# **GEOSCIENTIST** VOLUME 24 NO 6 • JULY 2014 • WWW.GEOLSOC.ORG.UK/GEOSCIENTIST

The Fellowship Magazine of the Geological Society of London

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# Hole load of trouble

Why was there such a rash of British sinkholes this year?

**CARNE COLLECTION** Exploring the mineral collection of a 19th Century Cornish banker **CHARTERSHIP FAIL** Why is Chartership still not appealing to academics? **PUT SOMETHING BACK** Now is your chance to join a Society committee







# William Smith Meeting 2014

### The Future of Sequence Stratigraphy: Evolution or Revolution?

22-23 September 2014

The Geological Society, Burlington House



### **Conference Sessions:**

- Does sequence stratigraphy provide testable predictions?
- · Are the assumptions in the sequence stratigraphic model still valid?
- Varying Earth surface systems through time and the consequences for sequence stratigraphic prediction
- Sediment routing and variable sediment supply: do these fundamentally change the model?
- The consequences of non-uniqueness for interpretation and prediction
- What next for sequence stratigraphy? Evolution of revolution?

### **Confirmed Keynote Speakers:**

Ron Steel (University of Texas & University of Aberdeen) William Smith lecture

Henry Posamentier (Chevron) Does sequence stratigraphy provide testable predictions?

Andrew Miall (University of Toronto) Are the sequence stratigraphic model assumptions still valid?

Mike Gurnis (Caltech) *Is there a stable reference point for eustatic curve construction?* 

Tetsuji Muto (University of Nagasaki) The consequences of non-uniqueness for sequence stratigraphy This meeting is intended to bring together a diverse range of sedimentary geologists to foster a critical examination of the current state of the sequence stratigraphic model, and to highlight robust new methods, concepts and protocols that could evolve or maybe even potentially revolutionize stratigraphic understanding and prediction.

Developments in this area seem likely to come from a combination of outcrop, geostatistical/stochastic approaches, physical experiments including large flume tank studies, and numerical approaches to the modelling of erosion-transport-depositional systems, all under the umbrella of the Landscape Into Rock concept. However, we will also encourage presentation of brand-new innovative methods, including cross-disciplinary methods that bring in ideas from other branches of science.

The meeting will be organized into a series of themed sessions, with an emphasis on provocative but practical presentations. Presentations will be scheduled to ensure there is plenty of time to debate all the issues raised in the meeting. In a final session, the conveners will chair a discussion targeted at achieving a consensus view on how the subject should move forward.

### **Convenors:**

Professor Peter Burgess (Royal Holloway University London) Professor Philip Allen (Imperial College London) Professor Paul Wright (PWGC Itd)

### **Further information:**

For further information about the conference please contact:

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

T: 0207 434 9944 E: naomi.newbold@geolsoc.org.uk W: www.geolsoc.org.uk/wsmith14



Follow this event on Twitter #wsmith14







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PETROLEUM GROUP

### **Registration now open**

## Operations Geology Conference "The Life-cycle of a well" 26-27 November, 2014

The Geological Society, Burlington House, Piccadilly, London



Following the highly successful Operations Geology Workshop held in Aberdeen in October 2012, the Petroleum Group of the Geological Society are pleased to announce the dates for the next event, which will be held over two days in 2014. Operations Geologists play key integrating roles at all stages of the life cycle of a well. This conference will look at the life cycle of a well and the contributions of Operations Geology at each stage:

- Well Planning hazard identification (due to rocks, fabric, pressure, stress, geometry etc) and avoidance/mitigation, targeted data acquisition for all disciplines for life of field
- **Execution** real-time techniques, managing the drilling window, the acquisition and use of Integrity test data, appropriate isolation of permeable zones in the overburden
- After Action Review NPT analysis and the learning loop, continuous improvement
- Emerging Technologies the next generation of needs and solutions logging, formation and gas detection/analysis, real-time well bore stability analysis tools, PPFG tools
- · Professional Competence the need to strengthen the available processes

### CONFIRMED KEYNOTE SPEAKERS:

Malcolm Brown, BG Group Iain Stewart, University of Plymouth

### **Conference Dinner**

Registration is now open for the Conference Dinner to be held on Wednesday 26th November at the Cavendish Hotel, Jermyn Street

For further information, please contact Laura Griffiths, Event Co-ordinator; +44 (0)20 7432 0983 or E-mail : laura.griffiths@geolsoc.org.uk www.geolsoc.org.uk/Operations-Geology-Conference

### At the forefront of petroleum geoscience

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### FROM THE EDITOR'S DESK: The wages of cheap

he 50th anniversary of the UK's worst mining-related disaster, Aberfan, falls in 2016. One hundred and forty four died, including 116 children, most of them my contemporaries.

Ironically Merthyr Vale Colliery, where my Great Grandfather was an Overman until his death in 1922 (happily, long before the tips on Merthyr Mountain were begun), had never suffered a major disaster. Not a single working miner died in Aberfan's great disaster, and so, by the rules of the National Coal Board, there was no formal requirement for it to be reported to NCB headquarters. For this reason news of a grimly prophetic slide in 1944 indeed never reached the NCB - that 'ignorant and arrogant monolith' as the Disaster Tribunal described it.

Aberfan is dwarfed, however, by Soma, Turkey, where the toll (at time of writing) has reached 301 – all miners. Sadly this comes as no surprise. Turkey's recently privatised mines have a lamentable record. Since 2000, there were 1308 fatal accidents before Soma. In 1992, 263 miners died in a single event. In 2012, over 10% of all work-related deaths in Turkey were of miners - most of them for coal.

The miners of Soma inevitably accept the personal risks they run, albeit unwillingly; but this level of risk, in this day and age, is not reasonable. Once again, coal mining, especially deep mining, is found to be the lot of poor people with no other means of supporting themselves thanks to a global market where price per tonne is all that counts. In this wide world there is always someone, somewhere, prepared to do the job for less money; in a country that does not have, or enforce, the costly but necessary environmental standards and safety practices that we would afford ourselves.

And so, the unregulated global energy market leads to safe mines closing, the import of unnaturally cheap energy (and deflation), and the export of poverty, environmental degradation - and death. We who are now too posh to mine our local rocks are not too bothered about allowing others to die doing it for us.

So far, 25 officials have been detained and three charged with negligence. But their prosecution, if it transpires, will not cure Turkey's mining malaise, any more than if Lord Robens had resigned in 1966, this would have solved the systemic problems of the NCB. Whether food, raw materials or energy, *Homo oeconomicus* must learn to pay the proper price. Otherwise, the planet is despoiled and people die, either of this generation or the next. It really is as simple as that.

DR TED NIELD, EDITOR - ted.nield@geolsoc.org.uk 🕥 @TedNield @geoscientistmag

## **SOCIETY***NEWS*

What your society is doing at home and abroad, in London and the regions



### Why not serve on a GSL Committee?



*Edmund Nickless (Executive Secretary)* believes now is the time for all good men and women to come to the aid of the party.

The Society is governed by an elected Council of 23 Fellows, chaired by the President. But it cannot take forward its strategy without the help of its committees and we are seeking volunteers. Not only will your help shape the future of the Society but serving on one of the committees gives the opportunity to network, work towards a common goal and to make a difference. The length of service is usually three years and the year runs from June to June.

If you are able to give some of your time we invite you to volunteer to serve on one of the following committees. You can also nominate another Fellow but please sound them out first. We need Fellows who are able to give the time required. Travel expenses are reimbursed but committee members receive no remuneration as such.

Use the online form at **www.geolsoc.org.uk/CommitteeService** or download a hard copy and mail it to Stephanie Jones, Geological Society, Burlington House, Piccadilly, London W1J 0BG. In case of difficulty please email Stephanie at **stephanie.jones@geolsoc.org.uk**.

### **Vacancies**

### ► Audit Committee

This committee reports direct to Council and is charged with keeping under review policy and procedures relating to internal and financial accounting procedures, conducting a detailed examination of the draft annual accounts and undertaking any such matters as may be required by Council, for example, making a recommendation to

### FUTURE MEETINGS

The dates for meetings of Council and Ordinary General Meetings until June 2015 will be as follows:

• OGMs: 25 September 2014; 26 November 2014;

4 February 2015; 8 April 2015

Council: 25 & 26 September 2014 (residential); 26 November 2014; 4 February 2015; 8 April 2015

Council about the selection of the Society's auditors. The committee meets twice a year.

Expertise required: Members must have experience of financial management.

### **>** Education Committee

This committee reports to the External Relations Committee. It is tasked with establishing a vision and strategy for the development of, and support for, geoscience education in the UK, ensuring that the Society maintains a coherent policy for education at all levels in the light of national and international developments and providing guidance on the integration and management of educational activities within the Society. The committee meets up to four times a year. **Expertise required:** *Members are chosen to ensure that all key areas of education are covered.* 

### **>** External Relations Committee

This committee reports to the Science & External Relations Committee. It is the outward-facing committee of the Society. Its aim is to raise public awareness and understanding of geoscience, and the professional activities of geoscientists. It co-ordinates the Society's public statements and responds to government and other consultations. It also looks after the Society's relationships with officials and Parliamentarians in London, and in the devolved administrations in Edinburgh, Cardiff and Belfast. The committee meets up to four times a year.

**Expertise required:** *Experience of science communication would be helpful but is not essential. Also experience of responding or contributing to government and similar consultations.* 

### Geoconservation Committee

The aim of the committee is to help conserve the diverse geology and rich geological and geomorphological heritage of the United Kingdom, and to pass it in good order to future generations for their investigation, education and enjoyment. There are up to four in-person or virtual meetings a year.

**Expertise required:** Committee members have a passion for outcrop geology and landscape, both in the UK and worldwide, together with a commitment to geo-heritage. Overall the committee aims to balance expertise across the various branches of Earth science.

