABLE

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

- **NEW! Practical Engineering Geology,** Steve Hencher. Spon Press (Taylor & Francis) 2012 450pp
- **Planetary Surface Processes,** Melosh, H.J. (2011), Cambridge
- **Structural Geology Algorithms: Vectors and Tensors, Cambridge.** Allmendinger, R.W., Cardozo, N. & Fisher, D.M. (2011)
- **An Introduction to Geological Structures & Maps** (8th Edition) George M. Bennison, Paul A. Oliver, Keith A. Moseley Hodder Education ISBN 978-1-444-11212-2
- **Continuum Mechanics in the Earth Sciences** by William I Newman Cambridge University Press ISBN 978-0-521-56289-8
- **Stratigraphic Paleobiology - Understanding the distribution of fossil taxa in time and space** by Mark E Patzkowsky and Steven M Holland. University of Chicago Press

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**

WE PROBABLY NEED SHALE GAS

Sir, Let us assume, for argument's sake, that we need gas for the foreseeable future – for cooking (70%), to generate electricity (47%) and perhaps fuel our cars for a while. The North Sea no longer provides enough, by 400 TWh. Where can we sustainably and ethically source our gas from among the following available options?

One. We could bring it by pipeline from countries where political demonstration is effectively illegal. In transit, 1.5% of methane (Greenhouse Gas potential of 72, 20-year timescale) is lost. This is the greenhouse equivalent of pumping the total volume of transported gas (72 x 1.5 = 108%), directly into the atmosphere as CO_2 - more than is generated by actually burning it! And remember, when Russia turned off the taps recently, we fell to three days' stock, and almost had to shut down UK industry to protect domestic supplies.

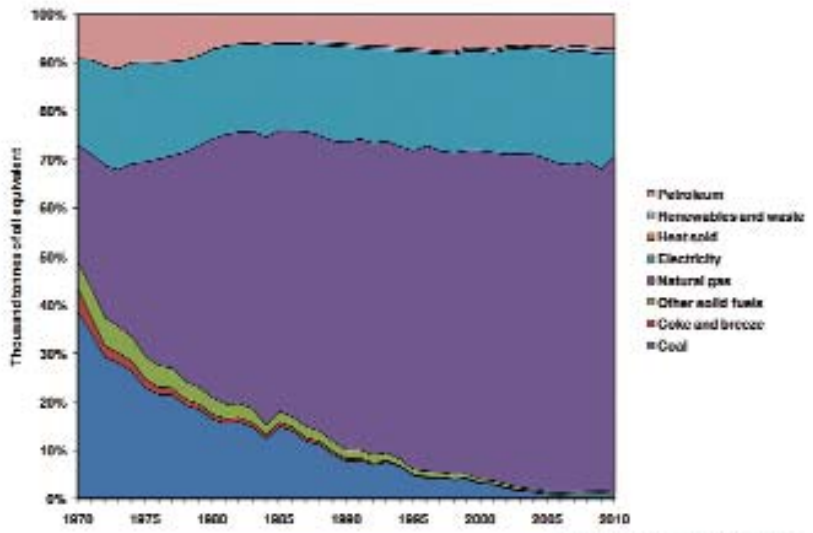
Two. We could bring natural gas, liquefied under pressure, by supertanker from Qatar through the Gulf of Aden, past Somali pirates currently holding 17 ships hostage. From Milford Haven we can pipe it across Wales but must use it immediately - as we only posess 12 days' worth of underground storage (France/Germany have c.120 days) as no-one wishes new facilities to be built.

Or, third, we could drill carefully to about 3km into coal seams or shales underlying 30%+ of the UK, using horizontal drilling and hydraulic stimulation ('fracking') and pump out natural gas. There is probably enough there to supply UK gas demands for decades without recourse to other countries/political systems, and will slash the price we pay for energy.

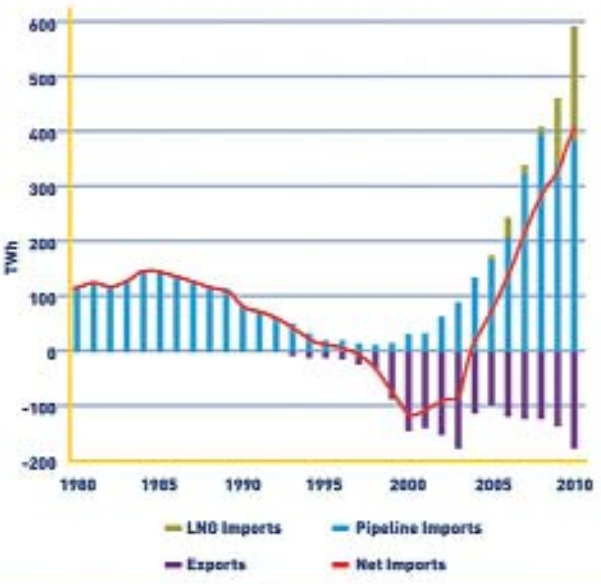
It must be carefully monitored, geochemically, hydrogeologically and seismically, to protect our water supply and environment but let's do this in the UK, with our arguably unparalleled legislative and regulatory frameworks, and not leave it to some other poorer and/or less scrupulous country to do the dirty work.

