

GEOSCIENTIST

VOLUME 30 No. 2 ♦ MARCH 2020 ♦ WWW.GEOLSOC.ORG.UK/GEOSCIENTIST

The Fellowship Magazine of the Geological Society of London

@geoscientistmag

**[ELECTION SPECIAL:
DON'T FORGET TO VOTE!]**

A SUSTAINABLE FUTURE?
The role of geoscience in decarbonising UK heat

GOING 'ON LINE'
A history of geologists
on trains

ROCKY GLACIERS
Meeting the challenge of debris
covered glaciers and related lakes

SHINE THE LIGHT
Is geology one of our
best kept secrets?

Deep geological disposal of radioactive waste:

The role of geoscience



Monday 30 March 2020

9.45 am to 5.00 pm

Rupert Beckett Lecture Theatre

Michael Sadler Building

University of Leeds

LS2 9DA

A series of invited talks reviewing the critical role played by the geosphere in deep geological disposal of higher activity radioactive waste.

Provisional Programme includes

- Jon Gluyas (University of Durham)
- Jonathan Turner (RWM, UK)
- Fiona McEvoy (BGS)
- Kaj Ahlbom (SKB, Sweden)
- Tim Vietor (Nagra, Switzerland)
- Neil Chapman
- Final Q&A Panel
(moderated by Iain Stewart)

YGS Members do not need to register and can gain entry with their Membership Cards.

Registration is required for non-members, to register (free) please visit our Eventbrite page

<https://ygs-radioactivewastegeology.eventbrite.co.uk>



For further information about
Yorkshire Geological Society events
see <http://www.yorksgeolsoc.org.uk/>

Geoscientist is the Fellowship magazine of the Geological Society of London

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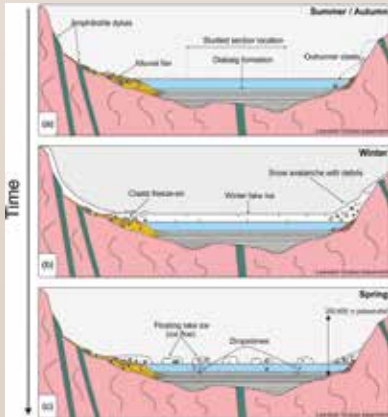
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New in the *Scottish Journal of Geology*

Ice-rafting in lakes in the early Neoproterozoic:
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By Adrian Hartley, Bartosz Kurjanski, Jessica Pugsley
and Joseph Armstrong



Read in the Lyell Collection

<https://sjg.lyellcollection.org/content/early/2020/01/10/sjg2019-017>



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GASS
2020

Geologists' Association Student Symposium

Geoscience in wider society:
What difference will
your research make?

15th of May 2020

Burlington House, Piccadilly, London, W1J0BG

- 🏆 Prizes will be awarded for the best oral and poster presentations
- ✓ Keynote speaker: **Professor Iain Stewart**
(Director of the Sustainable Earth Institute, Plymouth University)
- 📅 Registration opens 1/1/20

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ZEISS-GSL Scholarship

Carl Zeiss Microscopy Ltd. and the Geological Society of London are offering a scholarship of up to £8000 for innovative microscopy in Earth Science related projects. The scholarship is open to PhD students who are Fellows of the Geological Society.

Applications open: 20 January 2020

Application deadline: 16 March 2020

Open to UK and overseas PhD students
(excluding North America)

Find out more information at:

www.geolsoc.org.uk/ZEISS-GSL-Scholarship



“ THERE ARE REAL, PRACTICAL THINGS WE CAN DO TO MAKE A DIFFERENCE ”

FROM THE EDITOR'S DESK:

That's a wrap!

If you're reading this on paper, you'll hopefully already have noticed the good news – the plastic wrap is history. From now on, *Geoscientist* will be mailed to readers in biodegradable wrap, as part of a wider Society move that includes the flagship *Journal of the Geological Society* and a growing list of other publications.

It's clear how important this is to readers from the response to our October special issue on plastics – thank you to everyone who wrote in. Our new BIOPLAST 300 wrap, based on potato starch, is 100% home compostable and leaves behind no microparticles at the end of its life.

A big step forward for *Geoscientist* magazine might feel like a drop in the ocean when compared to the larger challenges of climate change, but there's truth to the adage that every little helps. It's easy to get overwhelmed – in researching this editorial, I learned the term 'eco anxiety' – more and more of us are feeling panicked by what we're seeing in the news, in scientific papers or in reports from experts.

It's easy, too, to tip from panic into hopelessness. Hopelessness is not, as panic can be, a motivating feeling. It doesn't provoke us to action, but paralyzes us on the spot. What we need, to avoid feeling powerless, is something to do.

There's plenty to do, of course, and most of us are working on some combination of recycling, trying to fly and drive less, use less plastic. Geoscientists are well placed to help in ways beyond the individual – for example, this month's feature discusses the potential of ground source heat technology in reducing emissions from UK heating systems. In their discussion of the current state of play, David Banks and David Birks take an

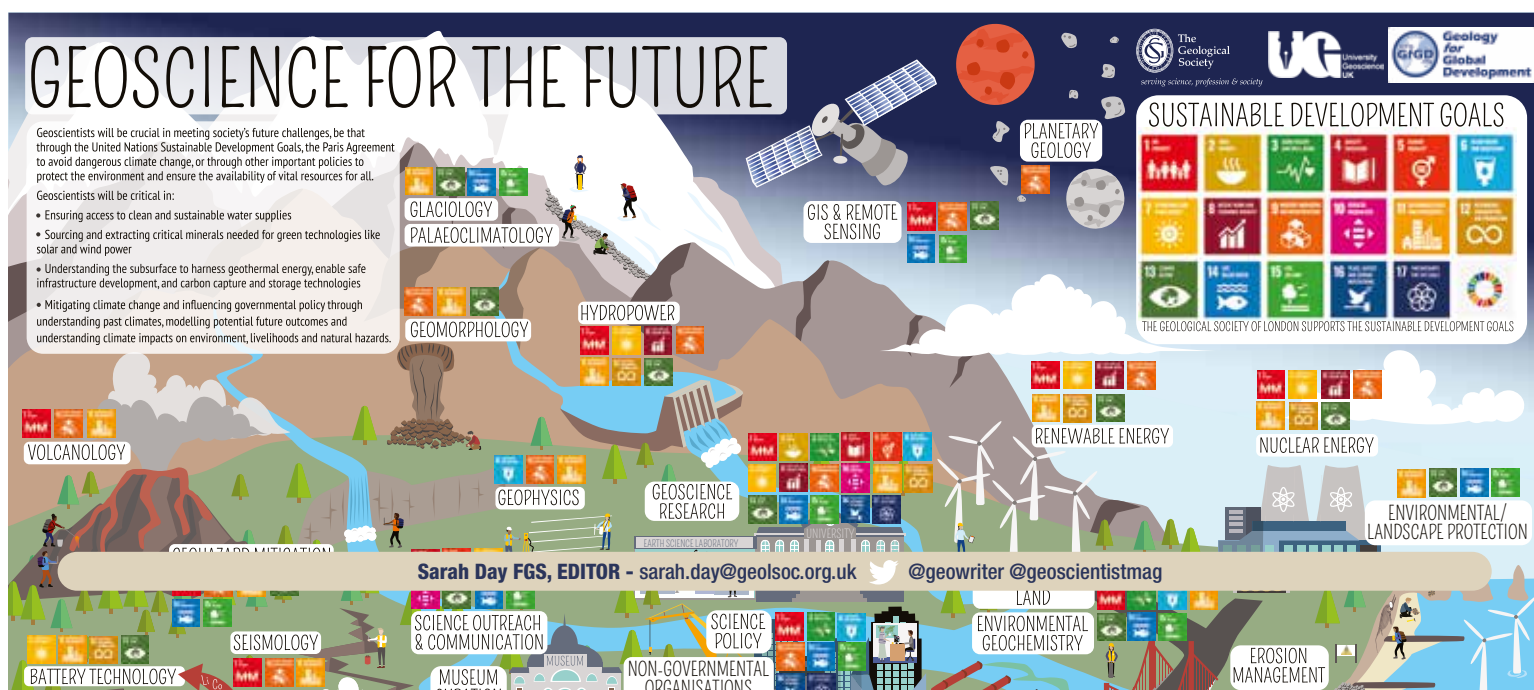
optimistic, yet practical approach. There's work to be done, but the rewards are clear - it's an industry which has the potential to change our energy consumption in a meaningful way, and geoscience expertise is a large part of that. There are real, practical things we can do to make a difference.

Recently, the Society's education team released 'Geoscience for the future', a poster (see below) outlining the many ways in which geoscience can help meet the UN sustainable development goals - seventeen goals which will help us achieve a better world for everyone. It serves as a useful reminder of how wide ranging our subject is, and might also help combat that familiar concern that we need to do more to communicate the real world relevance of our subject to prospective students. The poster has been shared hundreds of times online, and displayed in schools and offices around the country.

It seems to me that part of the reason for the popularity of resources like this are their realism – rather than lofty sentiments or expansive claims, they pin geoscientists' expertise directly to each goal, giving us a tangible way to see how we might make a change.

They're also representative of the world as it is – the oil and gas industry, renewable energy, academia and industry are all there, all showing how the expertise gained by a career in geoscience can and already has made a difference. It's a great way to directly correlate the relevance of our science to wider global issues.

So if you're feeling powerless at the state of the world, I recommend visiting www.geolsoc.org.uk/posters and downloading a copy. Not only are there things everyone can do – you might find you're doing more of them than you thought.



SOCIETY NEWS

SOCIETY BUSINESS

SOCIETY AWARDS 2020

The Society is delighted to announce the names of the winners of its medals and funds and offers all its heartiest congratulations. The President's Award winners will be announced at a later date. The Awards will be presented at President's Day on 4 June 2020.

Name	Affiliation	Award
Prof Barbara Romanowicz	Institut de Physique du Globe de Paris	Wollaston Medal
Prof Rachel Wood	University of Edinburgh	Lyell Medal
Prof Katharine Cashman	University of Bristol	Murchison Medal
Dr Alastair Ruffell	Queens University Belfast	William Smith Medal
Dr Kristján Saemundsson	Retired	Prestwich Medal
Prof Alastair Robertson	University of Edinburgh	Dewey Medal
Prof Sandra Herbert	University of Maryland	Sue Tyler Friedman Medal
Prof Richard Davies	Newcastle University	Coke Medal
Prof Lisa McNeill	National Oceanography Centre	Coke Medal
Dr Bill Gaskarth	Retired	Distinguished Service Award
Prof Bridget Wade	University College London	Bigsby Medal
Dr Andrew Newton	Queens University Belfast	Wollaston Fund
Dr Thomas Wong Hearing	University of Ghent	Lyell Fund
Dr Alexander Dunhill	University of Leeds	Murchison Fund
Ms Emma Jude	BP Exploration	William Smith Fund

FELLOWSHIP RENEWALS

Every year at this time we remind Fellows to renew their Fellowship for the current year, or face being struck off – with the subsequent inconvenience of having to re-apply. For the Society, late payment results in additional costs and administration. We must ensure that optimum use is made of Society resources and we rely on the support of Fellows to achieve this. Time is running out for you to renew your Fellowship. To ensure that you continue to support and belong to your professional body, please renew today, preferably online via the web site; or you can call Burlington House and ask for the Fellowship Department.

Richard Hughes, Executive Secretary

COUNCIL MEETINGS AND OGMS

The dates for meetings of Council and Ordinary General Meetings until June 2021 will be as follows:

2020: 8 April, 17 June, 8 September, 25 November.

2021: 27 January, 7 April, 23 June

ZEISS-GSL SCHOLARSHIP FOR PHD FELLOWS

The 2020 ZEISS-GSL Scholarship applications are now open with up to £8000 available for Geological Society Fellows undertaking PhD Earth Science projects. Your research could be in volcanology, planetary geology, palaeobiology, petrology, structural geology - as long as your project involves a level of innovative microscopy then you can apply for the scholarship.

More information, including the application form and our terms and conditions, can be found on our webpage: <https://geolsoc.org.uk/zeiss-gsl-scholarship>.

Please note that completed applications should be sent to education@geolsoc.org.uk by 16 March 2020 (23:55 GMT).

PUBLIC LECTURE SERIES

What have wildfires got to do with life on Earth?

Speaker: Claire Belcher, University of Exeter

Location: Burlington House, London

Date: 25 March

Programme

- Afternoon talk: 14.30 Tea & Coffee; 15.00 Lecture begins; 16.00 Event ends.
- Evening talk: 17.30 Tea & Coffee; 18.00 Lecture begins; 19.00 Reception.

Further information

Please visit <https://www.geolsoc.org.uk/Events/Public-Lectures-2020>. Tickets are now available on [Eventbrite.co.uk](https://www.eventbrite.co.uk) and will work on a first come first serve basis. The lectures will be available to watch livestreamed. To watch, please check the lecture webpage for the link.

Contact: The Geological Society, Burlington House, Piccadilly, London W1J 0BG
T: +44 (0) 20 7434 9944 E: conference@geolsoc.org.uk

What your society is doing
at home and abroad



ELECTIONS TO COUNCIL 2020-2021

The October issue of Geoscientist invited Fellows to nominate new members of Council for election to succeed those who will be retiring at the Annual General Meeting on 4 June 2020. Subsequent calls were made in the email newsletter.

There are seven nominations for the five vacancies. The process for the election of members of Council is set out at section 6 of the Bye-laws.

It is important that Council is representative of the views and diversity of all the Fellowship so Fellows are urged to participate in the preliminary ballot which will determine the list for the formal vote at the Annual General Meeting.

Civica Election Services (CES) – previously Electoral Reform Services – will manage the ballot for Council on behalf of the Society. CES is the UK’s leading independent ballot services provider, and has extensive experience of overseeing ballots for a wide range of organisations.

All Fellows for whom we have an email address should already have received voting information direct from CES. All other Fellows should have

received a postal ballot pack. If you have not heard from CES via email or post, or would prefer to receive a postal ballot pack, or have any other difficulties casting your vote, please contact Stephanie Jones (stephanie.jones@geolsoc.org.uk) at the Society.

