

# GEOSCIENTIST

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The Fellowship Magazine of the Geological Society of London

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[ ERUPTIONS  
IN THE  
SPOTLIGHT ]

## EARTH'S CRUSTAL DISTRIBUTION

Plate tectonic complexity  
illuminated by crustal thickness

**VOLCANIC HAZARDS**  
Anna Hicks and Jenni Barclay  
on risk communication

**ERUPTIONS AND SCANDALS**  
Nina Morgan on the colourful  
life of William Hamilton

**REGIONAL SUPPORT**  
A sense of community  
in the regions

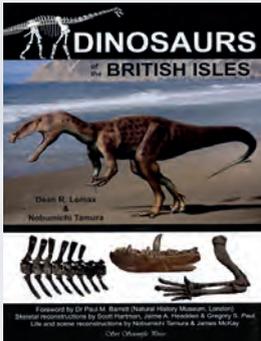


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# Regional Geology Books and Guides

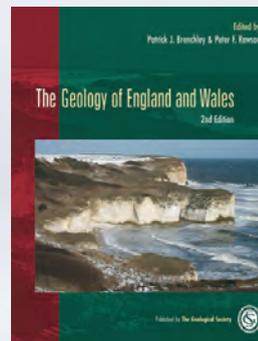
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This book is truly unique, providing the first comprehensive account of the dinosaurs of the entire British Isles. It will be of interest to a broad audience, from academics to those with a general interest in fossils.

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## The Geological Society Career and Industry Days 2018/19

Wednesday 7 November 2018

Venue: Our Dynamic Earth, Edinburgh, UK

[www.geolsoc.org.uk/careersday18edinburgh](http://www.geolsoc.org.uk/careersday18edinburgh)

Wednesday 14 November 2018

Venue: BGS, Keyworth, Nottingham, UK

[www.geolsoc.org.uk/careersday18nottingham](http://www.geolsoc.org.uk/careersday18nottingham)

Wednesday 20 March 2019

Venue: Royal School of Mines,  
Imperial College London, UK

[www.geolsoc.org.uk/careersday18london](http://www.geolsoc.org.uk/careersday18london)

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## CONFERENCE



# Marine Minerals: A New Resource for the 21st Century

31 October – 1 November 2018

The Geological Society, Burlington House, London



Event partner: Marine Studies Group

Marine minerals activities are gathering pace. More and more entities are seeking licences from the International Seabed Authority (ISA) for manganese nodule exploration and mining in the North Pacific and for hydrothermal minerals exploration and mining on mid-ocean ridges worldwide. The U.K. has an important role in marine minerals activities through its sponsorship of several exploration licences with the ISA and active marine minerals research by the NOC, BGS and Universities in U.K. waters and the North Atlantic and Pacific Oceans. Central themes of the Conference will include research on these increasingly important mineral deposits and their resource potential, together with mining and environmental considerations.

### Convenors

David Cronan (Imperial College London)  
Robert Gattiff (BGS)  
Bramley Murtton (NOC)

### Call for abstracts

We welcome oral and poster abstract contributions for this meeting. To be considered for a slot in the programme or a poster presentation, please send an abstract of no more than 500 words to [georgina.worrall@geolsoc.org.uk](mailto:georgina.worrall@geolsoc.org.uk)

### Further information

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Web: [www.geolsoc.org.uk/marineminerals18](http://www.geolsoc.org.uk/marineminerals18)

Follow this event on Twitter:  
#marineminerals18

### Expected highlights

In addition to featuring current U.K. work on marine minerals, expected highlights of the conference include the latest research and development on:

- Metalliferous brines and sediments in the Red Sea and island arcs
- Arctic Ocean, NW Pacific and NE Atlantic ferromanganese crusts
- Indian Ocean ferromanganese nodules and crusts
- Hydrothermal minerals on the Mid Atlantic Ridge including in the Norwegian EEZ
- Ferromanganese nodules in the Cook Islands EEZ and central Pacific
- Placer minerals in the EEZs

There will also be a keynote comparative evaluation of the resource potential of marine and land based mineral deposits by Dr James Hein of the USGS. It is additionally hoped to include an update on International Seabed Authority activities in regard to marine mining.



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## Mineral Resource Estimation: Recent Advances and Current Best Practice

22 October 2018

The Geological Society, Burlington House, London

In an era of rapid technological innovation, opportunities exist to improve efficiency and quality of resource estimates; both developing trust and encouraging investment in mining projects. Forming part of the Year of the Resource, this conference aims to provide a forum for resource estimate practitioners to meet and discuss new developments and advances in mineral resource estimation and reporting.

### Conference topics will include:

- **Exploratory data analysis:** analysis of geoscience data prior to use in a MRE including databasing, data quality analysis, utilising 'big data' and methods of critical evaluation.
- **Geological modelling:** methods and processes used for generating 3D models of geological features, including software advances and comparisons, how to integrate 'big data' and busting commonly encountered myths.
- **Geostatistics and grade estimation:** methods for estimating tonnage and grade/quality of a mineral deposit, including recent software advances, new techniques and comparisons of techniques in different mineralisation types. Reconciliation between estimates and production and ground truthing models.
- **Resource reporting:** methods used for generating mineral resource statements, including methods for demonstrating 'reasonable prospects for eventual economic extraction' (as defined in international reporting codes), including updates/comparisons of CRIRSCO standards and participating committees.

### Convenors

Ben Lepley (SRK Consulting)  
Lucy Roberts (SRK Consulting)

### Further information

For further information please contact:  
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Web: [www.geolsoc.org.uk/mineralresource18](http://www.geolsoc.org.uk/mineralresource18)

Follow this event on Twitter:  
#mineralresource18

### Call for papers

We welcome oral and poster abstract contributions for this meeting. To be considered for a slot in the programme or a poster presentation, please send an abstract of no more than 500 words to Georgina Worrall, no later than 17 August 2018.



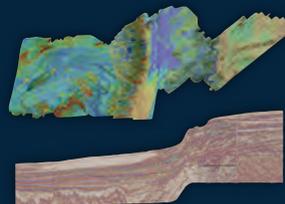
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## Seismic Characterisation of Carbonate Platforms and Reservoirs

10-11 October 2018

The Geological Society, Burlington House, London



Fundamental advances in the seismic imaging and characterization of carbonate platform strata, including reservoir rocks, have revolutionized understanding of carbonate geomorphology, stratigraphy and reservoir architecture. This meeting aims to synthesize these innovative developments and explore the variety of carbonate characteristics that can now be interpreted from modern and reprocessed seismic data. It will discuss and illustrate how the technology can be used in exploration, development and production evaluations, as well as for understanding long-term and large scale forcing of carbonate platform development. The focus will be on practical geoscience applications and the meeting will provide a forum for lively interaction between the upstream oil industry, seismic contractors, and carbonate sedimentology researchers.

### Convenors

Jim Hendry (Tullow Oil)  
Pete Burgess (University of Liverpool)  
Dave Hunt (Statoil)  
Xavier Janson (University of Texas, Austin)  
Valentina Zampetti (Shell)

### Further information

For further information please contact:  
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Web: [www.geolsoc.org.uk/carbonates18](http://www.geolsoc.org.uk/carbonates18)

### Conference Sessions

- Seismic Investigations of Platform Architecture and Development
- Seismic Data in Frontier Exploration for Carbonate Plays
- Extracting Geological Features Using Seismic Attributes and Blends
- Seismic Insights Into Carbonate Diagenesis and Fluid Flow
- Seismic Workflows and Advances in Inversion and Modelling
- Seismic Characterisation of South Atlantic Pre-Salt Carbonates
- Seismic Geomorphology and Seismic Facies Applied to Carbonate Depositional
- Processes and Products

### Keynote Speakers

James Bishop (Chevron) Manuel Poupon (Shell)  
Jeroen Kenter (Total) Lars Reuning (RWTH Aachen)

Event sponsors



## “ THE DEVASTATING ERUPTION AT FUEGO HIGHLIGHTS THE CRITICAL IMPORTANCE OF RESEARCH INTO THE EFFECTIVE COMMUNICATION OF VOLCANIC HAZARDS

FROM THE EDITOR'S DESK:

# Fuego caught on camera

**O**n June 3rd, Volcán de Fuego in southern Guatemala began erupting. Over 100 people are reported dead and several hundred more are still missing. The ferocity of the eruption caught local people and the government agencies responsible for natural hazard monitoring and mitigation largely by surprise.

Naïvely, I've often thought of eruptions as largely 'predictable' natural hazards, at least compared to the impossibilities of forecasting devastating earthquakes. Tremendous advances in satellite, seismic and geochemical monitoring allow scientists to track volcanic inflations and deflations, changes in gas emissions and, to an extent, sub-surface magma movements, giving clues to the imminence of an eruption. But, of course, forecasts are only as good as our monitoring capabilities and are limited by gaps in our understanding of fundamental volcanic processes. The events at Fuego are a reminder of how complex and unpredictable these beasts can be.

The last major eruption at Fuego occurred in 1974. The volcano has been almost continuously active since 2002, with several smaller blasts in 2007, 2012 and 2015, prompting evacuations. Many local people likely have first-hand experience of the threats posed by the volcano and most will have heard stories from friends and family.

It was shocking then to see numerous videos surfacing of pyroclastic flows – filmed at remarkably close range. Images of tumbling, tumultuous clouds of searing hot ash and gases racing over tree tops and along valley floors towards bystanders, smart phones held aloft as they recorded the unfolding events. I watched the videos with my jaw on the floor and screaming 'run!' in my head. The viewers seemed completely unaware of how fast these flows can travel and the threat they pose.

The footage is a stark reminder of the importance of collaboration between local communities, authorities and scientists for understanding the risk that volcanoes pose and how to respond during an eruption. On page 16 of this issue, Anna Hicks and Jenni Barclay discuss the power of film in this endeavour. They have shown that films featuring local residents significantly improve the effectiveness of the communications – recognisable faces and locations inspire audiences to take ownership of their risk and steps to strengthen resilience.

At Fuego, many victims were found close to their homes, implying that they were unable to flee, powerless to put into action any hazard response plans. But, as the videos show, there are still gaps in understanding. Hazard and risk communication remains a vital area of research.



# SOCIETY NEWS

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



## Society Awards 2019

**Make your nominations for our 2019 awards, writes Stephanie Jones.**

Fellows of the Society are encouraged to submit nominations for the Society's Awards for 2019 to the Awards Committee. Full details of how to make nominations are on the website at [www.geolsoc.org.uk/About/Awards-Grants-and-Bursaries](http://www.geolsoc.org.uk/About/Awards-Grants-and-Bursaries). Nominations must be received at the Society no later than 28 September 2018.

## Council & OGMs

**OGMS:** 2018: 18 September, 28 November.

2019: 6 February, 3 April

**COUNCIL:** 2018 18 & 19 Sept (residential), 28 November.

2019: 6 February, 3 April

## Outputs from our 2018 Year of Resources

**What has the society been doing for the Year of Resources? Amy Ball explains.**

Our public lecture series kicked off in January this year with some fascinating resource-themed lectures. So far we've covered topics such as oil and gas in future energy demand, new frontiers for metal and mineral resources, the role of the geologist in securing supply of critical minerals, and the ethics of gemstones and jewellery. All of our 2018 public lectures can be watched online on our events pages ([www.geolsoc.org.uk/gslondonlectures18](http://www.geolsoc.org.uk/gslondonlectures18)).

As part of our themed year, we've convened two innovative conferences at Burlington House, one on 'Lithium: From Exploration to End-User' and our Bryan Lovell Meeting on 'Mining for the Future'. Read a recent post about the lithium conference on our blog ([blog.geolsoc.org.uk/](http://blog.geolsoc.org.uk/)), and watch talks from these meetings on our

events pages.

We've launched a new minerals web resource ([www.geolsoc.org.uk/minerals](http://www.geolsoc.org.uk/minerals)), containing key information on important mineral resources together with some beautiful mineral illustrations drawn by Dr Hazel Gibson. We've also been working on some new resources for primary and secondary education based around energy and minerals, including a mineral resources card game, energy resources presentations and classroom activities, and information factsheets on energy, water and mineral resources. All of our education resources can be used by teachers, parents and STEM Ambassadors and are available to download on our education pages ([www.geolsoc.org.uk/education](http://www.geolsoc.org.uk/education)).

All of these resources and many more can also be found on our Year of Resources web page: [www.geolsoc.org.uk/Resources18](http://www.geolsoc.org.uk/Resources18).

## Paperless Billing 2019

**We are going paperless for 2019 membership renewals.**

For the last few years, many members have opted for paperless invoicing, with the majority choosing to pay online. This has significantly reduced the number of paper returns, contributing to the important objective of a reduced environmental footprint and improving the efficiency of payment processing, for the benefit of all.

Additionally, our new database system will come online soon, which, if run alongside paperless billing, will make the process of

renewing much easier. With this in mind, we feel the time is right to introduce paperless billing for all members, for the 2019 subscription renewals. Fellowship cards will be sent to all Fellows who have paid and renewed by December 2018.

For members who feel that paper billing is essential, we will of course be happy to send one to you, on request. Please contact the Fellowship office on [membership@geolsoc.org.uk](mailto:membership@geolsoc.org.uk) for more details.