You may, as this is a free country, pick options 1 or 2. But if you do pick number 3, that's Shale Gas.

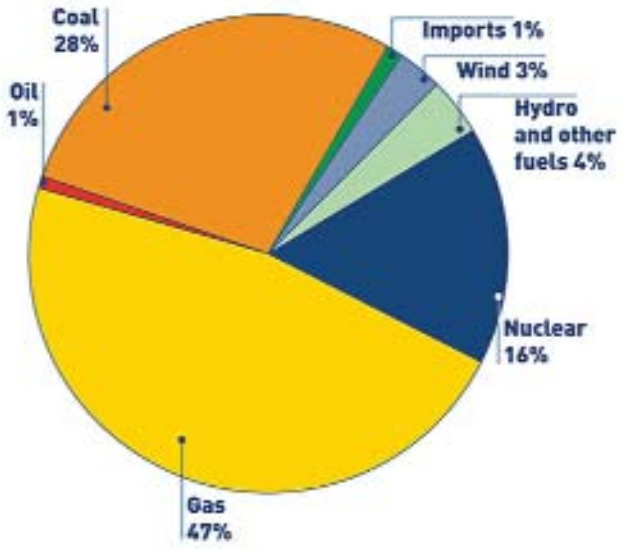
Peter Styles



Source: DECC, ECUK Table 3.1



Left: UK trade in natural gas



Right: UK electricity supplied by fuel type in 2010

Fossil raindrops help constrain atmosphere density – maybe…

WRONG KIND OF RAIN?

Sir, The June 2012 issue (*Geoscientist* 22.06, p07) carries a marvellous photograph showing raindrop impact structures produced by rain falling on a Ventersdorp tuff. The marks are large, and seem to have been formed by maximally-large raindrops. The source paper (in *Nature* - see article for reference) is quoted as using a calculated terminal velocity to estimate air density, assuming that the raindrops were formed by condensing water.

But that is not necessarily so! The pattern of large, densely packed raindrop marks, not overridden by later rain, looks much like that produced by early downbursts from thunderclouds. Downbursts can come down at several metres per second, and the rain, hail and sleet that they carry is a sampling of material carried by the clouds. A downburst may thus carry a large or small load of any of these, at a terminal velocity relative to the air of the downburst, not to the ambient air. Often the fall from the early downburst lies outside the track of the later main fall produced by the cloud.

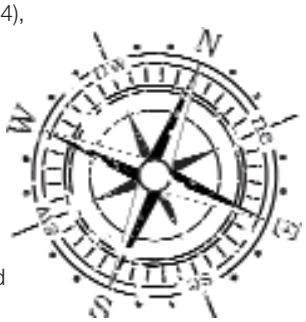
When a downburst carries rain, it is often melted snow or hail, or is three quarters-melted sleet, with some ice remaining in each drop, not directly condensed rain. I do not know how this affects flattening and breakup, or what changes to the algorithm used may be needed to accommodate it.

The authors of the *Nature* paper have plainly been careful to avoid over-interpreting their results. However, it would be interesting to know if these survive any refinement of the algorithm.

Alexander G Smith

GARBAGE IN...?

Sir, Although I agree with Wendy Cawthorne's sentiments (*Geoscientist* May 2012, 22.04), what is of more concern are the datasets that underpin the all singing and dancing digital map of the UK. In Scotland the 1:50k mapping coverage utilised in the not so seamless digital map, ranges from modern/recent, through ancient mutton dressed up and re-branded (yet again) as lamb, to the downright dodgy (as seen in some 1:50k Provisional Series paper maps). One of the 'black holes' is Forfar in Angus. Mapped in the 1870s and never re-surveyed, and yet the geology is there to see and buy in digital format.



While the digital map has its place, it is leading to a complacent, unquestioning mindset in information gathering. None more so in the compilation of Environmental Impact Assessments, where geology is increasingly dumbed down. There is an underlying attitude of - 'It is digital so it must be right'.

After all… UK Geology, there's an app for that!

Andrew Heighton

I'M A BELIEVER

Sir, Thank you for publishing the beautiful and informative article by Dr Alexis Drahos on the work of Thomas Moran (*Geoscientist* 22.06 July 2012). It has introduced me to a new favourite artist, for which I am very grateful.

