

GEOSCIENTIST

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Climate control

Sediment routing systems in California

BEYOND GDP

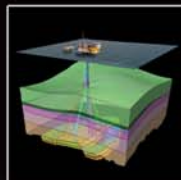
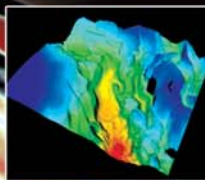
How to devise a progressive measure of economic success

CURIOUS HETEROMORPH

We explore Wolfgang Grulke's private collection of wonders

WHIN WIN

A classic British geosite gets a world class visitor centre



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Call for Abstracts – 31 October 2014

Recognising the Limits of Reservoir Modelling

4-5 March 2015

Elphinstone Hall, University of Aberdeen

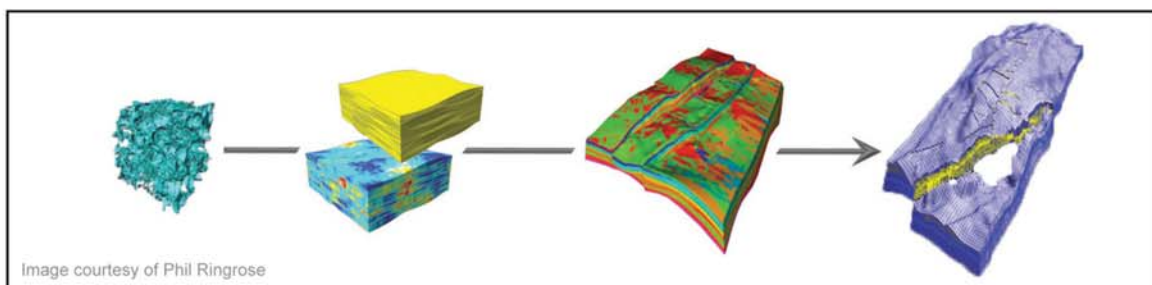


Image courtesy of Phil Ringrose

Nearly 20 years ago a paper describing some then best-practice reservoir modelling included this statement in the concluding section: "The parameters that we used to fine-tune this match were the well connection factors, the well skin factors and the relative permeability curves".

Can we honestly claim to have made progress from that situation?

Geoscientists and petrophysicists labour hard at reservoir characterisation. We are seduced by precision and enticed by the sophistication now offered by software. Meanwhile, we have become habituated to permeability multipliers, pore-volume multipliers, adjustments to the relative permeability curves and to modifying fault properties (up to and including their existence), and use the resulting models to support major capital investment decisions.

So what have we actually learned in the 20 years since geocellular modelling arrived on our desktops? Can we turn all that hindsight around into useful foresight? In situations where we cannot learn from the history-match, what can we learn from history? What are the most frequent failings of our geomodels?

Now that geomodelling is a mainstream activity, our attention moves to finding effective approaches to support investment decisions; multi-scenario, multi-scale modelling with multi-phase upscaling represents an ideal but requires smart and nimble application to be practical and efficient.

This conference seeks warts-and-all tales of reservoir models that eventually became accurate; descriptions of iteration between reservoir characterisation and reservoir performance; stories of managing small-scale heterogeneity in large scale models. The conference seeks to recognise the limits of our current workflows and chart a way forward to more accurate, useful and efficient reservoir modelling practices.

Contributions are invited on current reservoir modelling cases and techniques, dealing with:

- Handling incomplete or imperfect data – *modelling data or concepts?*
- Reconciling and integrating multi-scale data in models – *dealing with gaps*
- Multi-scale modelling – *rather than single detailed models*
- Impact of heterogeneity on fluid flow behaviour – *what matters to flow?*
- Conditioning to production data in mature fields – *how to iterate effectively*
- Advanced gridding and simulation techniques – *breakthrough technologies*
- Linking reservoir models to commercial decisions – *adding value through modelling*

Call for Abstracts:

Please email paper and poster contributions to laura.griffiths@geolsoc.org.uk and Richard.Sech@chevron.com by 31 October 2014

For further information please contact:

Laura Griffiths, The Geological Society, Burlington House, Piccadilly, London W1J 0BG. T: 020 7434 9944

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www.geolsoc.org.uk/petroleum





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Careers Day 2014

Wednesday 5 November 2014 - Keyworth, Nottingham

www.geolsoc.org.uk/careersday14

Careers in Earth Science 2014

Wednesday 26 November 2014 - Edinburgh

www.geolsoc.org.uk/careersearch14

Contact Information

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Burlington House, Piccadilly, London W1J 0BG

T: 0207 432 0981 E: naomi.newbold@geolsoc.org.uk

Follow these events on Twitter: #GSLcareers14



8TH PETROLEUM GEOLOGY
OF NORTHWEST EUROPE
CONFERENCE 2015

Call for abstracts

Deadline: 28 November 2014

The Queen Elizabeth II Conference Centre, London
28 – 30 September 2015

Petroleum geology of Northwest Europe: 50 years of learning – a platform for present value and future success

Key themes:

- Standing on the shoulders of giants – what we have learned from past successes and how do we transfer our knowledge effectively
- Finding and developing more oil and gas in a mature basin and discovering new plays
- The future – what we still do not know and how we can embrace these challenges

Conference organised by:



Visit www.PetroleumGeologyConference.com to
submit an abstract.

For further information please contact Vickie Naidu at:
e: vnaidu@energyinst.org; t: +44 (0)20 7467 7179

PETEX 2014

18 - 20 November 2014, ExCeL, London

Celebrating 25 Years 1989 - 2014

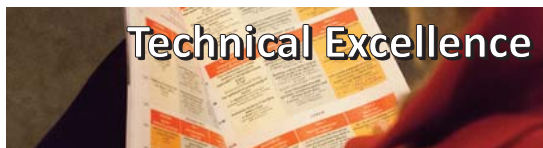
Event Information

Largest Ever Exhibition



PETEX is the largest subsurface-focussed E&P conference and exhibition in the UK, attracting thousands of delegates from across the world and across a spectrum of industry sectors, from supermajors to consultancies. Exhibition space is already 90% sold out, featuring the ever popular International Pavilion.

Technical Excellence



This year PETEX is celebrating 25 years of technical excellence. We're promising a comprehensive programme illustrating the latest global activity in exploration, field development, reservoir management and unconventional exploitation, in addition to the latest developments in the North Sea.

There will also be a special interactive Session, called the PETEX Forum consisting of a panel of experts who will debate on the technical aspects of hydraulic fracturing in the UK.

Following the success from last time, PETEX will again host the Petroleum Geoscience Research Collaboration Showcase, which this year will be moving into a larger area.

Lively Social Programme



PETEX has a rich social programme with an event on every evening - all of which are included in your standard ticket price.

We are particularly pleased to say that the Wednesday night Evening Excursion will be returning in 2014, bigger and better than ever before!

To register, or for more information: www.petex.info

Keep up to date with us on.....



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“EASTERN CALIFORNIA IS A BRILLIANT PLACE TO STUDY SEDIMENT ROUTING SYSTEMS IN ACTION”

Front cover image

FROM THE EDITOR'S DESK:

Reviews 'online first'

The fact that you're reading this
now, in October, when our
Twitter followers learned of it
in August when it happened,
neatly illustrates the point
I am about to make.

Announcements of the death of print
have been exaggerated beyond all
reason since online publication first
became 'a thing'. As with all media
revolutions, the way this one is playing
out is turning out to depend on how
readers use publications, and the
particular advantages offered by
different methods of delivery.

One obvious bonus of online
publication (there are many others) is
immediacy. To a print magazine with a
lead-time of one to two months (and,
for some slots with long waiting lists,
like *Books & Arts*, considerably longer
than that) the chance to get time-
sensitive material into the public
domain early is irresistible.

With so many new avenues of
communication opening up, the print
version of *Geoscientist* has had to adapt
and respond. We have stopped, for
example, running 'GeoNews' pages in
the print mag; and our obituaries,
which are published at a maximum rate
of two per month, have been published
'online first' for several years.

As the magazine has shifted its
emphasis towards long-form writing,
review and opinion, we have found

ourselves faced one of those problems
of success - so much more pleasant to
have to deal with than the other sort.
The growing popularity of our
reviews section has led to the
submission of even more books for
review. Since we are limited in print
to a maximum of four per month, a
considerable backlog of reviewed
titles has lately begun to build up.

A recent survey of reviews in hand
and in prep revealed that we had a
queue six months long, with a further
18 months' worth of books currently
out there with our volunteer
reviewers. Clearly, something had
to be done.

So, on August 13, 'Geoscientist
Reviews Online' went live.
Thenceforth, as with obituaries, all
reviews of books, plays, films and
other arts have been posted online
as soon as they are received.
This new system will also allow us to
be a little more selective about the
reviews that are eventually given
space in print, and so help us ease
the backlog further.

We know you value your print
Geoscientist, and (as with all 'non-
essential' reading matter) print still
offers the only viable medium.
We expect it to remain so. Meanwhile,
we shall continue to make the most of
online opportunities, to bring you an
ever better service.

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

SOCIETY NEWS

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



Nominations for Council

Would you consider standing for election to Council? If so, we would like to hear from you writes **Edmund Nickless** (Executive Secretary).

Are you willing to contribute to the work of the Society not only by becoming a member of Council and one of its standing committees but also by serving on working groups and undertaking particular tasks between meetings? Whatever your background and expertise in geoscience, membership of Council enables you to influence the role of the Society in acting as a respected voice, serving society and the geoscience profession.



Each of Council's 23 members is a Society Trustee. The trustees are the Council, accountable to Fellows and other stakeholders and regulators, such as the Charity Commission. The prime responsibility of trustees is to oversee the affairs of the Society and to act prudently in the management of its financial resources.

Meetings

Council meets five times a year, usually on a Wednesday. Four take place in the afternoon (14.00-17.00). Papers are circulated a week in advance. There is also a two-day residential meeting in late September beginning on the afternoon of the first day and finishing mid-afternoon of the following day. Its purpose is to allow Council to discuss issues such as strategy, business planning and so on.

All Council members also serve on one standing committee – Science & External Relations (to which Science Committee and External Relations Committee report), Publications & Information, Finance & Planning and Professional. Standing committees usually meet in person quarterly – though some have developed the practice of having three in-person and one virtual meeting.

From time to time, all standing committees may establish short-lived working groups, which could impose a further call on the time of Council members; but in agreeing to stand for Council you should think of a time commitment of eight to 10 days annually (for ordinary members of Council).

By being elected to Council and by serving on a standing committee you will be able to play an active role in the formulation and delivery of the Society's scientific and professional strategy; help facilitate the communication of new scientific findings; foster engagement with and translation of knowledge and expert advice to society, policy makers and government, and the certification of good practice in the geoscience professions and in geoscience teaching.

Nominations

With this month's *Geoscientist* you have received two nomination forms – one for the election of new Council members and the other for President Designate. Details of the nomination process are given on the forms (and also in the 'Governance' section of the website). Nominations must be received **no later than noon on Friday, 9 January 2015** and will NOT be valid unless they are fully completed, signed and accompanied by a statement from the nominee.



Image: Matt Gibson / Shutterstock.com

LONDON LECTURE SERIES

Geoheritage and the UK's most significant geological sites

Speaker: Rob Butler (University of Aberdeen)

Date: 15 October

This lecture will celebrate the launch of '100 Great Geosites', to coincide with Earth Science Week 2014.

Programme

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

Further Information

Please visit www.geolsoc.org.uk/gslondon **lectures14**. Entry to each lecture is by ticket only. To obtain a ticket please contact the Society around four weeks before the talk. Due to the popularity of this lecture series, tickets are allocated in a monthly ballot and cannot be guaranteed.

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

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➤ Please return to **Prof Alan Lord**, c/o Executive Secretary, The Geological Society, Burlington House, Piccadilly, London W1J 0BG



Ten young candidates with mentors Bob Sas, Sarah Cooper (Training Officer), Stuart Pugsley, Simon Pyle, Andre Mazur & Kevin Styles (Chairman, Training Committee) pictured at the Golden Dragon near the Fugro Wanchai Office

NEWS IN BRIEF

Future meetings

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

- OGMs: 26 November 2014;
4 February 2015; 8 April 2015
- Council: 26 November 2014;
4 February 2015; 8 April 2015

Geological Society Club

The Geological Society Club, successor to the body that gave birth to the Society in 1807, meets monthly (except over the field season!) at 18.30 for 19.00 in the Athenaeum Club, Pall Mall, or at another venue, to be confirmed nearer the date. Once a year there is also a buffet dinner at Burlington House. New diners are always welcome, especially from among younger Fellows. Dinner costs £57 for a four-course meal, including coffee and port. (The Founders' Dinner, in November, has its own price structure.) There is a cash bar for the purchase of aperitifs and wine.