### Programme: 2018

Meetings of the Geological Society Discussion Group (formerly the Geological Society Club) are 18.30 for 19.00, when dinner is served. Attendance is open to all members of the Society. For up-to-date information concerning topics for discussion and speakers, please go to W: <http://bit.ly/2AhEZrf>

- ◆ **Wednesday 19 September** – Burlington House
- ◆ **Wednesday 24 October** – Bumpkins
- ◆ **Wednesday 5 December** – Athenaeum

➤ Please contact Sarah Woodcock for more information and to make a reservation. E: [sarah.woodcock@geolsoc.org.uk](mailto:sarah.woodcock@geolsoc.org.uk)



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## Latest news from the Publishing House

### Jenny Blythe has the latest from the Geological Society Publishing House

#### Geology and hydrocarbon potential of the East African continental margin: a review

By Ian Davison and Ian Steel

The East African margin has a complex structure due to multiple phases of rifting with different stretching directions. The main phase of rifting leading to Indian Ocean opening lasted from the Late Pliensbachian to the Bajocian (c. 183–170 Ma). This occurred during impingement of the Bouvet hotspot which weakened the lithosphere sufficiently to allow continental break-up. Thick salt and marine shales were deposited during the Toarcian in the Majunga, Ambilobe and Mandawa basins and the onshore Ogaden Basin; marking the onset of the Indian Ocean marine incursion, when good quality oil-prone source rocks were deposited at this time. The recent giant gas discoveries in Tanzania and Mozambique are believed to be sourced from overmature Jurassic or, possibly, deeper Permian age Karoo shales. The margin from the Lamu Basin in the north to the Zambesi Delta in the south is covered by thick Tertiary and Cretaceous sediment derived from the East African rift shoulders, and Lower Jurassic source rocks are predicted to be in the gas window along most of the margin. However, the margins in South Africa, south Mozambique, northern Somalia and Madagascar are less deeply buried, and have better oil potential.



#### The Bolca Lagerstätten: shallow marine life in the Eocene

By Matt Friedman and Giorgio Carnevale



The Eocene limestones around the Italian village of Bolca occur in a series of distinct localities providing a unique snapshot of marine life in the early Cenozoic. Famous for its fishes, the localities of Bolca also yield diverse invertebrate faunas and a rich, but relatively understudied flora. Most fossils from Bolca derive from the Pesciara and Monte Postale sites, which bear similar fossils but are characterized by slightly different taphonomic and environmental profiles. Although not precisely contemporaneous, the age of these principal localities is well constrained to a narrow interval within the Ypresian Stage, c. 50–49 Ma. This places Bolca at a critical time in the evolutionary assembly of modern marine fish diversity and of reef communities more generally...

➤ [Read full abstract and paper in the Lyell Collection](http://pg.lyellcollection.org/content/24/1/57)  
<http://pg.lyellcollection.org/content/24/1/57>

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# In Praise of The Regional Group

Have you ever tried to put a lecture programme together?  
Because if you haven't, listen up

It takes ages. If you are lucky, you can get someone to respond to your emails. If you are very lucky, they are not a nutter. And if you are very, very lucky, they actually have a lecture that isn't a thinly veiled advertising campaign for the company they work for, or a four-hour monologue on aggregate abrasion values.

Then you have to find a date they are available. And a venue that's mostly free, will serve tea and coffee for 50p a go, and that everyone can travel to. Then you have to make a flier explaining where the lecture is and the start time. Then you have to answer 20 emails asking where the lecture is and what time it starts, and complaining that there's a spelling mistake. This is because you wrote the flier at 1.30 am, whilst making a costume for school's Viking Day out of the contents of the recycling bin.

## Priorities

The modern age of instant communication sets expectations that are unachievable. People forget that volunteers might have other actual jobs, and that mobile phones are... mobile...and it might not be convenient to talk. But if that hard-to-get-hold-of someone rings, and you are caught in the middle of the school run, scrawling on the back of a handy child with a board pen, then do choose a large child, and photograph the notes before said child sweats them off all over their school shirt on the way home.

Everyone still clinging to a job is doing so

with both hands and all their teeth. Unpaid work is last on the priority list, so why bother?

## Community

Back in the Middle Dryas, when I graduated with a degree in geology, I fell out of the education treadmill with no information and no idea about careers. I ended up at the sharp end of engineering geology, in a career I'd never heard of, in a tiny world of just 9 people. Then, I went to a Geological Society Regional Group Meeting. Suddenly, there was a big room full of people all working in geology – a whole community, a whole world. Belonging to a community is a human need, somewhere deep within the lizard brain; it's what keeps us sane, it provides us with information, a sense of safety, and people to talk to who know what you're on about. Our Regional Groups are a link to the wider geological world, and a chance to discuss rock-bothering with other local nerds. And don't go bleating that it's not worth it if only 20 to 40 people turn up to a lecture. That's plenty of people. Try talking to all of them. I bet you can't get round them all.

If you haven't been to a Regional Group Meeting, give it a go. You might enjoy it. And if you have an interesting topic and might like to give a lecture, why not contact your Regional Group. Just don't get upset if they don't get back to you right away.

Written by an anonymous Fellow.  
Name and address supplied

# SOAPBOX CALLING!

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

If you can write it entertainingly in **500 words**, the Editor would like to hear from you. Email your piece, and a self-portrait, to [amy.whitchurch@geolsoc.org.uk](mailto:amy.whitchurch@geolsoc.org.uk). Copy can only be accepted electronically. No diagrams, tables or other illustrations please.

Pictures should be of print quality – please take photographs on the largest setting on your camera, with a plain background.

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

“OUR REGIONAL GROUPS ARE A LINK TO THE WIDER GEOLOGICAL WORLD, AND A CHANCE TO DISCUSS ROCK-BOTHERING WITH OTHER LOCAL NERDS

ANONYMOUS





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Registration now open

## Operations Geoscience Adding Value

7-8 November 2018

The Geological Society, Burlington House, Piccadilly, London



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serving science, profession & society

Convenors:

**Richard Diggins**  
BP – Chairman

**Chris Samson**  
Independent – Secretary

**Hozefa Godhrawala**  
Centrica

**Chris Hayes**  
RPS

**Tim Herrett**  
Independent

**Rachael Horton**  
BP

**Mazim Kotenev**  
Sasol

**Kirstin McBeath**  
BP

**Christine Telford**  
Independent



The main focus will be on the value operations geoscientists deliver and the pivotal role they play via the following topics:

- **The value of learning lessons well** – what is a lesson?; how are lessons learned and managed (e.g. avoiding non productive/invisible lost time?); practical examples of lessons with demonstrable change; personal willingness to share failure/sub optimal performance
- **Risks and safety of operations** – identifying, managing, communicating risks and planning contingencies effectively
- **Formation pressure and geomechanics** – sharing good practice, techniques and knowledge, prediction and detection methods
- **The value of managing and interpreting data** – effective data management for field life, examples of cross company collaboration

Overarching themes:

- Value of these themes to **well life cycle**
- Sharing real world **examples and case studies**
- Importance of **personal behavioural skills** throughout (leadership, communication, relationship building and influencing others)
- Share good practice, showcasing **innovative approaches and technologies**

We look forward to active participation from our colleagues across subsurface, drilling and engineering disciplines to significantly broaden the main conference themes.

**There will be a parallel poster session in the library.**

**For further information and registration please contact:**  
Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG.  
T: +44 (0)20 7434 9944 or email: sarah.woodcock@geolsoc.org.uk

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Call for Abstracts – Deadline: 30 November 2018

## Petroleum Geology of Mexico and the Northern Caribbean

14-16 May 2019

The Geological Society, Burlington House, Piccadilly, London



The Geological Society  
serving science, profession & society

Convenors:

**Jonathan Hull**  
Ophir Energy – Chair

**Matthew Bowyer**  
Cairn Energy

**Ian Davison**  
Earthmoves

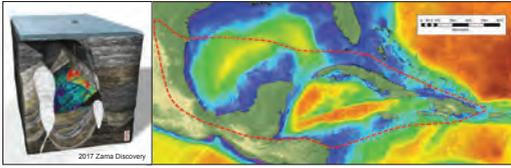
**Mike Hobbein**  
Ophir Energy

**Aruna Mannie**  
Premier Oil

**Chris Matchette**  
Downes  
CaribX

**Adrian Neal**  
Badley Ashton

**Mark Shann**  
Sierra Oil & Gas



The Gulf of Mexico is a world class prolific hydrocarbon system. As a result of recent energy reform the Mexican sector of this basin has been open to international companies for the first time through a series of competitive licence rounds. The first phase of drilling on these newly awarded permits has resulted in the discovery of giant hydrocarbon accumulations in the Mexican offshore sector. Geologically, the offshore and onshore basins of Mexico offer a diverse range of play types with multiple source / reservoir pairs and are characterised by complex tectonic evolution with associated halokinesis and shale tectonics.

More widely within the Northern Caribbean region, exploration activities are ongoing in several countries targeting both proven and frontier petroleum systems. Some of these play elements are potential extensions of the proven systems in Mexico. While geologically complex, these areas have the potential to emerge as major hydrocarbon basins.

This regional conference aims to bring together both academic and industry geoscientists together to discuss the current state of understanding of the geology and petroleum systems in these geologically complex, but prolific hydrocarbon basins.

The committee now invite submissions of abstracts along the following themes

- Regional Plate Tectonic Evolution
- Neogene Clastic Depositional Systems
- Basins of Mexico and the Northern Caribbean
- Carbonate Depositional Systems
- Onshore Basins and the Laramide and Chiapas
- Salt Tectonics
- Fold Belt effects
- Controls on hydrocarbon habitat – seal capacity
- Petroleum Systems
- Relevant GOM Analogues
- Exploration & Production History

**Call for Abstracts:**  
Please submit talk or poster abstract to sarah.woodcock@geolsoc.org.uk by 30 November 2018.

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Call for Abstracts – Deadline: 31 May 2018

## The Geology of Fractured Reservoirs

24-25 October 2018

The Geological Society, Burlington House, Piccadilly, London



The Geological Society  
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Convenors:

**Paul Gillespie**  
Statoil

**Jon Gutmanis**  
Independent

**Bob Holdsworth**  
University of Durham

**Danny Long**  
Independent

**Eddie McAllister**  
Shell

**Simon Price**  
Shell

**Alun Williams**  
Statoil



A large proportion of the world's oil and gas is produced from fractured reservoirs, with new discoveries continuing to be made and put into development. This conference will explore the many ways in which the geology of fractures is fundamental to the understanding of fluid flow in the subsurface, and hence to predicting and monitoring reservoir performance.

Fractured reservoirs are those in which fractures have caused a significant increase in total permeability. Carbonate reservoirs, tight sandstone reservoirs, basement reservoirs and shale reservoirs are all commonly fractured, and present significant challenges to petroleum geologists. The focus of these challenges, but not their significance, changes throughout a field's life-cycle from exploration to production. Many geothermal reservoirs are also fractured, and share common challenges. This meeting will highlight how multidisciplinary work is essential to develop an applicable understanding of the behaviour of fractured reservoirs.

Themed sessions to include:

- Fracture properties at micro and well scale – detection and characterisation
- Fracture properties at reservoir to basin scale – from outcrops to seismic to regional models
- The flow behaviour of fracture systems – the interaction of fluids, rocks and stress
- The integration of data, disciplines and insights – advancing our knowledge of fractured reservoirs

**Call for Abstracts:**  
Please submit paper and poster contributions to sarah.woodcock@geolsoc.org.uk by 31 May 2018.

**For further information please contact:**  
Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG.  
Tel: +44 (0)20 7434 9944

Keynote Speakers:

**Mohammed S. Ameen**  
Saudi Aramco

**Raffaele di Cuia**  
Delta Energy Ltd

**Steve Laubach**  
University of Texas at Austin

**Robert Trice**  
Hurricane Energy

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Call for Abstracts: 30 September 2018

## Celebrating the life of Chris Cornford (1948-2017) Petroleum Systems Analysis 'Science or Art?'

24-25 April 2019

The Geological Society, Burlington House, London



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Convenors:

**Steve Lawrence**  
Subsurface Resource Consulting

**Dan Cornford**  
IGI Ltd

**Elin Rein**  
Equinor

**David Gardiner**  
IGI Ltd

**Abhen Pather**  
RPS Energy

**Mark Groves**  
**Gidney**  
Energetical

**Richard Bray**  
Subsurface Resource Consulting

**John Argent**  
Mark Energy

**Mark Osborne**  
BP



Approaches to tackling the scientific and practical questions in the fields of Petroleum Geochemistry and Petroleum Systems Analysis range from the entirely theoretical to the empirical. Chris Cornford embraced both in his working life. The integrated approach he espoused will form the basis of the technical programme for the Conference covering two themes:

- Recent developments in the use of data including integration of models and (big) data; use of visualisation and data exploration or mining techniques.
- Topical issues & controversies ranging from mass balance approaches, petroleum migration to specific modelling studies and practical applications.

The Conference will be inspired by Chris' ethos of innovation, encouragement of youth and challenging received wisdom.

**Call for Abstracts:**  
Please submit abstracts for oral and poster contributions that cover any of the above themes to sarah.woodcock@geolsoc.org.uk before 30 September 2018

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

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# WHAT IS THE THICKNESS OF EARTH'S CRUST?



**Andy Alvey, Alan Roberts\*** and **Nick Kusznir** discuss how a new global map of crustal thickness is illuminating complexity in plate-tectonic restorations

**M**apping the thickness of Earth's crust, on land and in the oceans, allows us to understand fundamental geological and geographical observations, such as the location of mountain belts and the depth of the oceans. Over the past 10 to 15 years, companies interested in deepwater oil-and-gas exploration have also taken a close interest in how crustal thickness and crustal type (continental, oceanic or mixed-transitional) are distributed around the continental margins of the world's oceans and bordering seas. The particular focus of this interest has been to understand the thermal consequences of stretching and thinning the continental crust and lithosphere to form new ocean basins.

Our understanding of the processes

that lead to the formation of ocean basins and their continental margins has evolved significantly over the last 20 years, or so, and has been the focus of several previous Society Special Publications (SPs 167, 187, 282, 369, 476 between 2000 and 2018).

