Geoscientist

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OPEN ACCESS
Society publishing adapts to survive

ART OF THE MATTER
Jeanine Breaker on an 'art research' project

SO SOLID CREW
Collaborative effort to build 3D geological map

Geological Society of America's

125th Anniversary Scottish Field trips

The Great British Tertiary Volcanoes: Exploring the Palaeogene centres of Skye and Rum

27th May - 1st June 2013

The igneous centres of the NW Highland and Islands of Scotland, have provided the starting points for much of our understanding of petrology. Classic studies like that of Harker (Skye) and Emeleus (Rum), have unravelled the inner workings of volcanic plumbing systems and their products. This trip, based on the Isle of Skye, explores two of these great igneous centres, by foot and boat. Looking at layerd igneous rocks, sills/dykes, lava flows and explosive volcanism, amongst the backdrop and beauty o the inner Isles of Skye and Rum. Everything from textures to the wide expanse of flood basalts and beyond will be covered, with something for everyone's volcanic tastes.

Itinerary Outline

Monday 27th May	Travel from Inverness and arrive in Portree, Isle of Skye.
Tuesday 28th May	Trotternish peninsular, sediments, shallow intrusions, lavas and landslides (including Duntulm Castle).
Wednesday 29th May	The Central Cullins and boat trip along cliffs, visiting the inside of the Skye volcano (with seals and other wildlife).
Thursday 30th May	Lavas of Talisker bay and North West Skye, including Distillery tour.
Friday 31st May	A taste of Rum....Day trip to the Isle of Rum igneous centre!
Saturday 1st June	Travel back to Inverness with scenic stops and Castles en route

Structure and tectonics of the NW Highlands of Scotland: From deep crust to hydrocarbon reservoirs

2nd - 7th June 2013

The NW Highlands of Scotland is classic ground for structural geology. It was here that many of the key concepts were developed, from the recognition and analysis of thrust systems to the discovery of mylonites. This five day field excursion aims to provide an overview not only of the geology and tectonics of NW Scotland but also a broad range of faults and shear zones. These chart deformation styles in the deep crust through various forms of mylonites and cataclasites right up to faulting and damage in analogue hydrocarbon reservoirs. The trip involves a combination of landscape views and hands-on outcrops.

Itinerary Outline

Monday 3rd June	Excursion begins proper, travelling to Kinlochewe, Gairloch, Gruinard and then onto Ullapool. Overnight in Ullapool.
Tuesday 3rd June	Travel to Assynt and Laxford and then onto Tongue. Overnight in Tongue.
Wednesday 4th June	Visit the Thrust belt at Arnabol-Kempie. Overnight in Tongue.
Thursday 5th June	Travel to Sango and Portvasgo. Overnight in Tongue.
Friday 6th June	Travel to Eastern Moine, Portskerra (Devonian) and then back to Inverness by late afternoon. (Accommodation not included for this night)

To register your interest in attending or for more information, please email Naomi Newbold at naomi.newbold@geolsoc.org.uk

The Geological Society
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Cover image: Horia Bogdan Shutterstock.com

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STACKED, NOT SHELVED

By some odd coincidence of history, the answer to last month's crossword clue at 26 Down was – 'IDS', the 'Quiet Man', former Tory leader and lately, Secretary of State for Work and Pensions. He had not been quiet on the *Andrew Marr Show* on Sunday 17 February. Defending the Government's 'Back to Work' Scheme, which was successfully challenged in court by Cat Reilly, a geology graduate of Birmingham University, he said: "The next time somebody goes in – those smart people who say there's something wrong with this – they go into their supermarket and ask themselves...when they can't find the food they want... who is more important? Them, the geologist or the person who stacked the shelves"? (The 'this', incidentally, meaning 'being forced to work unpaid at Poundland'. *Sticks & Stones*, p.21)

Many of you took offence at IDS's remark, and the Society responded with a statement pointing out that geologists were not 'above' shelf- stacking – indeed, without us not only would there be little food (fuel, fertilizers) but no shelves to stack, either. A twitterfest of political knockabout ensued, as well as headlines about geologists 'erupting'. As the Society's Head of Policy and External Relations Nic Bilham pointed out in a *Guardian* blog published off the back of the controversy, the Society responded not so much in anger, but because IDS's remark might perpetuate a narrow idea of what geologists actually do. And a gift opportunity to get that before the public should be seized with both hands.

Most of the Society's political work isn't nearly so much fun. It issues serious, impartial advice, based on sound scientific knowledge, full of necessary caveats. Fellows would expect no less (and no more). But, as Bruce Yardley points out in *Soapbox*, all individuals – geologists not excluded – are proverbially entitled to lobby politically too, when moved to do so. Such lobbying may be distinguished by its style: for, as Adam Sedgwick once wrote: "He who asserts boldly and without doubt, will be sure of a school of followers."

As a Society, we hope that by dint of hard work we might, on occasion, persuade politicians to make a decision based on evidence, instead of doing the usual - namely following their political instinct and cherry-picking the evidence afterwards to make themselves look rational. But the last thing we need fear is that politicians won't see us coming, wherever it might be from. The unerring ability to detect an interest is one where the mental shelves are stacked well in politicians' favour.

DR TED NIELD EDITOR

SOCIETY NEWS

OPEN ACCESS

The Society cannot ignore changes to the established scientific publishing model, say Neal Marriott and Jonathan Turner*.

It is almost 350 years since the first scientific journals were published – the *Philosophical Transactions of the Royal Society* and the *Journal des Sçavans* - in 1665. Since then, scholarly publishers have flourished and the value of peer-reviewed publication in the sciences has been firmly established.

Throughout this time the business model that has supported the vibrant journal-publishing world has remained largely the same. Authors submit articles to preferred journals; publishers review, edit, process, print, sell and distribute it, largely via subscriptions. Online versions offer wide exposure, automatic linking to cited material, a range of email alerts, downloadable figures and a wider range of access options for readers.

CHANGE AFOOT

But these established business practices may be about to change. There has been a growing call for the outputs from taxpayer-funded research to be made available to all, without charge. Those in the Open Access (OA) movement who call for such a move argue that not only is it right to do this, but that it will benefit researchers in both academe and business and, indirectly, lead to increased economic growth.

Such advocates argue for different forms of Open Access, but the two most common are often known as 'Gold' and 'Green'.

In 'Gold OA', authors pay an upfront Article Processing Charge (APC) for the range of publication services offered by the publisher. The publisher makes the article freely and openly available to all, online, upon publication.

Below: The Society's publishing is a mainstay of its finances. How can it survive and prosper in a world of Open Access?

In such cases publication will be under licence terms allowing the re-use of all or part of the article (subject to appropriate attribution), even on a commercial basis.

With 'Green OA', no charge is made and the publisher continues to charge subscribers for access to the published article. However, in this case, the author may deposit a version of their paper in an online repository after an agreed embargo period has passed. The repository may be operated by their institution, or focused on a specific subject area.

There are those, of course, who make a different case and argue strongly for the continuation of the subscription model; but whichever view you side with – and there are plenty who shout loudly on this matter – the detailed arguments are complex and highly nuanced.

WORKING GROUP

In June 2012 a working group chaired by Dame Janet Finch reported on expanding access to research findings. Its key recommendations included: effective and flexible funding arrangements to enable a clear UK policy direction for APC-funded 'Gold' Open Access, and minimal restrictions on commercial use and re-use of publications arising from publicly funded research.

In July 2012 the Government accepted Finch's key recommendations and shortly afterwards Research Councils UK (RCUK) published their new OA policies. For research papers submitted from 1 April 2013, RCUK require Open Access publication, and will provide universities with block grants to be managed centrally to cover APCs. The intention is that, over time, these grants will fund an increasing proportion of papers arising from Research-Council-funded research, and that the number of Gold OA articles will rise. Authors who are unsuccessful in securing a share of the funds available for 'Gold' OA will be required to follow the 'Green' OA route.

For the Geological Society, Open Access presents both an opportunity and a serious challenge. There is the opportunity to enhance our attractiveness to authors, librarians and readers, and to form new relationships with the research community at home and abroad. If managed well, we also have the chance to ensure the widest possible exposure of new and novel research.

THREAT

But Open Access is a potential threat, too. The Society has established itself as a successful and internationally respected publisher of Earth science material. Using the subscription model, we have built a business which delivers a surplus that we reinvest in activities supporting the geoscience community. The Open Access transition has the potential to disrupt our ability to operate profitably, and so undermine our ability to offer the full range of services currently available to Fellows and others.

In preparation for the changes ahead the Publishing House has undertaken careful analysis of our costs, income and authorship, and Council has now agreed our policy. Its key features are that we will:

- give authors a choice between Gold (ie charged) and Green (ie free) OA routes.
- charge a flat rate APC of £1500 per article accepted for

publication where the author chooses the Gold OA route, and publish under the CC-BY licence (permitting sharing, copying, re-mixing, translation, text- and data-mining, and commercial use).

- offer a £250 discount to all Fellows submitting an article for Gold OA.
- allow the deposit of the final authors' versions of their papers (accommodating all peer-reviewer comments) in a repository, or on their personal website, after a 12-month embargo period.

In setting the level of APC, the Society needs to ensure the continuing profitability of the Publishing House, while competing with other publishers (who often operate at greater scale and adhere to lower standards). GSL journals and Special Publications, EGSPs and Memoirs will all offer choices, taking a 'hybrid' approach to OA, enabling a combination of Gold and Green articles.

So, will our journal titles and book series be given away free from now on? The answer is no. For as long as our publications continue to feature articles for which no APC has been paid, we will need to charge subscribers for access to the full text. However, we will take into account any APC income received and reduce our subscription prices accordingly so that we are not seen to be charging twice for the same material.

Changes come thick and fast in the world of modern publishing and we often need to pick and choose which developments we respond to, and which we don't. But Open Access, it must be said, is one we simply cannot afford to ignore.

For more information on open access and the Society's policy, go to **www.geolsoc.org.uk/open-access**

***Dr Jonathan Turner** is Publications Secretary of the Society. Neal Marriott is the Society's Director of Publishing

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

President's Day 2013

Last month the Society announced the winners of its medals and funds 2013. Those Awards will be presented at President's Day, on 5 June full details in next month's issue) As well as the Presidential Address, we will hear research talks by the four senior medallists. Kurt Lambeck (Wollaston Medal, Australian National University) will be speaking on Ice and Land, sea and strand: of Ice sheets, sea levels and the physics of the Earth; Paula Reimer (Lyell Medal, Queens University Belfast) on Calibrating the radiocarbon timescale; Peter Kokelaar (Murchison Medal, University of Liverpool) on Self-organisation and run-out behaviour of geophysical mass flows; and Martin Jackson (William Smith Medal, University of Texas) on Origin and Evolution of Allochthonous Salt Sheets.

All Fellows are welcome to attend the events of President's Day though Lunch with the Award Winners will incur a charge. Full details of charges and instructions as to how to register will be published in the May Issue, whose mailing will contain the Society's Annual Review 2012

MSG Student Awards

The Marine Studies Group is establishing new 'MSG Student Awards'. These will be made annually to the top student, based on the recommendation of the course tutor, for pre-registered courses in the Marine Earth and Environmental Sciences. Only one award will be made annually per institution.

Potential nominating tutors should obtain a registration form for their course from the MSG secretary **Alan Stevenson E: agst@bgs.ac.uk**

Students aboard the *Callista*

The Geological Society Club

The Geological Society Club, successor to the body that gave birth to the Society in 1807, meets monthly (except over the field season!) at 18.30 for 19.00 in the Athenaeum Club, Pall Mall. Once a year there is also a special dinner at Burlington House. New diners are always welcome, especially from among younger Fellows. Dinner costs £55 for a four-course meal, including coffee and port. (The Founders' Dinner, in November, has its own price structure.) There is a cash bar for the purchase of aperitifs and wine.

- 2013: 10 April (Burlington House); 15 May.

Please send cheques, payable to 'Geological Society Club' to: **Cally Oldershaw**, 14 Waterloo, Truro, Cornwall TR1 1QB. **E: cally.oldershaw@btopenworld.com** *DR*

FUTURE MEETINGS

Dates for meetings of Council and Ordinary General Meetings until April 2014 shall be as follows:

- **2013:** 16 April; 26 June; 25 September; 27 November
- **2014:** 5 February (OGM at 3pm); 9 April 2014

SOCIETYNEWS...

Library shop!

Watch the space to the right of the library counter: the Burlington House Bookshop is coming soon! From spring, we will be offering for sale a selection of recently published and bestselling publications from the Geological Society and a select few other publishers. To find out more, sign up to the e-newsletter by emailing **marketing@geolsoc.org.uk**.

New e-journal

Fellows of the Society now have offsite online access to *Island Arc* via the Library's Athens login facility. This journal focuses on the structure, dynamics and evolution of plate convergence zones and topics which are fundamental to understanding them. Visit the Virtual Library for details of how to apply for an Athens login and a list of all the Library's e-journals. **www.geolsoc.org.uk/ejournals**

Can you help the Archivist?

Caroline Lam writes: I have recently been cataloguing the 'Merriman Collection', an album of 412 glass lantern slides, primarily dating from 1880s-1910s, donated to the Society by Mrs Mary Merriman in 2002 after languishing in a garden shed for decades.

An unknown hill feature, by Ananda Kentish Coomaraswamy

Around half of the slides relate to Ananda Kentish Coomaraswamy FGS (1877-1947), an Anglo-Ceylonian who later abandoned geology (he discovered the mineral thorianite) to devote himself to the history of Indian and Ceylonese art, culture and philosophy.

There are 73 slides, such as this unknown hill, for which we have little or no information. Can Geoscientist readers help identify them?