2014: 15 October.

2015: 4 February (Burlington House - buffet); 4 March (Athenaeum); 8 April (Venue tbc); 6 May (Athenaeum)

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

Sponsor a Fish

Thanks to everyone who has so far donated to our appeal to conserve and digitise the three thousand watercolours from the fossil fish collection of Louis Agassiz. More information about the appeal can be found at www.geolsoc.org.uk/sponsorafish

► The library is open Monday-Friday 09.30-17.30
www.geolsoc.org.uk/library

Chartership news

FUGRO in Hong Kong Delivers a Unique CGeol Training Scheme, writes Adler deWind.

The Fugro Group in Hong Kong has developed a unique Training Scheme bringing together the skills and experience of FUGRO's consultancy, specialist marine & onshore ground investigations and material testing services. More than 10 young multi-national Hong Kong-based Geologists will enter the scheme and receive mentored training at FUGRO (HK) Ltd,

FUGRO Geotechnical Services Ltd (FGS) and Material Lab (MATLab). Fugro are one of the leading private employers of geologists in Hong Kong with currently some 30 geoscience staff.

Speaking from Hong Kong, Kevin Styles, (Chairman, Training Committee) said, "We are very excited that The Geological Society has accredited our scheme and are most grateful for the support of the Chartership Division during the process."

Accreditation Officer (Second announcement)

The post of Accreditation Officer will become vacant with the retirement of the present incumbent, Dr Colin Scrutton, in 2015.

The Society, therefore, seeks applications for the post of Accreditation Officer from 1 May 2015, or as soon as possible thereafter.

The post involves the processing of applications for the accreditation and reaccreditation of first degrees and taught MSc programmes in geosciences (www.geolsoc.org.uk/Education-and-Careers/Universities/Degree-Accreditation), arranging meetings of the Accreditation Panel and maintaining the lists of accredited programmes for the Society's website. The postholder is also responsible for recruiting members to the Accreditation Panel.

The ideal candidate will have experience of the planning and assessment of degree programmes and have a good knowledge of the present Higher Education system and the changes it is undergoing (and has recently undergone). The work requires considerable attention to detail in the manipulation of course descriptions and make-up, so that this can be presented

intelligibly to the Panel for decision. He/she will also be required to interface with universities to ensure that applications are presented in a way that satisfies the requirements of the Society's Accreditation scheme and also be able to explain what changes might be required by the Panel to meet those criteria. Further details of the work involved can be obtained from Dr Scrutton (Colin.Scrutton@dunelm.org.uk), who will be available for support during the changeover period.

The post would suit an academic geoscientist about to retire or considering switching to a part-time academic post. The applicant should be a Fellow of the Society and either Chartered or prepared to apply for Chartership if appointed. The post is part-time and remuneration is based on a daily rate.

- Applicants should send a letter of application outlining their interest in the job and relevant experience, together with their curriculum vitae by email to the Executive Secretary, **Edmund Nickless** (edmund.nickless@geolsoc.org.uk) to arrive no later than noon, 31 October 2014



CLIMATE CONTROL

Mitch D’Arcy*, who received a Society fieldwork research grant, on sediment routing systems in eastern California

The Earth's surface is made up of 'sediment routing systems', natural conveyor belts that transport eroded sediment from upland areas to depositional basins. Sediment may travel via landslides, debris flows or streams before being deposited, and these processes are links in a chain that starts with mountain bedrock and ends in the stratigraphic record. For geologists, understanding these systems is fundamentally important because they determine the locations, volumes, rates, and characteristics of sedimentary deposits.

Eastern California is a brilliant place to study sediment routing systems in action. The Sierra Nevada is a dramatic belt of rising mountains and deeply incised catchments that export sediment into the subsiding Owens Valley below to construct vast alluvial fans. Owens Valley is semi-arid today, with the fans fully exposed (apart from a sparse covering of desert shrubland). Drive east for a couple of hours through landscapes that might look more at home on Mars, and you'll reach Death Valley, which is even drier. Here, you can find more alluvial fans built from pebbles freshly eroded from the Cambrian limestones of the Grapevine Mountains. For anyone interested in how the Earth's surface is eroded, these systems have an appealing simplicity because you can see from the highest peaks of the catchments to the lowest toes of the alluvial fans. The landscapes are pristine, the surfaces barren, and ancient stream beds lie virtually untouched for tens, sometimes hundreds, of thousands of years.

Imagination

This simplicity is good for the imagination, and makes it easy to ask questions about sediment routing systems. If you could turn a dial and make it rain more - or less - what would happen to these mountains? Would doubling the rainfall erode twice as much sediment? How about accelerating basin subsidence? What if you covered the tops of the catchments with pine forests, periodic glaciers, or more thunderstorms?

We don't really know the answers to any of these questions, and we have a lot to learn about the sensitivities of various landscapes to climate and climate change. Recently, numerical models have given us ideas to test and clues about where to look for the answers, but we need empirical field data to make sense of them. We know that



Left (clockwise from top): Powerful debris flows are common in Owens Valley.

These destructive events can transport large volumes of boulder-rich sediment and debris for kilometres, threatening towns, roads, farmland, and infrastructure

Author Mitch D'Arcy pictured in Death Valley. Death Valley is extremely arid, and the alluvial fan deposits are very well exposed. Ancient stream sediments dating back to the wetter glacial period have been virtually untouched for tens of thousands of years

Opposite page: Alluvial fans in Owens Valley are dominated by debris flow deposition. Gravel channels are lined by characteristic levees rich in large boulders, and surface deposits can lie exposed for more than 100ka

volumetrically-closed systems are good places to start, because sedimentation is rapid and basin deposits form a complete stratigraphic record of how their sediment routing systems have evolved through time.

The mountain catchments and alluvial fans of Owens Valley and Death Valley fit the bill. They experienced powerful climate shifts during the last glacial cycle¹, and many of their sediments have been extensively dated using modern techniques like cosmogenic nuclide exposure dating^{2,3}. We visited these valleys in November-December 2013 to sample the alluvial fans and look for evidence of past climate changes recorded in their stratigraphy and sedimentology.

Gravel grains, desert rains

In Owens Valley, the alluvial fans mantling the Sierra Nevada range front have largely been built by debris flows. These powerful events have carved a maze of channels across the fan terraces and paved them with granite boulders and gravel. There are many ways to study these sediments. As a starting point, we measured the grain-size ►

“FOR ANYONE INTERESTED IN HOW THE EARTH'S SURFACE IS ERODED, THESE SYSTEMS HAVE AN APPEALING SIMPLICITY”



Sierra Nevada mountain catchments and Owens Valley, California



► distributions of the gravels left behind by ancient debris flows, because these should be intrinsically linked to both sediment sources and transport processes.

We recorded the grain-size distributions of gravels deposited on 36 dated alluvial fan terraces in Owens Valley, which have been deposited throughout the last ~140ka. As such, they should capture any climate signals from the last glacial cycle. The valley is semi-arid now, but 25ka ago it was much cooler and wetter. There was a large pluvial lake, pine and juniper woodland where today there is desert shrubland, and mountain glaciers in the catchments that have since melted away¹.

Our grain size measurements capture past climate changes at high resolution. The debris-flow sediments dating to the glacial period are consistently finer, and coarsen - more than doubling in average clast diameter - as the climate warmed and dried into the Holocene. Debris flows are often assumed to be chaotic, but we have found that over 10^{4.5} year timescales the grain-size distributions of their deposits are highly correlated with regional palaeoclimate records.

It may even be possible to use these sediments as terrestrial records of past climate changes themselves, once we know how to read them. In California, debris flows are typically runoff-induced mass flow events triggered by large storms, and we know that their properties are largely controlled by the maximum intensity of storm rainfall. Therefore, the climate signal preserved in the

sedimentology of these debris flow deposits may partly record a time series of past storm intensity in the Sierra Nevada.

Broken boulders

Geological fieldwork is hugely rewarding for many reasons. Often it is the only way to collect empirical data to test theoretical ideas, and is simultaneously a focused learning experience. Fieldwork can bring surprises too, and ours came in the form of fractures dissecting granite boulders lying on the alluvial fan surfaces. We noticed that these weathering cracks tended to be wider in boulders on the older terraces; not an astonishing observation after tens of thousands of years of weathering, but one with important implications.

We measured the widths of hundreds of boulder cracks on dated terraces, and when we plotted them against their independently-constrained exposure ages^{2,3} we found a very strong, linear correlation for the past 140ka. The widths of these cracks can be used as an age calibration for exposure dating, at least here in Owens Valley, and that's potentially very useful for establishing high resolution chronostratigraphies in the field. We didn't arrive in Owens Valley expecting to measure the ages of the deposits with a ruler, but you never know what you'll find.

Death Valley's dead rivers

Fascinating as debris flows are, a range of other processes operate in mountain catchments. Are they all equally sensitive

to principal drivers of environmental change, such as climate? We sampled more alluvial fans in Death Valley that are dominated by stream-flow and therefore experience different sediment transport dynamics from the debris flow fans in Owens Valley. Some theoretical models predict that the rates of grain size fining from apex to toe on an idealised alluvial fan might be partly determined by climate⁴.

To test this, we measured down-fan grain size transects on three different fan systems in Death Valley, where exposed surfaces date back to the wetter glacial period as well as modern arid conditions⁵. These alluvial fans are very different from those in Owens Valley, yet our early results indicate that climate change - at least a change in the rainfall budget - matters here as well, and that it can determine the grain-size fining rate on alluvial fans.

The sedimentary archive is our main record of the Earth's environmental history, but decoding it is not easy. While the grain sizes of basin sediments will not tell us everything about hazardous debris flows and catchment processes, they are a good starting point. Grain size data can record changing sediment sources and transport mechanisms, and form one step in analysing the relationships between climatic changes and landscape responses.

These data can turn terrestrial deposits into quantitative time series, and in California's deserts they reveal



Far left: The alluvial fans in Death Valley show dramatic incision, with cliffs of ancient stream deposits being cannibalised by Holocene channels

Left: Granite boulders in Owens Valley are commonly dissected by weathering fractures that are gradually enlarged over tens of thousands of years. They widen at a measurable rate, meaning they can be used to estimate the ages of surface deposits



Boulder-rich debris flow deposits in Owens Valley

that these landscapes are sensitive to climate change over short timescales. Alongside improving our ability to interpret basin stratigraphy, the past may be our key to understanding the future. How has sediment erosion and deposition responded to past environmental changes? How long did the effects last, and when did they occur?

The answers to these questions are of fundamental interest not only to geologists, but to the people who live in steep and arid landscapes, because they will give us clues about how continued warming might affect the hazards associated with destructive processes like debris flows, landslides, mudflows, and floods. ♦

* **Mitch D'Arcy** is a research student at Imperial College London. To find out more about applying for a Society fieldwork grant, visit www.geolsoc.org.uk/grants

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The grain size distributions of gravel deposits left behind by ancient debris flows correlate with palaeoclimate records. Deposits dating to the glacial period are finer-grained (16), while modern and interglacial deposits are measurably coarser



The tops of these cliffs are stream sediments deposited on the alluvial fan approximately 70 ka ago, which have been subsequently incised by 50 metres. The layered carbonate bedrock of the parent catchment can be seen in the background

BEYOND GDP



Image: iStockphoto / Shutterstock.com



**Kristin Vala
Ragnarsdottir and
the ASAP team***
explore the hidden
links between
geology, economics
and well-being

Above: Women harvesting salt at lake Sambhar, Rajasthan, India. How is economic growth improving poor workers' quality of life?

When it was conceived, Gross Domestic Product ('GDP') was a useful signpost on the path to a better world. Increased economic activity meant jobs, income, and basic amenities to reduce worldwide social conflict and prevent a third world war. But now, economic activity has created a world very different from the one faced by global leaders at their 1944 Bretton Woods, New Hampshire, meeting to design the post-war global economic order. We live in a world overflowing with people and man-made capital, where emphasis on growing GDP, consumption and economic activity is leading the world towards increasing instability, natural resource depletion and environmental degradation, while developing nations still need to lift people from poverty.

As John Kenneth Galbraith once

observed: 'to furnish a barren room is one thing. To continue to crowd in furniture until the foundation buckles is quite another'¹. More than 150 years ago, John Stuart Mill noted that, once assured decent living standards, human efforts should be directed to *mental* culture, the pursuit of social and moral progress, and the increase of leisure, rather than a never-ending struggle for material wealth and status^{2,3}.