Voting closes at 23.59 on Tuesday 31 March 2020. Postal ballot forms must be sent to CES (not to the Society) and must arrive by Tuesday 31 March.

ONLY FELLOWS OF THE SOCIETY ARE ELIGIBLE TO VOTE

The Council elections are your opportunity to choose who should serve on Council to best represent the interests of all Fellows and to shape the future of the Society. Fellows may wish to make their choices having regard to the area of expertise of the continuing and retiring members of Council which are shown on the tables below. Biographies of members of Council are at www.geolsoc.org.uk/biographies.

CONTINUING MEMBERS OF COUNCIL 2020-2021

Name	Expertise	Sector
Mr Thomas Backhouse	Risk / Environmental and Geological Hazards	Industry
Dr Andrew Bloodworth	Economic Geology	Government
Mr John Booth	Engineering Geology	Industry
Dr Michael Daly	Petroleum Geology	Academe
Dr Joel Gill	Social Geology, Disaster Risk Reduction, Sustainable Development	Government
Dr Kathryn Goodenough	Mineral resources, igneous petrology, crustal evolution	Government
Mr Graham Goffey	Petroleum Geology	Industry
Prof James Griffiths	Engineering Geology	Academe
Prof Chris King	Geoscience educator	Academe
Mr Andrew Moore	Contaminated Land	Industry
Prof Bryne Ngwenya	Microbial Geochemistry	Academe
Mr Nik Reynolds	Contaminated land, Geotechnical engineering	Industry
Mrs Sarah Scott	Hydrogeology	Government
Ms Gemma Sherwood	Engineering Geology	Industry
Miss Jessica Smith	Engineering Geology	Industry
Dr Helen Smyth	Petroleum Geology	Industry
Prof Robin Strachan	Tectonics, Geochronology	Academe
Mr John Talbot	Geotechnical engineering, Engineering Geology	Retired
Dr Alex Whittaker	Tectonics and Landscape Dynamics	Academe

MEMBERS OF COUNCIL RETIRING AT THE ANNUAL GENERAL MEETING ON 4 JUNE 2020

Name	Expertise	Background
Ms Lesley Dunlop	Geomorphology	Academe
Dr Sarah Gordon	Mining, Meteoritics, Risk	Industry
Prof Nick Rogers	Geochemistry	Academe
Prof Katherine Royse	Environmental Geology	Government
Mr John Talbot	Geotechnical Engineering, Engineering Geology	Retired



SUPPORTING STATEMENTS FOR COUNCIL NOMINEES



MRS JOANNA ALEXANDER

It's a unique time to be a Geologist. Humankind is becoming acutely aware of our dependence on a

healthy planet, the need to use resources sustainably and respond to the climate emergency. I want to help the Society use this moment of profound change as an opportunity, not only to adapt and evolve, but to lead and inspire.

After studying Earth Sciences at Oxford University, I worked as an Exploration Geoscientist with BP for 10 years. During that time, it became increasingly difficult for me to ignore my concern about climate change. Since leaving the oil industry I've worked with charities and businesses, promoted corporate purpose and influenced investors to consider environmental risks.

My experience has shown me that the benefits of change, both personally and for organisations, greatly outweigh the discomfort. It has also shifted what being a Geologist means to me. Geology used to be **what** I did, but now my love for the Earth defines **why** I do anything. It's my motivation.

I hope my positivity about change and sense of purpose will be infectious – to the Society and individuals. I will champion the skills of Geologists and support them in creating positive impact through their careers. (Chartered Geologist since 2016.)

Proposer: **Hugh Jenkyns**

Supporters: **Jenny Omma Panayi and Gavrielle Groves-Gidney**



DR JENNIE GILBERT

I attended my initial Society meetings as a geology undergraduate while at Imperial in the 1980s. Inspired,

I became a fellow in 1986. While a PhD student in volcanology and geochemistry at Cambridge, Society meetings – in particular Volcanic and Magmatic Studies Group (VMSG) meetings – were highlights because these were opportunities for me to present my work, extend my network and learn beyond my discipline. I continued into academia via post-doctoral positions in volcanology at the University of Bristol and later secured a permanent post at

Lancaster University which is where I am currently based. I have previously served the Society as a committee member and secretary of VMSG, and a member of the organizing committee of two VMSG meetings held in Lancaster and other meetings sponsored by the Society. As an academic, I offer knowledge and skills in research and teaching in Earth Sciences; I hold a Senior Fellow of the Higher Education Academy qualification. In addition, I am deeply interested in equality, diversity and inclusivity issues, and geologic conservation. I have benefitted from opportunities with the Society and am ambitious to help others do similarly. This is why I aspire to serve on Council.

Proposer: **Stephen Sparks FRS**

Supporters: **Lionel Wilson and Duncan Woodcock**



DR MICHAEL KEHINDE

I want to serve in Council, working with others, to help the Society achieve its outcomes and enhance its public brand. I bring on

board experience as trustee, school governor and as EDI champion in Environment Agency as Founder/ex-Lead of the B.A.M.E. Network and as Steering Group member of Defra's Project Race. I want to focus on improving the way we communicate the critical role of the geosciences in attaining the global sustainable development goals and in securing resources for the future; and on stretching EDI to include empowerment.

Prior to joining the Environment Agency, I worked in the water resources and environment management sector, in Europe and Africa as consultant to industry, to national government and to UNICEF on various local, national and international projects; and I was a senior university academic involved in teaching and research at the University of Lagos.

I have been a Fellow of the Society for six years, became chartered in 2014 via the 20-year route, and belong to the Hydrogeology group. I hold an MSc in Applied Geology and PhD in Hydrogeology and speak German fluently. Additionally I am a Prince2 certified project manager with good track record of managing successful projects.

Proposer: **Andrew Farrant**

Supporters: **Jane Dottridge and Theresa Cory**



DR DAVID LATIN

I am at a stage in my career where I have time and desire to give something back. I bring energy, creativity and a

wealth of cross disciplinary experience and connections from Industry, UK Universities, Government and Finance. Most recently I was deeply involved in private equity fund raising. I am interested in the Energy Transition and the Digital Transformation which are now taking place and would like to help the Council to think about where the Society, and the role of Geoscience, are headed within that overall context.

Currently an independent advisor, consultant and coach in the Energy sector. Also advising the Vice Chancellor's team at Newcastle University with focus on spin-out companies. Cross disciplinary background in the oil and gas industry and have worked on everything "from the rocks to the ops" including applications for digital technology at BP where I led the Upstream IT function for a period. I have served on several Boards. I have a long association with Geoscience and the Society. Prior to working for BP (18 years) and then OMV (6 years), I had a short academic career.

- Elected FGS 1987.
- Lyell Fund winner 1995.
- Accreditation Committee since November 2018.
- BSc Geology Newcastle; PhD Edinburgh;
- NERC Research Fellowship, Cambridge

Proposer: **Michael Bowman**

Supporters: **Godfrey Fitton and Andy Saunders**



DR JAMES LAWRENCE

I am passionate about the role the Society and its members have in supporting geosciences throughout the UK and

across the globe. I am currently a Senior Lecturer in Geotechnics at Imperial College London, but have had a varied career working as a geologist on many major infrastructure projects across the world in the Petroleum, Geotechnical and Mining sectors, both in industry and academia. So it is important to me that the Society represents all applied sectors of the geosciences community.

I have been a Fellow of the Society

for over 15 years. I serve on the Editorial Board of Quarterly Journal of Engineering Geology and Hydrogeology and I am a member of the Executive Committee of the British Geotechnical Association (BGA). I was the Organising Secretary for the BGA Engineering in Chalk 2018 Conference and editor of the conference proceedings. I am part of national trailblazer group for the Level 7 Apprenticeship Degree in Geotechnical Engineering which emphasizes my passion for bringing industry and education closer together. In 2019 I was a BGA Fleming Award Finalist. This varied experience means that I will be able to serve and make an effective contribution to the Society Council.

Proposer: **Richard Ghail**

Supporters: **Tony Maher and Susanna Marley**



MRS LUCY WILLIAMS

- Chartered Geologist
- Society Fellow since 1993
- Chair of the Petroleum Group 2018-19

- Member of the Society Awards Committee
- Geoscience Manager at Rockhopper Exploration
- 27 years industry experience
- BSc in Geology (UCL), MSc in Petroleum Geology (Imperial College)

It has been an absolute pleasure to Chair the Petroleum Group and I am proud of what the Group delivers, from technical conferences, publications and Awards to representation of petroleum geoscience on behalf of the Society. In this role I worked closely with the Society and appreciate

the tremendous work it does to support the broad discipline of geoscience. I will apply the considerable organisational and governance experience I have gained from convening high quality scientific conferences and workshops into the Society's broad events programme. I would love to continue my involvement and would consider it a great honour to serve on Council.

If elected I would be an advocate for my industry in the Society and equally strive to see the Society pro-actively support all geological sciences associated with delivery of the future energy mix, aimed towards a low carbon economy. I passionately believe the Society is uniquely placed to assume this role.

Proposer: **Adam Law**

Supporters: **Fiona MacAulay and John Argent**



DR JOHN PERRY

I have been a Fellow for 40 years and a Chartered Geologist with national and international expertise in engineering geology

for construction. Within the Society's Council, I would be honoured to assist in maintaining and improving the technical and professional awareness of geology and engineering geology, particularly in the field of sustainability. I believe the Society has a lot to offer in promoting the environmental, economic and social pillars of sustainability. I am also keen to employ my commercial, financial and development experience to the benefit of the Society. I would like to continue to develop its marketing and societal profile, and to look at different fund-raising methods.

I have a broad mix of experience in research at a national and international level (Transport Research Laboratory), in research implementation (government departments) and in industrial practice and commercial drivers (Mott MacDonald, a large international consultancy). I have experience in commercial business development and global leadership from the last ten years.

I am a past chair of the Engineering Group, co-author of two Engineering Group special publications (No.16 and 21) on Stone and Clay, and a past member of the QJEGH editorial board. I have over 20 publications in engineering geology.

Proposer: **David Shilston**

Supporters: **Robin Strachan and Ian Duncan**

NEWS FROM THE PUBLISHING HOUSE

NEAL MARRIOTT

Neal Marriott, the Society's Director of Publishing, stood down from his role at end of January 2020. Neal has been with the Society for nearly 18 years, having joined early in 2002. During that time Neal led the Publishing House team in transforming the Society's publishing operation from a print-based to an online business supported by a range of publishing technologies. Key amongst these developments was the launch of the Lyell Collection in 2007, which now forms the base for all our online publications and services. The continuing successes of the Society's

scholarly communications are due to Neal's exemplary leadership and the excellent work of the Publishing House team. Neal will not be leaving the Society altogether, and will be working on a review of our Library and Information Services throughout 2020.

I'm delighted to announce that Neal's successor as Director of Publishing is Maggie Simmons. Maggie joined the Society from the Institute of Physics in mid-2018 as Head of Editorial Development, and we wish her every success in her new role.

Richard Hughes, Executive Secretary



Neal Marriott



Maggie Simmons



Time to shine the light

Geologists need to make the most of our subject in order to inform environmental debate and combat disinformation, says **David Dennison**

The June 2019 *Geoscientist* editorial, 'Geology the Obscure' was a great and timely reminder that despite our best endeavours, the world of geology and Earth sciences remains one of our best kept secrets. We clearly have some way to go to consider ourselves a truly inclusive science.

Public interest and disinformation

As never before, there is huge public interest in understanding global trends in our physical environment, including relative changes in sea level, loss of ice sheet cover, variable and extreme temperatures, mass extinctions and increasing levels of carbon dioxide. Sadly, we are also confronted by disinformation on a daily basis and worryingly much of it is deliberately misleading.

As geologists, our expertise ranges across many of the significant changes that have occurred on Earth over time. There is a bigger role for us to play in informing the environmental debate and making use of our access to a considerable database going back literally millions of years.

It's all too easy for us to forget the complicated nature of some of the knowledge we hold and to assume others are on the same page. In order to shine that light more effectively we need to provide further regular and qualified insights in a form more readily understood and accessed by the general public.

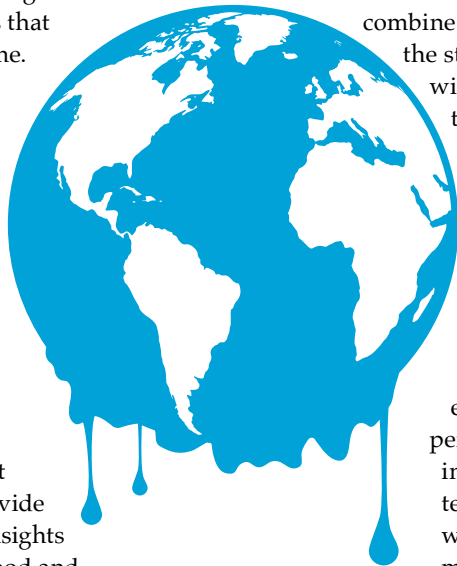
Wood for the trees

Even within our own ranks we are missing the opportunity to extract the most out of the insights and meaning from our research. The blame for this sits mainly at our door. We are a passionate, intellectual and friendly bunch, but much of our valued work is very

detailed, far ranging yet specific, which makes it hard for even some fellow geoscientists to fully appreciate – myself included. We should be incentivising authors to provide us with more technical papers connecting many of the latest key observations, rather than just encouraging new research that gathers new data to test new hypotheses. When do we stop and take stock?

Hail the geology ambassador

Good communication is a core skill respected across many industries. The ability to connect and impart knowledge or to relay a story well has been a valued attribute since year dot. There are many examples of great scientific orators, including the likes of Sir David Attenborough and Professor Brian Cox. They capture our imagination and leave us wanting to hear more. The trick has been to



combine the enthusiasm and the story-telling ability with providing the key technical detail in a form fit for general consumption.

It feels like there is a gap in our field of speciality that needs filling. The challenge for our profession is to encourage the right person to step forward in a similar way and tell our story more widely through the media. We probably already know the

right sort of person within our geological community, we just need to give him or her that gentle nudge. As Professor Brian Cox would undoubtedly say, things can only get better.

David Dennison, Director, Ridge Top Consulting
E: dajdennison@gmail.com

SOAPBOX CALLING!