Over the course of many commercial studies, we have undertaken our own mapping of crustal thickness and crustal type around many of the world's continental margins and their associated sedimentary basins. We aimed to provide constraints on crustal structure and crustal type as an aid to deepwater exploration. We continued mapping in order to produce a new global map of crustal thickness (Fig. 1). This map shows the first-order distribution of crustal-basement thickness (continental and oceanic) around the whole planet. It is derived from recent satellite-acquired gravity anomaly data in

“ THIS MAP ADVANCES ON THE PIONEERING SEISMOLOGICAL MAPPING OF THE 1990S BY BEING MUCH HIGHER RESOLUTION

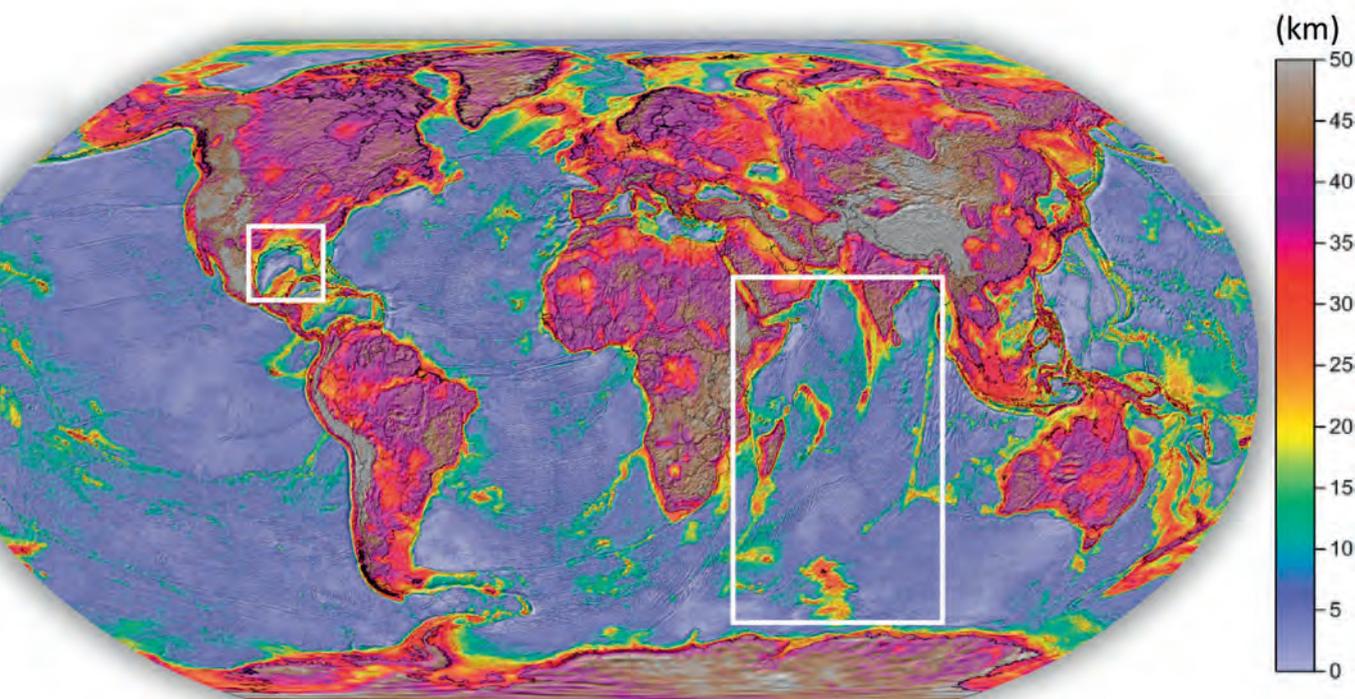


Fig. 1: Global map of crustal-basement thickness (continental and oceanic) derived by OCTek gravity inversion. The map is overlain by a shaded-relief display of the gravity anomaly data, which enhances the underlying tectonic features. Gulf of Mexico and Indian Ocean highlighted

combination with innovative geophysical techniques. The colours in the map represent the thickness of the crustal-basement. The overlying texture in the map (and all other maps) is a shaded-relief display of the gravity data, which highlights major tectonic features, both onshore and offshore. This map advances on the pioneering seismological mapping of the 1990s by being much higher resolution, courtesy of the global coverage of satellite gravity data (see Further Reading).

### Gravity inversion

The crustal-thickness map is the product of a geophysical modelling technique, which has acquired the shorthand name *OCTek gravity inversion* (Ocean Continent Transition Tectonics). Input to the modelling comprises satellite free-air

gravity anomaly data, topography / bathymetry data and information about sediment thicknesses above crustal basement. Global coverage for each is freely available in the public domain.

An illustrative summary of the modelling workflow is provided in figure 2. The modelling is iterative, seeking first to determine Moho depth and from that to determine crustal thickness and type. For any given set of input parameters and assumptions made, the model will converge to a unique solution for Moho depth.

Further technical details of the modelling technique can be found within the Further Reading, but it is worth drawing attention to two aspects that are distinctive and make the approach particularly suitable for investigating ocean basins and their margins (Fig. 2): (1) the modelling calculates and incorporates

the high geothermal gradients and corresponding decreased densities that result from thinning the continental crust and lithosphere, leading to the formation of an ocean basin; (2) as a consequence of quantifying continental thinning, the modelling can predict how much new magmatic crust (oceanic crust in the oceans) is likely to be present at any given location, such that the total thickness of the crust can be divided into old-continental and new-magmatic components.

The global map resolves the majority of known oceanic areas with a crustal thickness of about 5 to 7 km, that is, normal-thickness oceanic crust. Exceptions to this are: (i) known volcanic plateaus such as Iceland, Kerguelen and Ontong-Java; (ii) hotspot trails such as those in the Pacific, the Walvis Ridge ▶

Fig. 2: Schematic outline of the OCTek gravity inversion method to determine Moho depth, crustal-basement thickness and lithosphere thinning-factor, using gravity anomaly inversion incorporating a lithosphere thermal correction and prediction of magmatic addition to the crust

(figure modified from Roberts et al. 2013. *Petroleum Geosci.* 19, 65-88 and Kuszniir et al. 2018. In: McClay, K.R. & Hammerstein, J.A. (eds) *Passive Margins: Tectonics, Sedimentation and Magmatism*, GSL SP476)

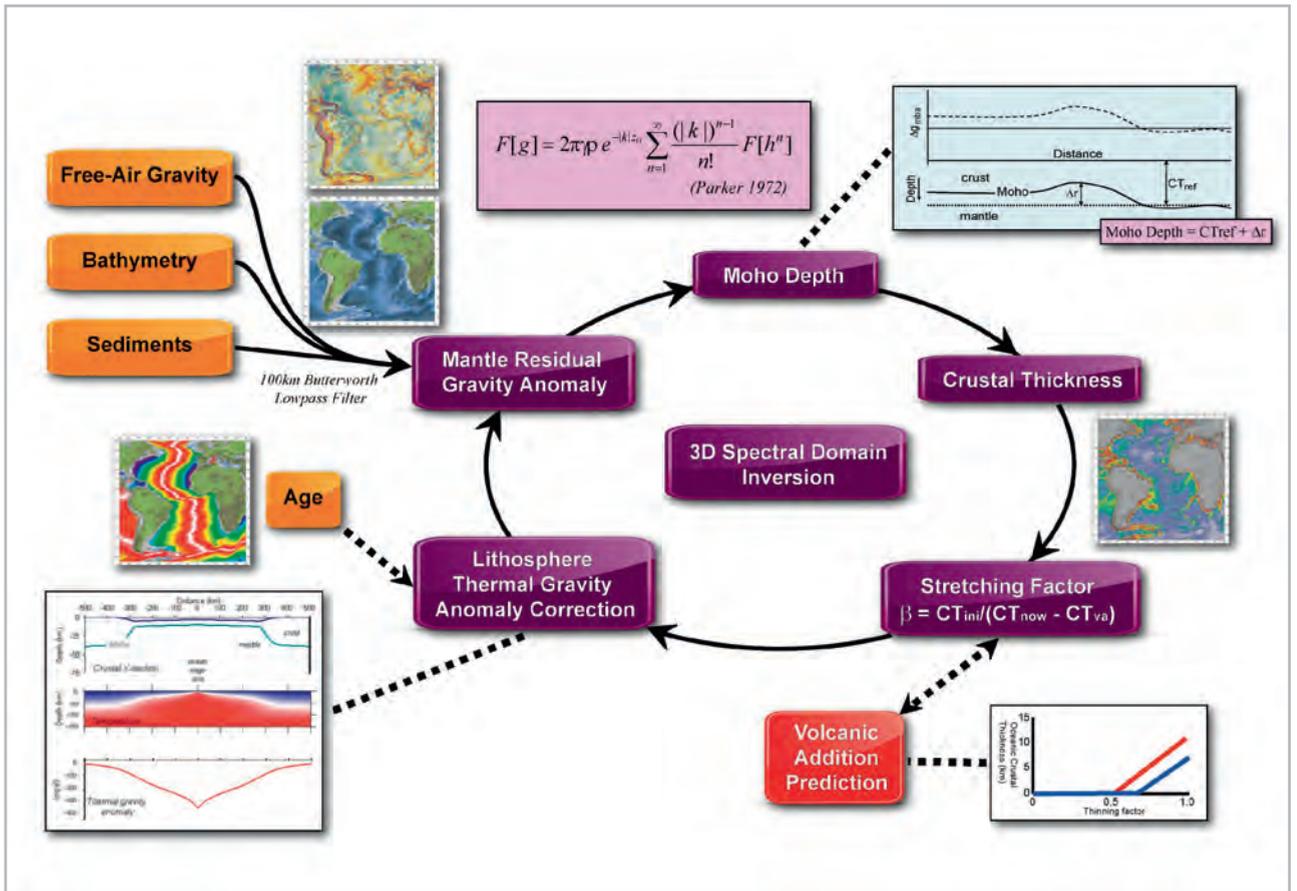
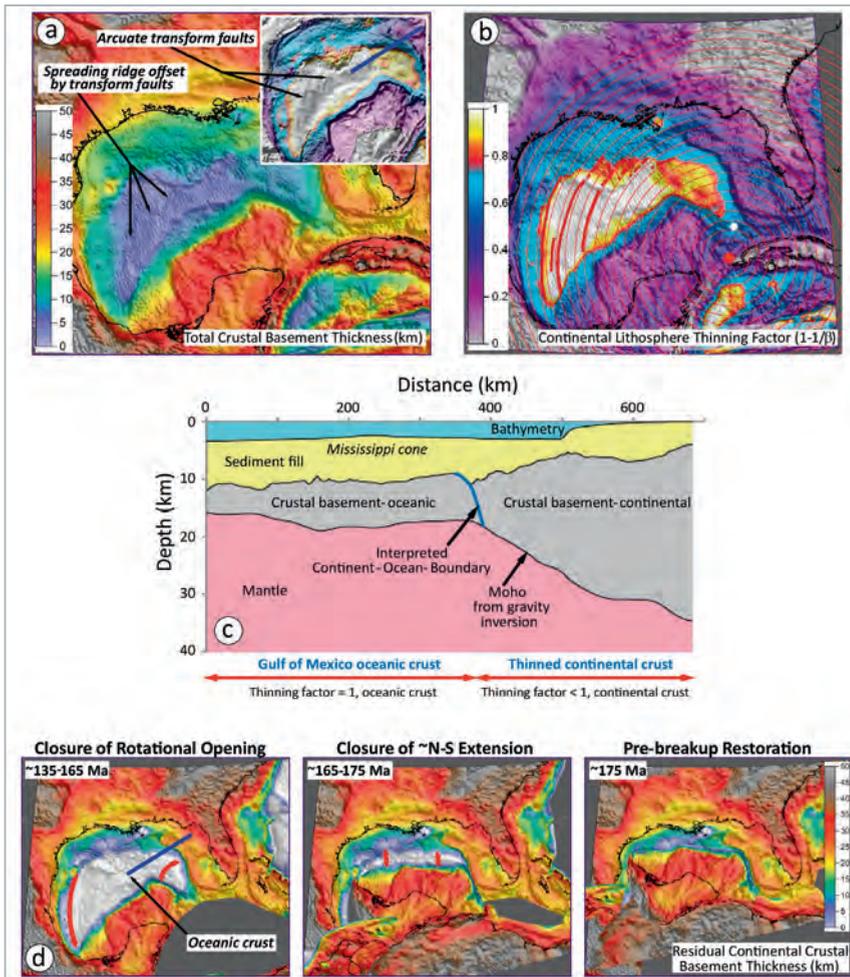


Fig. 3. Gulf of Mexico. (a) Map of crustal-basement thickness. Main and inset map with enhanced shading show an extinct Jurassic spreading ridge and associated transform faults. (b) Map of continental lithosphere thinning-factor. Small-circles of plate motion, centred on red pole of rotation, are aligned with the oceanic transform faults. (c) Crustal cross-section from NE Gulf of Mexico, extracted from gravity model results. Section located as blue line in Figs 3a&d. (d) Two-stage plate-restoration for the Gulf of Mexico. Rotational closure, preceded by N-S closure produces the Jurassic pre-breakup restoration



HONOURING THE ARCUATE TRANSFORM FAULTS REQUIRES THE GULF OF MEXICO TO HAVE OPENED AS A TWO-STAGE PROCESS, THE FIRST INVOLVING N-S RIFTING OF YUCATAN/SOUTH AMERICA AWAY FROM NORTH AMERICA, THE SECOND INVOLVING ROTATIONAL OPENING AROUND A LOCAL POLE, ROTATING YUCATAN AWAY FROM NORTH AMERICA

► in the Atlantic and the 90°-East Ridge in the Indian Ocean; (iii) micro-continental blocks such as Jan Mayen, the Seychelles-Mascarenes and possibly several others.

Onshore crustal thickness has a 'typical' value of about 37.5 km, with thicker crust delineating the major orogenic belts and also the thick cratonic crust of Africa. Onshore crust thinner than about 37.5 km typically delineates intra-continental rift basins, many of which also extend offshore and link into the thinned crust of continental margins. We would advise against taking the onshore results too literally, in terms of precise values, but we believe the first-order results to be reliable.

### Plate tectonic models

Maps of crustal thickness can be used to help constrain and modify plate-tectonic models. Traditionally plate restorations use present-day geomorphic features, such as coastlines and shelf-breaks as their continental constraint. Such features, however, evolve with time and are not necessarily in the same relative position now as they were at the time of

continental separation. By using a map of crustal thickness to constrain the plate restorations we can restore a property of Earth's crust which, at continental margins, was actually produced by the process of continental breakup.