GDP basis

Societal goods need natural resources that are converted through work and energy. The underlying basis of Gross Domestic Product (GDP) is the market value of all officially recognized final goods and services produced within a country in a year. 'GDP per capita' is often considered an indicator of a country's standard of living. GDP, however, does not directly measure

“EMPHASIS ON GROWING GDP, CONSUMPTION AND ECONOMIC ACTIVITY IS LEADING THE WORLD TOWARDS INCREASING INSTABILITY, NATURAL RESOURCE DEPLETION AND ENVIRONMENTAL DEGRADATION”

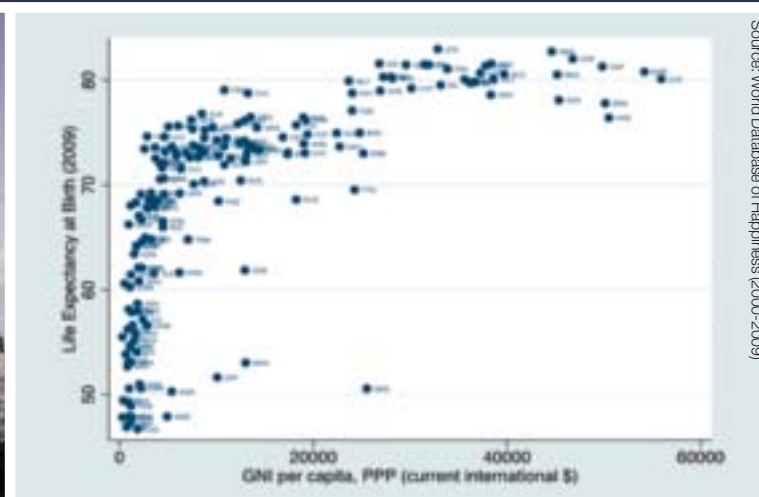


Figure 1: Gross National Income per capita and Life Satisfaction in 148 Nations, 200-2009

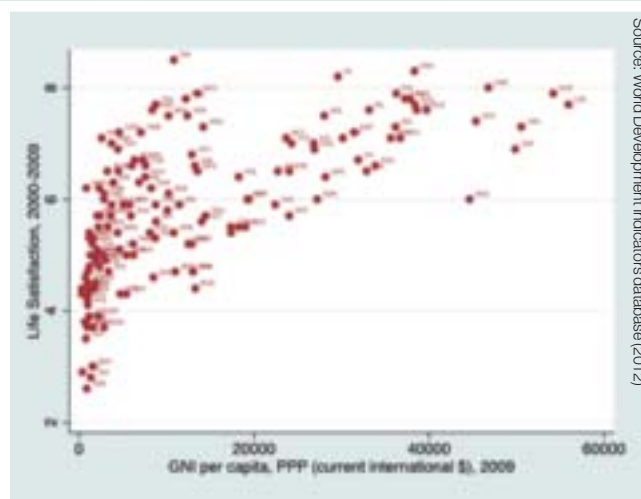


Figure 1: Life Expectancy at Birth in 175 Nations, 2009

societal well-being or happiness, as numerous authors have shown. Research shows that while money does buy well-being for the poor, and wealthier individuals are on average happier than poorer ones, above a certain income level more money does not make people any happier⁴.

Nations with a higher gross national income (GNI) enjoy, on average, better health (longer life expectancy) and wellbeing (higher life satisfaction) than poorer ones (Figure 1), but after a certain threshold of *per capita* income, more wealth does not necessarily make them healthier and happier. Although wealth is necessary for reducing human misery, it is only valuable up to a certain point. Thereafter it does not generate further improvements either in health conditions or quality of life.

Significant research on alternative indicators continues. We, at the Alliance

for Sustainability and Prosperity, believe it is time to build the consensus necessary to move beyond GDP towards better measures of sustainable and equitable prosperity of people and their well-being.

Natural resources and GDP

Natural resources provide raw materials for conversion through work and energy into goods that have higher value than those raw materials. They form the basis for GDP growth, and this is where geologists come in. They know where, and how, Earth resources have been formed, can quantify reserves and predict how long they will last.

Oil geologist King Hubbert predicted in the 1950s that oil production would peak around 2000⁵. Peak oil production was actually achieved in 2006⁶. More recently, my co-workers and I have shown peak production curves for dozens of natural resources^{7,8,9,10} (see S1,

page 14). The production of nearly all of these has either peaked already or will peak before 2050. This has serious consequences for technology development this Century. This historical research has also demonstrated a link between resource discovery peak, production peak, wealth peak and when costs overrun wealth (S2, Online). There is a 20-40 year period between the production peak of a nation's natural resources, and the point where the wealth of those nations starts to fall.

Governments around the globe are waking up to this world of limited resources. In using resources and transforming them into goods, capital stocks are built up that add to the wealth of present and future generations. With a global population of 7.2 billion and rising, our current resource-use means that the chances of future generations - and developing countries -



Image: mangostock/Shutterstock.com

View of a favela and the city in Rio de Janeiro, Brazil. Countries with bigger income differences between rich and poor also see greater prevalence of a wide range of health and social problems

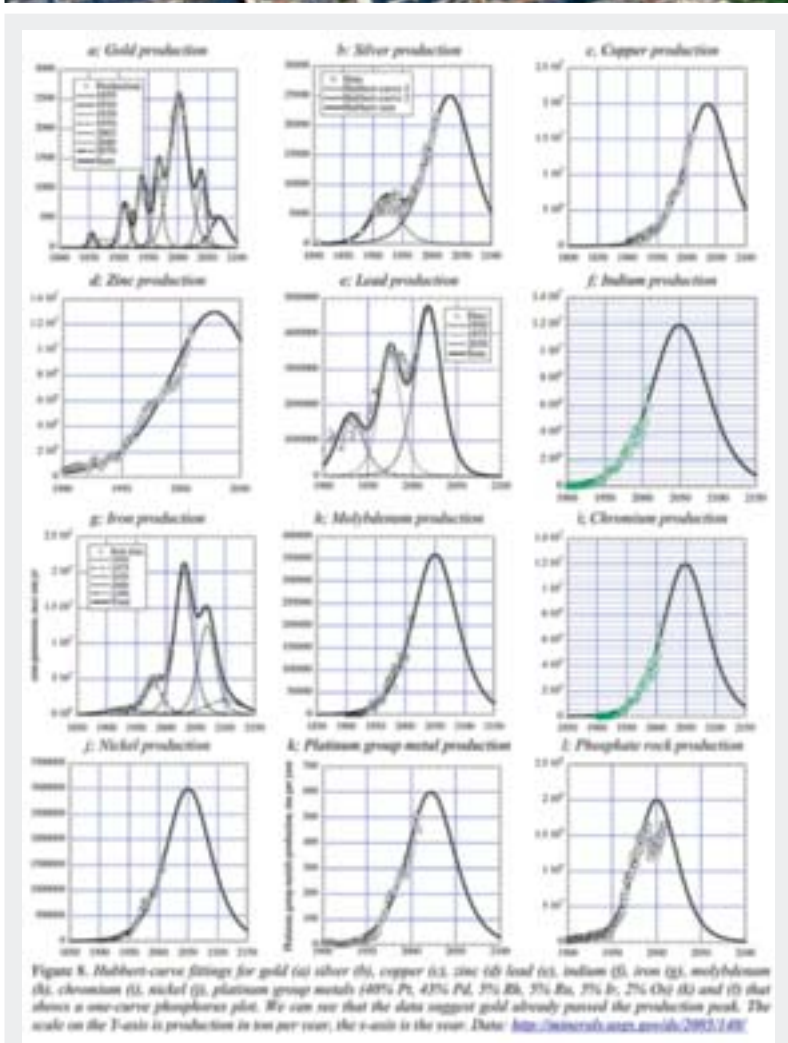


Figure S1: Twelve resource Hubbert peak curves. Curves show the peak production of gold, silver, copper, zinc, lead, indium, iron, molybdenum, chromium, nickel, platinum group metals and phosphate rock. Production of all 12 resources will peak by 2050



Image: Felipe Frazao/Shutterstock.com

Beef production in the Amazon Basin – delivering a double whammy to the global climate

► to have access to their fair share of scarce resources are endangered.

Moreover, the consequences of that continued resource-use may induce serious damage, beyond the carrying capacity of the environment. These effects may be aggravated once the developing world has taken up growth and resource-use at levels similar to those of already industrialized countries¹¹.

As Herman Daly, former World Bank senior economist, once observed: the expectation that we can overcome the physical limits of economic growth by 'angelizing' the GNP is a myth (we would need to become angels before doing so, he explained)¹². It follows that the progress of nations needs new indicators, and work is needed to underpin prosperity without growth³. It is finally becoming broadly recognized that maximizing GDP, which was never meant to measure societal well-being, is no longer an appropriate goal for national policy^{13,14,15,16,17}.

GDP – progress indicator

It has often been observed that if GDP goes up so do jobs, and since politicians care about jobs, GDP was deemed a proxy for well-being – a false conflation. Although no single measure will satisfy all purposes, GDP gained enormous power to influence national and international economic policy because of the broad consensus surrounding its measurement, over many years and countries¹⁸. However, GDP only measures market transactions; conflates costs and benefits, and completely ignores distribution of income and external social and environmental costs and benefits.

If a business used GDP accounting it

would try to maximize 'gross revenue' and ignore everything else - hardly a smart or sustainable approach. As Robert Kennedy once said: '[GDP] measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country; it measures everything, in short, except that which makes life worthwhile'¹⁹. There is therefore a critical need for alternatives that have similarly broad consensus.

New indicators

Communities, countries, and the planet as a whole, need ways to track progress toward meeting shared goals in order to achieve them. A key prerequisite is establishing what those shared goals are²⁰.

One suggested framework is that of finding steps toward equity within limits²¹, which shows (Figure 2) how the global South needs to move from the present day (increasing resource use and decreasing equality - quadrant 1) to decreasing resource use and increasing equality (quadrant 3) while supporting the global South to increase equality and resource use (quadrant 2b) on their way to quadrant 3.

While discussion continues, broad agreement is emerging that societal goals should include a high quality of life that is equitably shared, both within and between nations, and is ecologically sustainable. GDP cannot measure progress toward this goal, since it only measures the aggregate level of marketed production and consumption - with nothing about neither non-marketed contributions to quality of life (voluntary work, bringing up children). Nor does GDP address distribution of consumption, or sustainability.

How then can we measure progress toward these broader goals? A number of alternatives have been proposed over the years (S3 - Online). These can be divided into three broad groups: (1) measures that modify economic accounts to address equity and non-market environmental and social costs/benefits; (2) measures that use weighted indices of 'subjective' indicators based on survey results; and (3) measures that use weighted indices of a number of 'objective' indicators.

Some indicator alternatives are intended as explicit alternatives to reliance on GDP that address some of its shortcomings (S3). They cover annual income, net savings, and wealth, respectively. All three elements should form part of an integrated treatment of

societal well being, but here we focus on income since it is most directly comparable with GDP.

The Index of Sustainable Economic Welfare (ISEW) was first developed by Herman Daly and John Cobb¹³ and later slightly modified and renamed the Genuine Progress Indicator (GPI)²². GPI starts with Personal Consumption Expenditures (a major GDP component) but adjusts it using 24 other components, including income distribution, environmental costs, and negative activities such as crime and pollution, among others. GPI also adds positive components that are left out of GDP, including the benefits of volunteering and household work²³. By separating activities that diminish welfare from those that enhance it, GPI better approximates sustainable economic welfare²⁴.

Inequality

It is important to note the influence of the distribution of income on well-being. It is clear that there are decreasing marginal returns to income. A pound's worth of increased income to a poor person produces more additional well-being than a pound's increased income to a rich person. Also, if salaries across the board go up by, say, 3% per year, then a low salary of, say, £20,000 and a high salary of £80,000 will double at the same time (23 years - $70/3$) producing a low salary of £40,000 but a high salary of £160,000. That is as relevant to income differences within societies as to those between countries at different levels of development.

However, within societies inequality also has important psycho-social effects. As Plato (424-348 BC) noted: "there should exist among the citizens neither extreme poverty nor excessive wealth"²⁵. Since then, many others have regarded inequality as divisive and socially corrosive - as emphasized by the French Revolution. Now that we have the data to compare income distribution in different countries, Plato's intuition turns out to be profoundly true: inequality damages the social fabric of societies, reduces trust and weakens community life^{26,27,28}.