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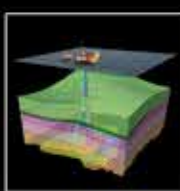
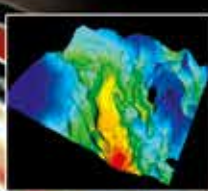
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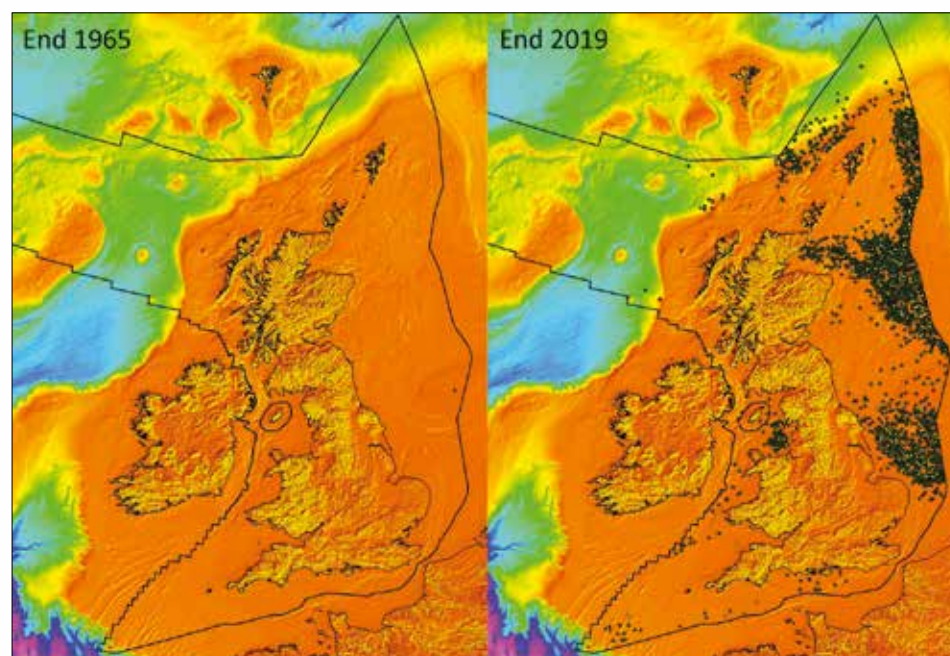
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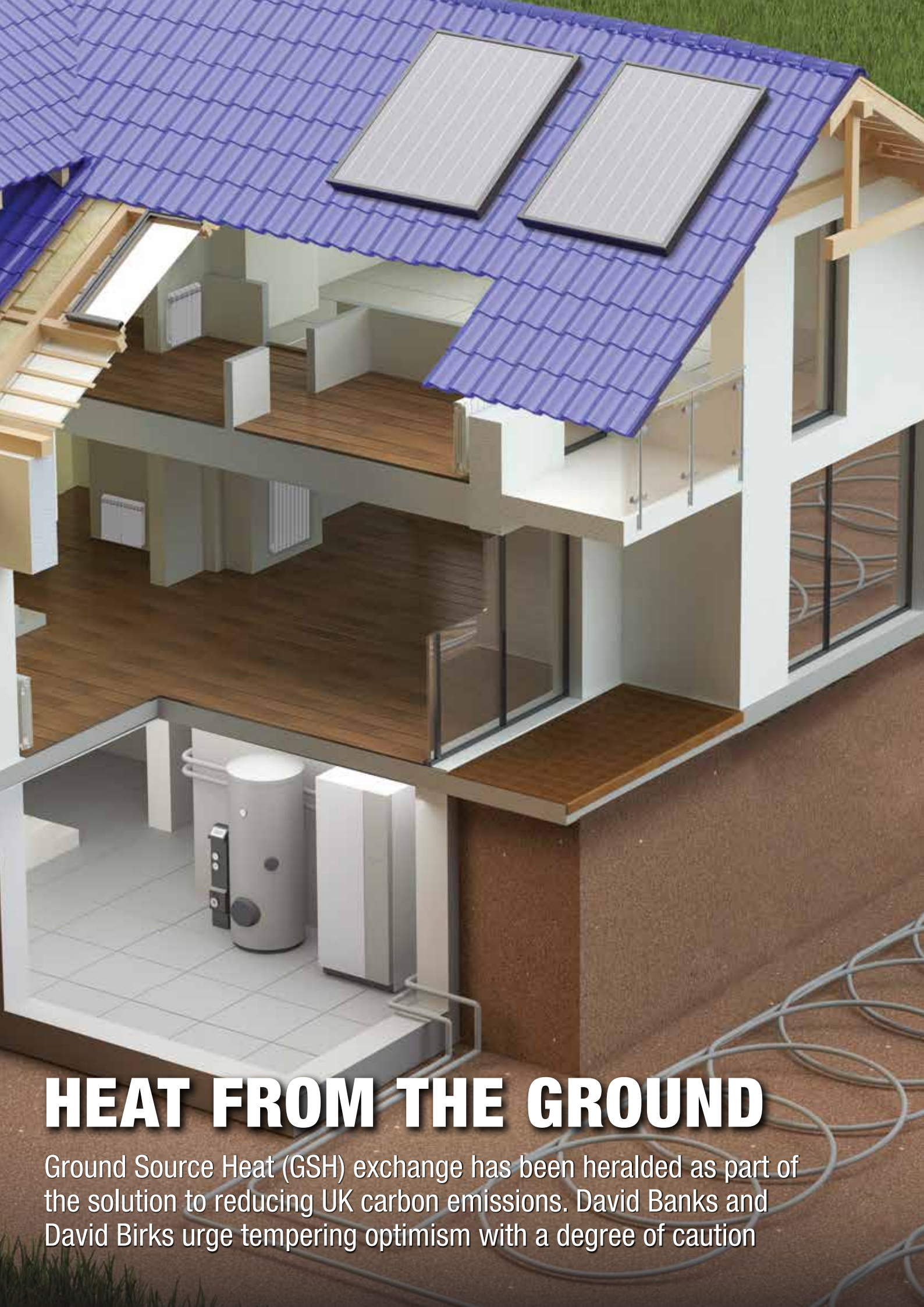
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HEAT FROM THE GROUND

Ground Source Heat (GSH) exchange has been heralded as part of the solution to reducing UK carbon emissions. David Banks and David Birks urge tempering optimism with a degree of caution



Amidst the growing international consensus of an imminent carbon emergency, there is a pressing need for all nations to reduce their carbon emissions quickly and significantly. In the UK, heating accounts for nearly half of all energy usage (DECC, 2011) and has thus become a national priority for carbon reduction, but easy strategies for achieving this have proved elusive (BEIS, 2018). Electrically-powered heat pumps “hoovering up” low temperature heat (e.g. in the range 0 – 15°C) from the ground beneath our feet, or from air, sea or rivers, are arguably the most promising technology, and two decades of GSH implementation across the UK have seen some remarkable successes and rapid accumulation of experience. Nevertheless, there remain significant flaws in the procurement, implementation and especially the management, monitoring and aftercare of such systems.

Decarbonising the electricity grid

In recent years, well-performing heat pump systems have become significantly more carbon efficient than mains gas boilers; a trend likely to continue as the electricity grid becomes progressively decarbonised (Figure 1). Such heat pumps use modest amounts of electricity to transfer environmental heat – from, for example, the ground - to a building, rather than simply converting electrical energy to heat energy, as conventional electrical resistance heaters do. Moreover, heat pumps can run in the opposite ‘direction’; providing air conditioning by transferring surplus summer heat from a building to the ground, where it can be stored until winter, given the right geological conditions.

Geologists, and especially hydrogeologists, have much to contribute to this field of low temperature GSH, or thermogeology. However, geology alone is not enough - we need to be able to communicate meaningfully with buildings services and heating, ventilation and air

conditioning (HVAC) engineers to deliver effective heating and cooling systems. We need to get to grips with the science and engineering of designing both:

- **closed loop** borehole systems, where a heat transfer fluid is circulated around an array of underground heat exchangers, extracting and carrying a cargo of heat back to a heat pump (Figure 2). While such systems benefit from favourable geological conditions (easily drillable rock with high thermal conductivity, such as sandstones or granite), they can be constructed and function well in a very wide range of geological conditions, including unconsolidated deposits, such as clays and silts. British closed loop boreholes are typically 50-150 m deep, but can be deeper or shallower.
- **and, open loop well doublets**, where natural groundwater is pumped from an abstraction well, through a heat exchanger or heat pump, back to the aquifer via a re-injection well (Figure 2). These systems rely on favourable geology: the presence of a good aquifer, relatively shallow groundwater levels (to avoid excessive pumping costs) and a suitable groundwater quality. The wells’ depths depend on the depth of the aquifer – they can be anything from 10 to several hundred metres deep, but in the UK are often 50 - 150 m.

Neither of these systems suffers from any fundamental theoretical flaw. Experiences from nations where GSH practice is several decades more advanced than the UK (e.g. Sweden) testify to the fact that subsurface heat exchange can work very well. Indeed, the Swedes (arguably because they have never enjoyed cheap, plentiful fossil fuels) tend to think about thermal fluxes and environmental sources, stores and sinks of heat in a way that does not come naturally to most British engineers.

However, in the UK, both system types are vulnerable to poor practice at the procurement, construction and management stages. ►

► Closed loop systems

In 2010, GSH practitioners were rudely awakened by an Energy Saving Trust report (Roy, et al., 2010) suggesting that a significant number of closed loop systems were underperforming and not delivering the cost and carbon savings that were promised. Several factors were at play, some of which were improved by minor

interventions (Energy Saving Trust, 2013). Among these factors were excessive heating delivery temperatures, user behaviour and poor hydraulic design.

In other cases, it seems that subsurface heat exchangers may have been under-designed (Dunbabin & Wickins, 2012). A closed loop geothermal system needs a certain amount of buried downhole heat

exchanger to extract a certain quantity of heat. If insufficient heat exchange pipe is present, the system *may* still work, but will run less efficiently. This, together with the fact that customers do not fully understand the complex interplay of hydraulic and thermal processes involved, yet still adopt a competitive tendering process, is an invitation to cut corners on design. Would you, as a client, purchase a 30-borehole scheme which will ‘work’ rather than a 36-borehole scheme that has a 20% greater capital cost but which will be more efficient?

An important distinction between closed and open loop systems is that closed loop systems require considerably more subsurface installation to achieve the same heat yield. For example, a notional 100 kW_{th} closed loop system may require several thousand metres of subsurface heat exchanger and a pipe network with several hundred joints, each representing a possible point of failure. We’re aware of a small number of large commercial closed loop systems with issues of leakage of thermal transfer fluid, resulting in poor performance, increased cost and potential environmental liability. It remains to be seen whether these are isolated incidents or symptomatic of a wider problem, resulting from poor practice at the procurement, construction and management stages.

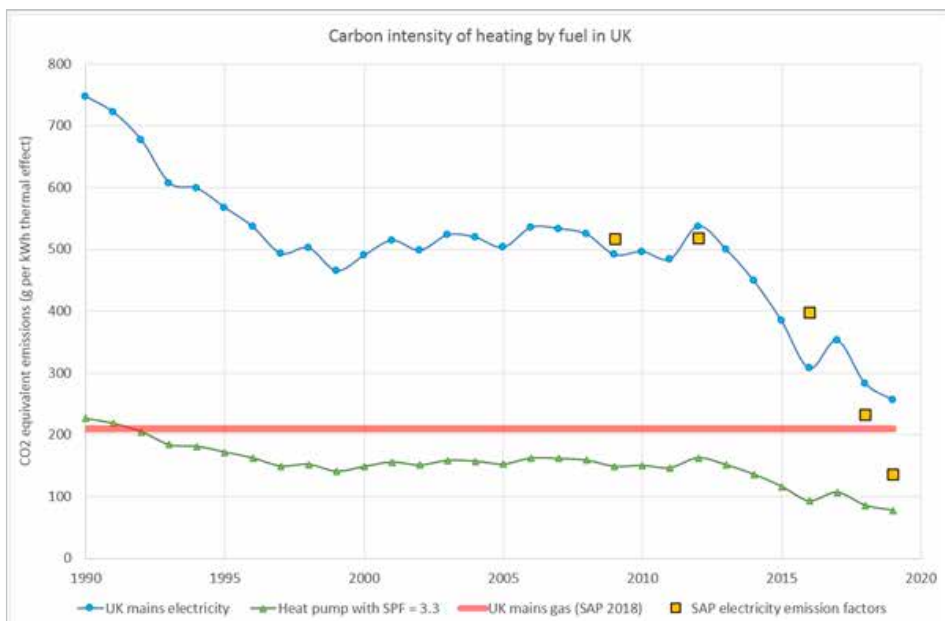


Fig 1: A plot of the carbon intensity of UK electricity, compared with mains gas, for heating, based on government statistics. The lowermost curve shows the carbon intensity of heat delivered by an electrically powered heat pump with a seasonal performance factor (SPF) of 3.3; these are now considerably more carbon efficient than mains gas boilers. SAP = Standard Assessment Protocol (BRE, 2019).