To see more images, visit **http://blog.geolsoc.org.uk/2013/02/25/sedimentary-my-dear-watson/** and add your comment there – or write to **E: archivist@geolsoc.org.uk**

Wellington Arch exhibition

A lithograph of Joseph Prestwich from the Geological Society Library collection is currently on loan to English Heritage for its new exhibition at the Quadriga Gallery, Wellington Arch: *'The General, The Scientist & The Banker: The Birth of Archaeology and the Battle for the Past'* (6 February to 21 April). Wellington Arch, Apsley Way, Hyde Park Corner, London - W1J 7JZ

[LECTURES]

Shell London Lecture Series

Image: Richard Whitcombe / Shutterstock.com

Rivers under the Sea

Speaker – Jeffrey Peakall (University of Leeds)

17 April 2013

The modern sea-floor has an abundance of giant channels that can be thousands of miles long, up to several miles wide, and hundreds of metres deep. These submarine channels are the feeder systems and arteries of submarine fans, the largest sedimentary deposits on Earth.

Jeff Peakall is Professor of Process Sedimentology in the School of Earth and Environment at the University of Leeds. Jeff is also Director of the NERC Sorby Environmental Fluid Dynamics Laboratory at Leeds, which acts as a national centre for the study of environmental fluid dynamics.

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

FURTHER INFORMATION

Please visit **www.geolsoc.org.uk/shelllondonlectures13**. Entry to each lecture is by ticket only. To obtain a ticket please contact the Society around four weeks before the talk. Due to the popularity of this lecture series, tickets are allocated in a monthly ballot and cannot be guaranteed.

Contact: **Naomi Newbold**, The Geological Society, Burlington House, Piccadilly, London W1J 0BG, **T: +44 (0) 20 7432 0981 E: Naomi.newbold@geolsoc.org.uk**

In association with **www.shell.com**

Of advice and lobbying

WRITTEN BY BRUCE YARDLEY

Bruce Yardley* ponders the distinctive difference in style between scientists who 'advise' and those who 'campaign' on science-related issues of public and political moment

In January, Cumbria County Council voted to withdraw from the Managing Radioactive Waste Safely (MRWS) process. Local opposition was joined by Professors Stuart Haszeldine and David Smythe, who characterised the geology of west Cumbria as well-known, yet also so unpredictable that finding a safe repository site there was impossible.

Reading these two authors' web pronouncements[1,2], what strikes me is the unambiguous way that cited evidence overwhelmingly supports their position. This lack of uncertainty clearly distinguishes 'campaigning' from the sort of technical writing most of us are more used to, which must be measured, and set out the limits of evidence and of authors' knowledge and competence. And it is easy to see how 'campaigners', armed with such apparent certainties, sound more persuasive to a layperson unfamiliar with scientific evidence, while those who show less certainty appear 'evasive' (and by implication, 'Establishment').

SUBMISSIONS

Before the vote, the All-Party Group of Cumbria MPs invited Bruce McKirdy (NDA), Stuart Haszeldine and myself as independent, to meet them. Our written submissions and the transcript can be read online[2]. Part of our discussion focused on how groundwater flows through possible repository sites near Sellafield. Early work, supervised by Professor Haszeldine, showed water sinking beneath the fells, then rising under the coastal plain[3]. The final, Nirex work[4] contained more data and a more sophisticated groundwater model showing limited, fracture-controlled flow taking place through the Borrowdale Volcanics.

Professor Smythe's public lecture slides[5] present the older, original model, somewhat simplified. The top of the proposed repository is apparently almost at sea level, rather than >500 metres below. Water is shown rising through this hypothetical repository site and discharging on land at artesian springs. Certainly this diagram makes a very clear point; but does it present the full scientific picture? Explaining where he believed the Nirex team went wrong, Smythe writes in his submission[2]: "My analysis of the modelling used to predict the water flow shows that the effect of the faults cutting the rocks has been ignored". Ignored? The title of the relevant paper begins with the very words "Fracture-controlled flow"[4].

Many radionuclides are only soluble in an oxidised environment. Professor Haszeldine told MPs[2]: "I consider that there is very solid evidence for oxidising water permeating through the fractures of rocks in this environment – it was measured in boreholes. Where there is evidence of the last minerals to precipitate in many of these faults, there is evidence of oxidising characteristics and glacial water has manifestly gone through these sites to the great depths in question".

My understanding of those studies[6] is that recent iron oxides are only present at shallow levels, above any possible repository. The PODAMOT project[7] found some deep, late calcites bearing isotopic evidence of input from glacial sources, but added: "It is very important to note that the calcite with potential glacial $\delta^{18}O$ signatures *does not correspond to calcite grown under oxidizing conditions* as indicated by Ce anomalies or Fe and Mn distribution" [my italics]. Professor Haszeldine is listed as fifth co-author of this paper.

***Bruce Yardley** is Professor of Metamorphic Geochemistry at the University of Leeds School of Earth and Environment

For the references please see online
http://www.geolsoc.org.uk/en/Geoscientist

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).

> WHAT STRIKES ME IS THE UNAMBIGUOUS WAY THAT CITED EVIDENCE OVERWHELMINGLY SUPPORTS THEIR POSITION. THIS LACK OF UNCERTAINTY CLEARLY DISTINGUISHES 'CAMPAIGNING' FROM THE SORT OF TECHNICAL WRITING MOST OF US ARE MORE USED TO
>
> **Bruce Yardley**

SOLID ACHIEVEMENT

Graham Leslie, Mark Cooper and **Brian McConnell*** have recast the regional geological map of northern Ireland in 3D in a groundbreaking collaborative project

For almost two centuries, geological maps have been used to deliver knowledge and understanding of the rocks beneath our feet. Those maps, along with their complementary cross-sections, can provide information in two, three or even four dimensions; but the depth of understanding achieved in that exchange is strongly dependent on the knowledge and experience of the user. An exciting, and potentially more dynamic, future lies in using modern computing power and web-delivery to provide widely accessible 3D models of national geology. Those same media can also seek contributions on-line from across the geological community that enhance the viability and robustness of any released model or derivative products.

The British Geological Survey (BGS), Geological Survey of Northern Ireland (GSNI), and the Geological Survey of Ireland (GSI) are now collaborating to build a 1:500 000 scale, 3D model of the upper crust of Britain and Ireland. To develop a methodology for future work, the partners have constructed a 'Version 1' test-block of the north-eastern half of Ireland. Currently, that model comprises a System-based stratigraphy, and an array of regionally important faults that divide the model into component blocks sharing a recognised geological history.

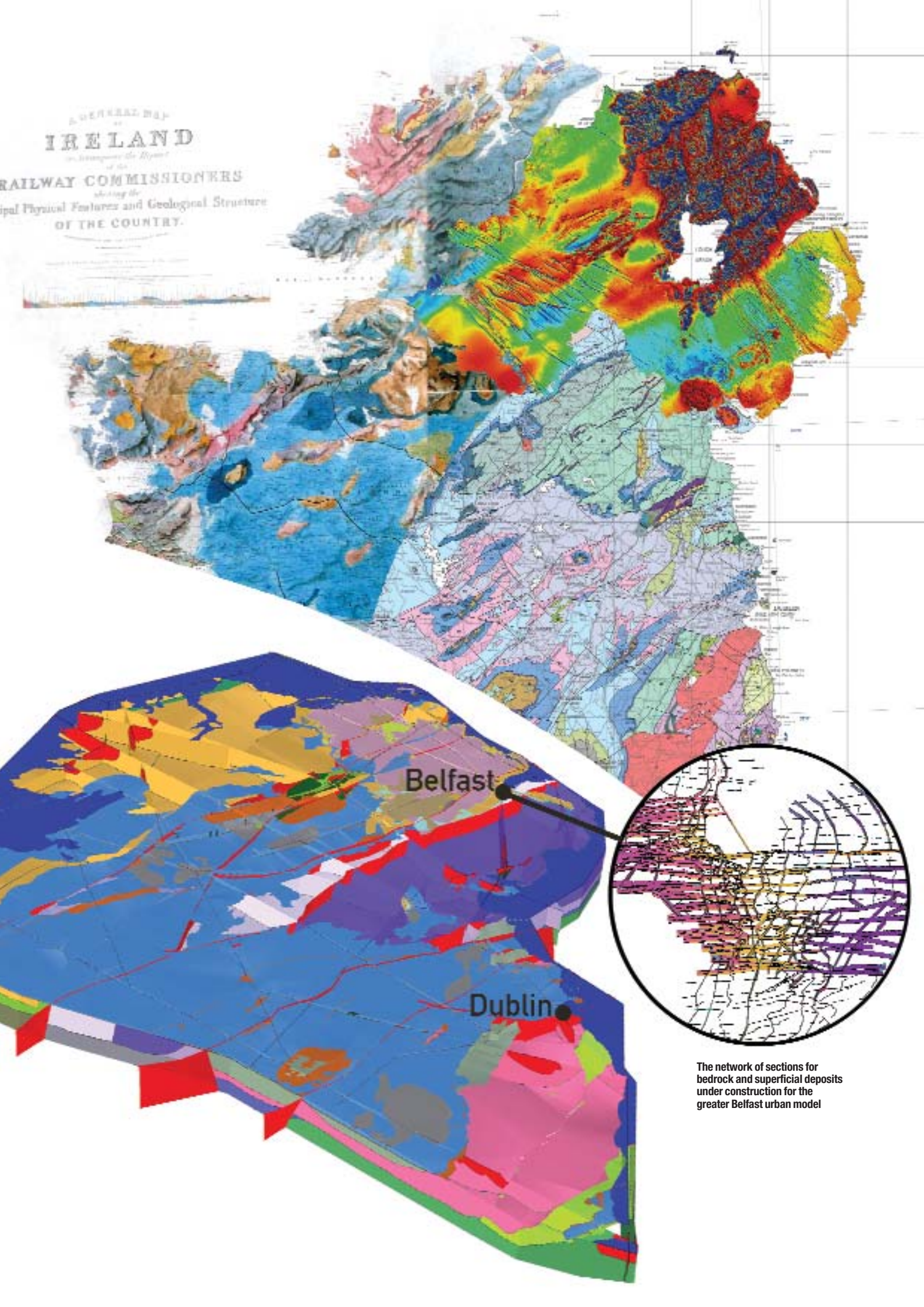
Stacked surfaces in the model represent the base and areal extent of individual geological units: for example, the spread of Carboniferous limestones that dominates the near-surface bedrock geology of the Irish midlands. The north-eastern Irish model is already providing a regional context for enquiry-driven, higher resolution case studies, such as the Belfast urban geological model. This new model is being constructed in consultation with Belfast City Council and other stakeholders in order to inform future sustainable urban development.

NATURALLY COMPLEX

Physical reality is three-dimensional. Earth systems and processes are naturally complex and operate, through time, in those three dimensions. A 3D model projects the geologist's understanding of this natural order and complexity. Identifying national resources, (energy, minerals and groundwater) and geo-engineering the infrastructure that secures their supply, both depend upon a consensual, national geological understanding. In the north of Ireland, the multi-award winning Tellus Project and current Tellus Border Project are addressing shortcomings in the regional baseline data for environmental protection and sustainable resources ▶

GSNI 2007 Tellus magnetic imagery superimposed on the GSI 2006 and original R.E. Griffith 1838 geological maps of Ireland

Version 1 geological model of the north of Ireland, major faults are shown in red. The modelled surfaces indicate the base of each geological System: the Palaeogene lavas (lilac) cap the Antrim Plateau in Northern Ireland; the Carboniferous limestones (blue) dominate the Irish Midlands. The model is currently bound by a c. 350 km long section drawn from Benwee Head in the NW to Carnsore Point in the SE



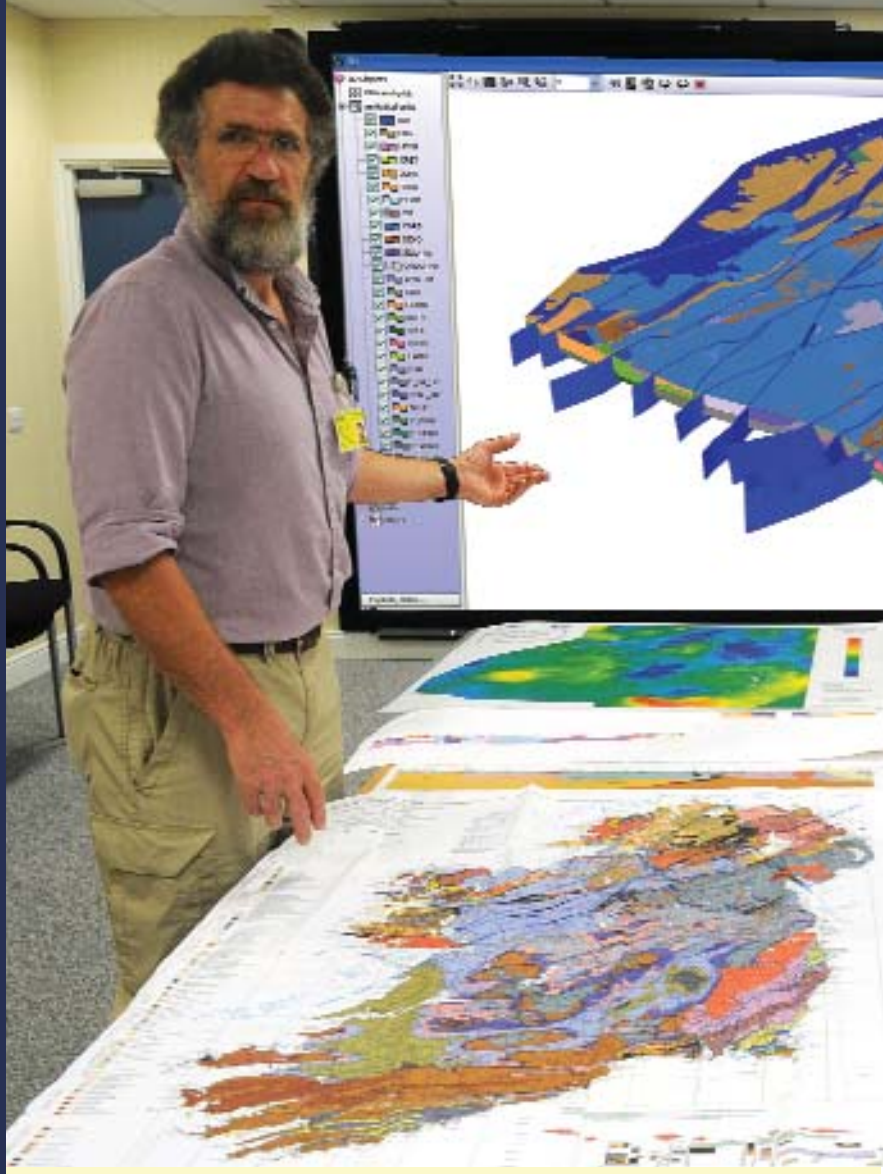
The network of sections for bedrock and superficial deposits under construction for the greater Belfast urban model

(**www.bgs.ac.uk/gsni/tellus/ & www.tellusborder.eu/**). Vast geophysical and geochemical datasets are now available to investigators and researchers. Integrating these rich new data with the existing geophysical and geochemical information, (e.g. seismic, gravity, soils), is rapidly providing fresh insights into the geology of Ireland, and a robust 3D model can provide the platform upon which they can be fully exploited. The model should be able to absorb any data (whether new or 'legacy', outcrop, borehole or remotely sensed) and then be regenerated with quality-assured attributes. It should be dynamic! The geologist's task is to communicate the essence of that 3D model, and so help government, industry, research and education to take properly informed decisions.