But its effects on well-being go wider than that. Countries with bigger income differences between rich and poor also see greater prevalence of a wide range of health and social problems - including more violence, less good physical and mental health, more drug abuse and higher levels of imprisonment^{29,30}. ►



Figure 2: A framework proposed for convergence. The scenario shows how the global South needs to move from quadrant 1 to 3 while allowing the global South to move via quadrant 2b

“GDP ONLY MEASURES MARKET TRANSACTIONS; CONFLATES COSTS AND BENEFITS, AND COMPLETELY IGNORES DISTRIBUTION OF INCOME AND EXTERNAL SOCIAL AND ENVIRONMENTAL COSTS AND BENEFITS”



- And the fact that societies with bigger income differences also have lower social mobility means that income inequality entrenches the inequalities of opportunity facing young people^{29,30,31}.

While the effects which larger income differences have on rates of health and social problems are greatest among the poor, evidence suggest that few if any sections of society remain untouched by their social or economic effects.

As well as having such important effects on the well-being of populations, greater inequality poses a serious obstacle to sustainability because large income differences amplify status competition and so intensify consumerism (and hence resource use). If we are to reduce consumerism we need to reduce inequality. Lastly, more unequal societies appear to be more prone to economic instability: inequality amplifies booms and slumps in the business cycle³².

GDP compared

A recent study collected data from 17 countries representing 53% of the global population, for which time series of GPI had been estimated³³. A global GPI/capita time series estimated from this data (Figure 3) shows that while GDP/capita and GPI/capita were highly correlated from 1950 to about 1978, after that point rising income inequalities - combined with increasing environmental and social costs - outweighed the benefits

of rising GDP, and global GPI/capita has leveled off.

From 1950 to 1978 GDP/capita correlated positively with GPI/capita ($R^2 = 0.97$); but after 1978 this correlation turned negative ($R^2 = 0.61$). The study also collected data on several other indicators (S3, Online), including Life Satisfaction (LS) based on subjective well-being surveys, the UN Human Development Index (HDI), the Gini coefficient to estimate income distribution, and the Ecological Footprint (EF). For the 17 countries surveyed, GDP/capita was highly correlated with HDI ($R^2 = 0.84$ $p < 0.0001$). This is to be expected since HDI is an index of GDP/capita along with life expectancy, and spending on health and education and all three of these variables are highly correlated with GDP/capita.

Ecological Footprint/capita was also highly correlated with GDP/capita weighted by population ($R^2 = 0.85$, $p < 0.0001$), since GDP is related to the consumption of the natural resources and energy included in EF. Interestingly, Life Satisfaction (LS), the only subjective well-being indicator used in this study, is not highly correlated with GDP/capita but it is highly correlated with GPI/capita weighted by population ($R^2 = 0.68$, $p < 0.0001$). This indicates that GPI does pick up many of the components relevant to Life Satisfaction, including fairness and social and environmental effects.

Life quality and happiness

Life Satisfaction (LS), based on surveys of subjective well-being, has been the object of much recent research^{34,35,36} and has been recommended by some as the appropriate measure of societal well-being³⁷. However, caution is needed when comparing subjective indicators across societies and cultures. For example, individual-level self-rated health is correlated with morbidity and mortality within countries, but average levels of self-rated health in different countries are unrelated to average life expectancy^{38,39} as demonstrated by Sen⁴⁰ who showed that self-rated health in India was comparable with that of USA, in spite of large gaps in life expectancy between those countries.

One interesting example of a subjective well-being measure is the country of Bhutan, which has developed an index called "Gross National Happiness" (GNH). The GNH index is based on elaborate surveys of the population around nine domains: psychological well-being, standard of living, governance, health, education, community vitality, cultural diversity, time use, and ecological diversity (Table 2, Online). However it is also clear that individuals do not always have access to full information about what contributes to their own well-being or the ability to process that information effectively⁴¹. A comprehensive picture of societal well-being and quality of life

GENUINE PROGRESS FLATTENS

World GDP has soared since 1950, but a metric for life satisfaction called GPI has not.



Figure 3: Gross national product and Genuine progress indicator as a function of time from 1950-2010



Woman and child outside their house at Giang Ta Chai village, Lao Cai Province, North Vietnam. GDP does not directly measure societal well-being or happiness



Bhutan has developed a "Gross National Happiness" index

therefore needs to integrate both subjective and objective measures⁴².

For example, the 'Happy Planet Index' from the London-based New Economics Foundation multiplies LS by life expectancy and divides by EF to get both the benefits (quality life-years) and costs (resources consumed) into the index. Another approach frequently taken is to collect a range of variables thought to influence well-being (income, housing, jobs, health, civic engagement, safety, life satisfaction, etc.) and develop a weighted index of these. How one weights these variables obviously strongly influences the ranking. The OECD 'Better Life Index' takes an interesting approach by allowing users to put in their own *weights* on an interactive website and see the results immediately⁴³. So far, this index only covers 36 OECD countries for one year.

Way forward

A framework for achieving the overall goal of sustainable, prosperous and equitable well-being for humans and the rest of nature is given in Figure 4. Only the items in black are currently partially picked up in GDP. The time is right to embark on a new round of consensus-building that will re-invent what has been institutionalized over the past 65 years. There is wide agreement on the need for (1) new goals with a broader view of the interconnectedness

among long-term, sustainable economic, social, and ecological well-being; (2) better ways to measure progress towards these goals; and (3) an invigorated campaign for the realization of this evolved economic system.

What is missing, however, is a global dialogue, akin to the original Bretton Woods meetings, in setting the goals, institutions, and measures of progress at multiple scales, from communities to states, countries, and the whole world. The critical differences would be that this new dialogue should create solutions to today's global challenges, and bring onboard new thinking about what 'progress' is, and how to measure it.

A new hunt for natural resources is breaking out the world over, because those resources form the backbone of every economy¹¹. Geologists can aid this process by correctly mapping out natural resources and making sure that their exploitations benefit the nations where they are found – for example, by signing up to the Extractive Industries Transparency Initiative⁴⁴. The goal of a new dialogue would be broad consensus, with broad participation, high-level input, and transparent discussion and incorporation of the various complex measurement issues. It would complement the framing of new UN Sustainable Development Goals by providing consensus on measures of progress. A new Alliance for

Sustainability and Prosperity (ASAP)⁴⁵ has been established to help facilitate this dialogue.

It is often said that 'you get what you measure'. To build a sustainable and desirable future we need to measure what we want, remembering that it is better to be approximately right than precisely wrong. The role of geologists in building this future cannot be overestimated. ♦

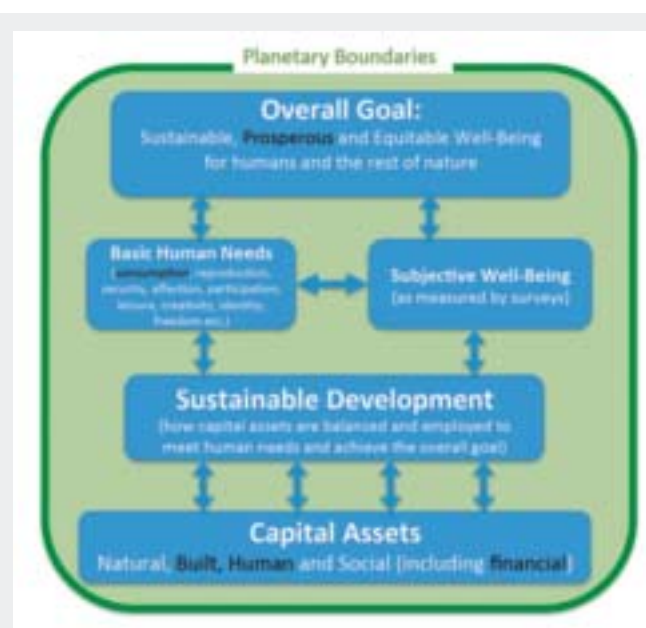
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* Kristin Vala Ragnarsdottir¹, Robert Costanza², Enrico Giovannini³, Ida Kubiszewski², Hunter Lovins⁴, Jacqueline McGlade⁵, Kate E Pickett⁶, Debra Roberts⁷, Roberto De Vogli⁸, Richard Wilkinson⁹. 1. Institutes of Earth Sciences and Sustainable Development Studies, University of Iceland. 2. Crawford School of Public Policy, Australian National University. 3. Department of Economics and Finance, University of Rome "Tor Vergata", Italy. 4. President, Natural Capital Solutions, Longmont, Colorado, USA. 5. University College, London and United Nations Environment Program, Nairobi, Kenya. 6. Department of Health Sciences, University of York, UK. 7. Environmental Planning and Climate Protection Department, eThekweni Municipality, Durban, South Africa. 8. Department of Public Health Sciences, University of California at Davis, USA. 9. Division of Epidemiology and Public Health, University of Nottingham, UK.



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Relationship between the overall goal of sustainable well-being and the subjective and objective elements that contribute to it. Only the items in black are currently partially picked up in GDP. Double-headed arrows indicate that influences go in both directions and that all elements are interconnected

CABINET OF **CURIOSITIES**



As copies of Wolfgang Grulke's ravishing book *Heteromorph* go on sale with GSL endorsement, **Ted Nield** visits the author's private museum

Down a narrow *cul de sac* in a tiny Dorset village, behind impressive wrought iron electric gates which part as we approach, can be found one of the most remarkable collections of fossils – and much more besides – ever assembled. Its presiding genius, Wolfgang Grulke, tells me it used to be an open barn. Outside, a giant fossil nautiloid sits on a stack of pallets. “I am working on that one now. It's Bajocian. The biggest ever found!” he says, in passing. “When it's finished I will have to get a crane in to move it...”

The door opens, and I have a subliminal flash of the ‘cabinet of curiosities’ from the frontispiece of Danish savant Ole Worm's 1655 book, *Museum Wormianum*. I see a huge ichthyosaur specimen mounted on one wall; the long wall before me is lined with backlit glass-fronted mahogany cabinets full of coiled cephalopods. Raptor egg nests sit as though waiting to hatch, or for their parent to return. Massive prepared slabs stand on easels like works of art, which indeed they are – masterpieces of the preparator's skill.

Stunning

In the middle of the room stand a desk, a dining table (with cookie jar) and a three-piece Chesterfield suite. I go to sit in one of the deep-buttoned armchairs, but find it already occupied by a huge ammonite, curled like a sleeping cat. And before me, the most stunning specimen of all – looking at first like a jumble of archaic wind instruments (a serpent, a rebec, a sackbut) – but which are actually among the largest and spiniest heteromorph ammonites I have ever seen. The specimen, from the Barremian of Haute provence, forms the cover illustration of Wolfgang's lavish new book, *Heteromorph*, published this month.

For a man clearly obsessed with reconstructing the past, there is a certain irony in the fact that Grulke, now Emeritus Director of the consultancy *Futureworld*, has built his career and reputation consulting to major blue-chip companies like IBM. It all seems a far

cry from the palaeontology of heteromorph ammonites.

I asked how his passion for collecting started. “When I was a teenager. I grew up in Germany and never saw the sea; then my parents moved to South Africa and one of the first holidays we took was to the sea. I was amazed by the rock-pools and so on and so I became a shell collector. All my life, as I have travelled around the world on business, I would say ‘OK, finished with business now’, and at first I have gone scuba diving and snorkelling. Then there came a time when I realised that nearly all the shells that ever existed were extinct, dead! So I began to start collecting fossils and asking ‘What's the geology?’ instead.”

Heteromorph

Grulke's *Heteromorph*, which has received the imprimatur of the Geological Society, has been peer reviewed by an international team of 15 academic experts and garnered advance praise from many more. Yet Grulke admits he came from ‘degree zero’ of geological knowledge. “When I started I was a typical idiot amateur. I annoyed the hell out of all kinds of geologists and palaeontologists, mainly in South Africa, asking all the dumbest questions until I understood. I went on a lot of digs with them and finding they had no money, started sponsoring them, paying their hotel bills and travel and so on, just so that I could learn from them.”

“I devote a whole chapter to this guy Herbert Klinger at the South African Museum. I am sure he hated me at first, with all my dumb questions about ammonites; but we've become firm friends and been on so many digs in South Africa and it's been fantastic. To find people like that, prepared to share their knowledge and skill – it's really wonderful. Now, if I find anything in the Cretaceous I pass it by him and he's replying within the hour with ideas and suggestions.”