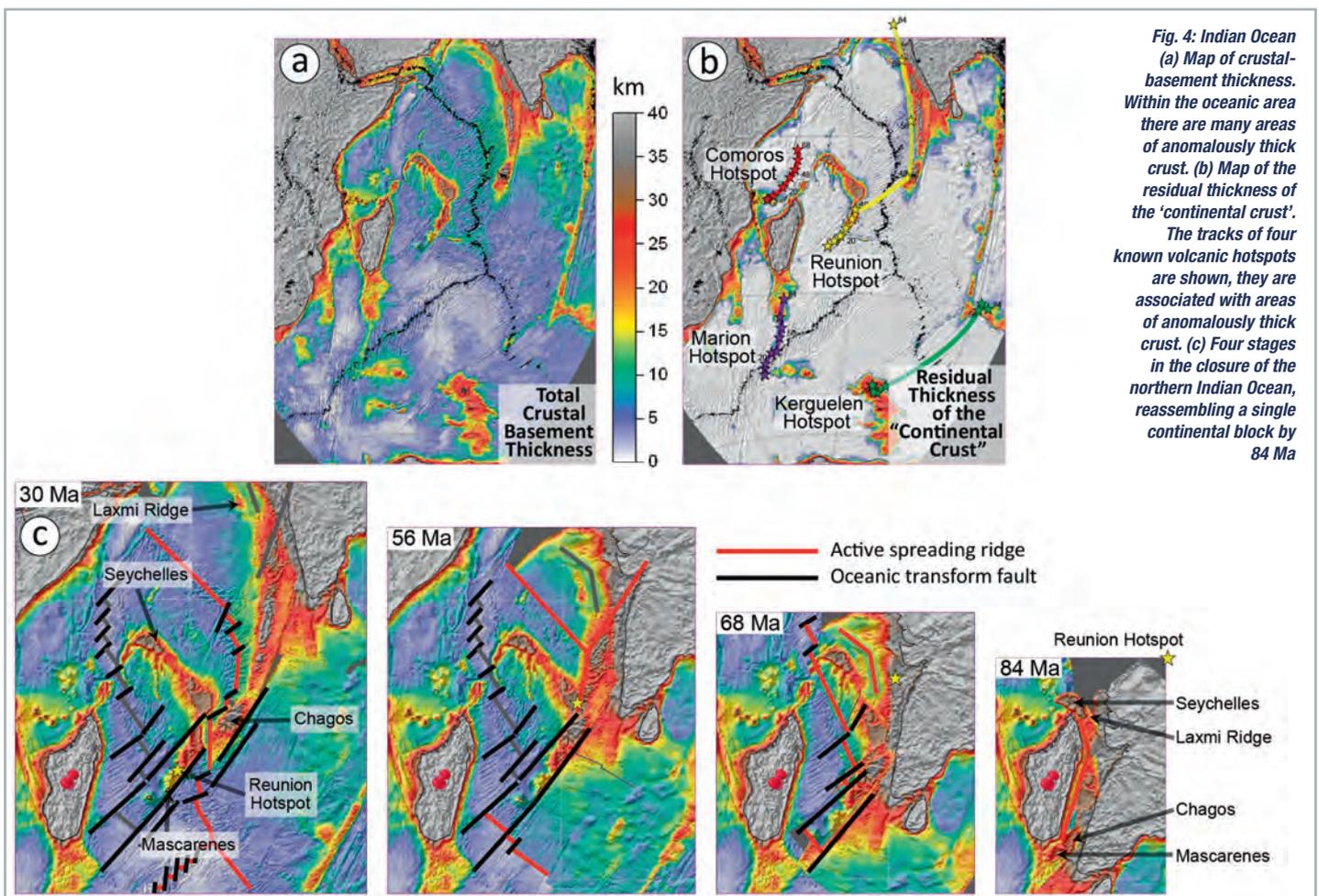
We have illustrated this here with two examples that involve a more complex plate-restoration sequence than the traditionally-illustrated closing of the Atlantic. They are the Gulf of Mexico (Fig. 3) and the Indian Ocean (Fig. 4).

### The Gulf of Mexico

The first map for the Gulf of Mexico (Fig. 3a) shows a central oceanic core of the Gulf picked out by crust about 5 to 7 km thick (blue) and flanked on all sides by the thicker continental crust of North America, Mexico and Cuba. An important feature of this map is that the textured overlay of the gravity data picks out the fossil spreading-centre and offsetting, arcuate transform-faults within the Jurassic oceanic crust. This is seen even more clearly in the inset map in which the shading has been further accentuated.

The importance of recognising transform faults is that these allow us to define the direction of plate motion during sea-floor spreading and opening of the Gulf of Mexico. The fact that they are visibly arcuate means that the pole of rotation for opening must lie nearby.

The second map for the Gulf of Mexico (Fig. 3b) shows another result from the gravity inversion, related to crustal thickness, known as *continental lithosphere thinning-factor*. This is a measure of how much the continental crust and lithosphere have been thinned by the process of rifting and breakup. A value of 0 means no thinning, a value of 0.5 means thinning to half its original thickness, a value of 1 means complete thinning and replacement by oceanic crust (white on the map). Overlain on this map are a set of concentric circles that have been constructed to align with the arc of the transform faults. At the centre of the concentric circles (red circle) lies the associated pole of rotation for the opening of the Gulf of Mexico. This pole of rotation is different from the 'traditional' location ►



► (white circle) and results in a modified opening history for the basin. The traditional pole does not align with the arcuate transform faults imaged by the gravity modelling.

A cross-section extracted from the results of the gravity modelling is shown in figure 3c (located in Figs. 3a&d and coincident with the track of a regional deep-seismic profile). The cross-section shows bathymetry and sediment fill, both of which are input to the model, underlain by crustal basement and mantle, separated by the Moho. The Moho is predicted by the gravity model and from the position of the Moho the model predicts the thickness of crustal basement. Further interpretation of the results, looking at the distribution of both thinning-factor and new magmatic crust, allows us to predict the position of the continent-ocean-boundary and the location of continental and oceanic crust on either side.

The final set of figures for the Gulf of Mexico (Fig. 3d) shows a new restoration sequence for the basin, which uses the new pole of rotation associated with the oceanic transform faults. Step 1 closes the basin along the transform faults (about 135 to 165 Ma) until the offshore continental margins of Florida and Yucatan (Mexico)

come into contact. This rotational restoration removes most, but not all, of the oceanic crust within the Gulf of Mexico. Step 2 shows that a narrow approximately E-W band of oceanic crust remains at about 165 Ma, which must be closed by a S-N motion of the Yucatan/South American block, producing the final pre-rift restoration of Step 3 at about 175 Ma. Honouring the arcuate transform faults requires the Gulf of Mexico to have opened as a two-stage process, the first involving N-S rifting of Yucatan/South America away from North America, the second involving rotational opening around a local pole, rotating Yucatan away from North America.

### The Indian Ocean

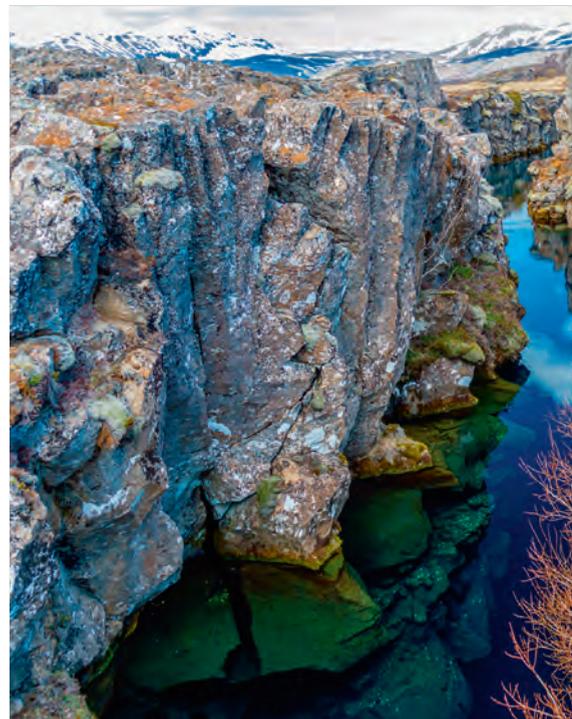
Crustal thickness within the Indian Ocean, as shown in the first map (Fig. 4a) is of particular interest because of the many blocks of thicker crust that sit within the background setting of a major ocean. The largest of these is the island of Madagascar, which is a continental block known to have separated in a south-southeast direction away from Somalia during the Jurassic. The affinity of some of the other regions of thicker crust is, however, less obvious.

The second map for the Indian Ocean (Fig. 4b) displays the residual thickness of the 'continental' crust. This is produced by subtracting the predicted new magmatic crust from the original map of total crustal thickness. This 'cleans up' the major oceanic areas (white, no continental crust), but numerous blocks of coloured, thicker crustal basement remain.

Also shown on this second map are the known tracks, relative to the present-day plate configuration, of four major volcanic hotspots (Reunion, Comoros, Marion, Kerguelen). Any regions of anomalously thick crust that lie on, or close to, one of the hotspot tracks can therefore be ascribed a likely volcanic origin. There remain other blocks of thick crust, such as the Seychelles, Laxmi Ridge and the southern Kerguelen Plateau, which are not associated with hotspot trails and are therefore likely to be microcontinental blocks. Precambrian granites are known in the Seychelles and so its continental affinity is well known. Precambrian zircons have also recently been recorded from Mauritius (within the Mascarenes area), leading to a suggestion that part of the Reunion hotspot trail may also be associated with a microcontinental fragment (Mauritia, see Further Reading).



*Cirque de Mafate, a caldera on Réunion Island. Anomalously thick crust close to the Réunion hotspot track likely has a volcanic origin*



*The divide between the Eurasian and North American Plates in Iceland*

The third set of figures, for the northern Indian Ocean (Fig. 4c), shows a new set of plate restorations back into the Late Cretaceous, at which time Madagascar, the Seychelles, India and their associated microcontinental blocks are all reassembled to a single continental block. The starting point for the restoration is the initial map of present-day crustal-basement thickness. The first-order sequence of closure in these restorations is not new and follows much previous work. In places, however, local details have been changed in order to honour tectonic features highlighted by the new crustal-thickness map and also to take account of the potential crustal fragments, which only a map such as this can show.

The restoration sequence shows that as the Arabian Sea is closed between the Seychelles and India, so the Chagos block comes to settle into the re-entrant of the Seychelles-Mascarenes block at about 30 Ma, closing oceanic linkage across the Reunion hotspot trail, as highlighted at 56 Ma. Full closure of the Arabian sea by 68 Ma brings together the continental blocks of the Seychelles and Laxmi Ridge, while oceanic crust still separates Madagascar from the Seychelles.

Finally, by 84 Ma, the four separate

continental blocks/fragments of Madagascar, Seychelles, Laxmi Ridge and India have all been reassembled to a single pre-breakup continent. Sandwiched between Madagascar and India are remnants of the Mascarene-Chagos-Maldives track of the Reunion plume, which the recent zircon work, supported by the results of the gravity inversion, suggests may contain several dismembered (here reassembled) microcontinental blocks in addition to the known volcanic material.

### Multi-purpose crustal mapping

The plate restorations illustrated here are two of many that have been produced from the results of the global crustal-thickness mapping. Such restorations hopefully stimulate a primary academic interest for most geoscientists, provoking memories of bygone lectures in a newly illuminating light. Plate restorations also have an applied context, however, in that they are frequently used to constrain models for reservoir and source-rock deposition on deepwater continental margins, as well as providing a predictive framework for models of past oceanic circulation and palaeoclimate modelling.

Away from plate restorations, mapping

crustal thickness and the distribution of crustal type has many other applied uses, such as: constraining continental limits for the law-of-the-sea; assisting with the planning and location of expensive deepwater seismic surveys for both hydrocarbon exploration and academic purposes; assisting with the interpretation of deep-seismic reflection and refraction data, by constraining Moho depth; and providing the basic input for petroleum-systems models.

All of this can be achieved using data that are freely available in the public-domain. Although illustrated here at the global/regional scale the OCTek technique is equally applicable down to the scale of individual basins, where confidence in the results can be improved by the input of local geological information and knowledge. ♦

### FURTHER READING

A list of selected references may be read in the Online version of this article. *Editor.*

#### Andy Alvey<sup>1</sup>, Alan Roberts<sup>1\*</sup> and Nick Kusznir<sup>1,2</sup>

1. Badley Geoscience Ltd, North Beck House, North Beck Lane, Spilsby, Lincs, PE23 5NB, UK;

2. University of Liverpool, Department of Earth & Ocean Sciences, Liverpool L69 3BX, UK; \*Correspondence alan@badleys.co.uk



*Mauritius is characterised by anomalously thick crust that may represent a micro-continental fragment*

# CITIZEN-CENTRIC **RISK COMMUNICATION**





## Anna Hicks\* and Jenni Barclay explore how co-producing risk communication strategies with those at risk can catalyse preparatory actions for the impacts of natural hazards

**T**he Soufrière Hills Volcano on Montserrat has been ‘in eruption’ now for over 23 years. In that time, this dynamic natural laboratory has triggered a profusion of research opportunities across the Earth sciences and innovative study crossing the boundaries of traditional academic disciplines. Following its most destructive event in June 1997, scientists used eyewitness accounts to support reconstructions of eruptive sequences at Soufrière Hills. Since then many studies have looked to human experience of events to understand the important drivers behind effective preparedness and response. Effective communication is at the heart of these efforts.

### Closer collaboration

As the science around disaster risk becomes more citizen-centric, there is a move towards closer collaboration between scientists and citizens, and away from one-way telling of information and extractive methods of knowledge production. Evidence suggests this produces a richer, shared knowledge. Based on recent experiences, we also argue that development of the *process* of collaboration, and communication around risk topics, is as crucial as development of the communication ‘product’ itself. By process, we mean the practice of communication to understand how we learn (not only what is learned) and how we co-produce knowledge by sharing expertise.