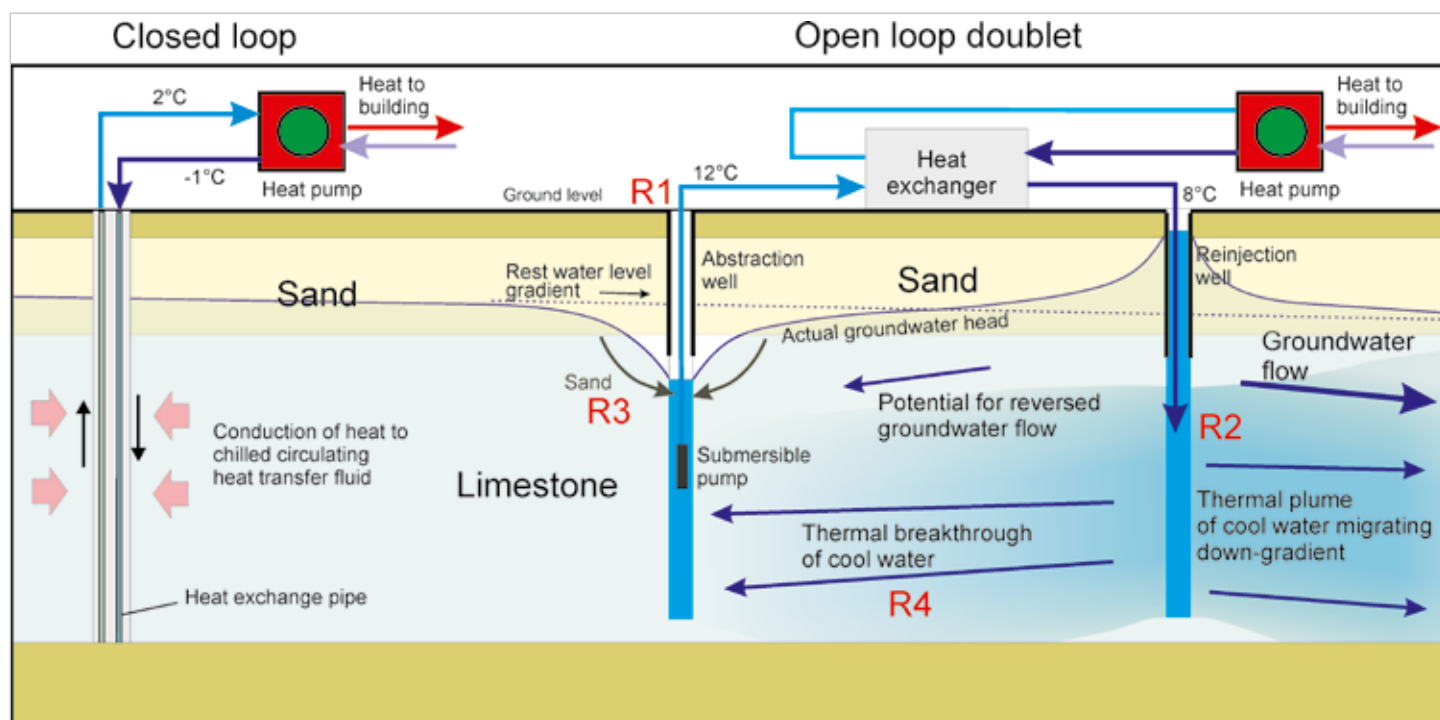


Fig 2: Indicative diagram of a closed-loop borehole system (left) and a groundwater-based open-loop well-doublet heat pump system (right). R1-R4 illustrate the locations of the key risks discussed in the article. © David Banks.



Fig 3: Two components of an open loop ground source heat system: (left) a water well - in this case installed with a submersible pump and reinjection main capable of abstracting/recharging up to 20 L/s (photo © David Birks) and (right) two plate heat exchangers (photo © David Banks).

It is encouraging that British GSH installers have taken steps to self-regulate. The Ground Source Heat Pump Association has now developed standards for closed loop systems (GSHPA, 2011), including recommendations for quality of joints and pressure testing. The Microgeneration Certification Scheme has published sets of tables outlining the expected lengths of borehole heat exchanger required for given heat loads (MCS, 2011). While not universally applicable, such standards do at least provide a level playing field for reputable contractors and provide the customer with some form of transparent means to verify designs.

Open loop systems

Because closed loop systems typically require a lot of drilling (100 kW_{th} of heat extraction may require at least 25 boreholes to 100 m depth), the open loop doublet option has become increasingly popular. Rather than relying on thermal conduction for heat transfer in the ground, an open loop system actively pumps groundwater from the ground, along with its convected cargo of heat. A simple open loop system comprises an abstraction well and pump, from where the groundwater is conveyed to a heat exchanger (Figure 3). At the heat exchanger, heat is either removed (with the aid of a heat pump) or rejected to the water flow. The

groundwater is then typically returned to the aquifer via a reinjection well, meaning that it is conserved for higher-value uses, such as potable water supply. The removal of, say, 4°C of heat from a pumped groundwater flow of 6 L/s is equivalent to extraction of

$6 \text{ L/s} \times 4 \text{ }^\circ\text{C} \times 4.19 \text{ kJ/}^\circ\text{C/L} = 101 \text{ kJ/s}$ or 101 kW_{th} of heat (a kW_{th} is a kilowatt, or kilojoule per second, of thermal energy. A small house may require around 6 kW_{th} heating in winter.)

Thus, an open loop system based on two wells, shifting 6 L/s of groundwater, can supply as much heat as 25 closed loop boreholes. It's not surprising that such open-loop systems have become increasingly popular, especially in cities underlain by productive aquifers, such as London. But there are risks involved and these need to be managed.

David Birks and his colleagues (Birks, et al., 2015) identified four principal geoscience performance indicators (or risk factors) to be documented on handover of this type of system, forming a baseline against which later performance can be monitored:

- Risk R1: Decline in borehole productivity.
- Risk R2: Decline in borehole injectivity.
- Risk R3: Pumping of particulates from aquifer.

- Risk R4: Progressive change in abstracted groundwater temperature.

The wells comprising an open loop doublet need to be properly constructed water wells; and it is not invariably the case that the HVAC and ground source heat engineers (or the drillers they employ) have sufficient experience of the local aquifers to construct durable, efficient wells.

Over our careers, we have watched some open loop systems succeed and continue to satisfy clients' heating needs. But we have also seen many fail - and have reluctantly come to the conclusion that groundwater-based open-loop ground source systems are *not* low maintenance heating and cooling solutions. On the contrary, they require the operator to take an active interest in monitoring the performance of the wells, heat pump and heat exchanger and the hydrochemistry of the water. And very few clients (quite reasonably enough) are prepared to do this. They, ultimately, simply want a functioning heating or cooling system that switches on and off in response to demand and which requires minimal maintenance.

As any experienced hydrogeologist or groundwater engineer knows, wells require monitoring and maintenance, and often regular programs of rehabilitation. Water wells suffer from corrosion, pump degradation and failure, chemical clogging, sediment mobilisation and ▶

► biofouling (Houben & Treskatis, 2007), which may result in long term decline in performance or yield (Risk R1). Almost all of the big water utility companies now recognise this and have implemented rolling programs of monitoring, responsive maintenance and rehabilitation. And what applies to abstraction wells applies also to reinjection wells, but probably doubly or triply so. At least with an abstraction well, the flow of water from formation to well may have some tendency to remove clogging materials. In a reinjection well,

the water, with its load of particulate matter, chemical flocs, gas microbubbles and microbes, is being forced into the well screen, gravel pack (if any) and aquifer. Small wonder that it is accepted lore that reinjection wells typically perform less well than abstraction wells, will likely require routine maintenance and rehabilitation and may have a finite life (Risk R2). A recent academic study (Birks, 2019) undertook a multi-year monitoring of the performance of two groundwater-based heating/cooling systems in Central London, the results of

which are presented in Figures 4 and 5, showing that regular observation can reveal declining well performance.

Design and monitoring

The potential for clogging and declining performance of reinjection wells can be enormous. Some particulate aquifers (sand and sandstones) anecdotally seem more prone to it than fissured limestone aquifers such as the Cretaceous Chalk of south-east England. Clogging can result from:

- particles (turbidity) in the water being reinjected into an aquifer.
- rearrangement of fine particles in the aquifer itself or gravel pack.
- precipitation of minerals on and in the well's walls. Iron and manganese oxyhydroxides, formed when dissolved Fe⁺⁺ and Mn⁺⁺ ions are exposed to oxygen, are particularly troublesome.
- growth of bacterial biofilms on and in well walls. Iron bacteria such as *Gallionella* are notorious.
- small bubbles of dissolved gas, exsolving from water due to pressure release or under-pressure in a reinjection well system, being forced into an aquifer matrix and lodging there

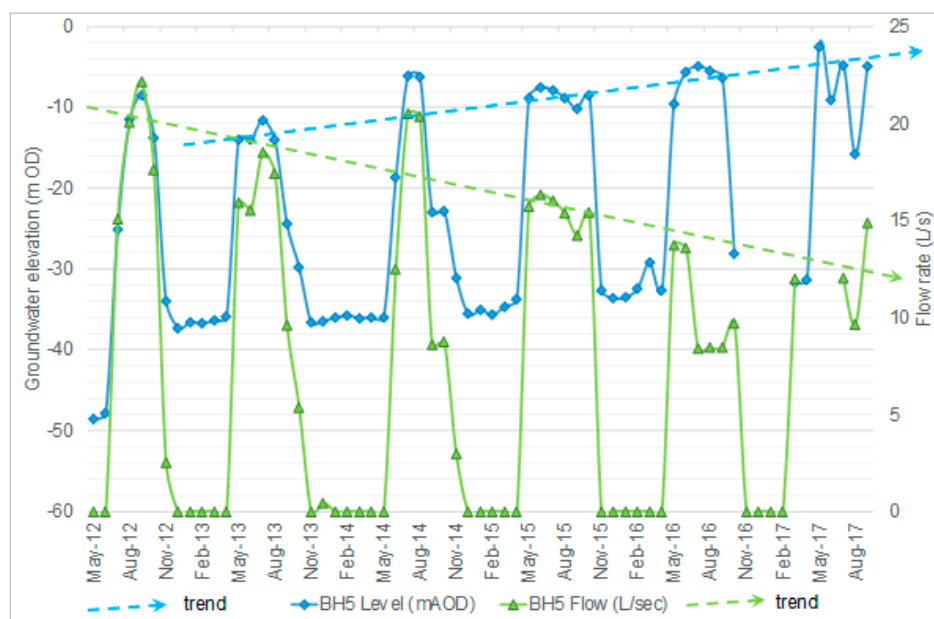


Fig 4: Monitoring of groundwater level and reinjection rate in a reinjection well in a Central London open-loop scheme. Flows (green) show a declining trend, while water levels (blue) rise, suggestive of progressive clogging.

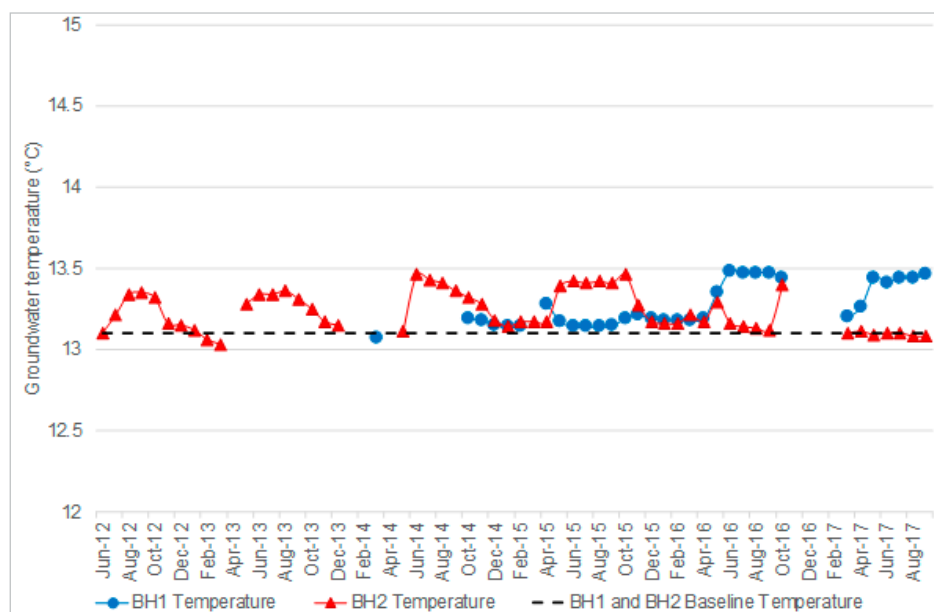


Fig 5: Monitoring of groundwater temperatures in two abstraction wells in an open loop system in Central London, over a six-year period, where the cumulative net heat input to the ground was approximately 1,800,000 kWh. The data show small annual cycles in temperature (rises following reinjection of waste summer heat), but little sign of any long-term trend.

Several text books (Bloetscher, et al., 2005; Pyne, 1994; Misstear, et al., 2017) are available to provide advice on these issues. But good design is only part of the story. Well doublet systems need regular monitoring of water levels, temperatures and flows. And collected data must not just sit in a logger or a hard drive. It needs to be regularly analysed by an experienced hydrogeologist to spot signs of deteriorating performance. If these signs are spotted, prompt action may be required – for example, iron oxyhydroxide slimes tend to harden over time if left untreated, evolving into progressively harder and more crystalline forms: goethite and ultimately something resembling haematite. Some conditions can be controlled by routine maintenance: regular back-pumping of reinjection boreholes to remove particulate matter from well walls; routine disinfection of wells to control bacterial growth; even dosing with reducing agents has been suggested to minimise iron and manganese deposits. Occasionally, more decisive intervention may be required:

acid / disinfectant treatments or high-pressure jetting.

Poorly designed water wells may tend to pump sediment particles along with groundwater (Risk R3). As well as fouling heat exchangers and injection wells, sediment pumping can cause ground movement. 6 L/s of water, with 2 mg/L sediment, equates to the removal of almost 0.4 tonnes of geology per year!

A finite capacity

We should remember also that the ground is not some 'infinite black hole' in its thermal behaviour. It has a very large, but ultimately finite, capacity to yield or store heat. While small GSH systems can usually rely on sustainable extraction of heating or cooling, large scale schemes need much more careful consideration of the subsurface thermal heat balance. For example, an open loop doublet where the wells are too closely spaced may suffer from 'thermal feedback' and a tendency for the temperature of the abstracted water to change (Risk R4). If a lot of open loop systems are constructed within a small area, all extracting heat from (or, more likely, rejecting heat to) groundwater, the temperature of the aquifer may change. There are already signs that this may be happening in Central London, with some observed warming trends (Figure 6). Happily, the Environment Agency is

monitoring the situation, although their powers to regulate it are somewhat hindered by heat/the absence of heat not being conventional contaminants that the law has evolved to regulate. It is problematic to construe heat as a polluting 'substance'.

In large-scale GSH systems (open- or closed-loop, and especially those constructed within a small property footprint) it is desirable to attempt to balance heating and cooling (heat rejection) fluxes over an annual cycle, thus using the ground more as a thermal 'store' or 'battery' than as merely a heat source or sink.

A gap in the market?

