

GEOSCIENTIST

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The Fellowship Magazine of the Geological Society of London

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FALLING SKYE

Simon Drake and
Andy Beard on
discovering a
Paleocene meteorite hit

BUFFON THE GEOLOGIST

Jan Zalasiewicz discovers a
new side to the great Frenchman

WHY MINE GOLD?

There must be better things
we could be doing

ONLINE SPECIAL

IPCC reports have the
bloats says Jonathan Cowie



DATES FOR YOUR DIARY

LONDON

- 🕒 **Tuesday 15 May, 18.00**
- 📍 **Cavendish Conference Centre**
- 👥 **Public event**
- 💰 **£15**

BIRMINGHAM

- 🕒 **Wednesday 16 May, 17.30**
- 📍 **Lyttelton Theatre,
The Birmingham & Midland
Institute**
- 👥 **Public event**
- 💰 **Free**

ABERDEEN

- 🕒 **Thursday 17 May, 18.00**
- 📍 **Aberdeen Science Centre**
- 👥 **Public event**
- 💰 **£10**

NORTH WEST HIGHLANDS

- 🕒 **2-3 June**
- 👥 **Field Trip**
- 💰 **£45 Mem / £55 Non Mem/
£120 Family of 4**
(2 adults, 2 children <18)

Registration and
Crowdfunding now open at
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geoliteracy-tour-2018/](http://www.pesgb.org.uk/geoliteracy-tour-2018/)

PESGB GEOLiteracy TOUR 2018

The Chicxulub Impact The End of an Era

With Professor Joanna Morgan

Professor of Geophysics,
Department of Earth Science & Engineering,
Imperial College London

In 1980 Luis Alvarez and his co-workers published an article asserting that a large body hit Earth ~66 million years ago and caused the most recent mass extinction, which notably included the dinosaurs.

The evidence for impact was the extraterrestrial composition of a thin clay layer at the boundary between the Mesozoic and Cenozoic Eras. This became known as the "Impact hypothesis", and was categorically dismissed by many geologists at the time, on the grounds that only two locations had been studied and the clay layer at these sites might be atypical or just unusual but terrestrial, and that the extinction was gradual and started before the impactor hit Earth. This boundary clay has now been studied at many sites around the world and is clearly formed from impact ejecta – material from the asteroid and impact site that has been ejected around the globe. Studies of small fossils in marine sediments, for which the fossil record is more reliable due to high numbers, show that life was thriving and the oceans productive immediately before impact and collapsed precisely at the boundary clay layer. The cause of the extinctions is still not widely agreed, but it is fairly certain that the impact triggered a nuclear winter – an extended period (3-14 years) when the entire Earth was cold and dark, which is likely to have been catastrophic for photosynthetic life.

It took over 10 years to find the impact site – the crater is buried beneath the surface of the Yucatán continental shelf, Mexico, and has a minimal surface expression. Geophysical methods have been used to image the crater and determine its size (~200 km in diameter) and structure. In 2016 we drilled into the impact crater to investigate large crater formation, recovery of life at the impact site (ground zero), habitability of the crater, and improve estimates of the climatic effects of this impact.

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Geoscientist is the Fellowship magazine of the Geological Society of London

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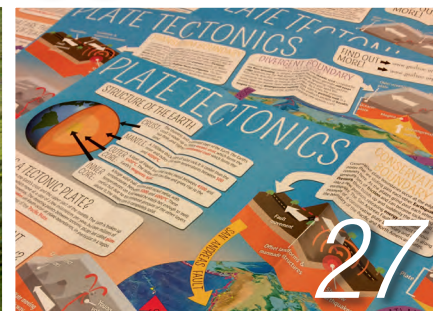
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ON THE COVER:
10 DEEP IMPACT

A new Paleocene ejecta layer discovered
by Society-funded fieldwork

FEATURES

16 BUFFON – GEOLOGIST

Jan Zalasiewicz, Anne-Sophie Milon and Mateusz Zalasiewicz
explore a neglected aspect of the great naturalist's *oeuvre*

REGULARS

05 Welcome Ted Nield laments the 'bread and circuses'
approach to space science

06 Society News What your Society is doing at home and
abroad, in London and the regions. This month, a focus on
the Society's policy work

09 Soapbox Should we dig gold? John Milsom thinks we're
wasting our time

20 Calendar Society activities this month

22 Books and arts Six new books reviewed by Robert Anderson,
Chris Hawkesworth, Jonathan Scafield, David Vaughan, Rob
Bowell and Nigel Press

25 Letters Online CPD reporting, Protecting our data,
and Scientific English

26 People Geoscientists in the news and on the move

28 Obituaries Malcolm Fletcher Howells 1934-2017
& Alan Gilbert Smith 1937-2017

**ONLINE
SPECIAL**

A CASE OF THE BLOATS.

JONATHAN COWIE
WONDERS IF THE
FORTHCOMING 6TH
ASSESSMENT REPORT CAN
AVOID ITS PREDECESSORS'
TENDENCY TO GET EVER
BIGGER AND MORE
INDIGESTIBLE – AND HAS
SOME SUGGESTIONS
ABOUT HOW THEY MIGHT
BE MADE EASIER
TO COMPARE.

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PETROLEUM GROUP

Petroleum Group

29th ANNUAL DINNER

Natural History Museum

21 June 2018

For further information or to book a table for this event, please contact sarah.woodcock@geolsoc.org.uk

GASS 2018

Geologists' Association
Student Symposium

Geoscience challenges in the 21st century:
What difference will your research make?

25th of May 2018
Burlington House, Piccadilly, London, W1J0BG

Prizes will be awarded for the best oral and poster presentations.

Confirmed keynote speaker: **Professor Iain Stewart** (Director of the Sustainable Earth Institute, Plymouth University)

Registration now open!
Abstract deadline: 31st March 2018

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Call for Abstracts – Deadline: 25 May 2018

Operations Geoscience Adding Value

7-8 November 2018

The Geological Society, Burlington House, Piccadilly, London

Convenors:

Richard Diggins BP – Chairman

Chris Samson Independent – Secretary

Hozefa Godhrawala Centrica

Chris Hayes RPS

Tim Herrett Independent

Rachael Horton BP

Maxim Kotenev Sasol

Kirstin McBeath BP

Jim Raggatt Independent

Christine Telford Independent

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

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

Overarching themes:

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

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

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

Call for Abstracts:
Please submit paper contribution to sarah.woodcock@geolsoc.org.uk by 25 May 2018.

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

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SEPM

Seismic Characterisation of Carbonate Platforms and Reservoirs

10-11 October 2018 The Geological Society, Burlington House, London

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

Conference Themes

- Seismic evidence for controls on carbonate platform development over millennial time scales and kilometric length scales
- Seismic geomorphology and 3D internal architecture of carbonate platforms
- Carbonate sequence stratigraphy and palaeogeography from seismic data, and the discrimination of carbonate, clastic and volcanic features
- Carbonate seismic facies interpretation at reservoir scales and seismic characterisation of fractured carbonates
- Seismic attributes for porosity and lithology discrimination, identification of epikarst, hypogene karst and hydrothermal dolomitisation
- Using 3D and 4D seismic in carbonate reservoir modelling
- Carbonate rock physics and potential for AVO and EEI in carbonates
- Forward modelling carbonate geometries, seismic inversion and synthetic seismic models of carbonates
- Tailoring acquisition and processing for carbonate objectives

Call for Papers

Submission for oral or poster presentations are welcome. Registration and abstract submission forms are available via the conference web page, and the deadline for abstract submission is 16th April 2018.

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

Further information
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“EARTH SCIENCES WILL BE CUT BY 6.5%, AND THE PLANKTON, AEROSOL, CLOUD, OCEAN ECOSYSTEM MISSIONS WILL BE SCRAPPED. THAT SUCH SCIENCE IS ESSENTIAL TO UNDERSTANDING CLIMATE CHANGE PROVIDES A CLUE TO POTUS'S CYNICAL MOTIVATIONS”

FROM THE EDITOR'S DESK:

Of showbiz and space science

A British professor of astronomy, interviewed on TV about Elon Musk's recent rocket stunt, suggested we ask ourselves "What is space for?". It may sound crass and stupid put like that, but it's a good question. The mantra "Why go to space with so many unsolved problems here on Earth?" has dogged space explorers since the beginning.

Mr Musk's roadster - 'Don't Panic!' on the dashboard, *Hitchiker's Guide* in the glovebox and David Bowie blaring - is now a man-made Near Earth Asteroid, destined one day to crash into the sun, Venus, or us – the latter chance estimated at 6% over the next million years. (Don't panic – it will burn up. We'll probably be extinct anyway.) For a real-life Tony Stark, space is for profit.

Sci-fi has two visions of space explorers. Either they are quasi-official emissaries of united humanity, simultaneously spreading and seeking enlightenment (*Star Trek*) or wage slaves of dodgy corporations grubbing after profit (*Alien*). But I am more interested in a different polarity – 'space for science' vs 'space for showbiz/politics' – the latter having now effectively fused, in the USA at least.

Sending men to the moon, (a one-horse race which only America was in),

was motivated by politics/showbiz. True, we learned a lot about the Earth by sampling the moon; but meanwhile the 'space race' was won by Russia. Russia's programme benefited from similar political motives but - given the nature of Soviet government - was hardly vulnerable to public opinion. Russians did all the necessary, technical stuff concerned with living in space and observing the Earth. The International Space Station (ISS) depends crucially on Russian science, somewhat grudgingly handed over in the later cost-saving spirit of international cooperation.

The currently rudderless US space agency NASA is now learning what President Trump wants – chiefly, a new moon programme (announced in the presence of first and last astronaut-geologist Harrison Schmitt Hon FGS). But now we learn there will be no extra money – which means cutting science, education and outreach, much of which is concerned with Earth observation. He wishes to pull out of ISS, too. Earth sciences will be cut by 6.5%, and the Plankton, Aerosol, Cloud, Ocean Ecosystem (PACE) missions will be scrapped. That such science is essential to understanding and raising awareness of climate change provides a clue to POTUS's cynical motivations.

Hope, meanwhile, rests with Congress, which has final say. But do they know any better what space 'for'?



SOCIETY NEWS

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



President's Day 2018

Steph Jones has a date for your diaries.

The winners of the Society's medals and funds for 2018 were announced in the February edition:

Terry Plank (Wollaston Medal); Julian Dowdeswell (Lyell Medal); Janne Blichert-Toft (Murchison Medal); Peter Dolan (William Smith Medal); Jan Zalasiewicz (Prestwich Medal); Robert Holdsworth (Coke Medal); David Shilston (Coke Medal); Girls into Geoscience (RH Worth Award); Simon Poulton (Bigsby Medal); Charlotte Adams (Aberconway Medal); Owen Weller (Wollaston Fund); Amanda Owen (Lyell Fund); George Cooper (Murchison Fund); Hannah Hughes (William Smith Fund). Recipients of the 2018 President's Awards will be

announced in the May issue.

Awards will be presented at President's Day on **6 June 2018**. On that day there will be research talks by the four senior medallists: Terry Plank (Lamont-Doherty Earth Observatory, Columbia University); Julian Dowdeswell (Scott Polar Institute, University of Cambridge); Janne Blichert-Toft (CNRS and École Normale Supérieure de Lyon); Peter Dolan (Ikon Science Limited) on their current or most recent work.

All Fellows are welcome to attend the events of President's Day, though lunch with the Award winners will incur a charge. Full details of charges and instructions for registration will be published in the May issue, and online.

Chartership news

New Chartered Geologists and Chartered Scientists, reported by Chartership Officer, Bill Gaskarth.

CGeol: Thomas Ader, Giovanni Aquilina, Davide Baldini, Alexander Beever, Gareth Burdell, Riccardo Cerri, Ada Crottini, Alexander Crow, Simon Eden, James Ferrari, Timothy Ferriday, Jemima French, Erika Gentile, Owen George, Luca Gioacchini, Dan Glazier, Maria Hartford-Beynon, James Howard,

Kristian Lomas, Kira Markham, Mauro Della Martera, Justin Morton, David Moy, Vincenzo Ragone, Dan Senkans, Athina Simon, Michael Tracy, Imtias Ali Ujjon, Charlotte Wakefield, Kirsty Walker, Xiaoyang Wu, Colin Kai Wing Yeung.

CGeol by reciprocity with the AAPG: Timothy Tylor-Jones,

CSci: Thomas Ader, Simon Eden, Maurizio Ferla, Adam Putt.