However, I am somewhat mystified by the author's need to explain that historically "a number of scientists of the time believed in God and did not regard science and religion as being at all incompatible".
A quick straw poll of the Fellows in my office suggests around 40% attend church on a weekly basis.

Apparently a significant number of scientists in our time also believe in God, and do not regard science and religion as being at all incompatible!

Alex Booer

The Chasm of the Colorado (1873-74) by Thomas Moran

PEOPLE

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

CAROUSEL

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

EDWARD DERBYSHIRE

Edward Derbyshire, former External Affairs Secretary of the Society and Chair of Science for the United Nations International Year of Planet Earth, has been awarded the James Harrison Award by the Executive Committee of the International Union of Geological Sciences (IUGS). The IUGS said it was 'expressing its gratitude to Professor Derbyshire for his outstanding contribution to the Union over a considerable time span'. The award was instituted to recognise those individuals who devote much of their time and continuous efforts to maintain the Union in fine shape. The award is named for the first IUGS President, James (Jim) Harrison, who was greatly respected as a man, as a scientist, and as a leader of IUGS. The award will be during the 34th International Geological Congress in Brisbane in this month.

JOE MCCALL

Geoscientist's very own Joe McCall has ventured again into biography with his forthcoming new book, *'Full Quivers'* (£10.00). The book covers the life of his maternal grandfather Joseph Kidd, born a 17th child in 1824, including ministering to victims of the Irish Potato Famine. As a physician in London later in his career he also tended Benjamin Disraeli during his last three years of life. Copies are available from **joemccall@tiscali.co.uk**, as well as from Amazon and other online outlets.

IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

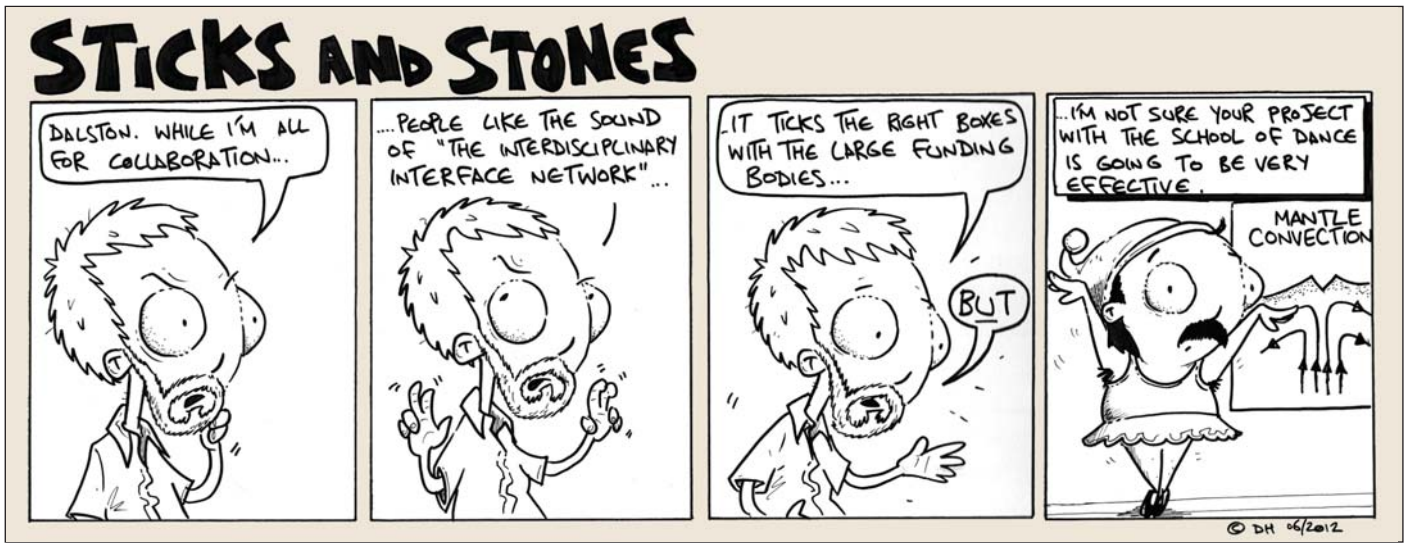
THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Chappell, Bruce *
Chapman, W T *
Flinn, Derek
Hooper, Peter L *
King, Bruce *
Middleton, John *
MacLean, Ronald G *
Smith, Donald I
Strachan, Isles *
Williams, Colin L *

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

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

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



HELP YOUR OBITUARIST

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

DISTANT THUNDER

A bit on the side

Geologist and science writer Nina Morgan celebrates the lasting legacy of a former brickpit

The Chawley Brick and Tile Works – now ironically hidden behind the bricks and mortar of a new housing estate on Cumnor Hill near Oxford – played an important role in the local economy for nearly 100 years. At Chawley the Jurassic Corallian limestone is overlain by around 24m of Kimmeridge Clay topped by the Iron Sands of the Cretaceous Lower Greensand. So geologically speaking, the Chawley works were well suited for the production of bricks, tiles and lime, with raw materials possessing suitable properties available on-site. The Kimmeridge Clay formed a particularly useful 'source rock' for brick-making because it is easy to dig and contains around 8% of bituminous material which burns during firing, thus helping to reduce fuel costs.