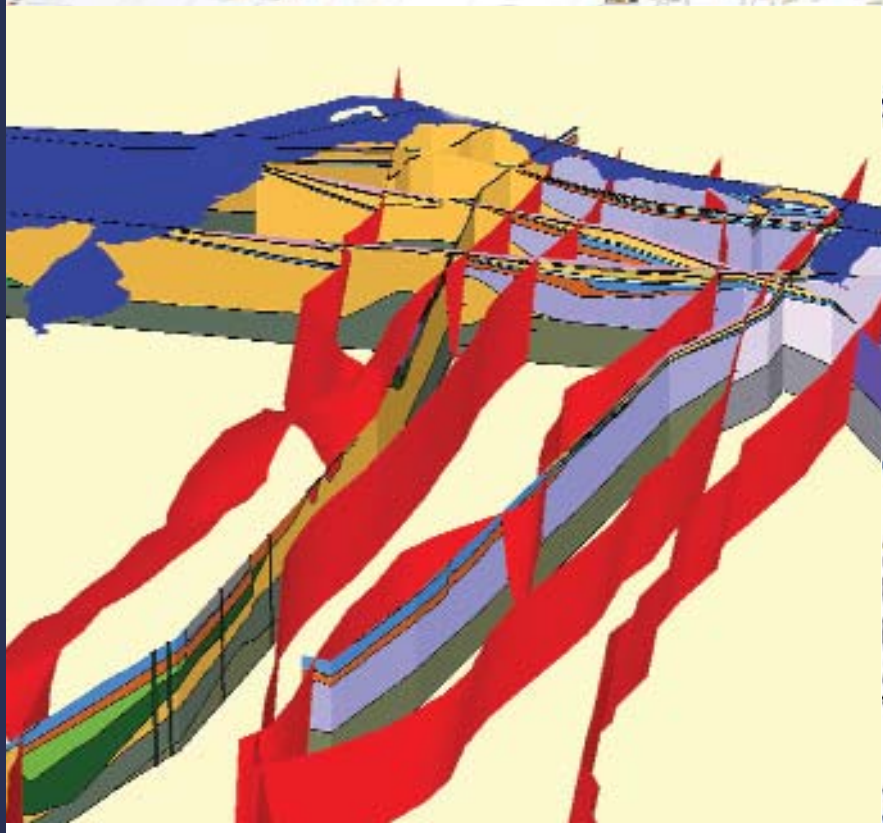
SCRIPT TO SCREEN

Constructing a geological model for the north-eastern half of Ireland, one that extends down to a depth of 15km, can only be described as an awesome challenge - not least in the sense that we encompass a volume of some 700,000 cubic kilometres of rock. To achieve a geologically realistic model, it is necessary to integrate knowledge and understanding that has been accumulating since 1838, when Sir Roger Griffiths' geological map of Ireland was first published, and encompassing modern regional geological maps (themselves summations of countless years of fieldwork), academic research, records from deep boreholes and the Tellus datasets.

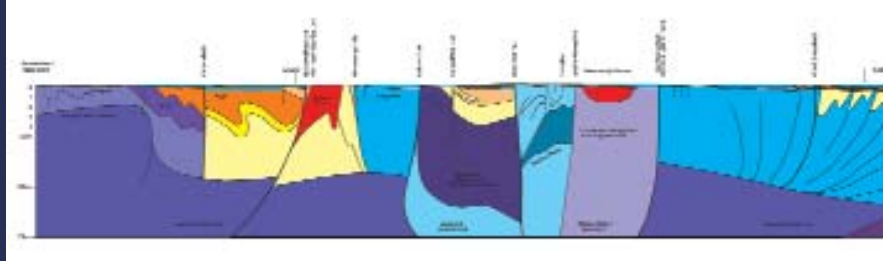
In recent years a wide range of 3D modelling packages have become available, but, for its geologically intuitive nature, the 'first build' for north-eastern Ireland was made using GSI3D software, developed jointly by BGS and INSIGHT GmbH. Steve Mathers, Holger Kessler and Ben Wood (all BGS) have provided continuous support and encouragement to the geological team. GSI3D (which stands for 'Geological surveying and investigation in three dimensions') is described by its developers as a methodology for 3D geological modelling that enables the geologist to quickly capture data and construct sub-surface models, for a wide range of consumer applications. The software is now available on general release through the not–for–profit GSI3D Research Consortium



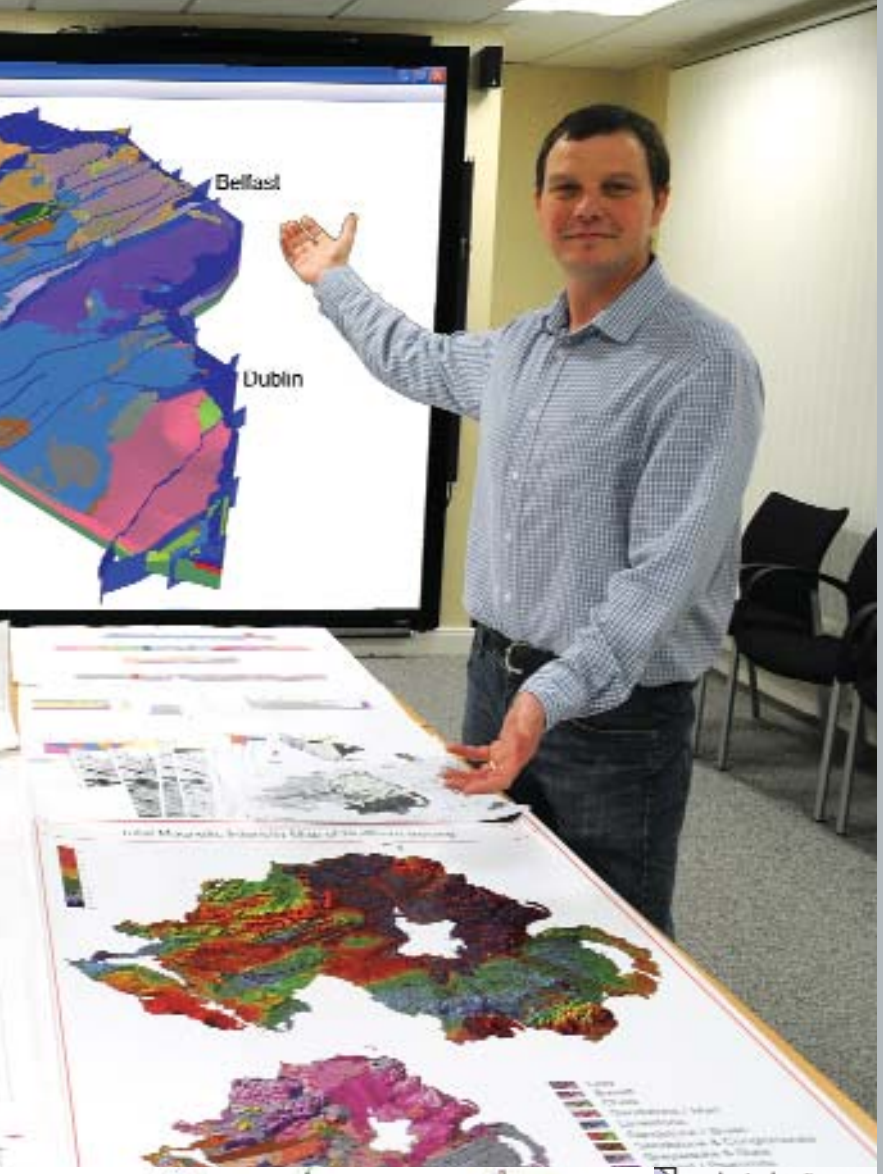
The array of data incorporated into the V1 3D geological model of the north-eastern half of Ireland

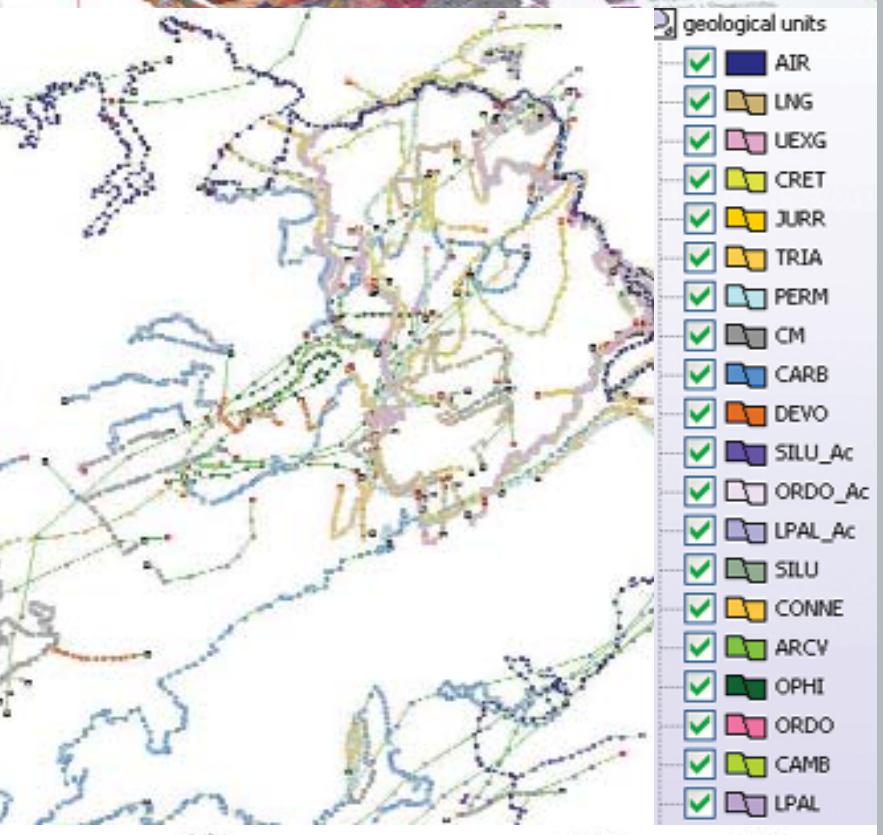


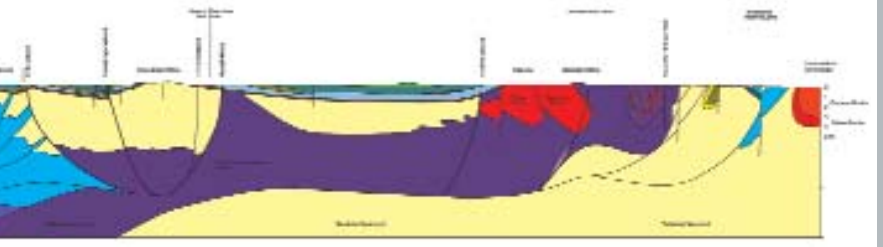
Close-up of geological cross-sections and faults (red) that form the framework on which calculated surfaces hang



Geologists' cross section from Benwee Head to Carnsore Point







Left: Tectono-stratigraphic GVS showing, for example, Ordovician accreted strata (ORDO-Ac) above Silurian strata (SILU)

Far left: The outcrop and subcrop limits of Systems (spaghetti)

(**www.gsi3d.org/**) and is rapidly becoming one of the preferred assets in the geologist's toolkit.

GSI3D uses geological cross-sections and boreholes to constrain model surfaces at depth. Few such sections existed for the crustal-scale model under construction, and the available borehole data have limited impact at this resolution. Our first step therefore was to build a regularly distributed network of 15km-deep sections across the area of interest. These detailed sections were compiled so as to capture current understanding of System-based stratigraphy and regional tectonic structure. Regular consultations with other experts on Irish geology provided further constructive input to our efforts.

The sections were then stripped down to provide a simplified skeleton on which key surfaces were calculated and displayed. GSI3D takes a 'younger over older' stratigraphical approach to the model calculation and, at this stage in its development, cannot directly deal with 'older over younger' rock relationships, as encountered with reverse faults and overturned strata. This has been overcome in the V1 model by adopting a tectono-stratigraphic approach to the units defined for the model's generalised vertical section (or 'GVS'). Lessons learned in these scenarios are being fed back to the GSI3D software developers.

In addition to the cross-sections, a network of regionally important faults, such as the Tempo-Sixmilecross Fault, divide the model into discrete blocks. In order to permit calculation, these model faults must, at present, be extended downwards from the capping topographical surface (digital terrain model, or 'DTM') through the full model thickness. However, faults associated with the Iapetus Suture in Ireland are largely concealed at surface by Carboniferous strata. Others, by contrast (such as the Orlock Bridge Fault) do cut all the way to the surface and are thus conspicuous features of the conventional geological map. Where appropriate therefore, the section lines have been constructed with minimal or no offset of geological units across these concealed master faults.