Diversity, Equality and Inclusion

The Society's diversity, equality and inclusion (DEI) activities are progressing well, writes George Jameson*

February 7 saw the launch event for the Science Council/Royal Academy of Engineering's *Diversity and Inclusion Progression Framework Benchmarking Report* where 21 scientific bodies, including the Society, self-assessed their performance. Its key findings may be read here: bit.ly/2sJYSbE.

Much of our diversity programme will focus on refining and implementing an action plan based on these findings.

Since the International Association for Geoscience Diversity (IAGD) became an Associated Society (9.17), we have been in discussion with British-based members of their Executive Committee, providing support and advice on setting up an IAGD UK chapter. The launch will be hosted at Burlington House on 4 June 2018.

Views and suggestions please to:

E: diversity@geolsoc.org.uk.

*** George is External Relations Officer with responsibility for Diversity.**



PUBLIC LECTURE SERIES

Securing supplies of critical raw materials – the geologist's role

Speaker: Kathryn Moore, Camborne School of Mines
Date: Wednesday 11 April 2018

Programme

- ◆ **Afternoon talk:** 14:30pm Tea & Coffee: 15:00
Lecture begins: 16:00 Event ends
- ◆ **Evening talk:** 17:30 Tea & Coffee: 18:00 Lecture
begins: 19:00 Reception.

Further Information

Please visit www.geolsoc.org.uk/gslondonlectures18. 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: **Sarah Woodcock**, The Geological Society, Burlington House, Piccadilly, London W1J 0BG,
T: +44 (0) 20 7432 0981 E: receptionist@geolsoc.org.uk

RoGEP news

The Register of Ground Engineering Professionals (RoGEP) was founded in 2011 jointly by the ICE, Geological Society and the IMMM writes Bill Gaskarth.

It is a competency register and offers a clear progression route from Professional Grade to Specialist Grade and then to Adviser Grade. Eligibility for entrance onto the Register for those GSL Fellows with the appropriate knowledge and experience starts at CGeol. RoGEP membership assures clients and the public at large that the member's technical expertise has been independently peer assessed and that they are maintaining their competence through following and recording a programme of appropriate CPD.

The Register has reached the milestone of 500 registrants, of whom 194 are CGeols.

- ◆ Fellows with the appropriate knowledge and experience may apply for registration by writing to **E: registers@ice.org.uk**

Policy update

As negotiations for leaving the EU continue, science and research policy discussions in Westminster continues to focus on the impact on UK R&D and plans for a post-Brexit UK research sector, writes Flo Bullough*.

In his Autumn Budget, the Chancellor announced an increase to the four-year block of R&D investment. This puts the Government on track to reach parity with our international competitors over the next 10 years of investment at 2.4% of GDP. This was followed by the publication of the Industrial Strategy White Paper, the government's long-term plan for business, skills, research, infrastructure and productivity growth.

Ahead of the White Paper and Budget, the Society prepared a response to the House of Commons Science and Technology Committee's inquiry into the Science Budget and Industrial Strategy. This supported plans for increased investment in science and research, but also raised concerns over the lack of consideration given to sustainable access to raw materials – especially in the context of Industrial Strategy funding initiatives (such as battery technology, where secure access to lithium is critical).

The response also highlighted the need for consistent funding for long-term monitoring projects, and increased financial support for regional growth initiatives (points covered in greater detail in our response to the Industrial Strategy Green Paper, March 2017).

In Higher Education policy, the recent reshuffle saw Jo Johnson MP (former Minister for Universities, Science, Research and Innovation) replaced by Sam Gyimah MP who will continue the roll-out of the Higher Education and Research Act 2017.

The Society works with University Geoscience UK to respond



on areas of HE policy relevant to geoscience. This includes the recent submission to the Migration Advisory Committee Call for Evidence on the impact of international students in HE. This covered a number of themes such as: international student enrolment on critical Masters courses, their role in 'soft power' and influence abroad, and the impact of UK immigration policy on fieldwork, data collection and cross-border working.

In energy policy, the Department of Business, Energy and Industrial Strategy published the Clean Growth Strategy (October 2017), setting out Government proposals for decarbonising the UK economy through the 2020s. This re-establishes the potential role of Carbon Capture and Storage (CCS) in meeting UK decarbonisation targets, following the earlier cancellation of the CCS Competition (2015).

We raised the issue of CCS development in our responses to the Industrial Strategy and the Science budget, as well as in our response to the Royal Society of Edinburgh Energy Inquiry into Scotland's future energy supply.

For more information **W:** www.geolsoc.org.uk/policy.

Radwaste disposal

Adler deWind writes: In the December/January double issue we announced that the UK Government was consulting on two proposals regarding a geological disposal facility (GDF) for the UK's higher level radioactive waste. The government then postponed their launch. However, there are now three such proposals, with closing dates of 19 and 20 April. For further details, go to **W:** www.geolsoc.org.uk/consultations.

Geoethics – what do you think?

Geologists are not immune from ethical considerations, say David Ovadia* and Nic Bilham*

'Geoethics' is a term that is both obvious and abstruse. Unlike our colleagues in the medical and biological sciences, who are often subject to intense ethical controls, often prescribed in law, Earth scientists practise in a relatively unregulated environment.

Pharmaceutical companies have been known to cancel expensive drug development programmes if it emerges that the product may improve the quality of life but not its extent (or vice versa) because of fears of subsequent litigation. Geologists rarely think of themselves as subject to lawyers' concerns in quite the same way. But this does not mean that we are immune from ethical considerations.

Mapping

A mapping geologist might be tempted to ignore an analysis or an outcrop that does not fit cleanly into the model being developed, or to make some convenient assumptions about the rocks in remote and inaccessible places beyond easy reach. A mining company geologist might be put under pressure by the board to be more optimistic about the economic viability of a mineral resource, especially when this could swing a critical investment, and perhaps preserve the person's job.

The volcanologist responsible for advising government whether or not to order a massively expensive and disruptive evacuation is

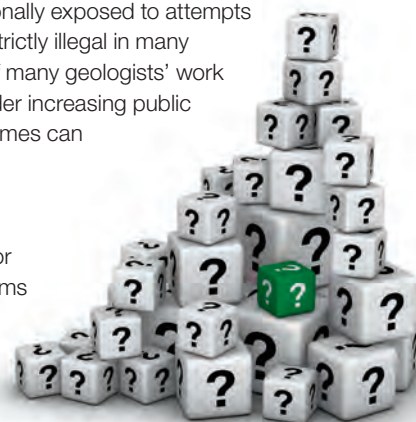
exposed to intense political, legal and media pressures, while an engineering geologist might feel it to be excessive and career-limiting caution to repeatedly refuse to sign off a bridge or tunnel scheme despite nagging doubts.

Behaviour

In the teaching environment, being ensconced with a group of people for long periods in a laboratory, field camp or research vessel requires the highest standards of ethical and moral behaviour by all parties. Geologists are occasionally exposed to attempts at bribery even though this is strictly illegal in many jurisdictions. And the impact of many geologists' work on wider society is coming under increasing public scrutiny. Acting ethically at all times can be challenging.

IAPG

The International Association for Promoting Geoethics (IAPG) aims at creating awareness about the application of ethical principles to theoretical and practical aspects of



► geosciences. It is affiliated to the International Union of Geological Sciences and the Geological Society of London, among others, as a not-for-profit association with 1816 members in 123 countries, and has a network of 28 national sections, including the United Kingdom. Details can be found on its web site at **W: www.geoethics.org**.

The present authors are interested to hear your views on what efforts the Geological Society, the IAPG and others should be put into creating and promoting greater ethical awareness, through discussions, meetings, education and enhanced codes of conduct; and on topics such as the desirability of regulatory or voluntary approaches to setting standards and spreading best practice, at national and global level, and how this may be achieved.

Geoethics overlaps with issues relating to professional standards, accreditation, indemnity and 'ombudsmanship', and no attempt is being made to distract from those important areas. We simply invite readers to share their views on geoethics, by contacting one or both of the authors. We will report back at a later stage with a synthesis of opinion.

* Keyworth NG12 5ED. **E:** mailto:davidovadia@outlook.com

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E: nic.bilham@geolsoc.org.uk

Programme: 2018

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

- ◆ **Tuesday 24 April** – Burlington House
- ◆ **Thursday 14 June** – Athenaeum
- ◆ **Wednesday 12 September** – Gay Hussar
- ◆ **Wednesday 24 October** – Bumpkins
- ◆ **Wednesday 5 December** – Athenaeum

► Please contact Sarah Woodcock for more information and to make a reservation. **E:** sarah.woodcock@geolsoc.org.uk



Latest news from the Publishing House

Jenny Blythe has the latest from the Geological Society Publishing House

Evidence for a grounded ice sheet in the central North Sea during the early Middle Pleistocene Donian Glaciation

By Carina Bendixen, Rachel M. Lamb, Mads Huuse, Lars O. Boldreel, Jørn B. Jensen and Ole R. Clausen

Interpretation of 3D seismic data from the central North Sea yields evidence of a pre-MIS (Marine Isotope Stage) 12 grounded glaciation. The glaciectonic complex shows buried push moraines resulting from the thrusting of multiple ice advance phases with horizontal shortening of 35–50%. The earliest feature observed within the complex, a hill-hole pair, represents the initial glaciation of the area. This is overlain and deformed by multiple thrust units with numerous inferred ice-flow directions. The thrust deformation observed shares characteristics with kinematic processes, push moraines and static gravity processes, seen as gravity spreading and contraction. The glaciectonic complex in its entirety is interpreted to correlate to a pre-Elsterian glaciation, because of its stratigraphic position below central North Sea tunnel valleys, estimated to be Elsterian in age (MIS 12; 450 ka). The study proposes that the thrust complex correlates to the Donian glaciation in Russia (MIS 16; 600 ka) with ice sourced from Norway. The complex therefore represents a glaciation where a significant area of the central North Sea was covered by an ice sheet, 200 kyr prior to the Elsterian. This study highlights the fragmentary record of pre-Elsterian glaciations and the importance of incorporating offshore sedimentary archives and regional frameworks when reconstructing Pleistocene climate change.

► Available in the Lyell Collection:
<http://jgs.lyellcollection.org/content/early/2017/11/23/jgs2017-073>

Sedimentary context and palaeoecology of *Gigantoproductus* shell beds in the Mississippian Eyam Limestone Formation, Derbyshire carbonate platform, central England

By L. S. P. Nolan, L. Angiolini, F. Jadoul, G. Della Porta, S. J. Davies, V. J. Banks, M. H. Stephenson and M. J. Leng

A sedimentological study was conducted at two localities exposing the Mississippian Eyam Limestone Formation of the Derbyshire carbonate platform, UK. Ricklow Quarry comprises seven facies with diverse skeletal assemblages, representing deposition on the inner to middle ramp within open marine waters. Once-a-Week Quarry comprises four facies, dominated by crinoidal debris representing deposition on the inner ramp. Both localities...



► Available in the Lyell Collection:
<http://pygs.lyellcollection.org/content/61/4/239>

Should we dig gold?

John Milsom* wonders why we bother wasting so much effort finding the stuff



Mining companies, and mining geologists by association, do not get a good press. Often there is hypocrisy involved. Many of the most articulate critics benefit hugely from what the industry produces, and ignore the fact that some of the less articulate may rely on those products for sheer survival. Moreover, as industry spokespeople never tire of pointing out, even the largest companies are constrained as to where they can put their mines. They must be in the places where the minerals exist.

And yet, and yet there are minerals and minerals. And there is gold.

Macho

There can be few industries where so much effort is expended for so little product. Ore grades are typically measured in parts per million (grams per tonne). To get at these miniscule traces, forests are stripped, vast pits are blasted into the ground beneath and enormous vehicles transport broken rocks to gigantic crushers where they are pounded into dust. The gold is then extracted by processes that may involve poisons such as mercury or cyanide. The worthless muddy remainders end up in sterile tailing dams where they must be confined for centuries, or for ever, because of what they originally contained or what has been added during processing. This is not an industry for the faint-hearted. The life of a gold miner is a tough one, and only the toughest survive. It is all very macho.

Which contrasts dramatically with the fate of the end products. Jewellers in Singapore cheerfully claim that half of the gold produced each year ends up around the necks, arms and ankles of the womenfolk of Asia. They are, of course, exaggerating. In 2016 world gold demand was 4337 tonnes; jewellery accounted for only 47% of that total, and not all of it was worn in Asia (or by women). An exaggeration, then; but not a monstrous one.