The Chartered Institution of Building Services Engineers (CIBSE) has recently published a readable and highly informative guide to open loop groundwater-based heat pumps (CIBSE, 2019). Even in this publication, we feel that the risks associated with groundwater wells, and reinjection wells in particular, are not given the emphasis they deserve. Such risks are often manageable by professional water utilities companies, who routinely monitor supply boreholes for efficiency and signs of deterioration. Such risks are not manageable by a typical heating and cooling customer (a school, large office,

community building or block of apartments), who simply want 'heating or cooling at the flick of a switch' and who have neither the experience of groundwater engineering nor the interest to run a water well doublet. We should not expect such clients to be aware of risks associated with well clogging or thermal feedback, still less to implement remedial interventions.

Clients have commented to us that it has been difficult to find a one-stop shop – a responsible contractor who can undertake to monitor, interrogate and maintain such groundwater-based heating systems. This is surely an obvious gap in the market, which should be filled by qualified groundwater engineers, supported by hydrochemists and hydrogeologists. Any handover procedure for a groundwater-sourced heat pump scheme should include the establishment of a contract for the aftercare of a completed groundwater heating/cooling well doublet, aligned to both performance and durability.

An elephant in the room

The drive to decarbonise the UK's energy supply finally appears to have gained traction amongst the public, politicians and industry. However, public consciousness often focuses on decarbonising electricity and transport, while the decarbonisation of heat remains an 'elephant in the room'. Environmental heat pumps in general, and ground source heat exchange in particular, will undoubtedly have a role to play in the heat revolution. If they are to succeed, geologists need to focus less on the ground as simply a source of heat and more on efficiently communicating with engineers to enable the subsurface to form a component of district-wide heating and cooling systems, incorporating sinks, sources and stores of heat. Practitioners need to step up their customer aftercare when it comes to monitoring and maintenance of existing GSH systems. ♦

David Banks, Holymoore Consultancy Ltd., Chesterfield, UK, also Senior Research Fellow at Glasgow University. David Birks, WSP Ltd., Bristol, UK.

REFERENCES

The full list of references for this article can be found online

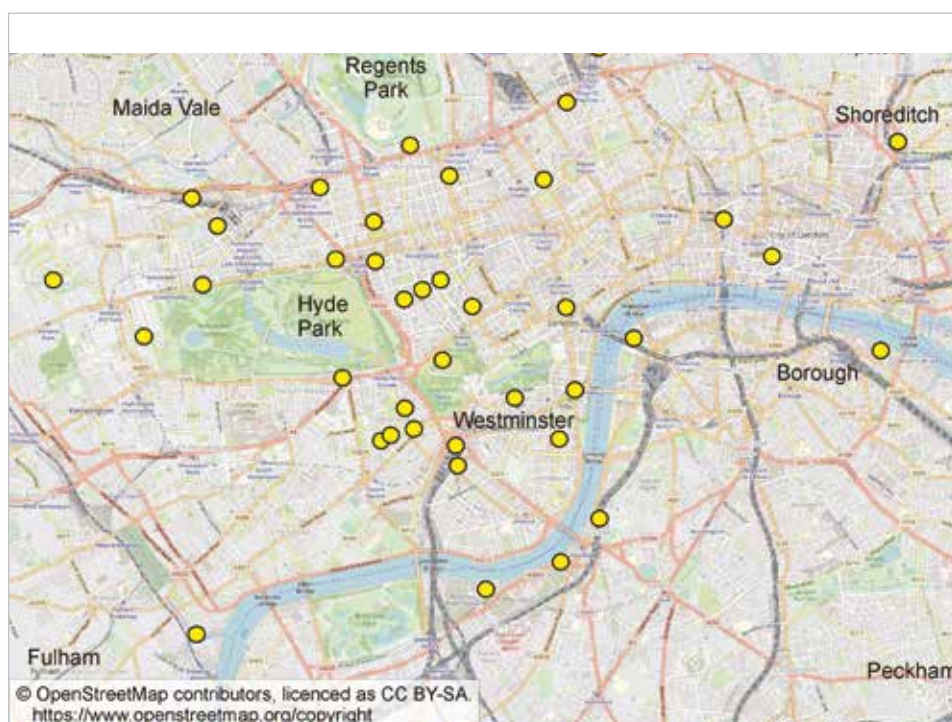
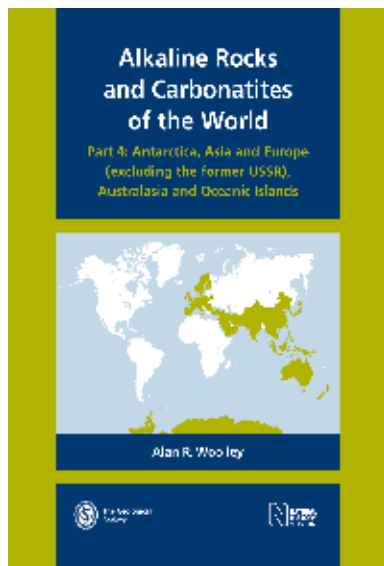


Fig 6: Locations of open loop ground-source heating / cooling systems in London as of 2018. Based on data provided in (Environment Agency, 2018).

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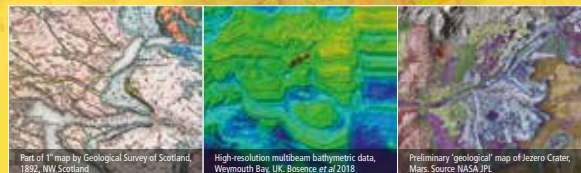


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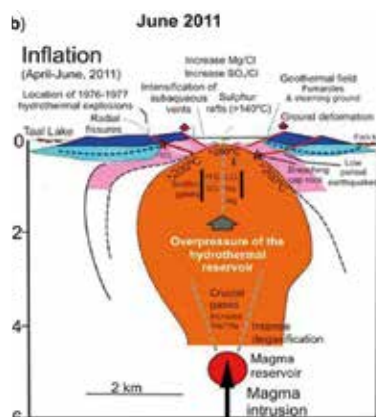


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The acid crater lake of Taal Volcano, Philippines: hydrogeochemical and hydroacoustic data related to the 2010–11 volcanic unrest

By Pedro A. Hernández, Gladys V. Melián, Luis Somoza, M^a Carmencita Arpa, Nemesio M. Pérez, Ericson Bariso, Hirochicka Sumino, Eleazar Padrón, Johan C. Varekamp, José Albert-Beltran and Renato Solidum

Studies of the water chemistry of Taal crater lake and echo-sounding surveys have provided new insights into its chemical and physical dynamics. During the volcano-seismic unrest of April 2010–June 2011, the waters of Taal crater lake showed changes in chemical composition and increases in CO₂ emissions associated with the seismic unrest. The chemical and isotopic data show that the lake water has contributions from both seawater and meteoric water and receives injections of deep hydrothermal water and gases during periods of intense volcano-seismic unrest. These inflationary periods may lead to faulting of the impermeable cap rock that usually seals the deeper Taal hydrothermal reservoir in response to degassing and convective movements in the underlying Taal magma chamber...

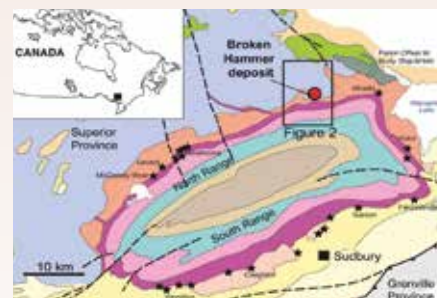


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Indicator mineral and till geochemical signatures of the Broken Hammer Cu–Ni–PGE–Au deposit, North Range, Sudbury Structure, Ontario, Canada

By M. B. McClenaghan, D. E. Ames and L. J. Cabri

The Broken Hammer Cu–Ni–PGE–Au footwall deposit in the North Range of the Sudbury Structure in Canada consists of a shallow surface zone of vein-hosted and vein stockwork-hosted mineralization within Sudbury breccia developed in the quartz monzonite Levack Gneiss Complex. The surface of the deposit consists of a 2–120 cm wide chalcopyrite vein and numerous smaller veins dominated by...



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Geological Society Discussion Group: February Meeting	5 Feb	Evening meeting Venue: TBC
Engineering Group & British Geotechnical Association: The many faces of Q	5 Feb	Evening lecture Venue: Institution of Civil Engineers, Westminster
Geology of England	7-9 Feb	Endorsed CPD course Venue: Higham Hall College, Cumbria
WMRG: Provenance, the search for a source – using microfossils to track the origins of various items, from paintings to murderers	11 Feb	Evening lecture Venue: St Martin in the Bull Ring, Birmingham
SWRG: School geoscience workshop and School Competitions 2020	12 Feb	Competition, workshop Venue: University of Plymouth
The Royal Society: Understanding earthquakes using the geological record	17-18 Feb	Conference Venue: The Royal Society, London
TVRG: Source-to-sink – a holistic Earth system approach for understanding sedimentary systems and aiding natural resource exploration	19 Feb	Evening lecture Venue: Halliburton, Milton, Abingdon
Geology of England	24-28 Feb	Endorsed CPD course Venue: The Green Park Hotel, Perthshire



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BOOK REVIEWS

Paleozoic-Mesozoic Geology of South Island, New Zealand: Subduction-Related Processes Adjacent to SE Gondwana



New Zealand is a very small part (about 6%) of a mostly-submerged continent, Zealandia. The emphasis of this volume is on the Paleozoic-Mesozoic subduction that

occurred along the active SE Gondwana margin (SE Australia and possibly eastern Antarctica), leading to Zealandia's rifting and separation from Gondwana in the mid-Cretaceous.

The concept of tectono-stratigraphic terranes is central to this study, and in South Island the terranes fall into two groups: those forming the Western Province (essentially intact Gondwana crust), and the somewhat larger Eastern Province (allochthonous units). By repositioning the terranes prior to the c.460 km Cenozoic dextral shift on the Alpine Fault, the Eastern Province terranes around Nelson at the north end of the island become contiguous with those of the Otago and Southland area at the other end. Recognizing this displacement was an important prerequisite to understanding how the terranes fitted into the picture of subduction along the Gondwana active margin.

The mountainous backbones of both the South and North islands are colloquially called 'greywacke ranges' (and the term greywacke has even been adopted as a brand of Marlborough white wine); this volume tells us that those mountains comprise rocks of the Torlesse Composite Terrane that formed as an accretionary wedge above the subducting Panthalassa oceanic slab. Most readers will have heard of the olivine-rich rock dunite; it takes its name from the Dun Mountain ophiolite, which we learn is a slice of Panthalassa Ocean crust that forms part of the Dun Mountain-Maitai Terrane, pushed on to the Gondwana margin in the Permian.

The general reader will wish to read Chapters 1, 2, 3 and 15, which give an excellent overview of the island's origins,

while Chapters 4 to 14 provide more detailed evidence for where terranes of the Eastern Province, in particular, may have related to the active Gondwana margin. The book is well-written and lavishly illustrated, with contributions from an international team of experts. Many of the figures are in colour, but one small quibble is that the use of colour alone to distinguish units on a geological map can lead to difficulty for the reader; Figure 1.6 will be referred to repeatedly by readers, and yet it has no fewer than four shades of pink. The addition of symbols would have helped. Nevertheless, I wish I'd had this book when I led a group of GA members around New Zealand a few years ago.

Reviewed by **Michael F Ridd**

PALEOZOIC-MESOZOIC GEOLOGY OF SOUTH ISLAND, NEW ZEALAND: SUBDUCTION-RELATED PROCESSES ADJACENT TO SE GONDWANA

by Alastair H. F. Robertson (Ed) 2019, Geological Society of London Memoir 49, 378 pp. (hbk.)
List Price: £140.00 Fellow's price: £ 70.00
W: <https://www.geolsoc.org.uk/M0049>

The Nile and Ancient Egypt: Changing Land- and Waterscapes, from the Neolithic to the Roman Era



The story of the Nile and its influence on the people of Ancient Egypt is an intriguing one.

This book is a chronological narrative, divided by geographic region, bringing

together evidence of environmental change and historical events that occurred throughout Ancient Egypt.

The text successfully portrays how archaeological evidence provides just one aspect for the description of how people lived their lives. Often, history took place in completely different environments to those we witness now. It is the environmental context drawn from geology that enables us to really understand the evidence used to construct our historical understanding of civilization. With that in mind, it was unfortunate to learn how early

Egyptologists (until the late 19th Century) disregarded geological context, preferring to focus purely on the interpretation of hieroglyphics, and missing out on context for recovered ancient texts.

The book outlines the people and environments of Ancient Egypt. In summary, a wetter landscape existed until the time period known as the Old Kingdom. What we now know as the Sahara Desert contained marshes, large lakes, and abundant plant and animal life. The text discusses some of the evidence for this, including rock art and stone tools in the Kharga Oasis, amongst other places. Due to environmental pressures, including desertification, communities began (around 3,100BC) to move into the Nile Valley.

The migration cumulates in the chapter on Egypt's capitals, a chapter that is particularly notable because it lays the ground for a climate crisis that led to the fall of the Old Kingdom. Long-term climate stresses pushed populations into the valley, resulting in the decentralization of political power, combined with an abrupt climate event—a massive influx of sand, postulated to have been laid down quickly into the valley—that instigated the collapse of the Old Kingdom. Later, Thebes rose in the south as the capital of the New Kingdom.

The book continues with the history of Nile Valley civilization, describing how during the New Kingdom the inhabitants learned a degree of control over the river. This control created some of the most elaborate river-management schemes in the ancient world. These schemes came into their own in the Roman Period and continued to be used through Coptic, Islamic and into Modern time.

This is an interesting read, recommended particularly for those looking for the geological context for Nile Valley civilizations and how the valley could be altered by future climate change.