### Investment Committee

This committee is chaired by the Treasurer and reports to the Finance & Planning Committee. It is tasked with ensuring the delivery of a budgeted level of income in each year and, if possible, real capital growth in the value of funds under investment. It also advises the Finance & Planning Committee on investment policies, including risk profile, and on targets for income generation from investments, and monitors the performance of the Society's investment managers. The committee meets four times a year.

**Expertise required:** Members do not have to be Fellows of the Society and will be selected in particular for their experience in making investment decisions.

### Library Users Group

The aims of this group, which reports to the Publications & Information Committee, are to support the development of Library services and



public engagement activities and to encourage the conservation and preservation of the archive, map and historical collections. It meets three times a year, either in- person or remotely. **Expertise required:** *Knowledge of the academic library world. It would also helpful to have practical knowledge of the digitisation of material and electronic information services.* 

### > Professional Committee

This committee, which reports to Council, is charged with promoting professional excellence and ethical standards in the Earth sciences for the public good by defining, maintaining and developing high professional standards for geoscientists; and promoting their career developments. The committee meets four times a year, although there may be the need for additional meetings.

**Expertise required:** A wish to promote the highest standards in professional excellence, not only in industry but also in academe. The majority of the committee will be chartered geologists.

### > Publications Committee

This committee, which reports to Council, ensures that publishing and library activity are planned in accordance with the Society's strategic priorities, and in line with financial objectives. It advises Council on matters relating to the development of the Society's publishing, library and information services including the fast-developing world of electronic publishing. It also provides oversight of the scientific quality of the Society's published output. There are at least three in- person meetings of the committee and between times business is conducted by e-mail.

**Expertise required:** *Publishing, library, financial experience or significant knowledge or experience of electronic information services.* 

### **>** Science Committee

This committee reports to the Science & External Relations Committee. Its main task is to ensure that the scientific output of the Society remains entirely consistent with the Science Strategy and to develop a high quality and relevant programme of scientific meetings in London, around the UK and internationally. As well as advising on ideas for future Special Publications/Thematic Sets it encourages publications in the Society's Journals and Memoirs. The committee comprises a Chair, five members of Council and five members from the Fellowship and meets three times a year.

An important aspect of the role will be to act as dedicated tags to the Specialist Groups, attend their meetings as an *ex officio* member and provide a two-way communication link between Science Committee and the Groups. As a result of a recent restructuring of Science Committee, there are three vacancies for Fellows with skills and interests in the following areas of Geoscience: Engineering geology, Environmental Geology & Geoscience Information and/or History.

To volunteer visit www.geolsoc.org.uk/ CommitteeService In case of difficulty please email Stephanie at stephanie.jones@geolsoc.org.uk

### NEWS In Brief

### **Office closure**

The Society will shut on Wednesday 30 July for staff training purposes. Both the Publishing House in Bath and Burlington House in London will be closed to all business. Visitors will not be admitted and no telephone calls will be answered.

### **Society Awards**

Fellows of the Society are invited to submit nominations for the Society's Awards for 2015 to the Awards Committee. Full details of how to make nominations are on the website at: www.geolsoc.org.uk/ gsl/awards. Nominations must be received at the Society no later than 1 October 2014. *Stephanie Jones* 

### **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, or at another venue, to be confirmed nearer the date. Once a year there is also a buffet dinner at Burlington House. New diners are always welcome, especially from among younger Fellows. Dinner costs £57 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. 2014: 24 September; 15 October.

➤ Fellows wishing to dine or requesting further information about the Geological Society Club, please email Cally Oldershaw (Hon Sec) at cally. oldershaw@btopenworld.com or T: 07796 942361. *DR* 

### SOCIETY NEWS...

### Memorial Trust Awards

Chartership Officer Bill Gaskarth writes: Two awards have been made this year. The first is to Kristoffer Harries and Richard Lavery who work for Ground Gas Solutions. They will use the funds to carry out a project on the Surface Characterisation of the Bowland Shales using isotopic and TOC analysis. They are looking to determine if thermogenic gases are retained in surface outcrops, to look at the adsorption capacity of the shales via their TOC values and to produce geochemical fingerprints for these hydrocarbon source rocks. Attendance at the Shale gas UK Conference is also planned.

The second award goes to James Whiteley (TerraDat UK Ltd.). His award will be used to finance his attendance at the EAGE Near Surface Geoscience 2014 meeting in Athens in September. At the conference he will attend practical workshops on Seismic and GPR methods for urban micro zonation studies and also one on Time-Lapse Electrical Resistivity Tomography (ERT) Monitoring. In addition there is a field visit to the Laurion mining area where near surface geophysics has been used to determine safe areas for the subsurface storage of toxic products.

The awards to these early career geologists will allow them to gain skills and knowledge which will further their professional development. DGMT makes up to two awards per year, of up to £2000 each, to early career geologists who are either working towards, or who have recently gained Chartership. The objective is to offer support for their professional development. A requirement of recipients is that they produce a report which may form the basis of an article to be submitted for publication in *Geoscientist*.

Information on the DGMT can be found on the Society's web pages in the 'Awards' section (www.geolsoc.org.uk/awards). Closing date for applications is 30 April each year and enquiries should be directed to the Chartership Officer (E: chartership@geolsoc.org.uk)





### **CHARTERSHIP NEWS**

Chartership Officer *Bill Gaskarth* brings tidings of two new initiatives in the chartership and professional accreditation area.

### PERC

The Pan European Reserves and Resources Reporting Committee (PERC) has produced a Europe-centric and Europe-based Standard for reporting that is directly responsive to European requirements. This Standard was specifically recognised by ESMA (European Securities and markets Authority) in 2011. The Eurocentric Standard is important because it is directly responsive to European requirements. When ESMA produces modifications in reporting rules to recognise particular requirements of a minerals sector then the PEC Standard can respond immediately.

PERC can now announce that its Standard has now been recognised for use in reporting to the Australian Stock Exchange (AMX). The PERC Standard is a member of the worldwide international family of reporting Standards and stands alongside Standards such as JORC (Australia), SAMREC (South Africa) and those of Canada, USA, Chile and others.

Chartered Geologist (CGeol), along with a suitable length of experience is recognised as an accepted professional qualification for the reporting of reserves and resources as a Competent Person by the various Stock Exchanges.

### Accreditation of company training schemes

The training scheme of Card Geotechnics Ltd is presently in the final stages of review and will probably have been accredited by the time this note is published. Fugro Group Hong Kong has now applied for their training scheme to be accredited and is now under review. They will look to have it adopted by other Fugro offices worldwide once accredited. Several other companies have expressed intent to submit their schemes for accreditation to add to the group of nine presently accredited (Hong Kong Government CEDD (GEO), Atkins, Gammon (HK), Jacobs (HK), Arup, URS, RPS Enrergy, RSK, CH2MHill)

For further information go online www.geolsoc.org.uk or email chartership@geolsoc.org.uk

### Sponsor A Book



#### Now in its sixth year, the Library's Sponsor-A-Book Appeal has helped conserve many of the Society's rare books collection, *writes Michael McKimm*.

Recently, a generous donation from an anonymous sponsor has allowed us to restore Robert Bakewell's An Introduction to Geology and Volume IV of Arthur Smith Woodward's Catalogue of the fossil fishes in the British Museum (1901), both of which were in serious disrepair and have now been returned to their former glory while preserving all original material.



The Library is also grateful to The John Daniels Fund of the London Branch of the Open University Geological Society, which has been used to sponsor William Topley's Geology of the Weald (1875) as a lasting tribute to that Society's late treasurer John Daniels FGS.

If you would like to know more about the Sponsor-A-Book appeal visit www.geolsoc.org.uk/sponsorabook or E: library@geolsoc.org.uk

### **From the Library**

The library is open Monday-Friday 09.30-17.30

#### Literature searching

Not enough time or struggling to find the information you need? We can search a wide range of resources on your behalf and send you the results directly to your inbox. To find out more about this service, please email library@geolsoc.org.uk

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## Science and profession

**Philip Allen\*** on why Chartership may not be compatible with the spirit that animates academic scientists, and how this may explain resistance within the Academy

#### t is with slight

embarrassment, rather than defiance, that I read of the Society's successful drive to increase take-up of chartership and accreditation (Geoscientist 23.11, p7). It is unambiguously a good thing, in my view, for practitioners of geoscience to be certified according to rigorous professional standards. Then why have I, along with many others in the academic community, resisted applying for

chartership despite having spent 40 years since graduation employed as a geologist and almost as long as a Fellow, and having served on Council and acted as Science Secretary? It's not that I am too lazy, or haven't the time.

### **Principles**

This sense of embarrassment got me thinking about what science actually is. The body of scientists is a community based on shared principles, and the dazzling success of science has been in large part because this community has held together over the centuries through adherence to ideas about freedom and scholarship, through being persuaded by nothing other than the discovery of what might be called 'fact'.

The sort of community that is needed to ensure the achievement of this virtuous goal is one of independence, so that we are not swayed by motives outside of the search for truth, and a mark of this independence is the value given to originality. Scientists therefore dissent rather than club together, since this is a signal of freedom to think independently rather than being browbeaten by dogma. True, scientists do not always live up to these ideals of scholarship and behaviour, but when they fail, it is generally recognized as bad and involves reputational damage.

It is because of this very nature of science that I find it difficult to align myself with the solemn codes of conduct of professional organizations. Such organizations rightly guide their members in what is recognized as good practice, protect their members from accusation from outside, provide models of behaviour and a college of like-minded professionals and I dare say friends. But unlike in the community of science, these codes do not spring from the work being regulated – they are imposed externally by the expectations of society at large.