Wealth

What of the rest? The next largest use is as a store of wealth. In 2016 gold bars, coin and stocks held by Exchange Traded Funds (ETFs) and central banks took 45% of production. Very little of this sees the light of day for more than a few moments. Finely-dispersed gold taken from some very large holes in the ground is then hidden away in pure form in other, much smaller, ones. It hardly seems a sensible use of resources.

Gold is amazing. It is fantastically ductile and malleable, and a very, very good conductor of electricity. Those properties account for its 'useful' uses, mainly in electronics. It would be hard to find alternatives for many of these, but dedicated gold mines may not be needed. In 2015 a single copper mine, the Grasberg (which, like many copper mines, is also a gold producer) provided the equivalent of a tenth of the global 'industrial' demand. The case for creating mines for gold and gold alone can be made only in terms of 'cultural' rather than essential uses. Can we afford this on a shrinking planet, or do our cultures need to change?



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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).

“THERE CAN BE FEW INDUSTRIES WHERE SO MUCH EFFORT IS EXPENDED FOR SO LITTLE PRODUCT”

DR JOHN MILSON

FALLING SKYE



Simon Drake* and Andy Beard on the recent discovery of Paleocene impact ejecta on the Isle of Skye

Recent fieldwork* on the Isle of Skye has led to the discovery of the extraterrestrially derived mineral vanadium-rich Osbornite (TiVN) within a one-metre thick layer at two separate sites seven kilometres apart.

How had this layer been deposited?

One site was right under the earliest Paleocene basalts on the Island; could there have been a meteorite impact before the first volcanic activity on Skye? Did the meteorite cause the volcanism? Where did this layer fit into a short lived (60-55Ma) volcanic episode on Skye?

To date, this mineral had only been reported as dust collected from the wake of the Wild II comet trail during the 2006 NASA Stardust mission. It had never been reported on Earth before, and therefore could prove an extremely important and interesting find.

Ignimbrite eyes

The story began in 2011 during PhD fieldwork when I was trying to identify silicic ignimbrites on Skye and from there to map and log these deposits.

The idea was then to correlate the logs and determine the nature and characteristics of eruptions. From there, I wanted to establish precisely where silicic volcanics fitted into Skye's volcanological evolution.

I first needed to check the earliest volcanic rocks on the Island, and began mapping with 'ignimbrite' eyes on. During this fieldwork, I decided to target the lavas on the Strathaird Peninsula near Torrin and look right at the base. My colleague Andy Beard and I traversed some very awkward ground and located a 1m-thick layer of extremely strange-looking rock beneath these lavas. The rock was buff-coloured and had a streaky

“ COULD THERE HAVE BEEN A METEORITE IMPACT BEFORE THE FIRST VOLCANIC ACTIVITY ON SKYE? DID THE METEORITE CAUSE THE VOLCANISM? WHERE DID THIS LAYER FIT INTO A SHORT LIVED (60-55MA) VOLCANIC EPISODE ON SKYE? ”



The tertiary volcanic complex of Skye, cut by swarms of vertical dykes, hides yet another geological marvel

fabric, akin to a welded ignimbrite. I'll refer to it as a meteoritic ejecta deposit (Site 1).

The layer is housed in a pronounced, recessed notch at the base of the An Carnach lava pile on the Strathaird Peninsula. A later sill has chilled between the lowermost part of the meteoritic deposit in the notch and the uppermost Mid-Jurassic sedimentary rocks. By stripping the sill out of the stratigraphy it became clear that the ejecta deposit layer was initially lying on top of Mid-Jurassic sedimentary rocks.

Fieldwork continued during the summer of the following year and I found a very interesting outcrop seven kilometres away, south of Broadford, near the Neolithic burial site known as Chambered Cairn. Rocks here were designated (on the 1900 Survey map) as Triassic conglomerate. However

this outcrop comprises two units, which resemble a pyroclastic deposit: a lower, light-coloured friable unit, full of vesicles, grades up into another unit that looks like a conglomerate and contains basaltic clasts. I'll refer to both units as meteoritic ejecta deposit (Site 2).

At that stage, we had no idea of the true nature of the rocks at both sites but we did know that both were highly unusual and undocumented. Indeed, Site 2 was out of published stratigraphical context due to the presence of the basalt clast. It could not therefore be Triassic as previously thought.

Unearthly viva

My PhD viva in March 2015 resulted in an interesting discussion with one of the examiners, Dr Adrian Jones from University College London. We debated whether Skye could have been hit by a

meteorite, and Adrian's enthusiasm for the potential of a new impact site was infectious. It was then that I decided to reinvestigate our samples. Probe work followed in the coming months, and a host of exotic minerals emerged from both sites, some of which were not known on Earth.

We now had two strange sites that seemed to contradict previous stratigraphical and accepted context. At Site 1, potassium-rich, bentonised ash, lying below the earliest basalts, suggested that the first volcanic outpourings on Skye were silicic and not basaltic as formerly thought. At Site 2, a Paleocene-aged conglomerate was found on top of rocks of Cambrian-Ordovician age - a contact unknown on Skye.

We decided to reinvestigate the samples from Sites 1 and 2 and used three analytical methods. ►

We couldn't get ashore easily when looking for more impact sites marginal to the Cuillin so hired the assistance of a high-speed RIB. However, we still ended up having to be rowed ashore due to tide conditions and hidden obstructions

The authors examining the nature of Site 2: lower unit road cut on B8083 south of Broadford on the Isle of Skye. The Cambro-Ordovician peak of Beinn Suidral lies beyond

Paleocene aged lower meteoritic ejecta layer deposit plastered on top of Cambro-Ordovician dolostone (grey) near Site 2. Note the vesicular nature of the buff coloured ejecta deposit (above finger). Very little of this deposit is preserved around the road cut, presumably because of erosion and glaciation



► First, thin-sections from both sites were made to determine whether any shock features could be determined from either site under both polarising microscope and electron microprobe. Second, zircons were extracted from samples at both sites with a view to dating using the U-Pb system. Could we date or provide a time bracket when impact occurred?

Third, we employed a method whereby samples were carefully ground down in a hand crusher, sieved, and then exposed to a strong Rare Earth Element magnet to extract any metallic minerals present. This process is laborious, but minimises the chance of cross contamination that may occur in larger crushers. The separated fractions were mounted on slides as polished grain mounts for analysis on an electron microprobe. Minerals with a higher total atomic weight relative to their silicate counterparts appear bright white on an electron microprobe using the backscatter image, whereas silicates generally appear darker grey to black. By this method, metals can be found and analysed for interesting inclusions. So the rule is 'white = weird'! Importantly, by this method we hoped to find parts of the relict meteorite itself.

Shocked quartz

Under the polarising microscope, samples from both sites showed evidence of terrestrial quartz being instantaneously shocked. Planar parallel deformation fractures within quartz occurred commonly. These features are quite easy to spot under high magnification. They stick out, since of course quartz has no cleavage. We also noticed the presence of diaplectic quartz glass, which was produced instantaneously upon impact. Here, the criss-cross effect of pseudo-cleavage was produced without melting of the quartz, by a solid-state transformation, which is known to occur at pressures of at least 35GPa.

The presence of shocked quartz alone is not compelling evidence of impact. Controversy surrounds the reporting of shocked quartz in impact-related studies. We could already hear the counter arguments: 'They're scratches made during the slide-making process' or 'the intersection angles are not convincing'.

However, zircons were showing interesting features - which was far more heartening. At extreme shock pressures of 30GPa, near Earth's surface, zircon

can in part retain the same chemistry but have a different crystal structure. It can instantaneously transform to its high pressure counterpart, reidite. To show how extreme this near-surface pressure really is, inclusions in diamonds form over time as quartz changes to coesite at depths ≥ 100 km, and at pressures of 2-3 GPa. The presence of reidite provided strong evidence that we were on the right track and that it was increasingly likely that a meteorite had fallen on Skye; but more evidence was necessary for a watertight case.

Returning to the electron microprobe, we examined the irons to try and find part of the meteorite itself. Native iron fragments were sporadically present in samples from both sites and contained rare vanadium rich osbornite (TiVN) in close association with barringerite (Fe,Ni)₂P inclusions. Native iron (also known as telluric iron) is extremely rare on Earth and only found in its metallic form, rather than as an ore. The only documented telluric iron deposit is in Greenland, at Disko Island, which itself is near a meteorite impact site. So what was native iron doing on Skye with TiVN inside it?

Solar nebula

This mineral is a refractory one, formed at temperatures in excess of 3000°C. It is believed to have been produced within the inner solar nebula close to the proto-sun, and then, transported outwards where it was accreted onto a growing planetary body. Interestingly, within our samples we found niobium-rich osbornite (TiNbN) - the first recorded example of this mineral. The osbornite was to prove extremely important since it formed part of the meteorite itself. Large meteorites usually vaporise upon impact with Earth and therefore only Earth rocks show evidence of impact. To find a meteorite impact deposit site with part of the impactor *itself* present is highly unusual and has only previously been reported from the Chicxulub crater in Mexico.

While the presence of TiVN provides compelling evidence of extra-terrestrial derivation, we also found barringerite in samples from both sites. This mineral has been found on Earth in phosphide and Cu-Ni sulphide deposits. Neither of these types of deposit is found on Skye. Barringerite was named after Daniel Barringer (1860-1929) the mining engineer

who first proved the meteoritic origin of the Meteor (Barringer) Crater in Arizona, where the mineral was first found.

At both Skye sites, rare, microscopic spherules of native iron are evident within the rock matrix. The native iron cores of the spherules are surrounded by iron-rich silicate glass. The shape, texture and chemistry of these spherules strongly suggest that they were formed very rapidly in conditions of very low oxygen fugacity. Such conditions can occur on Earth and iron-cored spherules are found within some ignimbrites. However, it is difficult to convincingly ascribe native iron cores to a terrestrial process. ►



Site 2 upper formerly mapped as Triassic Conglomerate. Note basaltic lithic lapilli close to coin at 3 and 6 o'clock



The recess housing the meteoritic ejecta layer at Site 1 above a later sill (white lichen, vertical cooling joints). Astonishing that this layer had not been spotted in the past. Perhaps the ground was so bad that nobody thought it was worth investigation



Andy scrapes back the lithology underneath the lowermost basalts at a third suspected impact site marginal to the Cuillins. We are continuing to research this layer. Chemically, it is very similar to the layer at Site 1 and 2

► Moreover, the iron spherules we have found in the Skye deposits are extremely similar, texturally and chemically, to those found in the Wabar Meteorite Crater (Saudi Arabia). Also, the minerals baddeleyite and alabandite are present within the matrix at both Skye sites. Although not exclusively extra-terrestrial, baddeleyite has been reported from achondrite meteorites. Such meteorites resemble terrestrial basalts. Alabandite has also been found in the very rare meteorite group the enstatite chondrites.

Conundrum

We now had a conundrum - compelling mineralogical evidence for meteorite impact in a layer just beneath the oldest volcanic rocks on Skye, which appeared very similar to another layer seven kilometres away. We also had a fragment of the meteorite itself. The find was surely going to be controversial. Skye holds a special place in geologists' hearts. Much of our knowledge of igneous processes comes from Skye and the British Paleogene Igneous Province (BPIP) (from the Inner Hebrides to Northern Ireland). Most workers today accept volcanism on Skye and the BPIP was initiated by a mantle plume

that melted into the base of ancient continental crust. This event was short-lived (between 60-55Ma). So where did an impact fit in the picture? We needed to try and date the impact.

Zircons from Site 1 were dated and clustered around the Archean and Proterozoic. Rocks of these ages on Skye at the time of impact would have been Lewisian Gneiss and Torridonian sandstone. The impact would have scavenged these rocks out of the subsurface and incorporated their zircons into our impact deposit. Importantly, some of our zircons were Triassic in age, which meant that our deposit could not be part of the mainland 1.2 Ga Stac Fada meteorite impact event. The lack of Paleocene-aged zircons in our deposits suggested that there were none available for incorporation at the time of impact.