OUTCROP, SUBCROP

The extent of the lower surface of each geological unit is established from exposed (outcrop) and/or concealed (subcrop) limits. Deep borehole records ▶

and geophysical interpretations are then incorporated with those crops, to gauge the extent of concealed sedimentary basins. The calculation integrates all of those limits with constraints provided by the cross-sections, faults and fault-offsets to deduce the model surfaces. Since the lower surface of each rock unit is also the upper surface of the underlying unit, the enveloping surfaces for each volume are therefore complete and Version 1 of the geological model is revealed. New or additional data can be rapidly added to the calculation as required.

Frame 1 (see strip below) shows that deformed and metamorphosed Neoproterozoic strata dominate the NW of the model (beige) and lie to the NW of the Galway-Carnlough Fault (GCF) system, a structure that potentially marks the edge of the Laurentian craton in Ireland.

The Stars highlight economically viable gold deposits in these rocks, while exploration for volcanogenic massive sulphide deposits (VMS) is taking place in adjacent Ordovician rocks (green). The southwestern continuation of the Scottish Midland Valley (MV) is clearly seen - but apparently terminates in the SW against the Galway-Carnlough Fault system. Farther to the SE lies the Lower Palaeozoic Accretionary Wedge and its major tract-bounding faults. Another set of major faults is shown in the convergence zone above the Irish trace of the Iapetus Suture (IS). To the south are the basal surfaces of the Lower Palaeozoic of SE Ireland.

In **Frame 2**, Devonian (brown) and Lower and Upper Carboniferous rocks (blue and grey) are added. The Lower Carboniferous rocks host the world-class Pb-Zn deposits of the Irish Midlands (e.g. Navan -starred), while the Upper and Lower Carboniferous contains important hydrocarbon source and reservoir rocks. The Northern Ireland Permian (light blue – **Frame 3**) encompasses a thick halite interval, which is a target for natural gas storage; while Triassic rocks (orange, **Frame 4**) are important groundwater reservoirs and have hydrocarbons and deep geothermal energy potential (starred).

The Jurassic (yellow) includes important hydrocarbon source rocks and seal. Cretaceous strata (light green, **Frame 5**) consist of extremely pure white limestones, valued as a raw material. Last but not least, we have the base of the Palaeogene basalts (lilac, **Frame 6**) famous for the World Heritage-listed Giant's Causeway (GC) and the Oligocene lignite-bearing deposits (dark green) of the Lough Neagh Group on top (starred). When stacked together, the surfaces broadly recreate the published map in plan view – as they should. Further information on this and other Northern Ireland models can be found at **www.bgs.ac.uk/gsni/geology/3d/index.html**.

TO BE CONTINUED

Of course, we accept that our 'V1' crustal-scale model of north-eastern Ireland is not yet 'fit for purpose'. The fault framework is still too simplistic and requires further shaping to match the complexity of the crustal-scale fault

Cliffs in County Antrim, Northern Ireland

Basalt columns of the Giant's Causeway, County Antrim

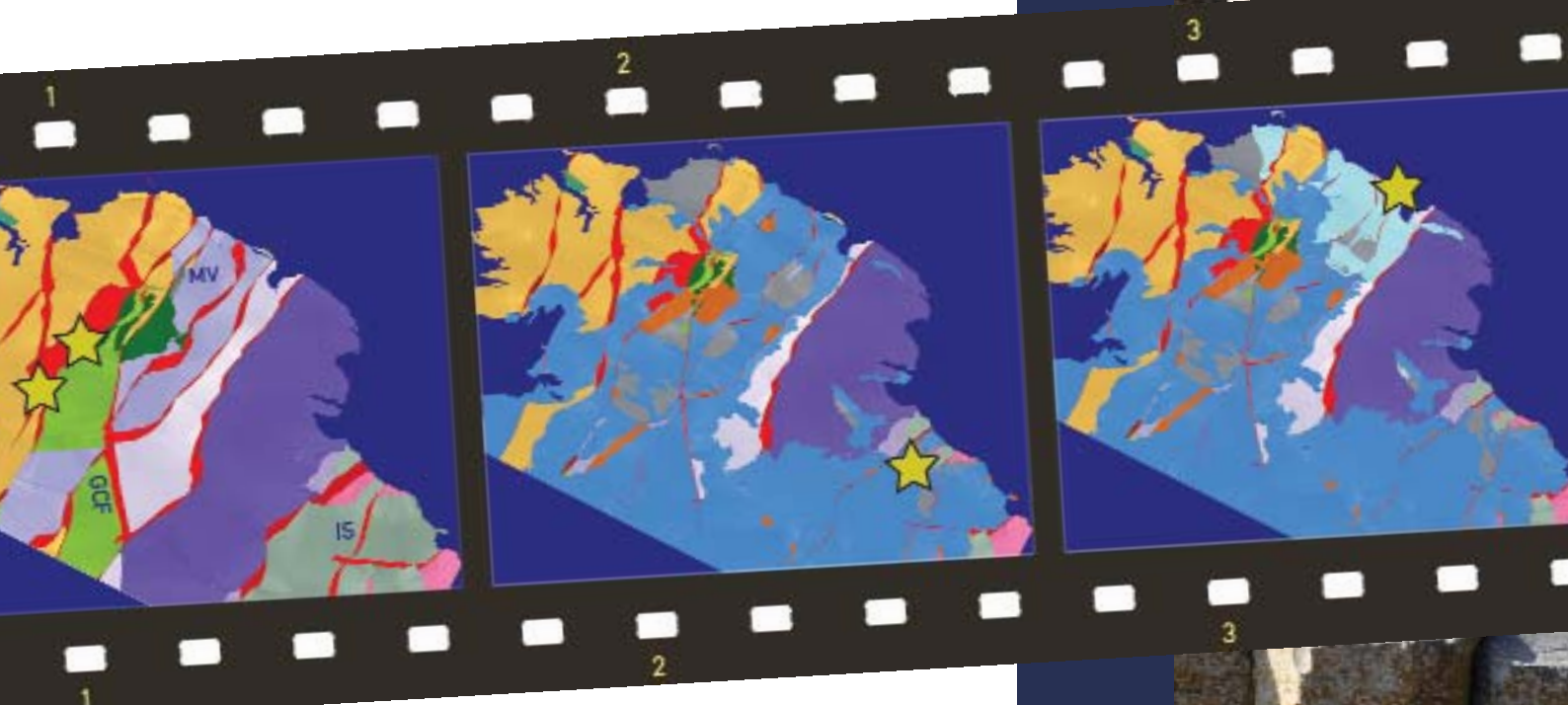
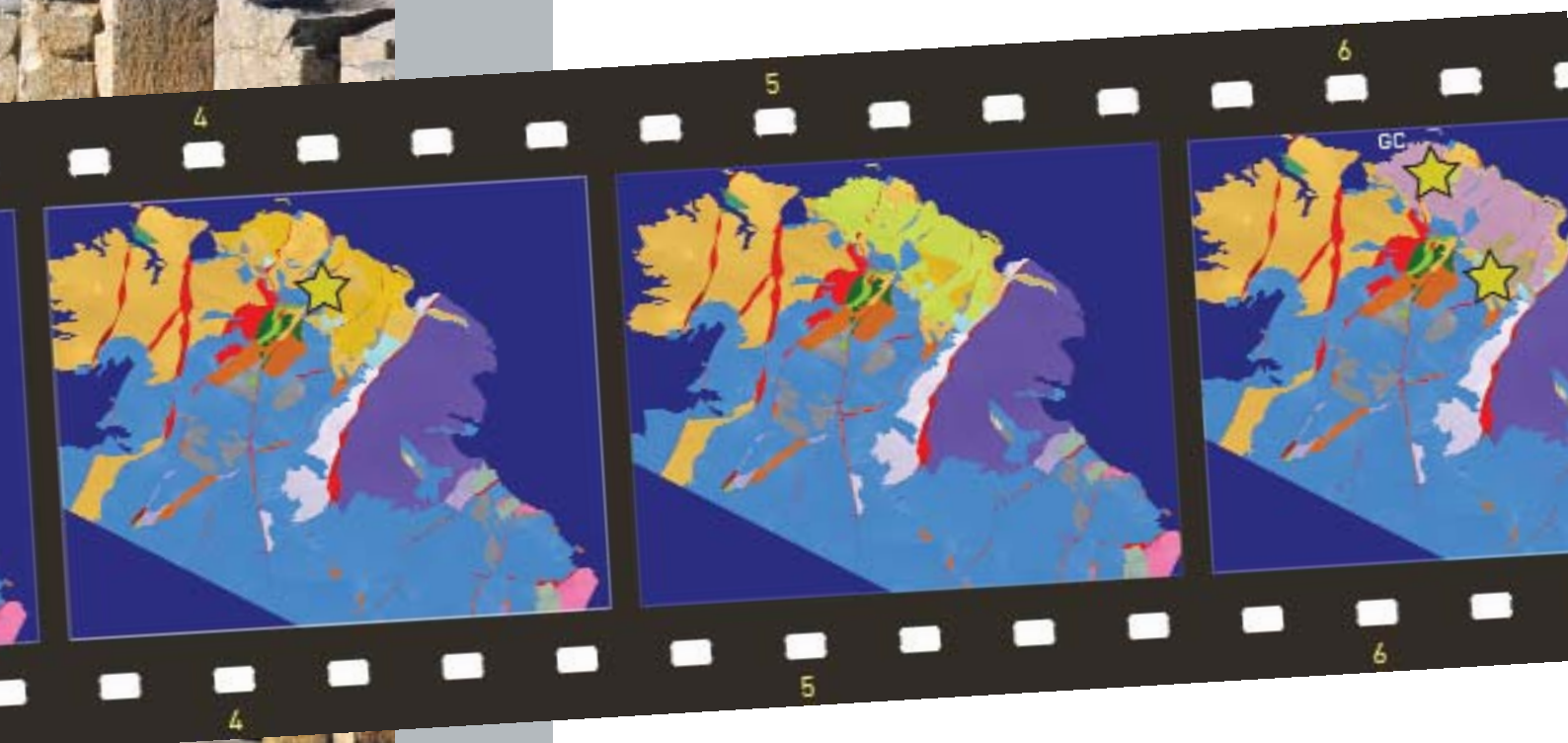
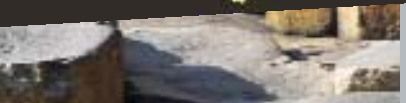


Image: NCG / Shutterstock.com





architecture seen across Ireland. Although visible in the component cross-sections, the major plutons are yet to be calculated as 3D objects in the model. While those enhancements are introduced, we intend to expand the model across the rest of Ireland and Great Britain, onshore and offshore.

We also accept that the collaborating geological surveys are not sole arbiters of a national geological model. As other 3D models (or their component objects) become available at a variety of scales and from a variety of sources, any national geological model must respond and incorporate those data – irrespective of whether those data derive from resource exploration or ground investigation. Faults and stratigraphical limits can then be recast in 3D. Such upgrades to the national model can be achieved - perhaps most effectively - in the form of 'versioned' downloads that clearly state the provenance of the datasets and ideas incorporated in that particular build.

The World Wide Web provides the ideal forum; crowd-sourcing external data, allowing uploads to a (mediated) web site that can then deliver model updates once those new inputs achieve the required level of confidence and quality assurance. In this way, we think that the national geological model would truly be nationally owned. ■

*Graham Leslie British Geological Survey; Mark Cooper Geological Survey Northern Ireland; Brian McConnell Environmental Simulations International

ACKNOWLEDGEMENTS

Construction of the V1 crustal scale model of the north-eastern Ireland was funded through Tellus 2. Staff resources were made available from all three surveys (GSNI, BGS & GSI) to allow this first model to be produced. The authors acknowledge geological and technical input from the GSI3D team, **Sarah Arkley, Bruce Napier, Alex Donald, Calum Ritchie** and **Tony Myers**. This article is published with permission of the directors of the UK and Irish surveys.

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- Tellus Border: www.tellusborder.eu/

THE CURRENT DISTURBED

'Art researcher' or 'exotic pet'? **Jeanine Breaker*** reflects on her art-science research experience, including a Leverhulme Trust research fellowship at BGS

Leonardo da Vinci said: "We know more about the movement of celestial bodies than about the soil underfoot." His statement is still relevant almost 600 years later, and in many ways, has led to pressing global concerns over energy, food and water supply, pollution and climate change. Dr Nicholas Riley, BGS Head of Grantsmanship and Science Policy (Europe) states: "Industrialisation and urbanisation have increasingly led to a disconnection between society and the constraints that the Earth places upon it. Public respect for landscape and responsibility to live in harmony with it relies upon our collective visual literacy – our ability to recognize how the landscape came into being, its evolution and how our actions may increase or diminish our vulnerability to its natural behaviour."

The UK's research culture is one of the most progressive in the world, and UK funding organisations are creating opportunities for artists to work with leading science research organisations like BGS to address such pressing concerns. My year with BGS was one of the most productive and pleasurable of my professional career, however art-science research collaboration poses conceptual challenges – to both sides. Finding an effective balance, which avoids confusing novices on one hand and patronising the informed on the other, can prove elusive when two disciplines' methods and approaches are as foreign to one another as are geology and contemporary art. One scientist, for example, asked if I would be drawing portraits of old men in beards, while a college art professor asked me if geology was even considered 'real science'. Caught between these two extremes, an art-science research fellow – though the scientists refer to me as their 'artist-in-residence' – can sometimes feel like an exotic pet.

Above: The 15 x 5 foot triptych, ***The Current Disturbed***, resulted from fieldwork conducted in the English Midlands near Swarkstone. Two soil-profile peelings flank my soft pastel drawing, which fastidiously replicates the soil-profile between the peels. The drawing is entirely comprised of visual and textual geological annotation derived from interviews with BGS sedimentologists after careful study of the peels. A truncated shadow is depicted against the soil-profile enveloped in light, literally and metaphorically overexposing the soil surrounding the embodied profile

FIELDWORK

While conducting fieldwork in Holland, I captured spectacular shadows cast by a geologist against striated soil that appeared almost primitive. These silhouettes against the soil-profile formed the conceptual basis of my film, *Embodied Profiles*, created as output for my fellowship. The geologist's initial response, springing from his habitual criteria for judging scientific pictures was, "Beautiful – too bad about the shadows." From my standpoint, the transparent primitive silhouette provided the creative resolve – a physical manifestation of evolution through which to access and engage with the science.