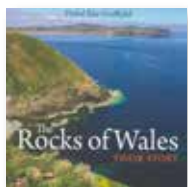
Reviewed by **Simon Kettle**

THE NILE AND ANCIENT EGYPT: CHANGING LAND- AND WATERSCAPES, FROM THE NEOLITHIC TO THE ROMAN ERA

by Judith Bunbury 2019.
Published by: Cambridge University Press, 182 pp. (hbk.)
ISBN: 9780511997884 List Price: £75.00 W: www.cambridge.org/doi/10.1017/9780511997884



The Rocks of Wales: Their Story



Wales, although small, is renowned for its diverse geology. It is one of the birthplaces of geological science, with fieldwork

commencing in the 1830s leading to the recognition of three early geological Periods—the Cambrian, Ordovician and Silurian. Elis-Gruffydd has in this delightfully illustrated, small book captured some of the excitement associated with Welsh geological discoveries. This is no ordinary field guide, but a book mingling geological history (the story told by the rocks) and historical geology (the stories of how geological discoveries are made). So, this is not a book to be carried in a backpack, but one to be dipped into before any fieldtrip, to add depth to one's appreciation of an area.

Dyfed has selected nine areas throughout Wales, covering geology ranging from Precambrian to Pleistocene. He has placed these areas in stratigraphic order (it would entail a lot of travelling to follow the book in order) and told something of the geology and a great deal of the historical geology of each. The result is a delight to read that contains stories rich with intrigue.

Naturally, writ large is the story of Sedgwick, Murchison and their acrimonious falling out over the overlapping Cambrian and Silurian Periods. So is Lapworth's solution to the problem—the erection of the Ordovician Period. But there are other stories too, such as much of Anglesey swinging between being Cambrian and Precambrian in age.

When, in 1849, Andrew Ramsay visited Anglesey with the Geological Survey of Great Britain's director, Sir Henry De la Biche, he thought some of the rocks to be of Precambrian age. This was not the Survey's view, so when Ramsay published his account of North Welsh geology in 1866, he toed the party line, writing that the Anglesey schists and gneisses were all of Cambrian age. Edward Greenly's 1919 account, however, stated the metamorphosed South Stack, New Harbour and Gwna Groups to be Precambrian. This was reversed yet again when work on zircons in the South Stack Group plonked it

firmly back in the Cambrian.

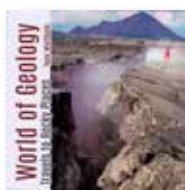
Such rollercoaster stories abound in this book, as do details such as Ramsay marrying Louisa Williams, whose father, the Reverend James Williams, was the great-grandfather of the famous Welsh artist, Sir Kyffin Williams. Dyfed also tells of Gerallt Gymro recording the submerged forests that line the Welsh coastline in 1188.

If you are heading to Wales, I recommend this book. If not, buy it anyway. It is a wonderful read.

Reviewed by **Brent Wilson**

THE ROCKS OF WALES: THEIR STORY by Dyfed Elis-Gruffydd 2019. Published by Garreg Gwalch, Llanrwst, Wales. 160 pp. (pbk.) ISBN-978-1-84524-295-4 List Price: £8.00. W (e-mail): books@carreg-gwalch.cymru

World of Geology: Travels to Rocky Places



A picture is worth a thousand words, as they say, and Tony Waltham's stunning photographs of geological phenomena and

landscapes, a regular and much loved feature on the back cover of the magazine *Geology Today*, certainly prove that point.

World of Geology: Travels to Rocky Places showcases 110 of Waltham's wonderful photographs, each with an informative accompanying text shown on the facing page. The book also includes an introduction that provides a clear and succinct description of the relationship between geology and landscapes and how geological processes relate to plate tectonics – complete with a very useful and informative colour diagram. In addition, there is a half-page generalised location map that gives a rough idea of where each photo was taken. The map also reveals that Waltham must be one of the most widely travelled geologists in the world. The only continent that appears to be unrepresented is Antarctica!

The photographs themselves are beautiful as works of art, and the addition of the accompanying texts turns them into informative introductions to a very wide range of geological sites and processes. Many of the photographs reflect Waltham's background in mining and engineering

geology and his interest in cave exploration, illustrating recent geological phenomena and showcasing real geology in action. Shots of classic geological sites around the world are also included, along with plenty of amazing pictures of active volcanoes, landslides and erosion.

Though the layout could have been improved, and the book unfortunately lacks an index, I can't imagine you'll find a more attractive and informative book of fantastic geological and landscape photos anywhere and at any price. It's both a real feast for the eyes, and food for the geological mind.

Reviewed by **Nina Morgan**

WORLD OF GEOLOGY: TRAVELS TO ROCKY PLACES by Tony Waltham, Published by Whittles Publishing, 219pp, paperback. ISBN 978-1-84995-437 List Price: £18.99 W: www.whittlespublishing.com/

BOOKS FOR REVIEW

Please contact sarah.day@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! Renewable Energy: A very short introduction**, by Nick Jelley, Oxford University Press 2020, 168pp, pbk.
- ◆ **NEW! At the crossroads of time: How a small Scottish village changed history**, by Andrew C. Scott, Amberley Publishing 2020, 256pp, hbk.
- ◆ **Fifty Years of the Wilson Cycle Concept in Plate Tectonics**, by R. W. Wilson et al (eds), Geological Society of London SP 470, 490 pp, hbk.
- ◆ **Crustal Architecture and Evolution of the Himalaya-Karakoram-Tibet Orogen**, by I. M. Villa & S. Kumar (eds), Geological Society of London SP481 2019, 377 pp, hbk.
- ◆ **Maps and Territories: Global Positioning in the Contemporary French Novel**, by Joshua Armstrong, Liverpool University Press 2019, 238 pp, hbk.
- ◆ **Paleozoic Plays of NW Europe**, by A.A. Monaghan et al. (eds), Geological Society of London SP 471 2019, 398 pp, hbk.
- ◆ **Development of Volcanic Gas Reservoirs: The Theory, Key Technologies and Practice of Hydrocarbon Development**, by Qiquan Ran, Dong Ren & Yongjun Wang, Elsevier (Petroleum Industry Press, Gulf Professional Publishing) 2019, 1066 pp, pbk.
- ◆ **Plant Flow Measurement and Control Handbook: Fluid, Solid, Slurry and Multiphase Flow**, by Swapan Basu, Elsevier Academic Press 2018, 1288 pp, hbk.

CODE OF CONDUCT

Dear Editor, A new flurry of climate change correspondence has been inspired by Hugh Richards' recent soapbox article (*Geoscientist* 29 (11), December 2019) - a periodic recurrence which confirms differing views among fellows on this major subject. With near universal agreement on the principal facts: CO₂ is a greenhouse gas, human emissions contribute to global warming, and we need to be cautious about the consequences - the differences (here and in wider scientific community) are principally on the scale and rate of impacts, how to mitigate and how quickly.

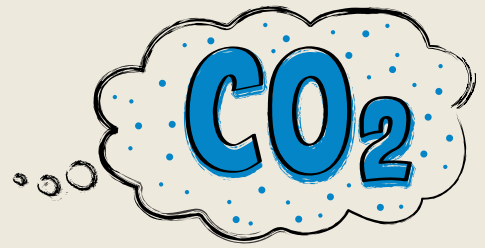
Given the confrontational and accusatory tone of some of the correspondence, I appeal for a more grown-up approach to discussions while respecting our Code of Conduct, including the following expectations (paraphrased for brevity):

- to practice the highest standard of integrity
- to act in all matters to all others in an honourable and ethical way
- to treat colleagues fairly and honestly and to not injure or discredit the professional reputation or personal standing of any others.

CODE OF CONDUCT – REPLY

Geoscientist is the independent magazine of the Fellowship of the Society and tries to reflect the views of Fellows. It is not an organ of the Society but does, on some occasions, work with Council and the Society executive to inform and update Fellows about the Society's views and activities.

Geoscientist's ability to reflect the views of Fellows is, of course, dependent on the letters, Soapbox pieces and articles it is offered by Fellows (and others). The balance of views received may or may not reflect the overall balance of views held by the Fellowship. Editorially, we will not influence the balance but will try to ensure that views published in *Geoscientist* express new points rather than repeat ones made previously.



Some correspondence and articles breach the Code through name-calling, motive questioning and conspiracy theories. I feel *Geoscientist* fails in its editorial responsibility by publishing such breaches in place of reminding the writer of the Code.

Commentators should also recognise their own responsibility, as scientists, to distinguish between science and personal opinion – whether their own or that of others (though most scientific conclusions involve an element of opinion – we are all human!)

If we cannot maintain respectful discussion between an educated and professional membership on the leading scientific, environmental, social and political subject of our time, we fail in our claim to be a world-leading scientific society and community.

PETER EASTON (FGS)

World climate, debates about the future of the planet and the responsive changes humanity should or should not make, and at what pace, have inevitably sparked different views from Fellows. The debates will continue. Peter Easton's letter is a timely reminder that the views contributed to these debates should be respectful to others, conscious of the Society's Code of Conduct, and clear about what is supportable science and what is opinion. *Geoscientist* will seek to contribute innovative and constructive ideas and points of view to the discussions in this spirit.

ANDY FLEET FGS (EDITOR IN CHIEF, GEOSCIENTIST)

THE CHALLENGE FOR GEOLOGISTS

Dear Editor, John Heathcote's letter in the February 2020 issue of *Geoscientist* ends with the provocative question "...is it ethical for geologists to be involved in exploration and production of fossil fuels?" One might equally ask is it ethical to deny global society access to energy and materials to create prosperity? A billion people on the planet lack access to electricity and the benefits this brings. Developing nations are trying to grow their economies to enjoy the societal benefits that developed nations already enjoy. Thus as global population continues to grow, so the demand for energy is predicted to grow. This demand will continue to in part be fulfilled by fossil

fuels for at least the next few decades. The challenge for geologists is to ensure that these resources are found and produced efficiently and with as low a carbon footprint as possible. *Geoscientists* will also contribute to solutions that may help achieve carbon neutrality targets. Carbon capture and sequestration (CCS) is entering prime time and will only grow in importance. Secure storage will require geoscientists who can model subsurface repositories, the behaviour of fluids injected into those repositories, and undertake ongoing monitoring of the subsurface.

Universities are seeing fewer students studying geology, especially applied geology, partly one may assume because they, like John Heathcote, are concerned about the ethics of doing so. Ironically, the energy transition we are living through requires geoscientists as much as ever. As a profession, we need to make sure that message is heard – we are integral to creating a prosperous, yet sustainable world.

MIKE SIMMONS (FGS)



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Registration Open

New learning from exploration and development in the UKCS Atlantic Margin

20-22 May 2020
Robert Gordon University, Aberdeen



Convenors:
Noah Jaffey
Shell
Jamie Collins
BP
Clayton Grove
Sicar Point Energy
Olga Shukert
Western Geoc
Christopher Bugg
Total
Douglas Watson
ExxonMobil

The UK Atlantic margin, including the West of Shetlands area, is the location of the UK's largest remaining hydrocarbon reserves, the largest recent field development investments and holds the greatest potential for future material discoveries in the UK.

In the 10 years since the last Geological Society conference on this region, great advances have been made in the understanding of its diverse plays, from fractured basement to Eocene coastal deposits, and everything in between.

This three day meeting gives a unique opportunity to learn about the geoscience of recent discoveries and field developments, as well as how technology is developing to meet the imaging and drilling challenges of the area. For a fully immersive experience, there is an opportunity to see the diverse range of reservoirs in outcrop on the Isle of Skye (15-17 May) and in core at the Iron Mountain facility at Dyce (19 May).

Conference themes:

- Paleocene deep water reservoirs
- Mesozoic pre-, syn-, and post-rift plays
- Paleozoic play (e.g. Carboniferous and Devonian at the Clair field)
- Non-clastic plays (e.g. fractured basement, volcanics, carbonates)
- Paleocene-Eocene volcanic-associated reservoirs
- Extra-UK Atlantic Margin
- Multidisciplinary technology session (e.g. advances in drilling techniques, sub-sill imaging, EOR)
- Geodynamics, basin modelling, thermal and uplift/subsidence history, migration routes
- What's next? The next 10 years for exploration and development in the region.

Associated events:

- Three day field trip to the Isle of Skye run by Nick Archer (Nautilus RPS), examining the strata of the Hebridean Basins in a petroleum systems context, as analogues for the basins West of Shetland.
- Guided core viewing day at Iron Mountain (Dyce), as a pre-cursor to the conference on the UKCS Atlantic Margin we will spend a day looking at selected cores from throughout the stratigraphy of the West of Shetlands area.
- Social programme to include a conference dinner.

For further information please contact:
Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG.
Email: sarah.woodcock@geolsoc.org.uk
Website: <https://www.geolsoc.org.uk/pg-atlantic-margins-2020>

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www.geolsoc.org.uk/petroleum
#PGAtlanticMargins20

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Registration Open

Core Values: the Role of Core in 21st Century Reservoir Characterisation

26-28 May 2020
The Geological Society, Burlington House, Piccadilly, London

Convenors:
Adrian Neal
Badley Ashton - Chair
Lucy Williams
Rockhopper
Mike Ashton
Ashton Geology
Steve Dee
BP
Cliff Lovelock
Shell
Emma Jude
BP
Anton Padin
Total



Keynote Speakers:
Mike Bowman
Manchester University
Patricio Desjardins
Shell UCs, Houston
Hakko Fossen
Bergen University
Bruce Levell
Oxford University
Anna Matthews
BP
Nordine Sabaou
BHP, Houston
Kate Smout
Shell

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Core has traditionally played a key role in the characterisation of conventional and unconventional hydrocarbon reservoirs, from exploration to mature production. It is the only means by which to observe and make measurements on actual reservoir rock. However, the recent oil industry downturn has driven many to question the value of taking core, due to the associated increased costs and potential risks to well operations. In tandem, advances in other reservoir visualisation techniques, such as seismic and borehole imaging, have been used to give weight to the contention that coring is an increasingly redundant means of characterising reservoirs.

Through four main themes this 3-day conference will aim to redress the balance in this debate by exploring the role core can, or should, play in the 21st century exploration to production cycle:

- Is core critical to sound commercial decision making?
- What are the challenges and benefits of integrating core-derived understanding across the geological, petrophysical and engineering spectrum?
- Integration of traditional core characterisation methods with new core, well and reservoir visualisation and mapping technologies - is the sum greater than its parts?
- How can the extensive network of global legacy core collections best be utilised to maximise their business and research worth?

Dedicated sessions will allow delegates to view core that has been central to addressing many key reservoir issues, under the direct guidance of those responsible for meeting such challenges. Speakers are thus invited to bring core to illustrate their presentation, and indicate if this is of interest when submitting an abstract.