The impact must therefore have taken place very early on in Skye's volcanic history. We knew that the overlying lavas formed part of the Skye Main Lava Series and had been dated as $60.00 \pm 0.23\text{Ma}$. The impact must have happened before this date, since Site 1 was immediately below the base lavas. We had the basaltic clast from Site 2 dated at $61.54 \pm 0.42\text{Ma}$ using the Ar-Ar

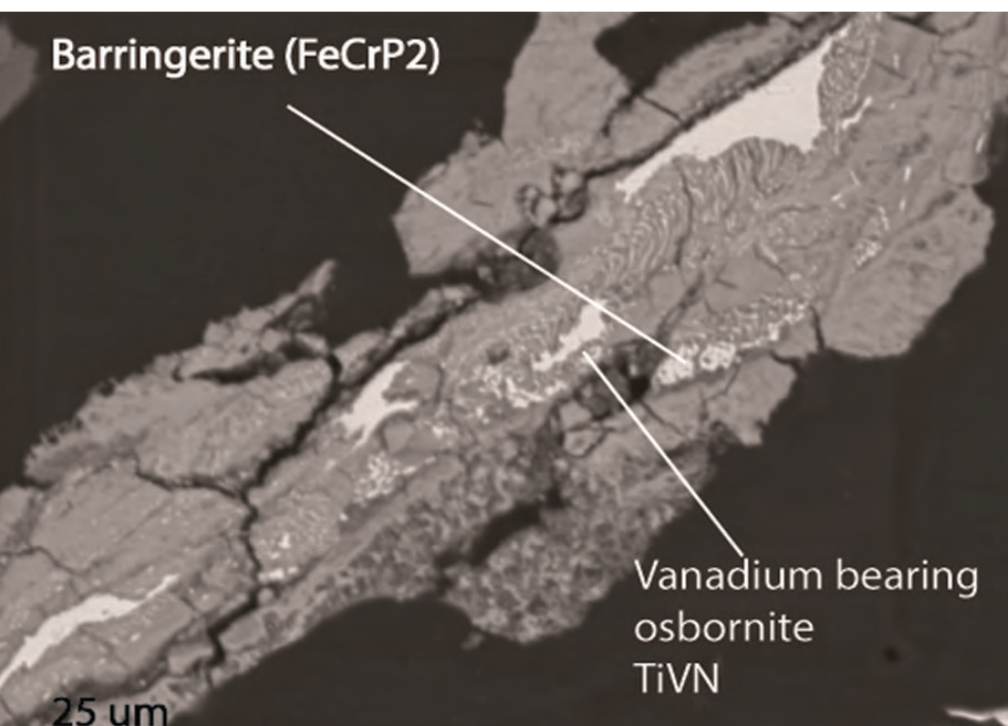
method. The date of this basalt clast locked in the earliest date that a meteorite impact could have taken place.

But the existence of the basalt within the deposit showed that some igneous activity must have been going on before the impact event. It is possible that this basalt could be part of a lava, or be the fine-grained margin of a shallow intrusive. There is no way of knowing. Yet, the presence of basaltic clasts brackets the date of meteorite impact between $61.54 \pm 0.42\text{Ma}$ and $60.00 \pm 0.23\text{Ma}$. Interestingly, the basaltic clast is one of the oldest igneous rocks known from the BPIP.

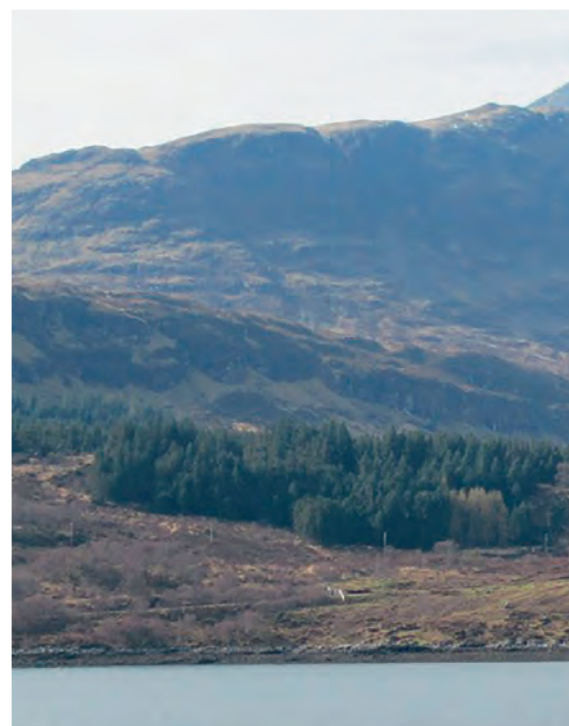
The discovery of the impact layers suggests that a meteorite might have acted as a driver for volcanism on Skye up to 62 million years ago. The meteorite itself must have been highly reduced, because of the presence of osbornite in its different varieties. Taking everything into account the most likely candidate for the type of meteorite is an enstatite chondrite.

Future research

We need to try and establish the extent of these impact deposits within the BPIP. We have located three new Skye



Backscatter electron microprobe image of Vanadium rich osbornite (TiVN) in close association with barringerite. Prior to the Paleocene Skye meteorite strike, TiVN had only been recovered as dust from the Wild II comet by NASA in 2006



Site 1 of the meteoritic ejecta deposit at the base of the lowest basalt flows above the white house on the far shores of Loch Slapin. To get to it involved traversing over a forest that had been cut down on very boggy ground. Note Blaven in the background

sites including a site adjacent to Loch Skavaig in the Cuillin Centre. This is quite a difficult site to reach and only accessible by boat.

We need to investigate whether the Skye meteorite ejecta deposits were deposited in a similar manner to terrestrial ignimbrites. The flow mechanics of terrestrial ignimbrites are highly complex, since high-concentration currents entraining large components frequently erode into the dusty layers they have previously deposited. Similarly, hot ash and pumice can ascend and shoot off from the main current in a 'decoupling' event. What this means is that ignimbrites, and probably meteorite ejecta deposits, do not commonly show a true vertical sequence of the whole eruption or impact record. It can therefore be very difficult to determine whether deposits are proximal or distal to an impact site if a crater is not present.

We will do a lot more exploration for this impact deposit, ideally further afield in the wider North Atlantic Igneous Province (NAIP). The zircon age clusters we have from both sites of Skye marry up well with zircon ages

in Scandinavia, Greenland and Canada within the NAIP. This means that any surviving crater could theoretically be located in several places within the Northern Hemisphere. At present we don't know if a crater exists for the Skye impact event or, where it is.

This work has attracted a lot of interest on Skye, as well as within the scientific community and the media. We are planning to give a public lecture on the Isle in March this year (and will donate all proceeds to the Skye Mountain Rescue). I am really looking forward to giving something back to the place that has enthused me so much for volcanism (and given me so many midge bites!). Indeed, the Isle of Skye holds a special place in my life since I got married on the side of the Eastern Red Hills during my 2010 fieldwork season.

The late doyen of Hebridean geology, Henry Emeleus, spoke to me during my PhD fieldwork about the region where we found site 2. He said "That corner is mapped wrongly. If you sort it out, you'll have a much better picture of the geology around here.". Tragically, he died before we published our paper so never realised how prophetic his words really were. ♦

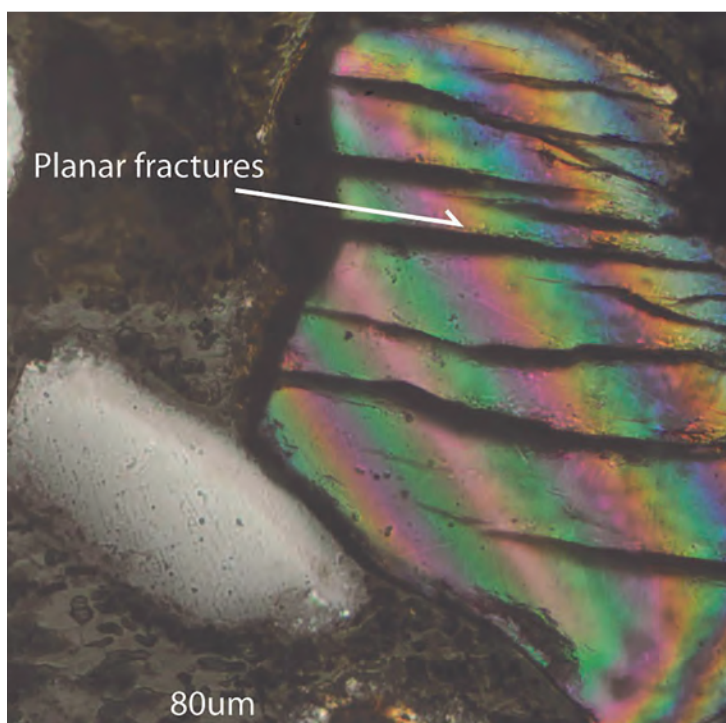
“ THIS WORK HAS ATTRACTED A LOT OF INTEREST ON SKYE, AS WELL AS WITHIN THE SCIENTIFIC COMMUNITY AND THE MEDIA. WE ARE PLANNING TO GIVE A PUBLIC LECTURE ON THE ISLE IN MARCH THIS YEAR ”

***Simon Drake** gratefully acknowledges funding from the Geological Society of London, Annie Greenly mapping fund which assisted greatly in this study. Birkbeck College, University of London.

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A zircon grain displaying planar fractures from Site 1. This grain has also in part been converted to zircon's high pressure polymorph reidite. The presence of reidite provides compelling evidence of instantaneous extreme pressure (≥ 30 GPa) shocking

BUFFON THE GEOLOGIST



Oil painting of Comte de Buffon, by François-Hubert Drouais - Musée Buffon, Montbard



Jan Zalasiewicz and friends* uncover an under-reported aspect of the great French biologist

Georges-Louis Leclerc, Comte de Buffon, was in many ways emphatically a man of *France's ancien régime*. Born into solid bourgeoisie, he inherited a title and a castle as a young man. He was no pampered and idle aristocrat, though. Through a combination of talent and lifelong, sustained hard graft, he came to be placed by Louis XV in charge of both the Jardin du Roi and the Cabinet du Roi (that were to become the Botanical Gardens and Natural History Museum of Paris).

Buffon showed good timing in death as in life, avoiding a likely appointment with Madame Guillotine by dying peacefully in 1788, the year before the French Revolution (his son was not so lucky). Known in his time as a savant of the Enlightenment to rival Voltaire and Diderot, his reputation today mainly rests on his explorations of biology. But it is less widely known is that he was an inspired and ground-breaking geologist too.

Odyssey

Buffon built his reputation upon a lifelong scientific odyssey - a 36-volume exploration of the natural world, his *Histoire Naturelle*. This work combined pioneering biological thinking with beautiful, evocative prose, provoking jealousy among his peers but building an audience that reached far beyond them. The style was no mere artifice - Buffon saw elegance of exposition and clarity of thinking as two sides of the same coin.

Buffon was deeply interested in the mysteries of the living world; but those interests extended more widely, to encompass our planet as a whole. Some volumes of the *Histoire Naturelle* focused on minerals as well as living organisms, and late in his life, in 1778, he penned a slim volume entitled *Les Époques de la Nature* (The Epochs of Nature). In this book he provided what is arguably the first scientific, evidence-based history of the Earth, from beginning to end.

It is a remarkable work, combining large-scale scientific synthesis in vividly telling the grand-scale story of our

planet as an interconnected whole from beginning to end, with vignettes of minute detail deduced from rock and fossil evidence. Its place in the history of geology has been somewhat overlooked outside the French-speaking world, not least because, only fragments of the book have ever been translated into English - a 240-year long omission that we have just remedied.

Classical

It is an Earth history deduced in a scientific context that is now alien to us. For instance, the classical elements of Earth, air, fire and water had not yet been replaced by such as oxygen, hydrogen, silicon. And Buffon was not a global traveller in the mould of Humboldt or Darwin; his own travels were mainly restricted to the annual migration between Paris and his chateau at Montbard. Nevertheless he was a sharp observer of his own terrain, a voracious reader and diligent correspondent. For him, that was enough - the mind, he said, was the best crucible.

Buffon's Earth of *Les Époques* was finite: it had a beginning, and will have an end, determined by the cooling of the Earth from a molten ball torn from the Sun, to an ultimate death by freezing sometime in the future. He calculated a span to the present day experimentally, from the cooling of iron spheres taken from a furnace, and published an age of the Earth of 75,000 years. In *Les Époques* he alluded to this figure being unreasonably brief from the evidence of rock strata - and his notebooks show that privately he thought three million years may be nearer the mark.

But 75,000 years was still a figure that shattered the Biblical timescale, and so he carefully constructed a 'First Discourse' to his book, arguing that his own ideas, being 'purely theoretical', could not possibly harm the eternal verities of the Bible. Despite some grumbling among the clerics, the ploy mostly worked, and with that deft piece of diplomacy out of the way, Buffon simply got on with the science. ►

Epochs

His Earth history comprised seven epochs, the first representing a molten, spinning, cooling globe, and the last when humans appeared on the planet. In between, oceans appeared from the condensation of water vapour, primary crystalline rocks were eroded and weathered to form sedimentary rocks, volcanoes erupted, life appeared and went through different forms as the Earth cooled, and the continents took on their present-day shapes.