As experts in both art and science become more specialised, value and respect between estranged cultures diminish and require continual reinvestment in art-science collaboration. University of Oxford Art History Professor Martin Kemp, a leading authority on the art and science of Leonardo da Vinci, has cautioned: "Many intelligent, motivated people were interested in art and science but found that a lot of art didn't relate to their lives, and that a lot of science was mightily obscure.[...] In an art-science collaboration, it is important that the artist does not impose a view on the science. Nature has more imagination than we do, so it is best to let it speak for itself.[…] Equally, if either party tries to impose too much – either by riding roughshod over the scientific content or by demanding needless technical accuracy – things can go wrong.[…] A successful art-science work should be more than simply communicating scientific ideas in a mathematics-free version. It should impact on people in a direct way, with a sensory component that moves them."

Gongbing Shan, a reviewer for *Leonardo Journal of Art Science and Technology* writes: "Multidisciplinary has become a catch-word of some currency. However, those who engage in multidisciplinary research typically find that it is considerably more

difficult to do than they initially anticipated. This is especially the case for the multidisciplinary research between art and science. If artists and scientists aim toward a common goal, then as fundamental research methodologies of constituent disciplines diverge, new demands are placed on both parties and their efforts must become complementary rather than merely integrative. Perhaps the next stage in the evolution of multidisciplinary research between art and science will be one where artists and scientists can supersede both disciplinary boundaries and the mere coordination perspectives, resulting in modes of thinking that ▶

Right: ***Earth Spine*** **(see image notes on page 19 for further information)**

Below: ***Fractal Fields*** **(see image notes on page 19 for further information)**

Left and above left: Stills from the film *Embodied Profiles*, an installation featuring 18 x 24 inch soil-profile peelings from Holland – two that are adjacent and a perpendicular cross section – and a third wall which features a film created from my footage in Holland. The film uses the distortion of slow motion to reveal mysterious sounds and the timeless elegance of Earth science fieldwork. Dr Westerhoff's profile is embodied against the soil-profile, in a distillation of time and evolution that speaks to the vulnerability of Earth at our hands

become transdisciplinary. I consider [such fellowship work to be] moving toward this direction."

The goal of my fellowship was to investigate the creativity of the scientific method and the methodology of scientific creation. Ann Pizsorusso, a geologist who researches Leonardo da Vinci's work, offers a relevant perspective here: 'Leonardo's paintings and drawings, viewed from a geological perspective, reveal a remarkable fidelity to nature.[…] He memorialised his observations in his notebook, now known as the *Codex Hammer*, which details his thoughts and observations on geology, hydrology and the effects of water and air on the Earth. He revealed his observations in his paintings and drawings by precisely depicting geologic formations which, at the time had not been named, but which are readily identifiable to a modern geologist.[…] All we know about Leonardo suggests that he had too much respect for the nuances of natural beauty to ignore them." Lack of resonance with the real world inevitably leads to reductive aridity. Without sensitivity to environment, an artist has little upon which to draw, and the work offers the viewer little to which to respond.

Advanced technologies have provided Earth science with a plethora of new ways to study the earth, and as a result of their prevalent use, the public risks losing touch with the physical environment. A decade ago a group of hikers were much less likely to risk a mountain trek without a map. Today emergency services are routinely called out to rescue hikers relying on satnavs and other devices that are unable to show features at the appropriate scale for fell walking, or that have lost signal, power, or both. Stanford University Professor Robert Harrison writes that these computer devices "draw [students] into their blinkered personal realms[...]. This retreat from the natural world is most evident in the young, but it is not a generational phenomenon.[…] The computer is changing the very essence of the human animal".

My time at BGS revealed the limited knowledge and understanding of the natural world

that prevails among those of us untrained in geoscience.
To paraphrase Hydrogeologist Dr Vanessa Banks, to the Earth scientist the landscape represents a 'time shot' of the continuing evolution of the Earth's crust, and understanding of the landscape is based on a range of scientifically tested conceptual models.
These models provide a route to an artificial visual literacy, as drawn from training and acquired experience.

MULTI-MEDIA

Engaging with the working methods and processes of geoscience through the first-hand experiences of a layman with very little physical science background, I focused on creating multi-media 'arte/facts' that integrate soft pastel drawing and geological annotation with geological techniques using soil itself as medium. One such technique is 'soil-profile peeling' in which lacquer is used to bind a thin layer of soil onto a backing-board with muslin to extract large-scale vertical slices of the soil-profile intact.

My drawings were created with the loosely bound materiality of soft pastel because it is such an intimate medium, much like drawing with soil. (In fact, my hues were matched to the geologically precise 'Munsel' colour chart.)
I created four large-scale multi-media arte/facts, collectively called 'Authentic Landscapes'. These were derived from rigorous study of the nuanced structure of the soil in collaboration with geoscientists at BGS and BGS affiliate, Dr Wim Westerhoff (Netherlands Organisation of Scientific Research-TNO). See captions for further explanation.

Although we all, to some extent, find ourselves immersed in an increasingly virtual world, a renewed investment in the material nature of drawing continues to emerge and engage on all levels and in all fields, because human beings continue to be drawn to an intimate, material experience of their environment – ever curious about how, as Paul Klee put it, 'to make unseen things visible'.

Below: The 7 x 4 foot triptych *Angle of Repose* features a 2 x 4 foot soft pastel and graphite drawing flanked by two soil-profile peelings of the same size created during our fieldwork in Holland. My drawing replicates a vertical section from each of the peels, and imbeds textual and graphic 'borehole log' annotation into the fabric of the drawing. 'Oscillating between the micro and macroscopic', Angle of Repose re/presents multiple layers and textures of the soil and its geology, which in this case dates back 70 million years

*Jeanine Breaker was funded by a Leverhulme Trust Research Fellowship, in the first ever art-based fellowship to be held at NERC British Geological Survey (BGS) jebre@bgs.ac.uk

FURTHER IMAGE NOTES

Fractal Fields, (P17) also resulted from the fieldwork in Holland. Fractals are the 'self-similar' patterns common in nature in which corresponding patterns recur at progressively smaller scales. The first panel is a highly textured 18 x 24 inch soil-profile peeling. My soft pastel drawing in the centre replicates the precise location from which the peel was taken. The third image uses microscopy to magnify a few sand grains taken from the peel. An antique brass film loop magnifying the sand grains hovers over the drawing. Written between the lines of the soil are riddles about landscape preservation comprised of antiquated phrases dating as far back as the 16th century.

Jeanine produced five short films. *Embodied Profiles* (see P18) *Authentic Landscapes* begins with a brief narrative describing insights about my investigation with BGS, and is followed by crisply edited documentation of the soil-profile peeling process. *The Dichotomy of Being Underfoot* is a frenzied three-minute filmic 'trip' compressed from two hours of footage taken down a 90-meter borehole with a 360-degree CCTV 'spinning camera' on a private estate in the Peak District. The audio track mixes the rhythmic sounds of borehole drilling with that of a human heartbeat.

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PROBLEMS IN THE WATERWORKS

Where will students learn their hydrogeology in future?

Image: Geoclliz / Shutterstock.com

Sir, I was disappointed by Bruce Misstear's Soapbox article (*Geoscientist 22.01, p09*) although I agree with him almost entirely. We seem to be faced once again with unthinking and fundamentally illogical bureaucracy. This is at least the third such occurrence with respect to hydrogeology in the last 30 years. It might have been reasonable to hope that current administrators, bureaucrats, politicians - call them what you will - would have learnt from the second round of such behaviour, if not the first.

My only issue is with the statement that: "... the implications for the profession will be serious". While that is certainly true, I do not believe that it is strong enough or its scope wide enough. The implications will be serious for the country and its environment as a whole; the profession is only one part of that, important though it is in itself.

I assume that the Hydrogeology Group will make strong representations in all relevant places. It is very important that it does so. I wonder whether the Council and President might approach government directly, both independently - ie, on behalf of geology - and in association with The Royal Society, The Institute of Environmental Management and Assessment, and any other bodies likely to share our concerns.

Jeremy Joseph

Ice Age Art: Arrival of the Modern Mind

Quite apart from its aesthetic appeal and general cultural value, the exhibition of Ice Age art at the British Museum also has specific interest for geologists and especially palaeontologists.

The exhibition includes over 130 objects - carvings, engravings and some of the oldest ceramic works known, mostly dating from between 35,000 and 15,000 years ago. The objects accurately depict a selection of the Middle to Late Devenisan bestiary encountered by the Late Paleolithic people who first occupied Eurasia. From their close encounters with the Ice Age megafauna, these hunters developed an intimate knowledge and understanding of their prey and the numerous dangerous carnivores, which saw them as prey.

These 'art' images were made mostly from mammoth ivory, bone, stone and clay and include mammoth, big cats, reindeer, bison, auroch, ibex and horses, along with fish such as salmon and sole, birds such as swans and ptarmigan and of course the humans themselves, especially the so-called 'venus figurines' of pregnant women. Many of these images represent the only existing first hand observations of these animals, especially the extinct species.

They show details of soft tissues that support other evidence from frozen cadavers and behaviours, which otherwise can only be assumed from comparisons with the closest living relatives. All these images may be familiar enough from photographs but seeing the real thing is still something of a shock, partly because of their antiquity but more especially from the great skill and sensitivity with which they were made.

The exhibition represents a once-in-a-lifetime opportunity to see works that are normally scattered through the archaeological museums of Western Europe from London to Brno. A visit is well worth the effort and the £10 entry fee but if you cannot get to it, consider the excellent book. It is a stand-alone work, covering much more background information than can be gleaned from the exhibition and iillustrates many more works than are on display.

Reviewed by ***Douglas Palmer***

ICE AGE ART: ARRIVAL OF THE MODERN MIND EXHIBITION
7 February – 26 May Room 35 - British Museum, Great Russell Street, London. **Entry: £10** Late opening: Fridays. Booking **T: 020 7323 8181. W: www.britishmuseum.org/whats_on/exhibitions/ice_age_art.aspx**

ICE AGE ART: ARRIVAL OF THE MODERN MIND
JILL COOK, Published by: The British Museum Press 2013
ISBN 9780 7141 2333 2 HB (hbk) 240 pp
List price £30 www.britishmuseum.org/publishing

Introduction to Geological Structures and Maps

The 8th edition of this classic geology text book has been updated and expanded and now includes colour photographs and maps as well as the extensive black and white figures and diagrams of previous editions. In addition to the improved look, the sections describing igneous intrusions, plate tectonics and impact structures have been expanded and there is the welcome addition of a new section on way-up criteria.

In summary, the book, which is aimed at students ('A'-Level to undergraduate level), leads the reader through the basics of interpreting geological structures and geological maps by first setting out some of the fundamental rules such as the laws of superposition, cross-cutting relationships etc. Once the foundation has been established the authors build up through the basics of the interpretation of horizontal and dipping strata that are the cornerstones of geological map and structure interpretation, before moving on to the more detailed aspects of geological structures including unconformities, faults and folding. The final portion of the book describes more complicated geological structures such as igneous and impact features, economic problems and complex structures.

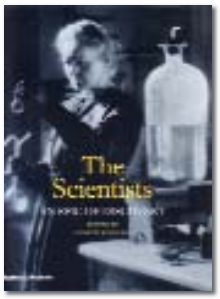
The book is peppered with maps, photographs and examples of the geological structures discussed in the text on practically every page. These frequent interludes bring the text to life and allow the reader to visualise clearly the topics under discussion. The photographs (many in colour) add a practical real-world dimension to the 'idealised' figures and the 3D models are useful.

This book is immensely practical and is chock full of examples to teach the student as he or she starts on this fascinating and rewarding journey - as well as offering the more experienced practitioner a reminder of the tools of the trade. (Don't worry - the answers are at the back!) Readers can work their way through simple bed thickness and interpretation of outcrop locations, essential for the practising engineering geologist, through to more specialised aspects of geological structure interpretation associated with ore deposits.

I would photocopy the maps before attempting the problems, as it can be difficult to work around the spine of the book (and it gives you the opportunity to have multiple attempts). Although this excellent book is aimed primarily at students (and it should be high up on their 'to buy' list), it would make a welcome addition to any geologist's bookcase. The manager who has been kept from field mapping might find this book provides a welcome antidote to his spreadsheets, while even the working field geologist may find it a useful reference - or light relief after a hard day. An excellent book well worth purchasing.

Reviewed by ***Tom Berry***

AN INTRODUCTION TO GEOLOGICAL STRUCTURES AND MAPS (8TH EDN.)
BENNISON, OLVER & MOSELEY, Published by: Hodder Educational, London 2011
ISBN: 978-1444112122 184pp. **List Price: £21.99**



The Scientists: An Epic of Discovery

Here's the game: choose the top 43 outstanding scientists who have revolutionised our understanding of the world. Or, to make it simpler, choose the eight who have had the biggest impact on Earth science. Andrew Robinson's geological pantheon includes James Hutton, Charles Lyell, Alexander von Humboldt, Alfred Wegener under the category 'Earth', Ernest Rutherford under 'Inside the Atom', Carl Linnaeus and Charles Darwin under 'Life' and Louis and Mary Leakey under 'Body and Mind'. I bet that you, 'dear, geologically minded reader', would have had a significantly different list.

Robinson's total list of 43 is heavily weighted towards European DWMs (Dead White Males) and I suspect that any non-UK scientist would produce a very different list. Perhaps 'The Scientists' is not pretending to be anything other than a vehicle for a well-presented selection of potted biographies of interesting scientists. At least they are written by appropriate authors, many of whom are emeritus professors of a discipline relevant to their subject, plus some well-known science journalists and historians of science.