This might sound obvious, but at the beginning of our six-year research project, ‘Strengthening Resilience in Volcanic Areas’ (STREVA), it became clear that there was very little evidence from geoscience research as to whether involving citizens and their own local knowledge might have a strong practical impact on effective risk communication. Back in 2012, as we started our research in Montserrat, we were concerned that many local residents had interview fatigue from journalists

and researchers repeatedly asking about their experiences of the eruption. Instead we simply offered a platform for people to share their stories in any way they wished to express themselves. The emotion captured by sharing experience through a song, a picture, or a film in turn evoked emotion in the audience—such powerful narratives were a strong source of knowledge and power to act.

### La Soufrière, St. Vincent

When we then started working in nearby St. Vincent, one of the strongest requests from community members and emergency managers was for us to find a means to capture and record the experiences of the generation who had experienced the sudden activity in April 1979, the last time their volcano (another Soufrière) erupted. Valuable information about the consequences of uncertainty, and emergency response during ashfall came tumbling out in those descriptions.

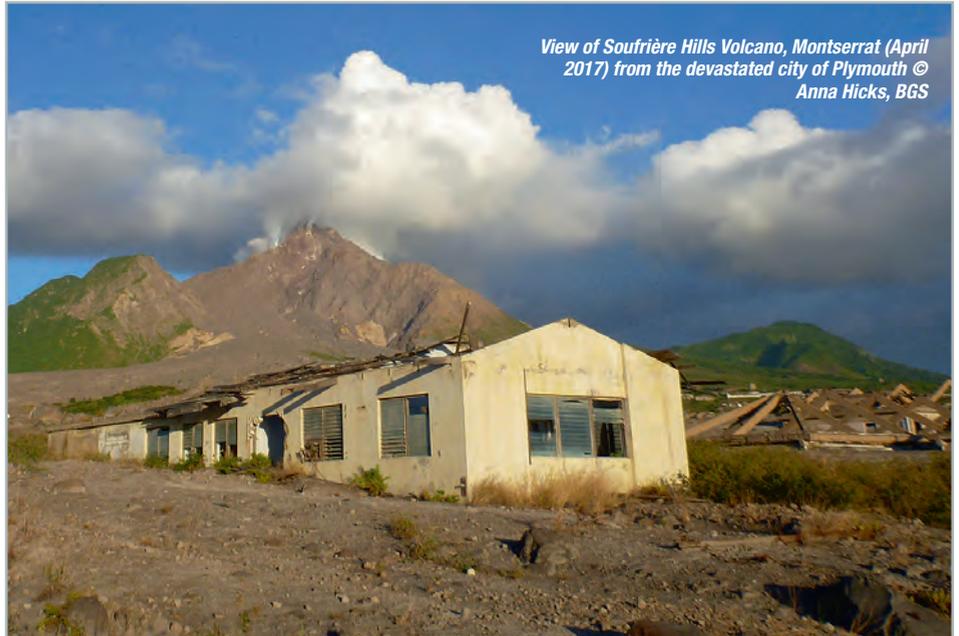
We decided to take film as an example of a communication device and record those experiences, in a way that conveyed some important messages to prepare for a future eruption. It is well documented that film can be used as a powerful and effective *hazard education tool*, but there was more limited evidence from geophysical hazard research as to the role of film (and storytelling more generally) in intervention strategies aimed at *reducing risk* to environmental threats. So we began to explore how we might use film—and the process of making a film—to engage, inform, and ultimately empower people to adapt their behaviour. Our journey started in St. Vincent (see STREVA YouTube film link), and following the film’s success in terms of audience numbers and subsequent engagement in volcanic risk reduction, in 2015 we were asked to capture stories from an eruption in Colombia—an eruption with a volcanic explosivity index of 3, the same size as La Soufrière, but with much more devastating consequences. ►

## Nevado del Ruiz, Colombia

In November 1985, the eruption of Nevado del Ruiz in Colombia shocked the world. Enormous lahars (mudflows) hurtled through ravines spreading into towns and villages around the volcano, killing over 25,000 people. While the contributing factors that caused the disaster were complex, ultimately poor communication was at the heart of the problems, as well as a lack of learning from previous events (many of the towns are built on lahar deposits that destroyed these areas in 1595 and 1845). As the 30th anniversary of the eruption loomed, engaging with a new generation that had no memory of the eruption was imperative. It was also necessary to give space for survivors to tell their stories. The Manizales-based director of geohazards at the Servicio Geologico Colombiano (SGC), Gloria Patricia Cortes remarked, “We [SGC] observed that many of the survivors, or those affected by the eruption of the 13th November 1985, had the need and willingness to tell their stories as an act of catharsis”. The emotional release through storytelling was something we also found from our research in the Caribbean.

### A focus on stories and storytellers

Our experiences from St. Vincent ensured that participants of our intended audiences



became the leading focus of our new films, guiding the viewer through their experiences of an eruption, the story of recovery, and the challenges of having an active volcano as a neighbour. The storytellers had ultimate control over what was said—potentially affording a representation of past events that more closely resemble the situation for communities at risk—but they also became co-producers of the films, sharing opinions about where to film and what they wanted to show.

“ AS THE SCIENCE AROUND DISASTER RISK BECOMES MORE CITIZEN-CENTRIC, THERE IS A MOVE TOWARDS CLOSER COLLABORATION BETWEEN SCIENTISTS AND CITIZENS, AND AWAY FROM ONEWAY TELLING OF INFORMATION



We edited the films back in the UK, but launched the films in Colombia at several local community-based film screenings. This was particularly important around Nevado del Ruiz as the volcano occupies a huge area and the communities at-risk from future eruptions reside on all sides of the volcano. Further, only sharing online would limit the reach of the films to individuals who had access to internet. Over 700 people attended the screenings. The events presented an opportunity to generate dialogue between scientists and citizens, and between the attendees themselves. Longstanding neighbours and friends began to talk about their experiences during the eruption, sharing personal stories from that tragic day and the months and years' that followed. The screenings also confirmed our hypothesis that the emotional response to the films could positively guide thinking and behaviour around risk. The powerful narrative thread and imagery had such an influence on affect, this in turn empowered people to use new knowledge (or their own knowledge) and develop preparedness efforts for future eruptions.

### A sensitive approach

Given recent events in Guatemala, it is important not to trivialise the power and the deep trauma of those experiences for communities—particularly when they have

ended in tragedy. We should not point microphones or cameras immediately at bereaved citizens; descriptions of the Nevado del Ruiz disaster were still powerful and difficult to relate 30 years later, and few people in Montserrat are comfortable discussing the fatal events openly in 1997, even now. But, the recent tragedy has served to remind us that the combination of hazardous volcanic activity with the complex social, cultural and political circumstances surrounding the volcano are what turn an eruption into a disaster. Communication processes that help remind us all of those lethal and difficult combinations—and effective means to unravel and avoid them, must surely enrich all of our understanding. ♦

**Anna Hicks<sup>1</sup> & Jenni Barclay<sup>2</sup>**  
**1. The British Geological Survey, Lyell Centre, Research Avenue South, Edinburgh, EH14 4AP; 2. University of East Anglia, Norwich Research Park, Norwich, Norfolk, NR4 7TJ; \*Correspondence ahicks@bgs.ac.uk**

### FURTHER READING

An extended list of selected references may be read in the Online version of this article. *Editor.*

Go to STREVA Youtube channel to see the video: [bit.ly/2zhrGLz](http://bit.ly/2zhrGLz)



*Teresa Armijos, a social scientist from the University of East Anglia (part of the STREVA team) and professional film company, Lambda Films, collaborating with local community members to tell their story of the 1985 eruption of Nevado del Ruiz (Nov 2015) © Anna Hicks, BGS*



*Public screening of the Nevado del Ruiz trilogy of films in the town of Lérica, Colombia (Mar 2016). Photo © James Hickey*

## ENDORSED TRAINING/CPD

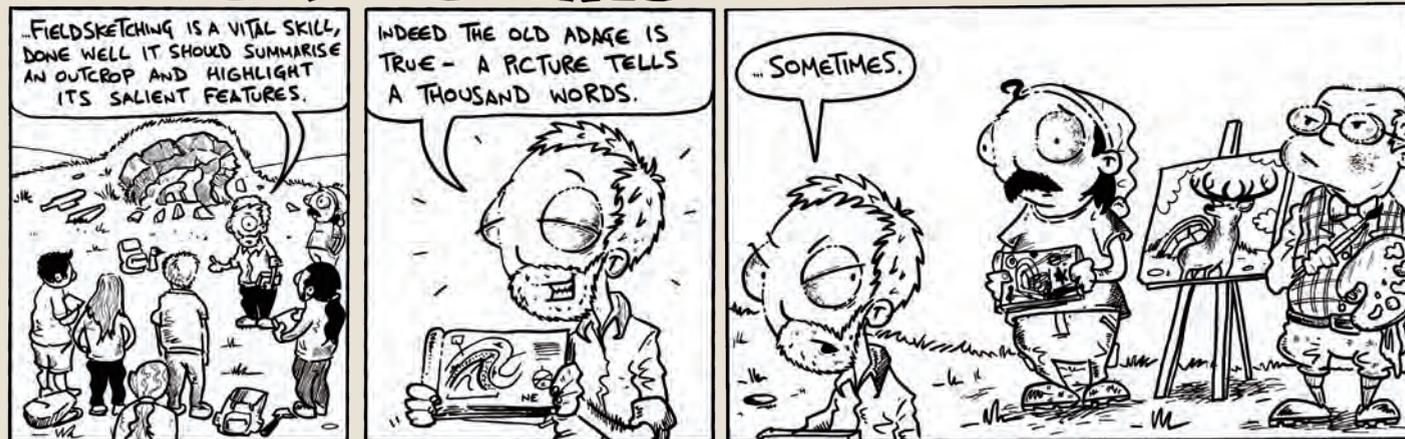
MEETING	DATE	VENUE AND DETAILS
Decoding Eurocode 7: Ground Investigation and testing course	02 - 16 AUGUST 2018	Accessed online over 5 sessions 1.5 hours each. Fees apply. See website for details and booking.
Lapworth's Logs	n/a	'Lapworth's Logs' is a series of e-courses involving practical exercises of increasing complexity. <b>Contact:</b> info@lapworthslogs.com. Lapworth's Logs is produced by Michael de Freitas and Andrew Thompson.

## EVENTS

PLEASE NOTE THAT THERE ARE MANY MORE MEETINGS FOR WHICH WE DO NOT HAVE SPACE.  
ALWAYS CHECK WITH [WWW.GEOLSOC.ORG.UK/LISTINGS](http://WWW.GEOLSOC.ORG.UK/LISTINGS)

MEETING	DATE	VENUE AND DETAILS
Drawing out the Dinosaurs: two centuries of science discovery and artistic inspiration	04 July - 27 October 2018	<b>Venue:</b> Lapworth Museum of Geology. Time: 10.00. Free. See website for details. <b>E:</b> lapworth@contacts.bham.ac.uk
Rockwatch Residential Fieldtrip to Dorset	30 July - 03 August 2018	<b>Venue:</b> Dorset. Fees apply. See website for details. <b>E:</b> rockwatchatga@btinternet.com
Rockwatch Family Activity Day at Ware Museum	14 August	<b>Venue:</b> Ware Museum, Hertfordshire. Free to Rockwatch members. See website for details. <b>E:</b> rockwatchatga@btinternet.com
6th Conjugate Margins Conference	19 - 22 August	<b>Venue:</b> Dalhousie University, Halifax, Nova Scotia, Canada. See website for registration and details. <b>W:</b> conjugatemargins.com/2018/
8th International Conference on Chemistry Education and Research	27 - 28 August	<b>Venue:</b> Zurich, Switzerland. See website for registration and details. <b>W:</b> <a href="https://chemistryeducation.euroscicon.com/">https://chemistryeducation.euroscicon.com/</a>
Rockwatch Runswick Bay Fieldtrip	28 August	<b>Venue:</b> Runswick Bay, Yorkshire Coast. Fees apply. See website for details and booking. <b>E:</b> rockwatchatga@btinternet.com

# STICKS AND STONES





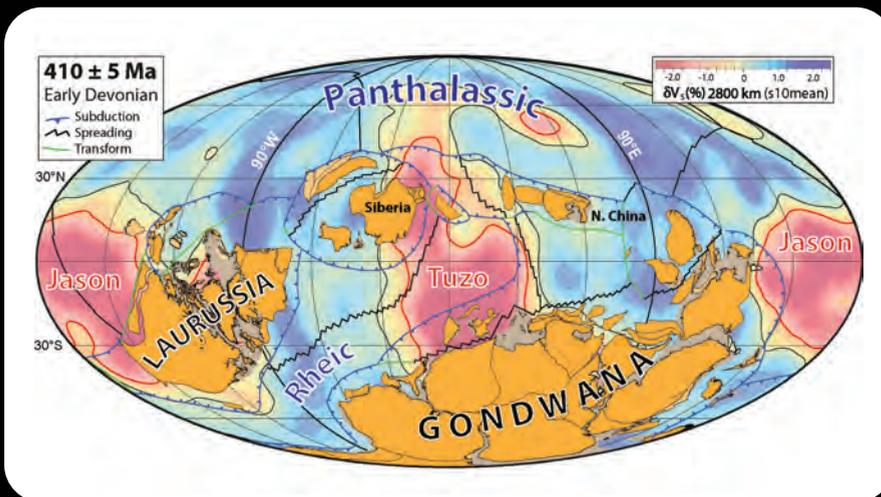
The  
Geological  
Society

servicing science, profession & society

# New Frontiers in Palaeogeography and Biogeography

21 September 2018

The Geological Society, Burlington House, London



The general acceptance of plate tectonics in the 1960s was the culmination of passionate debates among Earth scientists about Wegener's continental drift hypothesis over a century ago, and which led to a mobilistic theory for the dynamic evolution of the Earth's surface. Plate tectonics was originally developed only for the 'young' Earth (Cretaceous to Recent), but a key paper by Wilson in 1966 on the existence of a proto-Atlantic Ocean paved the way for efforts to untangle the past location of continents in pre-Mesozoic times. Palaeographic maps set the context for many aspects of Earth history, including biogeography, palaeoclimates, and the

## Invited speakers include:

Alycia L. Stigall (Ohio University)  
Grace Shephard (University of Oslo)  
Douwe van der Meer (CNOOC-Nexen)  
Richard Fortey (Natural History Museum)

## Convenors:

Conall Mac Niocaill (Oxford University)  
Trond Torsvik (University of Oslo)  
David Harper (Durham University)

## Further information:

For further information please contact:

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

T: 0207 434 9944

E: [georgina.worrall@geolsoc.org.uk](mailto:georgina.worrall@geolsoc.org.uk)

Web: [www.geolsoc.org.uk/  
palaeogeography18](http://www.geolsoc.org.uk/palaeogeography18)

 Follow this event on Twitter:  
#palaeogeography18

tectonic evolution of our home planet. The construction of such maps is best achieved through the integration of data from many sources, such as hotspots (since the Cretaceous), palaeomagnetism (including ocean-floor magnetic anomalies since the Jurassic), and the analysis of faunal distributions and biogeography (notably the identification of faunal and floral provinces), in addition to the character of the rocks themselves.