Buffon's Earth had to be internally consistent and logical, even if he was working on a tiny – and sometimes misleading – evidence base. He posited a long-term fall in sea level to explain marine strata on land, with ocean water tumbling onto subterranean caverns left over from the solidifying Earth. Noting that active volcanoes were common near coastlines, he powered them by exothermic reactions between the intruding seawater and buried minerals such as pyrite. Refreshingly, he presented these ideas not as incontrovertible fact, but essentially as hypotheses, for future generations of scholars to examine.

His examination of smaller-scale evidence showed that he was developing the reflexes of a field geologist. In the countryside around his Montbard estate, he deduced the three-dimensional arrangement of limestone and shale units. The limestones, he said, were the amassed remains of countless generations of shellfish, while the mudstones he saw as the weathered and decayed products of the Earth's original crystalline rocks.

He observed the fossils that the rocks contained, such as 'horns of Ammon' (ammonites) and belemnites, and said that these represented kinds of animals that were no longer alive on Earth. He thus in effect put forward the phenomenon of biological extinctions, a generation – and a political revolution – before Baron Cuvier, the man more generally associated with establishing this concept in geology.

Buffon worried away at this concept, noting that the shallow sediments above the ancient rock strata contained the remains of elephants and hippotamuses – while from north America he detailed reports of bones of an animal with elephant-like tusks and huge teeth more like those of a hippo. It was a more recently vanished giant, he said, of the beast that we would come to know as the mastodon.

Palaeontology

Buffon proposed that such petrifications should be studied and classified just as people were beginning to classify living organisms – and so foreshadowed the



Anne-Sophie Milon, *Second Epoch, When matter, being consolidated, formed the interior rock of the globe and the great vitrescible masses that lie on the surface*

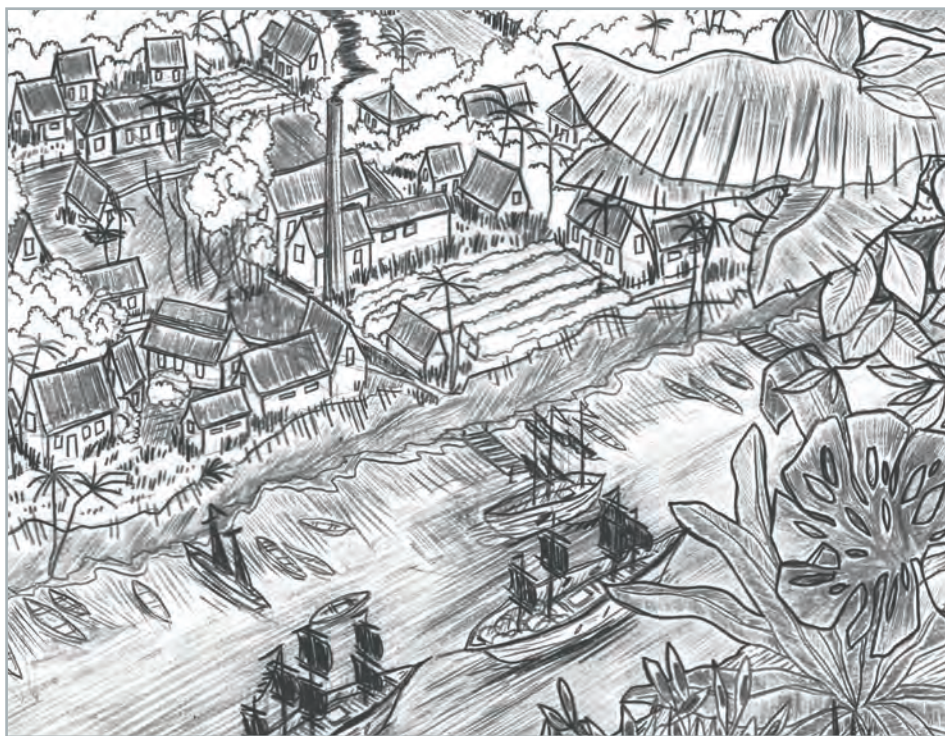
science of palaeontology. Though the science was yet to be established, it did not stop him making deductions from first principles. Coal seams, he proposed, were the compressed and carbonized remains of prehistoric swamp forests – and, in an inspired piece of palaeoenvironmental reconstruction, he made an overt comparison with descriptions of the extant forests of Guyana (he had never been there, but provided a vivid and atmospheric reconstruction based on travellers' accounts).

Les Époques was one of Buffon's most widely read books in his lifetime – blessedly briefer than the erudite but enormous *Histoire Naturelle*, written with scientific imagination and clarity, and with something of the verve of a Conan

Doyle or a Jules Verne. A fellow savant, Jean-Etienne Guettard, complained that it was an adventure story to be 'devoured by the maidservant and amuse lackeys' – but it was admired by Catherine the Great of Russia too, which pleased Buffon greatly. It is worth reading today, still, as one of the earliest and most impressive explorations of a vanished world.

And, in Buffon's description of the emerging world – his seventh epoch when humans appeared, with their powers 'assisting' the forces of nature – we have one of the first premonitions of the Anthropocene. Buffon, in true Enlightenment spirit, was an optimist and looked here towards a more peaceful and productive world.

Time, in this respect, will tell. ♦



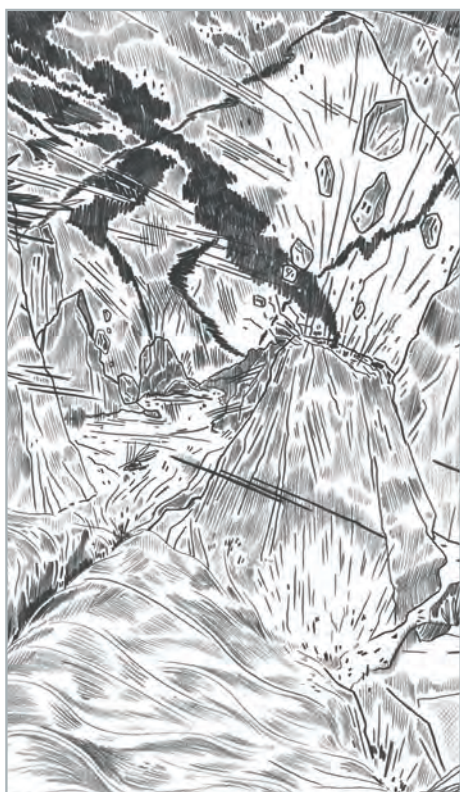
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“ IN 1778, HE PENNED A SLIM VOLUME ENTITLED *LES ÉPOQUES DE LA NATURE*. IN THIS HE PROVIDED ARGUABLY THE FIRST SCIENTIFIC, EVIDENCE-BASED HISTORY OF THE EARTH, FROM BEGINNING TO END ”



Anne-Sophie Milon, Fifth Epoch, When the elephants and the other animals of the south lived in the north

ENDORSED TRAINING/CPD

MEETING	DATE	VENUE AND DETAILS
Lapworth's Logs	N/A	Lapworth's Logs' is a series of e-courses involving practical exercises of increasing complexity. Contact: info@lapworthslogs.com. Lapworth's Logs is produced by Michael de Freitas and Andrew Thompson.

EVENTS

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

MEETING	DATE	VENUE AND DETAILS
Lithium: From Exploration to End-User Geological Society Year of Resources	9-10 April	Conference. Venue: Burlington House. See website for details, registration. Fees and discounts apply. Contact: Georgina Worrall E: georgina.worrall@geolsoc.org.uk
Managing the Impacts of Historical Coal Mining Yorkshire Regional	11 April	Evening lecture. Speaker: Tim Maple (Coal Authority). Venue: Leeds (TBC). See website for details. Time: 1800 for 1830. Contact E: yorkshireregionalgroup@gmail.com.
The role of the geologist in securing supplies of critical raw materials GSL Public Lecture	11 April	Venue: Burlington House. For details and registration see advert on p. ???. Speaker: Kathryn Moore (Camborne)
Annual Conference Engineering Group	12-14 April	Venue: Christ's College, Cambridge. Conference and field excursion. See website for details and registration. Fees and discounts apply. Contact E: georgina.worrall@geolsoc.org.uk
First Annual Early Careers Evening Engineering Group	18 April	Venue: Burlington House. Evening meeting. Time: 1730 for 1800. Contact: Tome Hall E: Tom.Hall@mottmac.com.
Dinner, Discussion & AGM Society Discussion Group	24 April	Venue: Burlington House. Evening meeting. For details see advert, p06.
Hydrogeology of the Chalk Hydrogeological Group, Contaminated Land Group, 2018 Year of Resources.	25-26 April	Venue: Burlington House. Conference – see website for details. Day one: chalk groundwater resources. Day two: chalk groundwater quality. Contact Rolf Farrell E: rolf.farrell@environment-agency.gov.uk

STICKS AND STONES APRIL GEOFOOLS.





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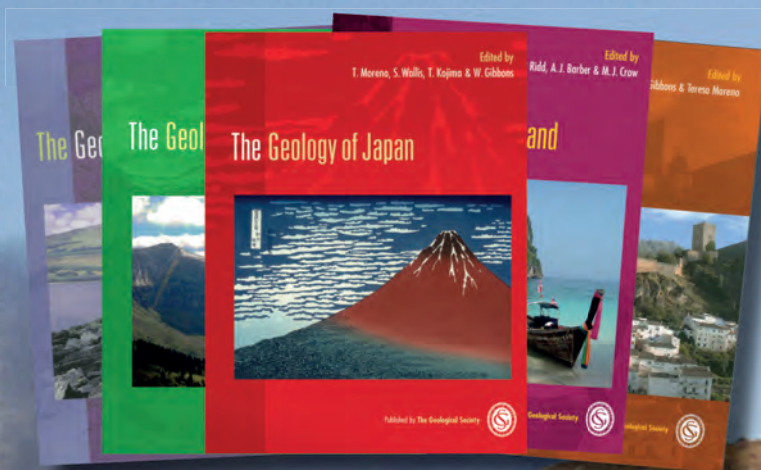
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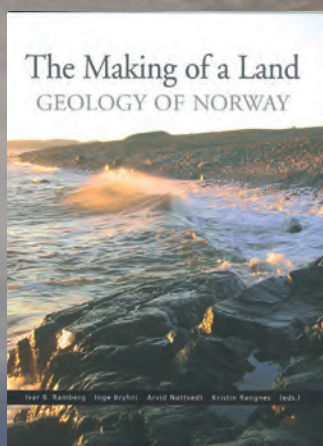
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Geohazards in Indonesia



The volume is made up of 11 papers, including the introduction. With two exceptions, the direct application of the papers by emergency managers is not presented.

This makes the full title somewhat misleading and the purpose of the volume inappropriate. In addition, the bulk of the papers' focus is on faulting and seismicity, estimating fatalities, or earthquake early-warning. This is disappointing since there is a significant amount of geologic hazard and related risk reduction information in the published literature, including volcanic hazards, tsunamis, and landslides.

There is a brief mention in one paper on the introduction and implementation of an Indonesian Tsunami Warning System and how the warning is carried out to public officials and emergency managers, even though locally there have been efforts to educate said audience and the public as to what to do if a tsunami warning is issued or strong ground shaking occurs at or near the shoreline. Since the tsunami warning system was first deployed there have been several tsunamis to strike portions of the country; however, there is no mention of how successful the system has been in alerting government officials including emergency managers as well as the public.

The same paper discusses the development of SHAKE MAPS for Indonesia. The maps do not use Indonesian specific ground motion prediction equations. The use of SHAKE MAPS in Indonesia is briefly discussed without a demonstrated tie to their use in disaster risk reduction or the use by emergency managers in mitigation, preparedness planning, public education, post-earthquake emergency response or in recovery operations.

The paper on the development of a Bayesian approach to fatalities estimating does not account for the topography or building types of the sites used as a control. In addition, a concise output is needed for use by the user. This method appears to need further development before it is useful.

Overall, I found the volume interesting

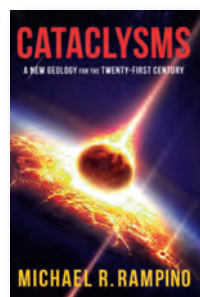
but generally not *directly* useful in developing and implementing disaster risk reduction schemes for emergency managers, utilities or the insurance industry. If the volume had been renamed it may have had been clearer to the reader as to the usefulness on the papers contained therein.