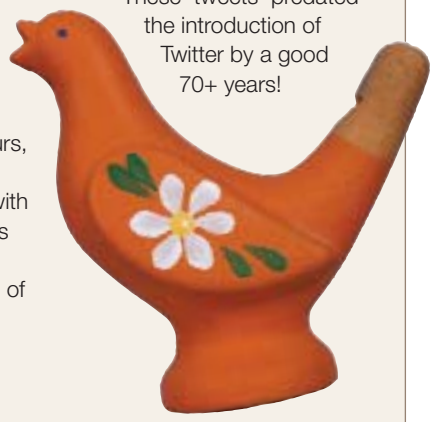
The brickworks were established in about 1846 by a local farmer, John Neale. The business prospered, and in one year a record five million bricks were made. However during the 1930s the combination of a disastrous fire and increasing competition from larger companies, such as London Brick weakened the business. By 1937 the company was bankrupt and work at Chawley ceased. Its closing also effectively marked the end of the use of Kimmeridge Clay for brickmaking in Britain.

Chawley Works, as mapped in the late 1930s

But while the Chawley Brick and Tile works may be long gone, they are certainly not forgotten. Orange-coloured Chawley bricks along with red or bluish Chawley 'treacle tiles' – so-called because treacle was burned in the kilns to produce a reducing atmosphere – can still be seen in 19th Century houses in the area. And an iguanodontid (now designated as the type specimen of *Camptosaurus prestwichii*) discovered by quarrymen and afterwards collected by Joseph Prestwich, then Professor of Geology at Oxford,is now on display at the Oxford University Museum of Natural History. Many other important fossils, including bones of plesiosaurs, pliosaurs, dacosaurs and ichthyosaurs, were also recovered, along with a great number of ammonites and other invertebrates.

Although the hand digging of clay using grafts was, palaeontologically and stratigraphically speaking, potentially very interesting work – it wasn't well paid. So workmen at the pit had to come up with other ways to supplement their meagre wages. The sale of fossils to visiting parties of geology students was one useful source of income, as was the selling of flower pots made from spare clay. But, in terms of modern communications, perhaps more the significant (if not the most lucrative) sidelines were the clay whistles in the shape of birds the workmen fashioned and sold.

These 'tweets' predated the introduction of Twitter by a good 70+ years!



ACKNOWLEDGEMENT

Sources for this vignette include an article about the Chawley Brick Pits written by Philip Powell which appeared in the May 2012 issue of the Cumnor Parish News; The Chawley Brick and Tile Works, Cumnor, by I.C. Dodsworth in *Oxoniensia*, vol. 41, 1976, pp. 348-353 (available at: **http://oxoniensia.org.volumes/1976/dodsworth.pdf**); Chawley Brick and Tile works, by Iris Wastie (available at: **www.bodley.ox.ac.uk/external/cumnor/articles/chawley-works.htm**); and *The Geology of Oxford* by W.J. Arkell

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 a geologist and science writer based near Oxford