For further information or to register:
For more information, please contact Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG. Tel: +44 (0)20 7434 9944. sarah.woodcock@geolsoc.org.uk

At the forefront of petroleum geoscience
www.geolsoc.org.uk/petroleum
#PGCoreValues20

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Call for Abstracts – Deadline: 24 April 2020

Operations Geology in 2020 and Beyond: Traditional and modern approaches

4-5 November 2020
The Geological Society, Burlington House, Piccadilly, London



Convenors:
David Baldwin
Genel Energy
Mariël Reitsma
HRH Geology
Pramit Basu
Baker Hughes
Alex Edwards
Iron Science
Brian Hodgson
Shell
Rachael Horton
BP
Tim Stephen
Aker BP
Jenny Windress
Ithaca Energy

The key theme of the 5th Operations Geoscience conference is how the role of the Operations Geologist will evolve as the Oil & Gas industry embraces the digital transformation. **Operations Geologists will be at the heart of this transformation** by bringing together digitalisation and geological expertise to improve operational efficiency and promote success.

The organisers invite contributions within all aspects of Operations Geoscience with a preferred focus on emerging technologies and advances in the digital oilfield.

Suggested themes include:

- Machine learning and artificial intelligence applied to planning and drilling a well
- Digitalisation and "disrupting" current work flows – can digitalisation and data mining generate additional information that will change the role of the operations geoscientist?
- New analytical technologies and technological advances – case studies of e.g. LWD, wireline or modelling solutions as applied during operations
- PPF, Geomechanics & surface logging showcasing innovative approaches and surprising outcomes
- Managing risks and improving safety

Keynote speakers to be announced soon. A parallel poster session will take place in the library during the breaks.

An informal social event will be held at BrewDog Seven Dials on the evening of Wednesday 4th November 2020.

For further information and abstract submission please contact:
Abstract Guidelines available on the conference website www.geolsoc.org.uk/11-pg-ops-geology-2020
Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG.
Tel: +44 (0)20 7434 9944 or email: sarah.woodcock@geolsoc.org.uk

Event Sponsors:
Sponsorship opportunities available.

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14 May 2020

Plastics in the Environment

The Geological Society, Burlington House, London



Primary Convenors
Wes Fraser (Oxford Brookes University)
Gordon Inglis (University of Southampton)

Further information
For further information about the conference please contact:
Conference Office,
The Geological Society,
Burlington House, Piccadilly,
London W1J 0BG
T: 0207 434 9944
E: conference@geolsoc.org.uk
Web: www.geolsoc.org.uk/plastics2020
Follow this event on Twitter: #plastics2020

The accumulation of plastic debris in the environment is a global problem which may have detrimental impacts on ecosystem health. Plastics are now widely enough distributed that they may also act as an anthropogenic marker horizon in the future rock record. However, there are still many outstanding questions regarding the: 1) source, 2) transfer, 3) degradation, 4) persistence and 5) measurement of plastics in the environment.

This one-day meeting will bring together researchers from a diverse range of disciplines (e.g. hydrology, sedimentology, geochemistry, earth science, biology) to discuss the fate of plastics in terrestrial, freshwater and marine environments.

This meeting seeks to foster conversation between these different communities to facilitate a more holistic approach towards understanding plastic in the environment.

2020 YEAR OF LIFE

Debris-covered glaciers and related lakes: understanding the challenges

At a Geological Society meeting last year, scientists discussed the current state of research into debris covered glaciers and related hazards, and concerns related to the effects of climate change. Adina Racoviteanu, Lindsey Nicholson and Neil Glasser report

In many people's imagination, glaciers in high mountains evoke dramatic, white icy landscapes. Some may not think of glaciers being covered by a mixture of debris made up of sand, gravel and rock, but this is the case with the majority of the glaciers of high Asia: tens of kilometres long expanses of debris covered ice and exposed ice cliffs and lakes. These so-called 'debris-covered glaciers' are harder to understand because of limited access and rugged terrain. They are a cause for concern due to rapid development and expansion of lakes at the glacier front. Sometimes, a rock fall or ice avalanche into the lake may cause the lake to break the dam and burst, triggering catastrophic flood events called "Glacier Lake Outburst Floods" (GLOFs). Given the possibility of an increase in this type of hazard due to climate change, it's understandable that there is high concern among local communities. To address these concerns, we need better communication between scientists and local

communities, as well as accurate and up-to-date debris cover evolution and lake hazard assessments schemes.

These topics were the subject of a Geological Society meeting held in London from 2-4 September 2019, which brought together scientists in an informal, working group setting to discuss concerns about the climate impacts on debris-covered glaciers and related mountain hazards, and strategies for community engagement.

Mapping and monitoring of debris covered glaciers

In order to understand and monitor debris-covered glaciers and their associated hazards, it's important to be able to map them accurately. The debris-covered glaciers working group discussed in detail the features and properties of the debris cover, as well as the remote sensing and field tools available to monitor it. A particular challenge in mapping these glaciers is posed by their rapidly changing surface features such as ice cliffs and supraglacial lakes. This group agreed that, even with the current advances in remote sensing tools and availability of high-resolution imagery, mapping the extent of

debris cover on glaciers is not a straightforward task. New methods based on new satellite imagery and topographic data include analysing thermal data, radar interferometry, differencing of digital elevation models and shape detection. However, no single method can work by itself, and combining various methods often requires expert knowledge. As an outcome of these discussions, the working group has initiated an inter-comparison study of the different remote sensing methods and recommendations for best practice, in view of developing an automated, open-source tool in the future.

Deconstructing myths about GLOFs

A number of myths surround GLOFs, contributing to the uncertainty and concern amongst local communities. It's often thought that the majority of glacier lakes in high mountain areas are dangerous, or that the growth of a lake necessarily increases its degree of hazard. Alarmist news stories often associate the outburst floods with climate change, whereas in reality climate is only one of the contributing factors. The GLOF working group focused on how we can estimate glacial lake outburst potential via a two stage assessment – first using



remote sensing and topographic data at regional scale, followed by a site specific investigation requiring expert knowledge and higher resolution data at local scale. The aim of this working group is to develop a hazard assessment protocol as open-source tools that could be applied by non-specialists using freely accessible satellite imagery.

Challenges in capacity building and communication

If we are to improve understanding of debris-covered glaciers and their associated hazards among local communities, we need to establish and promote community-wide outreach. Capacity building initiatives targeting local academic and government institutions are currently supported by the new IGCP 672- UNESCO project 'Himalayan Glaciers and risks to local communities.' Launched in 2018, the project, led by A. Racoviteanu, focuses on developing methods for systematic monitoring of GLOF potential in the Himalaya using remote sensing, and disseminating them via training workshops for local institutions in India, Bhutan and Nepal. Smriti Basnett, Asian co-leader of the IGCP project, summarised the challenges of lack of funding and support from local government in past initiatives in

India, and underlined the need for involving local stakeholders (state governments) in securing funds. She also recognised some specific regional challenges in border areas such as the states of Sikkim and Ladakh. Specialised training in glaciology alone is not enough – we need interdisciplinary, broader systems training which is long term, rather than the limited programmes funded externally.

During the meeting, Scott Watson (University of Leeds) reported on the 'Walk the Talk' initiative, held in December 2018 in the Khumbu region of Nepal, which brought together residents and scientists to discuss research, and was part of a wider initiative to engage communities and tourists. Plans are now underway to develop online resources – the website www.rockyglaciers.org and associated twitter account [@rockyglaciers](https://twitter.com/rockyglaciers) are already established. The science communication working group developed a basic set of advice and recommendations for scientists for engaging communities, based on our experience in rural communities in

High Mountain Asia and in the Andes. Good research practices include setting up collaborations with local partners, spending time with the communities, establishing networks and promoting local outreach. Next steps include securing funding to expand initiatives such as Walk the Talk or the UNESCO project, in order to further engage with local researchers and local communities

The organising committee thanks all the speakers and participants for their efforts and acknowledges the Geological Society for their support in hosting the workshop.

Adina Racoviteanu, Aberystwyth University, UK

Lindsey Nicholson, Univ. of Innsbruck, Austria

Neil Glasser, Aberystwyth University, UK

DISTANT THUNDER

Geology from the Train

Geologist and science writer Nina Morgan celebrates the advantages of going 'on line'

In 1835, the geologist John Phillips – among many other things, the first keeper of the Yorkshire Museum, and later first Professor of Geology at Oxford University and first keeper of the Oxford University Museum of Natural History – wrote to his sister Anne with a vivid description of his first train journey. He was travelling on a 'flying Steed of Iron' from Manchester to Liverpool.

Phillips quickly became a convert to travel by train, even though, as he described in a letter to Anne sent from Manchester on 30 March, 1841, delays were not uncommon.

"I found the Train of yesternight very good travelling till we entered on the Leeds & Manchester line at Normanton. Then began this singular amusement: to lose time so as to arrive in 4 hours from Leeds, the time really required being 2 1/2 hours. We did this odd railway feat by stopping 5 minutes each at about 10 stations & using all possible precautions not to go too fast. This is said to be on account of the recent embankments not allowing of rapid transit..."

Sound familiar?

Best seller

Delays on the line notwithstanding, Phillips, a prolific and fluent writer, was also quick to see the potential offered by the new lines to introduce the wonders of geology, scenery and history to the travelling public at large.

Phillips's book, *Railway Excursions From York, Leeds and Hull*, first published in 1853, was a popular success. It went through several editions and was republished under various titles. It also inspired other geologists to jump onto the platform. As the railway network expanded throughout Britain, so did the number of authors keen to describe the geology of their part of the country from the windows of a train. The number of

geologists who recognised the geological potential of the new lines also grew.

For example, in 1878 the Geologists' Association organised an excursion by train to examine the geology exposed in the cuttings being dug between Chipping Norton and Hook Norton as part of the Banbury and Cheltenham District Railway. Participants were advised to take the train from Paddington to Chipping Norton, with luggage directed to The White Hart, Chipping Norton, a journey that sadly is no longer an option.

Many others followed in their tracks, risking an addiction to train spotting in the cause of science. In 1886 Sir Edward Poulton published an account of The Geology of the Great Western Railway journey from Oxford to Reading; in the same year Edward Maule Cole published his classic book, *Geology of the Hull and Barnsley Railway*, complete with a fold-out coloured geological map. In 1945 the Oxford geologist W.J. Arkell published his classic paper, *Geology and Prehistory from the train, Oxford to Paddington*. Arkell's methods of observation were paid tribute by Philip Powell, who added a final chapter to his 2005 book, *The Geology of Oxfordshire*, outlining the geology that can be seen when travelling on part of the Cotswold Line from Moreton in Marsh to Reading. Meanwhile, the geologist Eric Robinson, now retired from University College London, prepared numerous handouts for students and amateur geologists describing the geology that

can be seen from trains leaving from various London stations.

Along the way all of the 'railway geologists' painted vivid pictures both of the geology and the countryside as they saw it, and their descriptions provide a valuable insight into landscapes and railway lines now lost.

Life in the fast lane

"A railway tour is life in a hurry", Phillips proclaimed in his pioneering railway book. He clearly enjoyed the rush, and so did the many other geological authors and lovers of the countryside who followed in his tracks. Even today, with a railway geology book in hand, those delays along the line can turn into a real pleasure – depending on where you get held up, of course!

End notes: This vignette is an abbreviated version of a presentation I gave at the joint conference of the Yorkshire Geological Society, University of Hull and the Hull Geological Society in March 2019 at Hull University. Thanks to Patrick Boylan and Eric Robinson for lending many of the references mentioned, and to the Director and archivist and librarian at the Oxford University Museum of Natural History for permission to quote from a letter in the John Phillips archive.

* **Nina Morgan** is a geologist and science writer based near Oxford. Her latest book, *The Geology of Oxford Gravestones*, is available via www.gravestonegeology.uk





Understanding the Ground

Chris Milne (FGS CGeol), Technical Director at Terrafirma, on his role at the company and why Terrafirma became a Corporate Patron of the Geological Society

Q What are your key responsibilities at Terrafirma?

A Terrafirma takes geological hazard data and uses professional, geological and engineering understanding to provide advice on ground risk. My role is overseeing Terrafirma's technical advice on ground risk, including developing new approaches and maintaining professional standards. As part of this I am responsible for the training and development of our team of professional geologists.

Q How has the business evolved over the past few years?

A Our mission is to understand the ground. Terrafirma was initially very focused on mining risks, but we have progressively applied new data technology to all ground risks, including the effects of climate change. As a result, we have expanded rapidly bringing together a range of data scientists and professional geologists to expand our range of services and taken advantage of new data such as satellite monitoring. As a Chartered Civil Engineer, my background in ground engineering allows us to further focus on the impacts of ground hazards in assessing risks and new applications.

Q Why did Terrafirma decide to become Corporate Patron members of the Society?

A Terrafirma relies on its professional staff and so it is important that we support the body which maintains and develops professional standards in geology. We are committed to engaging with the wider community to encourage new thinking on ground risk; we see supporting the Society as part of this role. We would like to be part of the Society's digital transformation, maintaining it at the heart of geological life in the UK.

Q How else do you support the community?

A We are an open company who work with a wide range of partners based on collaboration and knowledge sharing. We have a programme of continual outreach in seminars and publications to inform our clients and we take advantage of the events the Society organises. We encourage the next generation of professionals by engaging with local schools and universities to provide industry experience for students.

Q What is the best piece of advice you have for young geoscientists seeking to progress their careers? Patron members of the Society?

A Get into the field – it may be cold, wet and muddy but you will learn more in a day than a week in the office. Knowing how geological data is collected and used makes a huge difference how you interpret it. In engineering geology, understanding how soils logging and testing is carried out in practice (rather than in theory) is essential; seeing ground engineering works being constructed tells you all you need to know about the importance of ground conditions. It is advice I follow myself – being on site keeps you grounded (no pun intended).



CAROUSEL

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



Jeremy Ingham

Jeremy Ingham has been appointed as a Technical Director at Diales, who provide Expert Witness services to the global engineering and construction industry. Based in their City of London office, he will be continuing his work as an expert witness specialising in construction materials technology.