Reviewed by: **Robert Anderson**

GEOHAZARDS IN INDONESIA, EARTH SCIENCE FOR DISASTER RISK REDUCTION

edited by P R CUMMINS AND I MEILANO. Published by the Geological Society of London, ISBN: 978-1-86239-966-2
List Price: £90 Fellows Price: £45
W: www.geolsoc.org.uk/SP441

Cataclysms – a new geology



The debate between Catastrophism and Gradualism has swung to and fro for 250 years. It involved many of the fathers of geology, not least Hutton, Cuvier, Dana and Lyell, and it provided a uniformitarian framework for Darwin's ideas in the *Origin of Species*. It had been difficult to obtain evidence for extra-terrestrial activity in the geological record, but this changed dramatically with the evidence for the impact structure of the Chicxulub Crater in 1990 and its link to the extinction of the dinosaurs.

Michael Rampino has long been interested in, and an advocate of, extraterrestrial processes in shaping the history of the Earth. The book is well written and easy to read, and it is personal in that it documents the development of his ideas and some of the research he himself undertook. It is engaging, but also verges on the adversarial in setting up Catastrophism versus Gradualism, when in the end it concludes that both may have been important in creating the geologic record we see today.

Overall this book describes a journey as the author shrugs off what he regards as the shackles of Lyellian Gradualism, accepts the role of an impact in the mass extinction at the end of the Cretaceous, and explores what other aspects of the geological record might reflect extra-terrestrial activity.

Much of the discussion of the role

of extra-terrestrial processes involves establishing that there are regular cycles, as in for example the timing of mass extinctions. Cyclical activity is a feature of the geological record and so one challenge is to distinguish those cycles that imply extra-terrestrial activity. The case for periodicity in mass extinctions and its relationship to astronomical drivers is not new and remains controversial.

More broadly there remains some unease in the matching of patterns of different changes with time, although this seems more acceptable in some disciplines than others. *Cataclysms* contains much discussion of the kinds of physical changes that might result from impacts, climate change, anoxia, acid rain, volcanic winters, but less on the biological consequences of environmental change on different species, which seems to be a key step in the argument. Perhaps it has yet to be established that different impact events are characterized by different effects on the fossil record that might in turn characterize the kinds of impacts.

The last chapter notes there is evidence for ~30 Myr cycles related to changes in sea level, tectonics, palaeomagnetism, and discontinuities in sea-floor spreading rates. This is intriguing given that the periodicity suggested for extinctions is ~26 Myr. Every 30 Myr or so the Earth in its cosmic orbit is thought to pass through clumps of dark matter. Such matter could be a periodic source of energy, and Rampino speculates that this might be a way for the generation of 30 Myr cycles on the Earth to reflect extra-terrestrial activity.

Reviewed by: **Chris Hawkesworth**

CATAclysms – A NEW GEOLOGY FOR THE TWENTY-FIRST CENTURY

by MICHAEL RAMPINO. Columbia University Press (2017)
ISBN 9780231177801 224pp
List Price: (hbk or e-book): £27.95
W: bit.ly/2o3oaN2

Ocean Worlds



It is hard to imagine that thousands of years ago, the cave in which I sit was buried under hundreds of metres of ice. With water locked up in ice on land, sea level was lower and global temperatures cooler. This all



occurred well before the invention of the written word so how do we know? Subtle compositional changes in rocks, sediments, and ice hold the key along with the talented men and women who decoded them.

Ocean Worlds tells not just the story of how our oceans came to be and how they will evolve, but also the journey of human discovery that allowed us to understand these dynamic bodies of water. The story of Earth's oceans is fundamentally intertwined with the formation of our solar system, a topic covered in great detail in the book together with the heated debate surrounding the origin of Earth's water.

As humanity's reliance on fossil fuels warms and pollutes the planet ever more, the oceans are undergoing unprecedented change. Hunger for more protein from the sea is irrevocably altering the balance of marine ecosystems. But to what end? Is there a way to prevent disaster? Dipping into the policy side of climate change the authors make some interesting points here in a chapter on *Oceans in crisis*, while giving a brief history lesson on human effects on oceans in the last few hundred years.

The last two chapters are particularly fascinating as the focus shifts away from Earth and to distant shores in both space and time. As we explore our solar system with increasingly advanced probes and landers it has become apparent that oceans exist on some of our neighbours, the moons of Saturn and Jupiter being obvious examples. The debate about water and an ancient ocean on Mars comes with the tantalising possibility of alien life and how to find it. With increasingly sophisticated space telescopes we are now able to look beyond our own solar system to discover oceans on truly alien worlds.

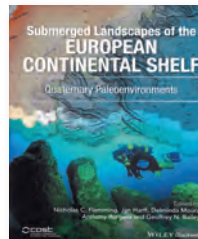
This book crams a lot of information into its 265 pages, all well referenced with notes at the back. From pirates to exoplanets and penis-worms to space probes this is truly the story of water, life, and discovery. A must-read for those with a hunger for general knowledge, or any interest in the topic. Everyone will certainly find something new to explore further in this fascinating and accessibly written book.

Reviewed by: **Jonathan Scafidi**

OCEAN WORLDS: THE STORY OF SEAS ON EARTH AND OTHER PLANETS

by JAN ZALASIEWICZ & MARK WILLIAMS, 2017.
Published by: Oxford University Press 294pp (pbk) ISBN: 9780199672899
List Price: £11.99 W: bit.ly/2o480rD

Submerged Landscapes of the European Continental Shelf



This volume is the product of a European-wide research collaboration named SPLASHCOS, 'Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf', financially supported by the Co-operation in Science and Technology office in Brussels. Over 100 researchers from 25 European countries took part, 65 of whom are credited with having contributed to this present volume, which is the first volume to be published by the initiative. A second volume, 'Archaeological Data and Interpretations' is to follow.

A central objective of the book is to answer the question of why some seafloor prehistoric evidence survives inundation by sea-level rise, when others are destroyed by wave action and currents. The book provides an analysis of general marine and coastal processes in early chapters, before dedicating the majority of the content to 14 chapters detailing the regional sea basins of Europe, summarising their geomorphology, oceanography, and examples of known archaeological sites.

These chapters do an excellent job of summarising a vast amount of data, originating from multiple disciplines. Although the exact content of each chapter varies, typically they adopt the following format.

First, the Quaternary geology of each region is described in detail, aided by a considerable number of maps and profiles of sea-level change. Next, the effect of climatic conditions on human migration is considered. This is followed by a summary of submerged terrestrial landforms which may be associated with archaeological sites.

For example, within the North Sea chapter, this largely focuses upon the complex environment of the Dogger Bank. Finally, an assessment of the archaeological potential of each basin is given; this is based upon environmental factors and the distribution of known sites.

The volume is impressively well-referenced and up-to-date throughout. Data examples are largely extracted from existing articles, and complement the text well. The only negative of the need to

source figures from various sources is a lack of consistent presentation. This lack of uniformity is also apparent in the writing style between chapters to some degree. However, this does not detract from the general flow of the book. Another minor comment would be on the absence of a concluding chapter, which would have aided the overall understanding of why some archaeological sites are preserved, but not others.

This is an impressive volume, offering a useful reference to all those working or interested in the European continental shelves.

Reviewed by: **David Vaughan**

SUBMERGED LANDSCAPES OF THE EUROPEAN CONTINENTAL SHELF: QUATERNARY PALAEOENVIRONMENTS

by FLEMMING, N C, HARFF, J, MOURA, D, BURGESS, A, BAILEY, G N, (eds) 2017. Published by: John Wiley & Sons 533pp (hbk) ISBN: 9781118922132
List Price: £80.00 W: bit.ly/2o7o1Hw

Silver - Nature and Culture



It has become popular over the last few years for authors to highlight a mineral commodity, and marry science and cultural history behind it. Silver has been

a useful element since early history; coins, medicine, photographs, teeth, swimming pools, ceramics, socks, bandages, homeopathic medicine, utensils, dining ware, sporting trophies, jewellery, cars, planes, space vehicles, electronics, computers and phones are just some of the use of this malleable metal. It was silver that drove the development of South America and the establishment of trade routes from Spain to China, including the settlement of the Philippines and Macau by the Spanish. Although gold initially drove the development mining camps throughout the south-west USA, it was silver that built the cities and towns of Nevada, the Rockies and Mexico.

This book seeks to explain the history behind the metal, and in this respect it succeeds. However, it also has its limitations. For me the largest area of contention is the limited geological ►

► content. When I think of great silver mining camps I think of Comstock, Rochester, Tonopah, Butte and Creede in the USA; Fresnillo and Zacatecas in Mexico; Potosi in Bolivia; Cobalt, Ontario; Kongsberg in Norway; Erzebirge in central Europe and Laurion in Greece. Needless to say when Alva, a small but largely irrelevant occurrence in Scotland is afforded more space than many of these 'world-class' deposits, then there is a problem. Creede is not even mentioned, and Cobalt only in passing.

Despite my disappointment over this aspect, the history and cultural importance of silver is covered in admirable detail. The book is well illustrated with excellent maps, historical images and photographs. The bibliography is limited and focused on the main aspects of the book.

This is an enjoyable light read and is recommended to anyone with a passing interest in this most versatile of metals.

Reviewed by: **Rob Bowell**

SILVER: NATURE AND CULTURE

by LINDSAY SHEN 2017 Reaktion Books.
ISBN 9781780237565
List Price: £14.95
W: bit.ly/2EwLF7c

Land Surface Remote Sensing



This book is the sixth volume in a set which aims to provide postgraduate-level information on the physics and applications of remote sensing.

Out of nine chapters, only four (119 pages of 337) cover areas of specific geological interest. The other chapters cover deforestation, wildfires, industrial plumes, locust management and epidemiology. This will therefore be a volume primarily for library or online/digital consultation by geologists.

Digital consultation would also be important since the printed book reviewed here is in a relatively small format and the important illustrations are mostly far too small and sadly exclusively in B&W; many of the grey-

tone images reveal nothing at all. URLs quoted in the figure captions provide only error messages. An e-book version is available, which presumably does have the colour illustrations.

The *Drylands and Desertification* chapter is relatively short (19pp) and focuses on vegetation and environmental issues rather than geomorphology. The chapter on *Earth surface motion and geomorphic processes* is limited to optical image correlation techniques and has been abstracted from reports on the EC-FP7 *Safelands; Living with landslide risk in Europe*. It gives a good summary of the physics behind optical image correlation but the application examples are quite limited and sadly no comparison is made with interferometric radar techniques which probably show more promise in this area.

The chapter on monitoring the environmental impacts from mining is also restricted to optical remote sensing, but undoubtedly is of value since it contains good case-studies within a relatively under-documented topic. The chapter on the contribution of SAR data to volcanology and subsidence studies does contain a good and concise summary of the theory behind interferometric radar, and although the actual application examples are rather limited, there is an extensive and comprehensive bibliography.

The editors stress the value of a holistic cross-disciplinary approach to the subject but this reviewer feels geologists will find the cover-price too high relative to the specific content and be interested only in the directly relevant chapters. With the plethora of new Earth-observation satellites currently being launched, there may be more postgraduate students from other disciplines seeking better broad knowledge of remote sensing for whom this book would provide an appropriate introduction.