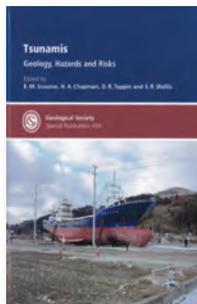
Recently-developed techniques, which pair palaeomagnetism and deep Earth structure – such as the location of subducted slabs and the source regions of mantle plumes from seismic tomography – provide new means of determining the pre-Cretaceous palaeolongitude of continents. These developments have unlocked a new way forward in developing detailed Earth geographies in deep time and this meeting aims to highlight these new opportunities to untangle Earth's intricate tectonic history, together with discussions about those challenges and controversies which remain outstanding. Expert speakers have been invited from the fields of tectonics, plate reconstructions, seismic tomography, and biogeography.

The conference is related to the 80th birthday (June 2018) of Dr. L. Robin M. Cocks and his pioneering contributions to the linkage of Palaeozoic stratigraphy and faunas to global and regional palaeogeography.

## Call for abstracts

Abstracts for oral or poster presentations are welcome. Abstracts should be approximately 500 words and include a title, authors and their affiliations. Please send your abstract as word document to Georgina Worrall by **September 1st 2018**.

## Tsunamis: Geology, Hazards and Risks



This book in the Society's Special Publication series discusses a variety of topics from reviewing tsunami hazards globally to risk modelling. The first four sections are entirely focused

on the 2011 Tohoku earthquake and the subsequent tsunami that was responsible for so much damage. Other papers examine the history of tsunami activity in locations such as Central America.

The collection is divided up into two categories: 1: tsunami hazards globally, which demonstrates the worldwide effect of tsunami activity; and 2: risk modelling, which evaluates the likelihood of tsunami hazards nationally (New Zealand is of particular focus here) and internationally. A personal and unexpected highlight was a paper discussing tsunamis that had affected the UK; a unique catalogue of events recorded through observations, tidal gauges and sedimentological deposits. As a bit of an eye opener, I was interested to learn about a list of probable tsunami events in the UK that date back as far as 1762.

Although teaching takes you a certain distance with geological topics this book expands on tsunami knowledge nicely, cutting out the chit-chat and delving straight into the scientific terminology, and assuming that the reader already has a grasp of how tsunamis function. Readers from such backgrounds as humanitarian/hazard response may find this a little jarring; however, the reader is eased in gently by the smooth writing of the articles.

As an undergraduate, I found most of the text easy to follow; the accompanying figures support the articles well. The content of papers appeals to many backgrounds due to a wide range of disciplines discussed - from geophysics to sedimentology and with a fair amount of interesting background history. On the whole, someone with basic geological knowledge should have little trouble making their way through the literature and interpreting the diagrams.

I would recommend this as an insightful read to someone who already takes an interest in the geological and historical

aspects of tsunamis, whether they be a student wishing to supplement their course, or an experienced academic. The quality of the papers is fairly consistent, each offering original data, analysis and interpretations.

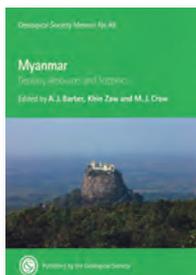
This publication brings together many unique aspects of tsunami research to create a refreshing collection that will be of interest to readers from geoscientific, technical, engineering, humanitarian and hazard related backgrounds.

Reviewed by: **Emma Smith**

### TSUNAMIS: GEOLOGY, HAZARDS AND RISKS

by E M SCOURSE N A CHAPMAN, D R TAPPIN & S R WALLIS, 2018. Published by: Geological Society of London  
252pp (hbk) ISBN: 9781786203182  
List Price: £90.00 Fellow's Price: £45.00.  
W: [www.geolsoc.org.uk/SP456](http://www.geolsoc.org.uk/SP456)

## Myanmar Geology, Resources and Tectonics



*Myanmar Geology, Resources and Tectonics*, Geological Society Memoir

No. 48 is made up of 31 chapters and an appendix on geochronology. Each chapter is a stand-

alone paper that has been assimilated into a single volume covering three related topics. Details of some of the papers present an easy-to-follow description of the tectonic setting of different mining areas throughout most the country. The introduction to the volume has a general description of some of the major mining organizations that have worked in Myanmar since the Chinese started silver mining at the Bawdwin mine site in the 15th Century. Myanmar's location and geologic evolution with respect to India, Eurasia, China, Thailand, Laos, Sumatra and the Andaman Sea from the Paleozoic to the present is discussed.

The authors note that, due to current internal conditions, not all of Myanmar is thoroughly discussed in the volume, or fully explored for mineral resources. For what is included and covered, an overview of the local geologic setting relationship between the ores and gemstones with respect to the local and

regional geology is well presented. In several places the authors discuss the relationships between different ores and ophiolites, faulting, as well as granites and limestones or sandstones. In several cases, samples of selected mines are discussed in enough detail to allow the reader to obtain a picture of the geologic setting at the mines, including how much ore had been removed, when data was available.

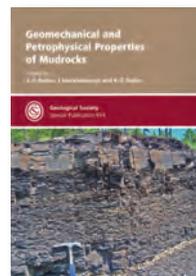
Overall, I found the volume to be an outstanding general reference for the geology, resources and tectonic description of Myanmar, including adjacent offshore areas. A suggested improvement would be a map depicting all the major mines and placer deposits for the metals and gemstones on one sheet, as a supplement to the volume. In addition, the discussion of coal, oil and gas resources is a little short and could be expanded. That said, I highly recommend this volume for anyone interested in the geology, resources and tectonics of Myanmar. The volume should be reviewed as a benchmark by anyone considering preparing a similar volume in another country or region.

Reviewed by: **Robert Anderson**

### MYANMAR GEOLOGY, RESOURCES AND TECTONICS

edited by A. J. BARBER, K. ZAW AND M. J. CROW 2017  
Published by The Geological Society, London, Memoir 48,  
ISBN: 978-1-86239-969-3  
List Price: £160.00 Fellow's Price: £80.00  
W: [www.geolsoc.org.uk/M0048](http://www.geolsoc.org.uk/M0048)

## Geomechanical and Petrophysical Properties of Mudrocks



The geomechanical and petrophysical properties of mudrocks have become a topic du jour recently, mainly due to the gas shale energy boom. Such properties are also critical for conventional

petroleum exploration and production in terms of top seal integrity, wellbore stability and pore pressure prediction for example, as well as for geological CO<sub>2</sub> storage and nuclear waste disposal. Characterisation of mudrocks as reservoirs and/or seals requires specialised



knowledge and testing equipment due to the response of clay-bearing materials to changes in saturation, fluid composition, effective stress and microstructure. Most sealing mudrocks are rich in clay minerals with small pore throat sizes and high ductility, while the so called gas shales tend to be rich in organic matter and low in clay, allowing them to better sustain natural and induced fracture systems.

This GSL special publication stems from a 2015 conference. There are a number of high quality papers researching laboratory properties of these materials with a couple more focusing on modelling. There is little in the volume however investigating these properties at a larger scale and 'petrophysics' as used here is a misnomer for physical properties (e.g. porosity and permeability) rather than traditional petrophysical log evaluation. As this volume came into being from a conference, this is likely a reflection of submitted content, and does not detract from the extensive laboratory-based research presented.

The volume is divided into three sections, the first covers petrophysical properties, the second part is on microstructure and mineralogy, and along with a third section covers fractures. There is a relatively even split between water saturated over/underburden mudrocks and gas shales. Determinations of porosity and permeability in mudrocks feature strongly, with links made to the impact of stress and microstructure, the latter in the main having SEM images of high quality. Lithology and pore structure effects are also covered, with impacts in areas ranging from engineering geology to shale reservoirs. The section on fracturing covers laboratory experiments, field scale seismicity and hydraulic fracture modelling, generally applicable to shale reservoirs.

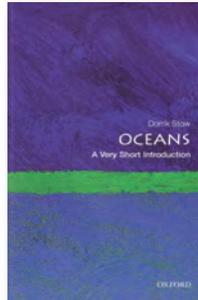
The papers are well set out, the vast majority of the diagrams are clearly visible and easy to read with the liberal use of colour throughout a bonus. This book would be a good read for specialists working on mudrocks for various applications and also for people wanting to know more about the topic as the reference lists throughout are very comprehensive.

Reviewed by: **David Dewhurst**

#### GEOMECHANICAL AND PETROPHYSICAL PROPERTIES OF MUDROCKS

by RUTTER E.H., MECKLENBURGH, J., & TAYLOR, K.G. (editors). Geological Society of London Special Publication No 454. 2017. Geological Society of London. ISBN 978-1-78620-316-8. Hbk. 368pp. ISSN 0305-8719  
List Price: £120.00 Fellow's Price: £60.00  
W: [www.geolsoc.org.uk/SP454](http://www.geolsoc.org.uk/SP454)

## Oceans: A Very Short Introduction



This pocket-size book condenses a lot of information into 150 or so pages. The author is oceanographer and sedimentologist Dorrik Stow, professor at Heriot Watt University and

publisher of over 250 research papers. In keeping with the idea behind OUP's long-running 'A Very Short Introduction' series, the text is clean and clear. Most of the precise, technical words that decorate geological literature have been replaced by simpler words or phrases. Importantly, this makes the book available to a far wider audience. I found it an interesting, but worrisome, read.

Oceans cover 71% of our planet; and we still know very little about them. Over the past 50 years, scientists have been gathering information at an ever increasing rate, and now know enough to indicate the presence of quite a few deposits we might choose to exploit.

In some areas, vast fields of a frozen mix of methane and ice lie only metres below the seabed. Manganese nodules found on the deep sea floor are not yet viable for their manganese alone, but may prove viable as the source of a 'pot pourri' of metals including copper, nickel and cobalt, as well as minor amounts of zinc, lead, vanadium and molybdenum along with the manganese. Narrow, elongate, deposits of metal-rich muds have been found beneath hot brine pools. Some of them are potentially mineable for lead, copper, zinc, and silver. Hydrothermal vents, found along the crest of the mid-ocean ridge system, sometimes form chimneys of condensed metal sulphides, comparable in mineral content to the largest metal sulphide deposits mined on land.

Of course, underwater drilling is not new, but as shallow deposits are exhausted we are drilling deeper. Stow tells us that, in the last decade, over 50% of oil and gas discoveries have been in the ocean deeps. Rigs routinely drill to depths of 2500 metres.

Add these factors to the already worrying issues of ocean plastic, coral reef

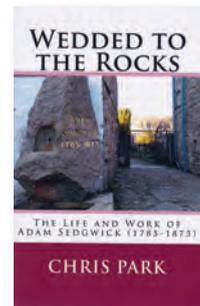
bleaching, and global warming, and the situation could move rapidly from bad to worse. This book needs promoting and updating annually.

Reviewed by: **David Edwards**

#### OCEANS: A VERY SHORT INTRODUCTION

by DORRIK STOW. Oxford UP 2017. 216pp, sbk.  
List price: £7.99. W: <https://global.oup.com/academic/product/oceans-a-very-short-introduction-9780199655076?cc=gb&lang=en&>

## Wedded to the Rocks: The Life and Work of Adam Sedgwick



Timed to coincide with the bicentenary of Adam Sedgwick's election to the Woodwardian professorship, Chris Park's *Wedded to the Rocks* is an eminently readable introduction to the life and work

of one of the most famous geologists of the mid-19th Century.

Son of a Cambridge educated vicar, born and bred in Dent, Cumbria, Adam Sedgwick rose through the 'ranks' of Trinity College Cambridge to become a Fellow in 1810 and tried to settle into teaching mathematics. However, when the Woodwardian professorship fell vacant in 1818 and despite knowing little geology, Sedgwick thought that the profession of geology would improve his health and provide an opportunity for intellectual advance in a way that teaching mathematics would not. Although, poorly remunerated at 100 pounds a year and with a prerequisite of bachelordom or 'domestic sterility', as Sedgwick called it, he applied and was elected.

Park ably shows how Sedgwick did indeed become 'Wedded to the Rocks' and used his 55 year-long tenure of the Woodwardian chair to transform the study of geology in Cambridge and build a major collection of geological materials, now housed in the Sedgwick Museum, which was opened as a memorial to him in 1904.

From 1890, the main source of information on Sedgwick's life and work has been the Clark and McKenny Hughes monumental two-volume 'Life and Letters etc.'. Being

Sedgwick's successor as Woodwardian professor, Hughes wrote a rather uncritical work designed to rescue Sedgwick's geological reputation and especially his work on the Cambrian, which had been all but obliterated from the record by his erstwhile collaborator Murchison.

Since then, the most notable popular account has been Speakman's 1982 'Adam Sedgwick: Geologist and Dalesman', which gave new information about Sedgwick's upbringing in the Dales. Long out of print, this useful little book is now republished by the Yorkshire Geological Society and Gritstone Writers Co-operative Ltd (145p. ISBN 9780995560949).

More recently, several historians of science have discussed Sedgwick and his work in various different contexts. And while Park uses many of these sources, 'Wedded to the Rocks' follows a fairly traditional chronological approach. This focuses successively on Sedgwick the Dalesman, Cambridge man, the Geologist, Churchman and old man, which is ideal for readers wanting a readable and not overly academic account.