He takes me over to the beautiful mahogany cabinets, handmade by a local craftsman to display his ammonite specimens and their ancestors. “When we moved here I created this room to ▶

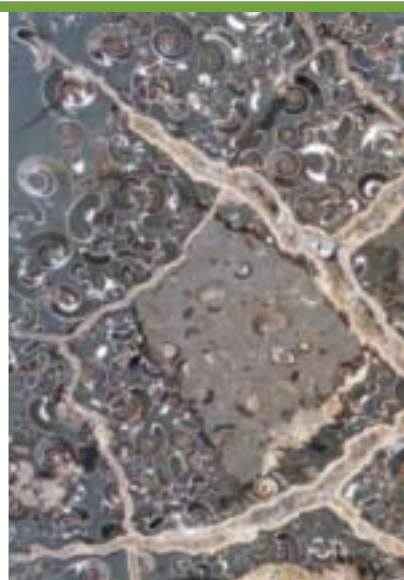


Above top: Grulke's cabinets of curiosity
Above middle: Wolfgang Grulke and friend, Lyme Regis
Above lower: Sleeping ammonite

“RAPTOR EGG NESTS SIT AS THOUGH WAITING TO HATCH, OR FOR THEIR PARENT TO RETURN. MASSIVE PREPARED SLABS STAND ON EASELS LIKE WORKS OF ART”



Grulke signs copy of *Heteromorph*



► show the complete chronology of the origin and evolution of ammonites and their ancestors from 500Ma to the time they died out - all to show how these guys evolved. I have not seen any museum in the world that shows you that."

"And so you can see that there were three times - in the Triassic, Jurassic and Cretaceous - when a couple of lineages became uncoiled. So I started with my 'Why, why, why...' and these uncoiled ammonites became my hobbyhorse. I found that there is rather little written about them. Also, methods of preparing these specimens have changed so much recently, so their fossils can reveal so much more now than they once did."

We stand before his prize specimen, prepared by Luc Ebbo, one of the world's leading fossil preparators, to whose work Grulke devotes an entire chapter of his book. "This locality is unique in the sense that all the spines are preserved, or are present as imprints; because many of these spines were hollow and don't usually preserve well. There are in fact two kinds of spine, both solid and hollow.

These are very delicate. If you go to the great museums in Paris or anywhere, you never see them - but that's because these old specimens were prepared when they didn't have the tools or techniques."

5000 hours

He shows me two contrasting specimens, one prepared in the 1990s, and one with more modern techniques. The difference is striking. "But that" he says, pointing to the featureless older specimen, "is what you'll find in every 'great' museum. Fossil preparation is an evolving skill - but I can't see many people going into it because commercially it just doesn't make sense."

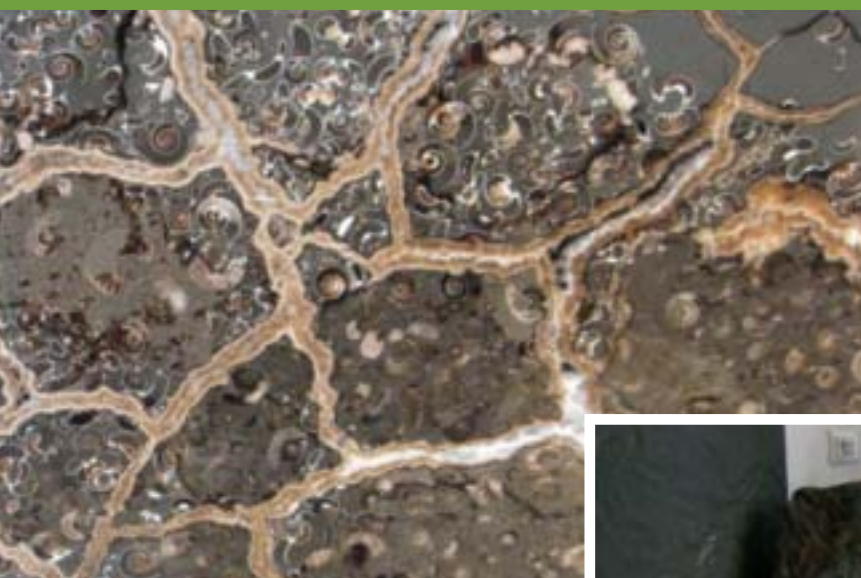
This fact is especially true for invertebrates. "This," he says, placing a hand on his prize specimen, "represents perhaps 5000 hours of work. What's really interesting is that there are 17 species of heteromorphs in this one block; they must all have been washed into some sort of lens on the ocean floor; the spines are preserved only on the undersides. This is why we always prepare them from the bottom first."

Luc Ebbo will be bringing another specimen to add to Wolfgang's collection soon, he tells me - "The largest heteromorph ammonite ever found, from Morocco, about as tall as I am. Quite incredible!" But the market for these exquisite works is vanishingly small. "When Luc finished this one he said 'I am never doing this again!'. Imagine how much you might pay your *gardener* for 5000 hours' work - it's just not worth it."

Naivety

"I hope that people enjoy [the book]" he says as I leaf through the mock-up version on the dining table. *Futureworld...* has always been about communicating technology-related stuff to business. Now, I am trying to apply the same sort of approach to this field, because it is astonishing how few palaeontologists step back, and look at the big picture, and it's the big picture that interest me."

"I have always been surprised by things, always had that sense of wonder about things. And yet I meet so many people who just shrug their shoulders, whether it's a narwhal tooth or a piece of



Clockwise from top right: Grulke's cabinets, hand made by a local craftsman

Prepared Ordovician crinoids stand on an easel

A giant Ichthyosaur specimen tells of a fatal Jurassic collision

Prepared septarian nodule reveals nest of (mostly) microconch ammonites



tribal art sculpture or whatever. They lack that naivety, and that's what I still have, I think. If you get too sophisticated you are never amazed by anything." ♦

FURTHER READING

An extended version of this interview is available online. *Editor*.
www.geolsoc.org.uk/geoscientist

- **Heteromorph The rarest fossil ammonites: Nature at its most bizarre** by Wolfgang GRULKE Published by: At One Communications. First edition (1 Oct 2014) 224 pages ISBN-10: 0992974003 ISBN-13: 978-0992974008. Amazon pre-order price: £38.00. Also available via www.heteromorph.com/order and the Geological Society Bookshop www.geolsoc.org.uk/bookshop. Collectors' limited edition: Luxury edition in slipcase, limited to 100 signed and numbered copies, ISBN 978-0-9929740-1-5. Publication late September 2014. Price £120 GBP (approx. \$205 USD; 151 EUR). See the Heteromorph website (above) for details and ordering. See also www.facebook.com/Heteromorph

Advance praise for Heteromorph

Once in several years a book arrives in my library that becomes a companion throughout life. This is an incomparable journey through shapes, spirals and sculptures as never imagined possible - it's where art and nature meet. The book is beautiful, diverse and surprising. When one arrives at the end, one wants to start again at the beginning.

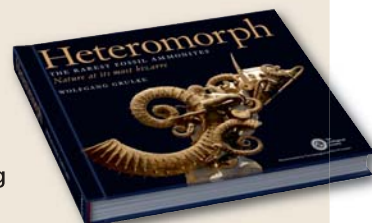
Guido Poppe, world-renowned conchologist, who has built many famous collections, and prolific author

Heteromorph ammonites are unique. Although we may never know for sure how they made a living, they will always cause us to think and wonder. It is a pleasure to find a book devoted solely to them. **Neil H. Landman**, Curator, American Museum of Natural History, New York

I am stunned. What a magnificent book. A great work of art. **Peter Ward**, Professor of Earth and Space Sciences, The University of Washington, Seattle

Beautiful, Fascinating, Outstanding! A must for all who love the bizarre, the beautiful and the best! **Neal L. Larson**, President, Association of Applied Paleontological Sciences; Owner, Larson Paleontology Unlimited

This authoritative and surprisingly beautiful book shows that nothing, absolutely nothing in nature, can be compared with the long, successful and extraordinary development of heteromorph in ammonites. **S. Peter Dance**, acclaimed author of *A History of Shell Collecting* and other works on natural history



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



Physician, heal thyself

Sir, How ironic that, in an issue beginning with an editorial noting that 'Unfortunately, gender stereotyping is too deeply rooted in the subconscious...', *Geoscientist* (August, v24.7) should be demonstrating how far these attitudes are embedded in its own psyche. On page 20, a letter about 'innumerate geologists' is illustrated by a picture of just such an innumerate person, apparently totally baffled by a blackboard covered with (mainly GCSE-level) equations. A female person, of course. We blokes know how difficult it is for the poor dears to understand such things.

If this was a one-off, it might pass - but it is not. In April, Jonathan Paul's terminally depressing *Soapbox* article about the (claimed) aversion of modern geology students to field work was illustrated by a picture of a student in a mortarboard and gown, captioned 'Somewhere warm and dry, please'. A female student, of course.

This is all not only sexist but flies in the face of reality. Anyone who has been involved in selecting PhD students for field-related projects over the last 20 years knows only too well that the more challenging, uncomfortable or plain insanitary a field area, the more likely it is that the applicants will be predominantly female.

And of course, both the recent letter and the earlier '*Soapbox*' article were written by blokes.

JOHN MILSOM

Designer Sarah Astington writes: As Designer of *Geoscientist* I have the opportunity to read and then source images to accompany many of the articles. I select images based on their relevance to the article and their aesthetic qualities, and try to select images of women and men to show a balance of genders throughout the magazine. It is interesting that John has picked on two images that he believes portrays women in a negative light but has ignored the many more instances where the image is a positive one, for example in the very same issue as one of John's examples August P15, also *Geoscientist* June P8, July P6 and P26, September P11 to name a few more. To focus on the gender of the person in the examples he gave is rather out dated and sexist in itself, why focus on the gender and not the message of the piece? But for balance see June P21 for an image of a man used in a similar way.

Fair play for Playfair

Sir, An unfortunate if inadvertent error has crept into Nina Morgan's Distant Thunder column on James Hutton and John Playfair (*Geoscientist* 24.7, August 2014).

Playfair was not 'Professor of Natural History' when he published his *Illustrations of the Huttonian Theory of the Earth* in 1802. He was Professor of Mathematics and (after 1805) of 'Natural Philosophy' (White 1956), or physics, in modern terms. Natural history scarcely existed as a discipline in Scotland (or England) in 1802, and Hutton was not its champion.

PAUL HOFFMAN

Reference - WHITE, G W, 1956, *Biographical sketch of John Playfair*, in *Illustrations of the Huttonian Theory of the Earth* by John Playfair, Facsimile Reprint, with an Introduction by George W White. Dover, New York, pp. xv-xix.

Nature does deal with carbon dioxide, but rather more slowly than we are creating it. It would be very good if we were to reduce the rate at which we produce it, very substantially. Doing so is not going to win votes, though.

JOHN HEATHCOTE

Of babies and bathwater

Sir, I fear that Chris Mackenzie has thrown away some babies with the bathwater in his *Soapbox* article (*Geoscientist* 24.7 August 2014).

I agree that there is a growing problem with substances that are chemically benign but resistant to degradation processes in the environment. Many polymers are in this category, e.g. HDPE, polyester. We use these materials not because 'Big Oil' makes them, but because they are convenient to use and inexpensive as currently accounted for. Remember wooden buckets and ironing cotton shirts?

We are also producing articles made from metals in non-natural valence states, e.g. aluminium and stainless steel, that are resistant to degradation in the environment. Metal has many advantages over wood and stone, and this has nothing to do with 'Big Mining'.

However, a little Googling reveals that 2,4,5-T and 2,4-D are not persistent in the environment and do not bio-accumulate. The problem is the trace amount of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) present in 2,4,5-T as an unwanted by-product of commercial manufacture. TCDD is persistent and does bio-accumulate. It is also produced by burning organic matter containing traces of chlorine and fires of all kinds are a significant source. Partly in response to *Silent Spring*, the commercial manufacture of many persistent organic pollutants has been banned for a long time.

Most non-natural radionuclides have reasonably short half-lives (Cs-137 is ~30 years) and they will decay reliably. Natural uranium, thorium and potassium have very long half-lives - they are effectively here forever. In most parts of the planet the radiation dose from artificial radionuclides is trivial compared with the dose from natural radionuclides.

Nature does deal with carbon dioxide, but rather more slowly than we are creating it. It would be very good if we were to reduce the rate at which we produce it, very substantially. Doing so is not going to win votes, though.

JOHN HEATHCOTE

Whin win situation

One of the most iconic pieces of British geology is about to be celebrated by a new National Landscape Discovery Centre – ‘The Sill’, write **Peter Styles** and **Ian Jackson***



The Northumberland National Park Authority and the Youth Hostels Association (it prefers to refer to itself simply as ‘YHA’ these days) have teamed up to build a new visitor centre and hostel on the site of existing facilities at Once Brewed (south-west Northumberland). The centre will sit unobtrusively, just a few metres south of the outcrop of the Whin Sill near the well-known viewpoint at Steel Rigg.