### **Different worlds**

The academic scientist and the professional are members of different social worlds. Ideally, the scientist does not need to be reminded to behave him/herself since he has an unwritten contract to do so with other members of the community of science. He/she does not need the geological version of a Hippocratic Oath. After 40 years of independence, originality and dissent, I find it difficult to exchange one social world for another.

The Geological Society has on its logo 'serving science and profession'. I now appreciate that this phrase means exactly what it says - not a merger of science and profession, but two linked social worlds serving society. The problem is that knowing this doesn't quite extinguish my sense of embarrassment.

\* **Philip Allen** holds the Chair in Earth Science at Imperial College's Department of Earth Science & Engineering

### 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 – please take photographs on the largest setting on your camera, with a plain background.

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

THE BODY OF SCIENTISTS IS A COMMUNITY BASED ON SHARED PRINCIPLES, AND THE DAZZLING SUCCESS OF SCIENCE HAS BEEN IN LARGE PART BECAUSE THIS COMMUNITY HAS HELD TOGETHER OVER THE CENTURIES Philip Allen





# A HOLE LOT OF TROUBLE



Andy Farrant and Tony Cooper\* tell the inside story of the media frenzy following the spate of 'sinkholes' this winter he winter of 2013-14 will be remembered for seemingly incessant rain and flooding, particularly in the Somerset Levels and across southeast England. Records from the UK Meteorological Office show that this winter was one of the most exceptional periods of winter rainfall in at least 248 years for England and Wales – possibly the most. For south-east and central southern England, over 492mm of rain fell - 238% of the average and beating the previous (1915) record of 437.1mm.

However, not only flooding made the headlines. During three weeks in late February/early March, over 25 'sinkholes' opened up across southern Britain (compared to half a dozen at most in a normal year). "Terrifying holes that are opening up all over Britain" reported the *Daily Mail* while *The Sun* proclaimed "Pits of despair. First rain, now Brits suffer sinkhole hell".

### Inundated

In turn, the British Geological Survey (BGS) was also inundated - by media requests for information, as well as by enquiries from concerned homeowners. While sinkholes are not uncommon in the UK, it was unusual to have so many collapses happening so close together in time. So why was this?

The term 'sinkhole' has come to encompass a whole range of unrelated processes that result in the collapse of the ground. In a strict geological sense, it refers to a natural surface depression caused by dissolution of soluble rocks at depth. Other more local names are often used; for example, 'shakehole' or 'swallow hole' is typical in northern England while 'swallet' is common in parts of the southwest. More academic literature, especially in Europe, tends to use the term 'doline', which is derived from the Slovene 'dolina' meaning valley or plain.

Above (and top right): A collapsed denehole at Rainham Mark Grammar School, Gillingham in Kent. The collapse occurred where chalk had been mined for agricultural purposes during medieval times

### WHILE SINKHOLES ARE NOT UNCOMMON IN THE UK, IT WAS UNUSUAL TO HAVE SO MANY COLLAPSES HAPPENING SO CLOSE TOGETHER IN TIME. SO WHY WAS THIS?



However, many of the recent 'sinkholes' reported in the media were not natural geological phenomenon at all, but related to the collapse of artificial cavities or to the failure of materials capping mine shafts or wells. These should be termed 'collapse subsidence', 'crown-holes' or 'mine entrance collapse'. Others were related to burst water mains and pressurised sewers, or simply compaction of loose fill. But for public use, 'sinkhole' means all these.

### **Soluble rocks**

Natural sinkholes (in the strict sense of the word) are caused by the dissolution of soluble rocks at depth. These include limestone, dolomite, chalk, gypsum and halite. Evaporites, predominantly halite and gypsum are by far the most prone to dissolution. Carbonate rocks are less soluble, although this largely depends on rock purity, while the solubility of dolomite is typically lower than that of pure limestones. Sinkholes occur in all these lithologies. How and where they form depends on bedrock geology (lithology, bedding and structure), the presence, type and thickness of superficial cover, and local factors such as drainage and topography.

Six main genetic types of sinkhole were defined by Culshaw and Waltham<sup>1</sup>, three of which involve subsidence of overlying deposits (rocks, granular soils or cohesive soils). Cap-rock sinkholes tend to be the largest and most spectacular. Culpepper's Dish (Dorset) is a good example<sup>2</sup>. Here Paleogene sand and clay has subsided into the underlying Chalk, creating a depression over 80m across and 20m deep. Other very large cap-rock sinkholes lie scattered beneath the uplands around the north crop of the South Wales coalfield. Localised collapses in the extensive cave systems that riddle the Carboniferous limestones have propagated though overlying sandstone to the surface. The removal of the collapse debris by underground streams has allowed these sinkholes to continue to enlarge, allowing them to grow, rather than become choked with their own debris. Some of the resulting breccia pipes are over 60m deep.

However, many of these are relict features. Contrary to popular belief, the collapse of cave systems to produce either a collapse or a cap-rock sinkhole is relatively rare. At the risk of ruining several action-movie plots, most limestone caves are actually pretty stable over 100,000-year timescales. Indeed, some caves in the UK are over 700,000 years old. Caves in gypsum or halite are the exception. In these rocks dissolution occurs far more rapidly, sufficient to be noticeable over human life-spans. In Ripon, dissolution of Permian gypsum at ► A dropout sinkhole near Cheddar, formed when cohesive loessic soil collapsed into an underlying cave (GB Cave) after heavy rain in 1968. The hole was partially infilled with old cars, and continues to slump today. The sediment formed an extensive mudslide in the cave below





Soluble rock types and their distribution in the Great Britain based on BGS 1:625,000 scale Bedrock Geology map of the UK



depth has created voids that have then migrated up through the overburden to cause subsidence at the surface, sometimes with catastrophic results as happed in Magdalen's Close, Ripon, North Yorkshire on 17 February.

### Suffusion and dropout

Suffusion and dropout sinkholes are more common and form in superficial deposits overlying the soluble rock, typically limestone. Suffusion sinkholes occur where sediment is gradually washed down into solutionally enlarged fissures in the limestone below, causing gradual subsidence. Dropout failures form similarly, but in more cohesive soils able to bridge voids until they become unsupportable, resulting in sudden failure and collapse. It is these unexpected events which often make headlines.

Thousands of suffusion sinkholes dot the limestone outcrops of the Yorkshire Dales where Devensian glacial till has been washed into bedrock fissures. In southeast England, similar features occur on the Chalk. Where the Chalk is covered by a thin cover of clay or sand (usually the Clay-with-Flints, but also river terrace deposits, glacial till, or locally the Thanet Sand<sup>3</sup>), acidic drainage can gradually dissolve out the Chalk beneath, creating dissolution pipes up to 10m deep. Normally they gradually become infilled with sediment as they form, so rarely contain voids and are generally stable.

Some sinkholes are caused by erosion of weak unconsolidated material by flowing water. Loose material can removed by a process called 'soil piping', creating large voids within the sediment. One of the most spectacular examples is the collapse that occurred in May 2010 in Guatemala City. Here cavities developed in weak unconsolidated volcanic deposits

Types of natural sinkhole following a tropical storm. These then collapsed, creating a shaft approximately 100m deep and 20m wide. Smaller examples occur in the UK on thick soils and in upland peat bogs.

### Mine collapse

Many so-called 'sinkholes', particularly those in southeast England are really due to the collapse of old shafts or mines. The UK is peppered with man-made underground cavities including mines, wells, tunnels, cellars and store-rooms (e.g. in central Nottingham), culverts, and drains. When these collapse they can cause subsidence, as happened in December 2013 near Foolow (Derbyshire) when old mine workings failed spectacularly.

Most of the recent collapses in southern England have been associated with old chalk workings, for example at High Wycombe and Hemel Hempstead. Historically, chalk was often dug for agricultural purposes, chiefly to lime acidic soils or in some instances to obtain flint. Rather than transport chalk from distant outcrops, it was often easier to sink a shaft. The resulting cavity, known as a 'denehole', generally comprised a number of small excavated chambers entered by a vertical shaft typically around 20m deep. The top of the shaft was usually capped or blocked and then forgotten.

Chalk was also used as an ingredient for making bricks, either to change the colour or to counteract shrinkage. As brickworks were normally sited on clay outcrops (usually the Clay-with-Flints, Reading Formation or London Clay) shafts were dug to reach the Chalk. This explains the common association between former brick-pits and 'sinkhole' events. In some instances, a combination of natural and anthropogenic factors conspires to cause subsidence. Chalk mines sometimes intersect sedimentinfilled dissolution pipes, leaving the sediment above unsupported and prone to collapse. Old Chalk wells are also implicated.

### Triggers

It is important here to distinguish between what causes a cavity to form, and what triggers collapse.

Most subsidence events are triggered by water. Heavy rain or surface flooding, such as that experienced this winter, can initiate the collapse of normally stable cavities (especially those in superficial deposits) or cause shaft-caps to fail. This happens in several ways. The additional weight of wet soil, floodwater or saturated superficial deposits can increase the load to a critical level. Alternatively, increased water flow can flush out or compact sediments infilling a cavity. Water can also reduce the strength of material capping shafts or old wells. Bricks in the base of a collapsed denehole at Rainham Mark Grammar School, in Gillingham, Kent suggest that this feature may once have been capped with a brick arch that failed. Prolonged winter rainfall or individual extreme rainfall events both have the same impact. Anthropogenic water-related sinkhole triggers include leaking drainage pipes, burst water mains, irrigation or even the act of emptying a swimming pool.

In some parts of the world, drought or groundwater abstraction can cause sinkholes by changing the level of the water-table. This removes the buoyant support water provides to a cavity, and so lead to collapse. Construction and development are also potential triggers, either by modifying surface drainage or altering loads imposed on ground without adequate support.