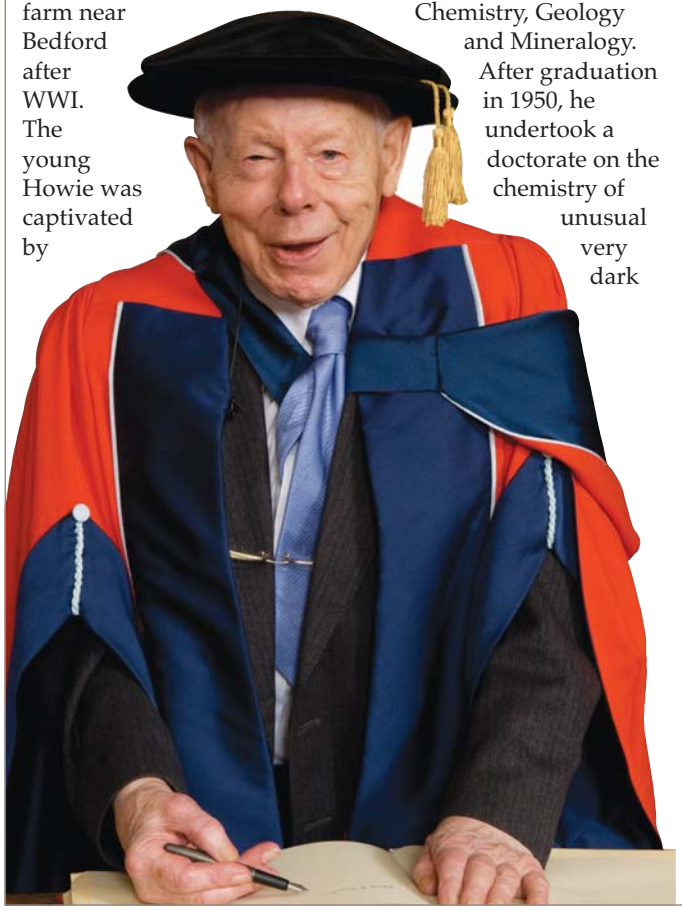
OBITUARY

ROBERT ANDREW HOWIE 1923 - 2012

Outstanding scientist, abstractor and author of the most widely known textbooks of the 20th Century

Professor Bob Howie, a giant of mineralogy, made a huge contribution to the rapid dissemination of scientific results through abstracting journals, particularly *Mineralogical Abstracts*, of which he was principal editor (1971-2003). He took retirement at 67 but continued to publish and write abstracts from his home at Bonsall in Derbyshire until almost his final day.

Bob Howie was born of Scottish parents who moved from Ayrshire to a farm near Bedford after WWI. The young Howie was captivated by the sight of the large airships that came to Cardington during the 1930s and flew enticingly over the farm. So in 1941, he joined the RAF University Six Months course hoping to go to Cambridge to take engineering. But he was assigned instead to Edinburgh where the speciality was meteorology. At the end of the six months he was nominated 'best cadet'.



TEXTBOOK

Invalided out of the RAF, he went to Trinity College, Cambridge to read Chemistry, Geology and Mineralogy. After graduation in 1950, he undertook a doctorate on the chemistry of unusual very dark granites from India known as charnockites. Bob Howie showed extraordinary perseverance in completing large numbers of mineral analyses despite the intensive labour they then involved. Following completion in 1953, Bob Howie was appointed Lecturer at Manchester University. In 1962, he was appointed Reader and later Professor at Kings College London. In 1986, he was appointed Lyell Professor of Geology at Royal Holloway, London.

> HOWIE UNDERTOOK THE PRODIGIOUS TASK OF PREPARING HUGE NUMBERS OF ABSTRACTS. HE WOULD WRITE OVER 1600 OF THESE PER YEAR

During this time Howie wrote a large number of papers on mineral assemblages in various rock types and the chemical composition of the component minerals. During the 1960s he co-authored with W A Deer and J Zussman a series of five specialist volumes describing the structure and composition of all the known families of minerals. In 1966, this led to the publication of the famous undergraduate textbook *An Introduction to Rock Forming Minerals*. During the 1970s and 1980s the three authors developed the original five-volume series into a comprehensive series of 10 volumes leading to the publication of a second edition of the undergraduate textbook in 1992. The total number of copies sold of the two editions of the textbook exceeded 125,000. At the same time, Howie undertook the prodigious task of preparing huge numbers of abstracts. He would write over 1600 of these per year, and maintained this productivity for over 35 years.

HOWIEITE

Bob Howie received many honours. In 1962, Dr Stuart Agrell named an iron - manganese silicate mineral 'howieite' after him. In 1974, Cambridge University awarded him a ScD degree and in 1976 he was awarded this Society's Murchison Medal. He was a Fellow of Kings College, an Honorary Life Fellow of the Mineralogical Society, Honorary Fellow of the Gemmological Association of Great Britain and in 1999 he became the first recipient outside the USA of the Public Service Award of the Mineralogical Society of America.

By **Paul Bridges**

Editor writes: A longer version of this obituary may be read online

CAN'T FIND YOUR MEETING? VISIT WWW.GEOLSOC.ORG.UK/LISTINGS FULL, ACCURATE, UP-TO-DATE

ENDORSED TRAINING/CPD

Course	Date	Venue and details
Geology of the Western European Alps	28 August - 9 September	The trip will involve the exploration of the tectono-thermal evolution of the Alpine orogeny including studies of high-grade metamorphism, deformation mechanisms, uplift and exhumation processes revealed in the Alpine molasse and Mesozoic palaeontology. **Fee:** £2500. GSL Fellows receive a 10% discount. Please mention when registering.
Cone Penetration Testing	28 September	Edinburgh. Free. Introductory course and technology update on Cone Penetration Testing theory and application. See website for other dates. Will also run on 14 December (Wallingford), 19 October (Nottingham), and 23 November (Exeter). **Contact:** Steve Poulter **E:** s.poulter@fes.co.uk **W:** www.fes.co.uk
Lapworth's Logs	n/a	'Lapworth's Logs' are a series of e-courses involving practical exercises of increasing complexity. 'Lapworth's Logs' provide training in applied geology for civil engineers, engineering geologists, environmental engineers, hydrogeologists, and anyone interested in ground modelling. **Contact:** info@lapworthslogs.com. Lapworth's Logs is produced by Michael de Freitas and Andrew Thompson. Price dependent on number of users/duration of licence.