No intrusion

There can’t be many members of the Society who, as students or professionals, haven’t stood on and marvelled at the raw and rugged landscape created by an intrusion that gave its name to all other sills worldwide. Here, perhaps as well as anywhere else in these islands, the relationship between landscape and the underlying geology is clear for all to see. As the rock that defined the edge of an empire in AD 122, it and the Roman remains that run along its course now draw over three million visitors every year. Where better to build a facility designed to inspire and engage people in their landscapes?

The Sill is planned to be in operation by the end of 2017. It aspires to be a world-class visitor centre and experience that inspires a new generation to discover, understand, interact with, and care for the landscape. Building it will cost about £12 million, of which £9.5 million has already been pledged. It will support approximately 180 new jobs

locally; an invaluable boost to a rural economy facing tough times. Estimates predict that the all-weather, all-seasons facility will (initially) attract 100,000 visitors a year. It plans to provide 23,000 individual educational & training activities each year and offer an international research facility for understanding and sharing best practice on landscape, land and water management. Its vision is to have an impact well beyond the borders of Northumberland and even the UK.

Pivotal

Given the pivotal role that geology plays in The Sill, its exhibitions and activities, the Northumberland National Park authorities have approached the Geological Society (and other organisations in the geological sector) to enlist their support. As two Fellows who through birth enjoy a very close affinity with this region, as well as with the Geological Society and UK geoscience generally, we feel this is an opportunity that the Society should grasp with both hands.

The chance to influence the displays, to promote geology, to have access to an in-field facility adjacent to an internationally renowned geological locality for meetings, field trips and teaching - but most of all to inspire and encourage the next generation of geologists - is too good to miss.

* **Peter Styles** Professor of Applied and Environmental Geophysics, Keele University. **Ian Jackson** formerly BGS Chief of Operations and Director of Information

SOAPBOX CALLING!

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

If you can write it entertainingly in **500 words**, the Editor would like to hear from you. Email your piece, and a self-portrait, to ted.nield@geolsoc.org.uk.

Copy can only be accepted electronically. No diagrams, tables or other illustrations please.

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

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

“THE CHANCE TO INFLUENCE THE DISPLAYS, TO PROMOTE GEOLOGY, TO HAVE ACCESS TO AN IN-FIELD FACILITY... - BUT MOST OF ALL TO INSPIRE AND ENCOURAGE THE NEXT GENERATION OF GEOLOGISTS - IS TOO GOOD TO MISS”

Peter Styles and Ian Jackson

Architect's projection of the new interpretation centre at Once Brewed



Geoscientist reviews are now 'Online First' – see Geoscientist Online for loads of newly received book reviews!

Underlands: a journey through Britain's lost landscape



As a geologist and science writer I've always felt that the best way to engage non-specialists in your specialist subject is to start with the familiar before moving into the obscure. And to my mind, references to

everyday objects and, especially, the history behind them, often provides a very good jumping off point. In *Underlands*, Ted Nield, draws on his own personal and family history to introduce what might be considered the more 'industrial' side of geology. It's a book that will appeal to a wide range of readers, whether or not they have a background in geoscience.

In chapters focusing on quarries, mining and gravestones, Nield deftly combines geological information, with history, politics, philosophy and personal memoir to highlight the important role geology plays in so many practical aspects of our lives. In these times when many would argue that new-style 'Earth Sciences' departments relegate geology to a minor role – if not ignore it altogether – the book also serves as a wake-up call, reminding us of what we stand to lose if students are not introduced to geological fieldwork and exposed to 'real rocks'.

For those of us who, like Nield, studied geology at UK universities in the late 1970s and early 1980s, then honed our skills working in the oil industry during the heady days of the North Sea boom, this book is also a wonderful trip down memory lane. How I remember the culture-shock I felt when I left university life behind and entered the corporate world as an exploration geologist working in the North Sea. And oh, the ordeal of those company Christmas parties and business lunches! Nield's colourful description of his own experiences took me right back. But while my memories of corporate life make me cringe, Nield has put his to better use – as a clever way of introducing the story of the Rubislaw granite quarry near Aberdeen.

As in his earlier books *Supercontinent*

and *Incoming!*, Nield incorporates a wide range of historical and literary references into his fluent prose, and relies on anecdotes – some very moving and others very amusing – to tell his stories. But with this book Nield goes a step further and also reveals more of his own personality and family history. It all makes for a great read. Were they still alive, his parents would have been very proud.

Reviewed by **Nina Morgan**

UNDERLANDS – A JOURNEY THROUGH BRITAIN'S LOST LANDSCAPE

TED NIELD Published by: Granta Books, May 2014
288pp hbk ISBN: 9781847086716
List price: £20.00 www.geolsoc.org.uk/bookshop

Conjugate Divergent Margins



The story behind conjugate margins is of great interest and importance to both industry and academia. Several of the biggest petroleum discoveries of the last decade have been found in the South Atlantic conjugate margins, leading to increased research and exploration in these areas.

This Special Publication from the Geological Society comprises 25 papers, split into three sections: South Atlantic, North Atlantic, and Continental Break-Up Processes. Of these, the South Atlantic chapter is easily the longest, making the North Atlantic chapter feel short in comparison. A good deal of time is spent looking at the margins of Brazil, while less time is spent on African counterparts. The Nova Scotia and Moroccan margins also receive a good deal of attention. The final section deals with continental break-up processes. A lot of time is spent, by a number of different authors, dissecting non-volcanic rifted margins, but conspicuously less on their volcanic counterparts.

The integration of gravity, magnetic and seismic data is a common theme among many papers. There are several

very good examples, and some beautiful maps and sections. Much of the seismic is recent and high quality, showing a high level of detail. The petroleum systems are reviewed thoroughly, including discussions on both individual fields and play concepts. The papers themselves are largely very good, while high quality printing makes the most of detailed and colourful images.

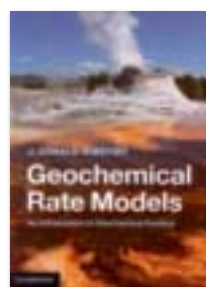
Overall this is another good volume from the GSL, but it cannot hope to be comprehensive due to the sheer size of the topic. It does present an interesting and absorbing story of the evolution of particularly the South Atlantic margins, but could have been better balanced, with more time spent on North Atlantic margins, and also more discussion of the evolution of volcanic rifted margins.

Reviewed by **Murray Hoggett**

CONJUGATE DIVERGENT MARGINS

W U MOHRIAK *et al.* (Eds). Published by: The Geological Society 2013. ISBN: 978-1-86239-349-3
568pp. List price: £120.00 Geological Society: £60.00; Other qualifying societies: £72.00
www.geolsoc.org.uk/bookshop

Geochemical Rate Models



This volume examines how kinetic (rate) models are used to predict rates of geochemical processes encountered in near-surface geological environments. Combining both

roles as a reference work and standard textbook, the volume provides a comprehensive and systematic description of rate models and how they are derived from the first principles of kinetic theory.

Presented in 10 main chapters, the author's approach is to focus on the fundamental and (relatively) simple rate models that underpin and inform the coding utilised in computer-modelling rate processes (an extensive reference list is included to direct the reader to other current literature dealing with the associated computer-modelling derivations if required).

The major topics covered include rate equations, reactor theory, transition state theory, surface reactivity, advective and diffusive transport, aggregation kinetics, nucleation kinetics and solid-solid



transformation rates. The detailed mathematical derivation and theoretical basis for each model is presented and illustrated with appropriate worked examples from applications to real-world geochemical problems. Additionally, the volume is supported by online resources, including self-study problems (with solutions) and data spreadsheets used in the text examples, allowing the reader to manipulate the data themselves and gain further appreciation and understanding of the models under consideration.

In general, all sections are well written and edited, concisely laid out with clear and appropriate figures and data-tables - as one has come to expect from Cambridge University Press publications.

Providing a valuable and concise overview of the subject, the primary readership is anticipated to be advanced undergraduate and graduate geoscience students, but will additionally appeal to established researchers and practising geochemists as a reference source for scientific and technical problem-solving.

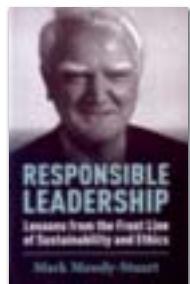
The author's 30 years of geochemical research and teaching experience is evident in the volume and I would definitely have benefited from having this book during my final-year undergraduate geochemistry courses! A recommended read.

Reviewed by **Mark Griffin**

GEOCHEMICAL RATE MODELS - AN INTRODUCTION TO GEOCHEMICAL KINETICS

J DONALD RIMSTIDT, Cambridge University Press. 2014. ISBN 978-1-107-02997-2. hbk 232pp.
List price: £45.00 www.cambridge.org

Responsible Leadership



Mark Moody-Stuart has had a distinguished career in the extractive industries culminating in being chairman of Shell, and non-executive chairman of Anglo-American. He was President of the

Geological Society from 2004-06. He spent much of his career overseas with Shell and he is admirably placed to offer insights from the front line of sustainability and ethics seen through the workings of large multi-national companies concerned with extraction of natural resources.

This book is part memoir, part reflection on the lessons learned from the issues and dilemmas faced on that journey. It is an engaging, insightful and even sympathetic book that outlines the pressures and challenges on companies working in different parts of the world in an industry that is often critical to the local economy, and which can be regarded as exploitative. It engages with relations with Government and the work done in setting up the UN Global Compact; it champions coalitions involving business, government and civil society, and makes the case that we should continue to interact with countries with poor records on human rights. Mary Robinson comments: 'This is an insightful book from a business leader who is willing to discuss openly the dilemmas and shortcomings of business in the area of human rights'.

Mark Moody-Stuart is a strong believer in the power of the markets, but he emphasizes the need for regulation, and that corruption is the biggest market failure of all. Companies can make significant contributions in very poor countries, both by offering employment and by building the capacity of local entrepreneurs as dealers and stockists. He analyses the lessons learned from China on poverty eradication, and Shell's

annus horribilis in 1995. This included the public reaction to the decision to dispose of the Brent Spar in the deep Atlantic, and the execution of Ken Saro-Wiwa, who had been involved in protests against Shell, by the government of Nigeria. He discusses the role of individuals in determining the behaviour of a company, of structure and governance, and of incentivisation. The book closes with a chapter on NGOs and a summary of Mark Moody-Stuart's life and career.

I greatly enjoyed this wide-ranging book. It prompted me to reappraise a range of issues linked to the extraction of natural resources. It will surely be widely read by people in business, but perhaps it deserves even more to be read by those outside business who are concerned and alarmed by the role of multinational companies, human rights and the protection of the environment. This is a view from the inside, one we don't hear often, and there is much to recommend it.

Reviewed by **Chris Hawkesworth**

RESPONSIBLE LEADERSHIP - LESSONS FROM THE FRONT LINE OF SUSTAINABILITY AND ETHICS
MARK MOODY-STUART, Published by: Greenleaf Publishing Ltd 2014, 349pp
ISBN-13: 978-1-906093-96-9
List price: £25.00 www.greenleaf-publishing.com

BOOKS Available for review

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

- ◆ **NEW! Geodynamics (3rd Edn)** by Turcotte D and Schubert, G 2014 Cambridge University Press 623pp sbk
- ◆ **NEW! Source Mechanisms of Earthquakes, theory & practice** by Uidas, A *et al.* 2014 Cambridge University Press 302pp hbk
- ◆ **NEW! Geostatistical Reservoir Modelling (2nd Edn)** by Pryce M and Deutsch C V 2014 Oxford University Press 433pp hbk
- ◆ **NEW! Geology off the Beaten Track - exploring South Africa's hidden treasures** by Norman, N 2014 DeBeers/Struik Nature 256pp sbk
- ◆ **Formation, Detection & Characterization of Extrasolar Habitable Planets** 2014 Nader Haghighipour (ed) IAU (CUP) 463pp hbk
- ◆ **The Finite-Difference Modelling of Earthquake Motions - Waves and Ruptures** 2014 by Peter Moczo *et al.*, Cambridge University Press 365pp hbk
- ◆ **Thick Skin Dominated Orogens - from initial inversion to full accretion** by Mencok, Mora & Cosgrove (eds), 2013 Geological Society Special Publication 377 482pp (hbk)
- ◆ **Materials Critical to the Energy Industry - an introduction** (2nd Edn.) Volker Zepf *et al.* 2014. BP/UNIA 90pp sbk
- ◆ **Palaeozoic Climate Cycles - their evolutionary & sedimentological Impact** Gasiewicz & Slowkiewicz 2014 Geological Society SP 376 hbk
- ◆ **World Mineral Production 2008-2012 Centenary Edition** Brown T J *et al.* BGS 2014 115pp (sbk)
- ◆ **Suffering the fire** 2014 Barry Hosson. Gillian Press, 246pp sbk. A novel based on first-hand experience of the Flixborough Disaster, when an oil refinery blew up causing many deaths - including that of the author's father - in 1974.
- ◆ **Isotopic Studies in Cretaceous Research**, by Bojar A-v *et al.* (Eds) Published by The Geological Society 2013 SP 382 221pp (hbk)
- ◆ **Remote Sensing of Volcanoes and Volcanic Processes: Integration Observation & Modelling**, by Pyle D M *et al.*, (Eds). Published by The Geological Society SP 380 2013 360pp (hbk)
- ◆ **Antarctic Palaeoenvironments & Earth-Surface Processes** by Hambrey M J *et al.* (eds), 2013 Geological Society Special Publication 381, 506pp (hbk)
- ◆ **Biological and Geological Perspectives on Dinoflagellates** by Lewis J M *et al.* (eds), 2013 Micropalaeontological Society Special Publications. Geological Society Publishing House. 373pp (hbk)

PEOPLE NEWS

CAROUSEL

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

◆ Matthew Eynon



Matthew Eynon (Director at Earth Science Partnership) has qualified as a RoGEP Specialist, recognising his skills in design, management and authorisation of assessments in a range of geological environments.