### Where?

Areas prone to sinkhole formation occur throughout the UK, though natural sinkholes show strong association with underlying geology. Most sinkholes occur in areas underlain by Carboniferous limestones (the Mendips, parts of Wales, Peak District, and northern Pennines, including the Yorkshire Dales). Fortunately many of these are upland areas away from urban centres. A few occur in Devonian limestone outcrops in Devon and on the Jurassic limestone outcrops of the Cotswolds, Lincolnshire and the North York Moors. The Chalk is also susceptible, especially where covered by thin clay and sand deposits (the 'Claywith Flints' and Paleogene strata), notably in parts of Dorset, Hampshire, the Chilterns, around Norwich, and Kent. In Scotland, sinkholes are generally rare except in parts of Assynt, Appin and Skye.

The most sinkhole-prone area in the UK is the Permian gypsum outcrop of north-east England between Doncaster and Darlington, particularly around Ripon. At least 30 major collapses have occurred in the last 150 years, some of which have affected property and infrastructure. This is because gypsum is far more soluble than limestone, and thus dissolves more rapidly.

Sinkholes also occur over salt deposits, especially where brine has been extracted **>** 



Above: A dissolution pipe in the Chalk

**Below:** Most subsidence events are triggered by water. Heavy rain or surface flooding, such as that experienced this winter, can initiate the collapse of normally stable cavities

AREAS PRONE TO SINKHOLE FORMATION OCCUR THROUGHOUT THE UK, THOUGH NATURAL SINKHOLES SHOW STRONG ASSOCIATION WITH UNDERLYING GEOLOGY



as in parts of Cheshire, making it difficult to separate naturally formed sinkholes from those created by humans. Thus anthropogenic cavities are also linked to geology, as well as land-use and settlement patterns. The Chalk outcrop in Kent and in parts of the Chilterns is especially susceptible, being areas where deneholes, shallow mines and water wells are common. Other former mining areas such as Derbyshire, the northern Pennines, the Mendips, North Wales and southwest England are also susceptible to mine shaft collapse.

### **Karst hazard**

A 'hazard' is any source of potential damage or harm under certain conditions; 'risk' is the chance or probability that someone or something will be harmed or damaged if exposed to a hazard. Sinkholes are a widespread hazard across the UK, but the risk to infrastructure, property and life is variable and dependent on many nongeological factors such as building and infrastructure design, population distribution, weather conditions and land use. The risk from sinkholes for the designer of a high-speed rail link or tunnel is different from the risk for a farmer. Sinkhole hazards, like any other geohazard, are factored into house

insurance premiums. However, as some homeowners found out this winter, building insurance will not cover repairs needed if there is no damage to your home. Hard luck if a sinkhole appears in your garden.

In many areas, the most problematic effect of karst is not sinkholes. The effect of dissolution on rock-mass strength and integrity has significant implications for civil engineering design and construction. Across the Chalk outcrop, especially beneath Clay-with-flints or other superficial deposits, dissolution can create a very irregular rock-head. This can make foundation-design problematic, especially when designing tunnels, roads and bridge supports.

Mortimore<sup>4</sup> highlights several examples during the construction of the Brighton Bypass where dissolution pipes in the Chalk led to issues with both bridge foundation design and roadcutting slope stability. Similar features were noted during the construction of High Speed rail link through Kent. Change in rock-mass properties due to dissolution can have implications for quarry and mine managers, civil engineers and hydrogeologists.

Karst also has major influence on groundwater, affecting the potential for rapid groundwater flow and impacting on the transmission and attenuation of contaminants. Karst hydrogeologists are interested in how meteoric water recharges karst aquifers; how water is stored within and transmitted through them; how groundwater is discharged as springs or water supply via boreholes, and how to protect the aquifer from potential contamination. Sinkholes are pertinent to these studies, in that they are sometimes used as illegal disposal facilities for a range of wastes, including farm runoff. Where uncontrolled filling occurs leachate may be introduced directly into groundwater flow-paths where the only potential for attenuation is by dilution. Recording the distribution of karst features provides invaluable data for the forensic investigation of contamination in karst aquifers.

### **BGS datasets**

Because the distribution of dissolution phenomena is highly dependent on bedrock and superficial geology, BGS has assessed the potential for dissolution hazards across the UK (including sinkholes, dissolution pipes, areas of irregular rock-head and caves) using 1:50,000 scale digital maps of superficial and bedrock deposits. These have been combined with other datasets, such as topography and superficial thickness, to



House partially collapsed at 26 Magdalen's Close, Ripon, North Yorkshire due to sinkhole formation over Permian gypsum in the Edlington Formation. The sinkhole affected the southern part of the house

Brimble Pit Swallet, near Cheddar, Somerset. A typical suffusion sinkhole developed in thick clay soils over limestone, formed by gradual washing out of the clay into a small cave below

produce hazard ratings. The detailed digital data illustrated in the map are available as attributed vector polygons, as raster grids and in spreadsheet format via the BGS Geosure dataset.

BGS is also constructing a more comprehensive database of karst features by collating site-specific data. Information is being culled from existing sources, such as historical and modern Ordnance Survey maps, cave surveys, academic papers and historical documents. Other datasets such as a legacy Applied Geology database are also being used to identify other sources of information. This site-specific data is being used to validate and improve BGS's dissolution hazard maps. We welcome any reports of new sinkhole events, natural or otherwise, as this can help us assess the rate at which these features typically occur.

### **Media storm**

Most of the recent subsidence occurred on the Chalk in south and south-east England, principally because this was where rainfall was most extreme, and also because of the many shallow Chalk mine-workings and deneholes. Only a few were the result of natural dissolution.

One of the interesting aspects of the recent weather is the way the media

reported the sinkhole events. Normally, sinkholes attract little or no publicity as they occur in upland or remote areas. Many form gradually over periods of time while others are simply not noticed or are infilled by the landowner without any fuss. The length and intensity of the media coverage was unusual given that the risk to human life from sinkholes is actually rather low. No-one was killed or injured in the recent spate, although the death of Mr Jeffrey Bush, who disappeared into a sinkhole in Tampa, Florida in March 2013, raised awareness of the potential risk to life.

The suddenness and unexpected nature of the phenomena are also fascinating, but attention spans are short. The clear media spike tailed off, even though more collapses occurred (including one that closed the B3356 in Somerset). An additional complication is that some reported 'sinkhole' events were not geological at all, but burst water mains or collapsed drains.

Although it is clear this winter's heavy rainfall has caused a significant increase in subsidence events across the densely populated southeast, the reporting bias makes it hard to assess the true magnitude of this increase relative to the normal background rate. But it is clear that if predictions of more extreme weather events prove correct, then we can expect more sinkholes - of whatever variety - in future.  $\blacklozenge$ 

\* **Dr Andrew R Farrant** is a principal geologist at the British Geological Survey in Keyworth. **Dr Anthony Cooper** is an Honorary Research Associate at the British Geological Survey.

ACKNOWLEDGEMENTS Special thanks to Vanessa Banks, Helen Reeves and Don Cameron who dealt with numerous sinkhole enquiries from the media, the public and government agencies.

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Caprock sinkhole caused by gypsum dissolution in April 2003 near Ripon, North Yorkshire

# CARNAL DELIGHTS

**Douglas Palmer\*** connects a Cornish Banker's mineral collection, the Sedgwick Museum, a Civil Lord of the Admiralty and the Brontës

Mong the million and half geological specimens in Cambridge University's Sedgwick Museum is the Carne collection of some 9000 Cornish minerals. Recently, I was asked if I knew anything about the collection and why it ended up in Cambridge, I did not but said that I would try to find out.

Taking the easy route first by 'Googling' the Carne mineral collection, the Wikipedia entry on Joseph Carne comes top of the list. A quick scan shows that indeed Joseph Carne and his daughter Elizabeth were responsible for amassing this remarkable collection in the middle of the 19th Century. However, for a more reliable source I turned to the Dictionary of National Biography, which clarifies some of the background to the Carne collection and the father and daughter who made it.

It appears that this important collection of Cornish minerals was mostly collected by Joseph Carne FRS (1782-1858) and then had some foreign mineral specimens added by his daughter Elizabeth (1817-1873), who was also a keen mineral collector and author. It seems that after her father's death Elizabeth offered the collection to the Royal Geological Society of Cornwall but they did not find her conditions acceptable. Then somewhat mysteriously the collection turned up in the University of Cambridge's Sedgwick Museum.

### **Brontës' source**

I was curious on two accounts: how the collection came to be in Cambridge and what the connection might be with the Brontë family? The latter possibility arose from the original question, put to me by Sarah Fermi, a member of the Brontë Society. She is investigating the Carne family because the Brontë siblings (Maria, Elizabeth, Charlotte, Emily, Anne and Branwell) were brought up by their aunt, Elizabeth Branwell (1776-1842), following the death of their mother Maria (1783-1821). The Branwell family came from Penzance in Cornwall. Elizabeth and her sister Maria were the daughters of Thomas Branwell (1746-1808) and Anne Carne (1745-1809) and spent their youth in Cornwall until the death of their father in 1808. The Branwell and Carne families were not only connected by marriage and location but also by their relative prosperity.

For Bronte aficionados there is the question of potential Cornish influence, passed on to the children by their mother and more especially their aunt Elizabeth Branwell, who was a great influence on all their lives. She was a well educated and informed woman of independent mind, typical of her Cornish background and it would be surprising if none of this had rubbed off on the children and their imagined worlds.

The Sedgwick Museum has a small display about Joseph Carne and his mineral collection. This includes a notice of sale in 1898 of the Carne mineral collection (Sedgwick Archive Ref.: DDF Box 545), following the liquidation of the Batten, Carne and Carne Bank. Apparently, Joseph Carne, the oldest son of William Carne, partner in the Cornish bank of Oxnam, Batten & Co. (subsequently Batten, Carne & Carne), was a self-taught geologist and mineralogist who made detailed investigations of the rocks and minerals of Cornwall and was appointed manager of the Cornish Copper Company's works at Hayle in 1807 - in which year he also was elected an honorary member of the Geological Society of London at its foundation.