DIARY OF MEETINGS AUGUST / SEPTEMBER 2012

Meeting	Date	Venue and details
Waterborne High-Resolution Geophysical Techniques and Applications Near Surface Geophysics	8-9 August	**Venue:** Rutland Water, Leicestershire. Workshop. See website for registration. **Contact:** John Arthur **E:** john.arthur@orangehome.co.uk **W:** http://www.nsgg.org.uk
The Quaternary Geology of North Yorkshire North Yorkshire Regional	See Website	**Venue:** North Yorks. **Leader:** David Boon. **Contact:** David Boon **E:** dboon@bgs.ac.uk
Geological Operations Workshop Petroleum Group	30 August	**Venue:** Kings College Conference Centre, University of Aberdeen. See Website for details, call for papers and registration. **Office contact:** Laura Hayward **T:** 020 7432 0983 **F:** 020 7494 0579 **E:** laura.hayward@geolsoc.org.uk
William Smith Meeting 2012 Strata and Time: Probing the gaps in our understanding Geological Society	4-5 September	International conference to explore the relationship between the preserved strata of the rock record and the passage of time. See Website for details and registration. **Office contact:** Naomi Newbold **T:** 020 7434 9944 **F:** 020 7494 0579 **E:** naomi.newbold@geolsoc.org.uk
Young Geoscientist Papers Competition South East Regional	11 September	See Website for details. **Venue:** Bell Inn, Godstone, 1800 for 1830. **Contact:** Jon Race **E:** jrace@southerntesting.co.uk
The Geology and Mining of Ballclays in the Bovey Basin South West Regional	12 September	**Venue:** The Dolphin Hotel, Bovey Tracey, Devon TQ13 9AL. 1830 for 1900. **Speaker:** Andrew Deeming
Geological Model of HS2 Engineering Group	13 September	**Venue:** Burlington House. Evening meeting. **Speaker:** John Perry. See Website. **Contact:** John Perry **E:** John.Perry@atkinsglobal.com
The Geology of the Isle of Wight from the Waverly Paddle Steamer Solent Regional Group	See website	Field trip. For details see website. **Leader:** Andy Gale. **Contact:** Karen Allso (Secretary) **E:** karen.allso@ramboll.co.uk
Petroleum Geology East Midlands	See website	Venue: TBC. Evening meeting. **Speaker:** Dorothy Satterfield. **Contact:** David Boon **E:** dboon@bgs.ac.uk
Fermor 2012 - The Neoproterozoic Era; Evolution, Glaciation and Oxygenation Geological Society	19-21 September	**Venue:** Burlington House. See website for details and registration. **Office contact:** Naomi Newbold **T:** 020 7434 9944 **F:** 020 7494 0579 **E:** naomi.newbold@geolsoc.org.uk
Volcanoes and Man Geological Society Shell UK	26 September	**Venue:** Burlington House. **Time:** 1500 and 1800. **Office contact:** Naomi Newbold **T:** 020 7434 9944 **F:** 020 7494 0579 **E:** naomi.newbold@geolsoc.org.uk

OBITUARY

JOHN GORDON ROBSON 1930-2012

Geophysicist with a passion for rugby who worked all over the world, while working exclusively for Shell

After leaving school Gordon was called up for National Service in 1949 having already gained a place at Brasenose College, Oxford, where he read Physics as well as representing the college at rugby, his passion. He then took an MSc course in Applied Geophysics at Imperial College.

Gordon joined Royal Dutch/Shell as a geophysicist in 1955 and spent most of his working life in that highly technical capacity or, later, as a manager, in various parts of the world, including Libya, Nigeria (three times), East and West Pakistan, the United States, the Netherlands (twice), the UK (London) and Bangladesh. Most of his assignments were for two years or more.

SEISMIC PROCESSING

While in Dallas in the early 1970s he worked on the Advanced Seismic Computer, a joint venture between Shell and GSI. His involvement was for digital seismic processing, then in its infancy; he continued this activity in Shell's processing centre in The Hague until 1976.