He is now able to act as a technical mentor to other ground engineering professionals. His colleague at ESP Jeremy Hucker has qualified as a RoGEP Adviser. Both were selected by means of qualification, training, experience and competence requirements as set out by the Geological Society, the Institute of Civil Engineers and the Institute of Materials, Minerals and Mining.

www.earthsciencepartnership.com

◆ Martin Preene



Martin Preene has established Preene Groundwater Consulting to provide specialist advice and design services in the fields of groundwater control and dewatering on construction and mining projects. Martin is a Chartered Geologist and Chartered Engineer and

has more than 25 years' experience with dewatering contractors and consultants on projects worldwide.

IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Baker, John Macrae
Christian Wellstood*
Crook, John P *

Foster, Michael *
Hull, John Hewitt*
King, Roy

Kosler, Jan *
Scott, Barry*
Waite, G J *
Williams, John B E*
Wright, John Bucknall

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

If you would like to contribute an obituary, please email ted.nield@geolsoc.org.uk to be commissioned.

You can read the guidance for authors at www.geolsoc.org.uk/obituaries.

To save yourself unnecessary work, please do not write anything until you have received a commissioning letter.

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



Mapping in the antipodes



Charlotte-Ellen Eales

Charlotte-Ellen Eales (University of Birmingham) received a £550 Society Undergraduate Fieldwork Bursary to assist her 42-day sojourn in Kaikoura, New Zealand.

New Zealand is renowned for being a geologically and geothermally active region with extensive mountain ranges, frequent earthquakes and a complex geology. The Kaikoura Peninsula is situated on the east coast of the South island and is composed of six main sedimentary lithofacies ranging from Upper Cretaceous to Miocene in age.

Sedimentary

The peninsula is comprised entirely of sedimentary rocks, including mudstones, limestones and sandstones all of which have been folded and recently uplifted due to the continuing Kaikoura Orogeny. As the rocks in the mapping region are all sedimentary, diagenetic features and other characteristics are crucial to distinguishing lithofacies at Kaikoura. The large dolomitic concretions of the Herring Formation are a textbook example of this, while siliceous nodules and distinctive tidal weathering pattern are also indicative of certain facies.

Millimetre-scale calcite veins indicate paleo pore-fluid activity and reflect the carbonate composition of the majority of the facies observed. Structurally the region demonstrates an idealised cross-section of four, kilometre-scale folds, which control the outcrop observed at surface.

Metre-scale parasitic folding also exists, especially within the limestone layers, and lateral faults are the most common type of brittle deformation.

Although petroleum plays are not present within the mapping area or its (onshore) vicinity, there are plans to explore and drill in the neighbouring Pegasus and Canterbury Basins. Currently the ownership is dominated by Anadarko but some blocks presently under consultation and others are yet to be released.

Exploration

Exploration in the Pegasus Basin is of deep concern to the Kaikoura community, largely because Kaikoura's economy depends on tourism. Tourists enjoy recreational fishing, water activities, bird spotting, whale watching and other marine life excursions, all of which rely on a pristine marine environment. Hence the danger posed by any oil-spill disaster would be exceptionally great for both the Kaikoura community and marine life. Concerns centre on the risk of developing deep wells (>2700m) in a seismically active region prone to mega-thrust earthquakes.

Additionally, many also fear that New Zealand's infrastructure and maritime services do not presently have the capacity to cope with a serious spill.

The Kaikoura community along with many similar coastal communities in New Zealand will continue to protest against offshore exploration and support green energy as an alternative means of economic growth, despite exploration plans having already been approved.

I would like to thank the Geological Society and Novas Consulting for their support for my undergraduate mapping project.

➤ To find out more about the Society's Undergraduate Fieldwork Bursaries, go to www.geolsoc.org.uk/grants



DISTANT THUNDER

Exit, pursued by a bear

As geologist and science writer Nina Morgan discovers, a curator's life is not always a happy one

The geologist John Phillips (1800-1874) first came to the attention of the fledgling Yorkshire Philosophical Society (YPS) in 1824 when he helped his uncle, William Smith (1769-1839), give a course of lectures in York. Recognising a major geological and curatorial talent when it saw one, the Society appointed Phillips as Keeper of its Museum in 1826, and charged him with the task of organising the burgeoning collection of specimens donated to the Society. For a salary of £60 per annum, Phillips was expected "to give his attendance at the Society's rooms, during nine months of the year, for three days in each week (Tuesday, Thursday, and Saturday, from Ten o'clock a.m. to Four p.m.) and conjointly with the [honorary] Curators, to take charge of the various departments of the Museum."

But the job actually encompassed much more. In practice, as well as maintaining,

arranging and cataloguing the various collections, Phillips also welcomed museum visitors, assisted lecturers to prepare their material, kept records of the scientific communications read at the monthly meetings, and dispatched the annual reports of the Society. When time permitted, he accompanied various members on geological expeditions, gave lectures at the YPS and at other scientific and philosophical societies elsewhere, conducted his own research, and wrote a number of books. He also played a key role in organising and running the first meeting of the British Association for the Advancement of Science held in York in 1831, where according to the *Yorkshire Gazette* he, "delivered an animated lecture on the Geology of Yorkshire – got up on the spur of the moment, without any premeditation, which showed the complete mastery he has of the science."

Added responsibilities

Phillips' duties expanded further in the 1830s after the YPS established its Museum at its

current site. One of the conditions for the grant of the site required the establishment and maintenance of a botanical garden. And in 1830 a group of members also proposed that a 'limited collection of living animals could be maintained in the grounds' and established a small private fund to 'defray the expense of it'. A few purchases were made for the menagerie and some 'valuable donations' received, including, it appears, a golden eagle, several monkeys and a bear. But the project was short-lived and ended in 1833. Misbehaviour on the part of the bear, it seems, was one of the precipitating factors that led to the menagerie's 'early extinction'.

After escaping from its cage and chasing Phillips and William Vernon Harcourt (1789- 1871), first President of the YPS, into an outbuilding, it was offered to the London Zoo. The Zoo was happy to accept, and when it came to removal arrangements, the Zoo's resourceful Secretary offered a novel suggestion:

"Zool. Soc. London, Dec. 26th 1831: Sirs, We shall feel much pleased in taking your bear on the terms proposed in your letter of 21st.

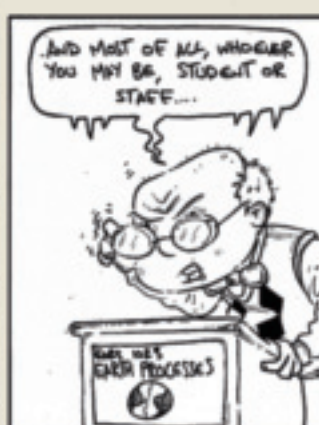
The best mode I can conceive of forwarding him to us is by one of the York coaches, you booking him on as an outside Passenger, and promising the Guard a recompense on his delivering him safe in London. Be so good as to send us a line to inform us of the Coach by which the animal is to travel and the place and probable time of his arrival in town. You will also oblige me by stating to whom we shall pay the price of the animal."

The response of the bear's fellow passengers is not recorded.

Acknowledgement

Sources for this vignette include a blog by Ann- Marie Akehurst at www.york.ac.uk/ipup/projects/york/stories/papers/akehurst.html the booklet *Philosophers and Provincials: The Yorkshire Philosophical Society from 1822 to 1844*, by A D Orange, published by the Yorkshire Philosophical Society in 1973, and the YPS Annual Report for 1831. I also thank Bob Hale, Honorary Archivist at the YPS, for providing helpful information about contents of the YPS archives and other sources of information about the early history of the YPS.

STICKS AND STONES

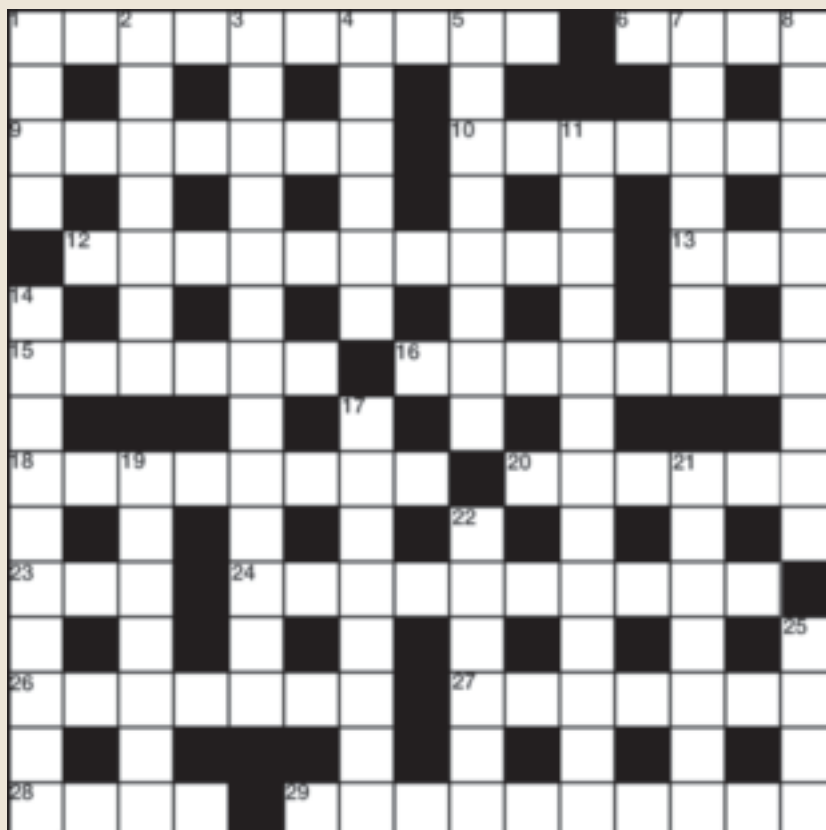


ENDORSED TRAINING/CPD

COURSE	DATE	VENUE AND DETAILS
2, 3 or 5-day Petroleum Geochemistry and Basin Modelling courses	06 - 10 October	Organised by IGI Ltd. Venue: The Kingsley Hotel, Bloomsbury Way, London, UK. See website for details.
Soil & Rock Description and Site Investigation	10-14 October	Organised by University of Sussex at University of Sussex. See www.sussex.ac.uk/geomorphology/ for details.
Terrain Analysis & Digital Mapping	20 - 24 October	Organised by University of Sussex at University of Sussex. See www.sussex.ac.uk/geomorphology/ for details.
Lapworth's Logs	n/a	'Lapworth's Logs' is a series of e-courses involving practical exercises of increasing complexity. Contact: info@lapworthslogs.com . Lapworth's Logs is produced by Michael de Freitas and Andrew Thompson.