In 1814 he was also a founder member, along with Henry S Boase, Sir John St Aubyn, William Bolitho and Davies Giddy, of the Royal Geological Society of Cornwall, the only geological society to enjoy Royal patronage. Carne became its treasurer from 1827 until 1858 and read 39 papers to the Society, mostly on the mining and economic geology of Cornwall, of which nine were published. He was also elected a Fellow of the Royal Society in 1818 and became an ▶





Above top: Photo of an oil portrait of Joseph Carne, attributed to the circle of William Owen RA (1769-1825) Above lower: Rough spherules of orange coloured calcite crystals on iron stained quartz, Botallack, near St Just, Cornwall

Left: Coast nr. Penzance, Cornwall. Cornwall's mineral riches are celebrated in the Sedgwick Museum's Carne Collection

> JOSEPH CARNE AND HIS DAUGHTER ELIZABETH WERE RESPONSIBLE FOR AMASSING THIS REMARKABLE COLLECTION IN THE MIDDLE OF THE 19TH CENTURY

Re BATTEN, CARNE, & CARNE'S BANKING COMPANY, LIMITED

### CORNWALL.

To Geologists, Mineralogists, Public Bodies, Trustees of Museums, Private Collectors of Minerals, and others.

Sale of a Large & Valuable Collection of Minerals.

### MR. GEORGE E. JENKIN

Has received instructions from Mr. H. H. PRELACE, the Lipsidator of BATTER, CARNE, & CARNE's RATER CONTRACT, LINETED, to offer for Safe by

### PUBLIC AUCTION,

At the LIQUIDATOR'S OFFICE, PUBLIC BUILDINGS, PENZANCE,

On Tuesday, the 13th day of December, 1898, at Three p.m., run works or

### 

Comprising Several Thousand Specimens, at the Museum at Carne (now called Baskenwyn), one mile from Penzance,

Late the Residence of Mr. C. C. Ross.

The above is recognized to be one of the facet private collections in England. It was founded by the late Josaren Casava, Eng., of Pensance, a gentlessan well known as a Geologist and Mineralogist, and it has been added to by purchases of special Minerals of exceptional rarity by his Daughter, the late Miss Extraorran C. T. CARRE, and also by Mr. C. C. Ross.

The Specimons (the larger perion of which being unique old Cornish Minerals from mines long since closed, now unobtainable, and unequalled in any public collections) are now in a Museum built for their reception and display. The amatler parties are fine illustrations of English and Foreign specimens.

There is a descriptive Canalogue of the collection which was carefully compiled by R. H. SULLY, Esq., M.A., F.G.S., Downing College, Cambridge, and will be handed to the Purchaser of the Minerale. Information may be obtained of A. K. BARRETT, Esq., F.G.S., Pennance, and permission to view may be had on application to the AUCTRONERR, Prince's Struct, Pennance, and

Dated afith November, 1848.

Poster for the auction in 1898 of the Carne mineral collection, following the collapse and liquidation of the Batten, Carne and Carne's Bank

honorary member of the Cambridge Philosophical Society.

### Werner

Although the Wikipedia entry on Carne claims that his published works prompted the eminent German geologist Abraham Gottlob Werner (1749-1817) to travel to Cornwall, I can find no reference to back this claim. On the contrary, it is generally stated that Werner never travelled beyond his native Saxony.

In 1820 Joseph Carne had also become a partner in the family bank of Batten, Carne & Carne but this does not seem to have stopped his geological and other social and philanthropic activities. During that part of his professional career, which was associated with Cornish mines, Carne amassed a unique collection of Cornish minerals, especially rare ore minerals. Upon his death in 1858, the fifth of his six children, Elizabeth, inherited £20,000, his mineral collection, the family house and a partnership in the bank. She also took her geology and natural history seriously, visiting Europe and authored books and published papers for the Transactions of the Royal Geological Society of Cornwall and the London Quarterly Review.

H. H. PEZZACK.

THE LIQUIDATOR,

Pennic Boildowos, PERFANCE.

### **Display**

The Sedgwick display on the Carne collection was put together in 2012 by Sandra Marsh, museum archivist. She found documentation on its acquisition, including a descriptive catalogue of the collection, which had been carefully prepared in 1885 by Richard Harrison Solly (1851-1925), a Cambridge mineralogist and Fellow of Downing College (Sedgwick Archive Ref.: DDF Box 577). This documentation includes an auction notice in 1898 for the collection from the liquidator of the family bank following its collapse in 1896, long after Elizabeth Carne's death. Persuaded of the collection's value, William J Lewis (1847-1926), then Professor of Mineralogy

in Cambridge, made a successful bid for the collection on 4 January 1899 but then had to raise £475 quickly to pay for it.

Sedgwick Archive Ref.

DDF Box 545

Letters and other documents in the Sedgwick archive suggest that Lewis sent a begging letter around all the 'great and good' of the University and beyond (Sedgwick Archive Ref.: DDF Box 545). One of the letters, dated 21 January 1899, shows that Lewis certainly had some good connections - although they did not always produce the 'goods'. One of them says 'Dear professor Lewis/ I am very sorry to refuse the request... but the claims upon me are so numerous that I cannot send you a contribution. As you probably know we are trying to endow a local University and what I can give just now for such purposes must go to it./ yrs. truly/ Austen Chamberlain. That University was Birmingham, Britain's first civic university, founded in 1900 from the radical vision of the local Chamberlain family of eminent politicians. So perhaps the then Civil







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#### Clockwise from far left: Poster for the auction in 1898 of the Carne mineral collection, following the collapse and liquidation of the Batten, Carne and Carne's Bank

Orange coloured calcite rosettes and broken plates on quartz, probably St Just, Cornwall

The list of contributors to the purchase of the Carne Mineral Collection

Sheaves of calcite prisms on quartz and fluorite, dusted with pyrite, North Crofty Mine, Cornwall

Carne Collection

Sedgwick Museum, University

of Cambridge, photographed by A. Tindle

Carne Collection, Sedgwick Museum, University of Cambridge,

photog

Elizabeth Carne, fifth of Carne's six children, inherited the collection

Levant Tin Mine, at Trewellard, Pendeen (nr St Just) Cornwall was sunk in 1820 and closed in 1930. It was the site of the famous

'man-engine' disaster of 1919 when 31 miners died

Pink coloured calcite rhombohedra with quartz and chalcopyrite, Tankerville Mione, Shelve, Shropshire



Lord of the Admiralty, Austen Chamberlain might be forgiven for not donating to the Carne fund.

Among the 68 named donors, there were four 'Lords', including a Rothschild, two City companies, eight masters of Cambridge colleges, three Darwins, two MPs, twelve Fellows of the Royal Society and a QC.

The interesting thing is that the acquisition of the Carne Collection occurred 26 years after Elizabeth's death so the old version of this story needs to be rewritten. It is also of interest that an obituary notice for Elizabeth in the Pall Mall Gazette claims that the Carne mineral collection was worth £3000. If true, the Sedgwick Museum got a bargain. What if anything of the Carne family's social and economic activities impacted upon the Brontë family remains to be seen. ◆

\*Douglas Palmer is Director of the Sedgwick Museum, Cambridge

# **BOOKS** & ARTS

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### Magnetic Methods and the Timing of Geological Processes



Any measurable parameter that changes through time is a potential contributor to historical interpretation of the rock record, and the various magnetic properties of rocks have more potential than most. Where

would continental drift be today without apparent polar wander paths or geomagnetic polarity reversals?

SP 373 is a collection of papers from three meetings of the American Geophysical Union in 2010 and 2011. All 18 papers deal with data from sedimentary successions. The Editors' introduction reminds us that knowledge of geomagnetic changes is 100+ years old, though appreciation of their global nature is nearer 50. The first five papers illustrate the ever-increasing stratigraphic resolution achievable by integrating polarity changes with biostratigraphy and other methods, in three IODP and two onshore Italian sections (all Cenozoic).

Mutual contradictions among datums in different sections - that bugbear of conventional stratigraphic interpretation suggest (to the reviewer) applying multidimensional scaling methods such as CONOP as a way forward. Four papers, three on or around Tibet and one from the Nankai Trough, use geomagnetic data, again from sediments, variously to determine timing and rates of sediment source uplift, history of episodes of deformation (contributing to discrimination between alternative regional tectonic models), block rotation history (from stratigraphically changing declination), and changing sediment accumulation rates at a subduction input site. In all cases, it is the stratigraphy that provides the age control; the critical part of each study is establishing that a magnetic signal is of an age with the enclosing sediment.

The four papers in the book's third section are more diverse than the declared theme of relative palaeointensity suggests, ranging from the extraordinary wanderings of the virtual geomagnetic pole through a Pleistocene polarity excursion, to even more recent (<3ka) secular changes used to calibrate radiocarbon dates in Sulawesi. In the final section, cyclostratigraphic analysis of



magnetic susceptibility and ARM data aims to establish orbital control over sedimentation, leading to various but sadly invalid chronological and paleoclimatic conclusions.

Although the two papers by Ellwood *et al* acknowledge the dangers of false positives, all five studies use methods known to raise power spectral peaks above most confidence thresholds even for random data. The fact that all five cyclostratigraphy papers use suspect methods does not detract from the continuing potential of these and other geomagnetic parameters for interpreting many aspects of Earth history.

Reviewed by David Smith

#### MAGNETIC METHODS AND THE TIMING OF GEOLOGICAL PROCESSES

L JOVANE, E HERRERO-BERVERA, L A HINNOV AND B A HOUSEN (Eds), Geological Society Special Publication 373, vi + 402 pp. ISBN 978-1-86239-354-7 List price: £110.00; Fellows' price: £55.00. www.geolsoc.org.uk.