He then spent some five years as Chief Geophysicist for Shell Expro in London; during that time he purchased his Westminster flat, where, in his retirement he spent his winters. In summer he migrated north to his "castle", an ancient tower house at Durris in Aberdeenshire. During his stay in London he became involved with the Society in setting up the Institution of Geologists with the aim (since achieved) of giving working geologists (and geophysicists) chartered status.

> THOSE WHO WORKED FOR HIM, WITHOUT EXCEPTION, LIKED AND RESPECTED HIM, OFTEN ENJOYING HIS COMPANY OUTSIDE OFFICE HOURS

As a stage in his early retirement he also took on the task of doing the university 'milk round' for Shell, interviewing likely Earth science undergraduates at various institutions around the country. He also assisted his old school, King's College, organising careers advice seminars.

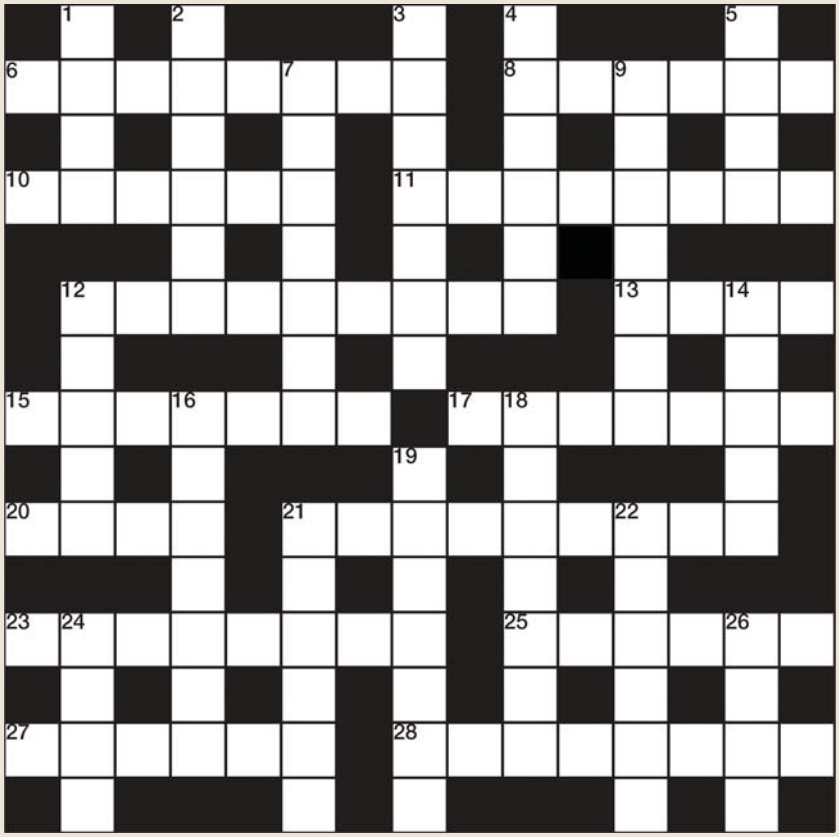
PRIVATE

In preparing this short resume of Gordon's professional career I have received recollections of his life from many of his ex-colleagues. Although most agree that he was a very reserved and private person, not easy to get to know well, the words 'generous' and 'kind' occur most frequently. He was a bit of a workaholic himself, single-minded in support of the company. In fact, on one occasion he had accumulated so much leave that his boss had to threaten to lock him out of his office unless he took a holiday. Nonetheless, those who worked for him, without exception, liked and respected him, often enjoying his company outside office hours, whether in his Westminster flat or at a restaurant or a pub (as long as real ale was on tap).

Gordon must have picked up his delightful Edinburgh accent from his parents as, until his retirement he spent little, if any time in Scotland. He never married, and after his parents and a lone aunt died, he had no close relatives; though he did have a number of good friends. He died aged 81, while apparently in the best of health, as the result of a fall in his London flat. He will be greatly missed by those who knew him.

By **Myles Bowen**

CROSSWORD NO. 160 SET BY PLATYPUS



ACROSS

6 Duricrust composed of gypsum (8)
8 Older within younger without (6)
10 Strengthen by heating and cooling (6)
11 Tunnel formed by erupted molten rock (4,4)
12 German Shepherds exiled in England, or persons from Alsace (9)
13 Andean civilisation with unequalled stoneworking skill (4)
15 Long ridge with sharp crest and steep flanks both sides (7)
17 Toxic metalloid, occurringin many minerals, usually in conjunction with sulphur and metals (7)
20 Fiery saint (4)
21 Rot (9)
23 Outflowing stream (8)
25 Columnar Admiral (6)
27 Social malaise, popularized by Émile Durkheim in his book Suicide (1897) (6)
28 Fossil bible published by the Geological Society of America and the University of Kansas Press (8)