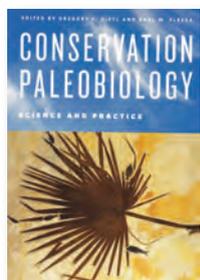
Although Sedgwick was a major contributor to the development of British geology in the early decades of the 19th Century he did not perhaps contribute as much as he could have. He was always promising to write a major work on the Palaeozoic geology of Britain but never managed to do so.

Reviewed by: **Douglas Palmer**

**WEDDED TO THE ROCKS: THE LIFE AND WORK OF ADAM SEDGWICK (1785-1873)**

by CHRIS PARK, 2017. Published by Chris Park, 329p (pbk) ISBN 9781548851705  
 List price £7.50, available from  
 W: [www.amazon.co.uk](http://www.amazon.co.uk).

## Conservation Paleobiology: Science and Practice



For centuries it was axiomatic that understanding the present is key to understanding the geological past. Geoscientists have awakened, however, to the realisation that

mankind has had an enormous effect on the present, whole ecosystems being impacted during at least historical times. Conservation ecologists have likewise realised that their own work is severely challenged by anthropogenic impacts. Modern ecosystems, on which ecologists and palaeoecologists alike have long modelled their work, are under great and unique stresses due to anthropogenic pressures. Habitats are being destroyed and climates are changing rapidly. How, then, should conservationists respond to such pressures? How can they maintain ecosystems while changing abiotic pressures (water supply, temperature) are affecting those ecosystems? What should the conserved or restored ecosystems look like? And how might palaeoecologists contribute to this work?

Conservation palaeobiology can assist by determining the past nature of present ecosystems, and so ascertaining what their normal state should be. This subject matter is the crux of this book, an expanded reprint of the proceedings of a short course titled Conservation Biology, Using the Past to Manage the Future. Given that 24 of the 26 authors are from the USA, a North American bias is to be expected. Nevertheless, the authors do an interesting job of assessing different ecosystems (terrestrial, aquatic, marine) at different time scales. They use geochemical, body and trace fossil evidence to suggest how we might use knowledge of ancient ecosystems and their food webs to manage and preserve present day ones. They also address the issue as to whether past ecosystem states are suited to our modern and changing climate.

This book abounds with case studies. Smol argues that we should assess what aquatic nutrient levels were prior to European style agriculture, and aim to restore such levels. He implicitly assumes that the First Nations people had no impact. Conversely, Jackson and McClenachan argue that historical records are too short, pre-Columbian humans having impacted marine tetrapod, fish and mobile invertebrate faunas. The subject of Pleistocene rewilding – the need to look back at the last interglacial – is addressed, as is the impact of the loss of megafauna on such projects. Near natural habitats existing only in isolated national parks, the authors discuss assisting migration between them. The fossil record is used to suggest what should be moved where, and at what rate. The final chapter is an informative

round-table discussion. This fascinating book is a must read for all involved with palaeobiology, ecology and environmental management.

Reviewed by: **Brent Wilson**

**CONSERVATION PALEOBIOLOGY: SCIENCE AND PRACTICE**

by DIETL, G. P. AND FLESSA, K. W. (Eds), 316 p. Published by The University of Chicago Press, ISBN 978-0-226-50672-2 List Price: £30.00 W: [bit.ly/2th7lu](http://bit.ly/2th7lu)

### BOOKS FOR REVIEW

Please contact [amy.whitchurch@geolsoc.org.uk](mailto:amy.whitchurch@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](http://www.geolsoc.org.uk/reviews)

- ◆ **NEW! Advances in Karst Research: Theory, Fieldwork and Applications** by M. Parise, F. Gabrovsek, G. Kaufmann & N. Ravbar (eds). GSL SP466 2018, 486 pp. hbk.
- ◆ **NEW! Reservoir Quality of Clastic and Carbonate Rocks: Analysis, Modelling and Prediction** by P.J. Armitage, A.R. Butcher, J.M. Churchill, A.E. Csoma, C. Hollis, R.H. Lander, J.E. Omma & R.H. Worden (eds). GSL SP435 2018, 464 pp. hbk.
- ◆ **NEW! Volcanic and Igneous Plumbing Systems: Understanding Magma Transport, Storage, and Evolution in the Earth's Crust** by Steffi Burchardt (ed). Elsevier 2018, 341pp. pbk.
- ◆ **NEW! Rockslides and Avalanches of Central Asia: Distribution, Morphology, and Internal Structure** by Alexander Strom & Kanatbek Abdrakhmatov. Elsevier 2018, 449pp. pbk.
- ◆ **The First Global Integrated Marine Assessment: World Ocean Assessment 1 (United Nations)**, by L. Ijnnick & A. Simcock (coordinators), Cambridge UP 2017, 973pp. hbk.
- ◆ **Circum-Arctic Lithosphere Evolution** by V. Pease & B. Coakley (eds), GSL SP460 2018, 476pp. hbk.
- ◆ **Subseismic-scale Reservoir Deformation** by M. Ashton, S.J. Dee & O.P. Wennberg (eds), GSL SP459 2018, 216pp. hbk.
- ◆ **Subterranean Norwich: The Grain of the City** by Matthew Williams. Lasse Press 2017, 160pp. sbk.
- ◆ **Geochemistry and Geophysics of Active Volcanic Lakes** by Ohba et al. GSL SP437 2017, 295pp. hbk.
- ◆ **Chesapeake Perspectives: Decoding the Deep Sediments: Ecological History of Chesapeake Bay** by Grace Brush. Maryland Sea Grant 2017, 63pp. sbk.
- ◆ **Tectonics of the Deccan Large Igneous Province** by Mukherjee et al. (Eds), GSL SP445 2017, 363pp. hbk.

# READERS' LETTERS

## *Missed opportunities with a misplaced example*

Dear Editor, I read with great interest the Soapbox piece by Michael Ridd (*Geoscientist*, June 2018). I fully agree that the Geological Society should be a venue where we can tackle controversial issues. However, I feel the use of climate change as an example, is misplaced. The scientific evidence for human-induced climate change is irrefutable.

From my perspective, there are huge controversial issues around climate change – but not whether it is happening, or whether humans are responsible. Rather, the debate should focus on how we can solve it. And this must involve a far wider pool of people than just climate change scientists. The challenge for us is to decarbonise our global economy by around 50 years' time. To do this, we need action now, and over the next decade. Having a debate on whether climate change is real or not passes this important opportunity and may contribute to holding up the progress that is urgently needed.

I welcome the Geological Society having a meeting on climate change solutions, including how the oil and gas sector can lead the low-carbon transition. That really could be an important contribution by the Society and its members.

MARTIN SIEGERT

## *No controversy – just bogus scepticism*

Dear Editor, With the greatest of respect, I am afraid Dr Ridd has fallen foul of at least two talking points that former BBC journalist, James Painter, has proven to be predominantly a feature of right-of-centre media in English speaking countries. The two most obvious fallacies implied in Dr Ridd's remarks are: (1) The marketplace of ideas and; (2) Climate Change 'sceptics' are like Galileo. With regard to (1) not all opinions are equally valid; and there is no rational reason to doubt the validity of a genuine consensus of expert opinion supported by a wealth of theoretical prediction that has now been validated by numerous independent lines of observational data. With regard to (2) Galileo used the genuine scepticism that is the basis of modern science to overturn an archaic and unscientific explanation for the nature of the Universe that was increasingly in conflict with accumulating observational evidence.

As suggested by James Painter, therefore, the significance of the journalistic distribution of supposed climate change 'scepticism' is this: It proves that it is not genuine scepticism at all. On the contrary, it is wilful ideological blindness akin to the dismissal by young earth creationists of any evidence that the Earth is very old on the basis that all such evidence must be wrong because it is not consistent with their antecedent beliefs.

Sadly, many scientists have already concluded that humanity is in danger of sharing the same fate as the proverbial frog that does not hop out of the saucepan of warming water because the rate at which the temperature is rising is not sufficiently large until it is too late. I hope, however, that they are wrong...

MARTIN LACK



## *Watson the walls?*

Dear Editor, I have been attending lectures in the main lecture theatre of the Geological Society of London in Burlington House for many years. The theatre became, by popular acclaim, 'The Janet Watson Lecture Theatre', and was graced by a fine Hesketh portrait on the front wall for all to see – of Janet apparently listening wisely to the presentations and deliberations.

Then, suddenly, a year or so ago, she disappeared! I wondered 'Has JW gone on a field trip to North West Scotland, or what?'

I was told 'she has been taken down [...] She will be coming back. It's something to do with a review of space within Burlington House.'

Currently a preliminary sketch of her has appeared in a corner on a side wall. It is a very nice sketch but not the lovely portrait, nor is it in a prime position. I, and many others who knew her, or simply enjoyed the portrait, would be pleased to see her back. Is that possible? If so when?

RICHARD DAWE

## *Merit of the Coke medals*

Dear Editor, The article by Marie Edmonds (*Geoscientist*, June 2018) gave a useful account of the Society's medals and awards. However, it is guilty of a serious omission, which has been perpetuated in the Society for the past few years.

In 1983, when the Society decided to institute the two Coke medals, following the most generous bequest from Lt. Col. Coke, I clearly recall it being recorded that these two medals were to be regarded as of equal status to the Lyell and Murchison medals; the only difference being that in the case of the Coke medals contributions to geology could include factors other than pure research.

This is ignored in Marie Edmonds' article and the society is equally guilty by referring at the President's Day of having the 'three senior medallists' to speak.

I trust that the Society will not forget the enormous benefit it received from the Coke bequest and that it will take steps to restore what was Council's clearly stated intentions in 1983 and accord the Coke medals their intended merit.

JOHN CW COPE

▶ **Geoscientist** welcomes readers' letters. These are published as promptly as possible in *Geoscientist* Online and an edited selection printed each month. Please submit your letter (300 words or fewer, by email only please) to [amy.whitchurch@geolsoc.org.uk](mailto:amy.whitchurch@geolsoc.org.uk). Letters will be edited and condensed for print. For references cited in these letters, please see the full versions at [www.geolsoc.org.uk/letters](http://www.geolsoc.org.uk/letters)

## DISTANT THUNDER

### *Explosive relationship*

#### **Geologist and science writer Nina Morgan discusses a hot topic**

With explosive eruptions taking place in Hawaii and Guatemala, volcanoes are all in the news these days. Back in the 18th and early 19th centuries, the pioneering volcanologist, Sir William Hamilton [1730–1803] was in the news too—but for all the wrong reasons.

Hamilton, son of Lord Archibald Hamilton, a lord commissioner of the Admiralty, and Lady Jane Hamilton, a mistress of the robes to the Princess of Wales, arrived in Naples as the British envoy to the Neapolitan royal court in 1764. Soon after his arrival, Vesuvius went into an eruptive phase, and Hamilton became hooked. By 1778 he was an ‘addict’, confessing in a letter to his nephew, Greville, “I am mad

on the subject of volcanoes”.

During the Vesuvius eruptions of 1767, 1779 and 1794, Hamilton made more than 65 ascents of the crater to observe and record the volcanic activity. He also studied Mount Etna on Sicily and shipped a large number of volcanic rock, ash and lava specimens to London. He was elected a Fellow of the Royal Society in 1766, and his observations and drawings of the volcanic activity were published in the *Philosophical Transactions* between 1767 and 1795, earning him the nicknames ‘the modern Pliny’ and the ‘professor of earthquakes’. He was awarded the Copley medal by the Royal Society in 1770 for one of his papers on volcanology.

#### **Picture book**

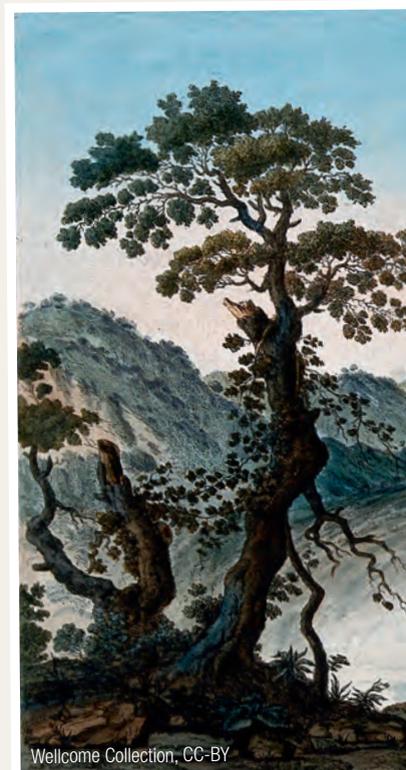
After publishing a book of *Observations on Vesuvius* in 1772, which included five illustrative plates and a map, Hamilton went on to create a definitive guide to Vesuvius, a book he hoped “may perhaps

render every other account of the late Eruption superfluous”. The main text consisted of Hamilton’s letters to the Royal Society, both in English and his own French translation. But it is the pictures rather than the words that proved to be the real highlight of the book. These included the 54 hand-coloured illustrations based on sketches made, *in situ*, by the Anglo-Neapolitan artist Pietro [Peter] Fabris, and individually coloured by local artists, under Hamilton’s personal supervision.

This great work was published in 1776 under the title *Campi phlegraei: Observations on the Volcanoes of the Two Sicilies*. The book’s title refers to the area around Naples known as ‘flaming fields’. Complete copies of the book are rare today, because the gouache-coloured plates proved so popular that they were often torn out and displayed as souvenirs in their own right.