Reviewed by: **Nigel Press**

LAND SURFACE REMOTE SENSING: ENVIRONMENT AND RISKS

by NICOLAS BAGHDADI & MEHREZ ZRIBI (eds), 2016.
Published by: ISTE Press 337pp (hbk) ISBN 978-1-78548-105-5
List Price: £104.00
W: www.iste.co.uk

BOOKS 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! Anthropocene - a very short introduction 2018** by Erle C Ellis 2018. Oxford University Press. 181pp, sbk
- ◆ **NEW! Rock, Bone & Ruin - an optimist's guide to the historical sciences 2018** by Adrian Currie 2018. MIT Press 372pp hbk
- ◆ **NEW! Adam Sedgwick - Geologist & Dalesman 2018** by Colin Speakman 145pp, sbk. Gritstone Writers/YGS. First pub'd 1982; reissued with new Introduction
- ◆ **NEW! Exploration of Subsurface Antarctica 2018** by Siegert M A, Jamieson S S R, & White DA (Eds). GSL SP461. 256pp (hbk)
- ◆ **NEW! Circum-Arctic Lithosphere Evolution 2018** by Pease V & Coakley B (eds) GSL SP460. 476pp (hbk)
- ◆ **NEW! Subseismic-scale Reservoir Deformation 2018** by Ashton M, Dee S J & Wennberg O P, (eds) GSL SP459. 216pp (hbk)
- ◆ **Conservation paleobiology - science and practice** by Gregory Dietl & Karl Flessa (eds) 2017 University of Chicago Press 316pp sbk
- ◆ **Lakes - a very short introduction** by Warwick F Vincent. 2017 Oxford University Press 146pp sbk
- ◆ **Tectonic Evolution of the Eastern Black Sea and Caucasus** by Sosson et al., GSPH Special publication #428 368pp hbk
- ◆ **Crustal Evolution of India and Antarctica: The Supercontinent Connection** by Pant & Dasgupta, GSPH/SCAR Special Publication #457 359pp hbk
- ◆ **Geological Evolution of the Central Asian Basins and the Western Tien Shan Range** by Brunet et al., GSPH Special Publication #427 605pp hbk
- ◆ **Subterranean Norwich - the grain of the city** by Matthew Williams. Lasse Press 160pp sbk
- ◆ **Geochemistry and Geophysics of Active Volcanic Lakes** by Ohba et al. GSL Publishing SP#437 295pp, hbk
- ◆ **Chesapeake perspectives - decoding the deep sediments: Ecological History of Chesapeake Bay** by Grace Brush. 2017 Maryland Sea Grant 63pp sbk
- ◆ **Tectonics of the Deccan Large Igneous Province** by Mukherjee et al. (Eds), 2017. Geol Soc Spec Pub #445 363pp, hbk
- ◆ **Petroleum Geoscience of the West Africa Margin.** Geol Soc Spec. pub. #438, 2017 by Sabato Ceraldi et al (eds)
- ◆ **Waves, Particles and Storms in Geospace** by Balasis et al. 2016 Oxford University Press 448pp hbk
- ◆ **Lake Pavin - history, geology, biogeochemistry and sedimentology of a deep meromictic maar lake** by Sime-Ngando et al., (Eds) 2016 Springer. 421pp, hbk
- ◆ **Lake Bonneville - a scientific update** edited by Oviatt and Shroder 2016 Elsevier, 659pp hbk
- ◆ **Subsurface Flow and Imaging** by Donald Wyman Vasco and Akhil Datta-Gupta 2016 Cambridge UP., 354pp, hbk
- ◆ **Source to Sink Fluxes in undisturbed Cold Environments** by Beylich et al., (eds) 2016 Cambridge UP., 4-8pp, hbk

Online CPD reporting

Sir, I can get no answer as to why we no longer have a system for recording our CPD online, more than two years after the technical issues that took the system offline. We now have, effectively, a paper system - with guidance documents that cannot be accessed through the website!

I used to explain smugly to members of other professional bodies how simple and useful the SOciety's CPD system was; but the situation is now so embarrassing that no-one in Burlington House seems willing to acknowledge my emails on the subject! CPD records are vital for professional geologists and a key function of the Society; I would appreciate a proper explanation of this debacle.

CHRIS MILNE

JONATHAN SILK REPLIES:

We had to suspend the original online CPD system back in 2016 due to a serious risk in the way it handled data. It was based on old and unsupported technology that the Society had been planning to replace for some time. Unfortunately, the timing of the old system's failure did not coincide with that of bringing on-stream its replacement, which is part of the complete overhaul of the Fellowship IT system that we have been engaged in since late 2015. The good news is that we are almost there and that before the end of June this year we will be rolling out the new system including online CPD recording as well as other features. Apologies that this has taken some time but we felt that it was important to get the new system right before announcing its arrival. More to follow – but you read it here first...

Protecting our data?

Sir, Most of us are aware of the need for data protection. However, I accept that few are as quite as concerned as I; perhaps most rely on things like the Data Protection Act of 1998, due to be tightened up very shortly with the introduction of European legislation under GDPR. The Geological Society has a legal duty to protect our data: things like your address and e-mail will not be given to third parties unless you have signed up for access to the Society's partner libraries and publishers. But there is a difference between 'good' (let alone 'competent') and 'best practice'.

I was saddened that for some events the Society uses a third-party organisation to manage bookings. One must register with a third party account, and what really worried me was the third party's 'privacy' or, more accurately, 'data dissemination' policy.

Past a few beguiling paragraphs ('we will never sell your details to other parties') you hit the worrying stuff. They will freely share your data with their business partners (which, of course, is not selling). So is the Society employing a third party, online event manager undertaking 'competent', 'good' or 'best' data protection practice?

Certainly it is not 'best'; however, it is better than 'competent' as, having contacted the Society, they quickly registered me for an event without sharing my data. Well done, Conference Office staff! However, I encourage the Society to always provide an alternative, data-secure method of registration. Ideally, I'd like it to desist from using third parties completely.

JONATHAN COWIE

Scientific English

Sir, I fully endorse John Cope's Soapbox (Geoscientist 28.01, February) but would go further. In some cases the standard of English is such as to undermine the integrity and comprehensibility of the paper. English is an international scientific language, and yet is almost everywhere garbled. The British are not blameless either as their glib usage of idiom frequently flummoxes foreigners.

We must accept that English does not belong to the British or Americans. Solving the problem is the hard bit. Clear, precise abstracts in major languages would help. So would simplified English. Scholars often write in overlong, complex sentences and the text becomes blurred by native grammatical structures. Perhaps international bodies could be set up and manuals on scientific English produced.

Study groups, formal or informal, in universities might also help. We can't just sit back and say 'it will sort itself out', as scientists mix more. The situation could become entrenched and worsen, aggravated by the acceptable casual language of online research offerings.

FRANK O'REILLY



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DISTANT THUNDER

Dinosaur deniers

Did dinosaurs really exist? Geologist and science writer Nina Morgan examines the evidence

I'm really concerned about dinosaurs, and I think something needs to be done", pleaded 'CADMinistry', an anguished parent, writing in 2015 on the popular parenting website Mumsnet. "The science behind them is pretty flimsy and I for one do not want my children being taught lies... Nothing about dinosaurs is suitable for children, from their total lack of family values through to their non-existence from any serious scientific point of view. Any proper look at the facts will reveal that dinosaurs simply never existed... I used to believe in dinosaurs. We all did. We were all raised on the dinosaur lie, and so we don't question it. I'm used to getting amused reactions at first, and then I'm equally used to people learning a bit about the facts themselves and coming to the obvious

realisation that they've been fed a fraud."

A fraud, it is implied on the official CAD website, www.christiansagainstdinosaurs.com, perpetrated by 'Big Paleo' [sic!] in order to undermine the Christian faith and to make millions by creating fake fossils.

CADMinistry's impassioned post, which attracted around 1000 comments, ends with the plea: "Please, do what you can to get dinosaurs taken off the curriculum," and notes that dinosaurs set a very bad example for children.

A comment from 'Polyesterslacks' on the same website goes on (just possibly with tongue in cheek?) to point out the dangers:

"You know that dinosaurs are just a gateway to the harder stuff... One day your children are watching *Walking With Dinosaurs* then suddenly they're onto the hard stuff and reading *The Origin of Species*. Dinosaurs, just say no!"

A grain of truth

Rubbish? Well, not entirely. 'CADMinistry' also claims that that nobody had even heard of

dinosaurs before the 1800s. Perhaps they have a point. It wasn't until 1824 that William Buckland [1784 – 1856] the first Reader in Geology at Oxford University, provided the first scientific description of a dinosaur in his *Notice about Megalosaurus* published in the Transactions of the Geological Society of London.

Gideon Mantell [1790 – 1852] followed in 1825 with his *Notice on the Iguanodon*, published in the Philosophical Transactions of the Royal Society. And it wasn't until 1842 that Richard Owen [1804 – 1892] coined the term 'dinosaur', after recognising that *Iguanodon*, *Megalosaurus* and *Hylaeosaurus*, shared a number of distinctive features and thus, in his mind, represented a distinct taxonomic group.

'CADMinistry's' scepticism about evolution is also not entirely out of line with Owen's own thinking. Many early geologists were, in effect, Creationists. Buckland, Mantell and Owen were among the numerous geologists and palaeontologists who found the idea of evolution hard to swallow. In an article discussing a talk given by Owen at the 1841 meeting of the British Association for the Advancement of Science meeting outlining his work on British fossil reptiles, the *Literary Gazette* of 14 August 1841 noted that: "Owen's grand conclusion, so essential to science and our knowledge of creation is that there was no graduation of one form into another ... each were distinct instances

of Creative Power, living proofs of a Divine will and the works of a Divine hand ever superintending and ruling the existence of our world."

Truth or Lies?

Some modern bloggers, including the geologist Dr Donald Prothero, have suggested that 'CADMinistry' and the accompanying website, Christians Against Dinosaurs, might be a hoax. But before you write 'CADMinistry' off completely, just consider: when was the last time you ever saw a real, live dinosaur? I rest my case ... No fooling! Happy April, everyone!

► **Acknowledgement**
Sources for this vignette include: an article by Alice Roberts about fake fossils available from W: bit.ly/2HrAfDG
Comments by CADMinistry on www.mumsnet.org; W: bit.ly/2o7n2YQ William Buckland, *Notice on the Megalosaurus or great Fossil Lizard of Stonesfield*, *Trans. Geol. Soc. Lond.* 1 (2): 390–396, 1824; Gideon Mantell, *Notice on the Iguanodon*, a newly discovered fossil reptile, from the sandstone of Tilgate forest, in Sussex. *Phil. Trans. Roy. Soc.* 115: 179–186, 1825; pages 140 – 141 in *The Dinosaur Hunters* by Deborah Cadbury, ISBN 9781857029635; and a blog by Donald Prothero available at W: bit.ly/2BER9DI

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





Plate Tectonic Stories Competition

To celebrate the 50th birthday of plate tectonics and the launch of our new Plate Tectonic Stories web resource, why not get involved in our Plate Tectonic Stories competition? writes Amy Ball

To enter our competition we are inviting you to create something that brings plate tectonics to life and demonstrates some of the processes involved. As it's a key topic in both science and geography national curricula, we particularly want primary, secondary and 6th Form teachers and students to participate.

Students could create projects inspired by plate boundaries, volcanoes, earthquakes and seismic waves, mountain-building, people and natural hazards, the structure of the Earth, heat transfer, radioactivity, Earth materials... whatever they find most interesting. We want imaginative and inventive entries - so students could construct models of a continental rifts or subduction zones, bake volcanoes,



produce animations explaining earthquakes, research projects on their favourite plate boundary, build and test their own seismographs, design plate tectonics puzzles or games: it's really up to them!

Each teacher entering a class's work will receive an A1-sized educational poster on plate tectonics for their classroom, as well as the chance to win up to £150-worth of Earth science books for their school!

All entries must be received by **30 April 2018**. To find out more about the competition and seeing plate tectonic resources for classroom use, please visit W: www.geolsoc.org.uk/tectonics-comp

* **Amy Ball** is Education Officer at the Geological Society.
E: amy.ball@geolsoc.org.uk



The Society notes with sadness the passing of:

Aitkenhead, Neil*

Booth, Tony*

Bowen, Geoffrey Gordon*

Chillingworth, Patrick Cecil Hamilton*

Drysdall, Alan Roy*

Droogmans, Serge L*

Elueze, Anthony Azbuike*

Fischer, Alfred*

Gladwell, David Robert*

Helm, Derick*

Helm, Douglas George*

Howell, Frank Travis*

Kelly, Desmond Michael*

Laws, Michael James*

Leighton, James*

Marshall, Mr John A*

Nelson, Kenneth Davies

O'Reilly, Kevin J O*

Parker, Andrew*

Shepherd, Colin*

Shingleton, Sam*

Whitlow, Roy*

Young, Paul Ivor*

Ziegler, Walter H*

CAROUSEL

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

◆ Professor Dame Jane Francis



Has been announced as the new Chancellor of the University of Leeds. Director of the British Antarctic Survey and a prominent polar scientist, Professor Francis has conducted pioneering research - with numerous expeditions to the Arctic and Antarctic - and has undertaken a wide range of international roles to promote the UK's polar interests. Appointed Dame Commander of the Order of St Michael and St George in the 2017 New Year Honours for her distinguished contributions to polar science and diplomacy, Jane is also a recipient of the Polar Medal, presented for outstanding polar research.