DIARY OF MEETINGS OCTOBER 2014

MEETING	DATE	VENUE AND DETAILS
Offshore Pile Design and Pile Driveability in Chalk Engineering Group	1 October	Venue: Burlington House. Evening Meeting. Speaker: Rory Mortimore. See website for details.
Advances in Geological/Geotechnical Data Handling & Modelling. Engineering Group	2 October	Venue: Burlington House. Fees apply. See website for details (registration closed 25 September).
The Quaternary of the Lower Thames QRA, Essex Field Club	3-5 October	Venue: Wat Tyler Country Park, Pitsea. Contact: Peter Allen E: peter.allen6@virgin.net
The Incredible Story of the Stone Pipe Company 1805-1815. Geologists Assoc.	3 October	Venue: Burlington House. Evening meeting, 1730 for 1800. Speaker: Hugh Torrens. Contact: Sarah Stafford E: geol.assoc@btinternet.com
Ineson Lecture 2014: Groundwater and Hydrocarbon Change. Hydro Group/IAH	6 October	Venue: Burlington House. Time: 0945 – 1700 (reception) Speaker: Jim Barker. Fees apply. See website for registration and details.
ProGeo 2014: The Quaternary. SW Regional	10 October	Venue: Lakeside, Roadford Lake, Broadwoodwider, Lifton. Devon. Conference. E: southwestrg@gmail.com
Sidmouth Science Festival 2014	13-19 October	Venue: Sidmouth and environs. Part of Earth Science Week. See website for details.
Science & Stormont: Science Education in Northern Ireland. Northern Ireland Regional	13 October	Venue: Parliament Bldgs. Belfast. Time: 1300-1730. See website or details. Contact: Mike Young E: GeolSocNI@gmail.com
Geoheritage and the UK's most significant geological sites. Geological Society	15 October	A London Lecture. Speaker: Rob Butler. Part of Earth Science Week 2014. See p.6 for details.
Shale Gas, what the frack is that all about!? Yorkshire Regional	15 October	Venue: Brewery Tap, Leeds. Speaker: Peter Styles. Evening meeting. Contact: James Barr E: james.barr@atkinsglobal.com
Green Chain Walk Geotrail. London Geodiversity Ptnshp. Earth Science Week	15 October	Venue: Thames Barrier Cafe, London SE18 5NJ. Time: 10.30-16.00. Field trip. See website for details. E: info@londongeopartnership.org.uk
Tipner Redevelopment – The Geology, Contamination & Remediation. Solent Regional	15 October	Venue: University of Portsmouth. Speaker: Sarah Haines. Contact: Wendy Furgusson E: wendy.furgusson@ramboll.co.uk
Geology under London and the Thames Valley BGS	17 October	Venue: Burlington House. Conference. Time: 12.00 – 15.50. Admission free, but registration required. See website. Contact: Rachel Dearden E: rach1@bgs.ac.uk
From Eros to Eternity: Piccadilly's Rock Heritage Earth Science Week/GSL	18 October	Venue: Green Park Tube, 10.45. Leader: Dr Ruth Siddall. See website for details or www.walks.com/
Ingleton Falls & White Scar Caves Earth Science Week 2014	18 October	Venue: Ingleton, Yorkshire Dales National Park, North Yorkshire. See website. Leader: Idil Hassan E: idilamin12@gmail.com
Towards and Through the Arun Gap, South Downs. West Sussex GS/ Earth Science Week	19 October	Venue: Pulborough to Arundel, South Downs. Leader: Tony Brook E: anthony.brook27@btinternet.com . See website.
Young Geologist Competition. TVRG	21 October	Venue: Peter Brett Associates, Reading. See Website. Contact E: tvrgsecretary@gmail.com
The Colours of Fossil Birds and Dinosaurs Western Regional	21 October	Venue: S.H. Reynolds Lecture Theatre (Room G25). Department of Earth Sciences, University of Bristol. Time: 1830. Speaker: Mike Benton. E: westernregionalgroup@gmail.com
Sediments, sequence stratigraphy and material behaviour: why the Lambeth Group presents a challenge. HC North Regional	23 October	Venue: Sir Robert McAlpine, Eaton Court, Maylands Avenue, Hemel Hempstead. Speaker: Jackie Skipper. Time: 1800 for 1830. See website. E: homecountiesnorthregionalgroup@gmail.com
The Glaciation of Dartmoor. QRA	23-26 October	Venue: Dartmoor Expedition Centre. Field trip. See website. Contact: David Evans E: d.j.a.evans@durham.ac.uk
Geological Walk: Malpas. Cheshire RIGS	25 October	Venue: Malpas, TBC. Leaders: Cynthia Burek and Veronica Cubitt-Caddy E: veronicacubitt@hotmail.com
Geology & the Low-Carbon Economy. NI Regional	27 October	Venue: Ulster Museum. Speaker: Paul Younger. Time: 18.20-21.00. Contact: Thomas Nash E: GeolSocNI@gmail.com
Small to Subseismic Scale Reservoir Deformation Petroleum Group	29-30 October	Venue: Burlington House. Conference – fees apply. See website for details and registration. Contact: Laura Griffiths E: laura.griffiths@geolsoc.org.uk

CROSSWORD NO.184 SET BY PLATYPUS**ACROSS**

- 1** Line of equal thickness (10)
6 Fourth order time units (4)
9 Solid petroleum (7)
10 Bivalve whose life hangs by a thread (7)
12 The wrong letters, or perhaps the right ones in the wrong order (10)
13 US tax authority (1,1,1)
15 Of the soil (6)
16 That which provokes a reaction (8)
18 Trilobite knob (8)
20 Cut, like a river (6)
23 Annoy (3)
24 Bad tempered shading? (10)
26 Unpowered wheeled conveyance often containing dessert (7)
27 Make concrete (7)
28 Salt of Na, often found in evaporitic lakes (4)
29 Tightening agent - see 28a (10)

DOWN

- 1** Every book has one, or these days, two (1,1,1,1)
2 Young rocks surrounded on all sides by old (7)
3 Relating to the gas layer surrounding a planet (13)
4 Bivalves, brachiopods and garden gates have these in common (6)
5 Coral, not likely to go off-grid (8)
7 Icy moment passes slowly (7)
8 Adoptive female sibling (10)
11 The accumulation of particulate deposits (13)
14 Lies dormant during hot, dry seasons (10)
17 False name for a species (8)
19 Turned for chessmen (7)
21 Slope (7)
22 Shylock (6)
25 Horizontal mine entrance (4)

WIN A SPECIAL PUBLICATION!

The winner of the August Crossword puzzle prize draw was **Lennart Meyer Beck of Bergen, Norway**.

All correct solutions will be placed in the draw, and the winner's name printed in the December/January issue. The Editor's decision is final and no correspondence will be entered into.

Closing date - October 24.

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

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

Name

Membership number

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Postcode

SOLUTIONS AUGUST**ACROSS:**

1 Meromictic **6** Ramp **9** Hammada **10** Cascade
12 Maturation **13** IPA **15** Astral **16** Methanol
18 Lattices **20** Molten **23** Age **24** Ironstones
26 Ecotype **27** History **28** Tusk **29** Megacycles

DOWN:

1 Moho **2** Remnant **3** Measurability **4** Cravat
5 Inclined **7** Arabian **8** Prevailing
11 Synchronously **14** Parliament **17** Kerosene
19 Tremors **21** Trefoil **22** Asthma **25** Eyes

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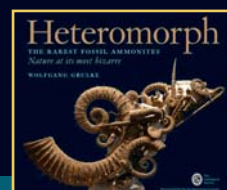
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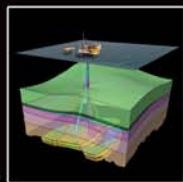
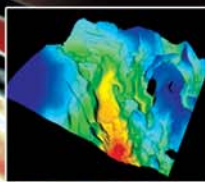


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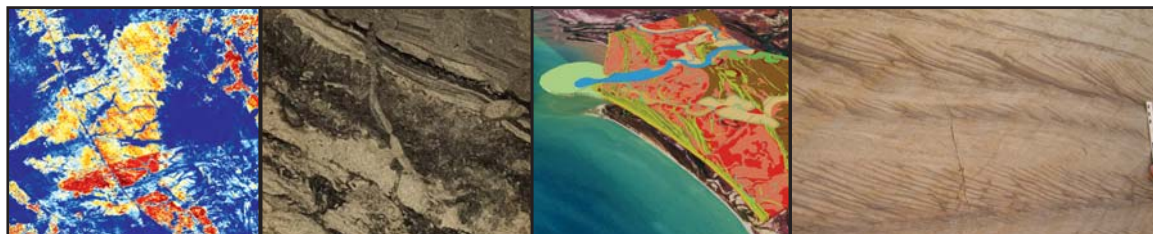


Call for Abstracts: Deadline 3 October 2014

Sedimentology of Paralic Reservoirs: Recent Advances and their Applications

18 - 19 May 2015

The Geological Society, Burlington House, Piccadilly, London



Paralic reservoirs record clastic deposition at or close to sea-level. They reflect a range of depositional environments including deltas, shoreline-shelf systems and estuaries and have provided the backbone of production in many mature basins around the world, currently contributing around 30% of global conventional hydrocarbon production. Strata that host these reservoirs are shaped by a wide variety of depositional processes and controls that reflect the upstream supply of sediment and water, the characteristics of the receiving basin, relative sea-level and tectonic setting. Consequently they exhibit much variability in their stratigraphic architecture and sedimentological heterogeneity, which translates into complex reservoir performances that are challenging to predict. However, new research themes have emerged in recent years: contrasts between regressive and transgressive coastlines; along-strike and cross-shelf variability; shoreline trajectory concepts and the impact of autogenic responses during constant forcing. This conference will address these new themes together with developments in established approaches to discuss the current state of knowledge in the exploration and production of paralic reservoirs.

Themes:

- Modern studies, numerical & experimental modelling of paralic systems
- Paralic reservoir character & behaviour: imaging, sedimentology, ichnology, architecture & reservoir models
- Classification & role of mixed energies in strike & dip growth of paralic systems
- Tide-generated heterogeneity in paralic reservoirs
- Paralic muds & mudstone reservoirs

Core Workshop:

20-21st May 2015 Core Workshop (Weatherford Labs, East Grinstead)

We will be holding a 2 day core workshop immediately after the main conference. To keep the range of depositional settings as broad as possible **we would like participants to bring poster presentations of their own core-based sedimentological studies** in addition to the core which will be provided. At this stage please let Martin Wells (Martin.Wells2@uk.bp.com), Boris Kostic (boriskostic@badley-ashton.co.uk) and Laura Griffiths (laura.griffiths@geolsoc.org.uk) know if you would be interesting in attending with (or without) a poster presentation so that we can assess numbers – likely maximum 40. This should also give you sufficient time to obtain the necessary permissions to share the material.

Call for Abstracts:

Please email paper and poster contributions to laura.griffiths@geolsoc.org.uk and copy to Martin.Wells2@uk.bp.com by Friday 3rd October 2014

For further information please contact: Laura Griffiths

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

T: 020 7432 0980 or email: laura.griffiths@geolsoc.org.uk



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Co-evolution of Life and the Planet

Future perspectives in Earth System Science



5th and 6th November 2014

The Geological Society, London

Long-term co-evolution of life and the planet (NERC research programme)

Evening Ice-breaker: 4th November at UCL

Convenors:

Dr Alistair Crame, *British Antarctic Survey*
Dr Gavin Foster, *University of Southampton*
Professor Tim Lenton, *University of Exeter*
Professor Richard Twitchett, *University of Plymouth*
Professor Graham Shields, *University College London*

Programme Manager:

Ying Zhou, *University College London* (y.shields-zhou@ucl.ac.uk)

Confirmed keynote speakers include:

Professor Peter Harries, *University of South Florida*
Dr Brian Huber, *Smithsonian National Museum of Natural History*
Professor Lee Kump, *Penn State University*
Professor Andy Ridgwell, *University of Bristol*



The Earth that sustains us today has arisen out of planetary scale co-evolution of the physical and biological worlds. The complexity of these interactions necessitates a multidisciplinary 'Earth System Science' approach. Two years on from 'Life and the Planet 2011', this two-day meeting will explore advances in our understanding of the coupled evolution of life and the planet.

The four main themes of this meeting are: 1) Precambrian origins of the modern Earth System; 2) Key events in the evolution of marine ecosystems; 3) Geological constraints on biological evolution in the polar regions; 4) Descent into the Icehouse during the Cenozoic Era.

www.lifeandplanet.net/2014-life-and-planet.html



For further information

For further information about the conference, please contact:
Georgina Worrall, The Geological Society, Burlington House,
Piccadilly, London W1J 0BG

T: 0207 434 9944 E: georgina.worrall@geolsoc.org.uk

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