#### **Popular imagination**

In spite of his pioneering studies on volcanism, Hamilton is



Wellcome Collection, CC-BY



Image credit: Wellcome Collection, CC-BY



probably best known in popular imagination as the cuckolded husband of Emma, the mistress of the married naval hero, Captain Horatio Nelson [1758–1805]. After Hamilton's first wife, Catherine, whom he described as 'an amiable and true friend' died in 1782 in Naples, Hamilton, in his grief, requested leave to return to London for a time. There he met Emma Lyon, then mistress of Hamilton's nephew, Greville. Hamilton was smitten, and Greville, wanting to replace Emma with a wealthy wife, encouraged the attraction. One thing led to another and Hamilton and Emma were married in London 1791. Emma's notorious loose morals created havoc with Hamilton's reputation, and her first encounters with Nelson in 1793 marked the end of Hamilton's diplomatic

career. By 1800 Emma was already pregnant with Nelson's child, and both Nelson and the Hamiltons returned to London. There Nelson abandoned his wife and went to live in a *ménage à trois* with the couple in a rented house in Piccadilly. The resulting scandal hit the headlines and the trio were ostracized by the court and polite society. Hamilton died in London in 1803, with Emma and Nelson at his side.

How Hamilton really felt about the loss of his diplomatic career and the scandalous publicity that ensued is hard to assess. But when it came to volcanoes, he was clearly keen to put himself into the picture. In a number of Fabris's illustrations for Campi phlegraei Hamilton appears prominently, dressed in a red coat.

### ► Acknowledgement

Sources for this vignette include the DNB entries for Sir William Hamilton by Geoffrey V. Morson and for Lady Emma Hamilton by Tom Pocock; *Aesthetic geology—Sir William Hamilton's 'Campi Phlegraei'*, which appeared on Dr Ralph Harrington's *Volcanism Blog*, posted on 14 June 2008 at <https://volcanism.wordpress.com/2008/06/14/aesthetic-geology-sir-william-hamiltons-campi-phlegraei/>; and the Glasgow University Library Special Collections Department Book of the Month for October 2007, available at <http://special.lib.gla.ac.uk/exhibns/month/oct2007.html>.

\* **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](http://www.gravestonegeology.uk)



### The Society notes with sadness the passing of:

Barnes, Simon James \*  
Booth, Tony \*  
Bowen, Geoffrey Gordon \*  
**Fletcher, Brian** \*  
Gladwell, David Robert \*  
**Ince, David Martyn** \*  
Kenna, Raymond \*  
**Matheson, William** \*  
Milward, Anthony Frederick \*  
Morgans, Michael William \*§  
Pegg, Eric Arnold \*  
Smith, Howard James \*  
Thomson, Martyn Hugh \*

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

If you would like to contribute an obituary, please email [amy.whitchurch@geolsoc.org.uk](mailto:amy.whitchurch@geolsoc.org.uk) to be commissioned. You can read the guidance for authors at [www.geolsoc.org.uk/obituaries](http://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](http://www.geolsoc.org.uk/obituaries).

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**OBITUARY** Robert Nathan Ginsburg 1925-2017

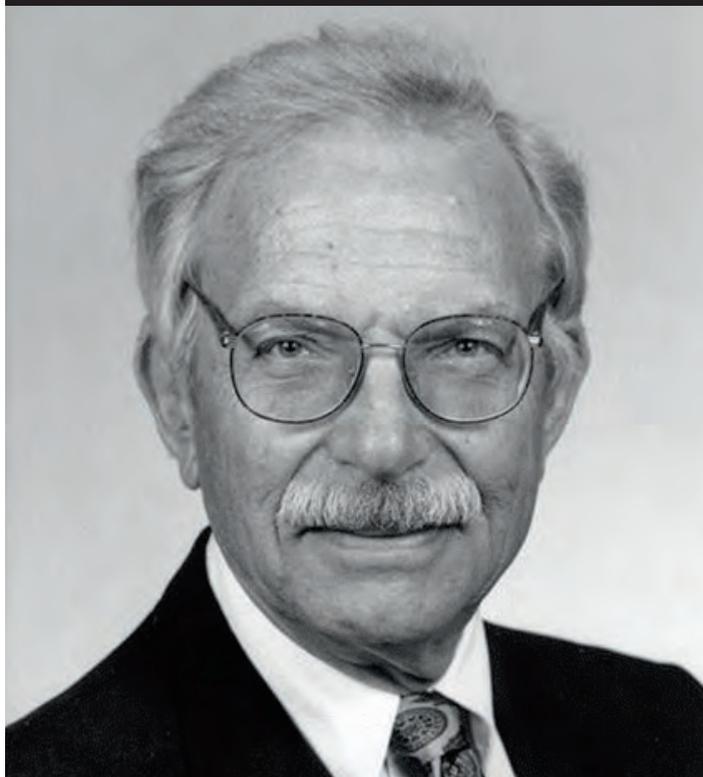
**B**ob Ginsburg was a geologist who studied carbonate sediments, their genesis, deposition, and transformation into mature rocks. He defined the profession of carbonate sedimentology and was one of the most influential thinkers in his field, working in both industry and academia, retiring at the age of 85.

His career began in 1950 when he left the University of Chicago to become a research assistant at the University of Miami's Marine Laboratory, the precursor of the present Rosenstiel School of Marine and Atmospheric Science (RSMAS). Subsequently he moved first to establish and lead a research and training program on carbonates for the Shell Development Company (1954–64), then to become Professor of Geology and Oceanography at The Johns Hopkins University (1965–70).

**Miami**

In 1970, Bob was persuaded by Cesare Emiliani to come back to the University of Miami as Professor of Sedimentology. At that time, he organized the T. Wayland Vaughan Laboratory for Comparative Sedimentology headquartered on ocean-facing Fisher Island at the entrance to the Port of Miami. In 1991, the University sold Fisher Island and Bob moved fulltime to the RSMAS campus. At RSMAS, he continued to develop and pursue new avenues, exchanging his role as head of

**Carbonate sedimentologist who defined his profession and was one of the most influential thinkers in the field**



the Sedimentology Laboratory for an effort to spearhead the assessment of declining coral reefs in the Caribbean. In this new direction, he touched an entire new generation of scientists.

His first published paper, 'Intertidal Erosion on the Florida Keys' (1953), appeared soon after his arrival in Miami. The paper was a harbinger of his future career as it questioned the prevailing chemical explanation for shoreline erosion by offering a biological alternative. In the following half century, with his associates, post-doctoral fellows and students, he has authored a series of

“BOB GINSBURG'S INFLUENCE UPON THE STUDY OF CARBONATE ENVIRONMENTS HAS BEEN IMMEASURABLE

seminal papers, books and reports on the links between contemporary and Holocene processes and products of carbonate deposition and their fossil counterparts.

**Dolomite**

These publications have ranged from the formation

of dolomite, precipitation of cements in reefs, health of coral reefs, sedimentation and history of carbonate platforms, and stromatolites. These studies, combined with countless field trips and lecture tours in North America, Europe, North Africa and Australia, have had a significant worldwide influence on research, teaching and our understanding of the petroleum potential of carbonate deposits. A measure of this impact is the awards of Fellowship in the American Association for the Advancement of Science and the Geological Society of America, the Twenhofel Medal of the Society for Sedimentary Geology, the Sorby Medal of the International Association of Sedimentology and honorary membership in four professional societies.

Bob's impact on his profession was immense, but he was also an inspiring teacher and the principal adviser for more than 20 graduate students, as well as numerous postdoctoral associates. While some of his students and postdocs stayed at home in Miami, others have become distinguished teachers and geologists throughout the world. It would almost be understated to say that Bob Ginsburg's influence upon the study of carbonate environments has been immeasurable.

► By Peter K Swart

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# OBITUARY **Walter Ziegler 1927-2017**

**W**alter Ziegler was born in Winterthur, Switzerland.

His father was a doctor who was interested in nature and encouraged his four children to follow the same subject. They took holidays in the Jura mountains, where Walter made his first observation of anticlines and started collecting fossils. Another influence was a family friend - an oil geologist who recounted his exciting experiences from Burma to South America.

## **ETH Zurich**

Walter went to boarding schools when war broke out, and there one of his teachers drew his attention to the natural world of mountains, rocks, plants and animals. In 1947, Walter took a course in natural science at ETH in Zurich but also had to undertake mandatory military service. He won a doctorate in 1955, before taking his first job with the Institut Français de Pétrole in Paris where he was engaged in mapping the Sahara of Algeria, largely with the help of air photographs, which he found a bit boring. Walter accepted an offer to work for Exxon in Canada, where he joined a field party mapping a remote area in the Rocky Mountains, having many colourful experiences. The company eventually decided it was better to import cheap oil from Venezuela than map the uncertain prospects of the Rocky Mountain foothills, giving Walter his first

**Swiss petroleum geologist responsible for prospecting in Canada, Europe and Africa, and who became Foreign Secretary of the Society**



appreciation of the economic factors influencing the oil industry.

In 1964, Walter transferred to the company's office in Geneva to use his Canadian experience to try to explore Triassic prospects in Austria and the southern Alps. He then spent time in Spain, Germany, Belgium and parts of Africa, before being recalled to Calgary. There he undertook sophisticated work, involving geochemistry to determine where oil and gas were generated and seismic stratigraphy to evaluate the prospects, but it became evident that most of the large fields in western Canada had

already been found.

## **Foreign Secretary**

Back working in Spain, Walter made many trips to Africa, evaluating the prospects of onshore basins, which had limited potential. An unexpected discovery in the northern North Sea prompted a new study of offshore opportunities and Walter was appointed Chief Geologist of an office in England to evaluate them. He enjoyed life in Britain and started his second marriage in 1974, being duly blessed with a son. He was also elected to be Foreign Secretary of the Geological Society.

In 1983, the company closed its office and offered Walter a transfer to Houston as frontier manager, but he decided to resign, as the company seemed to be losing interest in world exploration. Walter joined the Belgian company Petrofina. He helped build expertise in basin modelling, being duly offered a position in the head office in Brussels.

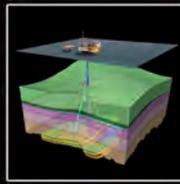
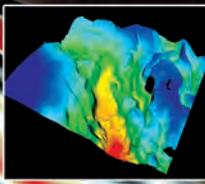
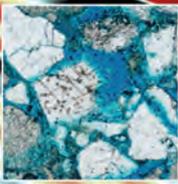
## **Lausanne**

He retired in 1992 and returned to Switzerland with his wife to live in a beautiful house near Lausanne, located in vineyards overlooking Lake Geneva with a backdrop of the Alpine mountains that had so captivated his imagination in childhood. With advancing years, the house became too much to manage. In 2007, Walter and his wife moved to a top floor apartment in Lausanne, also with spectacular views. Walter had become aware of resource limits and the nature of depletion, which led him to play an active part in the Swiss branch of the Association for the Study of Peak Oil.

Walter had a very good and friendly personality, being much admired by friends and those who worked with him. He liked classic cars and used the internet to stay in touch with friends to his final days. He led a very successful and colourful life.

► By Colin Campbell

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# Communicating Geoscience: Building Public Interest and Promoting Inclusive Dialogue

4 September 2018

The Geological Society, Burlington House, Piccadilly, London



Science communication can be difficult, with explanations of complex subsurface concepts and the use of scientific terminology often alienating those we seek to engage with. This is especially true when the energy industry engages the public regarding its activities, products and role in society, which can inspire a passionate and often polarised reaction. There is often a mistrust towards science experts and a bias towards industry, including those who undertake industry-funded research. While science communication can be challenging, it is a key tool to build trust, dispel myths and provide up-to-date scientific knowledge.

This conference aims to look in-depth at geoscience communication in the energy industry to better achieve effective public engagement. This includes evaluating case studies, establishing best practice and understanding the value of public perception. Speakers are invited from both industry and academia, and represent a range of disciplines, including oil & gas exploration, CCS, shale gas and geothermal energy. The conference will conclude with a panel discussion and a drinks reception to facilitate networking.

For further information or to register as a virtual delegate, please contact:

Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG.

T: +44 (0)20 7434 9944 or email: [sarah.woodcock@geolsoc.org.uk](mailto:sarah.woodcock@geolsoc.org.uk)

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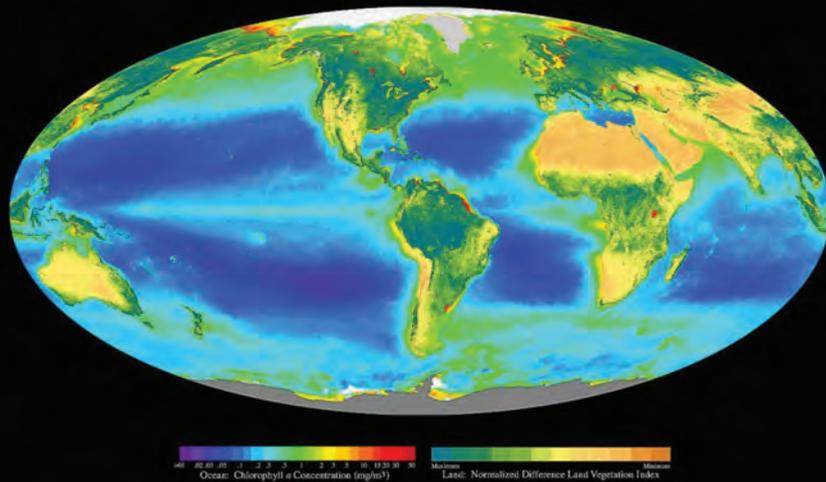
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# Earth System transitions

## How resilient is the biosphere?

17-18 January 2019 | The Geological Society, London



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### Further information

For further information please contact:

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### The Geological Society, London

#### Earth System Science special interest group

#### Biosphere Evolution, Transitions & Resilience (NERC research programme)

In an era of rapid technological innovation, opportunities exist to improve efficiency and quality of resource estimates; both developing trust and encouraging investment in mining projects. Forming part of the Year of the Resource, this conference aims to provide a forum for resource estimate practitioners to meet and discuss new developments and advances in mineral resource estimation and reporting.

#### The four main themes of this meeting are:

- Earth system transitions: the Precambrian
- Earth system transitions: the Palaeozoic Era
- Earth system transitions: the Mesozoic and Cainozoic eras
- How resilient is the biosphere – key notes and discussion.

### Call for abstracts

We welcome oral and poster abstract contributions for this meeting. To be considered for a slot in the programme or a poster presentation, please send an abstract of no more than 500 words to [georgina.worrall@geolsoc.org.uk](mailto:georgina.worrall@geolsoc.org.uk), no later than Friday 30 November 2018.

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