◆ Staff matters



Angharad Hills, Head of Editorial Development and Commissioning, who has worked for the Society for 32 years in both London and Bath (for much of that time as Staff Editor of the JGS), is to retire this month. **Nic Bilham**, Director, Policy and External Relations, will be leaving in June to pursue a PhD at Camborne School of Mines. **Jonathan Silk**, Director of Finance and Operations, will also be leaving the Society in April. The Society wishes them all well for the future and thanks them for their valuable contribution to its work.

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

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

Help your obituarist

The Society operates a scheme for Fellows to deposit biographical material. The object is to assist obituarists by providing contacts, dates and other information, and thus ensure that Fellows' lives are accorded appropriate and accurate commemoration. Please send your CV, publications list and a photograph to Ted Nield at the Society.

Crossword

The winner of the February Prize Crossword was Anne Wilkins of Portlethen. The winner of the final Platypus Crossword will appear here in the May issue.



OBITUARY Malcolm Fletcher Howells 1934-2017

Malcolm Howells died suddenly, painlessly and without fuss at his home in Leeds on Saturday 24 June 2017, aged 83. On the previous day he was fully himself, bemoaning the demise of “the Survey” while delighted that the “dreaded mission statement” concerning Wales was illustrated with ‘his’ photograph of Crib Goch (Snowdon). He was looking forward to family visits that weekend.

Field geologist

Malcolm joined the Geological Survey in Edinburgh in 1959 and mapped in the South Lowlands under G H Mitchell and A McGregor. There he played rugby for Langholm, when they won the Border Championship, and was expelled from the grounds of a nurses’ home for his wild appearance and suspicious behaviour (mapping). His wife Liz bore him Rachel, Anna and Sarah in Edinburgh. In 1967 Malcolm moved his family to Leeds where, from the (then) Institute of Geological Sciences, he was deployed - via compatriot, friend and mentor Howel Francis - to map in northern Snowdonia.

Geology of Wales

Born in the South Wales coalfield and brought up in the large house at the end of the terrace, by the ‘mountain’ at Abertridwr, within spitting distance of Senghennydd, Malcolm was most passionate regarding the Welsh people, heritage, language and song.

Legendary Welsh field geologist and mapper, expert on the marine volcanism and sedimentation of Snowdonia



“MALCOLM WAS MOST PASSIONATE REGARDING THE WELSH PEOPLE, HERITAGE, LANGUAGE AND SONG. TO THESE HE ADDED THE ORDOVICIAN VOLCANIC GEOLOGY OF SNOWDONIA”

To these he added the Ordovician volcanic geology of Snowdonia, which he and his great team(s) thoroughly recorded and portrayed

brilliantly. The series of conjoined 1:25k geological sheets of northern and central Snowdonia, with associated publications and field guides, constitute an extraordinary legacy as the most detailed and thorough depiction of marine volcanism and sedimentation ever produced, anywhere.

The picture here shows Malcolm in his element in 1981, during fieldwork in Llanberis Pass; he loved the Welsh mountain terrain and could paint-in its geology and its significance from almost anywhere. In 2007 BGS published Malcolm’s ‘British Regional Geology: Wales’. His

essay, Chapter 10 – ‘Geology and Man’, proved a headache for the editor in moderating the manifest passions; nevertheless, those pages stand now as a fabulous testament to the nature of Malcolm’s work - accurate, erudite and fascinating. He scored on my copy: “... over so many years, seeing not only the magic geology, but the place which shaped us!!”

Outstanding teacher

With his infectious enthusiasm and great humour, Malcolm generously helped numerous PhD students through their darkest - commonly wettest - hours, and he became a central figure in training exchanges involving young geologists from both Poland and South Korea, in particular. He was greatly loved abroad and typically furnished aspirants with unforgettable discussions in both field and pub. From international field workshops many remembered the man better than the rocks.

Malcolm was immensely popular, widely versed and equally happy proclaiming topics across the arts, sciences, socialism, media, chapels and cookery. He never lost his roots in the South Wales coalfield, its mining communities, language and rugby; although his singing one night in the Pen-y-Gwryd Hotel did send the Princess of Nepal early to bed. His daughters, his extensive family and his extraordinary array of friends will sorely miss him.

► By Peter Kokelaar

HELP YOUR OBITUARIST The Society operates a scheme for Fellows to deposit biographical material. The object is to assist obituarists by providing contacts, dates and other information, and thus ensure that Fellows’ lives are accorded appropriate and accurate commemoration. Please send your CV and a photograph to Ted Nield at the Society.

OBITUARY Alan Gilbert Smith 1937-2017

The eminent Cambridge geologist Alan Smith (FGS 1961) has died at the age of 80.

During his Cambridge career Alan made significant contributions to a number of research fields from plate motion and reconstruction to the tectonics of Greece and the development of the geological timescale.

Although he came from an East Anglian family, Alan Smith was born in Watford on 24 February 1937. His father, an accomplished engineer and inventor, made instruments for the Royal Navy during WWII. No doubt Alan got his appreciation of precision and detailed observation from him. A star pupil at Watford Grammar School, Alan matriculated at St John's College, Cambridge to read Natural Sciences. His interest in geophysics was greatly influenced by the work and ideas of Harold Jeffreys

Princeton

Even so, upon graduation Alan pursued postgraduate studies at Princeton on the stratigraphy of the western US and Canada. While there, he was exposed to the 'hot' new ideas on continental drift being proposed by the likes of Harry Hess. But coming from the Cambridge 'fixist' school led by Jeffreys, Alan was initially sceptical of the new theories.

The America of Princeton, its researchers and their 'can-do' approach to science and life in general greatly influenced Alan. He was also enamoured by Judy Walton, who worked

Pioneer of plate tectonic reconstruction, Cambridge University stalwart and stratigrapher



for Princeton University Press, and they were married before returning to the UK.

Mathematical fit

Back in Cambridge Alan was elected a Fellow of the Geological Society in 1961 and worked with Jim Everett on a mathematical fit of the continents on either side of the Atlantic, which they proved in 1965. During the course of this work Alan was recruited onto the staff of the Department of Geology.

Continued 'fitting' of the more problematic southern continents led to Alan's

“ALAN WORKED WITH JIM EVERETT ON A MATHEMATICAL FIT OF THE CONTINENTS ON EITHER SIDE OF THE ATLANTIC, WHICH THEY PROVED IN 1965”

1970 reconstruction of the Gondwanan supercontinent with the late Tony Hallam. This raised the problem of the palaeotectonics of the 'Tethyan Belt', which led to his 1971 GSA paper

"Alpine deformation and the oceanic areas of the Tethys, Mediterranean and Atlantic" partly informed by Alan's pioneering fieldwork on tectonics in Greece.

All these data contributed to a refinement of global plate motion. There was a succession of papers and, with the assistance of Lawrence Rush, the development of a computer programme of plate motion used both for teaching and commercial purposes.

Stratigraphy

Problems associated with the development of a geological timescale also intrigued Alan Smith. From the 1980s he worked on the first three editions of 'A geologic time scale' (1982, 1990, 2004), which became internationally accepted under the auspices of the International Commission on Stratigraphy. Refinement of the timescale continues today (www.stratigraphy.org).

Following retirement in 2004, Alan continued his research but also developed his watercolour painting and gardening. Alan's extensive network of friends and colleagues, included many ex-students who had benefited from his quiet, unassuming critical interest and humour. Judy, his wife predeceased him in 2010 and he is survived by his daughter Jessica and granddaughter Mia of whom he was very proud.

Alan was awarded the Society's Bigsby Medal in 1981 and was Lyell Medallist in 2008.

➤ By Douglas Palmer

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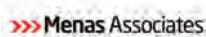
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- Africa Petroleum Club World Upstream Reception
- African Government & NOC's Showcase
- Panel Discussion: Risks, Challenges & Opportunities of Africa's Upstream
- Government Licence Round & Promotion

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Urgent call for help to save the eastern black rhino issued by Fauna & Flora International

In ten years, eastern black rhino populations could be almost completely destroyed.

Around 850 remain and poaching is at an all time high.

Fauna & Flora International has launched an appeal to raise £96,807 with the help of readers of Scotland in Trust to pay for the conservation of eastern black rhino in the Ol Pejeta Conservancy in Kenya. We need to raise the money urgently – time is running out to save the eastern black rhino.

Photo: Jelena Aleksić, www.souffire.org.uk



The eastern black rhino has been pushed to the verge of extinction. Just 850 remain. Please return the coupon or visit www.protectrhinos.org to help protect them.

One of the world's most powerful and awe-inspiring creatures is teetering on the edge of extinction. A hundred years ago, experts say there were around 65,000 black rhino in Africa. Over the decades, the numbers have plummeted due to relentless hunting and poaching, to the extent that there could be as few as 850 eastern black rhino left in the wild.

Unless we act now, the eastern black rhino could be reduced to a few tiny populations in a decade, and we will be the generation responsible for its loss. We cannot let that happen. That's why Fauna & Flora International (FFI) needs your donation today.

Specially trained rangers constantly patrol Ol Pejeta to spot and check every single one, every three days. It is gruelling work, as the rangers have to trek miles each day and risk their lives keeping the rhino safe.

By making a donation of £25, you could help recruit and train more rangers, ensuring we can cover more ground and keep the rhino safe. Your gift could help train rangers in military skills and dog handling to help them protect the rhino.

Every day rangers like Stephen Elimlim and his colleagues walk at least 20km. They urgently need trekking boots and camouflaged uniforms, as well as powerful binoculars to spot the rhino so they can protect them from the poachers. Your gift of £35 would help get this vital equipment to the rangers who need it.

So much is possible with your help. Amazingly, we have already seen the numbers of rhino rise in Ol Pejeta, and the population is growing by around 5% each year.

Yet we cannot be complacent. As the poachers grow bolder and become better equipped, the challenge becomes greater day by day.

We urgently need to raise £96,807 to train, equip and support the local rangers and help keep the rhino of Ol Pejeta safe. A gift of £100 from you today could assist us in building accommodation for rangers in the heart of the Conservancy, so they can stay one step ahead of the poachers.

Whatever amount you can spare, your gift will help us build on our successes. We know that our approach works, and with your help we can support the use of the same techniques elsewhere across Africa. Your gift really can help us save a species.

Please send a donation by 23 April in order to help ensure the safety and survival of the last few eastern black rhino in the wild. The future of a unique race of animals depends on it. Please complete the donation form now.



Stephen, a ranger at Ol Pejeta Conservancy

How you can help rangers like Stephen to save the eastern black rhino

- £25 could help buy a pair of binoculars, essential for surveying the rhino population
- £35 could help pay for a uniform and boots for a newly trained ranger, giving them protection and camouflage
- £100 could go towards training ranger and dog teams
- One exceptional gift could make a huge difference - £1,000 could fully equip and train a ranger

Cut the coupon below and return it with your gift to FFI. Alternatively, go to www.protectrhinos.org or call 01223 749019. Thank you.

YES! I want to support rangers like Stephen with a donation of £_____ to help save the remaining eastern black rhino



Title _____ Forename _____
Surname _____
Address _____
Postcode _____

☐ I enclose a cheque payable to Fauna & Flora International OR

☐ I wish to pay by credit/debit card

Card No: _____

Expiry Date: Security code: Issue Number: (Maestro only)

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To show how your support is helping, we will keep you informed of the progress on this and other important work by post. We will also send you carefully selected projects where you could help make a vital difference and invite you to events to see what your support has achieved. If you don't want these updates by post, just tick here ☐

Your personal details are kept secure and are never sold, traded or rented.

See full details at www.fauna-flora.org/privacy or call for more information.

YES! Please also keep in touch via

☐ email at: _____

☐ phone on: _____

(Please tick all the boxes that apply)

Please return to: Freepost FAUNA & FLORA INTERNATIONAL, The David Attenborough Building, Pembroke Street, CAMBRIDGE CB2 3QZ or go to www.protectrhinos.org to donate online now.

Please note: if Fauna & Flora International succeeds in raising more than £96,807.08 from this appeal, funds will be used wherever they are most needed.



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Photo: Gill Shaw/FFI



"If you value the natural world, if you believe it should be conserved for its own sake as well as for humanity's, please support FFI."

**Sir David Attenborough OM FRS
Fauna & Flora International
vice-president**

Rhino horn fetches a huge price in markets like Vietnam. Ruthless international gangs will stop at nothing to get it – they even supply poachers on the ground with equipment and rifles.

But there is a ray of hope. In 2004 Fauna & Flora International helped to purchase Ol Pejeta ranch, a substantial piece of land in Kenya, to create a safe haven for endangered animals. Now known as the Ol Pejeta Conservancy, it is home to over 100 eastern black rhino.

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