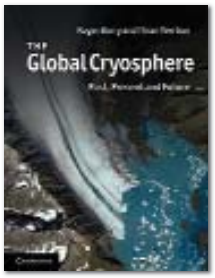
Our geological giants are appraised by writers such as Martin Rudwick, who certainly know their stuff. He does Hutton and Lyell, who would probably be members of any geological pantheon; but with only a thousand or two words available, the writer's horizons are quite limited. As we would expect, Rudwick turns in a couple of very interesting essays, which 'burst the limits' of space, if not time, imposed upon him. Both of his eminences are firmly placed in context without in any way belittling their individual contributions.

An American academic, Laura Walls, describes Alexander von Humboldt, who might seem a surprising choice but in the wider Earth science context is an important figure, admired and envied by Darwin, who in the early days of the Beagle voyage complained that he was just dogging Humboldt's footsteps without finding anything new.

And then the Leakeys; significant figures, but in the top ten? And Virginia Morell's brief biography is rather pedestrian compared with her much more searching and revealing biography, 'Ancestral Passions'. Perhaps the problem is the nature of Earth science where major breakthroughs are more incremental than in other sciences such as maths or physics, so choosing who made the most important find is inherently more difficult. *Ref: Morell, V 1995. Ancestral Passions. Touchstone, New York, 640pp.*

Reviewed by ***Douglas Palmer***

THE SCIENTISTS: AN EPIC OF DISCOVERY
ANDREW ROBINSON (ED.), Published by: Thames and Hudson Publication 2012 ISBN 978-0-500-25191-1. 304pp. List Price: £24.99



The Global Cryosphere, Past, Present and Future

This is an excellent book which deals with all the components of the Earth's cryosphere – all forms of snow and ice, both terrestrial and marine. It gives a summary of snow cover, glaciers, ice sheets, lake and river ice, permafrost, sea ice and icebergs – their history and projected future. It is agreeably written and suitable for undergraduate and graduate level students in environmental science, geography, geology, glaciology, hydrology, water resource engineering and ocean sciences.

The book includes a useful index, glossary and a large list of references. It has many black and white photographs, figures, maps, tables, colour plates and thematic boxes on selected topics. It also gives an up-to-date summary suitable for anyone undertaking research on the cryosphere.

There is a detailed discussion of the formation of snow. At continental scales, snow distribution depends on latitude and season. However, at regional scales snow cover depends on factors such as latitude, elevation, orography and meteorological factors, all of which are discussed in detail and at length.

The treatment deals with models considering snow cover (largely Land Surface and General Circulation Models). It gives details of the mathematics necessary to understand the processes involved; mathematics occurs often in this book, but it is neither too extensive nor too complicated to make the book unattractive.

Of course the authors explain the high albedo of snow and its effect on satellite images. They touch briefly on neural network algorithms but once again avoid the bear-trap of going into too much detail.

The book reviews the condition of glaciers all around the world, and avalanches, and then takes a longer perspective by examining ice ages and ice-free periods in the geologic past - including 'Snowball Earth' and the ice-free Cretaceous. The text examines recent changes in the cryosphere (retreat of glaciers and Arctic ice sheets and the degradation of the permafrost) and as you would expect, anthropogenic climate change issues make an appearance.

The book concludes with a survey of the winter sports industry, hydropower and the uses of freshwater ice (which has been used in China to keep things cool in summer since the 7th Century BC).

This is a very good book and taught me a lot. It represents good overall value at the rather peculiar price of £42.50

Reviewed by ***Steve Rowlatt***

THE GLOBAL CRYOSPHERE, PAST, PRESENT AND FUTURE
ROGER BARRY AND THIAN YEW GAN. Published by Cambridge University Press, 2011
ISBN 978-0-521-15685-1 Softback. 472pp.
List price: £42.50 **www.cambridge.org**

REVIEWS: COPIES AVAILABLE

Please contact **ted.nield@geolsoc.org.uk** if you would like to supply a review. These and more review books available on **www.geolsoc.org.uk/reviews**

- **Geochemistry of Fossil Fuels - from conventional to unconventional hydrocarbon systems** by Alain-Yves Huc. Editions Technip, 2013. Softback, 254pp.
- **Glaciogenic Reservoirs and Hydrdocarbon Systems** (2012) Edited by Huuse et al. Geological Society Special Publication 368.
- **Geology and Hydrocarbon Potential of Neoproterozoic-Cambrian Basins in Asia** (2012) Edited by Bhat et al. Geological Society Special Publication 366. hbk

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.

PAUL G MARINOS

Paul G Marinos, Emeritus professor, National Technical University of Athenshas been named "Chevalier dans l'ordre des Palmes académiques". The Order of Academic Palms is an Order of Chivalry of France for those persons with outstanding devotion and accomplishment in the areas of teaching, scholarship and research.

JOHN RAMSAY

John Ramsay, Professor Emeritus, University of Zurich, has been awarded the IUGS Science Excellence Award for his lifetime contribution to structural geology.

ALEX STATON

Alex Staton has passed the SiLC 2012b exam. Alex has over 10 years' experience as a contaminated land specialist and hydrogeologist working in a consulting environment. He is currently employed by URS in Glasgow. He has prepared numerous Phase 1 desk study reports and Phase 2/Phase 3 interpretative reports for a wide range of brownfield sites and has particular experience of carrying out detailed quantitative hydrogeological risk assessment using probabilistic models. Alex has experience of several other aspects of brownfield development including ground gas risk.

Al-Hashimi remembered

Society and IUGS commemorate murdered Iraqi geologist **Wissam Al-Hashimi** by publishing a memorial volume, reports Dawne Riddle

Dr Wissam Al-Hashimi (1942-2004), one of Iraq's leading geoscientists, did his PhD at the University of Newcastle (1968-1972) on the sedimentology and dolomitisation of Carboniferous limestones in Northumberland.
He became President of the Geological Society of Iraq, and of the Union of Arab Geologists, as well as Vice-President of IUGS (1996-2002), when he was a key supporter of the proposal to establish the International Year of Planet Earth. This eventually won UN approval for 2008, and operated over a triennium that began with the balloon release in Burlington House that opened the Society's bicentenary celebrations in 2007.

However, Wissam Al-Hashimi never witnessed its success. On the morning of 24 August 2004 while going to work, Wissam was kidnapped, ransomed and - despite payment being made to his captors - brutally murdered. His ID was stolen and it was two weeks before his family were able to locate his body in one of Baghdad's overstretched hospitals.

On 12 February, the Society welcomed members of Dr Al-Hashimi's family to Burlington House where they were presented with copies of the volume *Sustainable Development and Management of the Shallow Subsurface*, dedicated to his memory by IUGS.
The volume, published for IUGS by the Society, is currently out to review.

L-R: Prof. Eduardo de Mulder (IUGS, co-author); Balsam Wissam Al-Hashimi (daughter); Mrs Muatabar Hasan (widow); Mr David Shilston (President), and Farah Wissam Al-Hashimi (daughter)

HUGE DEBT

The lunch was hosted by David Shilston (President) and Alan Lord (Secretary, Foreign & External Affairs) and Eduardo de Mulder (former President, IUGS, Chair, IYPE and co-author of the volume), in the presence of Prof Mosa Almosawe (Iraqi Cultural Attaché), Dr Robert Hack (Unviersity of Twente, co-author), and members of Wissam's family, including his widow Mrs Muatabar Hasan, his daughters Farah Wissam Al-Hashimi, Balsam Wissam Al-Hashimi, and several other family members and friends.

Dr Hack described the volume, while Dr Ed de Mulder (speaking on behalf of Roland Oberhänsli, current IUGS President) described Wissam's life and work, and especially the debt owed to him by the geological community worldwide for IYPE.

Replying, Wissam Al-Hashimi's widow, Mrs Muatabar Hassan, thanked the IUGS and the Geological Society for the book and the event. "Wissam was an honest and dedicated scientist who worked for his country in its darkest hour. His death came as a great loss to his family and the whole community, but he was a kind hearted person - we miss him a lot and still suffer. May his soul rest in peace. If he were still among us he would be so grateful for all that has been done for him by those who appreciate science."

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.

Albert Ludford at 100

We learn that Dr Albert Ludford, (centre) in 1945 (one year after he joined the Society) and pictured in the main feature of our February issue, is 100 years old this month.

Some of his friends and former students are holding a celebration for him on April 6 in Hereford. Anyone wishing to attend should contact **Valerie Clure E: v.clure@btconnect.com**.

IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Bailey, Kenneth *
Blackburn, James Kirk *
Bowler, Christopher Michael Lance *
Chapman, W T *
Copp, Vera E *
Dawson, Barry
Holroyd, J D *
Hoare, R H (Bob)
Hobson, David M
Jones, Brian Lloyd *
Middleton, John *
Million, Ronald *
Williams, Colin L *
Willis, John Humfrey A.
Zwart, Hendrik *

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**.

DISTANT THUNDER

Wedi'i golli yn y cyfieithiad*

Geologist and science writer Nina Morgan asks - what's in a name?

The type localities for the Cambrian, Ordovician and Silurian Systems are all located in Wales – but the exact sites where they were first defined are not always easy to pinpoint. This is not necessarily because they are hard to reach geographically – the site where Roderick Murchison 'discovered' the Silurian is located just alongside the A470, south of Builth – but because for non-native speakers, the Welsh language, and particularly the spelling, can be very hard to grasp. The early 19th Century English-speaking surveyors working for the Ordnance Survey relied on noting down place names as they heard them spoken aloud by locals – and introduced some very creative spellings as a result.

While working in Wales, Murchison, it seems, adopted a similar approach and achieved similar results. In 1831 Murchison identified 'the first true Silurian' rocks at a place in the Wye Valley he referred to as 'Cavansham Ferry' – a name that isn't recognised locally, and doesn't appear on any map. The exact site of Murchison's discovery remained a mystery in until the 1990s, when a combination of very detailed field and linguistic work enabled it to be located.

In contrast, the Reverend Adam Sedgwick, who also worked in Wales, appeared to take the Welsh language in his stride. Although born in Yorkshire, he represented himself as somewhat of an expert in Welsh pronunciation. In a letter dated 'Tremadoc, July 23rd 1846', he instructed his niece Fanny Hicks how it should be done:

"….The miserable damp weather made me rheumatic and low-spirited, so I nursed one day in Carnarvon and then drove to Pwllheli. What a charming name! In order to pronounce the first part (Pwll), you must blow out you cheeks just as you do when puffing at a very obstinate candle; then you rapidly and cunningly put your tongue to the roof of your mouth behind the fore teeth, and blow hard between your cheeks and your tongue, holding your tongue quite steady all the while, as a man does a spade just before he is going to give it a good thrust with his right foot. With such a beautiful direction you cannot fail to pronounce Pwll quite like a Celt. Should the word be Bwlch, take care to observe the previous direction, only, in addition while the wind is whistling between your rigid tongue (sticking forwards spade-fashion), and your distended cheeks, contrive by way of a finale to give a noise with your throat such as you make when an intrusive fishbone is sticking in it. So much for my first Welsh lesson… If you write by return of post you may address me at Dolgelly, North Wales. "

But even Sedgwick had some trouble with Welsh spelling. The correct English spelling of Tremadoc – different Welsh spellings are often used in Wales these days -- is Tremadog, and Carnarvon translates as Caernarvon (Caernarfon, if you're Welsh). And Sedgwick's 'Doglelly' is more commonly referred to as Dolgellau. A case of the pot calling the kettle black? Or proof that when working in Wales, annigonol ydy un iaith (one language is never enough). Pob lwc! [good luck!].

ACKNOWLEDGEMENT
Thanks to Duncan Hawley for drawing my attention to Sedgwick's letter on Welsh pronunciation, showing me around Murchison's field area in the Wye Valley and discussing the methods he used to locate the site where Murchison discovered the Silurian. The location of the key Murchison Silurian site is described in: Hawley, Duncan, 1997, The first true Silurian: an evaluation of the site of Murchison's discovery of the Silurian, *Proceedings of the Geologists Association*, vol 108, pp. 131-140. Sedgwick's letter is reprinted in: Clark & Hughes, 'The Life and Letters of the Reverend Adam Sedgwick' vol. 2, pp. 105-106. The difficulties of recording Welsh place names in the 19th century are discussed on pp. 191-194 of the book, Map of a Nation by Rachel Hewitt. An Ordnance Survey guide, Introduction to the Welsh origins of place names in Britain is available at **www.ordnancesurvey.co.uk/oswebsite/freefun/didyouknow/placenames/welshglossary-a-b.html.**

* *'Lost in translation'*, somewhat awkwardly rendered into the Language of Heaven, but with less loss than Google translate, which suggests 'ar goll yn cyfieithu' or 'lost translating' *Editor*

OBITUARY

PETER RALPH HOOPER 1931-2012

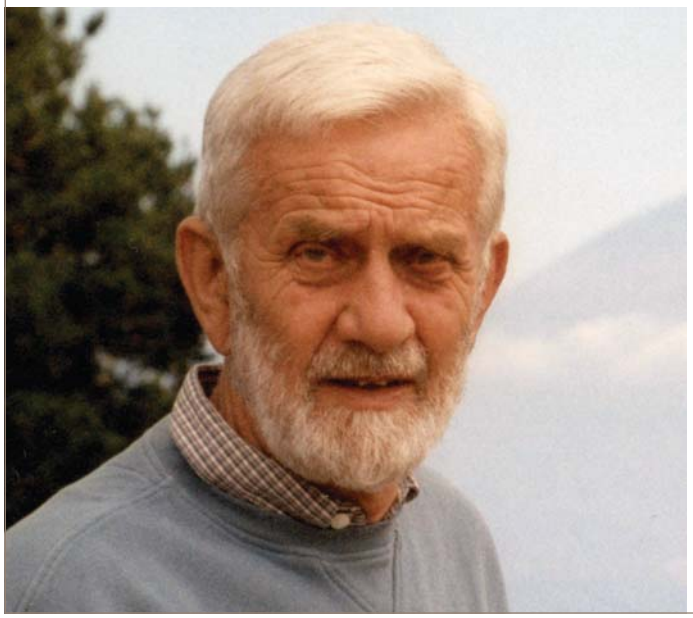
Igneous petrologist and pioneer of X-Ray Fluorescence Microscopy

Peter Hooper was born in Edinburgh, and spent his early years on his Canadian father's farm in Alberta, returning to Edinburgh for schooling. He gained his Geology degree at St Andrews, where he first evinced his lifelong interest in igneous processes (stimulated by Harold Drever). After a year of postgraduate study he joined the Falkland Islands Dependencies Survey, confessing later that he thought those Islands were in the South Pacific.