### **Dangerous Neighbors**



The first thing that one may notice about *Dangerous Neighbors* is how short the text is. Comprising only 183 A5 pages, the book could quite easily be absorbed in a day. However this has no

and serves only to enhance readability.

The book is arranged into several case studies of the close association of active volcanoes and population centres, rather than focusing upon individual hazards. There are good sections on the Philippines and Mexico, and examples from outside of the Ring of Fire are also given. Each chapter looks at an eruption event in terms of the different elements of the eruption (lahar, lava flow, ash plume etc), their individual and combined impact and the immediate response to the event.

Heiken then goes on to examine how each city or region developed mitigation strategies and comments upon whether these were successful in reducing the impact of future events. The case studies are given in social, economic, political and geographic context to enable to reader to better understand the nature and extent of the responses and future implications. It has to be said that chapter seven on the Pacific Northwest feels a little short in comparison to the others and pays little regard to Mt. St. Helens.

Examples are clearly explained, with minimal jargon and key points highlighted or expanded upon in separate boxed sections. There are also additional notes based upon Heiken's own experience, which either add a more personal dimension to the facts and figures - or are completely irrelevant. A selection of excellent diagrams illuminates the text, illustrating eruptive characteristics and locations. However, the book would have benefited from the inclusion of colour photographs where possible as the small page size coupled with inconsistent image sizes results in an unfortunate loss of detail with some of the greyscale pictures.

The book's case study format and the extended reading list provided at the back makes it a good entry-level text for students on natural hazards courses, but is pitched at such a level as to be accessible to students, experts and anyone interested in the impact of volcanic hazards.

Reviewed by Amy Ellis

DANGEROUS NEIGHBORS: VOLCANOES AND CITIES GRANT HEIKEN, Published by: Cambridge University Press, 183pp. ISBN: 978-1-107-03923-0 www.cambridge.org Would you like to receive a free book and write a review? Available titles are listed online, of which a small selection is shown below. Contact the editor for further information TED.NIELD@GEOLSOC.ORG.UK



### Landslides: Types, Mechanisms and Modelling



In acknowledging the surge of research on landslides, slope failure and associated aspects of hazard and risk assessment in recent years, the editors clearly set out their agenda to provide a

state-of-the-art summary of landslide science. In order to achieve this they have commissioned 32 chapters from 78 researchers and practitioners. Of the chapters, 12 deal with landslide types and mechanisms, 10 consider numerical modelling of slope failures and engineering measures aimed at assessing and/or reducing hazard and risk. The remaining 10 deal with individual landslides and/or those associated with specific events (e.g. Vaiont, Åknes and the Wenchuan earthquake) or with landslides in specific regions such as Hong Kong and, with considerably more geographical diversity, non-terrestrial landslides.

Individual chapters are reasonably concise, generally at about 10 to 15 pages, making each one relatively easily digestible over a lunch-break. The book is well illustrated with line drawings, photographs and computer-generated images. These are presented in black and white, but are generally well judged in that they work without the use of colour. Most of the chapters are extensively referenced, thus affording plenty of opportunity to explore the subject further. However, the referencing in some of the chapters does not really reflect the stated aim of reflecting the recent surge in landslide science. This does, however, seem to genuinely reflect the nonuniversality of the 'surge', rather than any major omissions on the part of the authors.

The proof of any text of this nature is its usefulness. Since its arrival and the submission of this review (a longer period than I intended and most certainly longer than the editor of *Geoscientist* desired!) I have systematically read the chapters of most interest to me in my day-to-day working life and dipped into other chapters as the opportunity arose. Importantly I have found myself returning to many of the chapters in order to check facts, assumptions and ideas on a fairly frequent basis.

If I were to have one small criticism it

might perhaps be that the individual chapters form neither a coherent whole (thus providing comprehensive and logically structured guidance on all or part of the subject) nor are they a collection of individual papers. Sitting somewhere between these two extremes it would be easy to conclude that the value of the entire collection is undermined. However, this would be neither fair nor true. Most of the contributions provide an excellent summary of the area with which they deal and point to sources for further exploration.

I found this to be a very useful book and, although the cover price might dissuade one from a personal purchase, it is a vital institutional acquisition.

Reviewed by Mike G Winter

#### LANDSLIDES: TYPES, MECHANISMS AND MODELLING

JOHN J CLAGUE AND DOUGLAS STEAD (Eds), Cambridge University Press, Cambridge, 2012. Hardback, 420pp. ISBN: 978-1-107-00206-7 List price: £95.00 www.cambridge.org

### Planetary Surface Processes



The book is divided into eleven chapters with a short overview (the 'grand tour'), followed by five chapters (planetary morphology, strength v. gravity, tectonics, volcanism, and impact cratering) on each

process as it is observed across planetary bodies. The book concludes with an additional five chapters (weathering, mass movement, wind, water, and ice) looking at increasing less prevalent surface processes.

Melosh does an excellent job honoring the historic literature, noting many seminal publications for readers to track down if a topic piques their interest, while keeping it firmly grounded in the presentday literature. Following each chapter is a set of exercises that requires readers not only to manipulate selected equations from the preceding but also to interpret the results in open-ended thoughtquestions to grasp the involved processes.

The text is targeted at advanced undergraduate and postgraduate students interested in planetary geology. The material covered demands that the reader have a working knowledge of many subdisciplines of geoscience (in particular structural geology, petrology, geophysics, geomorphology, and hydrogeology), as well as to be comfortable manipulating mathematical formulae.

This book is an excellent introduction to extraterrestrial geology, with its individual chapters providing concise, in-depth reviews of concepts. This is particularly apparent in the chapters on tectonics and volcanism where a wide array of topics is covered by brief (but excellent) overviews that nicely summarize the state of the science. The figures are a mixture of line drawings and black-and-white photos with a small number of colour plates supporting key figures.

This diversity of content in this book lends strength and increases its relevancy to readers. It would make a helpful addition to the bookshelves of lecturers interested in integrating aspects of planetary geology into their curricula, the inquisitive student or professional wanting to learn about a growing field, as well anyone desiring a handy, detailed reference to many geological phenomena.

Reviewed by Carson A Richardson

#### **PLANETARY SURFACE PROCESSES**

H. JAY MELOSH, Published by: Cambridge University Press. 520pp. ISBN: 978-0-521-51418-7 List price: £48.00 www.cambridge.org

### BOOKS Available for review

Please contact **ted.nield@geolsoc.org.uk** if you would like to supply a review. You will be invited to keep the review copy. See a full up-to-date list at **www.geolsoc.org.uk/reviews** 

- NEW! The hunt for the golden mole all creatures great and small and why they matter. Richard Girling 2014. Chatto & Windus 312pp hbk
- NEW! Tectonic evolution of the Oman Mountains. Rollinson et al., 2014. Geological Society SP392 hbk
- NEW! Stone in Historic Buildings. Cassar et al., 2014. Geological Society SP 391 hbk
- NEW! New perspectives on the Caledonides of Scandinavia and related areas. Corfu et al., 2014 Geological Society SP390 hbk
- NEW! Early Palaeozoic Biogeography and Palaeogeography. Harper & Servais 2014. Geological Society Memoir #38. hbk
- NEW! Palaeozoic Climate Cycles their evolutionary & sedimentological Impact.
  Gasiewicz & Slowakiewicz 2014 Geological Society SP 376 hbk
- World Mineral Production 2008-2012 Centenary Edition. Brown T J et al., British Geological Survey 2014 115pp (sbk)

## **PEOPLE** *NEWS*

### **CAROUSEL**

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

### Michael Benton



Michael Benton, Professor of Vertebrate Palaeontology at the University of Bristol, has been elected Fellow of the Royal Society. Michael Benton has made fundamental

contributions to the history biodiversity fluctuations through time. He has led in integrating data from living and fossil organisms to answer the question of how major groups originated and diversified through time. This has revolutionised our understanding of the relative roles of intrinsic and extrinsic factors on the history of life, diversity saturation, mass extinctions, and how major clades radiate.

### Andrew Mackenzie



Andrew Mackenzie, CEO of BHP Billiton, has been elected Fellow of the Royal Society. He has made seminal contributions to geochemistry, especially in relation to the formation of oil.

For most of his career he has been a leader in the energy and mining industries working within BP, Rio Tinto and most recently in BHP Billiton. He has made major innovations in both technical and business arenas within these companies, and is pre-eminent as an Earth scientist in the commercial world.

### Tony Watts



Tony Watts, Professor of Marine Geology and Geophysics, University of Oxford, has been elected Fellow of the Royal Society. Professor Watts is a marine geologist and geophysicist who has

made fundamental contributions to the understanding of the structure and evolution of the world's ocean basins and their margins. His science is distinguished by the application of the principles and methods of geophysics to the solution of major geological problems.

### Bob's big lycra-clad adventure

**Bob Holdsworth** plans a possibly suicidal bike ride and it is his final wish that you should sponsor him



"In a moment of possibly certifiable insanity", Prof. Bob Holdsworth (Durham University), at the ripe old age of 53, has decided to ride from Land's End to John O'Groats over 10 days from August 28. He tells *Geoscientist:* "I am riding to get sponsorship for Marie Curie Cancer Care, and in memory of my aunt, Sheila Holdsworth, who died from Leukaemia in 2012".

To help you sponsor him, Bob has set

up a 'Just Giving' page. It is easy to use for online payments. As Bob says: "Be assured that the next few months will be likely significantly painful for me – as will the main event – and surely, that's got to be worth a few quid!"