W: <https://www.diales.com/>



John Rees

Professor John Rees has been appointed by the British Geological Survey to be its new Chief Scientist for Multi-Hazards and Resilience. Based at the Lyell Centre in Edinburgh, but working across all BGS sites, the role completes the BGS' new Science Strategy Group to deliver the objectives set out in its science strategy, *Gateway to the Earth*.

Geological Curators' Group Brighton Medal Award to Monica Price

The 2019 Brighton Medal of the Geological Curators' Group has been awarded to Monica Price, recently retired from the Oxford University Museum of Natural History after a lifetime career of curating mineral and rock collections.

Monica has been integral to professionalising the role of geological curators throughout

her career, which began in Leicestershire Museums. At Oxford, she steered the Museum through Designation and Accreditation, and has served as Acting Director and Head of Earth Collections. Her book, *Decorative Stones: The Complete Sourcebook*, was published in 2007 and remains an excellent resource for curators.



Monica Price being awarded the 2019 Brighton Medal of the Geological Curators' Group by outgoing Chair Matthew Parkes (Natural History Museum, Dublin)



The Society notes with sadness the passing of:

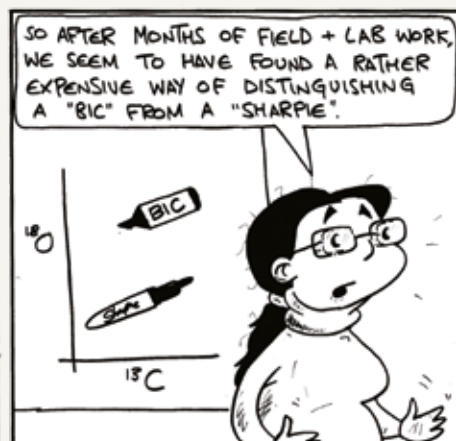
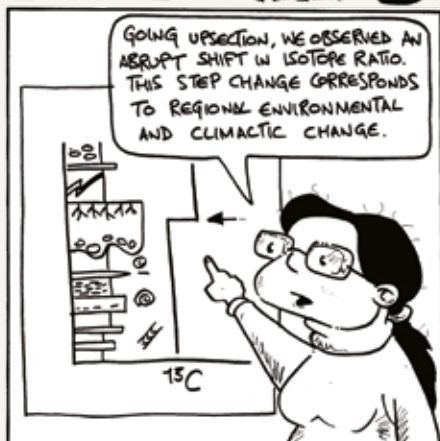
- Ashworth, Kevan*
- Bentley, Peter*
- Buist, David Stuart
- Chambers, Henry*
- Chew, Kenneth
- Donovan, Desmond***
- Glennie, Ken*
- Higginbottom, Ian
- Hunt, Albin Digby*
- Holland, Charles**
- James, Ella***
- King, Cuchlaine***
- Laughton, Anthony
- Parvizi, Fereydoun *
- Potter, John F
- Reading, Howard
- Snelling, Norman John***
- Urquhart, Elspeth
- Williamson, Iain

In the interests of recording its Fellows' work for posterity, the Society publishes obituaries online, and in *Geoscientist*. Bold, recent additions to the list; * Fellows for whom no obituarist has been commissioned; § biographical material lodged with the Society.

If you would like to contribute an obituary, please email sarah.day@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.

STICKS AND STONES



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News from the Hydrogeological Group



Professor Rick Brassington (L) being awarded the 2019 Whitaker Medal by the Hydrogeological Group Chair Rolf Farrell (R)



Professor Paul Younger

introducing a new medal dedicated to our late colleague Professor Paul Younger.

Paul, who died in 2018, was a great influence to many people in our professional community. The Hydrogroup felt that a new medal, recognising the good work that hydrogeologists undertake throughout their careers, would be a fitting way to remember him.

The Hydrogroup will be seeking nominations for the inaugural Paul Younger medal during the summer. The winner will be presented with the medal at the Ineson Meeting in Burlington House in November. It will be awarded for specific examples of outstanding contribution to hydrogeology. Full details of the award criteria are available at www.hydrogroup.org.uk/Paul-Younger-medal/.

The existing Whitaker medal will, from now on, be awarded in recognition of longstanding service to the community.

Whitaker Medal Award 2019

The Hydrogeological Group was pleased to be able to award the 2019 Whitaker medal to Professor Rick Brassington at the 2019 Ineson Meeting, held at Burlington House in November.

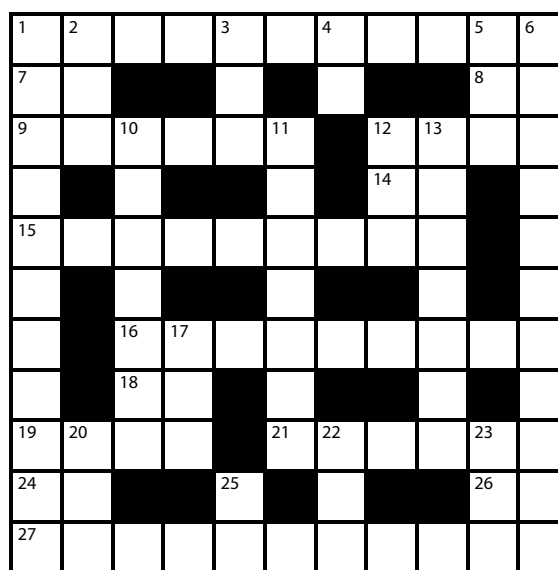
Rick is a highly popular winner who was recognised both for his long standing and wide-ranging contribution to hydrogeology, the Geological Society, and the geoscience community as a

whole and, more specifically, for his authorship of *Field Hydrogeology*, a default classic resource for over 30 years.

Younger Medal

The Hydrogeology Group of the Geological Society is pleased to announce that from 2020, in addition to the Whitaker medal that has been awarded for many years, we will be

Crossword



Across

- 1 The last 541 million years (11)
 7 See 8
 8/7 Middle of an apple (4)
 9 Glassy ornamental or protective coating (6)
 12/19 For example, hairdressers (8)
 14 Number estimated by the 11d series (2)
 15 Massif in northwest France (9)
 16 See 27
 18/4/25 Kiss heartily (6)
 19 See 12
 21 Fanatic (6)
 24 See 20 Down
 26 16.5mm model railway gauge (2)
 27/16 Jurassic deposit once mined around Corby (11,9)

By Bindweed

Down

- 1 Supereon comprising: Hadean, Archaean and Proterozoic (11)
 2 Female descendent of the dinosaurs (3)
 3 The Tiger's is chatoyant (3)
 4 See 18 Across
 5 Very cold (3)
 6 Jurassic 'slate' used in roofing (11)
 10 One of an early 20th century group of Russian poets (7)
 11 Leipzig born polymath who noticed the correspondence between I Ching hexagrams and binary numbers (7)
 12 Mineral-rich spring (3)
 13 Thin metal sheet (3,4)
 17 Arithmetic mean of squared values (3)
 20/24 Mustela erminea (5)
 22 Tree of genus Ulmus (3)
 23 9mm (ish) model railway gauge (3)
 25 See 18 Across

Solutions February | Across: 2/5 steel slag 6 logia 8 up 10/2D aluminosilicate 12 Li 13 grog 14 calcine 16 Asia 18 lecture hall 22 Genoa 23 IOC 25 fondly 26 mud volcano **Down:** 1 Ali 3 tau 4 lung 7 gallic 9 Portland 11 miner 14 calcium 15 ase 17 clay 19 ego 20 henna 21 lol 24 CID 25 Fal

Editor writes: Many apologies to those of you who were confused by the errors in the February crossword, and particularly to Bindweed for the misspelling – you can find the correct version of last month's crossword in the pdf of the online issue at www.geolsoc.org.uk/geoscientist

OBITUARY**David McCann, 1938-2019**

Dr Dave McCann was born on 1st April 1938 and died of cancer on 8th July 2019 after a long illness.

Dave followed an unusual career path, from an industrial apprenticeship to research of international importance and high level management in the British Geological Survey. He left school in 1954 for an electrical engineering apprenticeship with the Bristol Aeroplane Company. Whilst he was an apprentice he achieved a B.Eng. from the University of Bath. After taking a D.I.C. and an M.Sc. in Control Engineering at Imperial College, Dave became a Research Assistant in Marine Geophysics at the (then) University College of North Wales, Bangor, investigating the transmission of sound waves in sea floor sediments. During that work he devised original techniques for determining the ultrasonic properties of deep-sea cores and sediment samples. Dave successfully defended his PhD thesis in 1968.

Institute of Geological Sciences

He took up a post as a Senior Scientific Officer at the Institute of Geological Sciences (later the British Geological Survey) in London, working as a geophysicist in the Engineering Geology Unit (EGU). One of Dave's first tasks was undertaking engineering geophysical surveys in the area of the proposed Milton Keynes New Town. Later he and his team undertook many geophysical surveys in support

Talented geophysicist and enthusiastic supporter of academic research, with an unwavering loyalty to colleagues and friends



of engineering and geological investigations including the Channel Tunnel, potential nuclear repositories and pumped storage schemes etc. Throughout his career, Dave published his work, achieving over 140 authored and co-authored publications in international journals. Almost his last co-authored paper, in 2013, described how geophysical data facilitated the design of a new model for the origin of the Hot Springs of Bath and Bristol, a paper of which he was justly proud.

Dave led the EGU's Engineering Geophysical research and oversaw development of new near-surface techniques, particularly cross-hole seismic, to improve site investigation. This drive to develop the use of geophysics

“ DAVE WAS A FINE MAN AND A FINE SCIENTIST - PRACTICAL, HARD-WORKING, WITH AN ORIGINAL MIND ”

by geotechnical engineers led to a UK conference in 1994 and Dave was the Lead Editor of volumes on 'Modern Geophysics in Engineering Geology' and 'Geophysics in Engineering Investigations', the latter describing the conclusions of construction industry Working Parties.

Promotion and retirement

From 1985 to his retirement in 1998, Dave, now a Senior Principal Scientific Officer, became Manager of the Regional Geophysics Group and of the Engineering Geology and Geophysics Group, subsequently taking on the leadership of the Fluid Processes and Waste Management Group.

Dave was a Fellow of the Geological Society and a Member of Council from 1985 to 1988. He was Secretary of the Engineering Group from 1976 to 1980 and Chairman of the Environmental and Industrial Geophysics Group from 1990 to 1994.

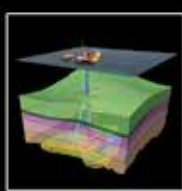
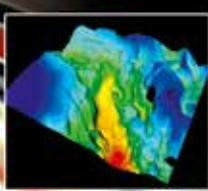
Through Dave, the BGS loaned expensive geophysical equipment to University Departments to support their research. Dave acted as External Examiner for Ph.D. vivas and undergraduate degrees. He contributed to the Reading University Geology Department as a Research Supervisor and as a member of graduate student Advisory Groups. On retirement from the BGS, Dave was appointed as Honorary Professor of Geophysics at the University of Edinburgh, teaching 'hands-on' geophysical techniques with Peter Fenning to Civil Engineering students who 'loved the on-to-one attention from Dave and Pete.'

Dave was a fine man and a fine scientist – practical, hard-working, with an original mind and unwavering loyalty to colleagues and friends.

Dave is survived by his wife, Pat, of nearly 60 years, his three children (a fourth pre-deceased him) and five grandchildren. He and Pat were keen gardeners and devout Christian members of the Baptist Church of Kilmington, Axminster, Devon. He was a lifelong supporter of the football team, Bristol Rovers. In retirement Dave again took up his former hobby of philately, one of many subjects on which he was an expert.

By Clive McCann and Martin Culshaw with contributions from Michael Forde

The full version of this obituary can be found online. *Editor*



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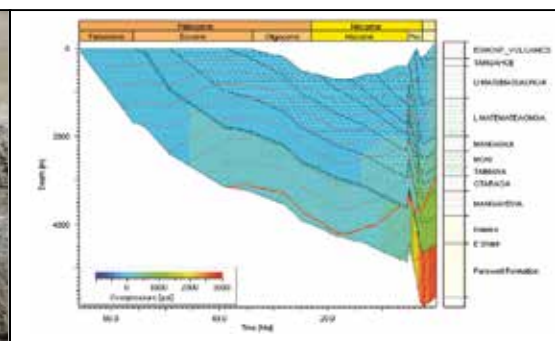
Registration Now Open

Geopressure 2020

Managing Uncertainty in Geopressure by Integrating Geoscience and Engineering

23-26 March 2020

Durham University, Durham UK



The organisers invite contributions within any aspect of geopressure but are particularly interested in the various phases of pore fluid pressure prediction, modelling and overpressure evaluation to manage uncertainty during the life cycle of a well. Suggested themes and sessions include:

- Pore Pressure and stress, especially complex stress regimes
- Impact of machine learning on PPFG
- Well engineering and PPFG
- Injecting fluids underground (including CO₂)
- Coupling of Pore Pressure and FG including depletion and closing the drilling window
- Seal capacity and relationship with PPFG
- PPFG issues in mature basins (including abandonment/decommissioning)
- Classic case studies, including Macondo and LUSI mud volcano
- Pore pressure as an exploration and prospectivity tool.
- Geopressure in mature basins – lessons learnt
- Pore pressure in active tectonic basins
- Unconventional stress regimes

Additional Activities

23 March 2020: Best practice for PP and FG - Mastery Class - Led by Richard Swarbrick

24 March 2020: Field Trip - Led by Richard Swarbrick and Jack Lee to North Yorkshire Coast, GeoPressure in shales - field data and discussion

24 March 2020: Icebreaker Reception

25 March 2020: Conference Dinner

Further Information or to Register:

For more information please contact sarah.woodcock@geolsoc.org.uk or visit the event website: www.geolsoc.org.uk/PG-Geopressure-2020



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This Special Publication is a celebration of research into the Folding and Fracturing of Rocks to mark the 50th anniversary of the publication of the seminal textbook by J. G. Ramsay. Folding and Fracturing of Rocks summarised the key structural geology concepts of the time. Through his numerical and geometric focus John pioneered and provided solutions to understanding the processes leading to the folding and fracturing of rocks. His strong belief that numerical and geometric

solutions, to understanding crustal processes, should be tested against field examples added weight and clarity to his work.

Image: © Wayne Brittle, Winnats Pass

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