DOWN

1 Oceanic circulation (4)
2 Central figure in the infamous Tennessee Monkey trial (6)
3 Wind-generated (7)
4 Sedimentologist's tools for separating grains of different grade (6)
5 Doing word (4)
7 Rock out of place (7)
9 Arrangement of atoms in a crystal (7)
12 Coral island with central lagoon (5)
14 Steep-sided river valley where the river flows through coastal cliffs to the sea (5)
16 A reef, by another name (7)
18 Fossils left behind (7)
19 Clear film used in making carbonate peels (7)
21 Fractional distillate of petroleum used in compression-ignition engines (6)
22 Rounded carbonate grain with concentric layers preserved in a limestone rock (6)
24 Wetlands associated with East Anglia and Vaughan-Williams (4)
26 'Great' version of this river drains the 24d (4)

WIN A SPECIAL PUBLICATION

The winner of the June Crossword puzzle prize draw was Bryan Jones of Bridport, Dorset.

All correct solutions will be placed in the draw, and the winner's name printed in the October issue. The Editor's decision is final and no correspondence will be entered into. **Closing date - August 16**.

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

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

Name .....

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Membership number .....

Address for correspondence .....

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SOLUTIONS JUNE

ACROSS:
6 Nacreous **8** Isogam **10** Pestle **11** Backfill **12** Cyclotron **13** Neve **15** Synonym **17** Meteors **20** Stet **21** Astrolabe **23** Sediment **25** Inhume **27** Quarry **28** Obsidian

DOWN:
1 Cave **2** Arctic **3** Isobars **4** Zircon **5** Marl **7** Ore Body **9** Offence **12** Crypt **14** Varve **16** Outlier **18** Exotics **19** Stetson **21** Acetyl **22** Aphids **24** Emus **26** Mean


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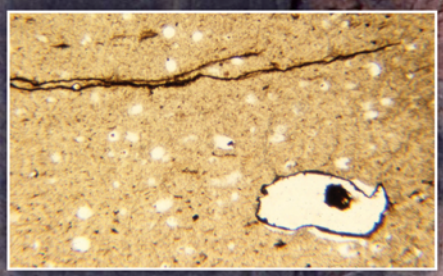
Evolution, Glaciation, Oxygenation

19-21 September 2012



The Geological Society of London, Burlington House, London

With an optional field trip to the Ediacaran geology of Charnwood and the Longmynd, English Midlands, 22-23 September

The Poster Abstract deadline has been extended to Friday 31st August

This conference brings together a diverse group of geoscientists interested in the extraordinary environments, biotas and Earth system responses of the Neoproterozoic. Presentations will be broadly grouped under four inter-related themes: (1) Sequencing the rock record, (2) proxy record data for oceans and atmosphere, (3) co-evolution of life and the Earth system, and (4) modelling the Earth system. There will be extended group discussions on future research agendas on the third afternoon.

Keynote and invited speakers:

Theme 1 (Sequencing): **Doug Benn**, **Ian Daizel**, **Paul Hoffman**, **Galen Halverson**, **Francis Macdonald**, **Adam Maloof** and **Alan Rooney**

Theme 2 (Proxies): **Magali Ader**, **Huiming Bao**, **Don Canfield**, **David Johnston**, **Simone Kasemann**, **Tim Lyons**, **Simon Poulton** and **Nick Tosca**

Theme 3 (Co-evolution): **Martin Brasier**, **Nick Butterfield**, **Andy Knoll**, **Guy Narbonne**, **Tony Prave**, **Erik Sperling**, **Phil Wilby** and **Shuhai Xiao**

Theme 4 (modelling): **Christian Bjerrum**, **Tais Dahl**, **Raymond Pierrehumbert**, **Gilles Ramstein**, **Andy Ridgwell** and **Dan Rothman**

Convenors:

Ian Fairchild (Birmingham), **Dan Condon** (NIGL), **Tim Lenton** (Exeter) and **Graham Shields-Zhou** (UCL) with field trip coordination by **Martin Brasier** (Oxford)

The meeting is sponsored by the Life and the Planet programme funded by the Natural Environment Research Council and the Gaia: Earth Systems Science Group of the Geological Society.

Call for papers and further information

For information about submitting a paper, please visit our website at www.geolsoc.org.uk/fermor12

For further information about the conference please contact:

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The Geological Society, Burlington House, Piccadilly, London W1J 0BG
T: 020 7432 0981 E: naomi.newbold@geolsoc.org.uk

Convenor contact: Ian Fairchild (E: i.j.fairchild@bham.ac.uk)