To make a donation go to www.just giving.com/Robert-Holdsworth1. UK tax payers please remember to tick the Gift Aid box

### IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

#### THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Baker, John Macrae Christian Wellstood\* **Bell, Fred**  Crook, John P \* Seilacher, Adolf

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.

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

### DISTANT THUNDER **Speak easy**



### As geologist and science writer **Nina Morgan\*** discovers, some lecturers are more enlightening than others

Sending out review copies of a new book in the hope that a favourable notice will appear in relevant and well read publications is done routinely today. It was no different in the 18th Century. All the great geological authors were happy to send complimentary copies of their latest opus magnum to colleagues who in turn provided comprehensive and very lengthy reviews which were printed in prominent publications of the day. Lecturing was another key promotion strategy, and this was one that William Smith (1769 -1839) – keen to promote his geological credentials - was more than happy to embrace.

### Prominent

In 1824 William Smith met some prominent members of the recently formed Yorkshire Philosophical Society, and as a result received an invitation to deliver a course of eight lectures on geology in York. According to Smith's nephew, the geologist John Phillips (1800-1874), this was an invitation Smith was delighted to accept. In his book, *Memoirs of William Smith*, LL.D, Phillips reports that:

"...Mr. Smith, who though he had never lectured [all italics sic], had for half his life been talking on geology, immediately accepted the proposal. New maps were coloured, new sections drawn, and even the distant cabinet of Mr. Richardson [the Reverend Benjamin Richardson, a great supporter of Smith] at Farley was laid under contribution to supply illustrations for these discourses. On his arrival in York, Mr. Smith was warmly greeted by the zealous President and first Secretaries (D. Goldie and Mr. Copsie) of the Society; the lecture-room fitted up for the occasion, was crowded; and the course was successfully conducted."

As Phillips reveals, during the lectures his uncle demonstrated his very engaging personality:

"...There was a charm thrown over these discourses by the novelty and appropriateness of



the diagrams and modellings which exemplified the arrangement of rocks, the total absence of all technical trifling from the explanations, and the simplicity and earnestness of the man."

But even Phillips, a great admirer of his uncle's achievements had to admit that Smith's lecturing style left something to be desired:

### Abstractedness

"A certain abstractedness of mind, generated by long and solitary meditation, a habit of following out his own thoughts into new trains of research, even while engaged in explaining the simplest facts, continually broke the symmetry of Mr. Smith's lectures. Slight matters, things curious in themselves but not clearly or commonly associated with the general purpose of the lecture, swelled into excrescences, and stopped the growth of parts which were more important in themselves, or necessary to connect the observations into an intelligible and satisfactory system.

When it came to conveying information, it appears that

Smith's 'pictures', in the form of maps and diagrams, were worth more than many thousands of his words. And these days they sell for many thousands of pounds!

#### > Acknowledgement

The main source for this vignette is *Memoirs of William Smith*, *LL.D, author of the "Map of the Strata of England and Wales"* by his nephew and pupil, John Phillips, F.R.S., F.G.S., John Murray, London, 1844. Smith fans will be glad to know that the vast of amount of Smith archive material in the collections of the Oxford University Museum of Natural History is now available online at www.williamsmithonline.com

If the past is the key to your present interests, why not join the History of Geology Group (HOGG). Visit the HOGG website at: www.historyofgeology group.co.uk, where you'll also find abstracts for the talks and posters presented at the Conference on Geological Collectors and Collecting, April 2011 available free to download as a pdf file.

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



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



### Appalled by Paul

*Sir*, Forgive me - I am not a member of the Society, but I picked up a copy at the EGU General Assembly in Vienna last week and wish to make some observations on Jonathan Paul's *Adapt or Die* Soapbox article (*Geoscientist* 22.03 April 2014)

I found the article frankly depressing; rocks do not occur in computers, GIS or 3D visualization models but out there in the real world. If geology does not continue to teach basic field observation and mapping skills, it will slowly die. Geoscientists, whether they choose academia or industry careers or somewhere in the middle, need the basic grounding in the basic disciplines of petrology, sedimentology and palaeontology to name but three. They will always be there, whereas hardware and software packages come and go.

Mr Paul recognises that all disciplines go through phases, using the example of the oil industry as an example. My early career in soil science (as a geology graduate) involved considerable fieldwork and I am still living off that experience as much of my work moved into the computing environment. More recently, those same field skills have become fashionable again; but we struggle with under-capacity in those skills (and knowledge), due to under-investment for around 20 years.

I realise that the thrust of Mr Paul's article was targeted at geoscience's stark choice, as he sees it, between industry or academia, but he does make some depressing assertions. Do students today really 'equate fieldwork with manual labour and prefer to stay at home'? I suggest that if so, they have chosen the wrong career or else it is a sad indictment of the effect that the digital age is having on society.

Many days in the field have stayed with me throughout my career (I am 59) both from a professional and personal perspective. The number of similarly memorable days spent staring at a computer is considerably smaller. I value the processing power of new technologies but we must have the grounding to interpret what they are actually telling us. WILLIE TOWERS

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### Only way is Ethics

*Sir*, I am writing in support of Roger Dunshea's Soapbox article, The only way is ethics, (*Geoscientist* 22.04 May 2014) in which he suggests that the Geological Society's professional code should be revised to support 'very long-term global economic sustainability'.

The Institution of Civil Engineers already has a Charter for Sustainable Development with the stated aim of 'meeting the needs of today without compromising those of tomorrow' and requires that 'all grades of membership must aim to develop and maintain a high standard of sustainability awareness and to continuously improve sustainability performance within their professional activities'.

It seems to me that the Society could explicitly support such surely uncontroversial aims.

Rocks do not occur in computers, GIS or 3D visualization models but out there in the real world. If geology does not continue to teach basic field observation and mapping skills, it will slowly die. Geoscientists, whether they choose academia or industry careers or somewhere in the middle, need the basic grounding in the basic disciplines WILLIE TOWERS

Tell us what your views are, tweet @Geoscientistmag



ENDORSED TRAINING/CPD		
COURSE	DATE	VENUE AND DETAILS
Lapworth's Logs	n/a	'Lapworth's Logs' is 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 JULY 2014

MEETING	DATE	VENUE AND DETAILS	
13th Young Geotechnical Engineers Symposium BGA	30 June – 2 July	Venue: Staff House Conference Centre, University of Manchester. Charges apply. Discounts for BGA members. See website for details. E: yges@manchester.ac.uk	
Late Mesozoic Insects - in Search of the Fossil Silk Road Geologists' Association	4 July	Venue: Geological Society, Burlington House. Time: 17.30 (Tea). Speaker: Ed Jarzembowski. Contact: Sarah Stafford E: geol.assoc@btinternet.com	
4th Data Management Workshop and Knowledge Exchange PESGB, GSL	7-8 July	Venue: BGS, Keyworth. A two-day international symposium. Charges. See website for registration and details. Contact: Paul Duller E: p.duller@btinternet.com	
Life-of-Mine 2014 AusIMM	16-18 July	Venue: Queensland, Australia. Charges. See website for details and registration. Contact: Cassandra Benn E: cbenn@ausimm.com.au	
Field Meeting: Wealden Excursion - Joint Meeting Geologists' Assoc. Hastings & District GS	20 July	Leaders: Ken Brooks, Peter Austen and Ed Jarzembowski . See website for details. Contact: Sarah Stafford E: geol.assoc@btinternet.com	
3rd International Conference on Earth Science and Climate Change Omics Group	28-30 July	Venue: San Francisco, USA. See website for details and registration. Contact: Chris Brown E: earthscience2014@omicsonline.net	



### **OBITUARY TREVOR BESTOW 1925-2013**

revor Terence Bestow, who died 19 March 2013 aged 87, made a considerable contribution to practical hydrogeology, both in East Africa and Western Australia, during a long and eventful life.

He was born 3 October 1925 in the Canary Islands. At the age of four he survived the shipwreck of the *Highland Pride* when it foundered after striking rocks off the coast of Spain. He attended Cambridge University (1943) to study aerodynamics, mathematics, physics and meteorology.

### Canada

Fortunately for the science of hydrogeology, this was a false start to his university education as studies were interrupted by being called up into the RAF (1944), travelling to Canada for aircrew training as a navigator in February 1945. The war ended before these skills could be put into practice, and he was demobilised in 1947.

At that time there were no vacancies at Cambridge, so Trevor entered Glasgow University to read Geology, Chemistry and Natural Philosophy (aka Physics), graduating with First Class Honours in 1951. The choice of Geology was decided by a previous mild interest in the subject, coupled with a desire to work overseas awakened by his time in Canada.

At the end of 1951 Trevor went out to Kenya as a geologist with the British Hydrogeologist who worked chiefly in East Africa and Western Australia



Colonial Service, in the Hydraulic Branch of the Public Works Department. In this post he selected water-bore sites for towns, settlers' farms, National Parks and mission stations, and sourced reliable watersupplies for nomadic tribes, the Masai in particular, for whom he had a great regard. Following the State of Emergency declared in response to the Mau Mau uprising (1952), Trevor was seconded to the Kenya Police until 1954 when he resumed geological work.

Trevor's duties also took him to Uganda, Sudan, Ethiopia and Tanzania. He also had an arrangement with the BBC, supplying them with 16mm film of wildlife and anthropology taken on his journeys throughout the region.

### **Salinisation**

Trevor was appointed Senior Geologist in charge of the groundwater section in 1962, remaining in that position until his departure from Kenya in 1965 when he decided that Australia offered a better future for his family. Trevor joined the Geological Survey of Western Australia, as Senior (later Supervising) Hydrogeologist under Chief Hydrogeologist Eugene O'Driscoll. In this role, Trevor was in the forefront of studies of regional groundwater resources, landfill leachates, the effects of bauxite mining and salinisation of farms in the wheatbelt.