He was recruited by FIDS Chief Geologist Vivian Fuchs to map the geology of Anvers Island, off the Antarctic Peninsula - an igneous complex dominated by basaltic lavas and a granodiorite batholith. After two field seasons Peter returned to Britain (1957), married Caroline (a fellow St Andrews graduate) and spent two years at Birmingham University preparing his PhD on Anvers Island, under the supervision of Ray Adie. He was awarded the Polar Medal in 1958.

SPECTROMETER

In 1959 Peter was appointed Lecturer at University College Swansea, sharing responsibility for igneous and metamorphic petrology. One of the first tasks he was allocated by HoD Frank Rhodes was to purchase an XRF Spectrometer – then a newfangled tool. Peter and his geochemist colleague, Wallace Bloxam, were among the first geologists in Britain to adapt the XRF for rapid analysis of rock powders. They also introduced the single-bead (tetraborate fusion) technique for determining major and minor elements.



In 1960 Peter began research on the Caledonian layered ultramafic complexes of the SW Finnmark-Troms region (N. Norway). Over a decade he and research students successfully unravelled the complex igneous and tectonic history of this sector of the Scandinavian Caledonides.

> "HE LEFT A SUBSTANTIAL BODY OF PUBLISHED WORK, AND A LEGACY OF STUDENTS WHO BENEFITED FROM HIS IMPECCABLY ORGANISED TEACHING AND INCISIVE SUPERVISION"

Peter spent a sabbatical year (1968-69) on a Fulbright Scholarship at Washington State University (Pullman), working on the Columbia River Basalts (CRB). Peter recognised that a key to understanding the CRB was indentifying and correlating individual lava flows, and thought that geochemical 'fingerprinting' using XRF might help. Accordingly, he and Phil Rosenberg collected multiple samples from each flow in typical sequences of lavas and brought these back to Swansea. The results confirmed Peter's hypothesis. The technique proved highly effective in establishing the architecture and elucidating the genesis of this and other flood basalt provinces.

NUCLEAR WASTE

In 1971, Peter became Chairman of the WSU Department, and remained there for the rest of his career, greatly expanding its geochemical and petrological facilities. WSU labs gained a global reputation, providing rock analyses for many external bodies, including the US Department of Energy's Hanford nuclear waste disposal site. The WSU Department became a world-leader in the study of continental flood basalt provinces. At the GSA Annual Meeting (Seattle, 2003) Peter was honoured for his achievements in this field.

Peter retired in 1996 and in 1999 returned to England, settling in Whitchurch-on-Thames, remaining active in research until his untimely death. He left a substantial body of published work, and a legacy of students who benefited from his impeccably organised teaching and incisive supervision. He will be greatly missed by his wife Caroline, daughters Lee and Bryony, four grandchildren and many friends locally and internationally.

By **Gilbert Kelling**, with thanks to **Caroline, Lee** & **Bryony**. 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 NW Highlands	4-22 April	Two week course examining the classic areas. Department of Earth & Environmental Sciences, University of St Andrews. **Venue:** St Andrews, Fife, Mull and Ullapool (Scottish Highlands) **Fee:** £2000. GSL receive a 10% discount. See online for links.
Risk Mitigation Planning and Engineering	7-11 April	**Organised by:** University of Sussex. **Venue:** University of Sussex. Convener – Dr David Robinson **E:** D.A.Robinson@sussex.ac.uk Details on website.
Introduction to Micromine Course	16-17 April	**Organised by:** MICROMINE Venue: Challoner House, 19 Clerkenwell Close, London. Full contact details on website. **Cost:** £110.00 (inc. VAT). **Time:** 0930- 1730. This course is also being held on: 15-16 July 2013 - Challoner House; 16-17 October 2013 - The Geological Society, London
Soil and Rock Logging Course	16 April	**Organised by:** First Steps Ltd. **Venue:** EM Drilling, Bath. Fee: £265 + VAT per person. GSL Fellows receive a 10% discount. **Contact:** Christine Butenuth. **T:** 0207 736 6889 **E:** office@firststeps-geo.co.uk
2, 3 or 5 Day Introductory & Advanced Geochemistry Courses	22-26 April	**Organised by:** IGI Ltd **Venue:** IGI Ltd, Hallsannery, Bideford, Devon, UK. **Fees:** 2 Day Introductory - £900.00 + VAT (GSL Fellows) £810.00 + VAT; 3 Day Advanced - £1350.00 + VAT (GSL Fellows) £1215.00 + VAT; 5 Day Intro & Adv Course - £2000.00 + VAT (GSL Fellows) £1800.00 + VAT For further details and to register, visit www.igiltd.com/future-courses.html.
3 Day Basin Modelling Course	24–26 April	**Organised by:** IGI Ltd Venue: IGI Ltd, Hallsannery, Bideford, Devon, UK. **Fees:** £1350.00 + VAT. GSL Fellows receive a 10% discount (£1215.00 + VAT). For further details and to register, visit www.igiltd.com/future-courses.html.
Lapworth's Logs	n/a	'Lapworth's Logs' are a series of e-courses involving practical exercises of increasing complexity. **Contact:** info@lapworthslogs.com. Lapworth's Logs is produced by Michael de Freitas and Andrew Thompson.

DIARY OF MEETINGS APRIL 2013

Meeting	Date	Venue and details
Holocene Climate Change Geological Society	4-5 April	**Venue:** Burlington House. Registration open online. **Contact:** Georgina Worrall **Tel:** 020 7434 9944 **E:** georgi.na.worrall@geolsoc.org.uk
Joint Workshop: Advances in Groundwater Quality Sampling and Environmental Analysis West Midlands Regional	9 April	Double lecture, Evening Meeting, Workshop **Venue:** Lapworth Museum of Geology, University of Birmingham. 1800 for 1815 (Talk 1)Talk 2 - 1900. **Contact:** Daniel Welch **E:** geolsoc_wmrg@live.co.uk
Skittles Competition, Southern Wales Regional	11 April	**Venue:** The Halfway, 247 Cathedral Road, Cardiff. **Time:** 1800. **Cost:** £36 per team, inc buffet (£6 per person) **Contact:** Karl Llewelyn E: kllewelyn@srk.co.uk
Coastal Processes and Environments Under Sea-Level Rise and Changing Climate: Science to Inform Management, GSA, Geological Society	14-19 April	**Venue:** Galveston, Texas. For all details please see website.
Ground Behaviour during the Christchurch Earthquakes, Engineering Group	17 April	**Venue:** Burlington House. **Time:** Evening meeting. **Contact:** Tom Casey **E:** Tom.Casey@arup.com
Incoming! Or, Why We Should Stop Worrying and Learn to Love the Meteorite, Southern Wales Regional	17 April	**Venue:** Large Chemistry Lecture Theatre, Cardiff University. **Time:** 1900. **Speaker:** Ted Nield (Editor, Geoscientist). Contact **E:** swrg@geolsoc.org.uk
Rivers under the Sea, Geological Society, Shell UK	17 April	**Venue:** Burlington House. Shell London Lecture. See advert on p.8
Doing More with Less, Geological Curators' Group	25-26 April	**Venue:** Guernsey Museums & Galleries, Guernsey. **Visit:** www.geocurator.org for further details. **Contact:** Jim Spenser **E:** cheirotherium@gmail.com

OBITUARY

GEORGE INNES LUMSDEN 1926-2012

Applied geologist who as Director of BGS helped save the organisation

Innes Lumsden FRSE, former Director of the British Geological Survey, died in Oxford on Tuesday 4 September aged 86. Brought up in Aberdeenshire, he completed a BSc in Physics at Aberdeen University and added a First Class Honours degree in Geology in 1949. Innes wanted to be involved in applied geology and so he turned down a lectureship at Glasgow University to take up an appointment as a geologist in the Geological Survey of Great Britain, in Edinburgh.

COALFIELD

His early tasks were in coalfield geology, including commissioning the Archerbeck Borehole, the deepest cored borehole in the country at the time. Innes dedicated himself to applied geology, establishing a route for the M9 avoiding abandoned oilshale workings, rerouting the A1 to achieve a suitable site for the Torness Power Station while allowing the maximum development of limestone resources in East Lothian and engaging with the feasibility of underground cavern storage.

In 1970 he was appointed District Geologist in charge of South Scotland and became heavily involved in the projects of the Industrial Minerals Assessment Unit and surveys for metallic mineral resources, developing strong links with the Scottish Development Department. On being instructed to resurvey the Southern Uplands he decided that traditional mapping would take too long and achieve little. Instead he started the first multi-disciplinary regional geological survey project, a pattern which was soon to be copied in similar projects throughout the UK.

In 1980 he was appointed Assistant Director, Edinburgh and developed the facilities in the Survey's new Murchison House site. This was terminated abruptly in 1982 when he was appointed Deputy Director at the Survey's new headquarters at Keyworth.

> "INNES WAS AN INNOVATOR, INTRODUCING NEW METHODOLOGIES AND CONCEPTS, NEW ATTITUDES TO GEOLOGICAL SURVEYING AND NEW STYLES OF END-PRODUCT"

His task was to complete the conversion of existing buildings and develop facilities for a modern Survey. He became heavily involved in the day-to-day management of the British Geological Survey (BGS) with reductions in overall funding and difficult relationships with the Natural Environment Research Council (NERC) who were contemplating the future of BGS (without giving BGS the opportunity to state its case).

CABINET OFFICE

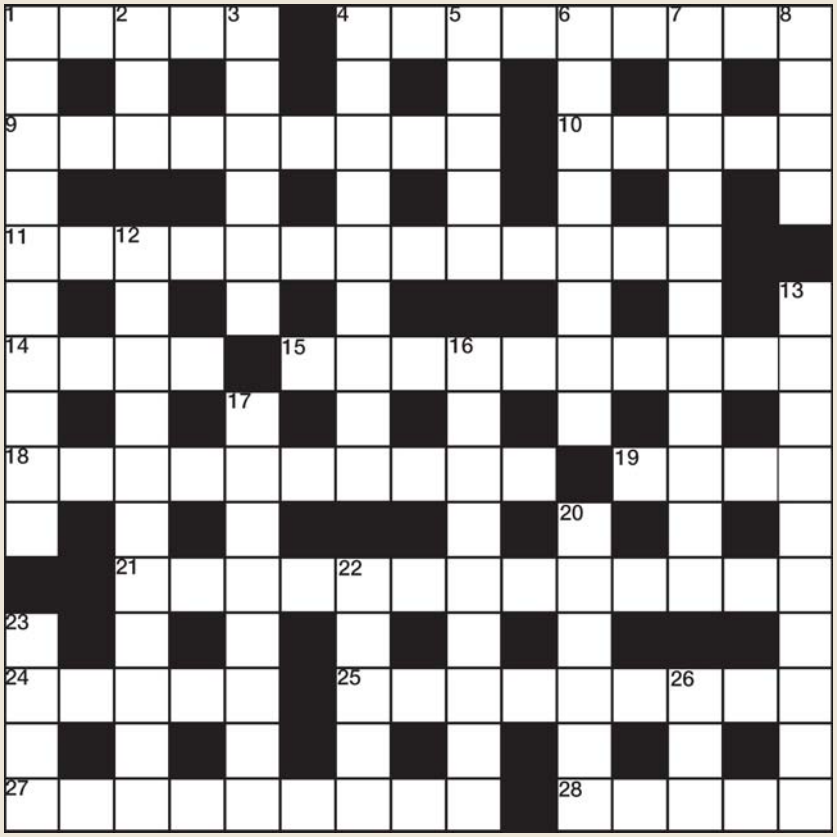
Lumsden sought the assistance of the Chief Scientist at the Cabinet Office and got an official reprimand from NERC for doing so. The result, however, was the setting up of the Butler Study Group into Geological Surveying and, in 1985 Innes was invited to become Director of BGS! He was responsible for ensuring that the Butler Study Group understood in detail what the function and responsibility of a national geological survey was; but when NERC appointed a Director of Earth Sciences based in Swindon, he decided to step away from the inevitable controversy and retired in August 1987.

Throughout his geological career Innes was an innovator, introducing new methodologies and concepts, new attitudes to geological surveying and new styles of end-product such as Environmental Geology Maps. He believed fundamentally in the need for a national geological survey, as a basic requirement for economic growth and development - a view not always held by the scientific mandarins. But BGS exists still, meeting the needs of the modern world. Innes Lumsden has a place in history as one of those that brought this about.

He is survived by his wife, Sheila and their three children, Graham, Richard and Gillian.