TREVOR MADE A CONSIDERABLE CONTRIBUTION TO PRACTICAL HYDROGEOLOGY, BOTH IN EAST AFRICA AND WESTERN AUSTRALIA, DURING A LONG AND EVENTFUL LIFE

As far back as 1982 he reported on the geothermal energy potential of Western Australia. He introduced innovative drilling and logging practices in coordination with the Mines Department Drilling Section and helped to establish dating of groundwater by measurement of tritium and carbon-14. In 1966 the family settled at Roleystone, in the hills behind Perth, establishing orchards, growing hydroponic vegetables and raising chickens.

Trevor passed away peacefully surrounded by his family. He is survived by Pat, his wife of 54 years, four children: Alistair, Clare, Sue and Ian, and nine grandchildren.

> By John Barnett

**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.



### ACROSS

- 1 Iron manganese tungstate mineral (10)
- 6 Jason & co's boat (4)
- 9 Stripped bare (7)
- 10 Continental hernia? (7)
- 12 Rare Earth Element, named for a mineral in which it occurs, named in turn by Johan Gadolin (10)
- **13** Category of caveat, the other being buts (3)
- Banded high-grade metamorphic rock (6)
- 16 To go into legislative recess (8)
- **18** Unit of measurement for ionizing radiation (8)
- **20** Asymmetrically distributed statistic (6)
- **23** The inner exterior of a bilaterian animal (3)
- **24** Triassic to Cretaceous marine reptile, the first *gen et sp* of which was named by Conybeare in 1824 (10)
- **26** Low angle reverse faults (7)
- 27 Rendered sightless, like Samson in Gaza (7)
- **28** Fortified wine from Spain or the Canaries, a butt of which remunerates the British Laureate (4)
- 29 Antisocial (10)

### DOWN

1

- Dry river bed in desert environment, where one should never camp but where one often must because one has no choice (4)
- 2 Evolutionary chain (7)
- **3** Unstable forms of elements that decay by emission of radiation (13)
- New version of this European capital is the centre of an intraplate seismic zone in the central US (6)
- 5 Haplorrhine primates of South East Asian islands (8)
- 7 Swedish Tetra Pak family (7)
- 8 Occasions when budget was exceeded (10)
- **11** Southwesternmost Welsh county whose natives so LOVE being called a 'Little England' (13)
- 14 Construction materials consisting of sand, gravel, crushed stone, slag, or recycled crushed concrete (10)
- 17 Canadian jazz pianist of almost unrivalled technique (8)
- **19** Native to the 23a (7)
- 21 In receipt of an injury (7)
- 22 Harvested wood in boards or planks (UK) (6)

#### 25 Back-swirling reverse current (4)

# WIN A SPECIAL **PUBLICATION!**

#### The winner of the May Crossword puzzle prize draw was Andrew Southworth of Preston.

All correct solutions will be placed in the draw, and the winner's name printed in the September 2014 issue. The Editor's decision is final and no correspondence will be entered into. **Closing date - 23 June.** 

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** 

Membership number
Address for correspondence
Postcode

### SOLUTIONS MAY

#### ACROSS:

Nomo

- 1 Breviconic 6 Lava 9 Ditcher 10 Olivine
- 12 Bathyscaph 13 Ova 15 Glycol 16 Highland
- 18 Predator 20 Bonsai 23 Ore 24 Rotational
- 26 Oxalate 27 Imitate 28 Yoda 29 Asymptotes

#### DOWN:

- 1 Bode 2 Estuary 3 Ichthyosauria 4 Ogress
- 5 Isobaric 7 Arizona 8 Alexandia
- 11 Ichthyologist 14 Egyptology 17 Softness
- 19 Emerald 21 Sealant 22 Atrium 25 Peas

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- Options for discounted subscriptions to Geology Today and Geology.
- Free subscription to our Fellowship magazine, Geoscientist, containing news, views and features.
- Free online access to the Books Archive which provides access to all book titles published prior to the current or previous three years.
- Access to all recent books is available via an optional subscription to the Full Book Collection.
- Deep discounts on the Society's highly acclaimed Special Publications and other books (usually 50%).

### Develop

- The Society offers two pathways to chartership: Chartered Geologist and Chartered Scientist.
  Equivalent in status, each requires high standards of knowledge, competence and professionalism.
- Training courses and CPD events endorsed by the Society are available free or at discounted rates to Fellows.
- Upload your CV online for free and let employers find you.
- Be informed about the progress of cutting edge science. Engage in the development and debate of GSL policy and position papers.

### Explore

- The Geological Society houses one of the most important libraries in the world, with over 300,000 volumes of books and serials, remote online access to over 60 subscribed journals and a collection of over 40,000 maps. The library's collection can be searched from anywhere in the world through the online catalogue. Items can be posted anywhere in the UK and photocopies can be sent to Fellows overseas.
- Reduced registration rates to conferences and meetings.
- As a Fellow you will be assigned to one of our Regional Groups and have the opportunity to sign up to a Specialist Group.

There is an appropriate grade of membership for each career stage, from student to retirement. Fees are graduated according to age, so that membership is made accessible to younger and older geoscientists. For further information www.geolsoc.org.uk/apply

For more information or to download an application form visit www.geolsoc.org.uk/join

serving science & profession

The

Geological

Society

PART OF THE WILLIAM SMITH MAP BICENTENARY PROGRAMME OF EVENTS

200 Years of Smith's Map



William Smith was an English geologist who created the first nationwide geological map. In 1794, as a surveyor for the Somerset Coal Canal, Smith recognised that each stratigraphic horizon contained unique fossils. This enabled him to work out the order of strata. From his 1799 map of the strata around Bath, Smith progressed to the publication in 1815 of 'A Delineation of the Strata of England and Wales'. His ideas disseminated widely but took time to become accepted.

This bicentenary meeting aims to address:

- Smith's achievements and his impact on the state of geology in his time
- His fossil collection
- His contemporaries
- His relationship with the **Geological Society of** London
- His various careers including canal builder, land drainer, mineral surveyor and lecturer.
- Contemporary concepts of geological survey and map design
- Past and present research into surviving Smith maps, sections and documents.

**Private Exhibition at Natural History Museum:** 22 April 2015 **Conference at the Geological Society, Burlington** House: 23-24 April 2015 Field Excursion in Oxfordshire: 25 April 2015

The History of Geology Group (HOGG) is organising the first of 2 Geological Society William Smith Meetings in 2015.

> audience prior to the poster sessions. 250-word abstracts should be submitted

by 31 August 2014 to John Henry:

It is intended that the conference

proceedings will be published as a

Please indicate your willingness to

abstract. Suggestions for written

contributions to supplement the

**Field and other visits** 

proceedings from the conference are

During the conference we aim to visit

Oxford University Museum of Natural

History, and Smith's birthplace and the

Smith Heritage Centre in Churchill village.

Smith's fossil and rock collections at the Natural History Museum. On Saturday 25

April we will visit the Smith Archive at the

Geological Society Special Publication.

contribute a paper when submitting your

wmsmith2015@gmail.com

**Publication** 

also invited.

### **Confirmed Keynote Speakers**

Professor Simon Knell, Professor Hugh Torrens, Tom Sharpe.

### Convenors

David Williams, Cherry Lewis, John Henry.

### **Call for Papers**

We are pleased to invite all interested participants to submit abstracts for 25 minute oral presentations and posters on topics of relevance. International contributions are most welcome, although no financial assistance can be given. 500-word abstracts should be submitted by 31 August 2014 to John Henry: wmsmith2015@gmail.com

### **Posters**

Given the fundamentally graphic contribution of William Smith to geology, posters are also invited and it is intended that short presentations of selected posters will be addressed to the conference

### **Further information**

For further information about the conference please contact: Naomi Newbold, Conference Office, The Geological Society, Burlington House, Piccadilly, London W1J OBG

- T: 0207 434 9944 E: naomi.newbold@geolsoc.org.uk W: www.geolsoc.org.uk/wsmith15
- B Follow this event on Twitter #wsmith15 W: www.historyofgeologygroup.co.uk

The 2nd 2015 William Smith meeting will be in November. W: www.geolsoc.org.uk/wsmithNov15

### The William Smith Map **Bicentenary** (1815-2015)







NATURAL HISTORY



OF





# **Deep Earth Processes**

### windows on the workings of a planet

### 15-16 September 2014



### **Further information**

For further information about the conference please contact:

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### The Geological Society, Burlington House, Piccadilly, London, UK

The physical and chemical nature of Earth's deep interior is key in controlling many of the processes that shape our planet: from mantle convection to melting, from volcanism to plate tectonics. Rationalising the latest observations – be they clues revealed in the compositions of mantle melts, diamond formation, seismological nuances, or atomistic scale predictions – requires interaction across sub-disciplines. This international meeting seeks to draw together the latest ideas and results from geophysicists, geochemists, mineral physicists, geodynamicists and petrologists to identify the processes shaping the inaccessible depths of our planet.

### Thematic sessions:

- Deep mantle structure
- Composition of the lower mantle
- Core formation, CMB & D"
- Surface expression of deep Earth processes

### **Convenors:**

Sally Gibson, University of Cambridge, UK Saskia Goes, Imperial College, UK Simon Redfern, University of Cambridge, UK Mike Walter, University of Bristol, UK

### **Keynote Speakers:**

John Hernlund, *Tokyo Institute of Technology, Japan* Bernie Wood, *University of Oxford, UK* 

### **Invited Speakers:**

Chris Ballentine, University of Oxford, UK John Brodholt, University College London, UK Arwen Deuss, University of Cambridge, UK Dan Frost, Bayreuth, Germany Matt Jackson, UC Santa Barbara, USA Peter van Keken, University of Michigan, USA Mike Kendall, University of Bristol, UK Graham Pearson, University of Alberta, CA Dan Shim, Arizona State University, USA