Written by **Prof Stuart K Monro** OBE DUniv FRSE

CROSSWORD NO. 168 SET BY PLATYPUS



ACROSS

1 Displacement surface along which shear movement has taken place (5)

4 Retreat, or descent into the underworld, Greekly (9)

9 Rare granite type featuring concentrically layered spheroidal structures (9)

10 Elijah Bond's talking board, yes yes (5)

11 Breakdown into constituents (14)

14 Winding road (4)

15 Extra-marital (10)

18 Destruction of religious symbols (10)

19 Highly alkaline evaporitic lake (4)

21 First commercially successful photographic process (13)

24 Galilean wedding and feast site (5)

25 Fragile (9)

27 Lofoten whirlpool (9)

28 Pour out suddenly and violently (5)

DOWN

1 Flat land across which a mature stream travels (10)

2 Industry standard covering computer connections (1,1,1)

3 Twice-bridged narrows of Puget Sound (6)

4 Microscopically dispersed (9)

5 Seven articulating foot bones (5)

6 Salts widely used in the 19th century as sedatives and sexual suppressants (8)

7 Elron's hokey cult (11)

8 'Spiced Ham' in aspic, allegedly 'wonderful' (4)

12 Statistical measure the agreement between two variables (11)

13 Verge, anchor, cylinder or deadbeat, for example (10)

16 Concentrated shaft of light (5,4)

17 Sets, usually when cooled - like lava, or aspic (8)

20 American English term, derived from Dutch, describing a small flat, baked treat (6)

22 Three days of abstension following the four seasonal fasts of the Christian calendar(5)

23 Layer of impurity on the surface of water or molten metal (4)

26 Traditional UK unit of energy, equal to about 1055 joules (3)

WIN A SPECIAL PUBLICATION

The winner of the February Crossword puzzle prize draw was Patrick Condon of Bangkok.

All correct solutions will be placed in the draw, and the winner's name printed in the June issue. The Editor's decision is final and no correspondence will be entered into. **Closing date - 22 April.**

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 .....

.....

Membership number .....

Address for correspondence .....

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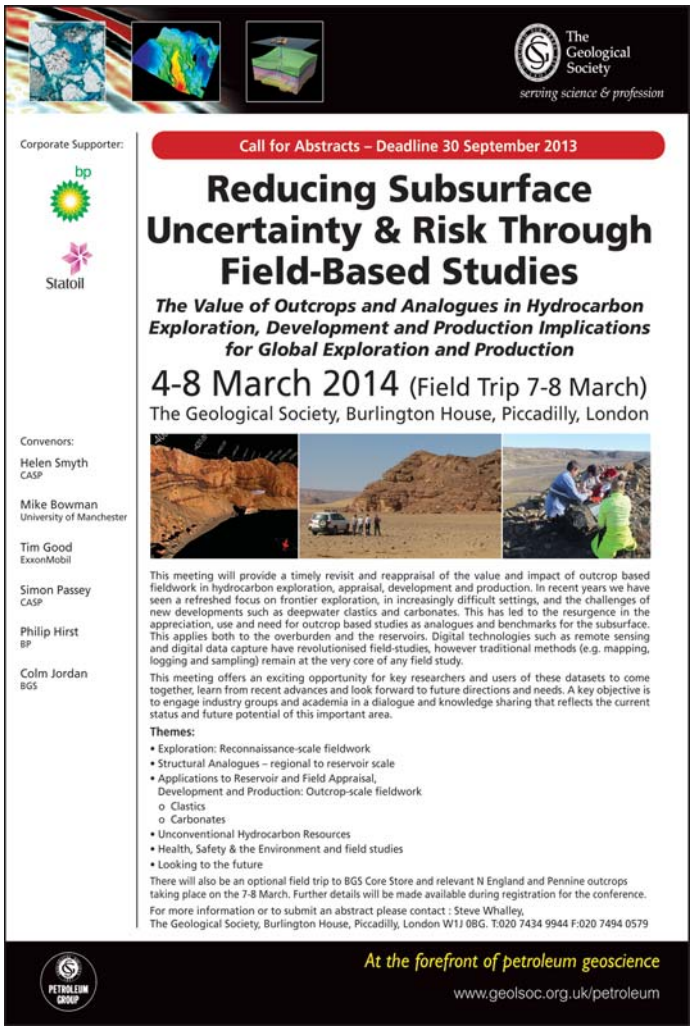
Postcode .....

SOLUTIONS FEBRUARY

ACROSS:
1 Epsom **4** Downfolds **9** Ephemeral **10** Auger
11 Replenishment **14** Gold **15** Distillers
18 Nimbleness **19** TGWU **21** Rationalistic
24 Laser **25** Adenosine **27** Redundant **28** Eosin

DOWN:
1 Epeirogeny **2** Soh **3** Member **4** Darwinian
5 Welsh **6** Flagella **7** Lightweight **8** Sort
12 Polymerised **13** Escutcheon **16** Testament
17 Flatiron **20** Ribose **22** Omaha **23** Blur **26** IDS



Deep Subsurface Geoscientist

The British Geological Survey (BGS), founded in 1835 is part of the Natural Environment Research Council (NERC), and is the world's longest-established national geological survey and the UK's premier centre for earth science information and expertise. A vacancy has arisen for a highly motivated and enthusiastic Deep Subsurface Geoscientist at our headquarters in Keyworth, Nottingham.

You will form part of a team of staff who work in the Energy Science Programme and contribute to high-profile scientific research, commercial and co-funded projects in the areas of Carbon Capture and Storage (CCS) and Geothermal Energy. These activities will involve modeling of the deep geology from seismic and well log interpretation on a workstation. In addition you will also be required to develop a principal scientific investigator role in one or more areas of CCS, Shale gas, Geothermal Energy or Geophysics, and build a scientific profile through the publication of research.

You should be qualified to 2i or above with a PhD in geoscience, geology or geophysics. The PhD should have a focus on the deep sub-surface, you should also have a very good knowledge and understanding of deep sub-surface imaging and modelling techniques used in basin analysis e.g. seismic and well data. In addition you should have excellent oral and written communication skills. As the post involves team working, you will be able to work effectively with others, and have good time management skills.

Starting salary will be between £26,450 per annum and £29,710 per annum depending on qualifications and experience. Working hours will be 37 per week excluding lunch breaks. A generous benefits package is also offered, including a company pension scheme, childcare voucher scheme, 30 days annual leave plus 10.5 days public and privilege holidays.

Applications are handled by the RCUK Shared Services Centre; to apply please visit our job board at http://www.topcareer.jobs/ and submit your up-to-date C.V. and covering letter, which clearly outlines why you are applying for this post and how you meet the criteria described in this advertisement. Applicants who would like to receive this advert in an alternative format (e.g. large print, Braille, audio or hard copy), or who are unable to apply online should contact us by telephone on 01793 867003, Please quote reference number IRC85229.

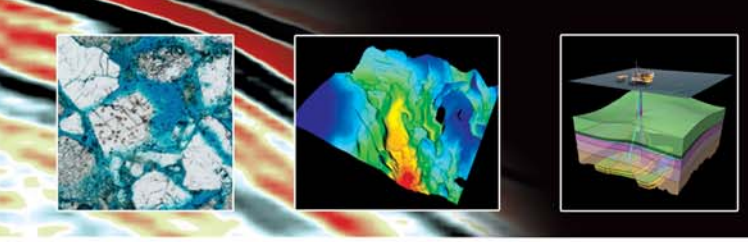
Closing date for receipt of application forms is Friday 19 April 2013.

The Natural Environment Research Council is an equal opportunities employer and welcomes applications from all sections of the community. People with disabilities and those from ethnic minorities are currently under-represented and their applications are particularly welcome. The British Geological Survey is an Investors in People organisation. There is a guaranteed Interview Scheme for suitable candidates with disabilities.

BGS 1835
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POSITIVE ABOUT DISABLED PEOPLE
INVESTOR IN PEOPLE

WE HELP KEEP THE WORLD MOVING



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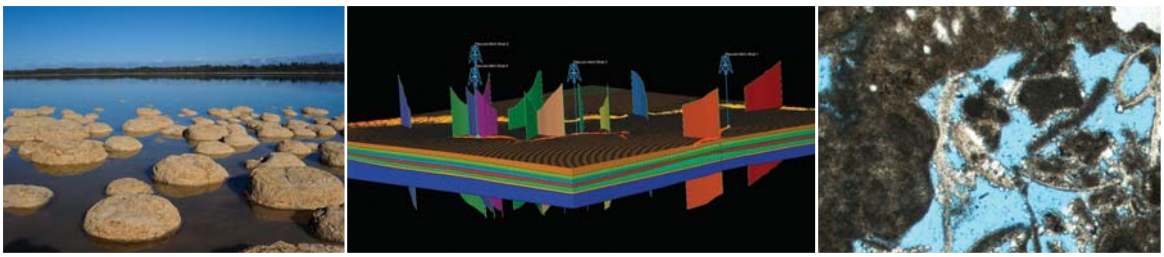
Microbial Carbonates in Space and Time: Implications for Global Exploration and Production

19-20 June, 2013

The Geological Society, Burlington House, Piccadilly, London



Microbial carbonates occur globally throughout the stratigraphic column, from the Archean to the present-day and occur in a wide range of environments. They constitute principal reservoirs of the recent pre-salt discoveries offshore Brazil, producing fields in the Middle East, and are the targets of the pre-salt play offshore Angola. Further development of our understanding and knowledge of microbial carbonates has significant implications for future worldwide exploration and production of these intriguing deposits.

Key themes to be explored by the speakers over the 2 day conference include:

- Regional and Basin settings, in particular new advances in the understanding of the pre-salt south Atlantic margins.
- Reservoir Studies: from Gulf of Mexico, to Kazakhstan (Karachaganak, Tengiz and Korolev fields) and Oman (South Oman Salt Basin and analogue).
- Analogues: Understanding of frontier Precambrian petroleum systems, with analogue studies in Namibia to well-known reservoirs from Oman.
- Depositional and environmental controls illustrated by a range of studies from the Great Salt Lake, Eocene Green River to the Permian Zechstein in the North Sea.
- Texture and diagenesis: unlocking the conundrum of texture, diagenesis, pore systems and preservational vs. depositional environment.
- Petrophysical Characterisation: challenges in sampling and measurements to techniques for 3D visualisation of porosity network.

Keynote Speakers:

Stanley Awramik: Microbialites in Time and Space.
Giovanna Della Porta: Non-marine carbonates: variety and porosity of microbially mediated and abiotic fabrics.
Paul Wright: To be or Not to be, Microbial: does it matter?

Registration:

For registration, more information and to view a listing of the presentations, go to www.geolsoc.org.uk/carbonates13 or contact: Steve Whalley, The Geological Society, Burlington House, Piccadilly, London W1J 0BG. T:020 7434 9944 F:020 7494 0579

PETROLEUM GROUP

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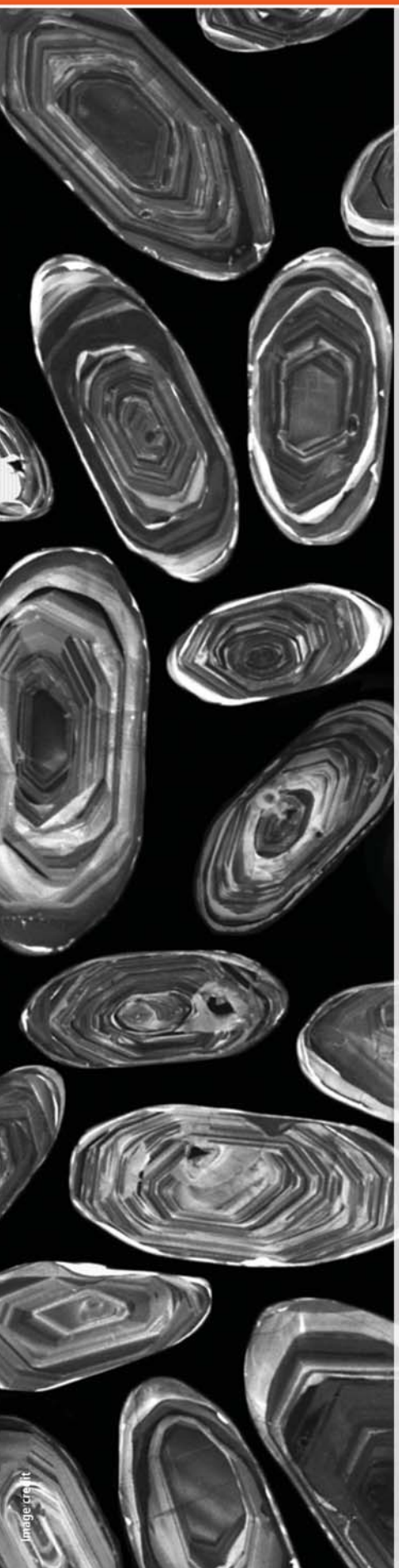
William Smith Meeting 2013



The first century of Isotope Geochronology:

The legacy of Frederick Soddy and Arthur Holmes

25–27 June 2013

The Geological Society, Burlington House, London, UK

In 1913, Frederick Soddy was carrying out research in Glasgow on the fundamentals of radioactivity which led, later that year, to the discovery of 'isotopes' (Soddy, F., Intra-atomic Charge, Nature, v. 92, p. 399-400, December 4th 1913). This was arguably the most important development in the 20th century with respect to the geological sciences and for which he received the Nobel Prize for Chemistry in 1921. That same year (1913), Arthur Holmes published his now famous booklet 'The Age of the Earth' (Harper & Brothers) in which he expressed his vision of developing a geological time scale, rightly anticipating that it would solve many of problems. Combined, these two landmark publications established the field of science known today as 'isotope geochronology'. From the discovery of radioactivity to establishing the precise chronology of the Earth's history in less than 100 years is one of the most important accomplishments in the history of science. The centenary anniversary in 2013 of the publication of these two milestones in science provides us with an ideal opportunity for celebration.

Themes:

- The age and early evolution of the Solar System
- Earth's first 0.6 billion years
- Rates and nature of crustal processes: magmas, minerals and metamorphism
- Geochronology of the stratigraphic record of Earth's evolution
- Dating our recent past, informing the future

Speakers include:

Alex Halliday (Oxford) · Randy Parrish (BGS/Leicester) · Ken Farley (CalTech)
Larry Edwards (Minnesota) · Paul Renne (Berkley) · William Compston (ANU)

Convenors:

Dan Condon · Sam Bowring · Jan Wijbrans

Call for Abstracts:

There is a call for abstracts and oral and poster contributions are invited. Abstracts of up to 500 words should be sent to **naomi.newbold@geolsoc.org.uk** by **30 April 2013**.

Further information:

For further information about the conference please contact:

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Email: naomi.newbold@geolsoc.org.uk Web: www.geolsoc.org.uk/wsmith13

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